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FEASIBILITY STUDY FOR INSURING DEDICATED ENERGY CROPS

PHASE 2: DELIVERABLE 2.4.2.2

FINAL SUBMISSION

SOLICITATION # N10PC18199

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EXECUTIVE SUMMARY

"The Food, Conservation, and Energy Act of 2008 (2008 Farm Bill) directed the Risk Management Agency (RMA) to 'offer to enter into one or more contracts with qualified entities to carry out research and development regarding a policy to insure dedicated energy crops.' The 2008 Farm Bill states that research and development shall evaluate the effectiveness of risk management tools for the production of dedicated energy crops, including policies and plans of insurance that (i) are based on market prices and yields, (ii)evaluate, to the extent that insufficient data exist to develop a policy based on market prices and yields, the policies and plans of insurance based on the use of weather or rainfall indices to protect the interest of crop producers, and (iii) provide protection for production or revenue losses or both." (USDA; RMA, 2010a) This draft feasibility report represents Phase 2 listed in section 2.4.2.1 of the Statement of Work (SOW) for the overall project entitled "Data Collection Report and Feasibility Research Report for Insuring Dedicated Energy Crops."

The submitted Data Collection Report representing Phase 1 of the SOW found camelina and switchgrass to be the only crops that meet the following criteria: they are commercially grown and dedicated to energy production, as defined in the SOW. RMA added energy cane to the feasibility report after the submission of the "Initial Data Collection Report". The report evaluates the insurability of camelina, switchgrass, and energy cane based on the current demand for an insurance product, production practices, market prices, yields, and data availability. Two principal tools were used to provide a quantitative analysis that aids in the feasibility determination. The Program Evaluation Tool was utilized to evaluate risk exposure, and the Environmental Policy Integrated Climate model or EPIC was utilized to simulate and quantify yield data series.

PROGRAM EVALUATION TOOL

The RMA's Program Evaluation Tool found in the USDA RMA Program Evaluation Handbook (FCIC-2210 (PEH) (http://www.rma.usda.gov/FTP/Publications/directives/22000/06_22010.pdf) was used by the Contractor as a supplement to assist in the development of the overall recommendation for each dedicated energy crop. This tool creates a better understanding of the risk of exposure and potential for various products to transfer a portion of that risk to an insurance pool. The tool also assists in gauging the demand for the insurance product and identifying potential design issues that may arise.

The instrument was applied separately to each of the four regions where listening sessions were held. These regions include Tennessee for switchgrass, Louisiana for energy cane, and Montana and Oregon/Washington for camelina. The program evaluation tool was completed with the information obtained through listening sessions with the producers, insurance agents, FSA personnel, university extension personnel, crop consultants, and conversations with RMA Regional Office personnel, as well as the Contractor's independent research and analysis of the current production and market conditions for each crop in each region and that of comparable crops. Each completed tool was then utilized to work through a decision tree process for determining a recommended course of action.

ENVIRONMENTAL POLICY INTEGRATED CLIMATE MODEL (EPIC)

EPIC (Potter, Atwood, Kellog, & Williams, 2004) is a daily time-step model capable of simulating a wide array of crop production and environmental processes that include plant growth, crop yields, plant competition, and soil erosion as well as water, and nutrient balances. Biomass growth is related to solar radiation intercepted by the plant canopy, vapor pressure deficit, CO_2 concentration, and other physiological stresses including water, temperature, N, P, and soil aeration deficits/surpluses.

Among the model's many features is a stochastic weather generator. Weather can be input from historical records or it can be estimated stochastically using precipitation, air temperature, solar radiation, wind, and relative humidity parameters developed from historical records. Utilizing the stochastic weather generator, the model simulates the growth and development of a crop each day from emergence to harvest. Producer collected data facilitated the setting up of the model for each crop and the simulating of 100 years of stochastically generated yields for developing a probability distribution. The yield distributions as developed using the EPIC model were then used to estimate yield insurance premiums for the best four distributions. These distributions were simulated in Simetar© for 25,000 iterations to estimate "fair insurance premiums" for eight yield coverage levels ranging from 50 percent to 85 percent of the average yield. Where possible these premiums are compared to a proxy crop to better quantify yield data and to better determine the potential for rating each crop.

DEDICATED ENERGY CROPS

Camelina

An oilseed crop in the Brassicaceae family, Camelina is currently grown in Montana, Oregon, and Washington on over 20,000 acres. Camelina is a short seasoned, annual plant that grows one to three feet tall at maturity and requires low inputs. It has been grown for thousands of years and has been called multiple names including leindotter, false flax, wild flax, German sesame, Siberian oilseed, gold of pleasure, and camelina. It is a member of the mustard family and a distant relative to canola. The crop was recently found to be suitable for energy production, utilizing the extracted seed oil for processing to biofuels.

Listening sessions held in Montana and the Oregon/Washington region with producers indicated that camelina was a low input, low risk crop that was easy to grow. These producers understand the benefits of a crop insurance program and suggested that an APH type insurance plan would be advantageous to manage their risk. After utilizing the Program Evaluation Tool it was determined that enough significant risk existed to develop and insure the product. As determined by the results of the research and analysis for camelina, currently commercially produced for dedicated energy, the contractor determined that a crop insurance program for camelina is feasible. As discussed in the recommendation section of this report, the recommended course of action is to develop an APH crop insurance program for camelina.

Switchgrass

Switchgrass is a perennial grass native to most of North America except for the west coast region--specifically California, Oregon, and Washington. This warm-season grass is well suited for (a) conservation uses such as erosion control and wildlife habitat, and (b) pasture, forage, and hay due to its deep root system and ability to thrive on marginal soils. It was recently identified as an ideal crop dedicated to energy production due to its native status and high biomass yields from relatively low inputs on marginal soils.

Commercial production of switchgrass for dedicated energy is currently isolated to Eastern Tennessee. The only commercial biorefinery utilizing switchgrass is located in Vonore, Tennessee, which was built by Genera Biofuels LLC, DuPont Danisco Cellulosic Ethanol LLC, and the University of Tennessee. Production is limited to Genera Biofuels' contracted producers who grew 6,000 acres of switchgrass in 2010. The producers are contracted with Genera Biofuels via acreage contracts that exhibit no revenue risk. Because of the lack of significant revenue risk and other sources of revenue risk, the Program Evaluation Tool decision tree framework suggests that no new product be developed or that no action is required. Combined with the remainder of research results, the contractor recommends that, for the eastern Tennessee region, it is not feasible to develop a crop insurance program for switchgrass at this time.

Energy Cane

Energy cane is simply sugarcane that is bred for higher fiber content. Most of the energy cane acreage is in test plots for further research and development; however, BP Alternative Energy has contracted two growers in Louisiana for their demonstration plant in Jennings, Louisiana and one grower in Florida for a plant that is currently under construction. Current production in Louisiana and Florida is less than 1,000 acres and 400 acres respectively. With no significant commercial market for energy cane, it is determined that it is not feasible to develop a crop insurance program for energy cane at this time.

CAMELINA

CROP DESCRIPTION

Introduction

Camelina is an oilseed crop grown in the northern and western plains regions of the United States. Camelina is a short seasoned, annual plant that grows one to three feet tall at maturity and requires low inputs. It has been grown for thousands of years and has been called multiple names including leindotter, false flax, wild flax, German sesame, Siberian oilseed, gold of pleasure, and camelina. It is a member of the mustard family and a distant relative to canola. Each camelina seed contains approximately 30 to 40 percent oil compared to the 20 percent contained in soybeans. (Stratton, Klienschmit, & Kenney, 2007)

Recently, camelina has been produced for biofuels and bio-based products from the crops' oilseed. Most notably, the U.S. Navy is using camelina biodiesel in its jet fuels, providing significant market potential. A few private companies have entered into the market as processors or first handlers, and most sign contracts with growers for oilseed production at a fixed price. Also, the camelina meal leftover from biodiesel production was recently approved by the United States Food and Drug Administration (FDA) for use in livestock feed rations.

Economic Importance

SUPPLY

United States

As the camelina industry is in its infancy, production data are limited. Discussions with industry leaders and the data collected for this report indicated that production is concentrated in the Northwestern United States, specifically Idaho, Montana, North Dakota, Washington, and Oregon. Publicly available data have been obtained for Montana and North Dakota, while published data for Idaho, Washington, and Oregon are not publicly available. Conversations with processors and first handlers indicate that less than 1,000 acres of camelina are currently produced in Oregon and Washington. Further, Scott Johnson with Sustainable Oils also indicated that Camelina was produced under contract in Idaho prior to 2010, but actual acreage estimates are not made publicly available.

Montana

Montana is currently the leading state for camelina production with 20,800-planted acres in 2009. Acreage, production, and crop value at a state and county level for 2007 through 2009 are illustrated in Table 1 and Table 2.

Table 1: Montana Camelina Production Data, 2007-2009

Year	Acreage		Production		Value	
	Planted	Harvested	Yield/Ac (lbs.)	Total Production (000)	Price/Cwt.	Value of Production $(000)
2009	20,800[1]	19,500	615	11,998.0	--	--
2008	12,200	9,100	569	5,181.5	--	--
2007	22,500	20,400	598	12,197.0	9.18	1,112

Source: (USDA; NASS, 2010)

[1] Correction: Montana published inconsistent data. Planted acres were confirmed to be 20,800 in 2009. Source: Montana NASS. Telephone Conversation. April 6, 2011.

Although the crop is produced statewide, the county level data in Table 2 shows a concentration of production in the North Central and North Eastern regions. Counties in the North Central region produced 30 percent of the state's total production, and the counties in the North Eastern region produced 37 percent in 2009.

Table 2: Montana County Level Camelina Production Data, 2008-2009.

County and District	2008				2009			
	Planted Ares	Harvested Acres	Yield/Ac (lbs)	Production (lbs)	Planted Acres	Harvested Acres	Yield/Ac (lbs)	Production (lbs)
Other	200	200	540	108,000	100	100	500	50,000
Northwest	**200**	**200**	**540**	**108,000**	**100**	**100**	**500**	**50,000**
Chouteau	700	700	473	331,100	800	700	1,070	749,000
Glacier	-	-	-	-	700	600	640	384,000
Liberty	-	-	-	-	900	900	615	553,000
Phillips	-	-	-	-	500	300	770	231,000
Pondera	1,200	1,200	1,581	1,897,200	1,800	1,800	760	1,368,000
Teton	1,200	700	768	537,600	1,400	1,300	100	130,000
Other	1,700	1,500	301	451,100	600	600	475	285,000
North Central	**4,800**	**4,100**	**785**	**3,217,000**	**6,700**	**6,200**	**597**	**3,700,000**
Dawson	-	-	-	-	900	900	1,000	900,000
Garfield	-	-	-	-	600	600	750	450,000
McCone	-	-	-	-	2,300	2,300	750	1,725,000
Sheridan	-	-	-	-	1,500	1,400	420	588,000
Other	1,800	1,600	238	381,500	800	700	1,180	828,000
Northeast	**1,800**	**1,600**	**238**	**381,500**	**6,100**	**5,900**	**761**	**4,491,000**
Broadwater	-	-	-	-	500	500	250	125,000
Fergus	1,300	400	443	177,200	-	-	-	-
Other	2,200	1,500	496	744,100	500	300	30	100,000
Central	**3,500**	**1,900**	**485**	**921,300**	**1,000**	**800**	**281**	**225,000**
Southwest	**500**	**500**	**508**	**254,200**	**800**	**500**	**614**	**307,000**
Big Horn	-	-	-	-	5,100	5,100	550	2,805,000
Stillwater	-	-	-	-	500	400	450	180,000
Other	1,000	400	394	157,500	-	-	-	-
South Central	**1,000**	**400**	**394**	**157,500**	**5,600**	**5,500**	**543**	**2,985,000**
Southeast	**400**	**400**	**355**	**142,000**	**500**	**500**	**480**	**240,000**
Montana	**12,200**	**9,100**	**569**	**5,181,500**	**20,800**	**19,500**	**615**	**11,998,000**

Source: (USDA; NASS, 2010)

North Dakota

A 2009 publication from North Dakota State University (NDSU) Area Extension Specialists, Chet Hill, reported camelina acreage in counties concentrated in northwest North Dakota; as well as a statewide total. As illustrated in Table 3, Hill reported a statewide total of 47 camelina acres in 2008. The statewide acreage reported in 2009 was 987; representing a 2000% increase from 2008. Williams County and Divide County reported 540 acres and 46 acres respectively in 2009 and all other counties in the state reported 401 acres in 2009. (Hill, 2009)

Table 3: North Dakota Camelina Acres for Select Northwestern Counties and Statewide Total

County	2006	2007	2008	2009
Divide	-	-	-	46
Mountrail	120	-	-	-
Ward	5	-	-	-
Williams	-	39	-	540
Other	-	8	47	401
Statewide Total	125	47	47	987

Source: (Hill, 2009)

Oregon

Currently, publicly published data are not available for camelina production in Oregon. Private companies such as Sustainable Oils and Willamette Biomass Processors have contracted with several growers for production in 2009 and 2010, but the data are not published. Tomas Endicott with Willamette Biomass Processors stated that the estimated current acreage for Oregon and Washington camelina is less than 1,000 acres. (Personal Communication; Oregon and Washington Listening Session, 2011)

In 2007, OSU received a grant through the Sun Grant initiative to develop camelina as an oilseed crop in Oregon, Idaho, and Washington. The study is ongoing and seeks to determine the optimum planting date, varieties, and inputs for production in the Pacific Northwest. Currently, the information available from this study is limited to brief reports without a yield data series. (Oregon State University, n.d.)

Washington

Currently, publicly available data from acceptable sources are not available for the state of Washington. Two producers who attended the listening sessions produced camelina in Whittman and Yakima Counties; although, their acreage was not reported. However, estimates of less than 1,000 acres for Oregon and Washington were reported at the Oregon/Washington listening session by Tomas Endicott, a sales manager from Willamette Biomass Processors. (Personal Communication; Oregon and Washington Listening Session, 2011)

Canada

In Saskatchewan, camelina production is being contracted, largely by Great Plains Oil & Exploration and Sustainable Oils. The Saskatchewan Ministry of Agriculture reported that 20,000 acres of camelina was planted in 2009 and 15,000 in 2010. The actual reason for the decrease in planted acres in 2010 has not been disclosed but may be attributed to lower production levels due to excess moisture. (Saskatchewan Ministry of Agriculture, 2011)

Production Costs

The production cost of camelina varies by geographic location and soil qualities. Table 4 contains a spring planted production budget for the Willamette Valley of Oregon (Jaeger & Siegel, 2008). At a 1,600-pound yield and a price of $0.095, the revenue net of variable costs is projected to be slightly over $40 per acre. However, Sustainable Oils sets their price to have a net return of $50 to $75 for the producer (Johnson S. , 2011).

A second set of camelina cost information for a Montana State University model (CropFarm) was reported using 555 acres of camelina. The data in Table 5 illustrates that an expected price of $0.205 and yield of 1,141 pounds per acre would have a total production cost of $101.35 and a net return of $132.56 per acre. (Schanczenski, 2009)

Table 6 illustrates the agronomic data for camelina trials in Havre, Montana. Depending upon variety and planting date, yields were as high as 1,789 pounds per acre for camelina planted on March 15 and as low as 731 pounds per acre for camelina planted on April 20. Priced at $0.09 per pound, revenues net of variable cost were also highest and lowest for those varieties and planting dates as well, ranging from $27.85 per acre to $123.04 per acre. (Johnson D. , 2007)

Table 4: Enterprise Budget Summary for Spring Planted Camelina.

	Oilseed crop
Costs and revenues	Camelina
Variable cost ($/acre)	111.81
Fixed cost ($/acre)	166.81
Land rent ($/acre)	125.00
Other ($/acre)	41.81
Total costs ($/acre)	278.62
Yield (lb./acre)	1,600
Seed price ($/lb.)	0.095
Cost ($/lb.)	0.174
Total revenue ($/acre)	152.00
Net revenue ($/acre)	-126.62
Revenue net of variable costs ($/acre)	40.19

Adapted from: (Jaeger & Siegel, 2008)

Table 5: Oilseed Profitability Montana State University Dryland Crop Farm

Crop:	Camelina
Acres in Crop	555
Income (per Acre):	
Government Payment	$0
Expected Yield (lb. per acre)	1141 lbs.
Expected Price per bu./lb.	$0.205
Total Income/acre	$233.91
Costs (per Acre):	
Seed and Treatments	$3.00
Total Chemicals	$10.00
Total Fertilizers	$16.50
Crop Insurance	$ -
Other Misc. Costs	$ -
Machinery Operating Costs	$19.08
Interest on Operating Costs	$0.85
Total Operating Costs/Acre	$49.43
Total Ownership Costs/Acre	$51.92
Total Costs	$101.35
Returns over All Costs/Acre	$132.56

Source: (Schanczenski, 2009)

Table 6: No-Till Dryland Camelina Trials: Havre, MT, 2005

	Celine Camelina	Celina Camelina	MT 1 Camelina	MT 5 Camelina
Planting Date	March 15	April 20	March 15	March 15
Yield (lb./acre)	1585	731	1789	1590
Seed price ($/lb.)	0.09	0.09	0.09	0.09
Total revenue ($/acre)	142.61	65.85	161.04	143.14
Variable Costs ($/acre)	37.00	38.00	38.00	38.00
Revenue Net of Variable Costs ($/acre)	105.61	27.85	123.04	105.14

Adapted from: (Johnson D. , 2007)

DEMAND

Recent efforts to reduce dependency on foreign oil have led to several alternative energy initiatives. The Department of the Navy plans to use eight billion gallons of renewable fuels by 2020, largely by switching to renewable jet fuels (Tindal, 2010). Camelina is among the alternative energy sources for jet fuel. As other potential markets may exist, the Navy's alternative energy goals provide a significant demand driver for camelina.

Although little data are available for camelina, the acreage needed to satisfy the Navy's initiative can be estimated. Previous research assumes a 1:1 conversion ratio for seed oil to biodiesel (Isom & Booker, 2008). The National Center for Appropriate Technology reported that 54.33 gallons of oil could be produced from one acre of camelina that yields 598 pounds, which is a conversion ratio of 0.090852843. Using the Contractor's simulated average production level of 1,241 pounds and the estimated 112 gallons of biodiesel produced per acre of camelina calculated in Table 7, it would take over 70 million acres of camelina to achieve the 8 billion gallons of renewable fuels that the Navy plans to use in 2020. In comparison, 88 million acres of corn were planted in 2010. (USDA; NASS, 2010)

Table 7: Estimating Biodiesel Yield per Acre of Camelina

Camelina to Biodiesel Conversion				
2007 Per Acre Yield in Montana[2]	Gallons of oil per acre (From a Yield of 598 lbs./acre)	Ratio of Yield to Gallons Per Acre[3]	Average Simulated Yield in Montana (lbs./acre)[4]	Estimated Biodiesel Production/Acre Capability[5]
598	54.33	0.090852843	1241	112.7483779

Adapted From: (The National Center for Appropriate Technology, 2009)

Marketing and Utilization

Camelina is marketed to oilseed crushing plants that use the oil to produce biodiesel; however, the industry is currently in its infancy. Seed companies, processors, first handlers, and researchers formed the industry's only trade organization, the North American Camelina Trade Association, in 2009. There are currently seven processing facilities in the U.S with an unknown production capacity and two marketing companies. The marketing companies include Sustainable Oils and Great Plains Oil and Exploration – The Camelina Company.

- Accelergy Pilot Facility (Grand Forks County, ND)
  University of North Dakota; Energy & Environmental Research Center (EERC)
  15 North 23rd Street, Stop 9018
  Grand Forks, ND 58202-9018

2 Source: (USDA; NASS, 2010)
3 Camelina Yield to Gallons of Biodiesel Ratio = (54.33 Gallons of Oil Per Acre)/(598 Pounds Per Acre)
4 Reference: Estimation of Yield Probability Distributions for Montana
5 (Biodiesel Conversion)(Average Simulated Yield) = Estimated Biodiesel Production/Acre Capability

- Anacortes Refinery (Skagit County, WA)
  10200 West March Point Rd.
  Anacortes, WA 98221
- Great Plains Oil & Exploration – The Camelina Company
  1 Enfield Street
  Cincinnati, OH 45218
- Northwest Crush Plant (Erie County, PA)
  Union City, PA
- Natural Selection Farms (Yakima County, WA)
  6800 Emerald Road
  Sunnyside, WA 98944-9708
- Willamette Biomass Processors (Polk County, OR)
  1055 South Pacific Highway West
  Rickreall, OR 97371
- Montana Specialty (Cascade County, MT)
  300 3rd Ave NW
  Great Falls, MT 59404
- Sustainable Oils
  2815 Eastlake Avenue E, Suite 300
  Seattle, WA 98102
- West Central Cooperative (Carroll County, IA)
  406 1st St
  Ralston, IA

Great Plains Oil & Exploration-The Camelina Company, Sustainable Oils, and Willamette Biomass Processors are the primary camelina companies. Currently, growers are contracted by processors or first handlers at a fixed price. An example of a production contract with Willamette Biomass Processors is presented in Appendix A and Sustainable Oils (first handler) in Appendix B. The market is currently driven by the demand for biodiesel jet fuel. Recently, Japan Airlines completed a flight on January 30, 2010 using a camelina based jet fuel (Sustainable Oils, 2009). In addition, the Department of Navy's initiative discussed earlier is driving up demand.

In 2010, the U.S. Food and Drug Administration (FDA) approved camelina meal as a livestock feed at specified portions of the diet. Camelina can be fed to cattle at no more than 10 percent of the diet, broiler chickens at no more than 10 percent, laying hens at no more than 10 percent, and growing swine at no more than two percent of the diet (Montana Deptment of Agriculture, 2010). This could potentially add economic value to the crop as the meal would be sold for animal feed, thereby increasing the amount paid to the grower.

Grading Standards

Currently, there are no USDA grading standards for camelina. However, grades for camelina would likely be similar to the canola standards found in Appendix F. The current canola grades are U.S. Numbers 1, 2, and 3, using kernel quality and the amount of conspicuous admixture as characteristics for evaluation. Loss of kernel quality can be due to damage from heat or kernels that are distinctly green. (USDA; Grain Inspection, Packers, and Stockyards Administration, 1992)

Camelina processors and first handlers expressed that quality standards were not a major factor for processing camelina seed; however, Willamette Biomass Processor's producer contract guidelines provide an outline of standards for the crop. Further, producers at listening sessions indicated that the crop is docked in price at a rate less than 1% for excess foreign matter. (Personal Communication; Montana Listening Session, 2011)

Agronomic and Botanical Characteristics

Introduction

Camelina sativa is a member of the Brassicaceae family and originated in Central Asia. Brassicaceae plants are commonly referred to as crucifers or mustards, which include common crops such as cabbage and mustard. Camelina grows up to 90 centimeters tall and has branched smooth or hairy woody stems. The leaves are arrow-shaped, sharp-pointed, five to eight centimeters long with smooth edges. It grows pods or bolls similar to flax and its seeds have a relatively high oil content of approximately 30-40 percent oil per seed with each pod holding eight to 10 seeds. (Saskatchewan Ministry of Agriculture, n.d.)

Phenological Stages of Growth

Camelina is an annual crop that mimics the exact stages of growth of flax (Wysocki, 2011). The growth cycle, shown in Figure 1, illustrates the basic stages of development of the plant during its 85-100 day lifespan. The cycle follows a seedling, vegetative growth, flower, and death pattern. The stages of growth are further broken down into seedling, leafing, blossom, boll, boll ripening, and maturity as illustrated in Table 8.

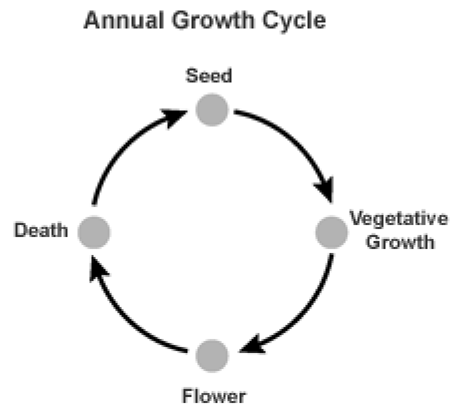

Figure 1: Annual Growth Cycle

Source: (Oregon State University, n.d.)

Table 8: Growth Stages of Camelina

Stage	Description	Timeline
Seedling	Emergence of basal leaves in early spring to sixth leaf	0-14 Days
Leafing	Flowering shoots form and first blossom	15-45 Days
Blossom	From first blossom to first boll	46-58 Days
Green Boll	Bolls forming through development of seeds	59-77 Days
Boll Ripening	When the bolls begin to turn color until seeds reach maturity	78-100
Maturity	Seeds are mature	100

Source: Adapted from (USDA; RMA, 2010c)

Chemical Composition

As an oilseed crop, the camelina seed is the principal portion of the plant and is used for analyzing the crop's chemical composition. Each seed can contain up to 30 to 40 percent oil, leaving 60 to 70 percent germplasm that can be utilized as livestock meal. (Stratton, Klienschmit, & Kenney, 2007)

Production Operations

Planting

Camelina is planted no deeper than ¼ to ½ inch by broadcasting the seed onto a clean seed bed that is then followed up by a harrow or rollers. Other practices include direct seeding into a minimum tillage or no-tilled seedbed via a seed drill. Seed to soil contact and soil compaction is vital and planting too deep will cause poor or no establishment.

Planting dates are variable across regions, and are still undergoing trials to find the optimal date in each region. In Oregon and Washington, camelina can be planted from August through the end of April. However, most fall seeding does not begin planting until October, while spring seeding occurs no later than the end of April (Personal Communication; Oregon and Washington Listening Session, 2011). In North Central Montana, spring planting dates range from late March through the end of April; however, Eastern Montana ranges from late April through early June. (Personal Communication; Montana Listening Session, 2011). The results from a 2009 survey conducted by Montana NASS indicate the average planting date in 2009 occurred statewide from early April to early June (Montana Agriculture Statistics Service, 2010).

Illustrated in Table 9 are the results of a 2009 camelina survey from Montana Agriculture Statistics Service. Montana NASS data indicate the following crop development timeline. Listening session feedback in West Central Montana (Conrad) also indicates that a month difference between planting and harvesting occurs between western Montana and Southeastern Montana (Billings) (Personal Communication; Montana Listening Session, 2011).

Table 9: Montana's Camelina Crop Development, 2009

Stage	Beginning	End
Planted	Early April	Early June
Emerged	Mid April	Mid June
Blooming	Mid June	Early July
Turning	Late June	Late July
Harvested	Mid July	Late August

Source: (Montana Agriculture Statistics Service, 2010)

Site Selection and Weed Control

Camelina should be planted in fields with limited weed pressure to reduce competition. The history of herbicide use should be reviewed, as camelina is susceptible to long-term residual herbicides such as Maverick, Glean, Ally, Harmony, Affinity, Agility, Express, Finesse, and Tordons. Camelina is also susceptible to IMI herbicides such as Beyond and Clearmax. Camelina should not be planted on fields where these herbicides are used within the plant-back date on the herbicide label. A list of plant-back requirements is provided in Appendix D.

Producers in both Montana and Oregon saw better yield results when they planted camelina in fields that were previously fallow or growing wheat, barley, peas or lentils (Personal Communication; Montana Listening Session, 2011) & (Personal Communication; Oregon and Washington Listening Session, 2011). Camelina does not perform well when grown back-to-back or when planted in fields following other Brassica crops such as rapeseed, canola, and brown mustard.

Throughout the vegetative growth period of camelina, weeds need to be closely monitored. A burn down of broadleaves and grassy weeds utilizing RoundUp (glyphosate) is recommended prior to planting to lessen weed competition during establishment. The herbicide Poast provides good post emergence grassy weed control; however, nothing is labeled for post emergence broadleaf weed control in camelina.

Harvest

Camelina is harvested from June to August depending on weather conditions, planting dates, and the time of maturity. However, in the case of Oregon producers, the planting dates have little to no effect on the harvest date. Growers will harvest in June or July despite varying planting dates.

Camelina needs to be harvested within a few days of maturity, as the pods shatter much easier at this stage. When the pods mature, they become pale brown in color and the seed shells easily from the pod. The seed moisture content must be less than eight percent to ensure proper storage quality. (Sustainable Oils, 2010)

Rotation and Isolation Requirements

As camelina is a short seasoned and hearty crop, producers are able to plant camelina in several different rotation patterns. Camelina has shown poor performance when planted consecutively or following canola or another Brassica such as mustard or rapeseed, but growers have the opportunity to use camelina as a replacement of the fallow portion of their crop rotation system. Some producers in Montana are currently replacing their fallow with camelina between wheat crops in a wheat/camelina/wheat pattern. Since camelina is susceptible to herbicide residuals from commonly used wheat herbicides, plant back restrictions must be monitored. Plant-back restrictions for canola are currently the best guideline available for camelina production.

Fertilizer and Moisture Requirements

Camelina is touted as a low input crop due to its relatively small nutrient requirements. Sustainable Oils recommends that soil nitrogen should be no less than 90 pounds per acre and no than less than 32 pounds of Phosphorous. Growers are encouraged to apply a fertilizer blend of 20-20-0 at seeding and maintain the required nutrient levels by applying top-dress Nitrogen or Phosphorous as needed. (Personal Communication; Montana Listening Session, 2011)

Camelina is grown in semi-arid regions on dryland, as it produces a crop with little rainfall. Golden Plains Area Extension Service in Akron, Colorado discovered that camelina has the highest water use efficiency of all oilseed crops evaluated. (Lafferty, Rife, & Foster, 2009)

Varieties

Sustainable Oils' plant breeding program has conducted extensive research on camelina varieties. The results from the variety tests are listed in Table 10. Other varieties, such as Calena, Celine and Lagina, are imported to the U.S. from Europe. Montana State University has released its Blaine Creek and Suneson varieties to the public. (Lafferty, Rife, & Foster, 2009)

Table 10: Sustainable Oils Camelina Variety Characteristics

Variety	Flowering Days	Plant Height	Seed Filling	Grain Yield	Test Weight	Seed Weight	Oil Content
	Days After Planting	Inches	Days	Lbs./Acre	Lbs./Bu	G/1000	%
SO-10	69.79	33.30	39.25	1466.85	52.34	1.12	36.69
SO-20	70.00	31.84	37.75	1443.37	51.36	1.07	36.76
SO-30	69.04	33.07	40.25	1489.62	52.43	1.11	37.12
Celine	71.75	36.06	37.37	1302.94	51.78	0.92	36.50
CV (%)	2	6	4	14	1	7	3
LSD (0.05)	0.81	0.94	1.54	76.65	0.33	0.003	0.50
Mean	69.58	33.14	38.31	1369.40	51.84	1.01	36.54

Source: (Sustainable Oils, 2011)

Adaptation and Distribution

There are little public data on the distribution of camelina; however, the crop is suited best for the northern United States and southern Canada. In most cases, it will be found growing in areas where production of canola, flax, and mustard are also produced such as Idaho, Montana, Minnesota, Oregon, North Dakota, South Dakota, and Washington. Figure 2 illustrates the states, in green, where camelina is presently able to grow according to USDA PLANTS. Currently, processors and first handlers contract camelina production in Montana, North Dakota, Oregon, and Washington. While the USDA PLANTS database does not graphically illustrate that camelina is distributed in

California, conversations with Scott Johnson from Sustainable Oils suggest "Camelina acreage will be contracted beginning in 2012" (Johnson S. , 2011).

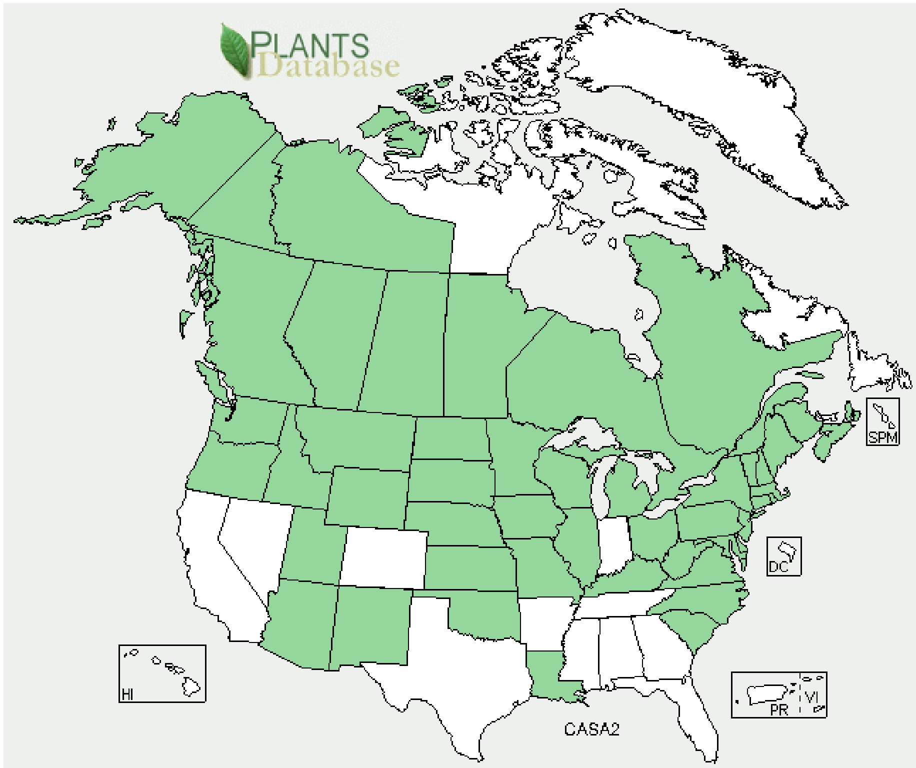

Figure 2: Distribution of Camelina

Source: (USDA, 2011)

Insects and Diseases

"Camelina is generally considered to be a disease resistant crop. It is resistant to some of the common pests and diseases of Brassica oilseeds. The greater resistance of camelina is attributed to the production of antimicrobial compounds in the roots, including two phytoanticipins and the phytoalexins camalexin and methoxycamalexin. Research suggests that camelina is considered to be alternaria blackspot resistant and is highly resistant to a wide range of blackleg isolates (Leptosphaeria maculans), which are major diseases of canola or Brassica crops." (Saskatchewan Ministry of Agriculture, n.d.)

Diseases

Downy Mildew

There have been a few reports of downy mildew in camelina in Saskatchewan, and it is common among other brassica crops. An infection can be localized or systemic. Symptoms on camelina include grayish-white mycelial growth on lower-leaf surfaces, stems, and pods. Severely infected plants may be malformed. Researchers have found some resistance to this disease that would allow the development of downy mildew resistant cultivars in the future.

Sclerotinia Stem Rot

Sclerotinia stem rot is caused by the fungus Sclerotinia sclerotiorum. Symptoms on camelina are similar to those on canola. Infection begins as a soft, watery rot on leaves or stems. Lesions develop up and down the stem from the point of infection, eventually girdling the stem and causing the plant to wilt and die. The disease affects many other crops, including sunflowers, potatoes, safflower, beans, peas, and alfalfa. These crops should only be grown once every three to four years on the same field to help reduce the disease. Agriculture and Agri-Food Canada research revealed that the development of stem rot resistant cultivars is feasible.

White Rust

White rust is caused by Albugo candida. It is a major disease of brassica crops worldwide. Symptoms on camelina include powdery white pustules containing sporangia on lower leaf surfaces and hypertrophied siliques or entire inflorescences (staghead) that are conspicuous later in the growing season. Stagheads are green at first, but become brown and brittle at maturity. They contain thick-walled oospores that may survive in soil for several years before germinating to produce motile zoospores that infect cotyledons and rosette leaves. So far, no resistance to white rust has been observed in camelina germplasm.

Clubroot

Camelina was found to be highly susceptible to clubroot. Research trials in Canada have revealed that the symptoms on camelina were typical to those observed on canola. To date, no resistance was found in camelina for clubroot disease. Therefore, this crop will not provide a viable rotation alternative in areas where clubroot is prevalent.

Aster Yellows

Aster yellows are the most diverse and widespread phytoplasma diseases worldwide. It was quite commonly observed in camelina trials. Stems, leaves, and siliques of plants exhibiting aster yellows symptoms were greenish-yellow or red, often with distorted inflorescences. Stunting was observed in most symptomatic plants. Small, flattened siliques containing small and misshapen seeds were observed on all infected plants. Small misshapen seeds were also observed in normal-looking siliques sampled from asymptomatic but infected plants. However, researchers have found some resistance in germplasm that could result in resistant cultivars.

Other diseases

Research trials have found other diseases on camelina such as damping-off and root rots caused by Rhizoctonia solani and Pythium debaryanum, grey mold caused by Botrytis cinerea, bacterial blight caused by Pseudomonas syringae and black rot caused by Xanthomonas campestris. Camelina was also found to be susceptible to viral diseases like turnip crinkle virus and turnip rosette virus that are transmitted by flea beetles.

In summary, camelina is highly resistant to alternaria black spot and blackleg of brassicas. It exhibits variation for resistance to sclerotinia stem rot, brown girdling root rot, and downy mildew, suggesting that disease resistant cultivars can be developed. The susceptibility of camelina to clubroot, white rust, and aster yellows disease will limit the adaptation of this crop in areas where these diseases are prevalent. (Saskatchewan Ministry of Agriculture, n.d.)

Insects

Few insects have been found to cause damage to camelina and the use of insect control measures is rarely reported. Flea beetles, cabbage seed pod weevil, and Brassica aphids may be observed on camelina, but the potential for damage is much less than that on canola or mustard (Saskatchewan Ministry of Agriculture, n.d.). Growers in the U.S. have not reported damage caused by flea beetles or other insects at this point.

Review of Other Programs

Currently a few state and federal programs support or subsidize producers of camelina. Federal programs such as direct payments and counter-cyclical payments are unavailable for camelina producers, but some available federal and state programs provide payments or tax credits to eligible producers of biofuel feedstocks. Further, one private insurance product sold by an agency was identified for camelina. This private product insures only hail and transit but the agency’s carriers are developing named-peril insurance policies that will cover frost/freeze, wind, and fire in addition to hail and transit coverage. Despite the existence of the hail and transit insurance product, producers attending the listening sessions indicated that they were either unaware of the program or did not participate in it. Details of available programs are discussed below.

State and Federal Programs

Biomass Crop Assistance Program

The Biomass Crop Assistance Program (BCAP) supports establishing and producing eligible crops for the conversion to bioenergy in project areas and in contracts on land for up to five years. Through a matching payment program BCAP assists agricultural and forest land owners and eligible material owners with collecting, harvesting, storing, and transporting eligible materials for use in qualified Biomass Conversion Facilities (BCF). These payments will be available at the rate of $1 for each dollar per dry ton paid by the BCF to the eligible material owners, limited to a maximum of $45 per dry ton and limited to a two-year payment duration.

Camelina falls under the non-edible fats, oils, and greases derived from plants category for eligible materials along with kenaf. United States producers of camelina and kenaf combined have received $162,067 in BCAP payments as of October 20, 2010. (USDA; FSA, 2010b)

Bioenergy Program for Advanced Biofuels

United States Department of Agriculture, Rural Development provides payments to producers of feedstocks for biofuels production under the Bioenergy Program for Advanced Biofuels. Eligible producers enter into a contract and are paid based on the quantity and quality of advanced biofuels production and on the net nonrenewable energy content of the advanced biofuels. The payment amount will depend on the number of producers participating in the program, the amount of advanced biofuels being produced, and the amount of funds available (National Sustainable Agriculture Information Service, 2010). Mandatory funding for this program has been set at $85 million in fiscal year 2011, $105 million in fiscal year 2010, and discretionary funding of up to $25 million each from fiscal year 2009-2012 (Crooks, 2010).

Sun Grant Research Initiative

The Sun Grant Research Initiative authorizes the United States Department of Agriculture, Department of Transportation, and Department of Energy to issue grants to five regional Sun Grant Centers and one sub-center. Each center is tasked to coordinate bioenergy efforts in their region to "develop, distribute, and implement biobased technologies, promote diversification and environmental sustainability through biobased energy and product technologies, promote diversification of rural areas through biobased energy, enhance efficiency of bioenergy and biomass research and development through collaborations among the United States Department of Agriculture, Department of Energy, and land grant universities." The initiative is awarded $75 million in annual funding through 2012 (Dohlman, Caswell, & Duncan, 2008). Although this program is not a direct subsidy to Camelina producers, it plays a vital role in the research in and development of camelina.

Montana State Hail Insurance Program

The Montana state insurance program was created to provide basic hail insurance coverage on any crop grown in Montana. It is directed by the Montana Board of Hail Insurance and administered by the Montana Department of Agriculture. The maximum coverage is $50 per acre on non-irrigated crops and $76 per acre on irrigated crops. The insurance program rates can be found in Appendix G. (Montana Department of Agriculture, n.d.)

Oregon Income Tax Credit for Biomass Producers and Collectors

The state of Oregon passed House Bill 2210 during November 2007, providing incentives for biomass production and collection for energy use. Producers or collectors of Oregon are eligible for tax credit incentives based upon the volume of production or collection. The credit provided under House Bill 2210 as it applies to camelina (oilseed crops) allows producers to claim tax credits of $0.05 per pound produced. (Oregon Department of Energy, 2007)

Private Products

PRAIRIE MOUNTAIN INSURANCE COMPANY

Prairie Mountain Insurance is a full line independent agency specializing in crop and farm/ranch insurance. They offer a standalone hail and transit insurance product for camelina; however, agent Lewis Zanto stated "no policies have been sold in the last 3 years." (Personal Communication; Prairie Mountain Insurance, 2011)

Contracting Clauses

SUSTAINABLE OILS

Sustainable Oils provides contracts with a "shared risk" program bonus. The shared risk program pays a guaranteed dollar amount to the producer regardless of delivery, but only if an established and confirmed stand of 12 plants per square foot is achieved. In the instance of a loss of the crop by an "Act of God: the farmer is guaranteed the dollar amount from the shared risk program (Sustainable Oils, 2011)

Saskatchewan Policy

The Canadian province of Saskatchewan currently provides an insurance policy for camelina through the Saskatchewan Crop Insurance Corporation. Yield risk coverage is available at 50, 60, or 70 percent levels. The terms and conditions of this policy are included in Appendix E.

DATA AVAILABILITY AND PRICE METHODOLOGIES

Yield Data

As previously discussed in the Economic Importance section, little production data is publicly available for camelina. The only public yield data from an acceptable data source was published by NASS and can be found in Table 1 and Table 2. Given the limited data, yield was simulated for the purposes of this report in the Estimation of Yield Probability Distributions for Montana and the Estimation of Yield Probability Distributions for Oregon/Washington. The methodology for simulating yield data includes developing a production schedule of tillage, planting, fertilization, pesticide applications, and harvesting operations along with management decisions regarding typical dates of each operation, seeding rates, and application rates of fertilizers and pesticides. Camelina producers were utilized to assimilate as much information regarding production and yields as possible. The farm level yields obtained from a producer from the states of Washington and Montana can be found in Table 11.

Table 11: Camelina Producer Yields

Camelina (Pounds Per Acre)				
	Year 1	Year 2	Year 3	Year 4
Washington	1100	1200	1135	
Montana	1150	2295	1135	1378

Sources: (Personal Communication; Oregon and Washington Listening Session, 2011) & (Personal Communication; Montana Listening Session, 2011)

Price Data

Currently, processors and first handlers whom contract production with producers set prices. Example contracts from Willamette Biomass Processors and Sustainable Oils are included in Appendix A and Appendix B, which list a price of $0.11 per pound and $0.15 per pound, respectively. While no price data set is publicly available, conversations with Mike Waring and Scott Johnson from Sustainable Oils and Tomas Endicott from Willamette Biomass Processors provided some historical contract prices (2011). Table 12 illustrates prices paid by Sustainable Oils and Willamette Biomass Processors for 2007, 2008, 2009, and 2011. Alternative pricing methods other than contracts currently do not exist and pricing methodologies are mostly proprietary among processors and first handlers; however, industry representatives indicated that prices would be set based on factors such as a floating

Chicago Board of Trade soybean oil basis, processor/first handler profitability, and/or farmer crop margins (Waring, Johnson, & Endicott, 2011). General Manager of Sustainable Oils and President of the North American Camelina Trade Association, Scott Johnson, stated "the contract price for camelina is established around September 1 and will not change for the crop year. For insurance purposes, Sustainable Oils would have no problem telling RMA what the contract price is at this time." (Personal Communication; Pricing Methodology, 2011)

Table 12: Camelina Contract Prices

Camelina (Cents per Pound)					
	2007	2008	2009	2010	2011
Sustainable Oils	$0.09	-	$0.145	-	$0.15
Willamette Biomass Processors	-	$0.11	-	-	$0.17

Sources: (Waring, Johnson, & Endicott, 2011)

LISTENING SESSIONS

As per requirement of section 2.4.2.1 of the Statement of Work, the Contractor conducted listening sessions with camelina producers. Locations in Montana and Oregon were chosen because processors and first handlers have contracted with producers in these regions, allowing for a higher likelihood of producer turnout by working with the processors and first handlers to promote the meetings. These processors and first handlers consisted of Great Plains-The Camelina Company, Natural Selection Farms, Inc., Sustainable Oils, Inc., and Willamette Biomass Processors, Inc.

Utilizing member contacts from the North American Camelina Trade Association (NACTA), the Contractor worked with NACTA President and general manager of Sustainable Oils; Scott Johnson and Sales Manager Tomas Endicott from Willamette Biomass Processors, Inc., to identify appropriate regions to host listening session meetings for producers of camelina. Locations were selected based on feedback from each member of the organization and their experience with the producers they have worked with.

Montana

Mike Waring with Sustainable Oils, Inc. assisted the Contractor in further determining the location and date of the Montana meeting; as well as, notifying and encouraging all available contract producers to attend the meeting. A flyer was developed and emailed to Sustainable Oils contract producers and personnel from Great Plains-The Camelina Company. The listening session was held on Wednesday, January 20, 2011 (12:00 pm) at the Home Café located in Conrad, Montana. Eight participants attended and included one agent, one agronomist, three producers, one processing manager, one RMA risk management specialist, and one elevator operator.

LISTENING SESSION SUMMARY

The meeting location in western Montana produced very good feedback on the perception of insurance for camelina and the demand drivers for camelina insurance. The producers attending the listening session indicated that they have been growing camelina for approximately four years and have had very good yield results with less risk than canola. Producers in this region praised the crop as being a low input, low risk crop that yielded well and fit well in a rotation with other crops. Specifically, camelina was regarded as a very water efficient crop that worked well following or replacing summer fallow ground. One producer mentioned that because of the water use efficiency of camelina he was using camelina in replacing the fallow period. Instead of a rotation of spring wheat and fallow, camelina can replace the fallow allowing for continuous cropping of spring wheat, camelina, and spring wheat allowing the producer to get three crops in three years versus two crops in three years.

The overall results of the feedback suggest that camelina is less risky than many of the current crops in these producers' rotations. Comparing camelina with relatively low yield risk crops in the area such as wheat and barley, camelina was determined to be much easier to grow with less risk. The crop was labeled as being very resistant to freeze/frost, heat and drought. More specifically, the crop was stated as being more tolerable to heat than lentils and canola. Perils that concern growers were those that could affect the crop just prior to harvest. Specifically, shattering of the seed pods by severe weather (hail and wind) was of concern. It was stated that shatter is more of a concern for camelina than that of canola, with one producer experiencing a production loss of about 70 percent due to shatter from wind and hail. The risk for hail and wind is greater approximately 10 days prior to harvest.

Quality and price risk were of less concern to these producers. Quality risk was not important to producers, as they were not docked for quality losses beyond foreign matter. Price risk was of no concern as the price was a fixed contract price set by the processor. Other sources of revenue risk such as prevented planting or replanting issues that were discussed did not seem to be a major concern.

The consensus was that camelina was a relatively low risk crop to grow that worked well in Montana. Yet all the attendees felt that a risk management program such as crop insurance was important to the overall success of the producers growing the crop.

Oregon/Washington

Scott Johnson with Sustainable Oils, Inc. and Tomas Endicott with the Willamette Biomass Processors Inc. assisted the Contractor in further determining the location and date of the Oregon/Washington meeting; as well as, notifying and encouraging all of their contract producers to attend the meeting. The listening session was held on Friday, January 22, 2011 (12:00 pm) at the Hermiston Agricultural Research and Extension Center located in Hermiston, Oregon. This location was selected to facilitate a meeting for producers in the Washington/Oregon/Idaho region. Eight participants attended and included one agent, two producers, two processing personnel, one RMA risk management specialist, and two extension agronomist.

Listening Session Summary

Feedback from the Oregon/Washington listening session producers indicates that they very much want an insurance program for camelina. While, producers were very favorable towards camelina production and its characteristics for tolerating freeze/frost, heat, and drought, they understand that mitigating catastrophic yield risk is crucial to the longevity of producing the crop in this region.

As in the case of Montana, attendees praised the crop as being a low input, low risk crop that yielded well and fit well in a rotation with other crops. Both producers attending the meeting were in their 4th year of camelina production and felt that camelina could only gain popularity among the masses if a crop insurance policy were available for the crop. These producers felt that while the crop was easy to grow, producers seek out the safety net of crop insurance for other crops to fit in a rotation. These producers suggest that a simple yield based policy would be perfect for camelina.

While the perception of crop insurance for camelina in this region was similar to Montana, attendee comments indicated that production practices are different. In Washington, 30-40 percent of the crop will be fall planted, which was determined to be between August and January, while central Oregon is planted more often in the spring. The crop in the Washington region can be broadcast seeded and then harrowed or packed using a roller/packer during planting or conventionally seeded with a drill. In one instance the crop was even broadcast on top of snow and was successfully established. Typical rotations would consist of winter wheat, camelina, spring wheat; or camelina, spring wheat, camelina. Regardless of spring or fall planted camelina, yields risk for camelina were determined to be lower compared to winter wheat, spring wheat, barley, and canola. In terms of management, camelina was determined to be similar to the management required for spring barley.

Pricing contracts also differed in this region compared to Montana. While Montana producers were not docked for oil quality parameters, producers who signed with Willamette Biomass Processors in Oregon/Washington receive a price reduction when the quality of oil does not meet contract requirements. Nonetheless, attendees indicated that price and quality were not a concern and presented very little risk. Concerns with fall planting were discussed as related to dry conditions in the fall presenting the potential for competition from volunteer wheat that could cause stand reduction. While many of the demand drivers such as yield, price, quality and other sources of revenue risk were determined by attendees to be low, the consensus was that a crop insurance program was needed to protect against catastrophic events.

Camelina Risk Evaluation

Introduction

The RMA's Program Evaluation Tool (Diagnostic Instrument) found in the in USDA RMA Program Evaluation Handbook FCIC-2210 (PEH) (http://www.rma.usda.gov/FTP/Publications/directives/22000/06_22010.pdf) was used by the Contractor as a supplement to assist in the development of the overall recommendation for each dedicated energy crop. This tool creates a better understanding of the risk exposure and potential for various products to transfer a portion of that risk to an insurance pool. The tool also assists in gauging the demand for the insurance product and potential design issues that may arise.

The instrument was applied separately to each of the four regions where listening sessions were held. These regions included Tennessee for switchgrass, Louisiana for energy cane, and Montana and Oregon/Washington for camelina. The program evaluation tool was completed from information obtained through listening sessions with producers, insurance agents, university extension personnel, crop consultants, and conversations with RMA Regional Office personnel, as well as the Contractor's independent research and analysis of the current production and market conditions for each crop in each region and that of comparable crops. Results of the Program Evaluation Tool are summarized below with the completed Diagnostic Instrument for each region included in Appendix N

Montana Program Evaluation Tool Summary

"The Program Evaluation Tool uses a series of questions to elicit information on production processes, market characteristics, availability of federally facilitated insurance products, as well as eight demand signals of which five are "Demand Shifter Categories" such as yield risk, quality risk, price risk, other sources of revenue risk, the sufficiency of non-insurance available to cope with risk, while three are "Product Design Categories" such as potential and realized risk classification challenges, potential and realized moral hazard and monitoring issues, and other problems that may affect insurance participation. Overall assessment questions are answered for the eight categories using a Likert scale of 1 to 5, where higher numbers for the "Demand Shifter" category indicate higher demand for insurance products while lower numbers suggest relatively lower demand. For the "Product Design Issues" categories, higher numbers indicated either a lack of product design problems or a high likelihood of being able to address any existing product design problems, while low numbers indicate more serious product design problems and/or problems that cannot be easily addressed. Using the overall assessment scores from each of the eight diagnostic categories for each region, the results have been graphically summarized for each region. Based on the overall scores assigned to each of the eight diagnostic categories, assessments are made and used to work through a generalized decision tree framework (See Appendix I), intended to facilitate decision-making. However, the diagnostic instrument may be used independently of the decision tree." (USDA; RMA, 2005)

The following is a summary of the completed Diagnostic Instrument for Montana. Note that the completed Diagnostic Tools in Appendix N provide the completed answers to the questions while the summary below is meant to provide summary level answers to the eight demand signal questions used for Likert scale ratings. This summary will be best understood by reviewing the Program Evaluation Tool and the completed Diagnostic Instrument in Appendix N.

Marketing

Great Plains Oil & Exploration (Great Plains – The Camelina Company) is a renewable fuels energy company founded with the purpose of manufacturing and marketing biodiesel produced from camelina (Great Plains, The Camelina Company, 2010). Great Plains currently contracts with producers utilizing a production contract in Montana. Sustainable Oils, Inc., also currently contracts for camelina utilizing production contracts in Montana (Sustainable Oils, 2011).

RMA-Facilitated Insurance Products

There are no RMA-facilitated insurance products currently available for camelina utilized for dedicated energy in Montana or any other region in the United States.

YIELD RISK

Relative risk is used to adjust absolute magnitudes that vary across crops to a relative level to facilitate comparability of crop risk. Because NASS reported yield data for Montana camelina is only reported for four years, assuming that the relative yield of camelina is similar to the relative yield of canola (both brassica crops); we can use canola yields to assist in better quantifying the yield risk for Montana camelina compared to other crops.

Utilizing the coefficient of variation (CV) helps to facilitate the comparison across crops with different expected yields. Calculated as the standard deviation divided by the mean, this allows the comparison of variation of unlike data series. As illustrated in Figure 3, yield risk for canola in Montana is higher than all other crops reported by NASS over the past ten years. The coefficient of variation for canola of 0.44 for both canola and peas suggests that these crops in this region may be perceived as having very high yield risk. Listening session attendees confirmed that these crops would be crops with the highest yield risk. Utilizing a Likert scale rating from 1 to 5 for non-catastrophic yield risk, where "1" is very low relative yield risk and "5" is very high relative yield risk, listening session participants indicated that canola, dry peas, and spring wheat were crops that would have the highest risk (rating of "5"), while camelina would have the lowest risk (rating of "1"). Listening session producers stated that camelina is very easy to grow, requires low inputs, and has very little risk and would have much less yield risk than canola or flax. Although listening session producers suggest that camelina has very little yield risk, the analyzed data suggests that camelina may more closely resemble the risk of canola and spring wheat. Utilizing this information, the Likert scale rating from 1 to 5 for non-catastrophic yield risk was rated at a "3"; thus, associating the crop with crops having moderate yield risk.

The risk for a catastrophic yield loss is hard to gauge for camelina but utilizing the canola cause of loss data from RMA, we can make a more informed estimate. Utilizing the loss cost ratio as a way of measuring severity of causes of loss, the number of observations for the loss cost ratio above 25 percent (captures a minimum 50 percent yield loss based on assumption that guarantee is established at 75 percent coverage level for all policies) was recorded. Analysis of these observations for all Montana canola suggest that cold wet weather, cold winter, drought, excess moisture, freeze and frost, hail, heat, hot winds, insects, plant disease, other (snow-lightning, etc.) and wind/excess wind can cause losses to canola in excess of 50 percent. The observations illustrated in Figure 4 suggest that drought has the potential to occur 52 percent of the time over 25 years[6]. Several other causes of loss might occur less frequently at a loss greater than 50 percent for canola. Using canola as a comparable crop, these observations are likely to occur for camelina. As such, catastrophic yield risk for camelina results in a moderate relative yield risk rating of "3" on the Likert scale.

[6]Where 25 years of Summary of Business Cause of Loss Data from RMA did not exist, the contractor estimated the observations over 25 years by taking the ratio of observations divided by years in dataset and multiplied by 25.

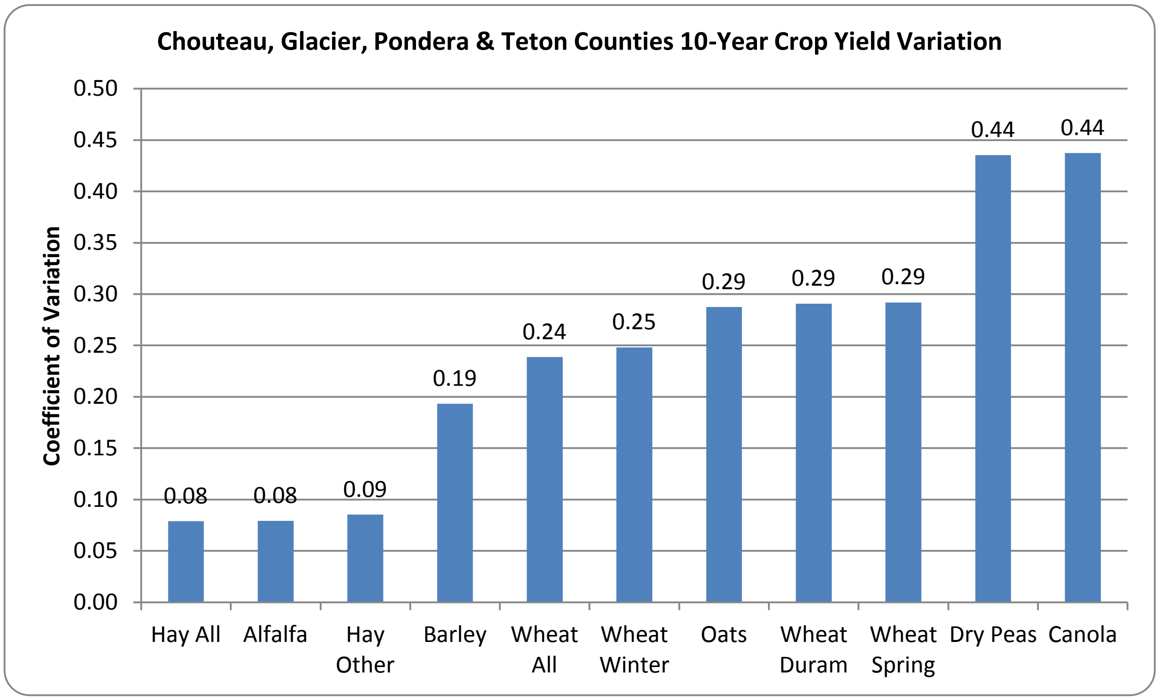

Figure 3: Chouteau, Glacier, Pondera, & Teton Counties 10 Year Crop Yield Risk Comparison

Adapted from USDA; NASS, 2011

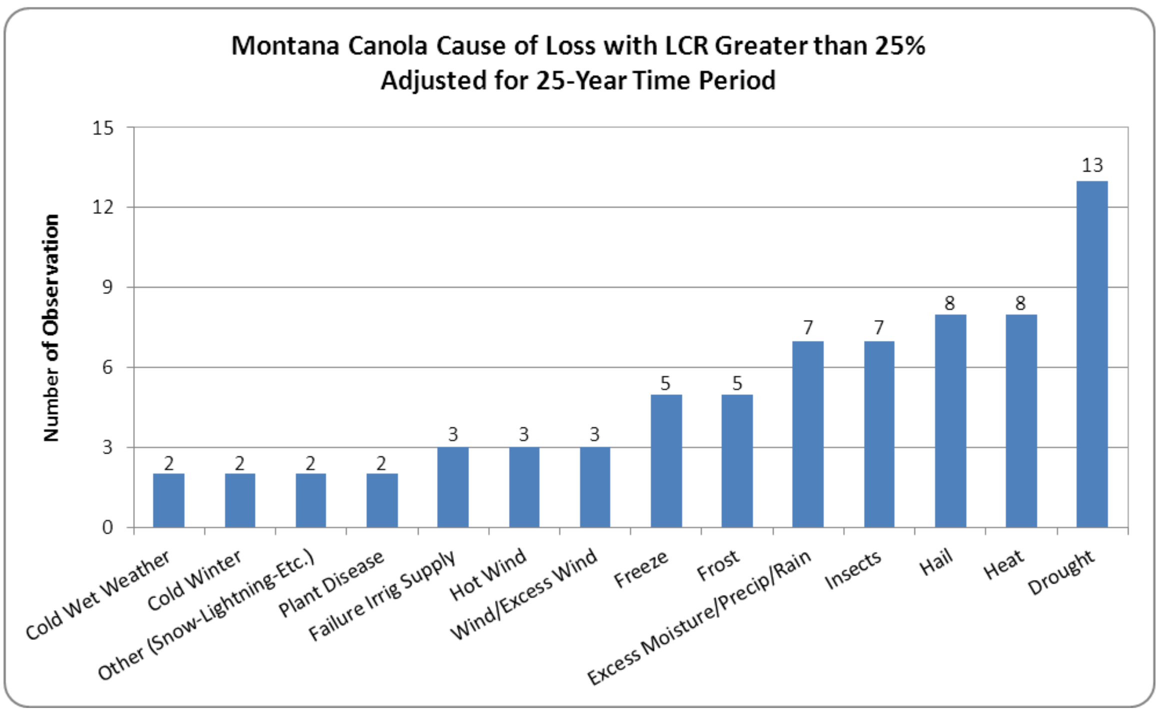

Figure 4: Montana Canola Cause of Loss Observations of Lost Cost Ratio in Excess of 25%

Adapted from (USDA; RMA, 2010b) Cause of Loss Summary of Business

QUALITY RISK

Camelina, to be utilized as a feedstock for dedicated energy, does not exhibit significant quality risk at the time of harvest and thus can be characterized as having very low quality risk. Sustainable Oils does not dock the price paid to a producer based on oil quality below specific parameters but does dock for excessive foreign matter (1 percent dockage). These quality risks are insignificant in terms of insurance design, and it is appropriate to characterize quality risk as very low (Likert scale "1").

PRICE RISK

Camelina in Montana is primarily grown under a production contract that is established before crop planting. The production contract pays a fixed amount per pound of camelina and sometimes includes storage, transportation, and, in some contracts, a "shared risk" program bonus. The shared risk program pays a guaranteed dollar amount to the producer regardless of delivery, but only if an established and confirmed stand of 12 plants per square foot is achieved. In the instance a grower loses the crop by an "Act of God", the farmer is guaranteed the dollar amount from the shared risk program (Sustainable Oils, 2011). Based on the contract pricing, price risk for camelina in this region of Montana is determined to be rated very low (Likert scale "1").

OTHER SOURCES OF REVENUE RISK

Camelina is a small seeded crop that prefers shallow planting, a firm seedbed and low competition. A planting depth of less than a ¼ of an inch is required, so this presents challenges for getting seed in good soil moisture and good seed to soil contact. Therefore, establishing stands is tricky and does present some levels of risk in terms of drought and/or poor management. Some contracts include technical assistance for growing camelina and include shared risk bonuses for established and confirmed stands, yet un-established stands would not qualify for such a bonus. Prevented planting is much less of a concern, but the crop will not tolerate standing water. Thus, assessing all other sources of revenue risk other than yield, quality, and price risk, this risk is rated as low (Likert scale "2").

SUFFICIENT NON-INSURANCE COPING MECHANISMS

The demand for various crop insurance products (existing and potential) is influenced by non-insurance coping mechanisms, such as government price and income support programs; government disaster programs; marketing contracts including futures and options on futures for exchange-traded commodities; crop portfolio and spatial diversification; risk reducing production technologies and practices; and lenders' attitudes, expectations, and rules-of-thumb.

Federal commodity programs tend to reduce farmer exposure to price risk and thus, revenue risk. For camelina, no government crop programs are available for this crop in terms of marketing loans and counter cyclical payments; however, the Biomass Crop Assistance Program is available. The Biomass Crop Assistance Program (BCAP) supports establishing and producing eligible crops for the conversion to bioenergy through project areas and through contracts on land of up to five years for annual and non-woody perennial crops or up to 15 years for woody perennial crops. Through a matching payment program BCAP assists agricultural and forest land owners and eligible material owners with collection, harvest, storage, and transportation of eligible material for use in qualified Biomass Conversion Facilities (BCF). These payments will be available to eligible material owners at the rate of $1 for each $1 per dry ton paid by the BCF to the eligible material owners, limited to a maximum of $45 per dry ton and limited to a 2-year payment duration. No listening session attendees indicated that they currently utilized the program. (USDA; FSA, 2010b)

Other programs such as NAP (Noninsured Crop Disaster Assistance Program) are available. However, there has not been a history of federal disaster payments as issued by the Crop Disaster Program, which is available to producers for losses in excess of 35 percent at a payment rate of 65 percent for insured crops and non-insurable crops; and 60 percent for uninsured crops.

Production contracts often reduce a farmer's exposure to some, but not all, risks. In terms of price mechanisms, approximately 100 percent of the crop in this region is under production contract with a first handler or processor and is priced before harvest and usually priced prior to establishment. Under the terms of the contract the grower is not exposed to contract risk (grower does not have to deliver on the contract under production shortfalls), the grower is exposed to quality risk (price penalties if the product does not meet the quality characteristics specified in the contract), and the grower is not exposed to price risk (prices for specific quality characteristics are not specified in the contract). For this reason, these mechanisms may reduce demand for crop insurance. Further, if price and yield are significantly negatively correlated, revenue variability is reduced and, all other things equal, the demand for crop insurance products will be reduced. Camelina yield and price are expected to be independent of each other because contracted production (supply) will always be adjusted to the appropriate demand level. Thus, the producer is not exposed to significant price risk or volatility, which alleviates risk exposure.

Financial leverage, growth strategies, and recent events all impact a farmer's ability to self-insure. Most listening session attendees currently purchase crop insurance on other commodities and indicated that they would feel more comfortable with their level of risk exposure under FCIC insurance rather than self-insuring; however, currently they are self-insuring.

Diversifying the farm enterprise across multiple commodities (crops and/or livestock) has the potential to significantly reduce whole farm revenue variability. Yield shortfalls on one crop may be partially offset by high yields on a different crop. In addition, a carefully diversified portfolio of crop enterprises can help farmers manage the revenue effects of price risk when other means of managing price risk are limited. For example, if yield risk for a crop (or crops) is small but price risk is significant, a farmer might choose to have no yield insurance and manage revenue risk due to price variation through diversification. Typically, in this region, for growers of camelina, 15-25 percent of total farm revenue can be attributed to this crop, while other commodities produced include barley, canola, peas, hard red winter wheat, and spring wheat with winter wheat and spring wheat being more prevalent for those attending listening sessions. For diversification to generate whole farm revenue risk reduction, the correlation between the commodities must be low (negatively correlated). Commodities with highly positive correlated revenue streams act as if they were a single commodity and, as a result, diversification will not significantly reduce revenue risk and the demand for crop insurance. Because barley, canola, peas, spring wheat and winter wheat all possess the same growth period, their yield risk and revenue risk are deemed to be positively correlated, hence this creates a higher demand for crop insurance.

Farmers at the camelina listening sessions indicated that they were all full-time farmers. Part-time farmers are typically less likely to focus on risk management strategies, including crop insurance. Since full-time farmers produce camelina in this region, the demand for crop insurance products is greater. Further spatial diversification, like commodity diversification, reduces whole farm revenue variability if the yield correlation across farm parcels is low. Typically, camelina farms in this region are not spatially diversified; thus, farms are more exposed to yield risk, increasing the demand for insurance.

Private-sector insurance products can have a mixed impact on the demand for RMA facilitated crop insurance products. If the private-sector products have features that complement or require the use of underlying RMA-facilitated crop insurance, they potentially increase demand for RMA-facilitated insurance products. On the other hand, some products may be substitutes or partial substitutes for RMA-facilitated crop insurance. Currently there is one private product offered through Prairie Mountain Insurance in Montana, but the amount of sales in this region is unknown and listening session participants were unaware of it, which helps to increase the demand for a FCIC camelina crop insurance policy.

Lenders can have a substantial impact on farmers' use of crop insurance products. Often, the insured's value on growing crops is treated as a current asset on the balance sheet. Lenders' awareness, understanding of, and attitudes toward crop insurance have an impact on demand, particularly under circumstances where farmers are highly leveraged. In the case of Montana farmers, lenders favor producers purchasing insurance.

Overall, based on the availability of sufficient non-insurance coping mechanisms for producers of camelina in this region Montana, the expectation of demand for insurance is very high (rated a "5" on Likert scale).

Risk Classification

Risk classification is a serious challenge in rating crop insurance products. Non-insureds and insureds have different perspectives on the cost of crop insurance coverage. Of course, some individuals choose not to insure because they utilize the non-insurance coping mechanisms discussed in the previous category. In other cases, however, the amount of insurance purchased is limited because some individuals perceive the premium rate as being "too high." However, it is possible that existing classification methods will result in premium rates that are appropriate (or even too low) for one group but too high for another group. Unfortunately, for camelina in this region, no FCIC insurance products exist nor have private products been purchased so classification cannot be measured. As such, no Likert scale measurement was provided for this category and it is assumed non-applicable in assisting the Contractor in following the decision tree process.

Moral Hazard

This category attempts to assess whether moral hazard may cause higher crop insurance indemnities. If so, the higher indemnities may be reflected in higher premium rates that could limit the purchase of insurance. By gauging the potential for "gaming the system," a quantitative measure may be used to help assess whether insuring camelina will likely be prone to significant moral hazard problems.

A measurement of variation in yield caused by unavoidable "acts of nature" or avoidable "acts of management" suggest that the yield variation would almost exclusively be due to "acts of nature" (potential for gaming is low), while quality variation caused by unavoidable "acts of nature" or avoidable "acts of management" would be exclusively due to "acts of nature" (potential for gaming is low). Since potential for gaming both yield and quality is low and very low respectively, then overall the extent to which moral hazard is a concern is small (Likert scale "4").

Problems Affecting Insurance Participation

The previous categories dealt with both the potential for, and realization of problems associated with risk classification and moral hazard. This category focuses on other problems that may limit demand for RMA-facilitated crop insurance products for this crop in this region. Because no FCIC programs currently exist for camelina, no Likert scale measurement was provided for this category and it is assumed non-applicable in assisting the Contractor in following the decision tree process.

Montana Program Evaluation Tool Results

As indicated above and illustrated in Figure 5 below, Montana camelina quality risk, price risk and other risk are rated very low ("1"), very low ("1"), and low ("2") respectively, while yield risk is rated as moderate ("3"). Other non-insurance coping mechanisms are rated very high (low availability). By placing more weight on the yield component and other coping mechanisms, these demand signals indicate moderate demand for an insurance product and/or a moderate potential market. Product design issues such as moral hazard are assigned a rating of high ("4"), indicating the extent of potential problems is small. Risk classification was not applicable at this time because no premium rates are available to gauge the program. Other problems affecting insurance participation were also not applicable because no programs exist to facilitate an answer to the questions. Nonetheless, the tool assisted in establishing a decision tree framework to help determine a recommended course of action for insuring camelina as a dedicated energy crop.

See Appendix J, to step through the decision tree process for Montana camelina. Highlighted red arrows mark the decision tree path. Because there is large potential market in Montana (greater than 20,000 acres), the path leads to the significant revenue risk node. Assuming that the relative yield risk rating of moderate justifies significant revenue risk, the path then evaluates the insufficient non-insurance coping mechanisms available. Since there is a low availability of non-insurance coping mechanisms, and there are no classification problems, there is low potential for moral hazard and other problems are not applicable, the decision tree suggests that a new product may be developed.

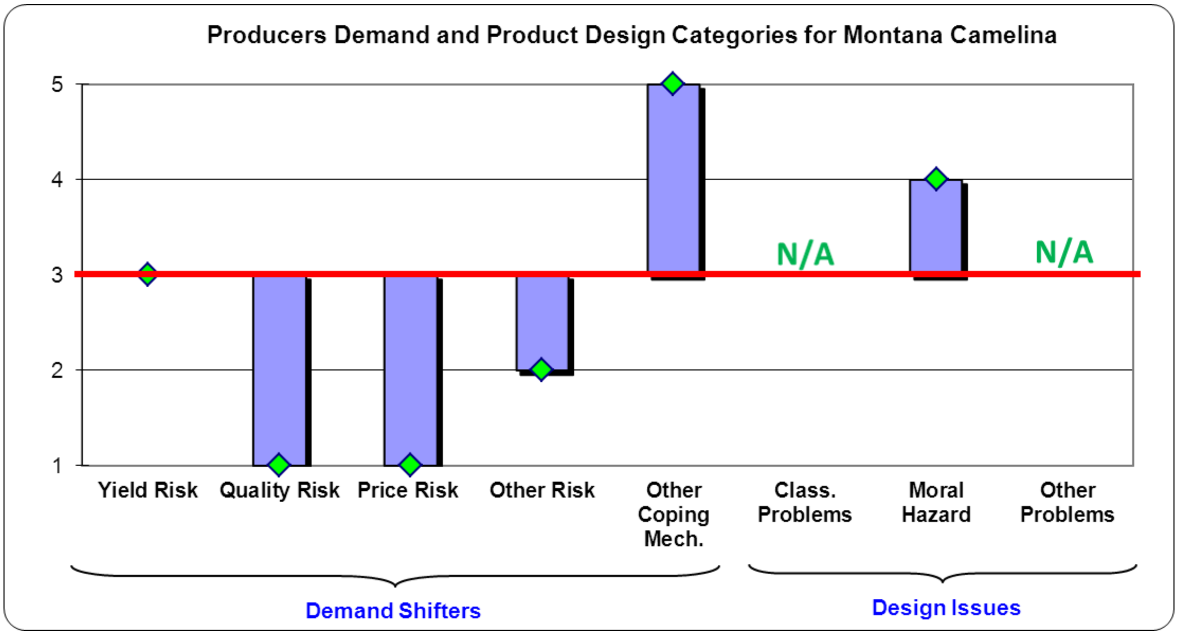

Figure 5: Montana Camelina Demand Shifter and Product Design Signals

Oregon/Washington Program Evaluation Tool Summary

The following is a summary of the completed Diagnostic Instrument for Oregon/Washington. Note that the completed Diagnostic Tools in Appendix N provide the completed answers to the questions while the summary below is meant to provide summary level answers to the eight demand signal questions used for Likert scale ratings. This summary will best be understood by reviewing the Program Evaluation Tool and the completed Diagnostic Instrument in Appendix N.

Marketing

Great Plains Oil & Exploration (Great Plains – The Camelina Company) is a renewable fuels energy company founded with the purpose of manufacturing and marketing biodiesel produced from camelina (Great Plains, The Camelina Company, 2010). Great Plains currently contracts with producers utilizing a production contract in Oregon. Also Willamette Biomass Processors, Inc. and Natural Selection Farms, Inc. currently contracts for camelina utilizing production contracts in Oregon and Washington. Although Sustainable Oils does not contract production in Oregon, often it will purchase contracted production from Willamette Biomass Processors to help meet its demand (Johnson S. , 2011).

RMA-Facilitated Insurance Products

There are no RMA-facilitated insurance products currently available for camelina utilized for dedicated energy in Oregon or any other region in the United States.

Yield Risk

Relative risk is used to adjust absolute magnitudes that vary across crops to a relative level to facilitate comparability of crop risk. Although camelina in Oregon and Washington are not reported by NASS, assuming that relative yield of camelina is similar to the relative yield of canola (both brassica crops); we can use canola yields to assist in quantifying the yield risk for Oregon's camelina in comparison to other crops. Canola is not reported by NASS in Oregon, so data from Oregon State's Agricultural Information Network are used for the analysis. Whitman County in Washington does not report canola, so we analyzed the NASS data for other crops in the region to illustrate the risk for canola. Whitman County was specifically selected due to the producer attending the Oregon listening session who grows camelina in that county.

Utilizing the coefficient of variation (CV) helps to facilitate the comparison across crops with different expected yields. Calculated as the standard deviation divided by the mean, this allows the comparison of variation of unlike data series. As illustrated in Figure 6, yield risk for canola in Northeast Oregon (Morrow, Umatilla, and Union Counties) is comparable to that of wheat, Kentucky bluegrass, and other hay over the past ten years. Alfalfa, corn, peppermint, potatoes, and onions appear to have less risk; however, we suspect that the majority of these crops are under irrigation, while camelina, canola, and wheat would be non-irrigated crops. Also, as illustrated in Figure 7, the other hay and spring wheat CV's in Whitman County, Washington, are very similar to those crops in Morrow, Umatilla, and Union Counties, Oregon. It is therefore possible to conclude that canola would perform similarly to other hay and spring wheat in Whitman County. Utilizing a Likert scale rating from 1 to 5 for non-catastrophic yield risk where "1" is very low relative yield risk and "5" is very high relative yield risk, listening session participants indicated that barley, canola, corn for grain, winter wheat, and spring wheat were crops that would have the highest risk (Likert scale rating of "5"), while camelina would have the lowest risk (Likert scale rating of "1"). Listening session producers stated that camelina is very easy to grow, requires low inputs, and has very little risk and would have much less yield risk than canola or flax. Although listening session producers suggest that camelina has very little yield risk, the analyzed data suggests that camelina may more closely resemble the risk of canola and wheat. Utilizing this information, the Likert scale rating from 1 to 5 for non-catastrophic yield risk was rated at a "3"; thus, associating the crop with crops having moderate yield risk (Likert scale "3").

An assessment of catastrophic yield risk results in a moderate relative yield risk rating of "3" on the Likert scale. The risk for a catastrophic yield loss is hard to gauge for camelina but utilizing the canola cause of loss data from RMA, we can make a more informed estimate. Utilizing the loss cost ratio as a way of measuring severity of causes of loss, the number of observations for the loss cost ratio above 25 percent (captures a minimum 50 percent yield loss based on assumption that guarantee is established at 75 percent coverage level for all policies) was recorded. Analysis of these observations for all Oregon canola suggest that cold wet weather, cold winter, drought, excess moisture, freeze and frost, hail, heat, hot winds, and insects can cause losses to canola in excess of 50 percent or more. These observations are illustrated in Figure 8, and the data suggest that as much as 60 percent of the time over 25 years[7], losses for any given cause of loss greater than 50 percent have occurred for canola, and could occur for camelina.

[7] Where 25 years of Summary of Business Cause of Loss Data from RMA did not exist, the contractor estimated the observations over 25 years by taking the ratio of observations divided by years in dataset and multiplied by 25.

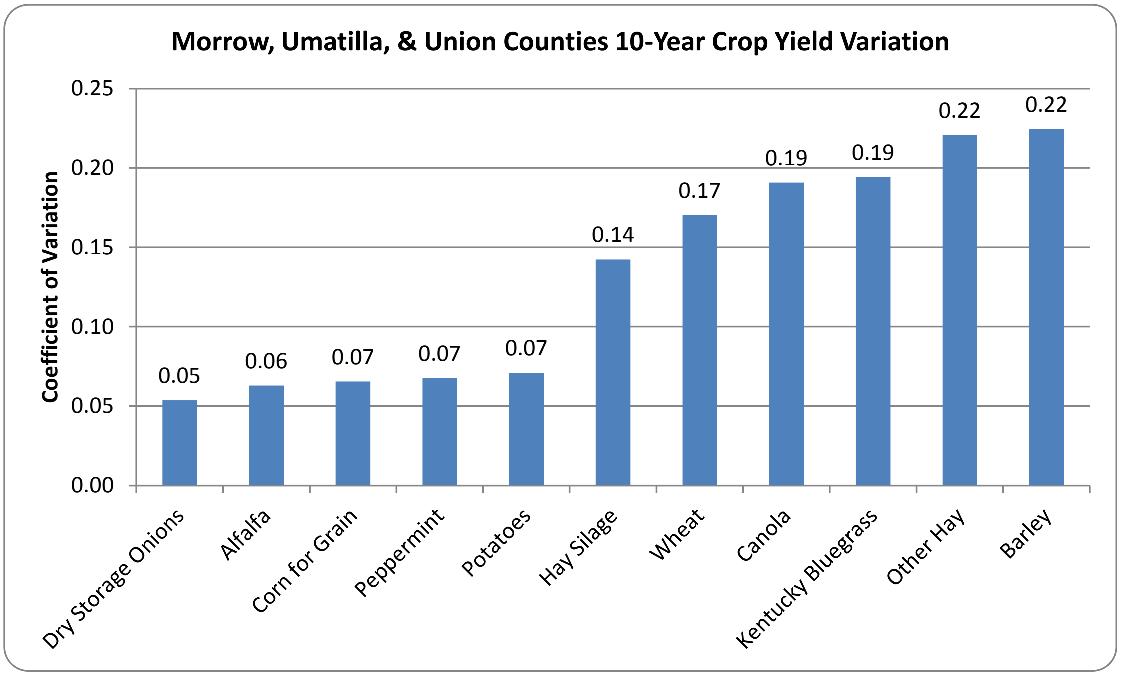

Figure 6: Morrow, Union, & Umatilla Counties 10 Year Crop Yield Risk Comparison

Adapted from OAIN, 2011

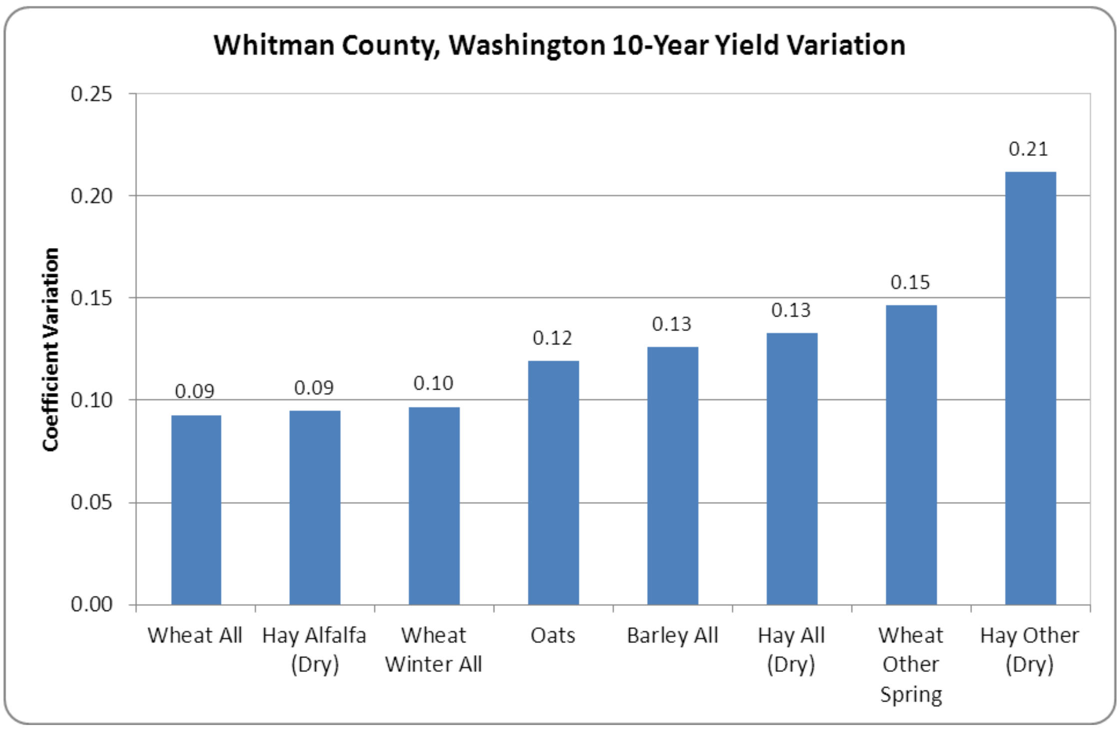

Figure 7: Whitman County, Washington 10-Year Crop Yield Risk Comparison

Adapted from USDA; NASS, 2011

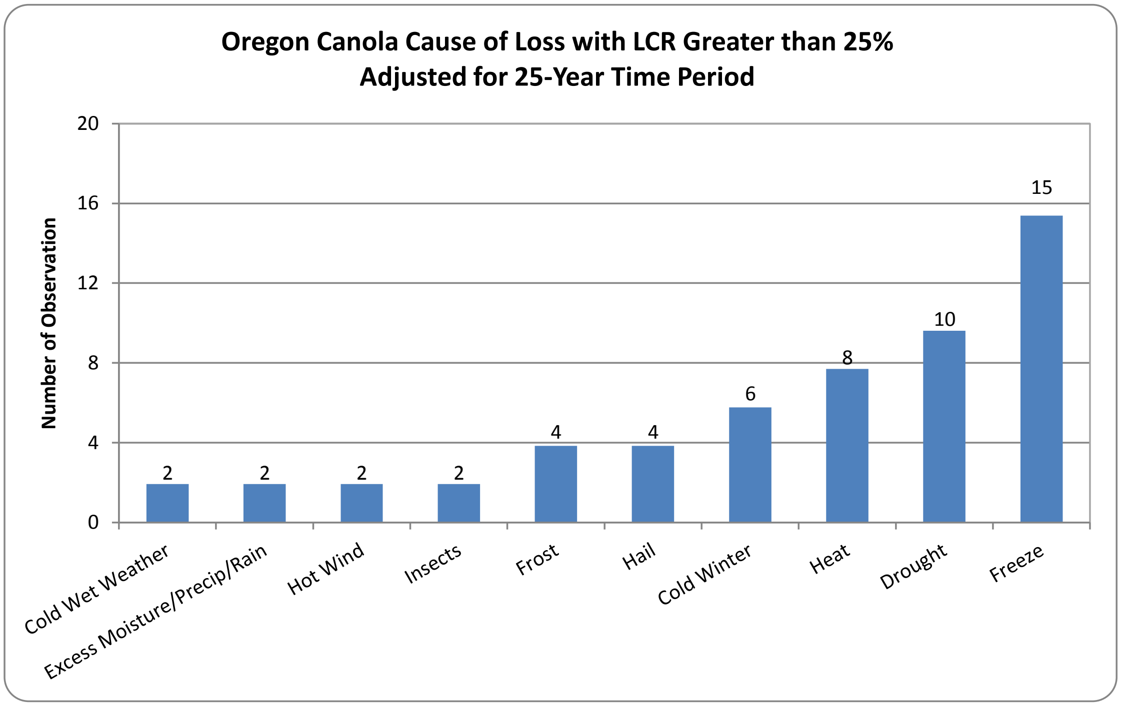

Figure 8: Oregon Canola Cause of Loss Observations of Lost Cost Ratio in Excess of 25%

Adapted from USDA; RMA Cause of Loss Summary of Business, 2011

Quality Risk

Camelina to be utilized as a feedstock for dedicated energy does not exhibit significant quality risk at the time of harvest and thus can be characterized as very low in quality risk. Willamette Biomass Processors in Oregon docks the price paid to a producer based on oil quality below specific parameters and excessive foreign matter (1 percent dockage); however, listening session attendees indicated that the dockage and oil quality was insignificant and not much of a problem. Therefore, quality risks are insignificant in terms of insurance design and it is appropriate to characterize quality risk as low (Likert scale "2").

Price Risk

Camelina in Oregon and Washington is primarily grown under a production contract established before crop planting. The production contract pays a fixed amount per pound of camelina and sometimes includes storage, transportation and in some contracts a "shared risk" program bonus. The shared risk program pays a guaranteed dollar amount to the producer regardless of delivery, but only if an established and confirmed stand of 12 plants per square foot is achieved. In the instance a grower loses the crop by an "Act of God", the farmer is guaranteed the dollar amount from the shared risk program (Sustainable Oils, 2011). Based on the contract pricing, price risk for camelina in this region of Oregon and Washington is determined to be rated low (Likert scale "2").

Other Sources of Revenue Risk

Camelina is a small seeded crop that prefers shallow planting, a firm seedbed and low competition. A planting depth of less than a ¼ of an inch is required, so this presents challenges for getting seed in good soil moisture and good seed to soil contact. Therefore, establishing stands is tricky and does present some levels or risk in terms of drought and/or poor management. Some contracts include technical assistance for growing camelina and include shared risk bonuses for established and confirmed stands, yet un-established stands would not qualify for such a bonus. Prevented planting is much less of a concern, but the crop will not tolerate standing water. Thus, assessing all other sources of revenue risk other than yield, quality and price risk, this risk is rated as low (Likert scale "2").

SUFFICIENT NON-INSURANCE COPING MECHANISMS

The demand for various crop insurance products (existing and potential) is influenced by non-insurance coping mechanisms, such as: government price and income support programs; government disaster programs; marketing contracts including futures and options on futures for exchange-traded commodities; crop portfolio and spatial diversification; risk reducing production technologies and practices; and lenders' attitudes, expectations, and rules-of-thumb.

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Diversifying the farm enterprise across multiple commodities (crops and/or livestock) has the potential to significantly reduce whole farm revenue variability. Yield shortfalls on one crop may be partially offset by high yields on a different crop. In addition, a carefully diversified portfolio of crop enterprises can help farmers manage the revenue effects of price risk when other means of managing price risk are limited. For example, if yield risk for a crop (or crops) is small but price risk is significant, a farmer might choose to have no yield insurance and manage revenue risk due to price variation through diversification. Typically, in this region, for growers of camelina 15-25 percent of total farm revenue can be attributed to this crop, while other commodities produced include alfalfa, other hay, hard red winter wheat, spring wheat, and barley, with winter wheat and spring wheat being more prevalent for those attending listening sessions. For diversification to generate whole farm revenue risk reduction, the correlation between the commodities must be low (negatively correlated). Commodities with highly positively correlated revenue streams act as if they were a single commodity and, as a result, diversification will not significantly reduce revenue risk and the demand for crop insurance. Because other hay, barley, winter wheat and spring wheat all possess the same growth period, their yield risk and revenue risk are deemed to be positively correlated, hence this creates a higher demand for crop insurance.

Farmers at the camelina listening sessions indicated that they were all full-time farmers. Part-time farmers are typically less likely to focus on risk management strategies, including crop insurance. Since full-time farmers produce camelina in this region, the demand for crop insurance products is greater. Further spatial diversification, like commodity diversification, reduces whole farm revenue variability if the yield correlation across farm parcels is low. Typically, camelina farms in this region are not spatially diversified; thus, farms are more exposed to yield risk, increasing the demand for insurance.

Private-sector insurance products can have a mixed impact on the demand for RMA facilitated crop insurance products. If the private-sector products have features that complement or require the use of underlying RMA-facilitated crop insurance, they potentially increase demand for RMA-facilitated insurance products. On the other hand, some products may be substitutes or partial substitutes for RMA-facilitated crop insurance. Currently there is one private product offered through Prairie Mountain Insurance in Montana, but the amount of sales in this region is unknown and listening session participants were unaware of it, which helps to increase the demand for a FCIC camelina crop insurance policy.

Lenders can have a substantial impact on farmers' use of crop insurance products. Often, the insured's value on growing crops is treated as a current asset on the balance sheet. Lenders' awareness, understanding of, and attitudes toward, crop insurance have an impact on demand, particularly under circumstances where farmers are highly leveraged. In the case of Oregon and Washington farmers, lenders favor producers purchasing insurance.

Overall, based on the availability of sufficient non-insurance coping mechanisms for producers of camelina in this region Oregon and Washington, the expectation of demand for insurance is very high (rated a "5" on Likert scale).

RISK CLASSIFICATION

Risk classification is a serious challenge in rating crop insurance products. Non-insureds and insureds have different perspectives on the cost of crop insurance coverage. Of course, some individuals choose not to insure because they utilize the non-insurance coping mechanisms discussed in the previous category. In other cases, however, the amount of insurance purchased is limited because some individuals perceive the premium rate as being "too high." However, it is possible that existing classification methods will result in premium rates that are appropriate (or even too low) for one group but too high for another group. Unfortunately, for camelina in this region, no FCIC insurance products exist nor have private products been purchased so classification cannot be measured. As such, no Likert scale measurement was provided for this category and it is assumed non-applicable in assisting the Contractor in following the decision tree process.

MORAL HAZARD

This category attempts to assess whether moral hazard may cause higher crop insurance indemnities. If so, the higher indemnities may be reflected in higher premium rates that could limit the purchase of insurance. By gauging the potential for "gaming the system," a quantitative measure may be used to help assess whether insuring camelina will likely be prone to significant moral hazard problems.

A measurement of variation in yield caused by unavoidable "acts of nature" or avoidable "acts of management "suggest that the yield variation would almost exclusively be due to "acts of nature" (potential for gaming is low), while quality variation caused by unavoidable "acts of nature" or avoidable "acts of management" would be exclusively due to "acts of nature" (potential for gaming is low). Since potential for gaming both yield and quality is low, then overall the extent to which moral hazard is a concern is small (Likert scale "4").

PROBLEMS AFFECTING INSURANCE PARTICIPATION

The previous categories dealt with both the potential for, and realization of problems associated with risk classification and moral hazard. This category focuses on other problems that may limit demand for RMA-facilitated crop insurance products for this crop in this region. Because no FCIC programs currently exist for camelina, no Likert scale measurement was provided for this category and it is assumed non-applicable in assisting the Contractor in following the decision tree process.

Oregon/Washington Program Evaluation Tool Results

As illustrated in Figure 9 below, Oregon camelina yield risk, quality risk, price risk and other risk are rated relatively moderate ("3"), low ("2"), low ("2") and low ("2") respectively, while sufficient non-insurance coping mechanisms are rated very high (very low availability). The quality, price and other risk demand signals suggest or indicate lower demand for an insurance product and/or a low potential market, yet yield risk and other coping mechanisms may suggest moderate to high demand. Product design issues such as moral hazard are rated a higher number ("4") indicating smaller potential for problems or an ability to address problems. Risk classification was not applicable at this time because no premium rates are available to gauge the program. Other problems affecting insurance participation were also not applicable because no programs exist to facilitate an answer to the questions. Nonetheless, the tool assisted in establishing a decision tree framework to help determine a recommended course of action for insuring camelina as a dedicated energy crop.

See Appendix K, to step through the decision tree process for Oregon/Washington camelina. Highlighted red arrows mark the decision tree path. Because listening sessions attendees suggest that the potential market is greater than 10,000 acres in the next 3-5 years the path leads to the significant revenue risk node. Assuming that the relative yield risk rating of moderate justifies significant revenue risk, the path then evaluates the insufficient non-insurance coping mechanisms available. Since there is a low availability of non-insurance coping mechanisms, and there are no classification problems, there is low potential for moral hazard and other problems are not applicable, the decision tree suggests that a new product may be developed.

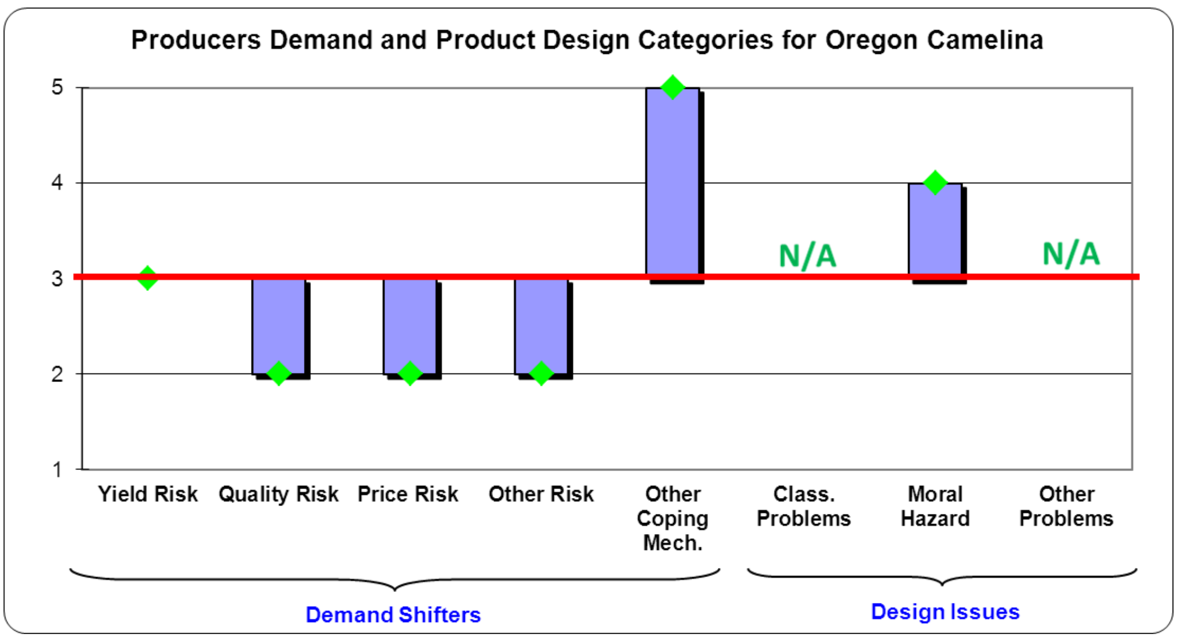

Figure 9: Oregon/Washington Camelina Demand Shifter and Product Design Signals

ESTIMATION OF YIELD PROBABILITY DISTRIBUTIONS FOR MONTANA

Estimating yields and yield risks of relatively new crops in regions heretofore unutilized as production areas raises questions regarding expected yields, yield variability, and profitability. With little or no production history, USDA's Risk Management Agency is faced with uncertain production capabilities when developing crop insurance programs. Agronomists, soil scientists, hydrologists, engineers, and others have developed tools for evaluating yield possibilities. Many of these tools are incorporated into computerized crop simulation models. One such model that began development in the mid-80s is EPIC, the original acronym for the *Erosion Productivity Impact Calculator* model.

EPIC has evolved over time to include many impacts of crop production along with climatic factors on the environment. The model has been utilized by scientists worldwide and EPIC is now the acronym for *Environmental Policy Integrated Climate* model. One of the principal developers is Dr. J.R.Williams, Blackland Research and Extension Center, Texas AgriLife Research, Temple, Texas. The EPIC model has been applied at regional (Williams, 1995) and national scales (Thompson, Izaurralde, Rosenberg, & He, 2006) & (Izaurralde, Rosenberg, Brown, & Thompson, 2003).

EPIC (Potter, Atwood, Kellog, & Williams, 2004) is a daily time-step model capable of simulating a wide array of crop production and environmental processes including plant growth, crop yields, plant competition, and soil erosion as well as water, and nutrient balances. Biomass growth is related to solar radiation intercepted by the plant canopy, vapor pressure deficit, CO2 concentration, and other physiological stresses including water, temperature, N, P, and soil aeration deficits/surpluses. Similarly, root growth is affected by bulk density, temperature, and aluminum content. Soil carbon algorithms calculate carbon balance including losses of carbon from water and wind erosion. Plant growth and development is influenced by temperature during the growing season, expressed within the model as heat units. The quantity of heat units necessary for the crop to reach maturity varies by latitude.

Among the model's many features is a stochastic weather generator. Weather can be input from historical records or it can be estimated stochastically using precipitation, air temperature, solar radiation, wind, and relative humidity parameters developed from historical records.

The model simulates growth and development of a crop each day from emergence to harvest. Initially, a crop production schedule is developed from producers indicating their dates (and application rates) of operations prior to and during the growing season for tillage, planting, pesticides, irrigations, fertilizers, and harvesting. Adding the rates and dates of crop production inputs and other management information facilitates the simulation of tillage, irrigation, and fertilizer applications. Each operation combined with climate can affect crop production; either through growth, erosion, soil water, or nutrients, and most times a combination of these elements.

The primary objective of this analysis of camelina in Montana is to utilize the EPIC model, which has been adapted to a Windows® application, WinEPIC, to estimate an array of stochastic yields from which to develop a probability distribution. Thereby, yield variability (risk) can be quantified and variations in revenues inferred. Sub-objectives include: a) by utilizing local weather data along with producer's camelina yields and management data from a designated area in west central Montana, calibrate crop coefficients to best represent the current yields and production conditions, and b) to utilize the calibrated model for producing 100 years of stochastic camelina yield observations utilizing successive 3-year rotations of winter wheat/fallow/spring camelina.

The methodology includes developing a production schedule of tillage, planting, fertilization, pesticide applications, and harvesting operations along with management decisions regarding typical dates of each operation, seeding rates, and application rates of fertilizers, and pesticides. Camelina producers were utilized to assimilate as much information regarding production and yields as possible.

They reported that fertilization of camelina typically included 80-100 pounds/acre Nitrogen and 15-20 pounds/acre Phosphorus. Planting, utilizing no-tillage or direct seeding into stubble, occurred in late March through early April and the crop was harvested in 105 days after planting in July or August.

A local producer provided his best estimate of historical non-irrigated yields on his farm from 2007-2010. Though the 2008 yield was actually known to be reduced significantly by shattering and 2009 yields suffered from harvesting losses through the combine, his best yield estimates were 1,150, 2,295, 1,135, and 1,378 pounds/acre for the four years, respectively. Each year of camelina production followed a summer fallow period for that specific field. Thus, a rotation of minimum-till winter wheat/no-till fallow/direct-seeded spring seeded camelina was utilized for calibrating the EPIC model to simulate the historical camelina yields as closely as possible. Daily maximum and minimum temperatures and rainfall for each year for Conrad, Montana, from the National Weather Service were used since on-site weather records were not available.

Upon calibrating the model's crop physiological coefficients, simulated yields were 832, 2,380, 1,264, and 1,395 pounds/acre for 2007-2010, respectively. The 4-year simulated average yield was 1,468 pounds/acre compared with the actual average yield of 1,490 pounds/acre, a difference of only 22 pounds/acre or 1.5 percent.

The following graph depicts the relationship of simulated to producer yields year-by-year; thereby producing a regression line having a slope of 1.14 with an R-squared=0.92. A slope of 1.0 with a zero intercept, depicted by the dashed line, indicates a perfect relationship or perfect correlation of simulated yields to producer yields. R-squared signifies the accuracy of the black regression line in predicting them; R-squared=1.0 being a perfect prediction.

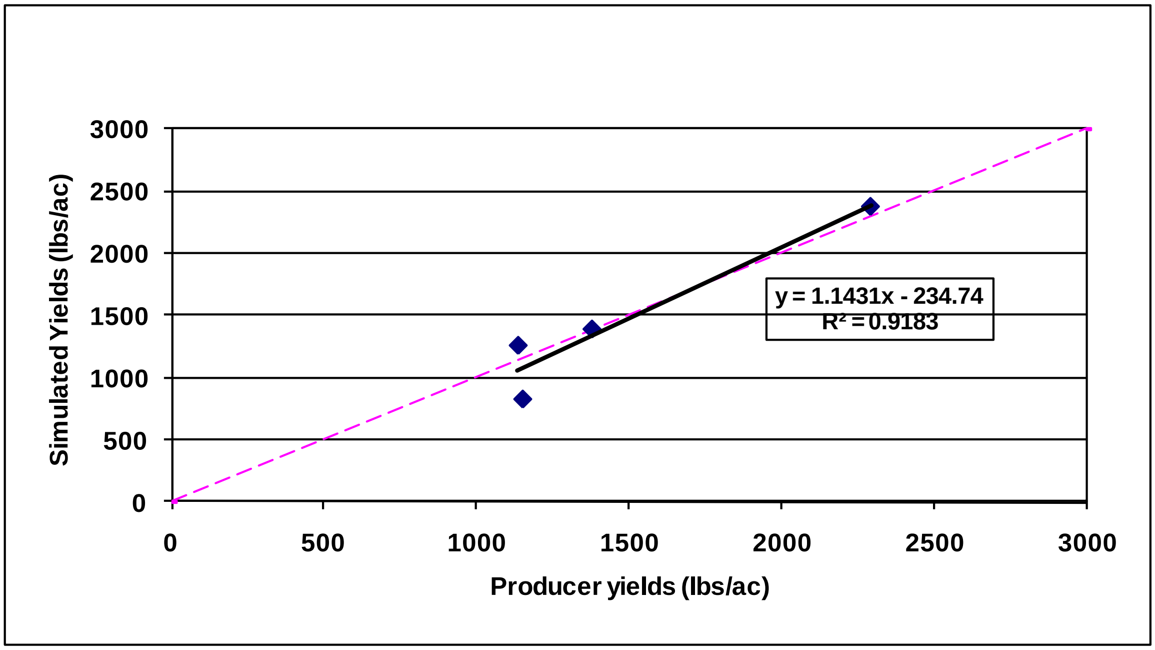

Figure 10: Correlation of Simulated Yields to Producer Average Yields

Further statistical evidence that the simulated yields approximate the producer yields is illustrated by the paired t-test (Table 13). A difference of zero is being tested between the means of both sets of fresh weight yields, 1,489.5 vs. 1,467.9 pounds/acre for the producer mean versus the simulated mean, respectively. In this case, t = 0.21 which is less than the critical t value of 5.84 indicates the means are not significantly different at the 1 percent level.

Table 13: Camelina Yield paired t-Test

Item	Simulated	Producer
Mean	1,489.5	1,467.853
Variance	300,731	427,868.2
Observations	4	4
Hypothesized Mean Difference	0	
df	3	
t Stat	0.214	
t Critical two-tail	5.841	

Utilizing the calibrated coefficients that were developed by simulating the producer yields above, 100 years of stochastically generated yields were simulated for developing a probability distribution. Two changes were made from the calibration simulations above: 1) the original soil profile was maintained throughout the long-term simulation by stopping erosion and 2) daily weather parameters were generated and were based on historical records for 1960-2010 from the nearby weather station at Conrad, Montana. This generated daily weather coupled with the production practices over the long-term simulation period produced a probability distribution, Figure 11 and Figure 12. The 100-year average grain yield was 1,241 pounds/acre. The range of yearly yields varied from a low of 249 pounds/acre to a high of 3,590 pounds/acre.

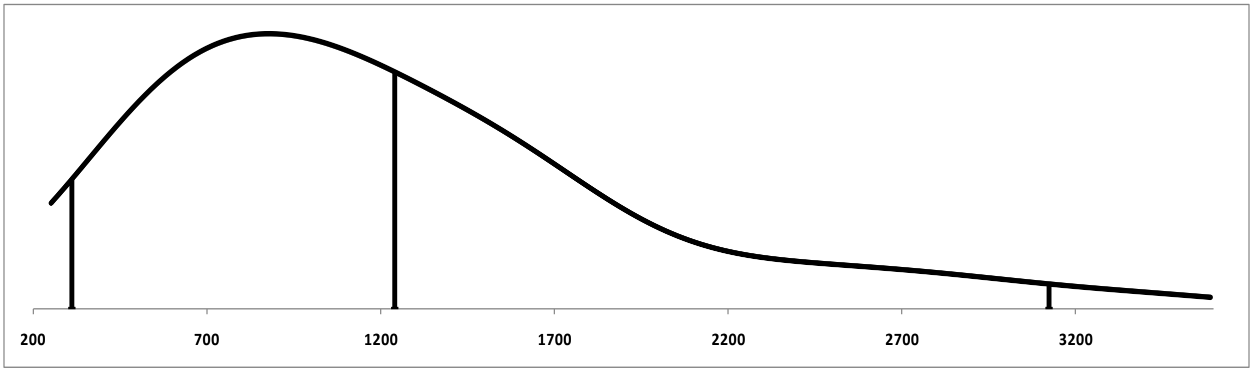

Figure 11: PDF of Camelina Yields in Montana

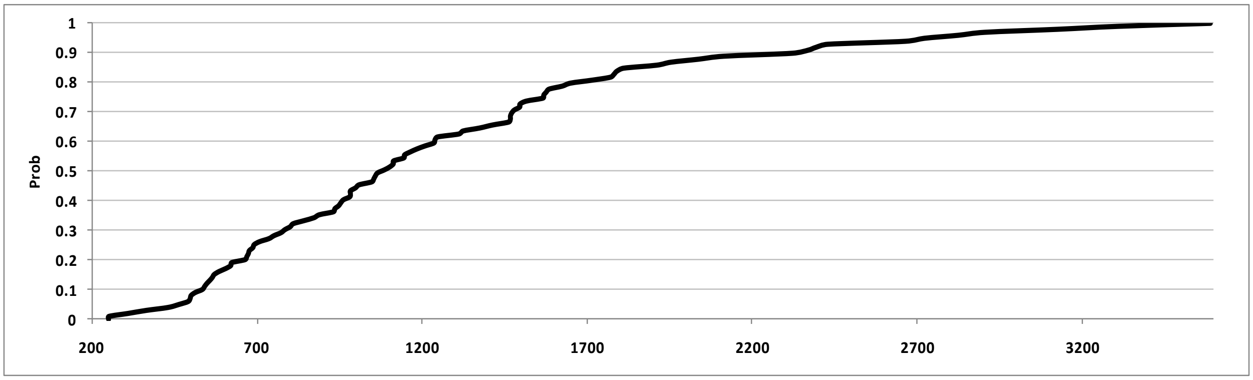

Figure 12: CDF of Camelina Yields in Montana

MONTANA CAMELINA INSURANCE PREMIUM CALCULATIONS

The yield distributions for camelina grown in West Central Montana, as developed using the EPIC model, were used to estimate yield insurance premiums. There is only one distribution for camelina. The analysis procedure used for the camelina yield distribution is the following:

- The summary statistics to describe the distribution are calculated. Probability density function (PDF) and cumulative distribution function (CDF) charts for the distribution are provided.
- The distribution was tested for normality.
- Parameters for 15 parametric distributions are estimated using a maximum likelihood procedure in Simetar©. The parameters for an empirical distribution are estimated as well.
- The parameters for the 16 distributions are used to simulate the yield distribution for 500 iterations. Summary statistics for the distributions are compared to the original distribution.
- The CDFDEV[8] function in Simetar© are used to determine how closely the 16 distributions reproduced the original distribution. Based on the CDFDEV criteria the four distributions that most closely simulate the original distribution are selected for analysis.

[8] The goodness-of-fit criteria selected for testing how closely the simulated PDFs compare to the original distribution is a weighted cumulative distribution comparison function (CDFDEV) available in Simetar©. The CDFDEV criteria is calculated as the sum of the squared distance between two distribution functions with penalty weights increasing in value as the observations move away from the mean. If a simulated PDF is identical to the original distribution, the CDFDEV value equals zero. When comparing two or more distributions as to their

- The best four distributions were simulated in Simetar© for 25,000 iterations to estimate "fair insurance premiums" for eight yield coverage levels ranging from 50 percent to 85 percent of the average yield reported by the farmers in a focus group interview. The random number generator used for the analysis uses a Latin hypercube procedure and generates pseudo random numbers based on a fixed seed.
- The no load and fully loaded fair premiums are reported as $/acre values for the four assumed probability distributions for eight levels of possible year coverage.
- The no load fair insurance premium is calculated by multiplying the probability of each state of nature (indemnity) by its respective probability. Using a Monte Carlo simulation approach each insurance policy was simulated for 25,000 yields drawn at random from assumed probability distributions.
- The loaded insurance premium is calculated using a 0.90 unit division load factor, a 0.88 FCIC disaster reserve factor, and a 1.30 qualitative load factor.

Camelina Yield Distribution

The summary statistics in Table 14 report that the average yield as 1,241.12 pounds/acre and the minimum expected yield is 249 pounds/acre. The distribution is slightly skewed to the right given a skewness statistic of 1.19. This shape is confirmed in the PDF and CDF charts for the Montana camelina yield distribution (Figure 11 and Figure 12).

Table 14: Summary Statistics for Base Yield Distribution of Camelina in Montana

	Base Yield
Mean	1,241.12
Standard Deviation	707.54
Min	249.29
Median	1,075.25
Max	3,589.97
Skewness	1.19
Kurtosis	1.25

Five statistical tests for normality were performed: Shapiro-Wilks, Anderson-Darling, Cramer von Mises, Kolmagarov-Smiroff, and Chi-Square (Table 15). All five tests reported that statically the distribution is not distributed normal at the alpha equal 5 percent level of significance.

Table 15: Normality Test for the Yield Distribution of Camelina in Montana

Confidence Level		95.000%	
Procedure	Test Value	p-Value	
Shapiro-Wilks	0.906	0.000	Reject the Ho that the Distribution is Normally Distributed*
Anderson-Darling	2.596	0.000	Reject the Ho that the Distribution is Normally Distributed*
Cramer von Mises	0.401	0.000	Reject the Ho that the Distribution is Normally Distributed*
Kolmogorov-Smirnov	0.117	NA	Consult Critical Value Table
Chi-Squared	38.400	0.005	Reject the Ho that the Distribution is Normally Distributed*
			*Based on approximate p-values

Parameters for the 15 parametric distributions reported in Table 16 were simulated using a common uniform standard deviate to insure the results are directly comparable. The summary statistics for these distributions and the goodness of fit criteria (CDFDEV) for the 15 distributions and the empirical distribution are summarized in Table

goodness-of-fit, the distribution with the smallest CDFDEV is considered "best" for the purposes of this study. A mathematical description of the CDFDEV formula is provided in the Appendix.

16. The 16 distributions were simulated 500 iterations with a common uniform standard deviate and the resulting summary statistics are reported beside the parameters. All of the distributions reproduce the mean, as expected but a number of them fail to reproduce the range of the distribution. The CDFDEV criteria indicate the four best distributions for simulating the distribution are empirical, beta, gamma, and Weibull; with the empirical distribution being best.

Table 16: Univariate Parameter Estimation for the Yield Distribution of Camelina in Montana

		MLEs		Statisitcs				Goodness of Fit	
Distribution	Parameters	Parm. 1	Parm. 2	Mean	Std. Dev.	Min	Max	CDFDEV	Rank
Beta	**α, β** ; A≤x≤B, α,β>0	1.068	2.397	1,279	731	251	3,424	20,000	Second
Double Exponential	**α, β** ; α≤x<∞, -∞<α<∞, β>0	1075.245	526.603	1,075	745	(2,256)	4,443	356,854	
Exponential	**μ, σ** ; -∞<x<∞, -∞<μ<∞, σ>0	249.290	991.835	1,241	992	250	7,280	546,105	
Gamma	**α, β** ; 0≤x<∞, α,β>0	3.387	366.466	1,241	675	97	4,461	33,191	Fourth
Logistic	**μ, σ** ; 0≤x<∞, -∞<μ<∞, σ>0	1161.592	380.917	1,161	691	(1,512)	3,861	187,152	
Log-Log	**μ, σ** ; -∞<x<∞, -∞<μ<∞, σ>0	931.362	506.802	1,224	650	(56)	4,524	46,469	
Log-Logistic	**μ, σ** ; 0≤x<∞, -∞<μ<∞, σ>0	3.091	1069.069	1,276	914	110	10,585	1,524,252	
Lognormal	**μ, σ** ; 0≤x<∞, -∞<μ<∞, σ>0	6.969	0.567	1,248	766	181	6,316	235,573	
Normal	**μ, σ** ; -∞<x<∞, -∞<μ<∞, σ>0	1241.125	703.997	1,241	705	(957)	3,454	110,938	
Pareto	**α, β** ; α≤x<∞, α,β>0	249.290	0.690	23,050	330,532	250	7,268,992	1.584195E+12	
Uniform	**a, b** ; a≤x≤b	249.290	3589.970	1,920	965	252	3,587	485,925	
Weibull	**α, β** ; 0≤x<∞, α,β>0	1.888	878698.998	1,248	688	34	3,967	22,665	Third
Geometric	**p** ; x=1,2,...; 0≤p≤1	0.001		1,242	1,241	2	8,798	1,281,170	
Poisson	**λ** ; x=0,1,...; 0≤λ<∞	1240.590		1,240	35	1,130	1,351	963,982	
Negative Binomial	**s, p** ; x=1,2,...; 0≤p≤1	3.000	0.002	1,265	674	3	3,494	43,320	
Empirical	Si, F(x)			1,229	670	249	3,567	1,808	Best

Insurance Premiums for Montana Camelina

Eight yield loss insurance policies were simulated for stochastic yields using the four best probability distributions. The eight policies are expressed as a fraction of the average yield of 1,241 pounds/acre (APH) assuming a price guarantee of $0.15/pound. The eight policies are defined in terms of fraction from the APH and are 0.50, 0.55, 0.60, 0.65, 0.70, 0.75, 0.80, and 0.85. The APH yield was assumed to equal the average for the base yield distributions from the EPIC runs.

The calculated insurance premiums are reported in Table 17. Based on the assumption that the yield for camelina is distributed empirically, the no load premiums are less than $10.50/acre for policies that insure 50 percent-65 percent of the APH. The no load premium at 70 percent APH is $13.56/acre. It increases rapidly thereafter with a $16.85/acre premium for 75 percent APH coverage, $20.58/acre for 80 percent APH coverage, and reaches $24.84/acre for 85 percent APH coverage.

The calculated insurance premiums for the other three probability distribution assumptions are generally higher than those for the empirical distribution. For example, for the 85 percent APH policy, the Weibull distribution indicates a $26.95/acre premium, the beta distribution has a $28.36/acre premium, and the gamma distribution has a $24.97/acre premium.

The difference in premiums for each yield insurance policy differs across probability distributions due to the weight the distribution places on the insured range of the yield distribution. This relationship can be seen in Figure 13, a PDF of the original yield distribution and the four selected distributions. The beta distribution is associated with the highest premiums for the 70 percent-85 percent APH policies because it has more weight in the higher yield values over the range of 250 to 500 pounds/acre.

The fully loaded premium for the 85 percent APH coverage ranges from $40.77/acre for the empirical distribution to $46.54/acre for the beta distribution (Table 17). The fully loaded premium was calculated by dividing the no load fair premium by 0.90 (the unit division load factor) and then dividing that result by 0.88 (the FCIC disaster reserve factor) and multiplying by 1.3 (the qualitative load factor). The qualitative load factor of 1.3 is used to adjust for the lack of risk on the regression equations for physical relationships and production functions in the EPIC model. EPIC's only risk component is from the weather variables so it lacks the risk normally associated with simulating a regression equation used to predict production based on the values for the independent variables.

Table 17: Yield Insurance Premiums for Camelina in Montana; Assuming Alternative Yield Coverage Levels and Yield Distributions, an APH Yield of 1,241 Pounds Per Acre, and Guaranteed Price of $0.15 Per Pound

	0.5 of APH	0.55 of APH	0.6 of APH	0.65 of APH	0.7 of APH	0.75 of APH	0.8 of APH	0.85 of APH
Liability ($/acre)	93.08	102.39	111.70	121.01	130.32	139.63	148.93	158.24
No Load Fair Premium ($/acre)								
Empirical	3.43	5.30	7.73	10.48	13.56	16.85	20.58	24.84
Beta	6.11	8.33	10.88	13.76	16.95	20.45	24.26	28.36
Weibull	6.46	8.40	10.66	13.24	16.16	19.42	23.01	26.95
Gamma	4.62	6.38	8.51	11.02	13.92	17.22	20.90	24.97
Fully Loaded Premium ($/acre)								
Empirical	5.63	8.70	12.69	17.20	22.25	27.66	33.79	40.77
Beta	10.02	13.67	17.86	22.58	27.82	33.57	39.82	46.54
Weibull	10.60	13.79	17.50	21.74	26.53	31.87	37.78	44.24
Gamma	7.58	10.48	13.97	18.09	22.85	28.26	34.30	40.98
Loss Cost (%)								
Empirical	3.68%	5.18%	6.92%	8.66%	10.40%	12.07%	13.82%	15.70%
Beta	6.56%	8.13%	9.74%	11.37%	13.01%	14.65%	16.29%	17.92%
Weibull	6.94%	8.20%	9.54%	10.94%	12.40%	13.91%	15.45%	17.03%
Gamma	4.96%	6.23%	7.62%	9.11%	10.68%	12.33%	14.03%	15.78%
Fully Loaded Base Premium (%)								
Empirical	6.0%	8.5%	11.4%	14.2%	17.1%	19.8%	22.7%	25.8%
Beta	10.8%	13.3%	16.0%	18.7%	21.3%	24.0%	26.7%	29.4%
Weibull	11.4%	13.5%	15.7%	18.0%	20.4%	22.8%	25.4%	28.0%
Gamma	8.1%	10.2%	12.5%	15.0%	17.5%	20.2%	23.0%	25.9%

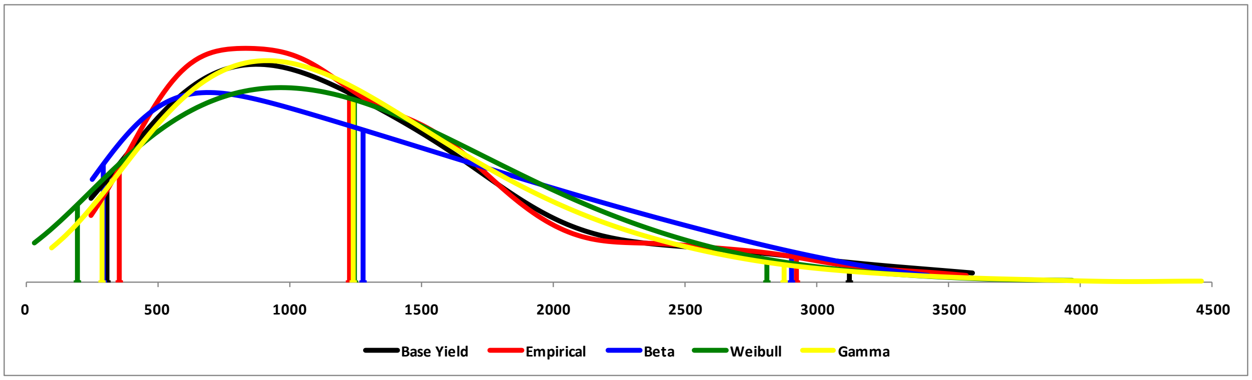

Figure 13: PDF of Alternative Distributions of Camelina Yields in Montana

The loss cost ratios for each of the eight yield insurance policies were calculated as the ratio of the expected indemnity or loss and the liability. The loss cost ratio for the 85 percent APH policy ranges from 15.7 percent to 17.92 percent based on the distribution assumed (Table 17).

Fully Loaded Base Premium Rate

As illustrated in Table 18, the calculated premiums for camelina are compared to those from non-irrigated spring canola in Teton county Montana. RMA's Cost Estimator for 2011 was utilized to determine the estimated liability and total premium for canola. Parameters used for the canola estimate included an APH equivalent to the reference yield, 100 percent price election and a basic unit. The base rate for each crop is illustrated in the table and is calculated by dividing the total premium by the liability for each coverage level. The results demonstrate that estimated premiums of camelina at the higher coverage levels track very close to those of canola. Specifically for the empirical distribution the difference in the estimated base rates at the 85 percent coverage level are 20.18 percent lower for camelina. At the 85 percent coverage level, the base rate for 2011canola is 32.28% while the empirical base rate estimate for camelina is 25.76%. While the exact canola rating methodology is unknown, these results demonstrate that the potential may exist to utilize canola data as a proxy for camelina rating, and perhaps the EPIC model.

Table 18: Comparison of Camelina Premium Estimates to Canola Premium Estimates

Non-Irrigated Spring Canola: Montana, Teton County Yield Protection								
Parameters: Non-Irrigated APH 713, Reference Yield 713, Basic Unit, Price Election 100% @ $0.299								
Canola 0015	**85%**	**80%**	**75%**	**70%**	**65%**	**60%**	**55%**	**50%**
Liability Amount	$158.00	$149.00	$139.00	$130.00	$121.00	$112.00	$102.00	$93.00
Total Premium Amount	$51.00	$44.00	$37.00	$32.00	$27.00	$23.00	$20.00	$17.00
Calculated Base Premium Rate	32.28%	29.53%	26.62%	24.62%	22.31%	20.54%	19.61%	18.28%
Non-Irrigated Spring Camelina: Montana, Teton County								
Parameters: Non-Irrigated APH 1241, Basic Unit, Price Election 100% @$ 0.150								
Camelina	**85%**	**80%**	**75%**	**70%**	**65%**	**60%**	**55%**	**50%**
Liability Amount	$158.24	$148.93	$139.63	$130.32	$121.01	$111.70	$102.39	$93.08
Total Premium Amount:								
Empirical	$40.77	$33.79	$27.66	$22.25	$17.20	$12.69	$8.70	$5.63
Beta	$46.54	$39.82	$33.57	$17.82	$22.58	$17.86	$13.67	$10.02
Weibull	$44.24	$37.78	$31.87	$26.53	$21.74	$17.50	$13.79	$10.60
Gamma	$40.98	$34.30	$28.26	$22.85	$18.09	$13.97	$10.48	$7.58
Calculated Base Premium Rate:								
Empirical	25.76%	22.69%	19.81%	17.07%	14.21%	11.36%	8.50%	6.05%
Beta	29.41%	26.74%	24.04%	13.67%	18.66%	15.99%	13.35%	10.76%
Weibull	27.96%	25.37%	22.82%	20.36%	17.97%	15.67%	13.47%	11.39%
Gamma	25.90%	23.03%	20.24%	17.53%	14.95%	12.51%	10.24%	8.14%
% Difference from Proxy Crop:								
Empirical	-20.18%	-23.17%	-25.58%	-30.64%	-36.30%	-44.68%	-56.67%	-66.91%
Beta	-8.88%	-9.46%	-9.68%	-44.45%	-16.38%	-22.14%	-31.91%	-41.11%
Weibull	-13.39%	-14.10%	-14.25%	-17.30%	-19.49%	-23.71%	-31.31%	-37.70%
Gamma	-19.77%	-22.01%	-23.97%	-28.77%	-33.01%	-39.10%	-47.80%	-55.45%

Summary for Montana Camelina Yield Distribution

The yield distribution has a mean of 1,241 pounds/acre and a range of 249 pounds/acre to 3,589 pounds/acre. The yield distribution is not normally distributed. Among 16 analyzed distributions, four of the best yield distributions were utilized to estimate premiums. These four distributions facilitated comparisons of simulation results for eight possible yield insurance policies. These estimates indicate that fully loaded premium rates for camelina would be less than those of canola and provide further support for gauging the potential yield risk and demand for a camelina crop insurance program.

The biggest problem with insuring camelina production is the lack of information to calculate the farmer's APH or establish transitional yields. There does not appear to be sufficient yield history for the farmer to calculate the APH or establish actuarially sound premium rates. Results from the EPIC model suggest that EPIC may facilitate development of yield data until sufficient results across years and fields are accumulated to develop a more appropriate estimate of the APH and its distribution.

Estimation of Yield Probability Distributions for Oregon/Washington

The primary objective of this analysis of camelina in Washington is to utilize the EPIC model, to estimate an array of stochastic yields from which to develop a probability distribution. Thereby, yield variability (risk) can be quantified and variations in revenues inferred. Sub-objectives include: a) by utilizing local weather data along with producer's camelina yields and management data from a designated area in southeast Washington, calibrate crop coefficients to best represent the current yields and production conditions, and b) to utilize the calibrated model for producing 100 years of stochastic camelina yield observations utilizing successive 2-year rotations of both spring wheat/spring camelina and spring wheat/winter camelina.

The methodology includes developing a production schedule of tillage, planting, fertilization, pesticide applications, and harvesting operations along with management decisions regarding typical dates of each operation, seeding rates, and application rates of fertilizers and pesticides. Camelina producers were utilized to assimilate as much information regarding production and yields as possible.

They reported that fertilization of camelina typically included 30 pounds/acre N since about 80 pounds/acre N was obtained from wheat crop residue. Planting, utilizing no-tillage or direct seeding into stubble, occurs in the fall and in the springtime with harvest in July.

A local producer near LaCrosse, Washington, provided his best estimate of historical yields on his farm from 2008-2010. His yield estimates were 1,100, 1,200, and 1,135 pounds/acre for the three years, respectively. The 2008 and 2010 crops were seeded in early and later springtime months, respectively, while the 2009 crop was seeded in November 2008. Thus, a 4-year rotation of minimum-till spring wheat/direct-seeded spring camelina/minimum-till spring wheat/direct seeded winter camelina was utilized for calibrating the EPIC model to simulate the historical camelina yields as closely as possible. Daily maximum and minimum temperatures and rainfall for each year for LaCrosse, Washington from the National Weather Service were used since on-site weather records were not available.

Upon calibrating the model's crop physiological coefficients, simulated yields were 1,107, 1,201, and 1,135 pounds/acre for 2008-2010, respectively. The 3-year simulated average yield was 1,148 pounds/acre compared with the actual average of 1,145 pounds/acre, a difference of only 3 pounds/acre.

Figure 14 depicts the relationship of simulated to producer yields year-by-year; thereby producing a regression line having a slope of 0.95 with an R-squared=0.997. A slope of 1.0 with a zero intercept, depicted by the dashed line, indicates a perfect relationship or perfect correlation of simulated yields to producer yields. R-squared signifies the accuracy of the black regression line in predicting them: R-squared=1.0 being a perfect prediction.

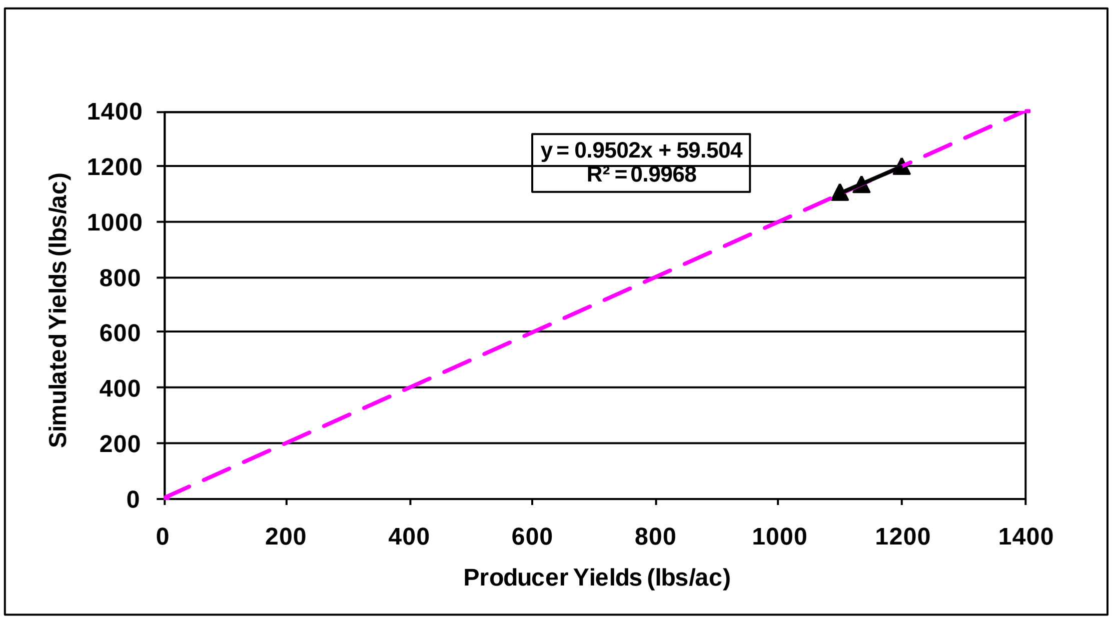

Figure 14: Correlation of Simulated Camelina Yields to Producer Average Yields

Further statistical evidence that the simulated yields approximate the producer yields is illustrated by the paired t-test in Table 19. A difference of zero is being tested between the means of both sets of fresh weight yields, 1,145 vs. 1,147.5 pounds/acre for the producer mean versus the simulated mean, respectively. In this case, t = 1.65 which is less than the critical t value of 5.84 indicates the means are not significantly different at the 1 percent level.

Table 19: Oregon/Washington Camelina Paired t-Test

Item	Simulated	Producer
Mean	1,147.51	1,145
Variance	1,554.995	1,716.667
Observations	4	4
Hypothesized Mean Difference	0	
df	3	
t Stat	1.653	
t Critical two-tail	5.841	

Utilizing the calibrated coefficients for both spring and winter camelina that were developed by simulating the producer yields above, 100 years each of stochastically generated successive yearly yields were simulated in four sets of 4-year rotations identical to those indicated by the producer for developing probability distributions. Two changes were made from the calibration simulations above: 1) the original soil profile was maintained throughout the long-term simulation by stopping erosion and 2) daily weather parameters were generated and were based on historical records for 1960-2010 from the nearby weather station at LaCrosse, Washington. This generated daily weather coupled with the production practices over the long-term simulation period produced two probability distributions for spring and winter camelina, Figure 15 and Figure 17

In the case of spring-seeded camelina, the 100-year average grain yield was 1,311 pounds/acre. The range of yearly yields varied from a low of 536 pounds/acre to a high of 2,908 pounds/acre. These were generally higher than fall–seeded camelina, which averaged 983 pounds/acre with a range of 289 to 1,418 pounds/acre for the 100-year simulation.

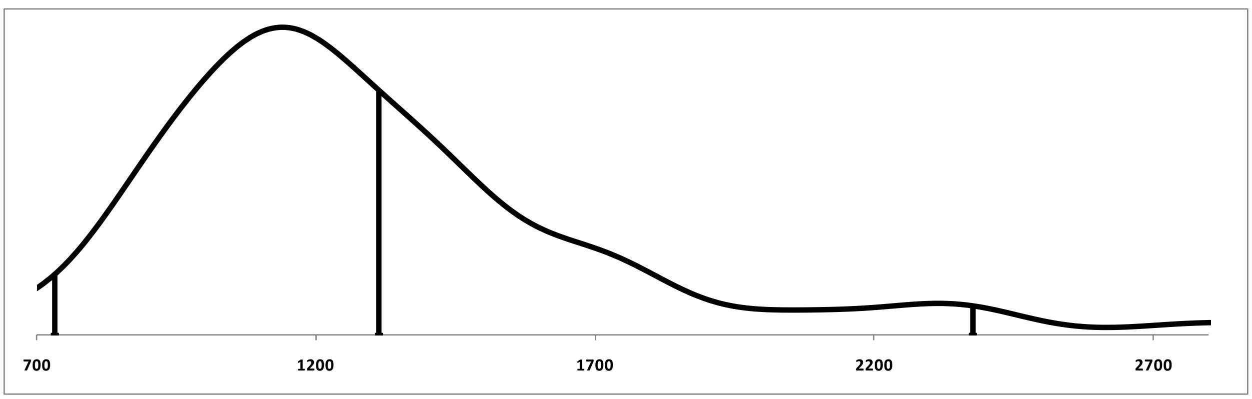

Figure 15: PDF of Spring Camelina Yields in Oregon/Washington (pounds/acre)

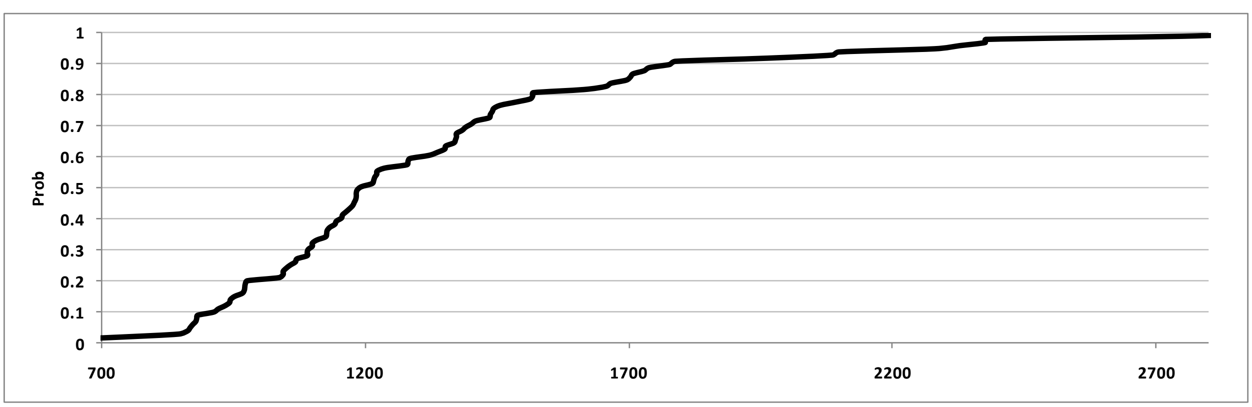

Figure 16: CDF of Spring Camelina Yields in Oregon/Washington (pounds/acre)

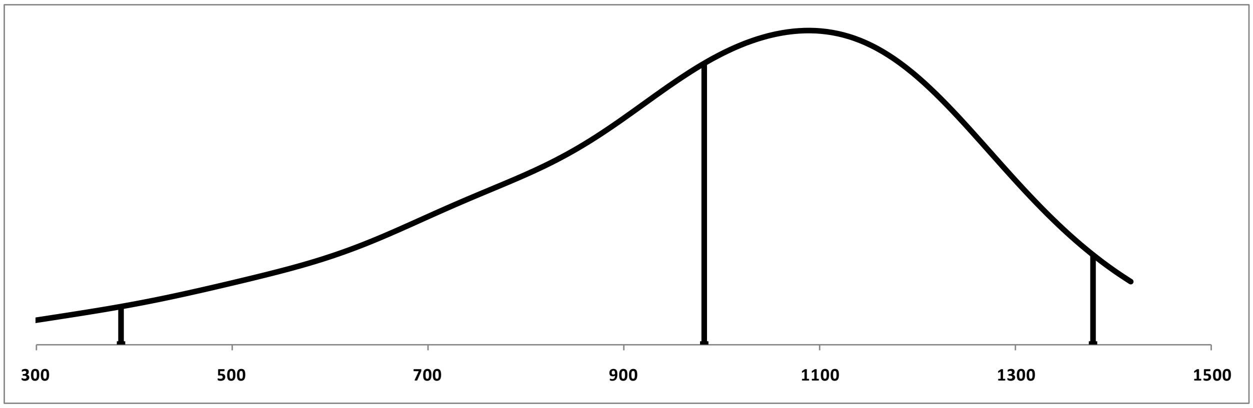

Figure 17: PDF of Winter Camelina Yields in Oregon/Washington (pounds/acre)

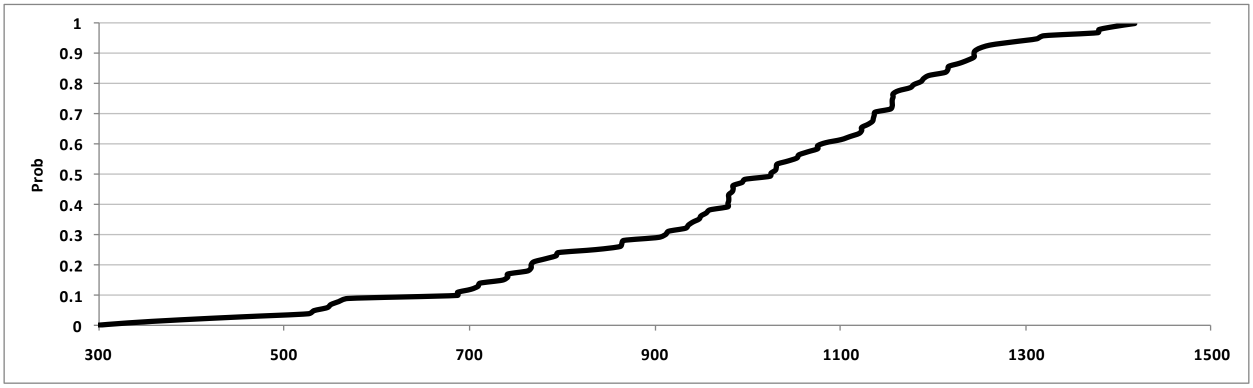

Figure 18: CDF of Winter Camelina Yields in Oregon/Washington (pounds/acre)

SPRING CAMELINA INSURANCE PREMIUM CALCULATIONS

The yield distributions for camelina grown in southeastern Washington, as developed using the EPIC model, were used to estimate yield insurance premiums. There are two yield distributions for camelina: spring planted and winter planted. The analysis procedure used for both camelina yield distributions is the following:

The summary statistics to describe the distribution are calculated. Probability density function (PDF) and cumulative distribution function (CDF) charts for the distribution are provided.

- The distribution was tested for normality.
- Parameters for 15 parametric distributions are estimated using a maximum likelihood procedure in Simetar©. The parameters for an empirical distribution are estimated as well.
- The parameters for the 16 distributions are used to simulate the yield distribution for 500 iterations. Summary statistics for the distributions are compared to the original distribution.
- The CDFDEV function in Simetar© are used to determine how closely the 16 distributions reproduced the original distribution. Based on the CDFDEV criteria the four distributions that most closely simulate the original distribution are selected for analysis.
- The best four distributions were simulated in Simetar© for 25,000 iterations to estimate "fair insurance premiums" for eight yield coverage levels ranging from 50 percent to 85 percent of the average yield reported by the farmers in a focus group interview. The random number generator used for the analysis uses a Latin hypercube procedure and generates pseudo random numbers based on a fixed seed.

- The no load and fully loaded fair premiums are reported as $/acre values for the four assumed probability distributions for eight levels of possible coverage.
- The no load fair insurance premium is calculated by multiplying the probability of each state of nature (indemnity) by its respective probability. Using a Monte Carlo simulation approach each insurance policy was simulated for 25,000 yields drawn at random from assumed probability distributions.
- The loaded insurance premium is calculated using a 0.90 unit division load factor, a 0.88 FCIC disaster reserve factor, and a 1.30 qualitative load factor.

Each of the EPIC distributions is presented separately because they are completely different distributions.

Spring Camelina Yield Distribution

The summary statistics in Table 20 report that the average yield for spring planted camelina is 1,311 pounds/acre, the minimum expected yield is 536 pounds/acre, and the maximum yield is 2,908 pounds/acre. The distribution is skewed to the right given a skewness statistic of 1.47. This shape is confirmed in the PDF and CDF charts for the spring planted yield distribution (Figure 15 and Figure 16).

Table 20: Summary Statistics for Base Yield Distribution of Spring Camelina in Oregon/Washington

	Base Yield
Mean	1,311.36
Standard Deviation	424.26
Min	536.41
Median	1,188.25
Max	2,908.06
Skewness	1.47
Kurtosis	2.77

Five statistical tests for normality were performed: Shapiro-Wilks, Anderson-Darling, Cramer von Mises, Kolmagarov-Smiroff, and Chi-Square (Table 21). All five tests reported that statically the distribution is not distributed normal at the alpha equal 5 percent level of significance.

Table 21: Normality Test for the Yield Distribution of Spring Camelina in Oregon/Washington

Confidence Level		**95.000%**	
Procedure	Test Value	p-Value	
Shapiro-Wilks	0.883	0.000	Reject the Ho that the Distribution is Normally Distributed*
Anderson-Darling	3.481	0.000	Reject the Ho that the Distribution is Normally Distributed*
Cramer von Mises	0.592	0.000	Reject the Ho that the Distribution is Normally Distributed*
Kolmogorov-Smirnov	0.143	NA	Consult Critical Value Table
Chi-Squared	42.400	0.002	Reject the Ho that the Distribution is Normally Distributed*
			*Based on approximate p-values

Parameters for the 15 parametric distributions reported in Table 22 were simulated using a common uniform standard deviate to insure the results are directly comparable. The summary statistics for these distributions and the goodness of fit criteria (CDFDEV) for the 15 distributions and the empirical distribution are summarized in Table 22. The 16 distributions were simulated 500 iterations with a common uniform standard deviate and the resulting summary statistics are reported beside the parameters. All of the distributions reproduce the mean as expected, but a number of them fail to reproduce the range of the distribution. The CDFDEV criteria indicate that the four best distributions for simulating the distribution are empirical, lognormal, log-log, and gamma. The empirical distribution as measured by the CDFDEV has the best fit.

Table 22: Univariate Parameter Estimation for the Yield Distribution of Spring Camelina in Oregon/Washington

		MLEs		Statisitcs				Goodness of Fit	
Distribution	Parameters	Parm. 1	Parm. 2	Mean	Std. Dev.	Min	Max	CDFDEV	Rank
Beta	***α, β*** ; A≤x≤B, α,β>0	1.757	3.425	1,340.50	452.17	551.68	2,692.96	21,604.6	
Double Exponential	***α, β*** ; α≤x<∞, -∞<α<∞, β>0	1188.250	293.852	1,188.14	415.75	(670.53)	3,067.52	105,755.6	
Exponential	***μ, σ*** ; -∞<x<∞, -∞<μ<∞, σ>0	536.410	774.952	1,311.44	774.73	537.10	6,029.63	493,263.9	
Gamma	***α, β*** ; 0≤x<∞, α,β>0	11.221	116.870	1,311.34	391.93	416.27	2,892.98	16,186.6	Fourth
Logistic	***μ, σ*** ; 0≤x<∞, -∞<μ<∞, σ>0	1260.260	216.626	1,260.18	393.23	(259.98)	2,795.63	58,663.1	
Log-Log	***μ, σ*** ; -∞<x<∞, -∞<μ<∞, σ>0	1129.993	308.356	1,307.97	395.64	529.14	3,315.63	13,295.3	Third
Log-Logistic	***μ, σ*** ; 0≤x<∞, -∞<μ<∞, σ>0	6.240	1230.916	1,284.30	391.49	399.77	3,832.72	39,146.5	
Lognormal	***μ, σ*** ; 0≤x<∞, -∞<μ<∞, σ>0	7.134	0.295	1,308.99	394.56	499.28	3,165.52	12,705.1	Second
Normal	***μ, σ*** ; -∞<x<∞, -∞<μ<∞, σ>0	1311.362	422.129	1,311.30	422.75	(6.96)	2,638.33	42,396.0	
Pareto	***α, β*** ; α≤x<∞, α,β>0	536.410	1.178	2,605.55	10,991.41	536.82	219,889.89	1,432,621,871	
Uniform	***a, b*** ; a≤x≤b	536.410	2908.060	1,722.20	685.38	538.53	2,906.08	277,728.8	
Weibull	***α, β*** ; 0≤x<∞, α,β>0	3.102	6571137183	1,306.36	461.42	152.09	2,746.27	39,759.4	
Empirical	***S, F(x)***			1,304.74	394.18	546.96	2,894.89	1,383.1	First
Geometric	***p*** ; x=1,2,…; 0≤p≤1	0.001		1,312.06	1,311.06	2.00	9,297.00	2,520,873.3	
Poisson	***λ*** ; x=0,1,…; 0≤λ<∞	1310.930		1,309.99	36.26	1,196.93	1,423.82	344,982.4	
Negative Binomial	***s, p*** ; x=1,2,…; 0≤p≤1	11.000	0.008	1,310.38	397.51	71.00	2,558.00	41,202.8	

Insurance Premiums for Spring Camelina

Eight yield loss insurance policies were simulated for stochastic yields using the four best probability distributions. The eight policies are expressed as a fraction of the average yield of 1,311 pounds/acre (APH) assuming a price guarantee of $0.15/pound. The eight policies are defined in terms of fraction from the APH and are: 0.50, 0.55, 0.60, 0.65, 0.70, 0.75, 0.80, and 0.85. APH yield was assumed to equal the average for the base yield distributions from the EPIC runs.

The calculated insurance premiums are reported in Table 23. Based on the assumption that the spring planted yield for camelina is distributed empirically, the no load premiums are less than $1.00/acre for policies that insure 50 percent - 65 percent of the APH. The no load premium at 70 percent of the APH is $1.33/acre. It increases rapidly thereafter with a $2.77/acre premium for 75 percent APH coverage, $4.82/acre for 80 percent APH coverage, and reaches $7.63/acre for 85 percent APH coverage.

The calculated insurance premiums for the other three probability distribution assumptions are generally higher than those for the empirical distribution. For example, for the 85 percent APH policy, the lognormal distribution indicates a $12.66/acre premium, the gamma distribution has a $9.78/acre premium, and the log-log distribution has a $9.32/acre premium.

The difference in premiums for each yield insurance policy differs across probability distributions due to the weight the distribution places on the insured range of the yield distribution. This relationship can be seen in Figure 19, a PDF of the original yield distribution and the four selected distributions. The lognormal distribution is associated with the highest premiums for all eight APH policies because it has more weight (the PDF line is higher) for yields below the mean.

The fully loaded premium for the 85 percent APH coverage ranges from $12.52/acre for the empirical distribution to $20.77/acre for the lognormal distribution (Table 23). The fully loaded premium was calculated by dividing the no load fair premium by 0.90 (the unit division load factor) and then dividing that result by 0.88 (the FCIC disaster reserve factor) and multiplying by 1.3 (the qualitative load factor). The qualitative load factor of 1.3 is used to adjust for the lack of risk on the regression equations for physical relationships and production functions in the EPIC model. EPIC's only risk component is from the weather variables so it lacks the risk normally associated with simulating a regression equation used to predict production based on the values for the independent variables.

The loss cost ratios for each of the eight yield insurance policies were calculated as the ratio of the expected indemnity or loss and the liability. The loss cost ratio for the 85 percent APH policy ranges from 4.56 percent to 7.57 percent based on the distribution assumed (Table 23).

Table 23: Yield Insurance Premiums for Spring Camelina in Oregon/Washington; Assuming Alternative Yield Coverage Levels and Yield Distributions, an APH Yield of 1,311 Pounds Per Acre, and Guaranteed Price of $0.15 Per Pound

	0.5 of APH	0.55 of APH	0.6 of APH	0.65 of APH	0.7 of APH	0.75 of APH	0.8 of APH	0.85 of APH
Liability ($/acre)	98.35	108.19	118.02	127.86	137.69	147.53	157.36	167.20
No Load Fair Premium ($/acre)								
Empirical	0.09	0.21	0.38	0.61	1.33	2.77	4.82	7.63
Lognormal	0.21	0.66	1.49	2.73	4.44	6.66	9.39	12.66
Log-Log	0.08	0.23	0.57	1.21	2.30	3.95	6.27	9.32
Gamma	0.13	0.34	0.76	1.50	2.68	4.39	6.74	9.78
Fully Loaded Premium ($/acre)								
Empirical	0.14	0.34	0.62	1.00	2.18	4.55	7.91	12.52
Lognormal	0.34	1.09	2.44	4.48	7.30	10.93	15.42	20.77
Log-Log	0.13	0.38	0.94	1.99	3.77	6.48	10.28	15.30
Gamma	0.21	0.56	1.25	2.46	4.39	7.21	11.06	16.05
Loss Cost								
Empirical	0.09%	0.19%	0.32%	0.47%	0.96%	1.88%	3.06%	4.56%
Lognormal	0.21%	0.61%	1.26%	2.14%	3.23%	4.51%	5.97%	7.57%
Log-Log	0.08%	0.22%	0.48%	0.95%	1.67%	2.67%	3.98%	5.58%
Gamma	0.13%	0.31%	0.65%	1.17%	1.94%	2.98%	4.28%	5.85%
Fully Loaded Base Premium (%)								
Empirical	0.1%	0.3%	0.5%	0.8%	1.6%	3.1%	5.0%	7.5%
Lognormal	0.3%	1.0%	2.1%	3.5%	5.3%	7.4%	9.8%	12.4%
Log-Log	0.1%	0.4%	0.8%	1.6%	2.7%	4.4%	6.5%	9.2%
Gamma	0.2%	0.5%	1.1%	1.9%	3.2%	4.9%	7.0%	9.6%

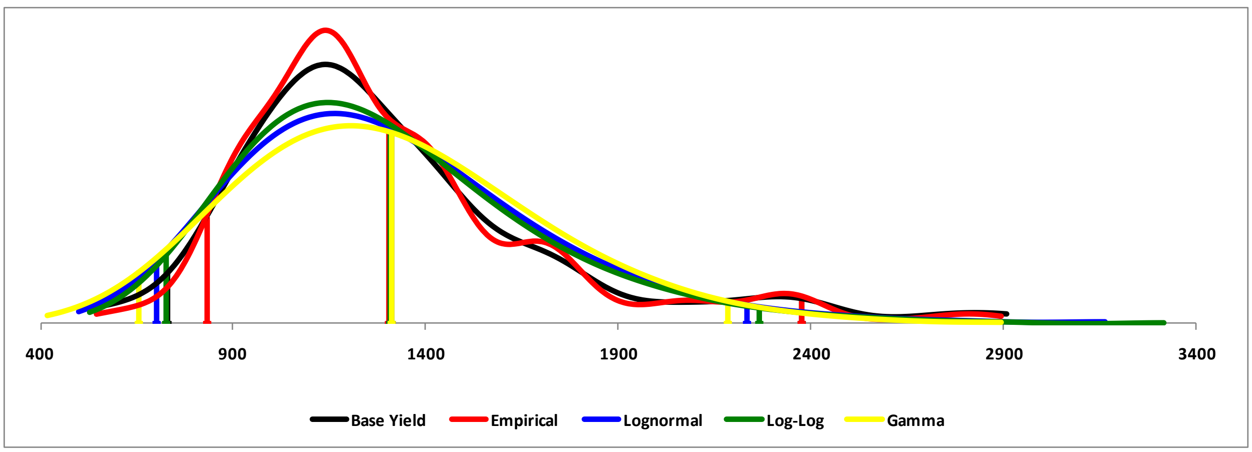

Figure 19: PDF of Alternative Distributions of Spring Camelina Yields in Oregon/Washington

Fully Loaded Base Premium Rate

As illustrated in Table 24, the calculated premiums for spring planted camelina are compared to those from non-irrigated spring canola in Whitman county Washington. RMA's Cost Estimator for 2011 was utilized to determine the estimated liability and total premium for canola. Parameters used for the canola estimate included an APH equivalent to the reference yield, 100 percent price election and a basic unit. The base rate for each crop is illustrated in the table and is calculated by dividing the total premium by the liability for each coverage level. The results demonstrate that estimated premiums for the lognormal distribution of camelina at the higher coverage levels track very close to those of canola. Specifically, for the lognormal distribution, the difference in the estimated base rates at the 85 percent coverage level are 17.53 percent lower for camelina than canola. At the 85 percent coverage level, the premium rate for 2011canola is 15.06 percent while the lognormal base rate for camelina is 12.42 percent. The difference in spring planted camelina premium rates for the empirical distribution is 50.29 percent less than canola at the 85 percent coverage level. Further, the larger percent difference in the base rates for Washington versus Montana is assumed to be attributed to a smaller variation in yields for the base data in Washington. In regards to the lognormal distribution, these results suggest that the EPIC model and a proxy crop such as canola may prove useful in establishing rates for camelina as more data becomes available.

Table 24: Comparison of Camelina Premium Estimates to Canola Premium Estimates for Washington

Non-Irrigated Spring Canola: Washington, Whitman County Yield Protection								
Parameters: Non-Irrigated APH 1071, Reference Yield 1071, Basic Unit, Price Election 100% @ $0.263								
Canola 0015	**85%**	**80%**	**75%**	**70%**	**65%**	**60%**	**55%**	**50%**
Liability Amount	$239.00	$225.00	$211.00	$197.00	$183.00	$169.00	$155.00	$141.00
Total Premium Amount	$36.00	$31.00	$26.00	$21.00	$16.00	$14.00	$11.00	$9.00
Calculated Base Premium Rate	15.06%	13.78%	12.32%	10.66%	8.74%	8.28%	7.10%	6.38%
Non-Irrigated Spring Camelina: Washington, Whitman County								
Parameters: Non-Irrigated APH 1311, Basic Unit, Price Election 100% @$ 0.150								
Camelina	**85%**	**80%**	**75%**	**70%**	**65%**	**60%**	**55%**	**50%**
Liability Amount	$167.20	$157.36	$147.53	$137.69	$127.86	$118.02	$108.19	$98.35
Total Premium Amount:								
Empirical	$12.52	$7.91	$4.55	$2.18	$1.00	$0.62	$0.34	$0.14
Lognormal	$20.77	$15.42	$10.93	$7.30	$4.48	$2.44	$1.09	$0.34
Log-Log	$15.30	$10.28	$6.48	$3.77	$1.99	$0.94	$0.38	$0.13
Gamma	$16.05	$11.06	$7.21	$4.39	$2.46	$1.25	$0.56	$0.21
Calculated Base Premium Rate:								
Empirical	7.49%	5.03%	3.08%	1.58%	0.78%	0.53%	0.31%	0.14%
Lognormal	12.42%	9.80%	7.41%	5.30%	3.50%	2.07%	1.01%	0.35%
Log-Log	9.15%	6.53%	4.39%	2.74%	1.56%	0.80%	0.35%	0.13%
Gamma	9.60%	7.03%	4.89%	3.19%	1.92%	1.06%	0.52%	0.21%
% Difference from Proxy Crop:								
Empirical	-50.29%	-63.52%	-74.97%	-85.15%	-91.05%	-93.66%	-95.57%	-97.77%
Lognormal	-17.53%	-28.88%	-39.88%	-50.26%	-59.92%	-75.04%	-85.80%	-94.58%
Log-Log	-39.25%	-52.58%	-64.35%	-74.31%	-82.20%	-90.39%	-95.05%	-97.93%
Gamma	-36.27%	-48.99%	-60.34%	-70.09%	-77.99%	-87.21%	-92.71%	-96.65%

Summary for Spring Camelina Yield Distribution

The yield distribution has a mean of 1,311 pounds/acre and a range of 536 pounds/acre to 2,908 pounds/acre. Statistically the yield distribution is not normally distributed. Among 16 analyzed distributions, four of the best yield distributions were utilized to estimate premiums. These four distributions facilitated comparisons of simulation results for eight possible yield insurance policies. These estimates indicate that fully loaded premium rates for camelina would be less than those of canola and provide further support for gauging the potential yield risk and demand for a camelina crop insurance program.

The biggest problem with insuring spring planted camelina production is the lack of information to calculate the farmer's APH. There is no long-term yield history for the farmers to calculate the APH. Using the average yield from the EPIC model will have to suffice until sufficient results across years and fields are accumulated to develop a more appropriate estimate of the APH and its distribution.

Winter Camelina Insurance Premium Calculations

Winter Camelina Yield Distribution

The summary statistics in Table 25 report that the average camelina yield for a winter planted stand is 982 pounds/acre and the minimum expected yield is 289 pounds/acre. The distribution is slightly skewed to the left given a skewness statistic of -0.721. This shape is confirmed in the PDF and CDF charts for the winter planted camelina yield distribution (Figure 17 and Figure 18).

Table 25: Summary Statistics for Base Yield Distribution of Winter Camelina in Oregon/Washington

	Base Yield
Mean	982.455
Standard Deviation	245.555
Min	289.060
Median	1,024.805
Max	1,418.140
Skewness	-0.721
Kurtosis	0.154

Five statistical tests for normality were performed: Shapiro-Wilks, Anderson-Darling, Cramer von Mises, Kolmagarov-Smiroff, and Chi-Square (Table 26). All five normality tests reported that statically the distribution is not distributed normal.

Table 26: Normality Test for the Yield Distribution of Winter Camelina in Oregon/Washington

Confidence Level		**95.000%**	
Procedure	Test Value	p-Value	
Shapiro-Wilks	0.956	0.002	Reject the Ho that the Distribution is Normally Distributed*
Anderson-Darling	1.370	0.001	Reject the Ho that the Distribution is Normally Distributed*
Cramer von Mises	0.232	0.002	Reject the Ho that the Distribution is Normally Distributed*
Kolmogorov-Smirnov	0.104	NA	Consult Critical Value Table
Chi-Squared	37.200	0.007	Reject the Ho that the Distribution is Normally Distributed*
			*Based on approximate p-values

Parameters for the 15 parametric distributions reported in Table 27 were simulated for 500 iterations using a common uniform standard deviate to insure the results are directly comparable. The summary statistics for these distributions and the goodness of fit criteria (CDFDEV) for the 15 distributions and the empirical distribution are summarized in Table 27. The 16 distributions were simulated 500 iterations and the resulting summary statistics are reported beside the parameters. All of the distributions reproduce the mean as expected, but a number of them fail to reproduce the range of the distribution. The CDFDEV criteria indicate the four best distributions for simulating the distribution are empirical, beta, Weibull, and normal; with the empirical distribution being best.

Table 27: Univariate Parameter Estimation for the Yield Distribution of Winter Camelina in Oregon/Washington

		MLEs		Statisitcs				Goodness of Fit	
Distribution	Parameters	Parm. 1	Parm. 2	Mean	Std. Dev.	Min	Max	CDFDEV	Rank
Beta	**α, β** ; A≤x≤B, α,β>0	2.146	1.485	956.44	258.30	321.08	1,413.29	2,137.9	Second
Double Exponential	**α, β** ; α≤x<∞, -∞<α<∞, β>0	1024.805	191.730	1,024.73	271.27	(188.00)	2,250.98	38,437.0	
Exponential	**μ, σ** ; -∞<x<∞, -∞<μ<∞, σ>0	289.060	693.395	982.52	693.19	289.68	5,204.16	837,084.1	
Gamma	**α, β** ; 0≤x<∞, α,β>0	12.740	77.116	982.44	275.57	339.72	2,079.23	24,065.3	
Logistic	**μ, σ** ; 0≤x<∞, -∞<μ<∞, σ>0	1001.615	137.970	1,001.56	250.45	33.36	1,979.50	16,540.0	
Log-Log	**μ, σ** ; -∞<x<∞, -∞<μ<∞, σ>0	852.770	272.559	1,010.08	349.71	321.67	2,784.68	99,681.3	
Log-Logistic	**μ, σ** ; 0≤x<∞, -∞<μ<∞, σ>0	6.339	980.500	1,021.68	306.14	324.06	2,999.52	102,294.2	
Lognormal	**μ, σ** ; 0≤x<∞, -∞<μ<∞, σ>0	6.850	0.304	988.78	307.77	365.43	2,454.67	55,261.6	
Normal	**μ, σ** ; -∞<x<∞, -∞<μ<∞, σ>0	982.455	244.324	982.42	244.68	219.42	1,750.49	6,653.5	Fourth
Pareto	**α, β** ; α≤x<∞, α,β>0	289.060	0.845	5,907.04	59,114.43	289.37	1,273,093.09	4.815192E+10	
Uniform	**a, b** ; a≤x≤b	289.060	1418.140	853.58	326.29	290.07	1,417.20	23,558.4	
Weibull	**α, β** ; 0≤x<∞, α,β>0	4.916	7.918679E+14	984.15	229.33	257.38	1,598.07	2,935.9	Third
Empirical	***S, F(x)***			985.08	233.33	296.38	1,416.32	244.2	First
Geometric	***p*** ; x=1,2,...; 0≤p≤1	0.001		983.13	982.22	1.00	6,965.00	1,928,139.1	
Poisson	***λ*** ; x=0,1,...; 0≤λ<∞	982.020		982.00	31.38	884.13	1,080.51	91,578.3	
Negative Binomial	***s, p*** ; x=1,2,...; 0≤p≤1	13.000	0.013	981.47	274.55	125.00	1,843.00	11,482.6	

INSURANCE PREMIUMS FOR WINTER CAMELINA

Eight yield loss insurance policies were simulated for stochastic yields using the four best probability distributions. The eight policies are expressed as a fraction of the average yield of 982 pounds/acre (APH) and assume a price guarantee of $0.15/pound. The eight policies are defined in terms of fraction from the APH and are 0.50, 0.55, 0.60, 0.65, 0.70, 0.75, 0.80, and 0.85. APH yield was assumed to equal the average for the base yield distributions from the EPIC runs.

The calculated insurance premiums are reported in Table 28. Based on the assumption that the yield for a winter planted stand of camelina is distributed empirically, the premiums are less than $2.00/acre for policies that insure 50 percent - 65 percent of the APH. The fair premium at 70 percent APH is $2.68/acre. It increases rapidly thereafter with a $3.64/acre premium for 75 percent APH coverage, $5.03/acre for 80 percent APH coverage, and reaches $6.81/acre for 85 percent APH coverage

The calculated insurance premiums for the beta probability distribution are generally higher than those for the empirical distribution. For example, for the 85 percent APH policy, the beta distribution indicates an $8.98/acre premium. The Weibull distribution generates lower premiums per acre for each level of coverage than the empirical distribution, with a premium of $5.71/acre for an 85 percent of APH policy.

The difference in premiums for each yield insurance policy differ due to the weight the distribution places on the insured range of the distribution. This relationship can be seen in Figure 20, a PDF of the original yield distribution and the four selected distributions. The beta distribution is associated with the highest premiums for the 70 percent - 85 percent APH policies because it has more weight for the yield values over the range of 300 to 700 pounds per acre.

The fully loaded premium for the 85 percent APH coverage ranges from $11.18/acre for the empirical distribution to $14.74/acre for the beta distribution (Table 28). The fully loaded premium was calculated by dividing the no load fair premium by 0.90 (the unit division load factor) and then dividing that result by 0.88 (the FCIC disaster reserve factor) and multiplying by 1.3 (the qualitative load factor). The qualitative load factor of 1.3 is used to adjust for the lack of risk on the regression equations for physical relationships and production functions in the EPIC model. EPIC's only risk component is from the weather variables so it lacks the risk normally associated with simulating a regression equation used to predict production based on the values for the independent variables.

Table 28: Yield Insurance Premiums for Winter Camelina in Oregon/Washington; Assuming Alternative Yield Coverage Levels and Yield Distributions, an APH Yield of 982 Pounds Per Acre, and Guaranteed Price of $0.15 Per Pound

	0.5 of APH	0.55 of APH	0.6 of APH	0.65 of APH	0.7 of APH	0.75 of APH	0.8 of APH	0.85 of APH
Liability								
($/acre)	73.68	81.05	88.42	95.79	103.16	110.53	117.89	125.26
No Load Fair Premium ($/acre)								
Empirical	0.46	0.74	1.31	1.97	2.68	3.64	5.03	6.81
Beta	0.43	0.85	1.47	2.34	3.49	4.95	6.78	8.98
Weibull	0.27	0.47	0.78	1.24	1.90	2.82	4.07	5.71
Normal	0.30	0.51	0.83	1.32	2.03	3.02	4.37	6.15
Fully Loaded Premium ($/acre)								
Empirical	0.76	1.21	2.14	3.24	4.39	5.98	8.26	11.18
Beta	0.71	1.39	2.41	3.83	5.72	8.13	11.12	14.74
Weibull	0.44	0.76	1.27	2.03	3.12	4.63	6.68	9.38
Normal	0.50	0.84	1.37	2.17	3.33	4.96	7.18	10.09
Loss Cost (%)								
Empirical	0.63%	0.91%	1.48%	2.06%	2.59%	3.29%	4.27%	5.44%
Beta	0.59%	1.05%	1.66%	2.44%	3.38%	4.48%	5.75%	7.17%
Weibull	0.36%	0.57%	0.88%	1.29%	1.84%	2.55%	3.45%	4.56%
Normal	0.41%	0.63%	0.94%	1.38%	1.97%	2.73%	3.71%	4.91%
Fully Loaded Base Premium (%)								
Empirical	1.0%	1.5%	2.4%	3.4%	4.3%	5.4%	7.0%	8.9%
Beta	1.0%	1.7%	2.7%	4.0%	5.5%	7.4%	9.4%	11.8%
Weibull	0.6%	0.9%	1.4%	2.1%	3.0%	4.2%	5.7%	7.5%
Normal	0.7%	1.0%	1.5%	2.3%	3.2%	4.5%	6.1%	8.1%

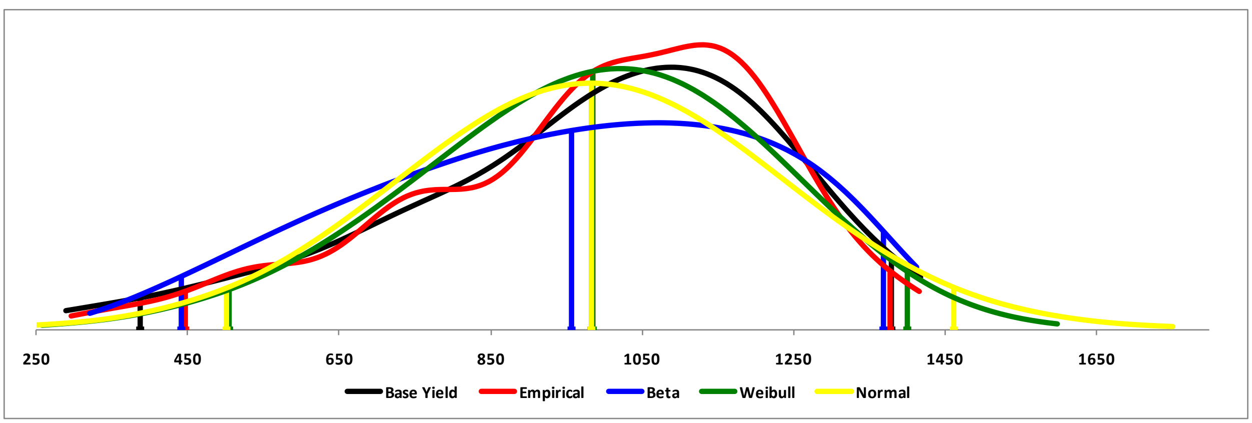

Figure 20: PDF of Alternative Distributions of Winter Camelina Yields in Oregon/Washington

Fully Loaded Base Premium Rates

The base premium rate for winter camelina ranges from 7.5% to 11.8% for the 85% level of yield coverage. At the 65 percent level of yield coverage, the base premium is between 2.1% and 4%. The winter planted camelina rates are lower than the spring planted camelina rates, due to lower variability of the simulated winter planted camelina yields. Further, since canola is not winter planted in Washington, no comparisons between canola and winter planted camelina are made.

Summary for Winter Camelina Yield Distribution

The yield distribution has a mean of 982 pounds/acre and a range of 289 pounds/acre to 1,418 pounds/acre. Among 16 analyzed distributions, four of the best yield distributions were utilized to estimate premiums. These four distributions facilitated comparisons of simulation results for eight possible yield insurance policies. Statistically the yield distribution is not distributed normal, yet it is the fourth best distribution for simulating the EPIC generated yield distribution.

At the highest levels of yield coverage (85 percent of APH), the fully loaded insurance premiums range from $11.18 to $14.74/acre, or 7.5 percent to 11.8 percent of liability. These fully loaded premium estimates provide support for gauging the potential yield risk for camelina and assist in assessing the demand for a camelina crop insurance program.

The biggest problem with insuring camelina production is the lack of information to calculate the farmer's APH or establish transitional yields. There does not appear to be sufficient yield history for the farmer to calculate the APH or establish actuarially sound premium rates. Results from the EPIC model suggest that EPIC may facilitate development of yield data until sufficient results across years and fields are accumulated to develop a more appropriate estimate of the APH and its distribution.

Feasibility Recommendation

As the aforementioned "Camelina Risk Evaluation" section indicated, the demand signals for camelina in Montana, Oregon and Washington suggest that moderate demand for an insurance product and/or a moderate potential market for camelina exist. Specifically, the Diagnostic Instrument demand signals are stronger for Oregon/Washington than Montana; however, the potential market is currently greater in Montana. Premium estimates in Montana also suggest that yield risk may in fact be greater for the area analyzed versus the area in Washington; thus, suggesting greater demand for an insurance program in Montana. Nonetheless, the RMA Program Evaluation Tool Decision Tree for both areas suggests that a new product be developed. Further, listening session comments from producers and attendees for both regions are in favor of an insurance product for camelina and expressed interest in an actual production history policy.

Crop Insurance Program Design Options

The following are potential options for designing a crop insurance program for camelina in the Northwest region of the United States.

1. Create an actual production history (APH) Multi-Peril Crop Insurance Program (MPCI) utilizing the current FCIC APH crop insurance program.

2. Create a revenue based Multi-Peril Crop Insurance Program (MPCI) utilizing the current FCIC revenue crop insurance program.

3. Create a weather or rainfall based index (Section 2.1 of SOW: "RMA does not wish to evaluate the policies and plans of insurance based on weather or rainfall indices at this time.").

4. Create an actual revenue history (ARH) Crop Insurance Program (MPCI) utilizing the current FCIC ARH crop insurance program.

The actual production history (APH) type program seems to be the most logical choice as; the characteristics of camelina are that of similar row crops currently insured in these regions. Specifically, those crops such as canola and mustard that are in the same genus as camelina are insurable in Montana, Oregon, and Washington. In discussions with industry representatives and listening session attendees, it was noted that camelina would have a similar growth stage of that of flax, also insurable in Daniels, Roosevelt, Sheridan, and Valley counties in Montana. While no known loss adjustment methodology has been developed, it is likely that the flax and canola Loss Adjustment Standards Handbook would serve as a preliminary guide for establishing such methodology. Further, the Crop Provisions would be modeled after the APH policy materials for canola and flax, while the Special Provisions of

Insurance could be modeled from the APH policy material for canola in each region, as planting dates are very similar for both fall and spring seeded canola and camelina.

Because camelina does not trade on a commodity exchange, it poses challenges for the formulation of an expected price for camelina. Currently the majority of camelina in all regions of the United States is produced under contract with a processor or first handler. While the price of the crop may be transparent between processor and producer, details on pricing methodology from some processors and first handlers remain proprietary and are not typically disclosed (Waring, Johnson, & Endicott, 2011). The lack of a price discovery mechanism presents potential design problems for a revenue policy such as the FCIC "Revenue Protection" insurance program. This further supports the development of an APH based insurance program with the basis of guarantee established from a contract price.

As measured by the demand signals from the Program Evaluation Tool, yield was rated as having higher risk than quality, price and other sources of revenue risk. With the price of camelina established prior to planting and fixed for the production and delivery spectrum, the risk for revenue variability becomes less than that of many of the row crops that can be produced in these regions. Very low quality risk also reduces the risk of price variability, hence significant revenue risk become a function based entirely on yield. While a program such as ARH could be developed for camelina, the ARH program is designed more to protect against revenue risk caused by losses from low yields, low prices, low quality, or any combination of these occurrences.

Recommendation

Based on the research and analysis of camelina commercially produced for dedicated energy in Montana, Oregon, and Washington; it is determined that the development of a crop insurance program for camelina grown for dedicated energy is feasible. Camelina possesses characteristics of other currently insured crops in the Northwest insured under the FCIC APH crop insurance programs; thus, potential exist for adding camelina to the existing APH crop insurance program. Based on conversations with industry representatives, producers, processors, and first handlers; an APH based crop insurance program would be viewed favorably to help mitigate production risk. Further, while the majority of the research results were based on specific geographic locations in Montana, Oregon and Washington, processors and first handlers suggest appropriate regions for a pilot program should include counties in Idaho, Montana, North Dakota, Oregon, and Washington (Waring, Johnson, & Endicott, 2011). Sustainable Oils also plans to contract production in California in 2012 (Johnson S. , 2011).

Program Outline

Guarantee

The guarantee would be that of the current FCIC APH plan of insurance program. Specifically, the guarantee would be equal to the producer's actual production history (APH) x selected coverage level.

Preliminary Premiums

As indicated in the aforementioned research, data availability is limited, yet two selected producers provided as much as four years of individual yields through 2010. For purposes of establishing rates for camelina, the limited data set may be of concern. However, as discussed in the "Estimating Yield Probability Distributions" section of the report, utilizing the EPIC model the Contractor demonstrated that unsubsidized no-load and loaded fair premium estimates could be developed. These premiums are illustrated in Table 17, Table 23, and Table 28.

The premium per acre would be equal to the production guarantee x contract price x applicable premium rate x applicable option factors.

Expected Price

Camelina is typically only produced under contract with a processor or first handler, since the current market for camelina is still being developed. The Contractor envisions camelina grown under a contract would be set as a basic insurability requirement. As such, the established price for camelina would be the contract price. RMA also currently list dry peas, dry beans, mustard, and buckwheat as crops grown under contract as a basic insurability requirement. If an established base price were preferred, the expected base price for camelina would likely be established as a contract price. Because producers can plant in the fall or spring, the price for camelina is set in the fall by processors and first handlers. This would allow RMA to contact the appropriate entities in the fall to determine a base price whereby the producer would then only be able to insure at that price or a contract price not to exceed a set percentage of the base price. Scott Johnson with Sustainable Oils stated, “The contract price is set by September 1 just prior to planting and will be fixed for the remainder of the crop year” (Personal Communication; Pricing Methodology, 2011). Further, Johnson stated, “I would not have a problem with the RMA calling me to determine our contract price for the crop year” (Personal Communication; Pricing Methodology, 2011).

Yield Determination

Approved yields for insurance will be determined from the producer’s actual production history (APH) on a practice basis (fall and spring). While many producers may not have a sufficient set of yield data, transitional yields (T-yields) would need to be developed as part of the rating methodology. One option available to minimize the number of T-yields required would be to establish a single unit for the county that would include all acreage in which the insured has a share (see unit discussion). Additional benefits may result (program simplification, improved program integrity, etc.).

Year of Implementation

It is anticipated that development of an actual production history crop insurance program for camelina would take approximately 1 year or less. A reasonable estimate for implementing such a program would be the 2013 crop year.

Units of Exposure

The Contractor envisions a unit structure for camelina of one county unit (all acreage in the county in which the insured has an interest). Implementation would require the modification of the definition of the basic unit.

Types

Separate types will not be applicable.

Practices

Producers in Idaho, Montana, North Dakota, Oregon, and Washington can plant camelina in both the fall preceding the harvest year or the spring of the harvest year. Therefore, separate planting practices can be defined for fall camelina and spring camelina. The yield of spring and fall planted camelina may vary but the extent has not been clearly established; as additional yield data is accumulated, separate yields including T-yields may be appropriate by planting practice. Separate yield databases for fall planting and spring planting practices should also be considered until more data is available to quantify yield differences by practice. The fall and spring planting practices for camelina will be further identified into Irrigated, Non-Irrigated, Organic (Certified) Irrigated, Organic (Transitional) Irrigated, Organic (Certified) Non-Irrigated, and Organic (Transitional) Non-Irrigated. Standard APH procedures and reporting requirements will apply.

Insurance Dates

Camelina can be seeded anywhere from October 1 through early June. Generally, fall seeded camelina is seeded in most regions between October 1 through the end of November; while spring seeded camelina is planted between Mid-March through the end of April in western Montana and closer to early April to early June for eastern Montana and North Dakota. In the instance of utilizing both fall and spring planting practices, the sales closing date and final planting dates for fall seeded camelina might be set similar to those listed in the wheat special provisions of insurance for counties in Oregon/Washington, while spring seeded camelina might be set similar to spring non-irrigated canola in Oregon/Washington. Fall and spring planted camelina sales closing dates and final planting dates in Montana might be set similar to the wheat special provisions of insurance. The acreage reporting date for fall seeded camelina in all regions might be set to 12/15/20XX; while spring seeded camelina in all regions might be set to 6/30/20XX.

Initial Insurability Requirements

Insurability requirements would be those similar to the Basic Provisions, the Crop Provisions and Special provisions of Insurance with the addition of the requirement that insured camelina must be grown under a processor contract and applicable rotation provisions.

Pilot Counties

The counties listed below are identified as eligible to pilot test a camelina insurance program. This determination was made using counties with existing production according to NASS, NDSU, and counties identified by Sustainable Oils as having existing or potential production (Johnson S. , 2011).

**Indicates counties with known production as identified by Sustainable Oils, NASS, and North Dakota State University.*

Idaho

- Blaine
- Bonner
- Boundary
- Butte
- Cassia
- Clark
- Gooding
- Lincoln
- Minidoka
- Twin Falls

(Johnson S. , 2011)

Montana

- Big Horn*
- Blaine
- Broadwater*
- Carbon
- Carter
- Cascade
- Chouteau*
- Custer
- Daniels
- Dawson*
- Fallon
- Fergus*
- Flathead
- Gallatin
- Garfield*
- Glacier*
- Hill

- Judith Basin
- Lewis and Clark
- Liberty*
- McCone*
- Meagher
- Musselshell
- Petroleum
- Philips*
- Pondera*
- Powder River
- Prairie
- Richland
- Roosevelt
- Rosebud
- Sheridan*
- Stillwater*
- Sweetgrass
- Teton*
- Toole
- Treasure
- Valley
- Wheatland
- Wibaux
- Yellowstone

(USDA; NASS, 2010)

North Dakota

- Adams
- Billings
- Bowman
- Burke
- Divide*
- Dunn
- Golden Valley
- Grant
- Hettinger

- McKenzie*
- McLean
- Mercer
- Morton
- Mountrail*
- Oliver
- Renville
- Sioux
- Stark
- Ward*
- Williams*

(Hill, 2009)

Oregon

- Baker
- Crook*
- Deschutes*
- Grant
- Harney*
- Jackson*
- Klamath*
- Lake*
- Malheur*
- Morrow
- Umatilla*
- Union*
- Wallowa*
- Wheeler

(Personal Communication; Oregon and Washington Listening Session, 2011)

Washington

- Adams
- Asotin
- Benton
- Chelan
- Columbia
- Douglas

- Ferry
- Franklin
- Garfield
- Grant
- Lincoln
- Okanogan
- Pend Oreille
- Spokane
- Stevens
- Walla Walla
- Whitman*
- Yakima*

(Personal Communication; Oregon and Washington Listening Session, 2011)

Insured Cause of Loss

Insured causes of loss will be those as specified in the Common Crop Insurance Policy, Basic Provisions, and similar to those contained small grains and canola crop provisions.

Uninsured Causes of Loss

See the Insured Causes of Loss section above.

Description of What Triggers Loss and Indemnity Calculation

Any production to count not meeting the producer guarantee due to an insurable cause of loss will trigger an indemnity. Indemnities will be calculated as specified in the established Crop Provisions. It is anticipated that a combination of the canola and rapeseed crop provisions and the small grain crop provisions will be utilized to develop the loss crop provisions for camelina.

Availability of Loss Adjustment Procedures

Loss adjustment methods found in the small grains LASH and the canola and rapeseed LASH would serve as models for loss adjustment procedures for camelina. Researchers at listening sessions indicated that since camelina is in the brassica family, losses should be similar to that of canola and rapeseed. They also indicated that camelina matches up almost exactly to the growth stages of flax, and that the small grains LASH could also facilitate developing a set of camelina loss adjustment procedures.

Impact Analysis

The impacts of implementing a crop insurance program for camelina in the Northwest are currently hard to gauge quantitatively. While there would be additional cost to develop and administer the program, the overall benefits to producers would be far reaching. Listening session comments indicated that the sustainability of the camelina industry would be dependent upon a crop insurance program. The demand signals from the Program Evaluation Tool suggest that the demand for camelina insurance is moderate; however, the full extent of producer participation is unknown. Listening Session producers all indicated a need for the program and the consensus was that they all would purchase a properly rated program. Based on estimated premium rates from the EPIC model and approximately 20,000 acres, total premium in the range of $540,000 and liability in the range of $2.6 million would become available to AIP's. Further, this crop insurance program would fit within the mission of the Risk Management Agency: "Serving America's agricultural producers through effective, market-based risk management tools and solutions to strengthen the economic stability of agricultural producers and rural communities" (USDA; RMA, 2011).

CROP DESCRIPTION

Introduction

Switchgrass (Panicum virgatum L.) is a perennial grass native to most of North America except for the West Coast region, specifically California, Oregon, and Washington. This warm-season grass is well suited for (a) conservation uses such as erosion control and wildlife habitat, and (b) pasture, forage, and hay due to its deep root system and ability to thrive on marginal soils.

In 1991, the U.S. Department of Energy identified switchgrass as a model crop for development to be dedicated to energy production. Within the last four years, switchgrass has been utilized as a low input biomass crop for cellulosic ethanol production. Factors including wide commercial seed availability, geographic adaptation, high biomass production, relative ease of planting, low input requirements, and compatibility with current equipment and production practices make switchgrass, if profitable, an ideal energy crop.

Economic Importance

SUPPLY

The commercial switchgrass industry is currently in its infancy, with limited alternative markets for growers to sell the crop for conversion to biofuels. The only market opportunity for growers to profit from growing switchgrass is to contract production with biomass processing firms. Currently, the only commercial switchgrass production is in east Tennessee, centered around the Vonore, Tennessee biorefinery built by Genera Biofuels LLC, DuPont Danisco Cellulosic Ethanol LLC, and the University of Tennessee.

Producers within an economically feasible distance from the biorefinery are contracted with Genera Energy for switchgrass production at a fixed price. An example contract from Genera Energy can be found in Appendix C. Figure 21 and Figure 22 illustrate the total commercially-contracted acres for switchgrass and the number of growers, respectively. From 2008 to 2010 the number of commercial acres increased by 730% from 723 acres to 6,000 acres.

As Genera Energy's biorefinery in Tennessee is the only commercial market for switchgrass producers, the production data shown in Figure 21 and Figure 22 represents the total commercial switchgrass production in the United States. However, there is significant potential for future commercial switchgrass production in other regions.

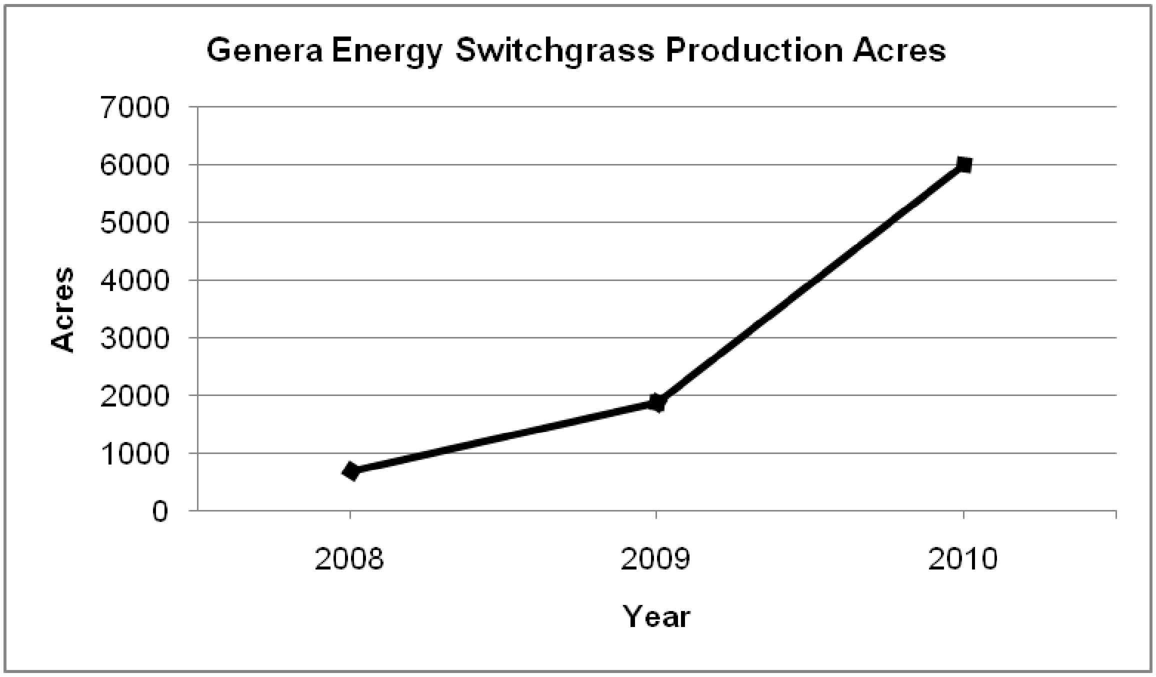

Figure 21: Switchgrass Production Chart

Source: (Genera Biomass, LLC, 2010)

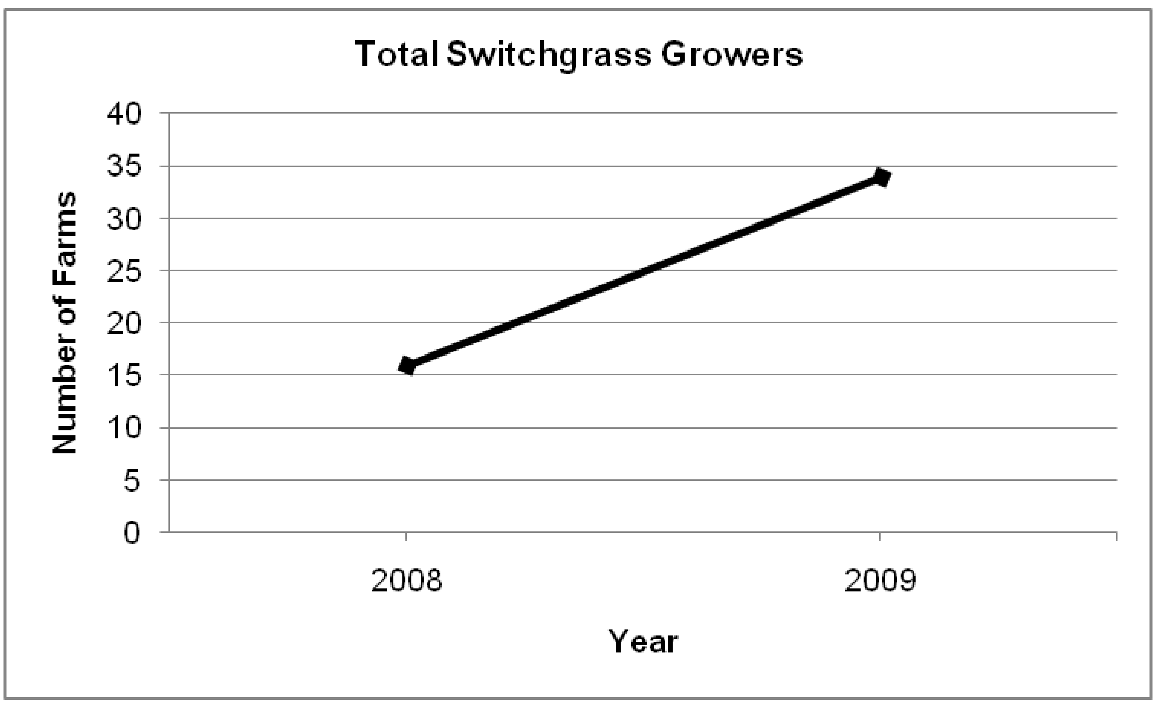

Figure 22: Total Switchgrass Growers

Source: (Genera Biomass, LLC, 2010)

PRODUCTION COSTS

As a perennial crop, switchgrass is planted once during its lifespan of ten or more years. The costs incurred during this period include the cost of establishment, and the cost of annual management activities such as nutrient inputs, pest control, harvest, and storage. A breakdown of production costs for switchgrass in Illinois by crop year can be found in Table 29. Switchgrass does not reach its maximum yield potential until three years after establishment; therefore, it is important to note that costs incurred during the first three years of production will likely see a low return on investments. Notable costs during the first three years include seed, fertilizer, and bailing. Seeding required $106.67 per hectare alone, and fertilizer inputs were 32% of the first-year operating cost. The total break-even price needed to cover the cost of production at delivery was found to be $64.84 per ton in Illinois, and $98.19 when including the opportunity cost of land rent, as shown in the annualized costs in Table 30.

Data is not available for commercial production costs; however, several university studies have been conducted on the costs of producing switchgrass. A summary of the current research can be found in Table 31. Based on these studies, production costs per ton at the farm gate are approximately $36 to $44 across all the regions studied; suggesting that the limiting factor in each region is the opportunity cost of land rent.

Table 29: Costs of Production for Switchgrass in Illinois

Cost Items/hectare	Switchgrass ($/hectare)			
	Year 1	**Year 2**	**Year 3-10**	**PV (10 yrs.)**
Fertilizer	**86.98**	**60.96**	**52.29**	**484.10**
- Nitrogen	0.00	37.07	49.42	355.57
- Phosphorous	16.31	4.66	0.78	25.81
- Potassium	13.84	5.03	2.09	32.22
- Lime	56.83	14.21	0.00	70.49
Herbicide	**17.89**	**17.89**	**0.00**	**35.09**
Seed	**106.67**	**26.67**	**0.00**	**132.31**
Interest on Operating Inputs	**14.81**	**7.39**	**3.66**	**45.61**
Pre-harvest Machinery	**44.12**	**23.55**	**17.65**	**181.06**
- Disking	16.80	0.00	0.00	16.80
- Harrowing	9.06	0.00	0.00	9.06
- Potato planter (for miscanthus planting)	-	-	-	0.00
- Airflow / fertilizer spreader	10.59	15.89	17.65	140.17
- Spraying chemicals (Atrazine and 2-4 D)	7.66	7.66	0.00	15.03
Harvesting	**0.00**	**146.35**	**271.28**	**1896.93**
- Mowing / conditioning	0.00	24.09	32.12	231.12
- Ranking / Swathing	0.00	6.30	8.40	60.45
- Baling	0.00	68.72	136.75	951.35
- Staging and loading	0.00	32.67	65.02	452.35
- Storage	0.00	14.57	28.99	201.66
Operating Costs at Farmgate ($ ha^{-1})	**270.47**	**282.80**	**344.88**	**2775.10**
Transportation	0.00	27.83	55.39	385.36
Operating Cost Including Transportation ($ ha^{-1})	**270.47**	**310.64**	**400.28**	**3160.46**
Delivered Yield (t ha^{-1})	**0.00**	**3.52**	**7.01**	**48.75**
Breakeven Farmgate Price Excluding Land Rent ($ t^{-1})				**56.93**
Breakeven Delivered Price Excluding Land Rent ($ t^{-1})				**64.84**

Source: Khanna, et al., 2008

Table 30: Annualized Costs of Production for Switchgrass in Illinois

Cost Items ($ ha $^{-1}$)	Switchgrass
Fertilizer	57.39
Chemicals	4.16
Seed	15.69
Interest on Operating Inputs	5.41
Storage/Drying/Crop Insurance	23.91
Machinery	222.44
Transportation	45.68
Annualized Operating Cost	374.67
Annualized Yield (t ha^{-1})	5.78
Opportunity Cost of Land	192.76
Breakeven delivered cost including opportunity cost of land ($ t^{-1} DM)	**98.19**

Source: (Khanna, Basanta, & Clifton-Brown, 2008)

Table 31: Summary of Five Economic Analyses That Estimate the Full Economic Cost to Produce Switchgrass as a Dedicated Energy Crop

Study	State	Yield Level(s) Assumed	Stand Lifespan(s)	Land Cost	Harvest Method	Estimated Cost of Production
		Tons/acre	Years	$/acre	Yes/No	$/ton
Khanna et al. (2008)	Illinois	9.4	10	$78	Large rectangular bales	$44 (farmgate, w/o land cost) $89 (delivered)
Mooney et al. (2009)	Tennessee	6.2 – 7.9	5 and 10	$68	Large round bales	$42 – $63 (farmgate, 10-year lifespan)
Perrin et al. (2008)	North Dakota, South Dakota, Nebraska	2.6 – 3.5	5 and 10	Various	Mixed	$42 – 71 (farmgate, 10-year lifespan)
Epplin et al. (2007)	Oklahoma	NS	NS	$60	Large rectangular bales	$36 – $52 (farmgate) $49 – $65 (delivered)
Wang (2009)	Tennessee	6.0 – 7.8	NS	Varied by productivity	Mixed	$66 – $77 (delivered)

Source: (Mooney & English, 2009)

Demand

As a commercially grown crop, switchgrass has the opportunity to fulfill the biomass needs for an emerging biofuels industry. Using the cellulosic process, the biomass from switchgrass can be converted to ethanol. The Energy Independence and Security Act (EISA) of 2007 mandates that the United States produce 36 billion gallons of ethanol by 2022, with 16 billion gallons coming from cellulosic biofuels. The biorefinery in Vonore, Tennessee has a 250,000 gallon per year capacity for ethanol production, which is half of the mandate for 2012 production set by EISA's timetable, shown in Table 32.

Given this mandate, there is considerable opportunity for producers to enter the market. Assuming that one ton of biomass from switchgrass can produce 103 gallons of ethanol, and that an average yield would be approximately eight tons per acre (Estimation of Yield Probability Distributions for Montana), it would take over 22 million acres of switchgrass to meet the 16 billion gallon cellulosic ethanol mandate. (Wang, Saricks, & Santini, 1999)

As mentioned in the camelina description, The United States Department of the Navy has made a commitment to have half of their energy consumption come from alternative sources by the year 2020. To accomplish this, the Navy plans to use a stair-step approach, increasing the amount of alternative energy consumption to eight billion barrels in 2020, giving switchgrass producers another market opportunity. (Tindal, 2010)

Table 32: EISA Cellulosic Ethanol Mandate

Energy Independence and Security Act Applicable Volume for Cellulosic Ethanol	
Calendar Year	**Volume (Billions of Gallons)**
2010	0.1
2011	0.25
2012	0.5
2013	1
2014	1.75
2015	3
2016	4.25
2017	5.5
2018	7
2019	8.5
2020	10.5
2021	13.5
2022	16

Source: (One Hundred Tenth Congress of the United States of America, 2007)

Marketing and Utilization

Currently, switchgrass is primarily utilized for biomass production and marketed for conversion to ethanol using the cellulosic process. It is also being explored as a fuel to be co-fired with coal in electricity production plants. To date, co-firing switchgrass is in the research and development stage. (U.S. Department of Energy, 2003)

The only commercial production is located near the Genera Biofuels biorefinery in Vonore, Tennessee. This is the only facility for producers to market their crop. Genera Biomass has contracted with producers at a fixed price of $450 per planted acre in previous years. A sample contract is included in Appendix C. Genera plans to move its pricing toward a production-based price once area growers have established switchgrass stands. (Personal Communication; Tennessee Listening Session, 2010)

Agronomic and Botanical Characteristics

Phenological Stages Of Growth

Switchgrass is a warm-seasoned native grass that requires few inputs and generates high yields. A herbaceous perennial grass that follows the life cycle illustrated in Figure 23, it is grown for its tall, dense shoots that produce high amounts of biomass. Commercial plantings take two to three years to reach maturity, but have a productive life of 10 years or more.

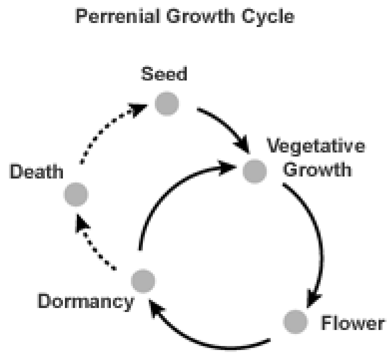

Figure 23: Switchgrass Growth Cycle

Source: (Oregon State University, n.d.)

Germination Stage

The germination stage encompasses the events occurring after a seed is placed in the soil through its emergence from the soil. Under ideal soil and climate conditions, this process will take five to seven days. (Wolf & Fiske, 2009) This stage is critical for production, as the stand is at risk of yield loss due to weed competition. This can be managed by having a weed-free seedbed.

Vegetative Stage

The vegetative stage refers to the developmental period comprising leaf growth and development. This begins with the emergence of the first leaf. Each successive sub-stage refers to the number of fully emerged live leaves currently present. Leaves are considered fully emerged when collared. Once stem elongation commences, the elongation stage begins and the vegetative stage ceases. During this stage, the stand is still susceptible to competition from weeds.

Elongation Stage

Elongation is the stage during which culm or stem elongation occurs, and is often referred to as jointing. Sub-stages of the elongation stage are defined by the number of nodes that have become visible as the result of stem elongation. The elongation stage ceases when the inflorescence is enclosed in the uppermost leaf sheath, which is commonly referred to as the boot stage. Additional nodes may become visible after this time. This stand is considered to be well established at this stage and can withstand weather related perils.

Reproductive Stage

The reproductive stage begins with emergence of the inflorescence and continues through fertilization. Seed ripening begins when the developing seed becomes visible and ends when it is ripe. Growth is completed at this stage. (Moore, Moser, Vogel, Waller, Johnson, & Pedersen, 1991)

Chemical Composition

Switchgrass is composed of lignin, cellulose, hemicellulose, and other compounds known as extractives. A breakdown of the amount of chemical characteristics in switchgrass can be found in Figure 24. The cellulose and hemicellulose are polysaccharides that can be hydrolyzed to sugars and then fermented to ethanol. On average, 66% of switchgrass' dry matter is cellulose and hemicellulose, which can be utilized for conversion to ethanol. The lignin cannot be utilized for fermentation.

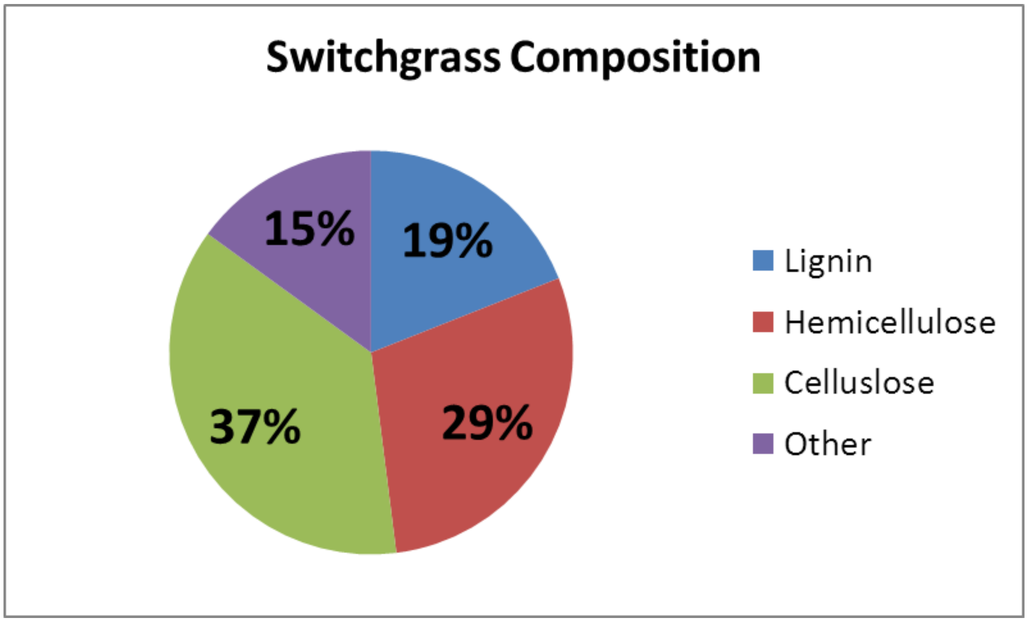

Figure 24: Switchgrass Chemical Composition

Source: (DoKyoung, Owens, Boe, & Jeranyama, 2007)

Production Operations

As the market for switchgrass is new and underdeveloped, production practices are currently being researched. The current practices are the result of experience through forage production and limited research. Production is separated into three phases: establishment, management, and harvest. Switchgrass does not require replanting once a successful stand is established.

ESTABLISHMENT

From planting the crop to the second year of growth, the establishment of a switchgrass stand is paramount to the success of the crop. This initial phase of production often presents the most challenges to the producer in the form of seed dormancy and competition from other grasses and weeds. Producers have seen yields ranging from zero to five tons per acre in the first year of production.

Planting occurs early May to mid-June using a no-till practice. If planting takes place after a row crop, the seedbed must be smoothed out and firm. The seed has a period of dormancy; therefore, the highest level of pure live seed is desirable, and is often sold by its "Pure Live Seed" percentage[9] (USDA; NRCS, 2009). At this stage, the seedling is vulnerable to weed competition, especially in fields with perennial weed infestations. Proper field preparation is necessary to avoid competition. Field condition before planting is preferably smooth with little or no vegetation. The field is typically grazed heavily, and RoundUp (glyphosate) needs to be applied before seeding.

Seeds are planted from one-quarter to one-half inch deep at a rate of five to six pounds of pure live seed per acre. Switchgrass takes 15-20 days to germinate, and during this period, the field is typically sprayed with Round-Up (glyphosate) to kill weeds and grasses that compete for establishment. Nitrogen will hinder establishment by producing additional weed competition, but 40 to 80 pounds of phosphorus can be applied. (Personal Communication; Tennessee Listening Session, 2010) Currently, there are no approved herbicides to aid in weed control for switchgrass.

[9] Pure Live Seed Calculation: %PLS = (% purity × % viability) × 100; % Viability = % germination + % dormant seed

Management

Once a switchgrass stand is established, it requires a relatively small amount of inputs and is susceptible to few perils. During this stage of growth, switchgrass develops a large root system that can reach more than 10 feet below ground, giving it an increased ability to withstand drought and wind (Bransby, n.d.).

During this phase, yield can reach ten tons per acre. The highest-yielding results were from producers using 40-60 pounds of nitrogen, but producers using applications beyond 60 pounds did not see any yield increase. Over the years of production, little variation in yield occurs.

Weed control is necessary until the stand becomes very dense, in order to mitigate yield loss. Once a stand becomes mature, the base can reach 20 inches in diameter, which will prevent weeds from becoming established.

A successful switchgrass stand is assumed to last more than ten years before seeing any reduction in yield. However, it is likely that a higher-yielding variety will be developed in the next ten years. Should a higher-yielding variety be developed, producers would likely reestablish a stand with the new variety. (Personal Communication; Tennessee Listening Session, 2010)

Harvest

Switchgrass is typically harvested after the second or third hard freeze of the year. The goal is to reduce the moisture content to below 15 percent for baling immediately following the windrower. The switchgrass is harvested at six inches from the ground, and the entire cutting is baled in round or square bales and may be chopped. (Teel, 1998) Once the crop is harvested, switchgrass can be stored either covered or uncovered. There is a cost trade-off between the amount invested in storage and the amount of money lost due to higher moisture content (Searcy, 2010).

As of 2010, yield is determined in the field by portable scales, which eliminates shrinkage. This system is likely to change in the future. Yield and moisture content will be measured at delivery to the plant in order to determine if the product is acceptable to the plant based on its standards. Moisture management of switchgrass is critical, as ethanol production is generally higher from properly stored switchgrass. (Personal Communication; Tennessee Listening Session, 2010)

Rotation and Isolation Requirements

As switchgrass is a perennial grass, there is no need to replant or rotate the crop after establishment. (Teel, 1998) The economic life of the crop is usually over ten years without replanting. However, new varieties are expected to be released before the current crop's economic life is over, which would require a replant.

Soil Requirements

Switchgrass can be produced in a wide variety of soil types and is tolerant of poor soil conditions without irrigation. Higher yields are seen in soils such as loam and sandy soils, which allow roots to spread easily. Planting in a smooth, firm, clod-free seedbed and ensuring good seed-to-soil contact at a consistent depth provides the best establishment results. In addition, greater soil depth gives roots more access to soil water and nutrients. (Caddel & Redfearn, 2008) Switchgrass is most productive in soils with a pH at 5.0 or higher. (Garland, n.d.)

Susceptibility to Pests and Diseases

At this time, the impact of disease and pest on switchgrass production is not known. However, occurrences of rust and smut were reported in South Dakota and Iowa test plots, respectively. As acres increase, biomass yield reductions could be attributable to pests and diseases in the future. (Nyoka, Jeranyama, Owens, Boe, & Moechnig, 2007)

Diseases

Rust (Puccinia emaculata)

Rust is a type of airborne spore that germinates and infects plants it lands on. At first, light yellow flecks on the surface of the leaves or on culms can be observed. As the disease progresses, numerous lesions containing mature small brown spores erupt through the leaf surface. Upland varieties have shown more severe symptoms. Control is achieved by planting resistant varieties and possibly by the use of foliar-applied fungicides.

Smut (Tilletia maclagani)

Smut is a fungi that survives as spores on seed and in infested soils. Spores infect coleoptiles before seedling emergence in the spring. The fungus grows through the plant and primarily colonizes at points of plant growth. In the developing seed head, the fungus displaces the kernel and upon maturity, bunt balls emerge, releasing spores that are dispersed by wind, rain, and healthy seed. The disease can cause reduced yields and stand decline. Control is facilitated through clean seed, plant resistance, and fungicidal seed treatments.

PESTS

Grasshoppers are known to feed on switchgrass, but the extent of their damage has not been quantified. Commonly found insects on switchgrass include aphids, leafhoppers, blister beetles, chinch bugs, grasshoppers, stem bores, and wireworms. There are also several beneficial insects found on switchgrass, including ants, rove beetles, ground beetles, parasitoid wasps, and spiders.

Weeds

Both weedy grasses and broadleaf weeds can cause serious problems during switchgrass establishment, but usually only minor problems occur after the first year. The array of weeds found in any field depends on the previous use of the land and any nearby plants whose seeds may have been blown or washed onto the site. (Caddel & Redfearn, Pest Management, n.d.)

Weed competition can be controlled during establishment by eliminating weeds before planting and not applying nitrogen until the stand is established. An application of RoundUp (glyphosate) applied before seeding will help reduce competing weeds (Personal Communication; Tennessee Listening Session, 2010).

Adaptation and Distributions

As a native grass to North America, switchgrass is adaptable to most areas of the United States with suitable soils. Areas with sandy to clay loam soils have seen the highest yields, whereas areas with rich, heavy soils tend to have poor yields (USDA; PLANTS, 2011). Figure 25 and Figure 26 illustrate the projected yield for switchgrass throughout the United States. The far western states are shown to be unsuitable for switchgrass production, and the highest-yielding areas are in the central to eastern parts of the country.

Varieties

Switchgrass varieties are typically categorized by their ecotype, as either an upland variety or lowland variety. The upland varieties, discussed in Table 33, are best suited for production north of 40° latitude (north of Kansas) and require less precipitation.

While these varieties can endure the colder, drier climates, they have lower yields than lowland varieties. Of the two lowland varieties shown in Table 34, Alamo has the highest yield, and the highest demand for seed in Tennessee. Producers contracted with Genera Energy in the Madisonville, Tennessee area had yields as high as ten tons per acre with the Alamo variety. In the near future, Genera Energy expects yields to reach 15 tons per acre from their producers. (Personal Communication; Tennessee Listening Session, 2010)

Table 33: Upland Switchgrass Cultivars

Varieties	Description
Trailblazer	This cultivar was released in 1984 from USDA and the University of Nebraska, and is adapted to the Central Great Plains.
Blackwell	Blackwell was developed by USDA in Manhattan, Kansas in 1944 for the Kansas, Oklahoma, southern Nebraska, and northern Texas areas. This cultivar is adapted to those regions provided they have 20 inches or more of annual precipitation.
Cave-In-Rock	This variety was released by NRCS-USDA and the Missouri Agricultural Experiment Station in 1973 to be tolerant to flooding and adapted to the Midwest.
Pathfinder	The Pathfinder variety was developed by Nebraska Agricultural Experiment Station and ARS-USDA in 1967 to be winter-hardy and mature late.
Caddo	This cultivar recovers well after mowing and can be high yielding using irrigation. It was developed by Oklahoma Agricultural Experiment Station and ARS-USDA.

Source: Adapted from (Rinehart, 2006)

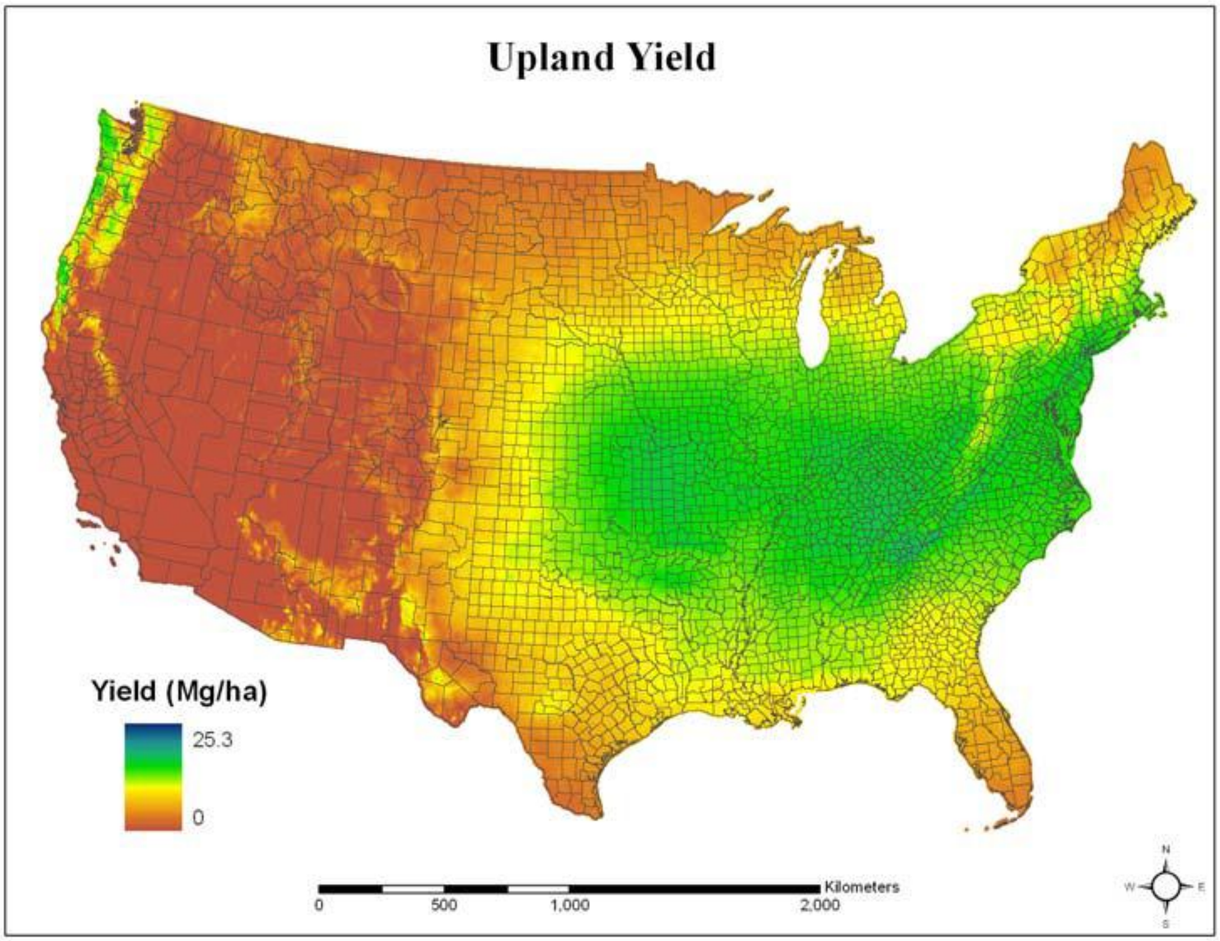

Figure 25: Yield Projections for Upland Varieties

Source: (Wright, et al., 2009)

Table 34: Lowland Switchgrass Cultivars

Varieties	Description
Alamo	In 1978, Texas Agricultural Experiment Station and NRCS-USDA released the Alamo variety. It is typically high yielding and is the premier lowland variety.
Kanlow	This variety was developed by Kansas Agricultural Experiment Stations and ARS-USDA for soil conservation.

Source: Adapted from (Rinehart, 2006)

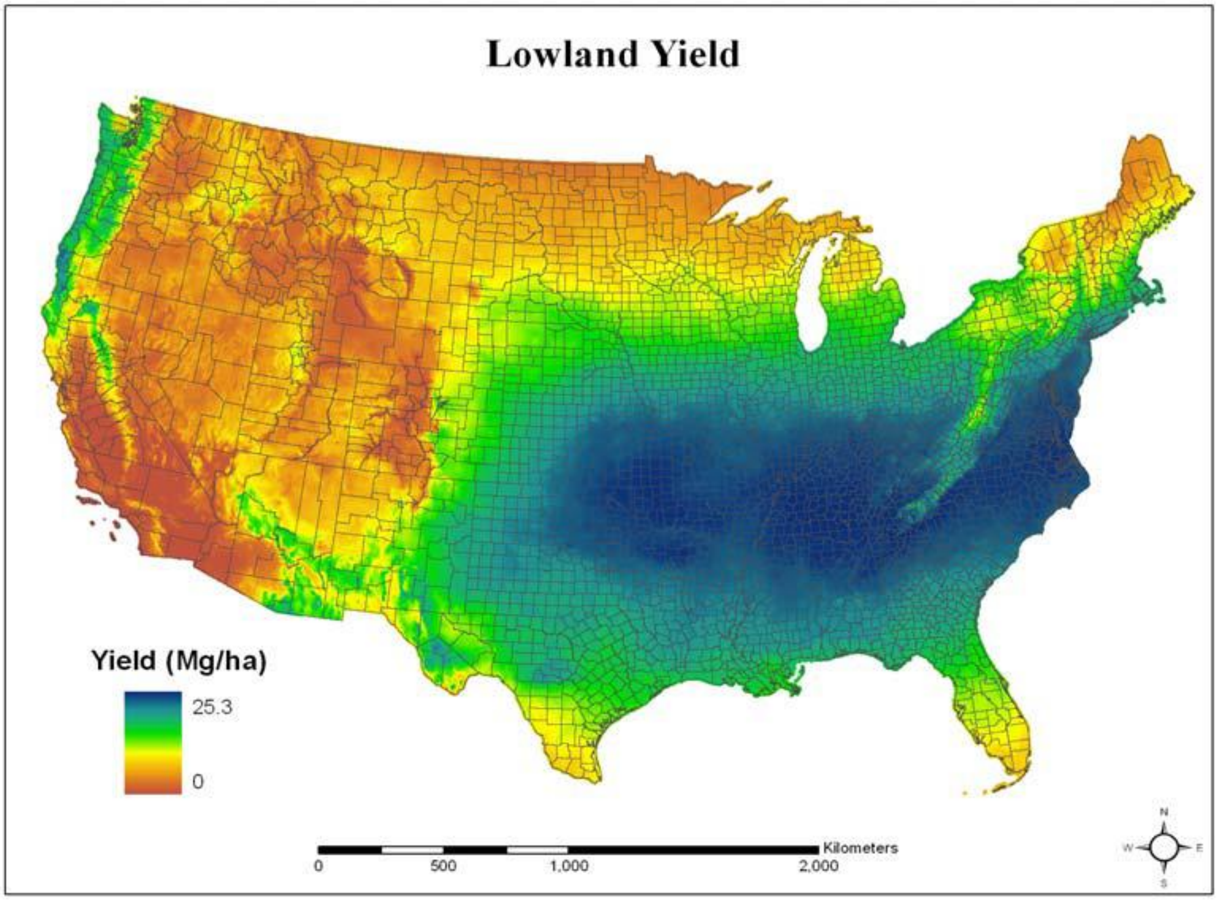

Figure 26: Yield Projections for Lowland Varieties

Source: (Wright, et al., 2009)

REVIEW OF OTHER PROGRAMS

State and Federal Programs

BIOMASS CROP ASSISTANCE PROGRAM

The Biomass Crop Assistance Program (BCAP) supports switchgrass establishment and management through project areas and contracts on land for up to five years. Switchgrass is listed as an eligible material under the renewable plant material category of herbaceous resources. Through a matching payment program, BCAP assists switchgrass owners with collection, harvest, storage, and transportation for use in qualified Biomass Conversion Facilities (BCF). These payments are available to switchgrass growers at the rate of $1 for each dollar per dry ton paid by the BCF to the eligible material owners, limited to a maximum of $45 per dry ton and a 2-year payment duration. (USDA; FSA, 2010a)

Bioenergy Program for Advanced Biofuels

Payments are made to switchgrass producers for the purpose of biofuel production. Eligible producers entering into a contract are paid based on the quantity and quality of advanced biofuel production and on the net nonrenewable energy content of the advanced biofuel. The payment amount depends on the number of producers participating in the program, the amount of advanced biofuels being produced, and the amount of funds available. (National Sustainable Agriculture Information Service, 2010)

Mandatory funding for this program has been set at, $105 million in fiscal year 2010, $85 million in fiscal year 2011, and discretionary funding of up to $25 million each year from fiscal year 2009 - 2012.

Rural Energy for America Program

The Rural Energy for America Program (REAP) established a grant and loan guarantee program to assist producers in purchasing renewable energy systems and making energy efficiency improvements. (Crooks, 2010)

Biorefinery Assistance Program

This program provides grants for construction of demonstration-scale biorefineries and loan guarantees for commercial-scale biorefineries. The demonstration-scale biorefineries are funded up to 50 percent of their project cost. Each loan is guaranteed up to $250 million for commercial-scale biorefineries. Although assistance does not go directly to the grower, this program assists in developing the industry and indirectly benefits the producer. (Crooks, 2010)

Sun Grant Research Initiative

This research initiative authorizes the United States Department of Agriculture, Department of Transportation, and Department of Energy to issue grants to five regional Sun Grant Centers and one sub-center. Each center is tasked to coordinate bioenergy efforts in their region to "develop, distribute, and implement bio-based technologies, promote diversification and environmental sustainability through bio-based energy and product technologies, promote diversification of rural areas through bio-based energy, enhance efficiency of bioenergy and biomass research and development through collaborations among United States Department of Agriculture, Department of Energy, and land grant universities." The Initiative is awarded funding of $75 million annually through 2012 (Dohlman, Caswell, & Duncan, 2008). Although this program will not provide a direct payment, it will provide future benefits to producers through research and development.

Private Products

To date, there are no private insurance products available for switchgrass in Tennessee or any other states.

Data Availability and Price Methodologies

Yield Data

Currently, yield data for switchgrass is not publically available; however, producers who attended the listening sessions provided the Contractor with yield estimates. These yield estimates were then utilized to simulate a historical data series. The methodology includes developing a production schedule of tillage, planting, fertilization, pesticide applications, and harvesting operations, along with management decisions regarding typical dates of each operation, seeding rates, and application rates of fertilizers and pesticides. Illustrated in Table 35 is the collected yield data.

Table 35: Switchgrass Average Producer Yields

Tennessee Switchgrass (Tons Per Acre)		
Year 1	Year 2	Year 3
3.33	5.21	7.53

Source: (Personal Communication; Tennessee Listening Session, 2010)

Price Data

Currently, first handlers who contract with growers for switchgrass production solely determine switchgrass price (i.e., contract price). Genera Energy and University of Tennessee currently price their contracted production at $450 per year for each acre planted. Dr. Sam Jackson of Genera Energy indicated that pricing will move to a production/yield-based price in the future, but would not release the pricing methodology for proprietary reasons (Jackson, 2010). An example contract can be found in Appendix C.

LISTENING SESSIONS

Tennessee

As per requirement of section 2.4.2.1 of the Statement of Work, the Contractor conducted a listening session with switchgrass producers in Southeast Tennessee. Tennessee was chosen because of the role the University of Tennessee has played in developing a cellulosic biofuels industry in the state. As part of the Tennessee Biofuels Initiative, Genera Energy, a limited liability company wholly owned by the University of Tennessee Research Foundation, was created. Genera partnered with DuPont Danisco Cellulosic Ethanol, LLC to construct and operate a demonstration-scale cellulosic ethanol biorefinery in Vonore, Tennessee using 6,000 acres of switchgrass produced in the region. (Genera Energy, 2010) & (Tiller, 2010)

Genera President Dr. Kelly Tiller and Dr. Sam Jackson assisted the Contractor in determining the location and date of the meeting, and notified and encouraged all their contract producers to attend the meeting. The listening session was held on Friday, November 19, 2010 (7:30 am) at Donna's Old Town Café located in Madisonville, Tennessee. Twenty-three participants attended, including producers, bankers, extension agronomist, and university professors, with the majority in attendance being producers.

LISTENING SESSION SUMMARY

The majority of the attendees at the listening session were landowners who have not previously participated in FCIC insurance. Among the total in attendance, only two switchgrass producers had bought FCIC crop insurance to cover other crops. These two producers were the most vocal of the group, and indicated that FCIC crop insurance was essential to their risk management practices on their farms. They indicated that based on their experience with the crop, switchgrass was a relatively low-risk crop that can be grown on marginal land. Color Wheel Farm owner Brad Black stated, "20 bushel soybean ground can make 10 tons of switchgrass, and class 8 ground will make 8 tons." (Personal Communication; Tennessee Listening Session, 2010). Producers also indicated that crop insurance would be an effective risk management tool for switchgrass, given that potential changes of the current contract structure will be implemented in the near future.

Additional comments confirmed that switchgrass is a low input and low maintenance crop that yields well across various areas and diverse environmental conditions. At present, the majority of switchgrass producers were indifferent to insuring switchgrass since current contracts are paying $450 per acre to the growers, with no risk of loss for revenue. However, acreage contracts would gradually phase into production/yield contracts, under which the growers will be paid at a fixed dollar amount per ton of switchgrass produced. It is reasonable to believe that more interest for a FCIC crop insurance program for switchgrass will develop as revenue risk becomes a more relevant concern to the growers. Current factors driving the demand for crop insurance such as yield, price and quality risk for switchgrass are relatively low in Tennessee, which helps explain the attitudes of producers that are indifferent to purchasing crop insurance for switchgrass. Nonetheless, the two producers with existing FCIC crop insurance provided useful information from the perspective of current insured growers, and emphasized the importance of a FCIC crop insurance program as an effective risk management tool in the near future.

SWITCHGRASS RISK EVALUATION

Introduction

The RMA's Program Evaluation Tool found in the USDA RMA Program Evaluation Handbook FCIC-2210 (PEH)[10] was used by the Contractor as a supplement to assist in the development of the overall recommendation for each dedicated energy crop. This tool creates a better understanding of the risk exposure and the potential for various insurance products to transfer a portion of that risk to an insurance pool. The tool also assists in gauging the demand for insurance products and potential design issues that may rise.

This instrument was applied separately to the four regions where the listening sessions were held. These regions included Tennessee for switchgrass, Louisiana for energy cane, and Montana and Oregon/Washington for camelina. The program evaluation tool was completed based on information obtained through (a) listening sessions with producers, insurance agents, FSA personnel, university extension personnel, crop consultants, (b) conversations with RMA Regional Office, and (c) the Contractor's independent research and analysis of the current production and market conditions for each crop in each region and that of comparable crops. Results of the Program Evaluation Tool are summarized below and the completed Diagnostic Instrument for each region is included in Appendix N.

Tennessee Program Evaluation Tool Summary

"The Program Evaluation Tool uses a series of questions to elicit information on production processes, market characteristics, availability of federally facilitated insurance products, and eight demand signals, of which five are "Demand Shifter Categories" such as yield risk, quality risk, price risk, other sources of revenue risk, and the sufficiency of non-insurance available to cope with risk. The remaining three are "Product Design Categories", such as potential and realized risk classification challenges, potential and realized moral hazard and monitoring issues, and other problems that may affect insurance participation. Overall assessment questions are answered for the eight categories using a Likert scale of 1 to 5, where higher numbers for the "Demand Shifter" category indicate higher demand for insurance products, while lower numbers suggest relatively lower demand. For the "Product Design" categories, higher numbers indicate either a lack of product design problems or a high likelihood of being able to address any existing product design problems, while low numbers indicate more serious product design problems and/or problems that cannot be easily addressed. Using the overall assessment scores from each of the eight diagnostic categories, the results have been graphically summarized for each region. Based on the overall scores assigned to each of the eight diagnostic categories, assessments are made and used to work through a generalized decision tree framework (See Appendix I), intended to facilitate decision-making. However, the diagnostic instrument may be used independently of the decision tree." (USDA; RMA, 2005)

The following is a summary of the completed Evaluation Tool for Tennessee switchgrass. The completed Evaluation Tool in Appendix N provides the completed answers to the aforementioned questions, while the sections below provides summary level answers to the eight demand signal questions used for Likert scale ratings. This summary will be better understood by concurrently reviewing the Program Evaluation Tool in Appendix N.

BACKGROUND INFORMATION

Switchgrass is a perennial plant that grows in most areas of the United States. Its distribution spans south from Canada over most of the United States to east of the Rocky Mountains. Switchgrass is a hardy and deep-rooted, perennial rhizomatous grass that begins growth in late spring through early fall, then it becomes dormant and unproductive during colder months. Once established, a switchgrass stand can survive for ten years or longer. Unlike corn, switchgrass can grow on marginal lands and requires relatively modest levels of chemical fertilizers.

MARKETING

Genera Energy was formed in 2007 to execute the capital construction projects and business elements of the Tennessee Biofuels Initiative. Genera Energy partnered with DuPont Danisco Cellulosic Ethanol to jointly construct

[10] The document can be downloaded from http://www.rma.usda.gov/FTP/Publications/directives/22000/06_22010.pdf.

and operate a demonstration scale cellulosic biorefinery. As part of the Tennessee Biofuels Initiative, University of Tennessee developed a local farm-based switchgrass energy crop industry. Currently University of Tennessee provides acreage contracts to farmers for $450 per acre of switchgrass which began in 2009 and lasts three years. A yield-based component will be added in 2010, under which Genera Energy will provide a yield-based production contract for $50-$75 per ton of switchgrass going forward. (Tiller, 2010)

RMA-Facilitated Insurance Products

Currently there are no RMA-facilitated insurance products available for switchgrass utilized for dedicated energy in Tennessee or any other region in the United States.

Yield Risk

Switchgrass in Tennessee is exposed to fire as a catastrophic risk. It was noted that, at the Tennessee listening session, this risk may be caused by a catastrophic event such as lightening or more so by a spark from equipment during harvest or even a hot bearing. Under the occurrence of fire, yields for switchgrass could quickly be reduced to a 100 percent loss which has occurred at least once since 2009 as a result of an equipment fire. Although the risk for a catastrophic fire would be hard to gauge, utilizing the cause of loss data from RMA for the counties within a 50 mile radius of the DuPont Danisco plant enables us to make a more informed estimate. For Anderson, Blount, Bradley, Cumberland, Hamilton, Knox, Loudon, McMinn, Meigs, Monroe, Morgan, Polk, Rhea, Roane, and Seiver Counties fire has occurred as an insurable cause of loss two times in the last 25 years (1985-2009). Both instances occurred to tobacco and, although significantly different from switchgrass, it provides the best quantitative measures to evaluate the yield risk for switchgrass.

On a Likert scale from 1 to 5, “1” being very low relative yield risk and “5” being very high relative yield risk, non-catastrophic yield risk was deemed to be very low (“1”). Although switchgrass data are not reported by NASS, assuming similarity of switchgrass to all dry hay yields, all dry hay yields for the aforementioned counties in Tennessee and the coefficient of variation for each crop can be used to assist in quantifying the yield risk associated with switchgrass.

The coefficient of variation, calculated as the standard deviation divided by the mean, facilitates the comparison across crops with different expected yields and allows the comparison of variation in unlike data series. As illustrated in Figure 27, yield risk for all dry hay in the aforementioned counties in Tennessee has been significantly lower than most of the other crops produced over the past ten years. The coefficient of variation for all dry hay is 0.10, while corn for grain and soybeans are 0.21 and 0.28. This suggests that switchgrass is a relatively low risk crop to compared to corn for grain and soybeans. However, switchgrass used for dedicated energy may encounter significant biomass yield losses during storage. In addition, improper storage may decrease the quality of biomass so that it lowers the yield potential for conversion to ethanol. (Jackson, 2010)

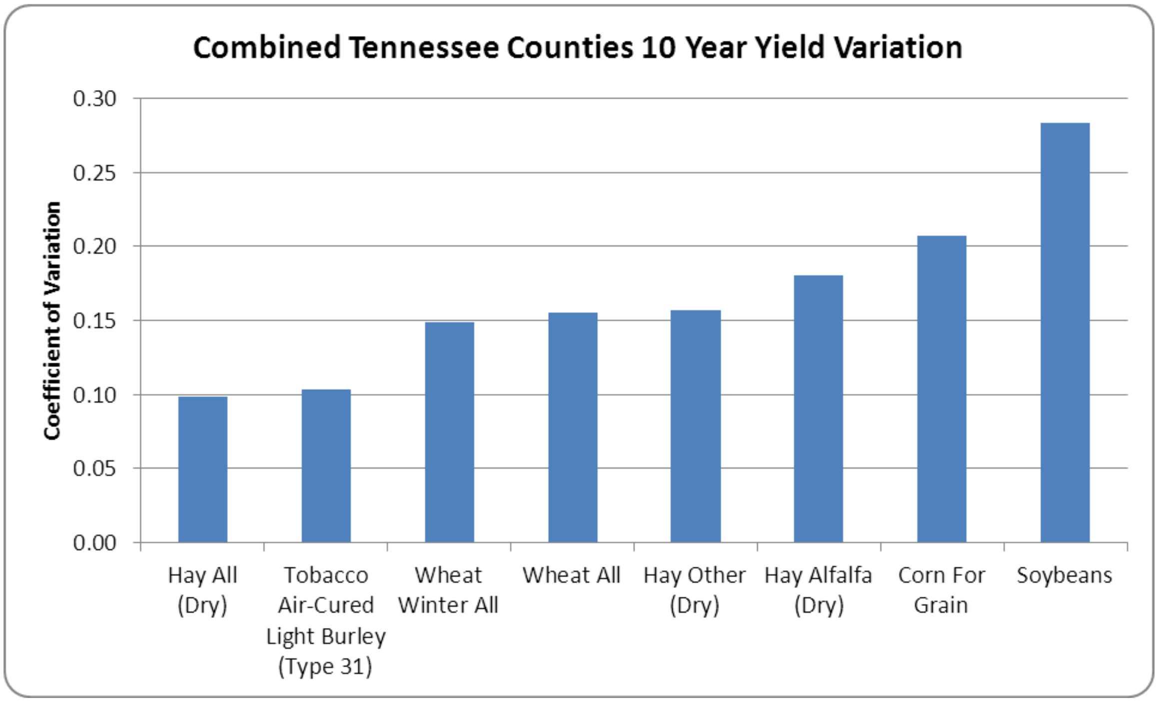

Figure 27: Tennessee Combined County Crop Yield Risk Comparison

Adapted from (USDA; NASS), 2011

Quality Risk

Switchgrass utilized as a feedstock for dedicated energy does not exhibit significant quality risk at the time of harvest and therefore can be characterized as very low ("1") in quality risk. However, the quality of the switchgrass may decline in storage resulting in significant biomass losses and actual enzymatic hydrolysis (EtOH), which in turn lowers ethanol yield from cellulosic conversion. Producers are currently not docked for quality losses and will be paid based on switchgrass as measured by weighing bales coming directly from the field. Therefore, quality risk is insignificant in terms of insurance design and it is reasonable to characterize quality risk as very low (Likert scale "1").

Price Risk

As part of the Tennessee Biofuels Initiative, University of Tennessee developed a local farm-based switchgrass energy crop industry. Currently, University of Tennessee provides acreage contracts to farmers for $450 per acre of switchgrass, which began in 2009, and lasts three years. Genera Energy will then provide a yield based production contract for $50-$75 per ton going forward. (Tiller, 2010) Based on the current contract pricing, price risk for switchgrass in the aforementioned counties in Tennessee is rated as very low (Likert scale "1").

Other Sources of Revenue Risk

Switchgrass is a small seeded crop that prefers shallow planting, a firm seedbed and low weed competition. Establishing stands is difficult and does bear some levels of risk. Currently producers are provided seed and technical assistance for establishing switchgrass stands. The technical assistance has been instrumental and the free seed has lowered production cost, making it less risky for a producer to produce switchgrass. When a replanting is needed, University of Tennessee provides the seed, while the farmer pays for land preparation and seeding. (Jackson, 2010) Since the free seed and technical assistance help to reduce other sources of revenue risk, this demand signal is assigned a rating of low (Likert scale "2").

Sufficient Non-Insurance Coping Mechanisms

The demand for various crop insurance products (existing and potential) is influenced by non-insurance coping mechanisms including government price and income support programs, government disaster programs, marketing contracts including futures and options on futures for exchange-traded commodities, crop portfolio and spatial diversification, risk reducing production technologies and practices, and lenders' attitudes, expectations, and rules-of-thumb.

Federal commodity programs tend to reduce farmers' exposure to price risk and revenue risk. For switchgrass, no government crop programs are available in terms of marketing loans and counter cyclical payments; however, the Biomass Crop Assistance Program (BCAP) is available. BCAP supports establishing and producing eligible crops for the conversion to bioenergy through project areas and contracts on land for annual and non-woody perennial crops up to 5 years or for woody perennial crops up to 15 years. Through a matching payment program BCAP assists agricultural and forest land owners and eligible material owners with collection, harvest, storage, and transportation of eligible material for use in qualified Biomass Conversion Facilities (BCF). These payments will be available to eligible material owners at the rate of $1 for each dollar per dry ton paid by the BCF, limited to a maximum of $45 per dry ton and a 2-year payment duration. No listening session attendees indicated their current utilization of the program. (USDA; FSA, 2010a)

Other programs such as Noninsured Crop Disaster Assistance Program (NAP) are not available, nor has there been a history of federal disaster payments issued by the Crop Disaster Program[11]. Producers who (a) elect not to obtain federal crop insurance on non-insurable crops or crops for which the producer received crop loss assistance and (b) elected not to participate in NAP for the year in which benefits are received, must purchase crop insurance at a level greater than the catastrophic coverage for insurable crops for the next two crop years in the administrative county where the crop was produced or prevented from being produced. (USDA; FSA, 2011)

Production contracts often mitigate farmers' exposure to some, but not all risks. Almost 100 percent of the crops in these counties are under production contracts with a first handler or processor and are priced prior to harvest and establishment. Under the terms of the contracts the growers are not exposed to (a) contract risk (i.e., growers do not have to deliver on the contract under production shortfalls) (b) quality risk (i.e., no significant price penalties if the product does not meet the quality characteristics specified in the contract), and (c) price risk (i.e., prices for specific quality characteristics are not specified in the contract). Therefore, these mechanisms may reduce the demand for crop insurance products. Furthermore, if price and yield are significantly negatively correlated, revenue variability and the demand for crop insurance products will be reduced, *ceteris paribus*. Switchgrass yield and price are expected to be independent of each other because contracted production (supply) will always be adjusted to the appropriate demand level. Therefore, producers are not exposed to significant price risk or volatility.

It should be noted that financial leverage, growth strategies, and recent events all impact farmers' ability to self-insure. Most listening session attendees have no previous experience purchasing crop insurance since they are comfortable with their level of risk exposure and choose to self-insure. Farmers and lenders show little interest in crop insurance until they experience a few catastrophic events, which cause them to reevaluate their risk bearing capacity and willingness to take risk.

Diversifying the farm enterprise across multiple commodities (crops and/or livestock) has the potential to significantly reduce farm revenue variability. Yield shortfalls on one crop may be partially offset by high yields on a different crop. Also, a carefully diversified portfolio of crop enterprises can help farmers manage the revenue effects of price risk when other means of managing price risk are limited. For example, if yield risk for a crop (or crops) is small but price risk is significant, a farmer might choose to have no yield insurance and manage revenue risk due to price variation through diversification. In this region (i.e., the aforementioned counties), 15-25 percent of total farm revenue can be attributed to switchgrass, while other commodities produced including alfalfa, other hay, corn, soybeans and livestock, with other hay and livestock are more prevalent for the attendees of the listening sessions. For diversification to generate farm level revenue risk reduction, the correlation between the commodities must be

[11] The Noninsured Crop Disaster Program is available to producers for losses in excess of 35 percent at a payment rate of 65 percent for insured crops and non-insurable crops; and 60 percent for uninsured crops.

low (negatively correlated). Commodities with highly positively correlated revenue streams act as if they were a single commodity and, as a result, diversification will not significantly reduce revenue risk and the demand for crop insurance. Because alfalfa, other hay, corn, and soybeans all possess the same growth period, their yield risk and revenue risk are deemed to be positively correlated, therefore creating a higher demand for crop insurance.

Farmers at the Tennessee switchgrass listening sessions indicated that they were all full-time farmers. Part-time farmers are typically less likely to focus on risk management strategies, including crop insurance. Since switchgrass in this region is produced by full-time farmers, the demand for crop insurance products is greater. In addition, spatial diversification such as commodity diversification reduces farm level revenue variability if the yield correlation across farm parcels is low. Typically, switchgrass farms in this region are not spatially diversified and farmers are therefore exposed to higher yield risk, which creates higher demand for insurance.

Private-sector insurance products can have a mixed impact on the demand for RMA facilitated crop insurance products. If the private-sector products have features that complement or require the use of underlying RMA-facilitated crop insurance, they potentially increase demand for RMA-facilitated insurance products. On the other hand, some products may be substitutes or partial substitutes for RMA-facilitated crop insurance products. Currently there are no private products for switchgrass, which may increase the demand for a FCIC switchgrass crop insurance policy.

Lenders can have a substantial impact on farmers' adoption of crop insurance products as well. Often, the insured's value on growing crops is treated as a current asset on the balance sheet. Lenders' awareness, understanding of, and attitudes toward crop insurance have an impact on demand for crop insurance, particularly under circumstances where farmers are highly financially leveraged. In the case of Tennessee Switchgrass, lenders may be indifferent to producers purchasing crop insurance.

Overall, based on the low availability of sufficient non-insurance coping mechanisms for producers of switchgrass in this region of Tennessee, the expectation of demand for insurance is very high (Likert scale rating "5").

Risk Classification

Risk classification represents a serious challenge in rating crop insurance products. Non-insureds and insureds have different perspectives on the cost of crop insurance coverage. Some individuals choose not to insure because they utilize the non-insurance coping mechanisms discussed in the previous section. In other cases, however, the amount of insurance purchased is limited because some individuals perceive the premium rate as being "too high." It is possible that existing classification methods may result in premium rates that are appropriate (or even too low) for one group too high for another. Unfortunately for switchgrass, no FCIC insurance products or private products exist so risk classification cannot be measured. As a result, Likert scale measurement is not provided for this category and is assumed to be non-applicable in assisting the Contractor in following the decision tree process.

Moral Hazard

This category attempts to assess whether moral hazard may cause higher crop insurance indemnities. If so, the higher indemnities may be reflected in higher premium rates that could limit the purchase of insurance. By gauging the potential for "gaming the system", a quantitative measure may be used to assess whether insuring switchgrass will likely be prone to significant moral hazard.

A measurement of variation in yield and quality caused by unavoidable "acts of nature" or avoidable "acts of management" suggests that the yield variation and quality variation are almost exclusively due to "acts of nature" (potential for gaming is low). Since potential for gaming both yield and quality is low (Likert scale "4"), the extent to which moral hazard is a concern is small.

Problems Affecting Insurance Participation

The previous categories dealt with both the potential for, and actualization of problems associated with risk classification and moral hazard. This category focuses on other problems that may limit demand for RMA-facilitated crop insurance products for switchgrass in this region. Because no FCIC programs currently exist for switchgrass, a

Likert scale assessment is not provided for this category and is assumed non-applicable in assisting the Contractor in following the decision tree process.

Tennessee Program Evaluation Tool Results

As illustrated in Figure 28 below, Tennessee switchgrass yield risk, quality risk, and price risk are all "very low" (Likert scale "1"), other sources of revenue risk are "low" (Likert scale "2"), and sufficient non-insurance coping mechanisms are rated as "very high or low availability" (Likert scale "5"). These demand signals suggest a very low demand for an insurance product and/or a low potential market. Product design issues such as moral hazard are rated a higher number (Likert scale "4"), indicating smaller potential for problems or an ability to address problems. Risk classification is not applicable at present because no premium rates are available to gauge the program. Other problems affecting insurance participation are also not applicable because no programs exist to facilitate the answers to the questions. Nonetheless, the Evaluation Tool assisted in establishing a decision tree framework to help determine a recommended course of action for insuring switchgrass as a dedicated energy crop.

See Appendix L to step through the decision tree process for Tennessee switchgrass. The decision tree path is highlighted by red arrows. Currently there is a very small market for switchgrass (6,000 acres) grown for dedicated energy, yet as much as 50,000 acres may be grown in the next few years establishing a significant potential market. Regardless of the size of the potential market for switchgrass, the demand signals suggest low underlying demand. The low revenue risk and the relatively limited other risks in conjunction with the decision tree results suggest that no new product will be developed or no action is required.

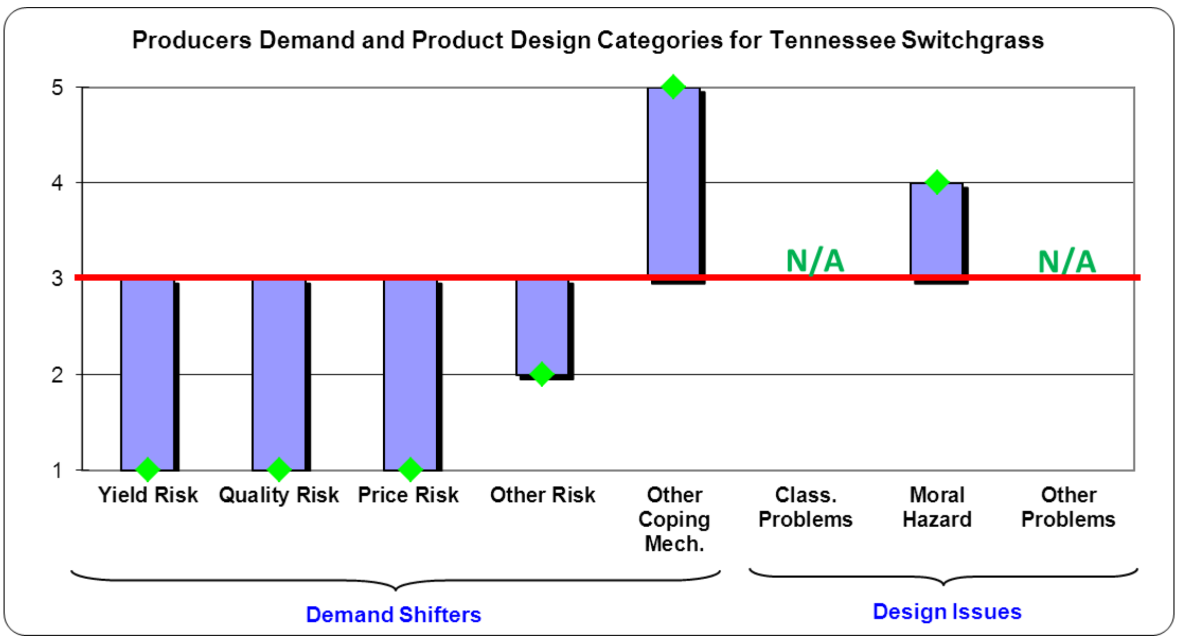

Figure 28: Tennessee Switchgrass Demand Shifter and Product Design Signals

ESTIMATION OF YIELD PROBABILITY DISTRIBUTIONS FOR TENNESSEE SWITCHGRASS

Estimating yields and yield risks of relatively new crops in regions heretofore unutilized as production areas raises questions regarding expected yields, yield variability, and profitability. With little or no production history, USDA's Risk Management Agency is faced with uncertain production capabilities when developing crop insurance programs. Agronomists, soil scientists, hydrologists, engineers, and others have developed tools for evaluating yield possibilities. Many of these tools are incorporated into computerized crop simulation models. One such model that began development in the mid-80s is EPIC, the original acronym for the Erosion Productivity Impact Calculator model.

EPIC has evolved over time to include many impacts of crop production along with climatic factors on the environment. The model has been utilized by scientists worldwide and EPIC is now the acronym for Environmental Policy Integrated Climate model. One of the principal developers is Dr. J.R.Williams, Blackland Research and Extension Center, Texas AgriLife Research, Temple, Texas.

EPIC is a daily time-step model capable of simulating a wide array of crop production and environmental processes including plant growth, crop yields, plant competition, and soil erosion as well as water, and nutrient balances. Biomass growth is related to solar radiation intercepted by the plant canopy, vapor pressure deficit, CO2 concentration, and other physiological stresses including water, temperature, N, P, and soil aeration deficits/surpluses. Similarly, root growth is affected by bulk density, temperature, and aluminum content. Soil carbon algorithms calculate carbon balance including losses of carbon from water and wind erosion. Plant growth and development is influenced by temperature during the growing season, expressed within the model as heat units. The quantity of heat units necessary for the crop to reach maturity varies by latitude.

Among the model's many features is a stochastic weather generator. Weather can be input from historical records or it can be estimated stochastically using precipitation, air temperature, solar radiation, wind, and relative humidity parameters developed from historical records.

The model simulates growth and development of a crop each day from emergence to harvest. Initially, a crop production schedule is developed from producers indicating their dates (and application rates) of operations prior to and during the growing season for tillage, planting, pesticides, irrigations, fertilizers, and harvesting. Adding the rates and dates of crop production inputs and other management information facilitates the simulation of tillage, irrigation, and fertilizer applications. Each operation combined with climate can impact crop production; either through growth, erosion, soil, water, or nutrients, and most times a combination of these elements.

The EPIC model has been applied at regional (Thompson, Izaurralde, Rosenberg, & He) and national scales (Izaurralde, Rosenberg, Brown, & Thompson), (Potter, Atwood, Kellog, & Williams). (Brown, Rosenberg, Hays, Easterling, & Mearns) and (Thompson, Izarraulde, West, Parrish, Tyler, & Williams)utilized EPIC to simulate switchgrass response to climate change in the central United States.

The primary objective of this analysis of switchgrass is to utilize the EPIC model, which has been adapted to a Windows® application, WinEPIC, to estimate an array of stochastic yields from which to develop a probability distribution function. Thereby, yield variability (risk) can be quantified and variations in revenues inferred. Sub-objectives include: a) by utilizing local weather data along with producer's switchgrass yields and management data from a designated area in Tennessee, calibrate crop coefficients to best represent the current yields and production conditions, and b) to utilize the calibrated model for producing 100 successive 11-year rotations of switchgrass, making a total of 1100 simulations (years) of stochastic yield observations.

The methodology includes developing a production schedule of tillage, planting, fertilization, pesticide applications, and harvesting operations along with management decisions regarding typical dates of each operation, seeding rates, and application rates of fertilizers and pesticides. Feedback from seven switchgrass producers at Tennessee listening sessions was utilized to assimilate as much information regarding switchgrass production as possible.

For most of the producers, three years of production experience had occurred by mid-November 2010. They reported that fertilization typically included 40-80 pounds/acre P applied before seeding and 60 pounds/acre N the two following years. Planting occurred in early spring around May 1 and harvest of each crop occurred after the first or second frost, about November 1. Two quarts of glyphosate was applied as a preplant burn down and another two quarts for weed and grass control just prior to germination, 2-3 weeks after seeding. Excluding the seeding year, the switchgrass rotation is expected to last for ten production years and possibly longer.

Producers reported forage yields to be the lowest in the seeding year, averaging 3.33 tons/acre for three producers who seeded and harvested in 2008. The average yield of six of the seven producers climbed to 5.21 tons/acre in 2009 and in 2010, it increased to 7.53 tons/acre. A production schedule was developed to simulate their typical operations and was coupled with actual National Weather Service daily weather data for Athens, Tennessee, since on-site weather records were not available.

Using EPIC to simulate the three years of historical production by the producers, yields, after calibrating crop physiological coefficients, were 3.38, 5.50, and 7.44 tons/acre for years 1-3, respectively. The following graph depicts the relationship of simulated to producer yields; thereby producing a regression line having a slope of 0.9629 with an R-squared=0.9927. A slope of 1.0 with a zero intercept, depicted by the dashed line, indicates a perfect relationship or perfect correlation of simulated yields to producer yields. R-squared signifies the accuracy of the black regression line, developed from the three producer yields, in predicting them; R-squared=1.0 being a perfect prediction.

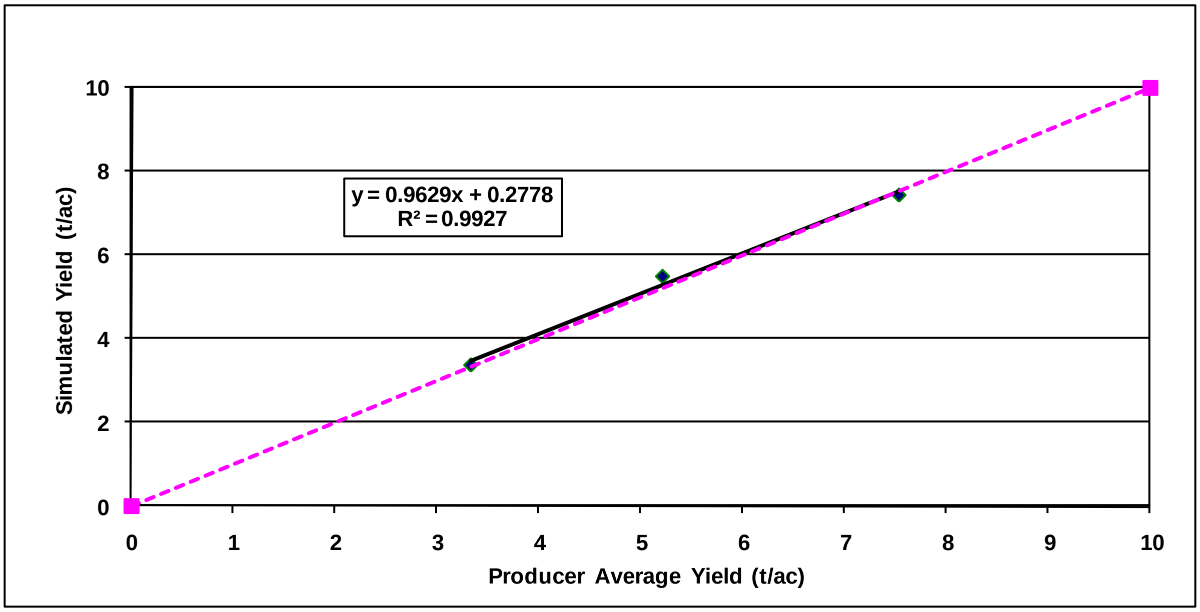

Figure 29: Correlation of Simulated Yields to Producer Average Yields

Further statistical evidence that the simulated yields approximate the averages of all producer yields is illustrated by the paired t-test in Table 36. A difference of zero is being tested between the means of both sets of yields, 5.36 vs. 5.44 tons/acre for the producer mean and the simulated mean, respectively. In this case, t = 0.72 which is less than the critical t value of 9.92 indicating the means are not significantly different at the 1 percent level.

Utilizing the calibrated coefficients that were developed by simulating producer yields, a single run of 1100 years was then simulated to produce one hundred 11-year rotations (10 production years plus the first seeding year). Three changes were made from the calibration simulations: 1) the original soil profile was maintained throughout the long-term simulation by stopping erosion, 2) fertilizer rates were adjusted to maintain adequate plant nutrition throughout the 1100 years, and 3) daily weather parameters were generated and were based on historical records for 1962-2010 from the nearby weather station at Athens, Tennessee. The daily weather coupled with the production practices over the long-term simulation period produced a probability distribution.

Table 36: Switchgrass Yield Paired t-Test

Item	Simulated	Producer
Mean	5.439	5.360
Variance	4.134	4.426
Observations	3	3
Hypothesized Mean Difference	0	
df	2	
t Stat	0.720	
t Critical two-tail	9.925	

Annual yields for years 2 through 11 of each of 100 rotations, excluding the seeding year, are illustrated in Figure 30 and Figure 31. The 1000-year average stochastically generated forage yield was 8.04 tons/acre. The range of yearly yields varied from a low of 4.08 tons/acre to a high of 12.81 tons/acre.

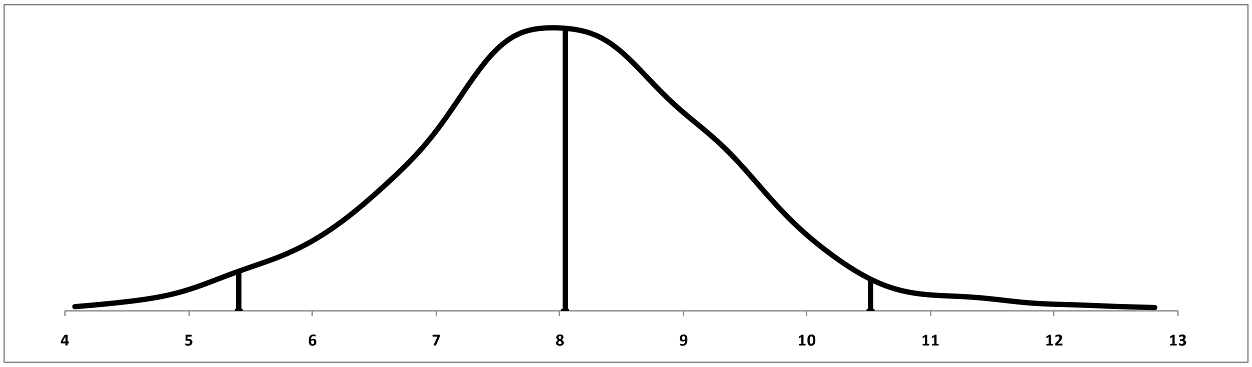

Figure 30: PDF of Mature Switchgrass Yields in SE Tennessee

Figure 31: CDF of Mature Switchgrass Yields in SE Tennessee

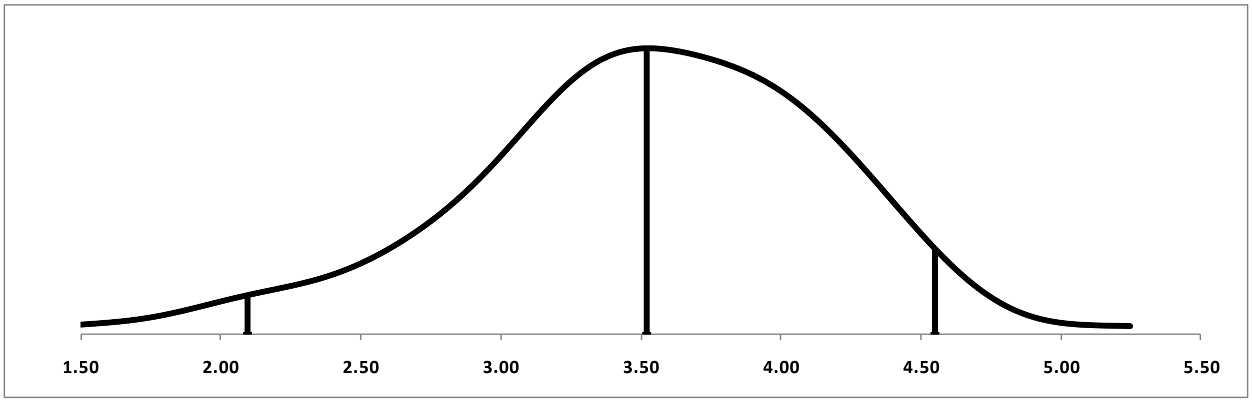

Figure 32: PDF of Switchgrass Yields for Establishment Year in SE Tennessee

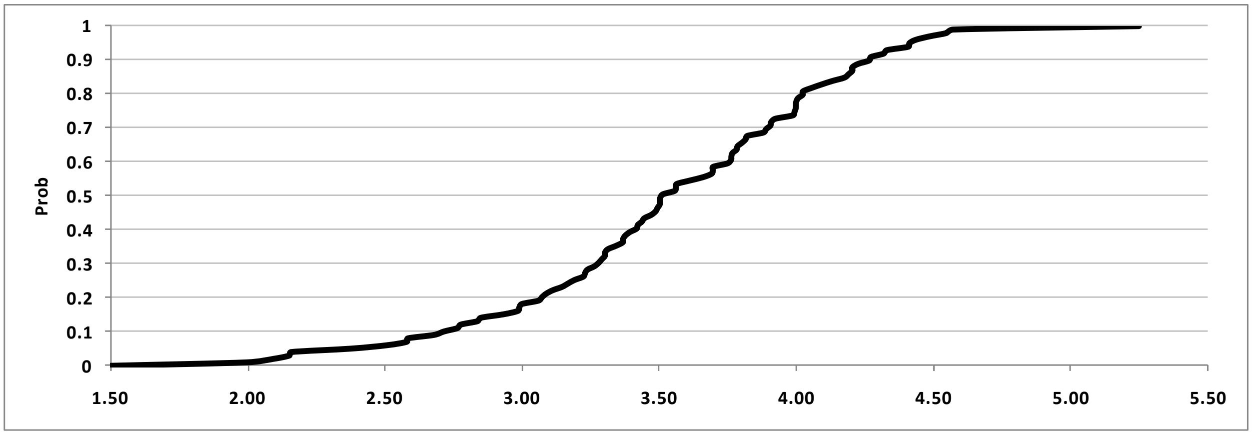

Figure 33: CDF of Switchgrass Yields for Establishment Year in SE Tennessee

SWITCHGRASS INSURANCE PREMIUM CALCULATIONS

The yield distributions for switchgrass grown in Southeastern Tennessee, as developed using the EPIC model, were used to estimate yield insurance premiums. There are two yield distributions for switchgrass: establishment year and a mature stand of switchgrass (post establishment years). Insufficient data are available to model the correlation between the establishment year yields and mature crop yields. The analysis procedure used for both switchgrass yield distributions is the following:

- The summary statistics to describe the distribution are calculated. Probability density function (PDF) and cumulative distribution function (CDF) charts for the distribution are provided.
- The distribution was tested for normality.
- Parameters for 15 parametric distributions are estimated using a maximum likelihood procedure in Simetar©. The parameters for an empirical distribution are estimated as well.
- The parameters for the 16 distributions are used to simulate the yield distribution for 500 iterations. Summary statistics for the distributions are compared to the original distribution.

- The CDFDEV[12] function in Simetar© are used to determine how closely the 16 distributions reproduced the original distribution. Based on the CDFDEV criteria the four distributions that most closely simulate the original distribution are selected for analysis.
- The best four distributions were simulated in Simetar© for 25,000 iterations to estimate "fair insurance premiums" for eight yield coverage levels ranging from 50 percent to 85 percent of the average yield reported by the farmers in a focus group interview. The random number generator used for the analysis uses a Latin hypercube procedure and generates pseudo random numbers based on a fixed seed.
- The no load and fully loaded fair premiums are reported as $/acre values for the four assumed probability distributions for eight levels of possible year coverage.
- The no load fair insurance premium is calculated by multiplying the probability of each state of nature (indemnity) by its respective probability. Using a Monte Carlo simulation approach each insurance policy was simulated for 25,000 yields drawn at random from assumed probability distributions.
- The loaded insurance premium is calculated using a 0.90 unit division load factor, a 0.88 FCIC disaster reserve factor, and a 1.30 qualitative load factor.

Each of the EPIC distributions is presented separately because they are completely different distributions.

Establishment Year Switchgrass Yield Distribution

The summary statistics in Table 37 report that the average yield in the establishment year is 3.5 tons/acre and the minimum expected yield is 1.5 tons/acre. The distribution is slightly skewed to the left given a skewness statistic of -0.47. This shape is confirmed in the PDF and CDF charts for the year one yield distribution (Figure 32 and Figure 33).

Table 37: Summary Statistics for Base Yield Distribution of Establishment Year Switchgrass in SE Tennessee

	Base Yield
Mean	3.521
Standard Deviation	0.635
Min	1.500
Median	3.510
Max	5.250
Skewness	(0.474)
Kurtosis	0.644

Five statistical tests for normality were performed: Shapiro-Wilks, Anderson-Darling, Cramer von Mises, Kolmagarov-Smiroff, and Chi-Square (Table 38). All five tests reported that statically we cannot reject the null hypothesis that the distribution is distributed normal at the alpha equal 5 percent level of significance.

[12] The goodness-of-fit criteria selected for testing how closely the simulated PDFs compare to the original distribution is a weighted cumulative distribution comparison function (CDFDEV) available in Simetar©. The CDFDEV criteria is calculated as the sum of the squared distance between two distribution functions with penalty weights increasing in value as the observations move away from the mean. If a simulated PDF is identical to the original distribution, the CDFDEV value equals zero. When comparing two or more distributions as to their goodness-of-fit, the distribution with the smallest CDFDEV is considered "best" for the purposes of this study. A mathematical description of the CDFDEV formula is provided in the Appendix.

Table 38: Normality Test of the Yield Distribution for the Establishment Year of Switchgrass in SE Tennessee

Confidence Level		95.000%	
Procedure	Test Value	p-Value	
Shapiro-Wilks	0.981	0.168	Fail to Reject the Ho that the Distribution is Normally Distributed*
Anderson-Darling	0.513	0.190	Fail to Reject the Ho that the Distribution is Normally Distributed*
Cramer von Mises	0.070	0.720	Fail to Reject the Ho that the Distribution is Normally Distributed*
Kolmogorov-Smirnov	0.061	NA	Consult Critical Value Table
Chi-Squared	9.800	0.958	Fail to Reject the Ho that the Distribution is Normally Distributed*
			*Based on approximate p-values

Parameters for the 15 parametric distributions reported in Table 39 were simulated using a common uniform standard deviate to insure the results are directly comparable. The summary statistics for these distributions and the goodness of fit criteria (CDFDEV) for the 15 distributions and the empirical distribution are summarized in Table 39. The 16 distributions were simulated 500 iterations with a common uniform standard deviate and the resulting summary statistics are reported beside the parameters. All of the distributions reproduce the mean, as expected but a number of them fail to reproduce the range of the distribution. The CDFDEV criteria indicate the four best distributions for simulating the distribution are: empirical, Weibull, normal, and beta; with the empirical distribution being best.

Table 39: Univariate Parameter Estimation for the Yield Distribution of the Establishment Year of Switchgrass in SE Tennessee

		MLEs		Summary Statistics				Goodness of	
Distribution	Parameters	Parm. 1	Parm. 2	Mean	Stnd Dev	Min	Max	CDFDEV	Ranking
Beta	***α, β***; A≤x≤B, α,β>0	3.200	2.881	3.47	0.70	1.71	5.11	0.02717	fourth
Double Exponential	***α, β***; α≤x<∞, -∞<α<∞, β>0	3.510	0.494	3.51	0.70	0.38	6.67	0.13690	
Exponential	***μ, σ***; -∞<x<∞, -∞<μ<∞, σ>0	1.500	2.021	3.52	2.02	1.50	15.83	7.11008	
Gamma	***α, β***; 0≤x<∞, α,β>0	27.296	0.129	3.52	0.67	1.78	6.03	0.05973	
Logistic	***μ, σ***; 0≤x<∞, -∞<μ<∞, σ>0	3.548	0.354	3.55	0.64	1.06	6.06	0.04677	
Log-Log	***μ, σ***; -∞<x<∞, -∞<μ<∞, σ>0	3.190	0.706	3.60	0.91	1.81	8.19	0.54565	
Log-Logistic	***μ, σ***; 0≤x<∞, -∞<μ<∞, σ>0	9.560	3.537	3.60	0.70	1.70	7.42	0.22866	
Lognormal	***μ, σ***; 0≤x<∞, -∞<μ<∞, σ>0	1.240	0.200	3.53	0.71	1.85	6.47	0.11505	
Normal	***μ, σ***; -∞<x<∞, -∞<μ<∞, σ>0	3.521	0.635	3.52	0.64	1.54	5.52	0.01673	third
Pareto	***α, β***; α≤x<∞, α,β>0	1.500	1.198	6.96	28.02	1.50	557.56	9310.92	
Uniform	***a, b***; a≤x≤b	1.500	5.250	3.37	1.08	1.50	5.25	0.38515	
Weibull	***α, β***; 0≤x<∞, α,β>0	6.410	5006.121	3.52	0.64	1.26	5.13	0.00659	second
Binomial	***n, p***; x=0,1,2,…,n; 0≤p≤1	14.000	0.217	3.04	1.55	0.00	8.00	1.95276	
Geometric	***p*** ; x=1,2,…; 0≤p≤1	0.248		4.05	3.50	1.00	25.00	27.76166	
Poisson	***λ*** ; x=0,1,…; 0≤λ<∞	3.040		3.04	1.75	0.00	10.00	3.19032	
Empirical	***Si, F(x)***			3.53	0.59	1.59	5.19	0.00136	best

Insurance Premiums for Establishment Year Switchgrass

Eight yield loss insurance policies were simulated for stochastic yields using the four best probability distributions. The eight policies are expressed as a fraction of the average yield of 3.5 tons/acre (APH) assuming a price guarantee of $75/ton. The eight policies are defined in terms of fraction from the APH and are 0.50, 0.55, 0.60, 0.65, 0.70, 0.75, 0.80, and 0.85. APH yield was assumed to equal the average for the base yield distributions from the EPIC runs.

The calculated insurance premiums are reported in Table 40. Based on the assumption that the establishment year yield for switchgrass is distributed empirically, the no load premiums are less than $1.00/acre for the policies that insure 50 percent - 65 percent of the APH. The no load premium at 70 percent APH is $1.27/acre. It increases rapidly thereafter with a $2.13/acre premium for 75 percent APH coverage, $3.46/acre for 80 percent APH coverage, and reaches $5.36/acre for 85 percent APH coverage.

Table 40: Yield Insurance Premiums for the Establishment Year of Switchgrass in SE Tennessee; Assuming Alternative Yield Coverage Levels and Yield Distributions, an APH Yield of 3.5 Tons Per Acre, and Guaranteed Price of $75 Per Ton

	0.5 of APH	0.55 of APH	0.6 of APH	0.65 of APH	0.7 of APH	0.75 of APH	0.8 of APH	0.85 of APH
Liability								
($/acre)	132.00	145.20	158.40	171.60	184.80	198.00	211.20	224.40
No Load Fair Premium ($/acre)								
Empirical	0.03	0.07	0.19	0.65	1.27	2.13	3.46	5.36
Weibull	0.13	0.27	0.51	0.92	1.59	2.62	4.18	6.42
Normal	0.04	0.10	0.22	0.47	0.95	1.79	3.20	5.40
Beta	0.01	0.07	0.27	0.73	1.61	3.04	5.20	8.23
Fully Loaded Premium ($/acre)								
Empirical	0.04	0.12	0.32	1.07	2.08	3.50	5.68	8.80
Weibull	0.22	0.44	0.84	1.52	2.61	4.31	6.86	10.54
Normal	0.06	0.16	0.36	0.77	1.56	2.94	5.26	8.87
Beta	0.01	0.11	0.44	1.20	2.63	5.00	8.54	13.51
Loss Cost Ratio (%)								
Empirical	0.02%	0.05%	0.12%	0.38%	0.68%	1.08%	1.64%	2.39%
Weibull	0.10%	0.19%	0.32%	0.54%	0.86%	1.33%	1.98%	2.86%
Normal	0.03%	0.07%	0.14%	0.27%	0.51%	0.91%	1.52%	2.41%
Beta	0.01%	0.05%	0.17%	0.43%	0.87%	1.54%	2.46%	3.67%
Fully Loaded Base Premium (%)								
Empirical	0.03%	0.08%	0.20%	0.62%	1.12%	1.77%	2.69%	3.92%
Weibull	0.17%	0.30%	0.53%	0.88%	1.41%	2.18%	3.25%	4.70%
Normal	0.05%	0.11%	0.23%	0.45%	0.84%	1.49%	2.49%	3.95%
Beta	0.01%	0.08%	0.28%	0.70%	1.43%	2.52%	4.04%	6.02%

The calculated insurance premiums for the other three probability distribution assumptions are generally higher than for the empirical distribution. For example, for the 85 percent APH policy, the Weibull distribution indicates a $6.42/acre premium, the normal distribution has a $5.40/acre premium, and the beta distribution has an $8.23/acre premium.

The difference in premiums for each yield insurance policy differs across probability distributions due to the weight the distribution places on the insured range of the yield distribution. This relationship can be seen in Figure 34, a PDF of the original yield distribution and the four selected distributions. The beta distribution is associated with the highest premiums for the 70 percent - 85 percent APH policies because it has more weight in the higher yield values over the range of 2 to 3.2 tons/acre.

The fully loaded premium for the 85 percent APH coverage ranges from $8.80/acre for the empirical distribution to $13.51/acre for the beta distribution (Table 40). The fully loaded premium was calculated by dividing the no load fair premium by 0.90 (the unit division load factor) and then dividing that result by 0.88 (the FCIC disaster reserve factor) and multiplying by 1.3 (the qualitative load factor). The qualitative load factor of 1.3 is used to adjust for the lack of risk on the regression equations for physical relationships and production functions in the EPIC model. EPIC's only risk component is the weather variables, so it lacks the risk normally associated with simulating a regression equation used to predict production based on the values for the independent variables.

The loss cost ratios for each of the eight yield insurance policies were calculated as the ratio of the expected indemnity and the liability. The loss cost ratio for the 85 percent APH policy ranges from 2.39 percent to 3.67 percent based on the distribution assumed (Table 40).

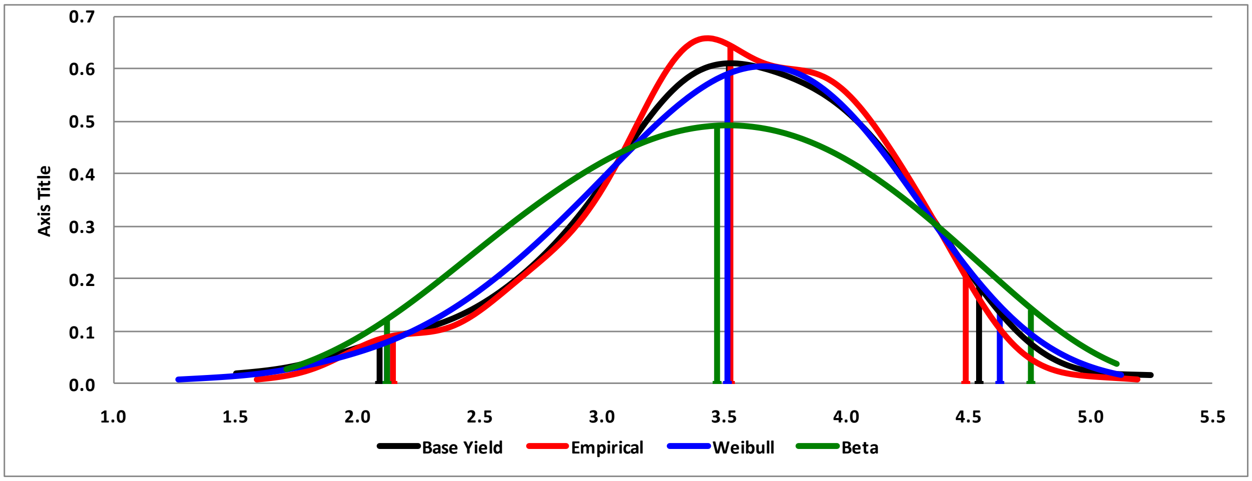

Figure 34: PDF of Alternative Distributions of Switchgrass Yields for Establishment Year in SE Tennessee

Base Premium Rates for Establishment Year Switchgrass

The base premiums for the 85% APH coverage level ranges from 3.9% to 6% and at the 65% level of coverage, the base premium ranges from 0.45% to 0.88%.

Summary for Establishment Year Switchgrass Yield Distribution

The yield distribution has a mean of 3.52 tons/acre and a range of 1.5 tons/acre to 5.25 tons/acre. The yield distribution is not normally distributed, yet it is the third best distribution for simulating the EPIC generated yield distribution. Simulation results for eight possible yield insurance policies indicate low fully loaded premiums (less than $2.63/acre) for insured yield less than 70 percent of an APH equal to 3.5 tons per acre and a price election of $75/ton. At the highest levels of yield coverage (85 percent of APH) the fully loaded insurance premiums range from $8.80 to $13.51/acre.

The biggest problem with insuring switchgrass production for the establishment year is the lack of information to calculate the farmer's APH. There is no 10 year yield history for the farmer to calculate the APH. Using the average yield from the EPIC model will have to suffice until sufficient results across years and fields are accumulated to develop a more appropriate estimate of the APH and its distribution.

Mature Switchgrass Yield Distribution

The summary statistics in Table 41 report that the average Switchgrass yield for a mature stand is 8.0 tons/acre and the minimum expected yield is 4.08 tons/acre. The distribution is slightly skewed to the right given a skewness statistic of 0.1069. This shape is confirmed in the PDF and CDF charts for the mature crop yield distribution (Figure 30and Figure 31).

Table 41: Summary Statistics for Base Yield Distribution of Mature Switchgrass in SE Tennessee

	Base Yield
Mean	8.043
Standard Deviation	1.277
Min	4.082
Median	8.055
Max	12.814
Skewness	0.107
Kurtosis	0.608

Five statistical tests for normality were performed: Shapiro-Wilks, Anderson-Darling, Cramer von Mises, Kolmagarov-Smiroff, and Chi-Square (Table 42). The first four normality tests reported that statically the distribution is not distributed normal. The Chi-Square test failed to reject the null hypothesis that the yield distribution is distributed normal at the alpha equal 5 percent.

Table 42: Normality Test for the Yield Distribution of Mature Switchgrass in SE Tennessee

Confidence Level		**95.000%**	
Procedure	**Test Value**	**p-Value**	
Shapiro-Wilks	0.99	0.001	Reject the Ho that the Distribution is Normally Distributed*
Anderson-Darling	1.03	0.010	Reject the Ho that the Distribution is Normally Distributed*
Cramer von Mises	0.15	0.024	Reject the Ho that the Distribution is Normally Distributed*
Kolmogorov-Smirnov	0.03	NA	Consult Critical Value Table
Chi-Squared	20.70	0.354	Fail to Reject the Ho that the Distribution is Normally Distributed*
			*Based on approximate p-values

Parameters for the 15 parametric distributions reported in Table 43 were simulated for 500 iterations using a common uniform standard deviate to insure the results are directly comparable. The summary statistics for these distributions and the goodness of fit criteria (CDFDEV) for the 15 distributions and the empirical distribution are summarized in Table 43. The 16 distributions were simulated 500 iterations and the resulting summary statistics are reported beside the parameters. All of the distributions reproduce the mean, as expected but a number of them fail to reproduce the range of the distribution. The CDFDEV criteria indicate the four best distributions for simulating the distribution are empirical, logistic, normal, and gamma; with the empirical distribution being best.

Table 43: Univariate Parameter Estimation for the Yield Distribution of Mature Switchgrass in SE Tennessee

		MLEs		Summary Statistics				Goodness of Fit	
Distribution	Parameters	Parm. 1	Parm. 2	Mean	Stnd Dev	Min	Max	CDFDEV	Rank
Beta	***α, β*** ; A≤x≤B, α,β>0	4.398	5.380	8.01	1.33	4.72	11.74	0.0524	
Double Exponential	***α, β*** ; α≤x<∞, -∞<α<∞,	8.055	0.991	8.05	1.40	1.79	14.39	0.0930	
Exponential	***μ, σ*** ; -∞<x<∞, -∞<μ<∝	4.082	3.962	8.04	3.96	4.09	32.17	16.7265	
Gamma	***α, β*** ; 0≤x<∞, α,β>0	38.501	0.209	8.04	1.30	4.59	12.74	0.0295	Fourth
Logistic	***μ, σ*** ; 0≤x<∞, -∞<μ<∞,	8.041	0.712	8.04	1.29	3.04	13.09	0.0118	Second
Log-Log	***μ, σ*** ; -∞<x<∞, -∞<μ<∝	7.408	1.276	8.14	1.64	4.92	16.45	0.5135	
Log-Logistic	***μ, σ*** ; 0≤x<∞, -∞<μ<∞,	11.075	7.983	8.09	1.35	4.24	15.14	0.0807	
Lognormal	***μ, σ*** ; 0≤x<∞, -∞<μ<∞,	2.072	0.164	8.05	1.33	4.76	13.28	0.0464	
Normal	***μ, σ*** ; -∞<x<∞, -∞<μ<∝	8.043	1.277	8.04	1.28	4.06	12.06	0.0257	Third
Pareto	***α, β*** ; α≤x<∞, α,β>0	4.082	1.503	11.60	25.01	4.08	456.08	1358.5197	
Uniform	***a, b*** ; a≤x≤b	4.082	12.814	8.45	2.52	4.09	12.81	2.8183	
Weibull	***α, β*** ; 0≤x<∞, α,β>0	6.586	1411993.854	8.01	1.43	2.96	11.56	0.1178	
Binomial	***n, p*** ; x=0,1,2,...,n; 0≤p≤	107.000	0.071	7.56	2.66	1.00	17.00	3.7838	
Geometric	***p*** ; x=1,2,...; 0≤p≤1	0.117		8.56	8.03	1.00	58.00	102.1045	
Poisson	***λ*** ; x=0,1,...; 0≤λ<∞	7.556		7.56	2.76	1.00	18.00	4.3875	
Empirical	***Si, F(x)***			8.04	1.27	4.33	12.81	0.0047	Best

INSURANCE PREMIUMS FOR MATURE SWITCHGRASS

Eight yield loss insurance policies were simulated for stochastic yields using the four best probability distributions. The eight policies are expressed as a fraction of the average yield of 8.0 tons/acre (APH) and assume a price guarantee of $75/ton. The eight policies are defined in terms of fraction from the APH and are: 0.50, 0.55, 0.60, 0.65, 0.70, 0.75, 0.80, and 0.85. APH yield was assumed to equal the average for the base yield distributions from the EPIC runs.

The calculated insurance premiums are reported in Table 44. Based on the assumption that the yield for a mature stand of switchgrass is distributed empirically, the premiums are less than $1.00/acre for policies that insure 50 percent - 65 percent of the APH. The fair premium at 70 percent APH is $1.12/acre. It increases rapidly thereafter with a $2.52/acre premium for 75 percent APH coverage, $4.89/acre for 80 percent APH coverage, and reaches $8.72/acre for 85 percent APH coverage.

The fully loaded premium for the 85 percent APH coverage ranges from $14.32/acre for the empirical distribution to $14.84/acre for the logistic distribution (Table 44). The fully loaded premium was calculated by dividing the no load fair premium by 0.90 (the unit division load factor) and then dividing that result by 0.88 (the FCIC disaster reserve factor) and multiplying by 1.3 (the qualitative load factor). The qualitative load factor of 1.3 is used to adjust for the lack of risk on the regression equations for physical relationships and production functions in the EPIC model. EPIC's only risk component is from the weather variables so it lacks the risk normally associated with simulating a regression equation used to predict production based on the values for the independent variables.

The calculated insurance premiums for the logistic and normal probability distributions are generally higher than those for the empirical distribution. For example, for the 85 percent APH policy, the logistic distribution indicates a $9.04/acre premium; the normal distribution has an $8.85/acre premium. The gamma distribution generates lower premiums per acre for each level of coverage than the empirical distribution, with a premium of $7.90/acre for an 85 percent of APH policy.

The difference in premiums for each yield insurance policy differ due to the weight the distribution places on the insured range of the distribution. This relationship can be seen in Figure 35, a PDF of the original yield distribution and the four selected distributions. The logistic distribution is associated with the highest premiums for the 70 percent - 85 percent APH policies because it has more weight in the yield values less than 5 tons per acre.

Table 44: Yield Insurance Premiums for Mature Switchgrass in SE Tennessee; Assuming Alternative Yield Coverage Levels and Yield Distributions, an APH Yield of 8 Tons Per Acre, and Guaranteed Price of $75 Per Ton

	0.5 of APH	0.55 of APH	0.6 of APH	0.65 of APH	0.7 of APH	0.75 of APH	0.8 of APH	0.85 of APH
Liability								
($/acre)	301.63	331.79	361.96	392.12	422.28	452.45	482.61	512.77
No Load Fair Premium ($/acre)								
Empirical	0.00	0.02	0.12	0.41	1.12	2.52	4.89	8.72
Logistic	0.19	0.33	0.58	1.02	1.78	3.09	5.33	9.04
Normal	0.02	0.06	0.18	0.46	1.09	2.36	4.74	8.85
Gamma	0.00	0.01	0.04	0.17	0.57	1.59	3.78	7.90
Fully Loaded Premium ($/acre)								
Empirical	0.00	0.03	0.20	0.67	1.85	4.14	8.02	14.32
Logistic	0.31	0.54	0.96	1.67	2.92	5.08	8.75	14.84
Normal	0.03	0.11	0.30	0.76	1.78	3.87	7.79	14.52
Gamma	0.00	0.01	0.07	0.28	0.93	2.60	6.21	12.96
Loss Cost (%)								
Empirical	0.00%	0.00%	0.03%	0.10%	0.27%	0.56%	1.01%	1.70%
Logistic	0.06%	0.10%	0.16%	0.26%	0.42%	0.68%	1.10%	1.76%
Normal	0.01%	0.02%	0.05%	0.12%	0.26%	0.52%	0.98%	1.73%
Gamma	0.00%	0.00%	0.01%	0.04%	0.13%	0.35%	0.78%	1.54%
Fully Loaded Base Premium (%)								
Empirical	0.00%	0.01%	0.06%	0.17%	0.44%	0.91%	1.66%	2.79%
Logistic	0.10%	0.16%	0.26%	0.43%	0.69%	1.12%	1.81%	2.89%
Normal	0.01%	0.03%	0.08%	0.19%	0.42%	0.86%	1.61%	2.83%
Gamma	0.00%	0.00%	0.02%	0.07%	0.22%	0.58%	1.29%	2.53%

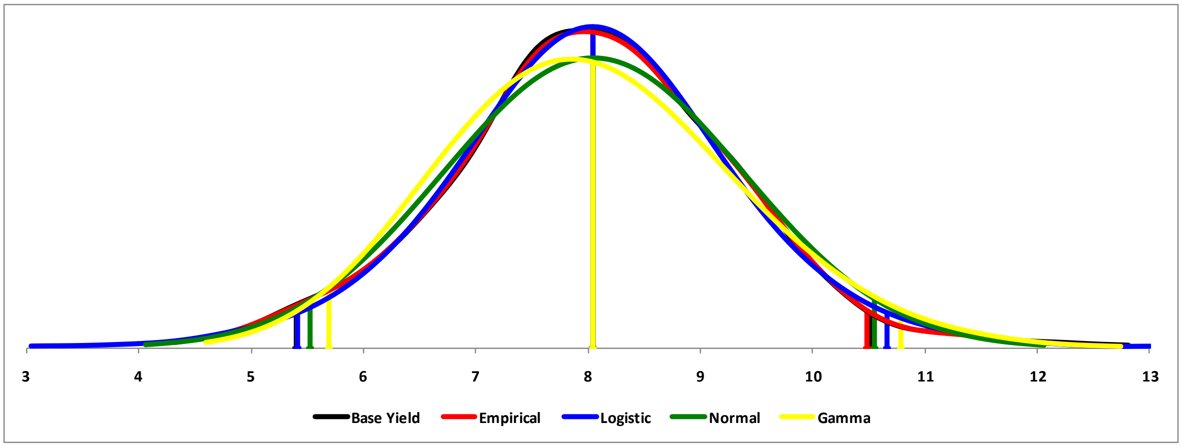

Figure 35: PDF of Alternative Distributions of Mature Switchgrass Yields in SE Tennessee

Base Premium Rates for Mature Switchgrass

The base premium for insuring 85 percent of the APH ranges from 2.5% to 2.9% across the four yield distributions tested. Base premium rates at the 65 percent coverage level range from 0.07% to 0.4%.

Summary for Mature Switchgrass Yield Distribution

The yield distribution has a mean of 8 tons/acre and a range of 4 tons/acre to 12.8 tons/acre. The yield distribution is not normally distributed, yet the normal distribution is the third best for simulating the EPIC generated yield distribution. Simulation results for eight possible yield insurance policies indicate low fully loaded premiums (less than $2.95/acre) for insured yield less than 70 percent of an APH equal to 8 tons per acre and a price election of $75/ton. At the highest levels of yield coverage (85 percent of APH) the fully loaded insurance premiums range from $12.96 to $14.84/acre or 2.83 percent to 2.89 percent of liability.

The biggest problem with insuring switchgrass production for a mature stand is the lack of information to calculate the farmer's APH. Producers do not have sufficient years of experience growing switchgrass to have 10 years of yields for establishing an APH. Using the average yield from the EPIC model will have to suffice until sufficient results across years and fields are accumulated to develop a more appropriate estimate of the APH and its distribution.

Feasibility Recommendation

As the aforementioned "Switchgrass Risk Evaluation" section indicated, the demand signals for switchgrass in Tennessee suggest that low demand for an insurance product and/or a low potential market for switchgrass exist. Specifically, the Diagnostic Instrument demand signals in Tennessee indicate that yield, quality and price risk are very low. The results of the "Switchgrass Insurance Premium Calculations" section also suggest that yield risk may be low in this region. Estimated loaded premium rates are less than 1 percent for the 75 percent coverage level for mature switchgrass stands. Utilizing the RMA Program Evaluation Tool Decision Tree for switchgrass in Tennessee, the results indicate that either no actions are required or no new product need be developed. While, listening session comments from producers and attendees in the region are in favor of an insurance product for switchgrass, many factors indicate that the program may not be viable in Tennessee.

Recommendation

Since commercial production of switchgrass grown for a dedicated energy resource is currently confined to Tennessee, the Contractor implies that this recommendation is valid only for switchgrass currently commercially grown in Tennessee and does not imply feasibility to develop coverage for commercially produced switchgrass for dedicated energy that might be grown in other geographic regions in the future. Based on the research and analysis of switchgrass commercially produced for dedicated energy in Tennessee, it is determined that the development of a crop insurance program for switchgrass grown for dedicated energy is not feasible at this time. Current contracting structures, demand signals, estimated premium rates, and concern for risk being spread over an acceptable pool of insureds and acres in the region of Tennessee lend support for this recommendation. While this recommendation is based solely on current commercial production located in Tennessee and given the expected growth of the dedicated energy industry, potential may exist for a crop insurance program for commercial production of switchgrass for dedicated energy in other regions within the United States.

ENERGY CANE

CROP DESCRIPTION

Introduction

During the oil crisis of 1970's, high gas prices spurred research in renewable energy resources. Sugarcane was identified as a potential source of energy by converting the sugar and biomass into ethanol. In 1976, USDA began developing high fiber sugarcane varieties or energy cane to serve as a crop dedicated for energy production (Legendre, 2011). As fuel price decreased, interest in energy cane production decreased as well; however, the variety development process had already been initiated. Now that fuel prices and global warming have become prominent social and political issues, interest in energy cane production has increased once again.

Despite the considerable duration of research and development, there are no commercial producers for energy cane as a dedicated energy crop (Personal Communication; Energy Cane Conference Call, 2011). Private companies such as Verenium and British Petroleum (BP) have shown interest in entering the market as energy cane processors by contracting production with growers. Verenium Corporation owned a pilot plant and demonstration scale facility in Jennings, Louisiana. In 2010, BP Biofuels North America acquired the Jennings facilities from Verenium. These facilities are used for research and development of the cellulosic biofuels. Currently, two energy cane producers are under contract to provide the facilities with feedstocks (Musial, 2011). BP plans to construct another cellulosic ethanol plant on a commercial scale with a 20 to 30 million-gallon capacity within the next year. (BP Alternative Energy, 2010)

Economic Importance

SUPPLY

There are a limited number of energy cane growers. Most of the energy cane acreage is in test plots for further research and development; however, BP Alternative Energy has contracted two growers in Louisiana for their demonstration plant in Jennings and one grower in Florida for a plant that is currently under construction. In Louisiana and Florida, energy cane production takes place on less than 1,000 acres and 400 acres, respectively. It is expected that the Florida facility will have commercial capacity and will require 20,000 acres of energy cane. (Musial, 2011)

Research suggests that cellulosic conversion of energy cane will yield 1,800 to 2,000 gallons of ethanol per acre annually, compared to conventional conversion of sugarcane sucrose that yields only 800 gallons per acre. Currently, sugarcane grows on 830,000 acres in Florida, Hawaii, Louisiana, and Texas. Research efforts are directed towards developing energy cane varieties that will grow outside of the traditional sugarcane growing states including Mississippi, Oklahoma, Arkansas, California, Alabama, Georgia, and northern Florida. (USDA; NASS, 2010)

PRODUCTION COSTS

Currently, other than the BP Biofuels demonstration facility, energy cane is not commercially produced and there are no commercial cellulosic processing facilities in operation for energy cane in the United States. Therefore, production costs are estimated based on current sugarcane costs and experimental yields. Researchers at Louisiana State University estimated the total production costs of energy cane to be $73.95 per dry ton (Mark, Darby, & Salassi, 2009). Others estimated $50 per dry ton to break even and a total per acre production cost to be approximately $600. (Gravois, et al., 2011)

DEMAND

The market demand for biofuels is driven by the aforementioned government mandates. The Energy Independence and Security Act (EISA) of 2007 mandates that the United States will produce 36 billion gallons of ethanol by 2022 with 16 billion gallons coming from cellulosic biofuels. BP Biofuels anticipates that biomass from energy cane will be utilized to meet the mandate for cellulosic biofuels. (Musial, 2011)

Marketing and Utilization

Although energy cane is not commercially produced, it is reasonable to assume that it will be utilized as the plant biomass to produce ethanol through lignocellulosic fermentation and/or as the extracted sugar through the traditional fermentation process. BP Alternative Energy has contracted two producers in Louisiana to supply its demonstration plant with biomass from their energy cane production. (Musial, 2011)

Agronomic and Botanical Characteristics

Sugarcane is classified as a sugar or sweetener crop. As energy cane is a variety of sugarcane, its agronomic classification can be defined as a sugar crop dedicated to energy production (Bareja, n.d.). “Energy cane and sugarcane are from the same genus, S*accharum*, and the only difference between them is energy cane is bred for high fiber content whereas sugarcane is bred for low fiber content but high sugar content.” (Mark, Darby, & Salassi, 2009)

Phenological Stages of Growth

As a variety of sugarcane, the same morphology and growth stages apply to energy cane. The stages include germination and establishment, tillering, grand growth, and maturation and ripening. Commercial sugarcane is seeded by vegetative propagation using cuttings of the stalk sometimes called seed cane. Each cutting usually contains two or more nodes with buds. The cane root system enables the intake of water and nutrients from the soil and anchors the plant. Two kinds of roots will develop from a planted seed piece. The set roots, which rise from the root band, are thin and highly branched, while the shoot roots, originating from the lower root bands of the shoots, are thick, fleshy, and less branched. (Miller & Gilbert, 2009)

Germination and Establishment Phase

The inception of this phase starts at seven to ten days after planting and lasts an additional 30 to 35 days. During this time, the crop completes the germination of its buds. The germination denotes activation and subsequent sprouting of the vegetative bud. This phase results in an increase of respiration (and good soil aeration is important). Therefore, open structured porous soils facilitate better germination. (Netafim)

Before shoots form, the germinating seed piece must depend entirely on the set roots for water and nutrients. The set roots, however, are only temporary and their function is eventually taken over by the shoot roots as they develop. The life of the shoot roots is also limited. Each new tiller (shoot) develops its own roots that eventually take over the function of the original shoot roots. This rejuvenation, guided by the periodicity of tillering, is important because it allows the plant to adjust to changing environmental conditions.

A longitudinal section of a root tip consists of four parts: the root cap, the growing point, the region of elongation, and the region of root hairs. The root cap protects the tender tissues of the growing point as the root pushes through the soil. The growing point consists of an apical meristem, where cell division takes place. In the region of elongation, the cells increase in size and diameter until they reach their ultimate size. The region of root hairs is characterized by epidermal cells forming outgrowths (hairs), which dramatically increase the root-absorbing surface.

The bud— a miniature stalk with growing point, root, and leaf primordia— forms a new shoot. In addition, a seed piece contains root primordia within its root band, which develops into set roots, and functions until the young shoot develops its own roots.

The transition from the dormant into the active stage constitutes a complex phenomenon characterized by changes in the activity of enzymes and growth regulating substances (e.g., hormones and auxins). Maximum germination and shoot vigor will result when both internal and external factors are optimal. (Miller & Gilbert, 2009)

Tillering Phase

Tillering is the physiological process of developing secondary shoots, which takes place at 40 days after planting and lasts up to 120 days (Netafim). Ultimately, tillering is related to the phenomenon known as "apical dominance" and plant hormones are involved in the process of tillering. The most important external factors influencing tillering include light, temperature, nutrition, moisture, and the spacing of the plantings. Among these factors, experiments have shown that light plays the most significant role. Increasing light intensity and duration, in general, greatly increases tillering. Sunlight reaching the base of the plant is pivotal, as approximately 50 percent of the tillers will die due to inadequate light (Miller & Gilbert, 2009). The tillers forming earlier have thicker stalks, thus generating a higher yield than the later forming tillers.

Once the crop has been planted for 90-120 days, the tiller population reaches its maximum of 1.5 to 2 tillers per bud and forms into canes. A ratoon crop begins its tillering phase much earlier than a planted crop; therefore, a ratoon crop can expect to see higher tillers. (Netafim)

Grand Growth Phase

At approximately the 120-day mark, the grand growth stage begins. It is aptly named as the stalks can grow four to five internodes per month during this period. The actual canes are formed and elongated, producing yield.

Water is critical during this period for optimal yields. Therefore, the crop is susceptible to yield loss due to drought at this time. (Netafim)

Ripening and Maturation Phase

The ripening and maturation of the crop is the final stage of growth, which begins at the 270th day and lasts until the crop is harvested. During this period, the crop, which rapidly accumulates sugar and vegetative growth, is reduced. The monosaccharide, fructose and glucose, or simple sugars, are converted to disaccharide or cane sugar. The ripening begins at the base of the plant and moves upward; therefore, the base contains more sugar.

At this point, the crop reaches its reproductive stage. The plant stops growing new leaves and produces a red to white colored inflorescence or tassel. The tassel is the flowering portion of the plant, which produces several thousand flowers. Each flower is only capable of producing one small seed, which is too small to be used in commercial crop production. Thus, vegetative propagation is the only viable means of planting energy cane. (Rainbolt & Gilbert, 2008)

Portions of the mature cane are reserved for vegetative propagation. Once the cane is harvested, the reserved sections of cut stalks can be replanted, which sprout genetically identical daughter plants. (Baucum & Rice, 2009)

Chemical Composition

The chemical composition of energy cane can be broken down into two parts, the juice, and bagasse. The juice of energy cane comprises a smaller percentage of the plants composition than sugarcane with 9.8 percent fermentable sugars. The bagasse is 43 percent cellulose, 24 percent hemicelluloses, and 22 percent lignin. (Kim & Day, 2010)

Production Operations

ESTABLISHMENT

Energy cane is planted from August through October. The seed cane should be placed three to four inches above the final water furrow or higher in poorly drained soils in order to avoid water damage. Typically, a sugarcane field is replanted every two years; researchers expect, however, a stand of energy cane to extend several years beyond the traditional sugarcane cycle to the third or fourth ratoon. (Personal Communication; Energy Cane Conference Call, 2011)

Energy cane plants are propagated by horizontally planting sections of the stalk in the soil. The stem has joints or nodes as in other grasses. These nodes range from four to 10 inches apart along the aboveground section of the stem. At each node, a broad leaf, consisting of a sheaf or base and a leaf blade, rises. The sheaf is attached to the stem at the node and surrounds the stem with overlapping edges. The sheath from one node encircles the stem up to the next node above and may overlap the base of the leaf on the next higher node.

The leaf blade is very long and narrow and varies from one to three inches in width and up to five feet or more in length. At each node along the stem is a bud, protected under the leaf sheath. Stem sections are planted by laying them horizontally and covering them with soil; a new stem grows from the bud, and roots grow from the base of the new stem. The stem branches below the ground so that several stems may raise as the clump forms the growth of the bud at a node.

In planting cane fields, mature cane stalks are cut into sections and laid horizontally in furrows. In the continental United States, sections with several nodes are laid in a furrow, while in tropical countries sections with two or three nodes are commonly used since temperatures for growth are more favorable. Usually only one node on a stem piece develops a new plant because of the polarity along the stem piece.

Planting is done in rows approximately six feet apart to make cultivation and use of herbicides for early weed control possible. As plants become taller, lower leaves along the stems are shaded and die. These lower leaves ultimately drop off and only leaves toward the top remain green and active. Between the nodes, the stems have a hard, thin, outer tissue or rind and a softer center. Complete shading of the ground occurs five to eight months after planting and is referred to as “close in” or “lay-by.”

No-till system is used in ratoon fields where the gaps in rows are mechanically replanted. For sugarcane production, a maximum of two ratoon crops are grown, but the norm is one ratoon crop. More than 70 percent of sugarcane fields are tilled and planted every two years to improve stands by eliminating soil compaction, improving soil aeration and drainage, changing cultivars, incorporating soil amendments or field residues, minimizing insect and other pests, and eliminating perennial weeds. Since energy cane is heartier, multiple ratoon crops are grown, decreasing the need for the aforementioned stand improvements that sugarcane requires. (Markle, Baron, & Schneider, 1998)

Harvest

Energy cane harvest occurs from October to January, although researchers are developing varieties that will last up to January and through to March in order to increase biomass growth. The crop should be allowed to dry to reduce the moisture content to approximately 60 – 75percent. The field should be dry as well to minimize foreign matter, such as mud from harvest. Fields are mechanically harvested, using all parts of the plant for biomass and sugar extraction. During the first crop year, the crop may be harvested twice. Cutting the crop in January of the first crop year is a standard cultural practice to achieve higher yield. This cutting may produce enough crop growth to be harvested. After the first crop is harvested, subsequent crops are grown from the stubble or ratoon. In the continental United States, where winter freezing is a hazard, the leftover stubble is susceptible to freeze damage, which can cause considerable yield loss for the following crop year. (Gravois, et al., 2011)

Rotation And Isolation Requirements

Energy cane is a perennial that typically is grown successively (back-to-back). The stubble from the previous crop is utilized for the next crop year; therefore, rotation is not required. If the harvest is late, another crop such as rice or sweet corn may be substituted for the next growing season. This is termed fallow planting. (Baucum & Rice, 2009)

Soil Requirements

Research on energy cane indicates the same soil requirements as sugarcane. Ideally, soils for energy cane should be medium to heavy with a pH of 5.0 to 8.5. Liming is required if the pH is less than 5.0, and gypsum should be used if the pH is greater than 9.5. The organic muck soils of the Florida Everglades are rich in nitrogen and support vigorous cane growth. In Louisiana, sugarcane production has been concentrated in the Delta region where soils are fertile. In Texas, soils typically need an application of 150-200 pounds per acre of Nitrogen to achieve comparable yields as in Florida and Louisiana. (Rainbolt & Gilbert, 2008)

Susceptibility to Pests and Diseases

Weather-related Perils

Given that sugarcane is grown in the same regions as energy cane, and given energy cane is a variety of the same plant, analyzing the historical cause of loss data of sugarcane gives an accurate assessment of the perils that affect energy cane production. Figure 36 illustrates the significance of each peril. The historical data shows that weather related perils account for 83 percent of sugarcane indemnities during a ten-year period, with drought and excess moisture having the highest cause of loss percentages. (USDA; RMA, 2010b)

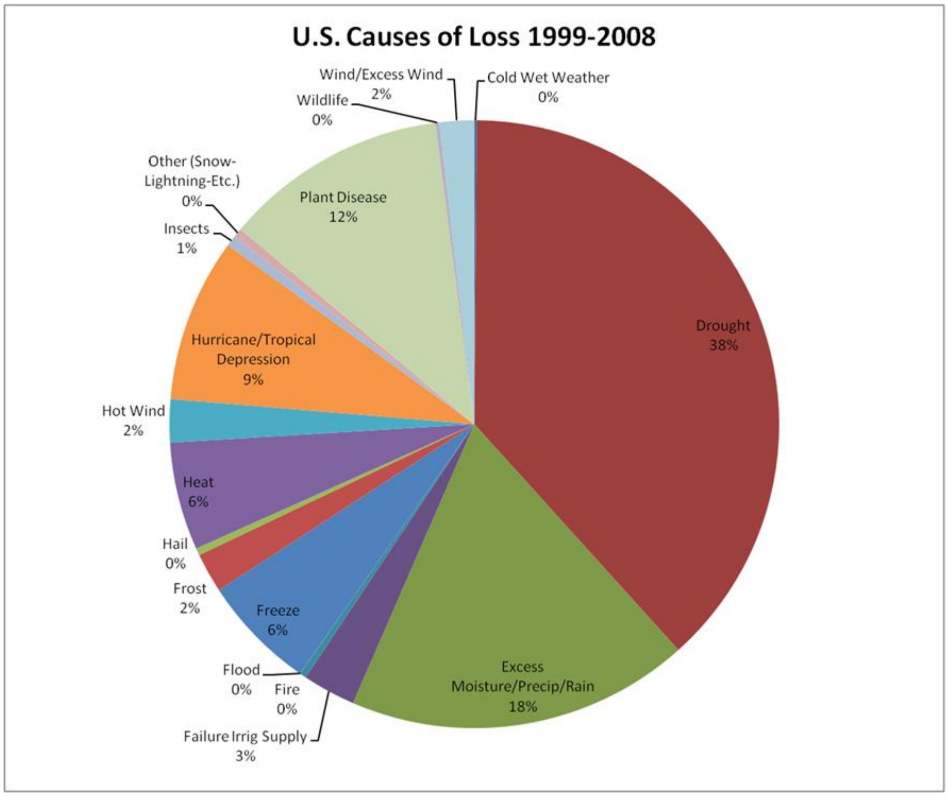

Figure 36: U.S. Sugarcane: Ten-Year Causes of Loss

Source: (USDA; RMA, 2010d)

Frost/Freeze

For young plant cane and young ratoon cane, most or all of the above ground primary and secondary shoots that have growing points above ground will be killed by a freeze event. Post-freeze regrowth will come from secondary shoots whose growing points are below ground and protected from the cold. The killing of the young cane shoots by freeze may result in poor stands. Freeze can also cause loss of stalk weight over time, after the freeze.

Freezing temperature causes leaf damage first. A very light freeze, between 29° and 32°F for a few hours, will cause burning of the leaf tips. A slightly harder freeze, between 25° and 28° F for a few hours will cause extensive leaf browning and terminal bud death. A few lateral buds will be killed and the freeze may damage tissue in the top few internodes. Responses to freezing temperatures of different varieties differ.

A more severe freeze, between 23° and 24° F for a few hours, will completely brown leaves and partially or entirely freeze stalks. The terminal bud and all or nearly all the lateral buds will be killed. (Personal Communication; Energy Cane Conference Call, 2011)

PESTS

Sugarcane Borer (Diatrea saccharalis)

The sugarcane borer is known to be a major pest of sugarcane, and therefore energy cane. The sugarcane borer is a crambid species whose larvae tunnel grows in the stalks of many gramineous plants including, sugarcane, corn, rice, and sorghum in Louisiana. Its egg masses are deposited on the sugarcane leaves and newly hatched larvae migrate to the leaf sheath and feed around that area until about half grown. At the internodes, the larvae bore into and tunnel along the stalk. The sugarcane borer completes development inside the stalk then emerges through an exit hole carved earlier by the larvae. There are five to seven instars. The reduction in stalk weight is the most severe damage, but sugarcane borer also stunts growth, weakens stalks, kills terminal buds and causes suckering, destroys some vegetative buds of seed cane, and increases plant susceptibility to pathogens. The sugarcane borer is monitored by visually inspecting the stalks. Economic treatment threshold is reached when five percent of the crop has live larvae feeding in the leaf sheaths on the outside of the stalk.

Wireworm

When present in the sugarcane field, wireworms can cause significant damage and are difficult to control. During winter, these insects mature from the larval or adult stage in the cane field. The adults emerge in the spring and appear to stay in the same area to lay eggs. The larvae hatch within a few days and feed on the roots of the plant. (USDA; Integrated Pest Management Centers, 1999)

Mexican Rice Borer

Mexican rice borer (MRB), *Eoreuma loftini*, represents 98 percent of insect damage in Texas sugarcane. The economic damage due to MRB is estimated to be $10 to $20 million annually. No known chemical treatment is fully effective because the larvae enter the stalk early hindering insecticide effectiveness. Damages include stunted growth, lodging, breakage, reduced juice quality, and “deadhearts” (green shoots with dead whorl centers). (Reay-Jones, n.d.)

New Guinea Sugarcane Weevil

Since the 1880’s, the New Guinea sugarcane weevil or sugarcane beetle borer has been a chronic and persistent pest of sugarcane. It is most damaging in regions where temperatures are warm and rainfalls are high. The adult female bores a hole with its long beak into young cane and lays an egg in either this puncture in splits, fractures, cuts, and rat bites on matured stalks. The larva or grub feeds on the tissue within the stalks for 45 to 80 days and causes extensive tunneling. The adult weevil can live for six months to one year. Each female lays about 120 to 150 eggs during this period. For a two-year crop, there can be five or six weevil generations before the cane is harvested. Effective control of the weevil can be achieved by integrating biological control and growing resistant cultivars without the use of insecticides. An example of biological control is the tachinid fly (*Lixophaga sphenophori*), a parasitoid of the weevil, introduced to Hawaii from New Guinea in early 1910’s and again in early 1970’s. To date, this parasitoid exerts substantial control of the weevil.

Lesser Cornstalk Borer

In Hawaii, the lesser cornstalk borer (LCB) is considered the most destructive pest of young sugarcane, killing shoots up to six weeks of age. It damaged thousands of acres of sugarcane on the Island of Maui from 1986 to the present. It is more abundant during spring and summer in dry, hot areas. LCB population decreases after shoots are 30 cm or taller. Infestations of the LCB may cause a delay in crop development resulting in a small reduction of stand the extreme cases where the entire field must be replanted. Two parasitoid species, *Orgilus elasmopalpi* and *Horismenus elineatus*, have been introduced from Texas and Bolivia, respectively. *H. elineatus* provided control that is more effective. Both species have been recovered from field collected LCB larvae. Integrated practices of biological control, resistant cultivars, and frequent irrigation prior to close-in have been effective against this pest. Since 1993, LCB damage has been reduced but remains heavy in localized areas.

Yellow Sugarcane Aphid

The yellow sugarcane aphid (YSCA) has been established in Hawaiian sugarcane fields since 1989. Its population increases during the spring and continues through the summer. The aphids colonize the lower surface of the leaves, generally the lower to middle leaves on a stalk. When large outbreaks occur, even upper leaves may become heavily infested. Feeding results in a reddish stippling followed by a general yellowing with irregular purplish areas along the leaves. Severely affected leaves die. (USDA; Integrated Pest Management Centers, 1999)

White Grubs Sugarcane

The grub, *Ligyrus subtropicus*, feeds on the underground roots and stems causing stunted growth and, in some cases, death of the plant. In an area with a high infestation, it can cause a 39 percent reduction in yield. A heavily infested crop may not be harvested. The damage is more significant in ratoon crops. (Cherry, 2008)

Diseases

Eyespot

Eyespot is a fungal disease. It causes the appearance of leaf lesions with necrotic centers surrounded by a yellow halo that may extend into a long streak parallel to leaf venation. The fungus is spread through airborne spores. In the past, it caused severe plant necrosis, stunting, and death in susceptible cultivars. The destructiveness of the pathogen is due to its ability to produce a toxin that kills plant cells. The disease is no longer prevalent because resistant cultivars have been planted for many years. Nonetheless, screening for resistance is still undertaken in the breeding program and any clones found susceptible are discarded. Fungicides are not necessary for control of eyespot disease.

Ratoon Stunting Disease

Ratoon stunting disease (RSD) is caused by a fastidious, xylem-limited bacterium. The disease is insidious since it has no visible symptoms other than stunting and thus spreads without detection through plantations. Over time, RSD can cause severe yield reduction in lost cane tonnage. The bacterium is spread from plant to plant by cutting tools so that the percentage infection increases with each ratoon. New field areas are infected through planting of infected seed pieces. There are no pesticides available for the control of this systemic bacterial disease. The disease is kept under control in Hawaii by continuous monitoring of seed fields with serological testing. New seed fields are established with seed pieces that have been treated with a two-hour hot water treatment to eliminate the bacterium. If RSD is suspected, harvesting knives are sanitized with sodium hypochlorite (bleach) before moving to a new field.

Leaf scald

The symptom of leaf scald disease is characterized by colorless streaks in leaves, which eventually become necrotic giving a characteristic scorched look to foliage. Severe yield loss or complete crop loss can happen. The causal organism is a bacterium that is spread through infected seed pieces. There are no pesticides available for control of this disease.

Yellow Leaf Syndrome

This viral disease recently originated in Hawaii and causes severe leaf yellowing. It begins with the midrib and leaf tip, then progresses down the leaf blade. The amount of yield loss is not well documented at this time and may vary with cultivars and cultural practices. These symptoms occur in stressed cane. The virus is vectored and transmitted by the sugarcane aphid (*Melanaphis sacchari*). The only control method practiced at this time is to discard any new sugarcane clones that show symptoms.

Pineapple Disease

Pineapple disease is caused by a fungal pathogen that has soil and air-borne spores. It enters stalk pieces cut for seed through the cut ends of the seed pieces. There it spreads rapidly through the stalk, killing the buds and preventing germination. The disease is ubiquitous in Hawaii and causes high mortality in newly planted fields. There are no resistant commercial cultivars and the only available treatment is pre-plant dip of the seed pieces in fungicide.

Smut

Smut is a fungal disease caused by a basidiomycete (*Ustilago scitaminea*). This fungus invades plants directly by means of airborne spores that are produced on long sori called "whips." The fungus systemically invades standing cane and can be spread through planting of infected seed pieces. Genetic resistance to the disease exists and resistant cultivars are planted when possible. Fungicides have no effect on the pathogen. Seed stocks are routinely inspected for the presence of the whips and infected fields are not used for planting material. Seed stock fields are first planted with seed pieces treated in a hot water dip, which greatly reduces any systemic fungus present. Through the continuous use of these control measures, losses from the disease are kept to a minimum.

Rust

Rust is a fungal disease of leaves that is caused by an obligate parasite. Airborne spores from the leaf lesions germinate and infect new leaves during periods of high humidity. In susceptible sugarcane cultivars, the leaf lesions may be so severe that most of the leaves on the plants become necrotic and non-functional. This results in crop stunting and loss in yield. While copper sprays are used in other crops for control of rust diseases, copper is not used on sugarcane in Hawaii. Instead, the disease is controlled using resistant cultivars. During development of new cultivars in the breeding program, any rust susceptible clones are discarded. (USDA; Integrated Pest Management Centers, 1999)

Pokkah Boeng Disease of Sugarcane

Pokkah Boeng is caused by the fungus, Fusarium moniliforme, which can cause yield losses in certain cases. However, losses are rare and do not require any preventative measures. (Raid, 2009)

Sugarcane Mosaic Virus Disease

Sugarcane Mosaic Virus (SCMV), commonly known as simply "mosaic," is caused by a viral pathogen. Louisiana and Florida have both seen outbreaks in the past, with an outbreak in Louisiana causing a detrimental amount of loss across the state during the 1920s. Losses caused by SCMV vary depending on the time period and regions involved. The most distinctive symptom of the virus is the varying island-shaped shades of green on the leaves. This discoloration can turn yellow-green to red with varying degrees of necrosis. Younger plants are more susceptible to the disease. SCMV is mainly spread by aphid vectors and infected seed cane. SCMV resistant varieties have been developed and are essential to the prevention of the disease. (Comstock & Gilbert, 2009)

Weeds

Weeds potentially cause more economic loss in sugarcane than all other pests combined. Weeds cause loss of tonnage in the field, reduce sucrose recovery in the mill, and shorten ratoon lives. Weeds compete with energy cane in many ways by reducing solar heating of soil for early growth/re-growth, extracting soil water, reducing light, robbing the crop of nutrients, and serving as reservoirs for numerous insect and disease pests. Along with harvesting, weed control is a costly component of production. The sugarcane industry is highly dependent on herbicides for profitable, environmentally sound production.

The most common and troublesome weeds are the sunflower, pigweed (Careless weed), guinea grass, johnsongrass, winter annual broadleaf weeds, annual grasses (Colorado or Jungle), morning glories, vines, nut sedge, and Bermuda grass. (USDA; Integrated Pest Management Centers, 1999)

Adaptation and Distribution

Energy cane, like sugarcane, is adapted to the southern tropical regions of the United States, specifically southern Louisiana, Texas, Hawaii, and Florida. Texas sugarcane production is confined to an area classified as a subtropical climate - long hot summers and short mild winters. Killing freeze is a recurrent threat, and hurricanes and drought have significantly reduced production in some years as well. The sugarcane production in Hawaii is on the islands of Maui and Kauai. Maui has consistent weather with mild temperatures and modest annual rainfall. Kauai is slightly cooler with considerably less rainfall. Most of the Florida sugarcane is produced along the southern and southeastern shore of Lake Okeechobee in Southern Florida where the growing seasons are long and winters are generally warm. Florida is a hot-humid region. Abundant sunshine, large bodies of water and 60 inch per year rainfall contribute to Florida's hot-humid climate. Louisiana is the northern most sugarcane growing state in the contiguous United States and the climate can be characterized as warm, moist, and almost tropical. Because of this, the sugar industry in Louisiana has been expanding both northward and westward into non-traditional sugarcane growing areas. Figure 37 illustrates the distribution and adaptation according to USDA PLANTS. Currently, researchers are working on developing energy cane varieties that are adaptable to areas farther north than the traditional sugarcane growing areas. (USDA; PLANTS, 2011)

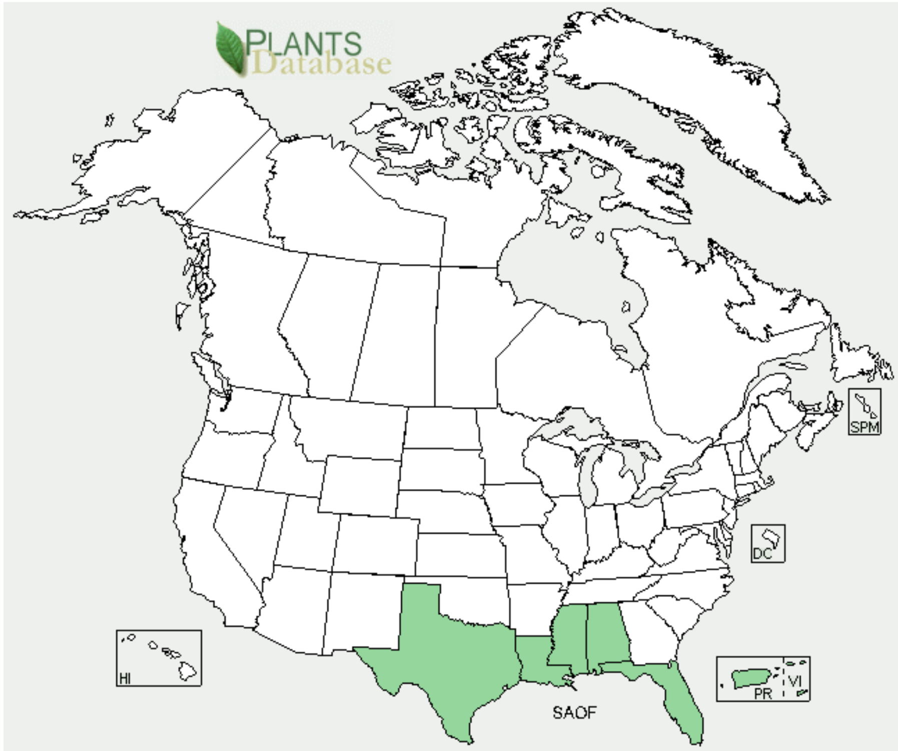

Figure 37: Energy Cane Distribution

Source: (USDA; PLANTS, 2011)

Varieties

Research on energy cane varieties began in the mid-1970s in Louisiana. The variety L79-1002 was an outcome of that research project and is currently the variety used for energy cane production. The development process for new sugarcane or energy cane varieties normally takes 12 years. Of the current commercial varieties, L79-1002 yields the highest amount of fermentable solids. However, it is highly susceptible to smut, creating a need for a disease resistant variety. A variety released in 2010, Ho 02-113, has been developed with resistance to smut and biomass yields compare to those of L79-1002. (Legendre, 2011)

At the Southern Agricultural Economics Association Annual Meeting in 2009, Mark, Darby, and Salassi compared the attributes of commercial sugarcane varieties in their estimation of feedstock costs. A summary of their findings can be found in Table 45. The evaluation concluded that Ho 00-961 produces the highest amount of fiber per acre of the commercial type sugarcane varieties evaluated (Mark, Darby, & Salassi, 2009). However, an interview conducted with Dr. Ben Legendre indicated that the variety L79-1002 produces approximately a 10 percent more fiber per acre than the Ho 00-961 variety. (Personal Communication; Energy Cane Varieties, 2011)

Table 45: Energy Cane Variety Comparison (Commercial Type)

				Solids		
Variety	Gross Cane	Brix	Fiber	Brix	Fiber	Total
	(tons/ac)	(% cane)	(tons/ac)		(tons/ac)	
Ho 00-961	34.6	17.7	15.9	6.1	5.5	11.6
HoCP 91-552	38.9	16.8	15.2	6.6	6	12.6
LCP 85-384	31.5	18.2	14	5.6	4.4	10

Source: (Mark, Darby, & Salassi, 2009)

Review of Other Programs

State and Federal Programs

Biomass Crop Assistance Program

The Biomass Crop Assistance Program (BCAP) supports establishing and producing eligible crops for the conversion to bioenergy through project areas and contracts on land up to five years. Energy cane bagasse qualifies for assistance as an eligible crop residue. Through a matching payment program, BCAP assists eligible material owners with collection, harvest, storage, and transportation of eligible material for use in qualified Biomass Conversion Facilities (BCF). These payments will be available to eligible material owners at the rate of $1 for each dollar per dry ton paid by the BCF, limited to a maximum of $45 per dry ton and a 2-year payment duration. (USDA; FSA, 2010b)

Biorefinery Assistance Program

This program provides grants for demonstration scale biorefineries and loan guarantees for commercial scale biorefineries. The pilot or demonstration scale biorefineries are funded up to 50 percent of the project cost. Each loan is guaranteed up to $250 million for commercial scale biorefineries. Although assistance does not go directly to the grower, this program assists in developing the industry and indirectly benefiting the producer. (Crooks, 2010)

Bioenergy Program for Advanced Biofuels

Payments are made to producers of feedstocks for the purpose of biofuels production. Eligible producers entering into a contract are paid based on the quantity and quality of advanced biofuels production and on the net nonrenewable energy content of the advanced biofuels. The payment amount will depend on the number of producers participating in the program, the amount of advanced biofuels being produced, and the amount of funds available. (National Sustainable Agriculture Information Service, 2010) Mandatory funding for this program has been set at $105 million in fiscal year 2010, $85 million in fiscal year 2011, and discretionary funding of up to $25 million each year from fiscal year 2009-2012 (Crooks, 2010).

Private Products

To date, there are no private insurance products available for energy cane.

Data Availability and Price Methodologies

Yield Data

Currently, there is no commercial production of energy cane; therefore, there are no published public commercial yield data available. For the purposes of this report, research yields from Louisiana State University were utilized to simulate a yield data series. The collected data are illustrated in Table 46 and are reported in fresh (wet) weight. The methodology for simulating the yield data is described in the section of this report titled "Estimation of Yield Probability Distributions for Louisiana Energy Cane." (Gravois, et al., 2011)

Table 46: Energy Cane Yields

Louisiana Energy Cane (Tons Per Acre)			
Year 1	Year 2	Year 3	Year 4
35.91	46.1	34.2	33.8

Source: (Personal Communication; Energy Cane Conference Call, 2011)

Price Data

Given that no commercial markets currently exist for energy cane, no pricing data are publicly available. However, Gravois, et al., (2011) determined that based on cost of production studies, prices paid would need to range from $50

– $74 per dry ton in order to breakeven. This range is equivalent to $12.50 – $18.50 per wet ton, assuming an energy cane crop at 75% moisture (Personal Communication; Energy Cane Conference Call).

LISTENING SESSIONS

Louisiana

Subcontractors Dr. James Richardson and Dr. Joe Outlaw assisted in setting up the meetings for energy cane. Since there is currently no commercial production of energy cane, a conference call was conducted with researchers at Louisiana State University, USDA's Agriculture Research Service, and Texas A&M Agriculture Research Center in Beaumont in order to gather feedback on Thursday, January 13, 2011 at 9:00 a.m. There were seven researchers on the call as well as two subcontractors and two employees from the Contractor.

While the conference call provided critical energy cane production information, the lack of producer input prevented assessing the producer's perception of insurance. Researches did elaborate on risk and causes of loss that they have encountered for sugarcane and indicated that these risks would most likely be applicable to energy cane. Specifically, researchers recalled freeze events in 1976, 1983, and 1989 that caused significant damage to sugarcane ratoon crops for the following years' crops. Fifty percent losses were recorded in 1990 following the 1989 freeze. Un-harvested sugarcane suffered little damage because the growth acted as insulation, while stubble cane suffered significant damage and losses were seen on the following year's crop.

Where the epicenter of production was described as being around Jefferson Davis Parish, drought constituted substantial risk that could reduce yields of sugarcane and energy cane. These soils were said to be soggy in the winter and dry in the summer, resulting in droughty conditions during growth in the summer. These conditions favor irrigation, which can increase yield by 30 to 40 percent, although not all production is irrigated. The other risk that was of concern was the establishment of plant cane. Plant cane is vegetatively propagated (recommended practice) and some varieties (particularly F1 hybrids) have characteristics (undefined buds) that cause poor germination. Plant cane is propagated in August to December, with a low yield of approximately 6 tons achievable between January to March. It is a common practice to harvest this initial biomass in January to March. This harvest is followed by the harvest of the actual plant cane crop in the fall and will carry on production from ratoon crops for approximately 4 years. Timing of harvest each year affects stand life and harvesting too early in consecutive years can cut the following years yield in half. The harvest window runs from October through January. A variety known as L79 - 1002 would last 10 years if cut in December each year, but would only last to the third ratoon if cut in October each year. Although the Contractor probed for further discussions on relative yield risk of energy cane, researchers did not indicate the perceived yield risk in relation to other crops.

Further discussions with the energy cane researchers indicated that yield trials exist in Louisiana in a commercially scaled field. These trials are in small plots that run the length of the non-irrigated field. Each plot has three to four replications. It was stated that 200 acres of energy cane are currently being transported to the demonstration plant in Jennings, Louisiana. Although the Jennings plant is taking in the aforementioned 200 acres of energy cane, no actual market for energy cane exist. Growers are currently looking for buyers to contract production; however, BP Biofuels is at capacity for the demonstration plant in Jennings and does not envision expansion at this plant. Additional details were unavailable as BP Biofuels keeps much of their information confidential.

Since no producers were interviewed, the consensus for developing a crop insurance program for energy cane in Louisiana is hard to evaluate. Therefore, comments received from researchers are employed to form the basis of the perception of an energy cane crop insurance program. Researchers perceptions were that crop insurance on sugarcane acted as a very effective tool for managing yield loss. Since the production practices and growth of energy cane is identical to sugarcane, a crop insurance program for energy cane is expected to be as effective and well received by producers who grow this crop.

ENERGY CANE RISK EVALUATION

Introduction

The RMA's Program Evaluation Tool (Diagnostic Instrument), found in the USDA RMA Program Evaluation Handbook FCIC-2210 (PEH)[13], was used by the Contractor as a supplement to assist in the development of the overall recommendation for each dedicated energy crop. This tool creates a better understanding of the risk exposure and the potential for various insurance products to transfer a portion of that risk to an insurance pool. The tool also assists in gauging the demand for insurance products and potential design issues that may arise.

This instrument was applied separately to the four regions where listening sessions were held. These regions included Tennessee for switchgrass, Louisiana for energy cane, and Montana and Oregon/Washington for camelina. The program evaluation tool was completed based on information obtained through listening sessions with producers, insurance agents, university extension personnel, crop consultants, conversations with RMA Regional Offices, and the Contractor's independent research and analysis of the current production and market conditions for each crop in each region and those for comparable crops. Results of the Program Evaluation Tool are summarized below and the completed Diagnostic Instrument for each region is included in Appendix N.

Louisiana Program Evaluation Tool Summary

"The Program Evaluation Tool uses a series of questions to elicit information on production processes, market characteristics, availability of federally facilitated insurance products, as well as eight demand signals of which five are "Demand Shifter Categories" such as yield risk, quality risk, price risk, other sources of revenue risk, the sufficiency of non-insurance available to cope with risk, while three are "Product Design Categories" such as potential and realized risk classification challenges, potential and realized moral hazard and monitoring issues, and other problems that may affect insurance participation. Overall assessment questions are answered for the eight categories using a Likert scale of 1 to 5, where higher numbers for the "Demand Shifter" category indicate higher demand for insurance products while lower numbers suggest relatively lower demand. For the "Product Design Issues" categories, higher numbers indicated either a lack of product design problems or a high likelihood of being able to address any existing product design problems, while low numbers indicate more serious product design problems and/or problems that cannot be easily addressed. Using the overall assessment scores from each of the eight diagnostic categories for each region, the results have been graphically summarized for each region. Based on the overall scores assigned to each of the eight diagnostic categories, assessments are made and used to work through a generalized decision tree framework (See Appendix I), intended to facilitate decision-making. However, the diagnostic instrument may be used independently of the decision tree." (USDA; RMA, 2005)

The following is a summary of the completed Diagnostic Instrument for Louisiana energy cane. Note that the completed Evaluation Tool in Appendix N provides the completed answers to the aforementioned questions while the section below provides summary level answers to the eight demand signal questions used for Likert scale ratings. This summary will best be understood by concurrently reviewing the Program Evaluation Tool in Appendix N.

BACKGROUND INFORMATION

Sugarcane is classified as a sugar or sweetener crop. As energy cane is a variety of sugarcane, its agronomic classification can be defined as a sugar crop dedicated to energy (Bareja, n.d.). The botanical classification is species of the genus Saccharum. Cultivars or complex hybrids are bred from six to thirty-seven species (depending on taxonomic system) of tall perennial grasses of the genus Saccharum. "Energy cane and sugarcane are from the same genus, saccharum, and the only difference between them is that energy cane is bred for high fiber content and that sugarcane is bred for low fiber content but high sugar content." (Mark, Darby, & Salassi, 2009)

Energy cane, like sugarcane is planted as a perennial crop. It is harvested only once per year beginning as early as October and ending as late as the end of January. It is typically planted in August via vegetative propagation and, as

[13] The document can be downloaded from http://www.rma.usda.gov/FTP/Publications/directives/22000 /06_22010.pdf.

a standard practice for any biomass, should be removed in January of the first crop year in which yields are about one-quarter of the regular yield wet weight. Yields are at peak production in the following year and stands are harvested for 4-5 years before replanting. (Personal Communication; Energy Cane Conference Call, 2011)

MARKETING

Louisiana is home to Verenium's pilot plant operating in Jennings using bagasse in a cellulosic ethanol process (Mark, Darby, & Salassi, 2009). Verenium is a Massachusetts-based company that was formed in June 2007 through the merger of Diversa Corporation, a global leader in enzyme technology, and Celunol Corporation, a leading developer of cellulosic ethanol process technologies and projects. In February 2007, Verenium broke ground with a 1.4 million gallon-per-year demonstration plant right next to its Jennings pilot site. (Zimmerman, 2008) In July 2010, BP bought the Verenium plant and technology to accelerate delivery with its low cost, low carbon, sustainable biofuels (LaMonica, 2010). To date no information has been obtained on contracting or pricing mechanisms for this pilot site. Dr. Ben Legendre suggested that the plant may not "go full scale" and no current commercialized production is in place at the Jennings plant; however, production may commence at a Florida based plant.

RMA-FACILITATED INSURANCE PRODUCTS

Currently there are no RMA-facilitated insurance products available for energy cane utilized for dedicated energy in Louisiana or any other region in the United States.

YIELD RISK

Relative risk is used to adjust absolute risk magnitudes, which vary across crops, to a relative level in order to facilitate comparability of crop risk. Although data for energy cane are not reported by NASS, (assuming similarity of energy cane to sugarcane in relative yield) sugarcane yields can be used to assist in quantifying the yield risk associated with energy cane.

The coefficient of variation, calculated as the standard deviation divided by the mean, facilitates the comparison across crops with different expected yields and allows the comparison of variation of unlike data series. As illustrated in Figure 38, yield risk for sugarcane in Louisiana is lower than most of the other crops produced over the past twenty years. The coefficient of variation for sugarcane is 0.13, while winter wheat is 0.24. This suggests that energy cane is a relatively low risk crop to produce, compared to winter wheat and other small grains. Utilizing this information, a Likert scale rating from 1 to 5 for non-catastrophic yield risk, "1" being very low relative yield risk and "5" being very high relative yield risk, can be assigned. This non-catastrophic yield risk of energy cane was rated a "1" on the Likert scale; therefore, the crop has a relatively low yield risk.

Factoring in catastrophic yield risk results in a higher relative yield risk rating of "3" on the Likert scale. The risk for a catastrophic yield loss is hard to measure for energy cane, but a more informed estimate can be obtained by utilizing the cause of loss data for sugarcane from RMA. Utilizing the loss cost ratio as a way of measuring severity of causes of loss, the number of observations with the loss cost ratio above 25 percent[14] was recorded. Analysis of these observations for Louisiana sugarcane suggest that cold wet weather, drought, excess moisture, freeze and frost, heat, hurricane, insects, other (e.g., snow, lightning, etc.), and plant disease can cause sugarcane losses in excess of 50 percent or more. These observations are illustrated in Figure 39, and the data suggest that as much as 40 percent of the time over 25 years, losses greater than 50 percent have occurred for sugarcane due to drought and excess moisture; therefore, for energy cane, potential exist for a similar frequency and severity of loss for these types of events.

[14] It captures a minimum 50% yield loss based on assumption that guarantee is established at 75 percent coverage level for all insurance policies.

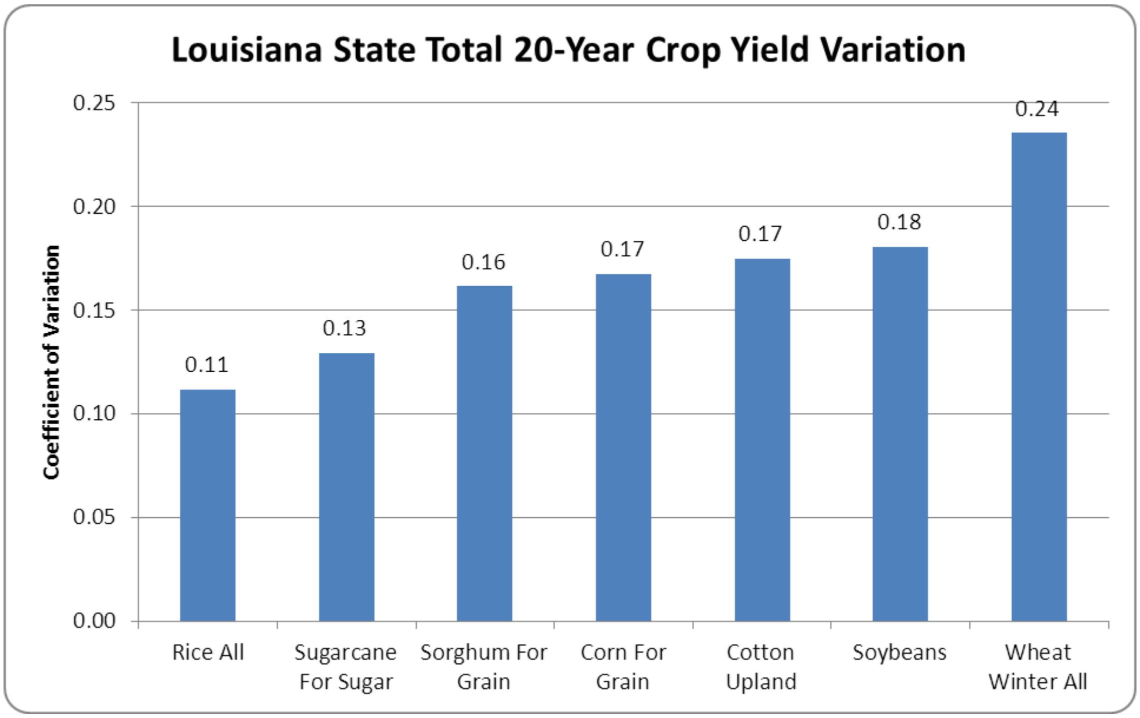

Figure 38: Louisiana State Total Crop Yield Risk Comparison

Source: Adapted from USDA; NASS, 2011

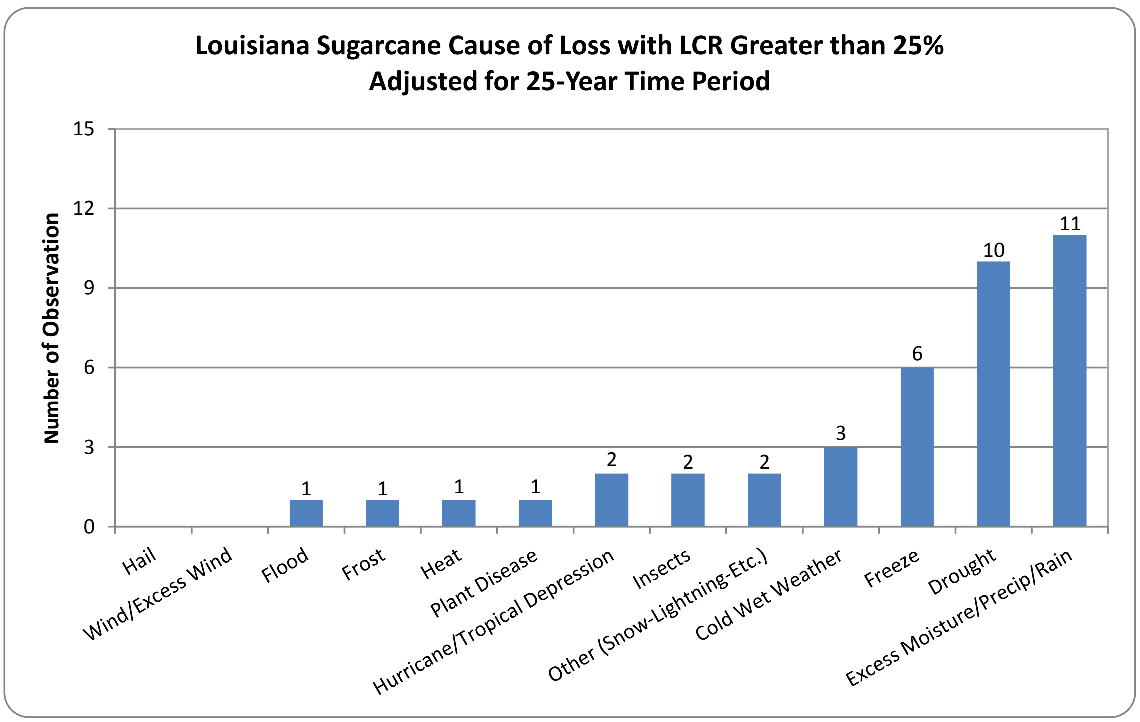

Figure 39: Louisiana Sugarcane Cause of Loss Observations of Lost Cost Ratio in Excess of 25%

Source: Adapted from USDA; RMA Cause of Loss Summary of Business, 2011

QUALITY RISK

Two processes to convert energy cane from a feedstock to dedicated energy can be utilized: (1) convert the sugar to ethanol and/or (2) use bagasse and/or biomass in a cellulosic ethanol process. Because low sucrose content would lower ethanol yield, quality risk may be of concern when utilizing the sugar to convert to ethanol. A more typical scenario is to use bagasse and/or all the energy cane biomass in a cellulosic process to convert to a dedicated energy product. Since the pilot plant process in Jennings focuses on using bagasse and all of the energy cane biomass, discussions are focused on this process for evaluating quality risk. This results in a very low quality risk (Likert rating of "1") assessment for energy cane in Louisiana.

PRICE RISK

There are no operational commercial cellulosic processing facilities operating in the United States beyond the demonstration plant in Jennings; therefore, price risk is difficult to quantify, as no publicly available price data exist. Growers contracted with BP Biofuels are paid solely based on total biomass (i.e. dry ton) delivered to the processors. Production practices are the same for sugarcane and energy cane; therefore, to attract acres of energy cane, BP Biofuels provides growers with prices that will help return similar net margins of sugarcane. While pricing data for BP Biofuels remains confidential, Matt Musial (2011) indicated that producers are paid per dry ton for all biomass, with a guaranteed payment based on an unspecified yield. Further, establishment and transportation cost to the demonstration plant are paid for by BP (Personal Communication; BP Biofuels, 2011).

Utilizing "United States Prices Received by Farmers" published by USDA ERS, a quantitative assessment of price risk can be performed. The ten-year average price and standard deviation of prices for each commodity were calculated and a coefficient of variation was utilized to determine the crops with the least variation. In Louisiana, sugarcane is the primary crop and it exhibits less variation in price than many other commodities grown as illustrated in Figure 40. Sugarcane and cotton exhibited the least price variation with a coefficient variation of 0.18 and 0.21 respectively, while corn, grain sorghum, soybeans, winter wheat and rough rice in ascending order were substantially more variable year to year. As previously mentioned, if processors provide comparable prices to motivate energy cane production, the data suggest that the price risk of energy cane from year to year would be less than that of other commodities. As such, price risk is rated very low (Likert rating of "1").

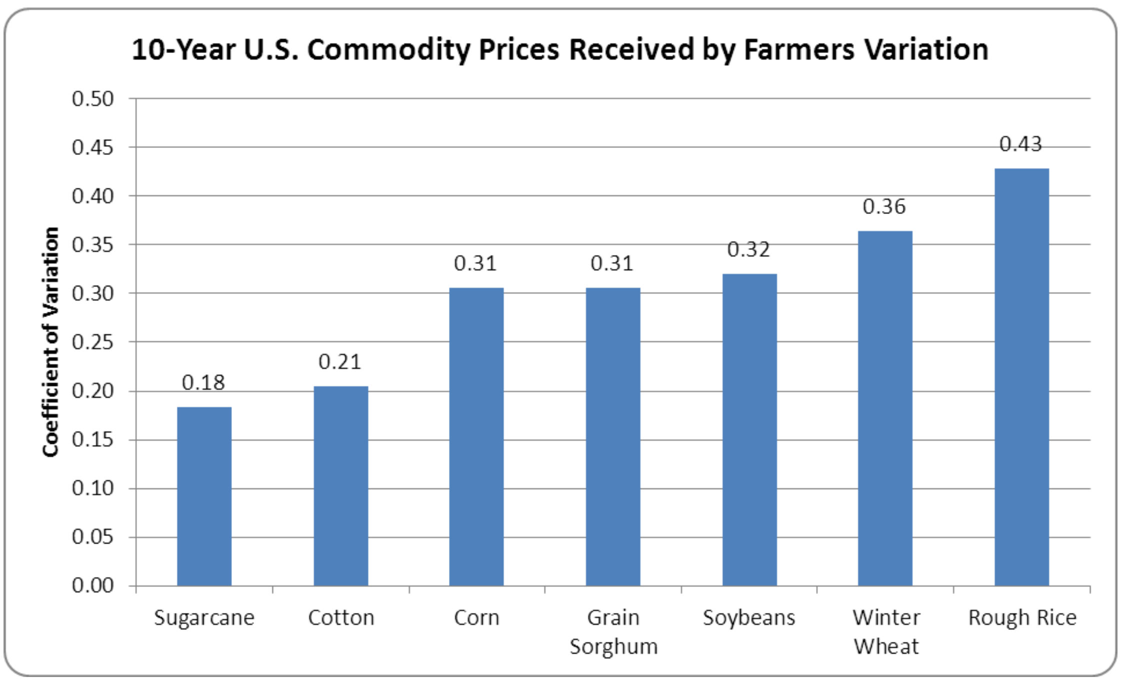

Figure 40: U.S. Commodity Prices Received by Farmers 10 Year Variation

Source: Adapted from USDA; ERS, 2011

Other Sources of Revenue Risk

Production practices of energy cane are similar to sugarcane and are not impacted to an extensive degree by other sources of revenue risk such as prevented planting or replanting. Therefore, other sources of revenue risk are rated very low (Likert rating of "1").

Sufficient Non-Insurance Coping Mechanisms

The demand for various crop insurance products (existing and potential) is influenced by non-insurance coping mechanisms including government price and income support programs, government disaster programs, marketing contracts including futures and options on futures for exchange-traded commodities, crop portfolio and spatial diversification, risk reducing production technologies and practices, and lenders' attitudes, expectations, and rules-of-thumb.

Federal commodity programs tend to reduce farmers' exposure to price risk and therefore, revenue risk. For energy cane, no government crop programs are available in terms of marketing loans and counter cyclical payments; however, the Biomass Crop Assistance Program (BCAP) is available. BCAP supports establishing and producing eligible crops for the conversion to bioenergy through project areas and contracts on land for annual and non-woody perennial crops up to five years or for woody perennial crops up to 15 years. Through a matching payment program BCAP assists agricultural and forest land owners and eligible material owners with collection, harvest, storage, and transportation of eligible material for use in qualified Biomass Conversion Facilities (BCF). These payments will be available to eligible material owners at the rate of $1 for each dollar per dry ton paid by the BCF, limited to a maximum of $45 per dry ton and a 2-year payment duration. (USDA; FSA, 2010b)

Other programs such as Noninsured Crop Disaster Assistance Program (NAP) are not available, nor has there been a history of federal disaster payments issued by the Crop Disaster Program[15]. Producers who (a) elect not to obtain federal crop insurance on non-insurable crops or crops for which the producer received crop loss assistance and (b) elected not to participate in NAP for the year in which benefits are received, must purchase crop insurance at a level greater than the catastrophic coverage for insurable crops for the next two crop years in the administrative county where the crop was produced or prevented from being produced (USDA; FSA, 2011).

Production contracts often mitigate farmers' exposure to some, but not all, risks. Although no contracting guidelines have been acquired, it is anticipated that in terms of pricing mechanisms, approximately 100 percent of the crops would be produced under a production contract with a first handler or processor and would be priced before harvest and establishment. Under the terms of the contract the grower is (1) not exposed to contract risk (the grower is not required to deliver on the contract under production shortfalls); (2) the grower is not exposed to quality risk (no significant price penalties if the product does not meet the quality characteristics specified in the contract); and (3) the grower is not exposed to price risk (prices for specific quality characteristics are not specified in the contract). For this reason, these mechanisms may reduce demand for crop insurance. In addition, if price and yield are significantly negatively correlated, revenue variability is reduced and, all other things equal, the demand for crop insurance products will be reduced. However, energy cane yield and price are expected to be independent of each other because contracted production (supply) will always be adjusted to the appropriate demand level. Thus, the producer is not exposed to significant price risk or volatility, which alleviates risk exposure.

Financial leverage, growth strategies, and recent events all impact farmers' ability to self-insure. Since no energy cane producers were interviewed, a perception of producers ability to self-insure was in between "strongly disagree" and "strongly agree."

Diversifying the farm enterprise across multiple commodities (crops and/or livestock) has the potential to significantly reduce whole farm revenue variability. Yield shortfalls on one crop may be partially offset by high yields on a different crop. In addition, a carefully diversified portfolio of crop enterprises can help farmers manage the revenue effects of price risk when other means of managing price risk are limited. For example, if yield risk for a crop (or crops) is small but price risk is significant, a farmer might choose to have no yield insurance and manage

[15] The Noninsured Crop Disaster Assistance Program is available to producers for losses in excess of 35 percent at a payment rate of 65 percent for insured crops and non-insurable crops; and 60 percent for uninsured crops.

revenue risk due to price variation through diversification. In this region there are two growers of energy cane; however, no assessment can be made on the total farm revenue attributed to this crop. For diversification to generate whole farm revenue risk reduction, the correlation between the commodities must be low (i.e., negatively correlated). Commodities with highly positively correlated revenue streams act as if they were a single commodity and, as a result, diversification will not significantly reduce revenue risk as well as the demand for crop insurance. Assuming growers also grow sugarcane on their farm, since the crops possess the same growth period, their yield risk and revenue risk are deemed to be strongly positively correlated which creates a higher demand for crop insurance.

It is assumed that 75 percent of farmers that would grow energy cane would be full-time farmers. Part-time farmers are typically less likely to focus on risk management strategies, including crop insurance. Since energy cane in this region is assumed to be produced by more full-time farmers, the demand for crop insurance products is greater. Further spatial diversification, like commodity diversification, reduces whole farm revenue variability if the yield correlation across farm parcels is low. The assumption is that energy cane farms in this region are not spatially diversified; thus, farms are more exposed to yield risk, increasing the demand for insurance.

Private-sector insurance products can have a mixed impact on the demand for RMA facilitated crop insurance products. If the private-sector products have features that complement or require the use of underlying RMA-facilitated crop insurance, they potentially increase the demand for RMA-facilitated insurance products. On the other hand, some products may be substitutes or partial substitutes for RMA-facilitated crop insurance. Currently there are no private products for energy cane; therefore, this may increase the demand for a FCIC crop insurance policy.

Lenders can have a substantial impact on farmers' use of crop insurance products. Often, the insured's value on growing crops is treated as a current asset on the balance sheet. Lenders' awareness, understanding of, and attitudes toward crop insurance have an impact on demand, particularly under circumstances where farmers are highly leveraged. In the case of energy cane, it is assumed that lenders may be indifferent to producers purchasing insurance.

Overall, based on the low availability of sufficient non-insurance coping mechanisms for producers of energy cane in Louisiana, the expectation of demand for insurance is high.

Risk Classification

Risk classification is a serious challenge in rating crop insurance products. Non-insureds and insureds have different perspectives on the cost of crop insurance coverage. Some individuals choose not to insure because they utilize the non-insurance coping mechanisms discussed in the previous category. In other cases, however, the amount of insurance purchased is limited because some individuals perceive the premium rate as being "too high." However, it is possible that existing classification methods will result in premium rates that are appropriate (or even too low) for one group but too high for another group. Unfortunately, since there are no FCIC insurance products or private products for energy cane, risk classification cannot be measured. Therefore, no Likert scale measurement was provided for this category and it is non-applicable in assisting the Contractor in following the decision tree process.

Moral Hazard

This category attempts to assess whether moral hazard may cause higher crop insurance indemnities. If so, the higher indemnities may be reflected in higher premium rates that could limit the purchase of insurance. A quantitative measure is used to help assess whether insuring energy cane will likely be prone to significant moral hazard problems.

A measurement of variation in yield and quality caused by unavoidable "acts of nature" or avoidable "acts of management" suggests that the yield variation and quality variation are almost exclusively due to "acts of nature" (potential for gaming is low). Since potential for gaming both yield and quality is low, overall concern for moral hazard is small (Likert scale rating "4").

Problems Affecting Insurance Participation

The previous categories dealt with both the potential for, and realization of problems associated with risk classification and moral hazard. This category focuses on other problems that may limit demand for RMA-facilitated crop insurance products for this crop in this region. Because no FCIC programs currently exist for energy cane, no Likert scale measurement was provided for this category and it is non-applicable in assisting the Contractor in following the decision tree process.

Louisiana Program Evaluation Tool Results

As illustrated in Figure 41 below, Louisiana energy cane quality risk, price risk, and other sources of revenue risk are rated very low (Likert scale "1"), while yield risk is rated moderate (Likert scale "3"). Sufficient non-insurance coping mechanisms are rated high (low availability). Weighting the yield component as a higher demand variable, these demand signals indicate a moderate demand for this insurance product and a potential market. Product design issues such as moral hazard are assigned a higher rating (very low moral hazard), indicating that the extent of potential problems is small.

See Appendix M for a graphical representation of the decision tree process for Louisiana. Highlighted red arrows mark the decision tree path. Since currently there is no significant market, the decision tree suggests that no insurance policy needs to be developed.

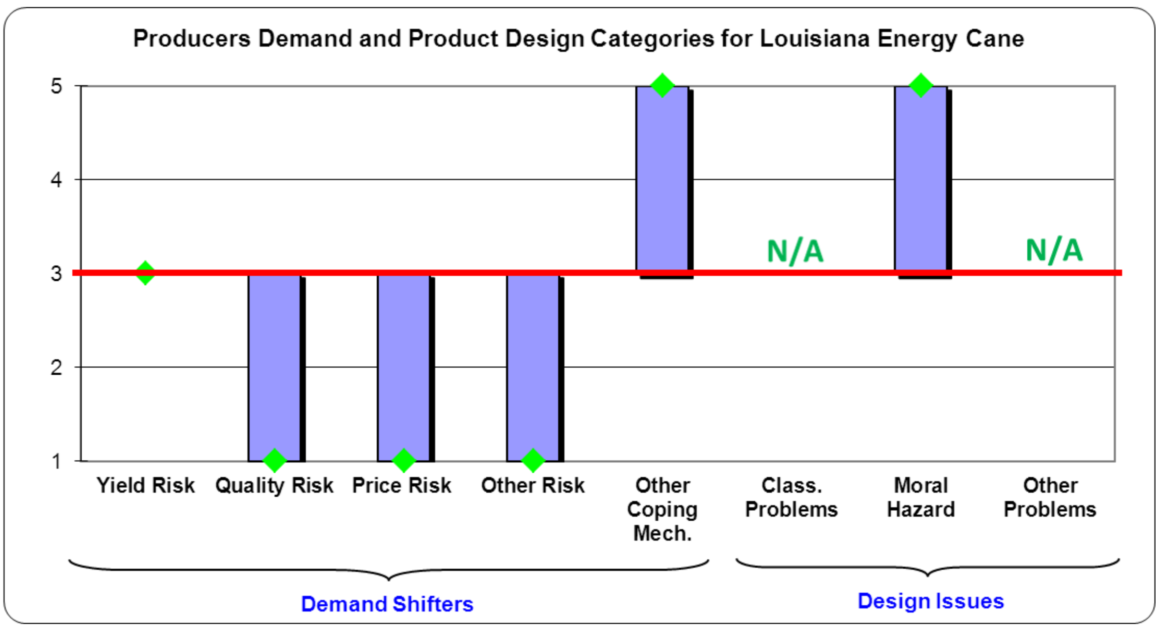

Figure 41: Louisiana Energy Cane Demand Shifter and Product Design Signals

Estimation of Yield Probability Distributions for Louisiana Energy Cane

Estimating yields and yield risks of relatively new crops in regions heretofore unutilized as production areas raises questions regarding expected yields, yield variability, and profitability. With little or no production history, USDA's RMA is faced with uncertain production capabilities when developing crop insurance programs. Agronomists, soil scientists, hydrologists, engineers, and others have developed tools for evaluating yield possibilities. Many of these tools are incorporated into computerized crop simulation models. One such model that began development in the mid-80s is EPIC, the original acronym for the *Erosion Productivity Impact Calculator* model.

EPIC has evolved over time to include the many impacts of crop production along with climatic factors on the environment. The model has been utilized by scientists worldwide and EPIC is now the acronym for *Environmental*

Policy Integrated Climate model. One of the principal developers is Dr. J.R. Williams, Blackland Research and Extension Center, Texas AgriLife Research, Temple, Texas. The EPIC model has been applied at regional (Williams, 1995) and national scales (Thompson, Izaurralde, Rosenberg, & He), (Izaurralde, Rosenberg, Brown, & Thompson).

EPIC (Potter, Atwood, Kellog, & Williams) is a daily time-step model capable of simulating a wide array of crop production and environmental processes including plant growth, crop yields, plant competition, and soil erosion as well as water, and nutrient balances. Biomass growth is related to solar radiation intercepted by the plant canopy, vapor pressure deficit, CO2 concentration, and other physiological stresses including water, temperature, N, P, and soil aeration deficits/surpluses. Similarly, root growth is affected by bulk density, temperature, and aluminum content. Soil carbon algorithms calculate carbon balance including losses of carbon from water and wind erosion. Plant growth and development is influenced by temperature during the growing season, expressed within the model as heat units. The quantity of heat units necessary for the crop to reach maturity varies by latitude.

Among the model's many features is a stochastic weather generator. Weather can be input from historical records or it can be estimated stochastically using precipitation, air temperature, solar radiation, wind, and relative humidity parameters developed from historical records.

The model simulates growth and development of a crop each day from emergence to harvest. Initially, a crop production schedule is developed from producers indicating their dates (and application rates) of operations prior to and during the growing season for tillage, planting, pesticides, irrigations, fertilizers, and harvesting. Adding the rates and dates of crop production inputs and other management information facilitates the simulation of tillage, irrigation, and fertilizer applications. Each operation combined with climate can impact crop production; either through growth, erosion, soil water, or nutrients, and most times a combination of these elements.

Among its many features is a stochastic weather generator. This weather generator utilizes historical weather data from a given site including maximum and minimum daily temperatures, humidity, rainfall, wind velocity, and solar radiation. The model simulates growth and development of a crop each day from emergence to harvest. Initially, a crop production schedule is developed from producers indicating their dates (and application rates) of operations prior to and during the growing season for tillage, planting, pesticides, irrigations, fertilizers, and harvesting. Each operation combined with climate can impact crop production; either through growth, erosion, soil water, or nutrients, and most times a combination of these elements.

The primary objective of this analysis of energy cane in Louisiana is to utilize the EPIC model, which has been adapted to a Windows® application, WinEPIC, to estimate an array of stochastic yields from which to develop a probability distribution function. Thereby, yield variability (risk) can be quantified and variations in profits revenues. Sub-objectives include: a) by utilizing local weather data along with producer's energy cane yields and management data from a designated area in southern Louisiana, calibrate crop coefficients to best represent the current yields and production conditions, and b) to utilize the calibrated model for producing three probability distributions of 1) the establishment year, 2) the plant cane year, and 3) the four ratoon years. These 600 years of stochastic yield observations were developed utilizing 100 successive 6-year rotations.

The methodology includes developing a production schedule of tillage, planting, fertilization, pesticide applications, and harvesting operations along with management decisions regarding typical dates of each operation, seeding rates, and application rates of fertilizers and pesticides.

Four years of production experience were utilized from the period 2005-2008. Yields were averaged each year over four energy cane varieties. At harvest, the fresh weight yields were 35.91, 46.1, 34.2, and 33.8 tons/acre in 2005 - 2008, respectively. Fertilization typically included 90 pounds/acre N the plant cane year and 120 pounds/acre N for subsequent ratoon years. Energy cane was established in the late summer 2004 and harvested in December to remove first year growth. Harvest dates for the plant cane and ratoon crops were a few days before the milling dates of Dec. 13, 2005, Dec. 12, 2006, Dec. 16, 2007, and Nov. 23, 2008.

The energy cane rotation is expected to be for five to six years, including the establishment year. A production schedule was developed to simulate typical operations and was coupled with actual National Weather Service daily weather data for Jennings, Louisiana, since on-site weather records were not available.

Using EPIC to simulate the historical fresh weight yields, after calibrating crop physiological coefficients the simulated yields were 36.3, 43.0, 33.8, and 33.7 tons/acre for 2005-2008, respectively. The following graph depicts the relationship of simulated to producer yields; thereby producing a regression line having a slope of 0.916 with an R-squared=0.9869 (Figure 42). A slope of 1.0, depicted by the dashed line, indicates a perfect relationship or perfect correlation of simulated yields to the average producer yields for the four years.

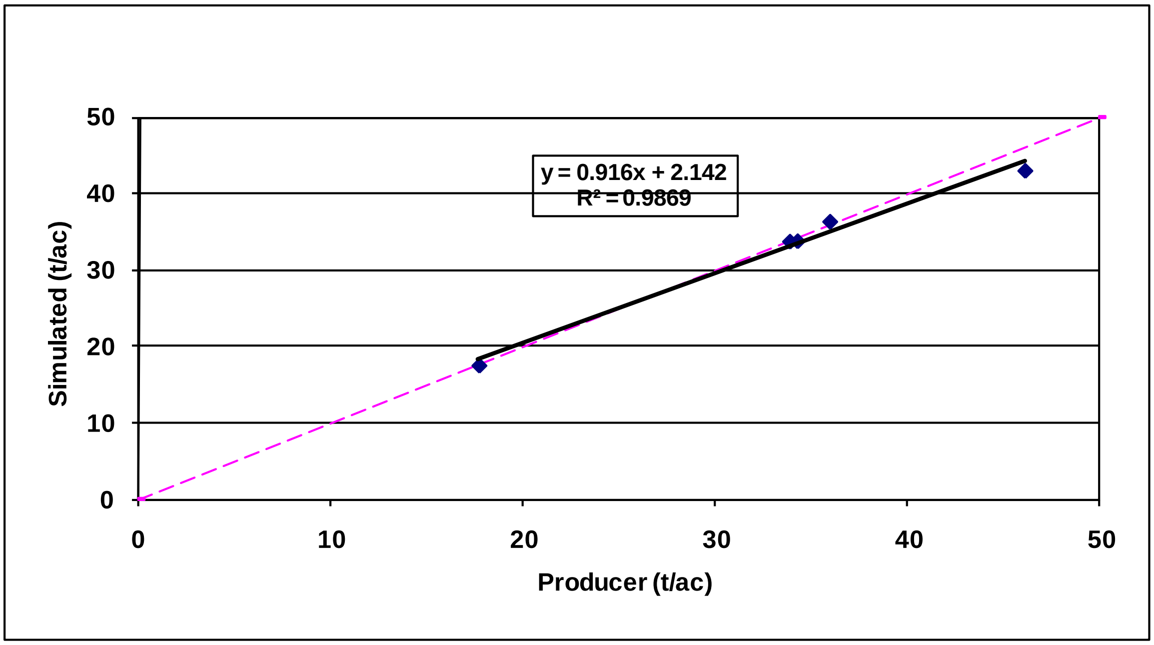

Figure 42: Correlation of simulated yields to producer average yields

Further statistical evidence that the simulated yields approximate the producer yields is illustrated by the paired t-test in Table 47. A difference of zero is being tested between the means of both sets of fresh weight yields, 36.71 versus 37.51 tons/acre for the producer mean versus the simulated mean, respectively. In this case, t = 1.03 which is less than the critical t value of 5.84 indicates the means are not significantly different at the 1 percent level.

Table 47: Energy Cane Yield Paired t-Test

Item	Simulated	Producer
Mean	37.505	36.708
Variance	33.425	19.093
Observations	4	4
Hypothesized Mean Difference	0	
df	3	
t Stat	1.025	
t Critical two-tail	5.841	

Utilizing the calibrated coefficients that were developed by simulating producer yields, a single run of 600 years was then simulated to produce 100 six-year rotations (the first year for establishment, the second is the plant cane year, and four ratoon crops). Daily weather based on historical records for 1960-2010 from the nearby weather station at Jennings, Louisiana, was utilized for the stochastic simulation. Three factors were adjusted in the long-term simulation: 1) the initial soil profile was maintained each year by stopping erosion, 2) N and P rates were adjusted from those in practice above to provide adequate plant nutrition over the long-term, and 3) weather parameters were developed from maximum and minimum temperatures and rainfall from daily weather records at Jennings, Louisiana. Wind speed records were obtained from Crowley, Louisiana. Daily weather coupled with the production practices over the long-term simulation period produced three probability distributions of 1) the establishment year, 2) the plant cane year, and 3) the four ratoon years. The following graphs depict the probability distributions.

The 100-year probability distribution of the fresh weight yield with typical 75 percent water content at harvest for the establishment year is illustrated in Figure 43 and Figure 44. The average was 18.48 tons/acre fresh weight. Yields varied from a low of 5.38 tons/acre to a high of 28.54 tons/acre.

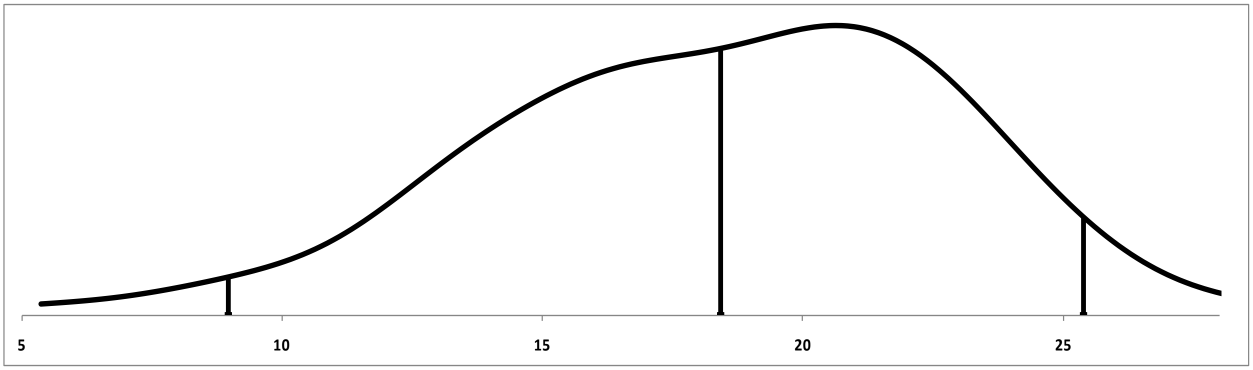

Figure 43: PDF of Establishment Year 1 Energy Cane Yields in Louisiana

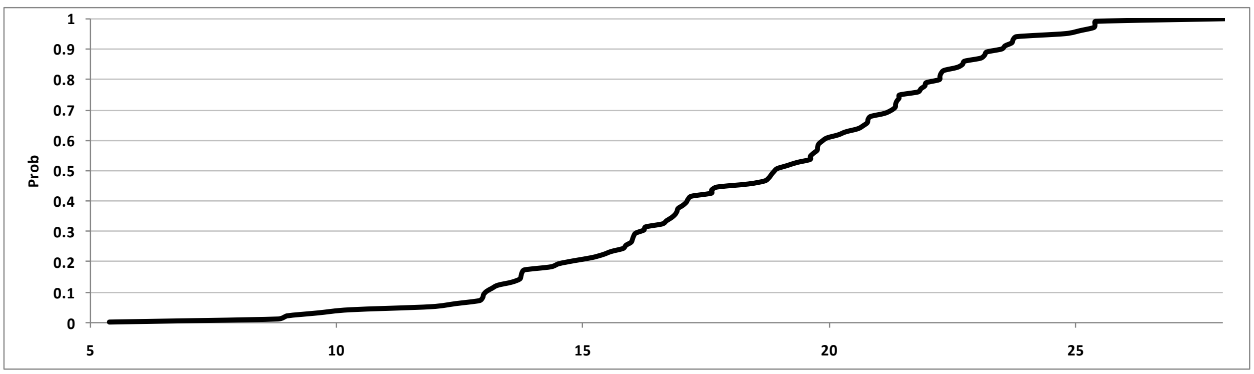

Figure 44: CDF of Establishment Year 1 Energy Cane Yields in Louisiana

The average fresh weight yield of the 100 stochastic observations for the plant cane year was 45.99 tons/acre. The range was 33.18 to 65.12 tons/acre. The probability distribution is illustrated in Figure 45 and Figure 46.

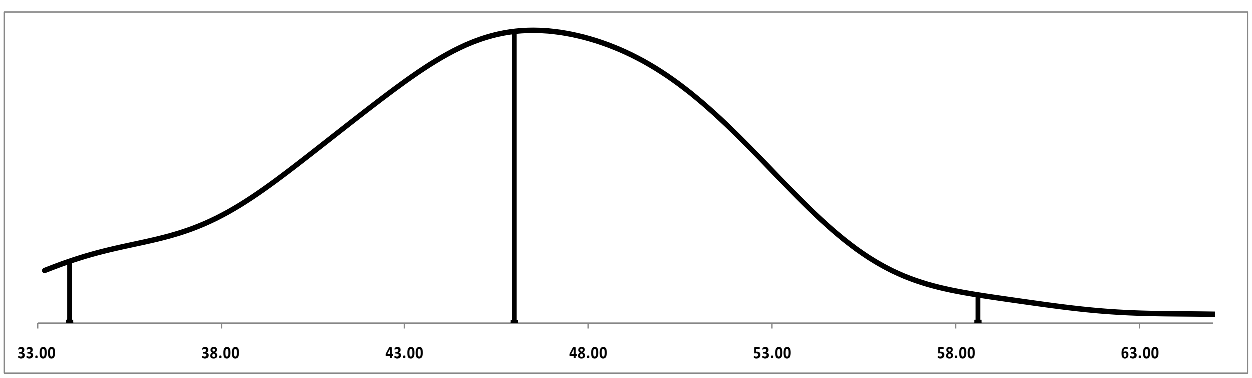

Figure 45: PDF of Plant Cane Year 2 Energy Cane Yields in Louisiana

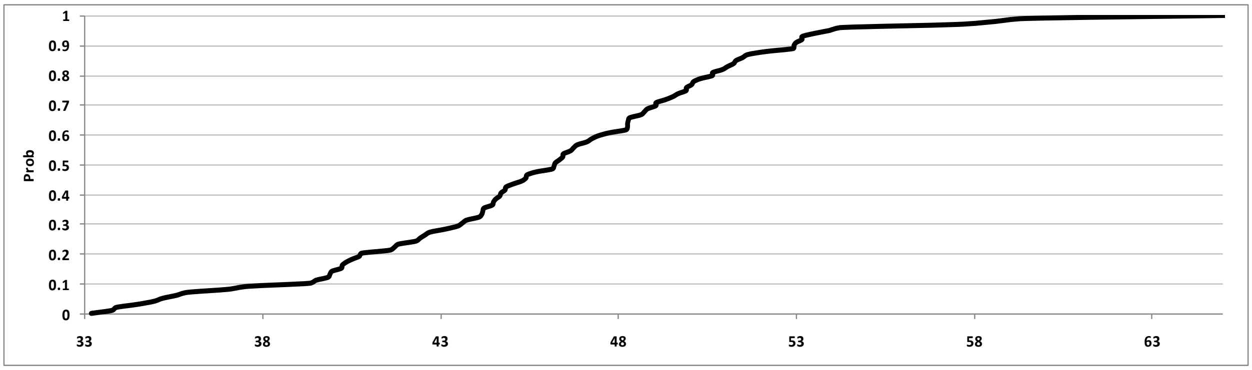

Figure 46: CDF of Plant Cane Year 2 Energy Cane Yields in Louisiana

The probability distribution for all four ratoon years of 100 stochastically generated yields per year is illustrated in Figures Figure 47 and Figure 48. The average yield was 42.94 tons/acre fresh weight with a range of 12.71 to 63.8 tons/acre.

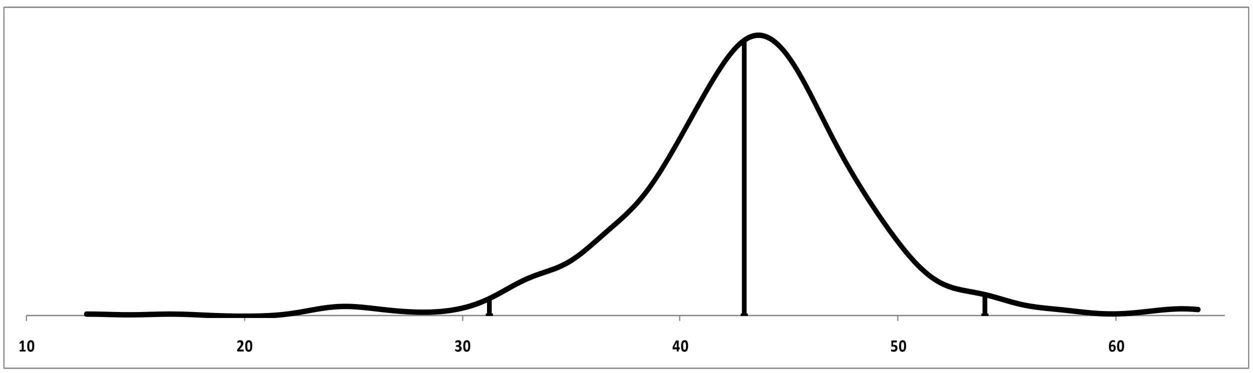

Figure 47: PDF of Ratoon Years 3-6 Energy Cane Yields in Louisiana

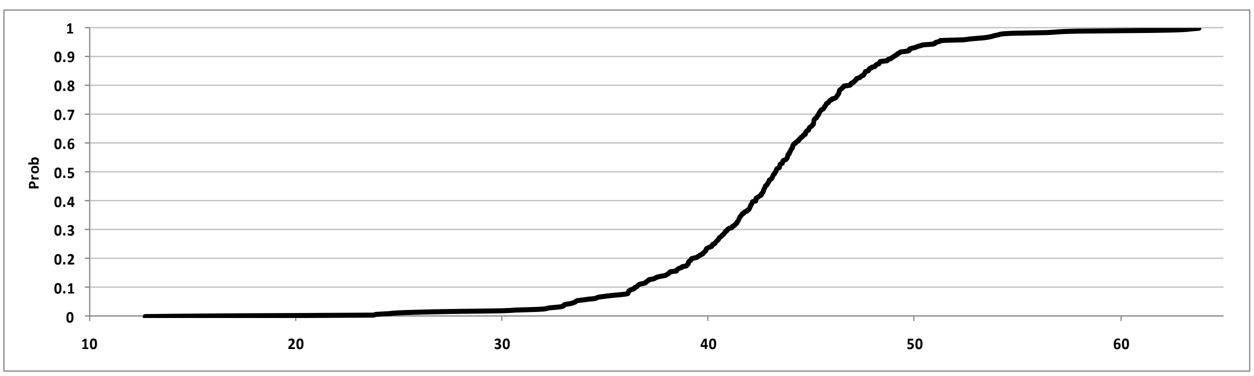

Figure 48: CDF of Ratoon Years 3-6 Energy Cane Yields in Louisiana

ENERGY CANE INSURANCE PREMIUM CALCULATIONS

The yield distributions for energy cane grown in southern Louisiana, as developed using the EPIC model, were used to estimate yield insurance premiums. There are three yield distributions for energy cane: Establishment Year 1, Plant Cane Year 2, and Ratoon Crop Energy Cane. These three yields distributions are best defined as:

- Establishment Year 1 – the crop is planted in August and it will produce a small crop that year which has to be harvested to make room for the next year's crop. This short harvest is pure biomass and because that is the purpose of the crop, we have estimated a probability distribution for the yield.
- Plant Cane Year 2 – in the sugar cane industry the first crop harvested after planting a crop is called the "plant cane year." We adopted that terminology to describe the distribution for energy cane yields obtained from the first full year of production.
- Ratoon Crop – is the yield we calculated for energy cane in years 3-6.

The analysis procedure used for all three Energy Cane yield distributions is the following:

- The summary statistics to describe the distribution are calculated. Probability density function (PDF) and cumulative distribution function (CDF) charts for the distribution are provided.
- The distribution was tested for Normality.
- Parameters for 15 parametric distributions are estimated using a maximum likelihood procedure in Simetar©. The parameters for an empirical distribution are estimated as well.
- The parameters for the 16 distributions are used to simulate the yield distribution for 500 iterations. Summary statistics for the distributions are compared to the original distribution.
- The CDFDEV function in Simetar© are used to determine how closely the 16 distributions reproduced the original distribution. Based on the CDFDEV criteria the four distributions that most closely simulate the original distribution are selected for analysis.
- The best four distributions were simulated in Simetar© for 25,000 iterations to estimate "fair insurance premiums" for eight yield coverage levels ranging from 50 percent to 85 percent of the average yield reported by the farmers in a focus group interview. The random number generator used for the analysis uses a Latin hypercube procedure and generates pseudo random numbers based on a fixed seed.
- The no load and fully loaded fair premiums are reported as $/acre values for the four assumed probability distributions for eight levels of possible year coverage.
- The no load fair insurance premium is calculated by multiplying the probability of each state of nature (indemnity) by its respective probability. Using a Monte Carlo simulation approach each insurance policy was simulated for 25,000 yields drawn at random from assumed probability distributions.
- The loaded insurance premium is calculated using a 0.90 unit division load factor, a 0.88 FCIC disaster reserve factor, and a 1.30 qualitative load factor.
- During the conference call with energy cane, breeders and experimentation sugar cane growers we were told that energy cane yield could be susceptible to freeze damage. The EPIC model is not capable of simulating freeze damage so a separate Bernoulli distribution with a 10 percent probability was used to augment the EPIC generated yield distributions during the insurance simulation step. At the beginning of each iteration, a uniform random deviate (0, 1) was drawn at random and if the value was less than 10 percent, the simulated yields for the four probability distributions were reduced by 50 percent. The 50 percent yield reduction was based on the scientists' experience with sugar cane under freeze conditions. The 10 percent probability of a yield reducing freeze event was calculated by counting the number of times the minimum daily temperature fell below 29 degrees for five consecutive days in December and January over the 121 year period from 1889 to 2010.

Each of the EPIC distributions is presented separately because they are completely different distributions.

Establishment Year Energy Cane Yield Distribution

The summary statistics in Table 48 report that the average yield in the establishment year is 18.4 tons/acre and the minimum expected yield is 5.38 tons/acre. The distribution is slightly skewed to the left given a skewness statistic of

-0.41. This shape is confirmed in the PDF and CDF charts for the establishment year (year one) yield distribution (Figure 43 and Figure 44).

Table 48: Summary Statistics for Base Yield Distribution of Establishment Year Energy Cane in Louisiana

	Base Yield
Mean	18.43
Standard Deviation	4.27
Min	5.38
Median	18.90
Max	28.54
Skewness	(0.41)
Kurtosis	0.04

Five statistical tests for normality were performed: Shapiro-Wilks, Anderson-Darling, Cramer von Mises, Kolmagarov-Smiroff, and Chi-Square (Table 49).All five tests reported that statically we cannot reject the null hypothesis that the distribution is distributed normal at the alpha equal 5 percent level of significance.

Table 49: Normality Test of the Yield Distribution for Establishment Year Energy Cane in Louisiana

Confidence Level		95.000%	
Procedure	Test Value	p-Value	
Shapiro-Wilks	0.983	0.226	Fail to Reject the Ho that the Distribution is Normally Distributed*
Anderson-Darling	0.541	0.162	Fail to Reject the Ho that the Distribution is Normally Distributed*
Cramer von Mises	0.088	0.841	Fail to Reject the Ho that the Distribution is Normally Distributed*
Kolmogorov-Smirnov	0.078	NA	Consult Critical Value Table
Chi-Squared	26.200	0.125	Fail to Reject the Ho that the Distribution is Normally Distributed*
			*Based on approximate p-values

Parameters for the 15 parametric distributions reported in Table 50 were simulated using a common uniform standard deviate to insure the results are directly comparable. The summary statistics for these distributions and the goodness of fit criteria (CDFDEV) for the 15 distributions and the empirical distribution are summarized in Table 50. The 16 distributions were simulated 500 iterations with a common uniform standard deviate. The resulting summary statistics are reported beside the parameters. All of the distributions reproduce the mean, as expected but a number of them fail to reproduce the range of the distribution. The CDFDEV criteria indicate the four best distributions for simulations: empirical, Weibull, normal, and beta; with the empirical distribution being best.

Table 50: Univariate Parameter Estimation for the Yield Distribution of Establishment Year Energy Cane in Louisiana

		MLEs		Statisitcs				Goodness of Fit	
Distribution	Parameters	Parm. 1	Parm. 2	Mean	Std. Dev.	Min	Max	CDFDEV Coefficient	Rank
Beta	**α, β**; A≤x≤B, α,β>0	2.842	2.336	18.09	4.64	6.48	28.03	0.8666	Fourth
Double Exponential	**α, β**; α≤x<∞, -∞<α<∞, β>0	18.900	3.479	18.90	4.92	(3.10)	41.15	10.0144	
Exponential	**μ, σ**; -∞<x<∞, -∞<μ<∞, σ>0	5.375	13.057	18.43	13.05	5.39	97.93	296.1777	
Gamma	**α, β**; 0≤x<∞, α,β>0	15.974	1.154	18.43	4.62	7.29	36.39	3.9075	
Logistic	**μ, σ**; 0≤x<∞, -∞<μ<∞, σ>0	18.595	2.448	18.59	4.44	1.42	35.95	3.1404	
Log-Log	**μ, σ**; -∞<x<∞, -∞<μ<∞, σ>0	16.234	4.579	18.88	5.87	7.31	48.69	22.8514	
Log-Logistic	**μ, σ**; 0≤x<∞, -∞<μ<∞, σ>0	6.996	18.256	18.88	5.08	6.70	50.28	19.5618	
Lognormal	**μ, σ**; 0≤x<∞, -∞<μ<∞, σ>0	2.883	0.266	18.50	5.01	7.78	41.21	9.0547	
Normal	**μ, σ**; -∞<x<∞, -∞<μ<∞, σ>0	18.433	4.254	18.43	4.26	5.15	31.80	0.8395	Third
Pareto	**α, β**; α≤x<∞, α,β>0	5.375	0.833	119.98	1,237.79	5.38	26,709.11	21,401,740.0980	
Uniform	**a, b**; a≤x≤b	5.375	28.540	16.96	6.69	5.40	28.52	12.6028	
Weibull	**α, β**; 0≤x<∞, α,β>0	5.061	3915773.381	18.44	4.18	5.02	29.55	0.2544	Second
Geometric	**p** ; x=1,2,...; 0≤p≤1	0.053		18.88	18.37	1.00	131.00	684.2553	
Poisson	**λ** ; x=0,1,...; 0≤λ<∞	17.880		17.89	4.24	6.00	33.00	1.3368	
Empirical	Si, F(x)			18.47	4.02	5.98	28.28	0.0647	Best

INSURANCE PREMIUMS FOR ESTABLISHMENT YEAR ENERGY CANE

Eight yield loss insurance policies were simulated for stochastic yields using the four best probability distributions. The eight policies are expressed as a fraction of the average yield of 18.4 wet tons/acre (APH) assuming a price guarantee of $65/dry ton or $16.25 per wet ton[16]. The eight policies are defined in terms of fraction from the APH and are 0.50, 0.55, 0.60, 0.65, 0.70, 0.75, 0.80, and 0.85. APH yield was assumed to equal the average for the base yield distributions from the EPIC runs.

The calculated insurance premiums are reported in Table 51. Based on the assumption that the Plant Year yield for energy cane is distributed empirically, the no load premiums are less than $11.00/acre for policies that insure 50 percent-65 percent of the APH. The no load premium at 70 percent APH is $10.70/acre. It increases rapidly thereafter with a $14.32/acre premium for 75 percent APH coverage, $18.74/acre for 80 percent APH coverage, and reaches $23.75/acre for 85 percent APH coverage.

The calculated insurance premiums for the other three probability distribution assumptions are all higher than those for the empirical distribution. For example, for the 85 percent APH policy, the Weibull distribution indicates a $24.23/acre premium, the normal distribution has a $23.92/acre premium, and the beta distribution has a $28.44/acre premium, while the empirical distribution calculated a premium of $23.57/acre.

The difference in premiums for each yield insurance policy differs across probability distributions due to the weight the distribution places on the insured range of the yield distribution. This relationship is illustrated in Figure 49, a PDF of the original yield distribution and the four selected distributions. The beta distribution is associated with the highest premiums for the 70 percent - 85 percent APH policies because it has more weight in the higher yield values over the range of 5.5 to about 15 tons/acre.

The fully loaded premium for the 85 percent APH coverage ranges from $38.69/acre for the empirical distribution to $46.69/acre for the beta distribution (Table 51). The fully loaded premium was calculated by dividing the no load fair premium by 0.90 (the unit division load factor) and then dividing that result by 0.88 (the FCIC disaster reserve factor) and multiplying by 1.3 (the qualitative load factor). The qualitative load factor of 1.3 is used to adjust for the lack of risk on the regression equations for physical relationships and production functions in the EPIC model. EPIC's only risk component is from the weather variables so it lacks the risk normally associated with simulating a regression equation used to predict production based on the values for the independent variables.

The loss cost ratios for each of the eight yield insurance policies were calculated as the ratio of the expected indemnity or loss and the liability. The loss cost ratio for the 85 percent APH policy ranges from 9.26 percent to 11.17 percent based on the distribution assumed (Table 51).

[16] A typical moisture content of 75 percent at harvest was utilized to convert from dry weight to wet weight.

Table 51: Yield Insurance Premiums for the Establishment Year of Energy Cane in Louisiana; Assuming Alternative Yield Coverage Levels and Yield Distributions, an APH Yield of 18.4 Tons Per Acre, and Guaranteed Price of $16.25 Per Wet Ton

	0.5 of APH	0.55 of APH	0.6 of APH	0.65 of APH	0.7 of APH	0.75 of APH	0.8 of APH	0.85 of APH
Liability								
($/acre)	149.77	164.74	179.72	194.70	209.67	224.65	239.63	254.60
No Load Fair Premium ($/acre)								
Empirical	2.11	3.58	5.55	7.95	10.70	14.32	18.74	23.57
Weibull	2.33	3.84	5.87	8.43	11.51	15.12	19.33	24.23
Normal	2.27	3.75	5.73	8.20	11.18	14.73	18.94	23.92
Beta	2.80	4.50	6.79	9.73	13.35	17.67	22.69	28.44
Fully Loaded Premium ($/acre)								
Empirical	3.46	5.88	9.11	13.05	17.56	23.51	30.76	38.69
Weibull	3.82	6.30	9.64	13.84	18.89	24.82	31.72	39.76
Normal	3.72	6.16	9.41	13.46	18.36	24.18	31.08	39.26
Beta	4.59	7.39	11.15	15.96	21.91	29.01	37.24	46.69
Loss Cost (%)								
Empirical	1.41%	2.17%	3.09%	4.08%	5.10%	6.37%	7.82%	9.26%
Weibull	1.56%	2.33%	3.27%	4.33%	5.49%	6.73%	8.07%	9.52%
Normal	1.51%	2.28%	3.19%	4.21%	5.33%	6.56%	7.90%	9.39%
Beta	1.87%	2.73%	3.78%	4.99%	6.37%	7.87%	9.47%	11.17%
Fully Loaded Base Premium (%)								
Empirical	2.3%	3.6%	5.1%	6.7%	8.4%	10.5%	12.8%	15.2%
Weibull	2.6%	3.8%	5.4%	7.1%	9.0%	11.0%	13.2%	15.6%
Normal	2.5%	3.7%	5.2%	6.9%	8.8%	10.8%	13.0%	15.4%
Beta	3.1%	4.5%	6.2%	8.2%	10.5%	12.9%	15.5%	18.3%

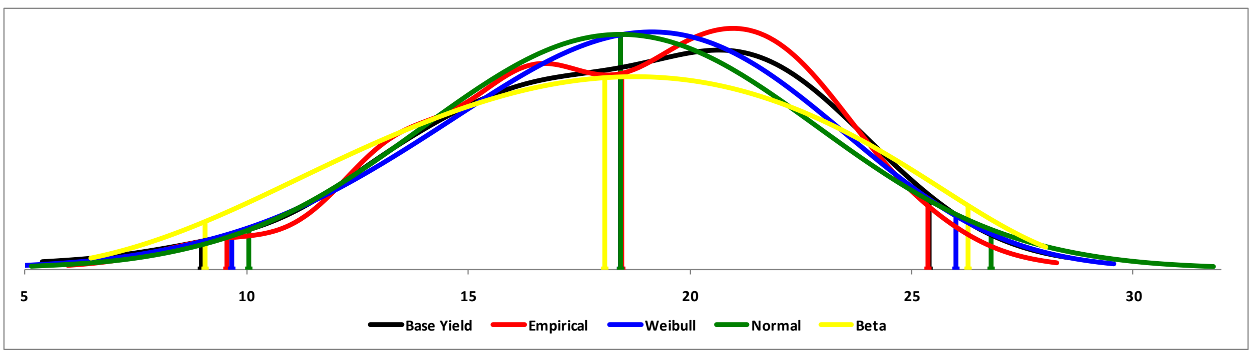

Figure 49: PDF of Alternative Distributions of Energy Cane Yields for Establishment Year in Louisiana

Base Premium Rates for Establishment Year Energy Cane

The base premiums calculated for the fully loaded premium range from 15.2% to 18.3% for the 85% APH yield coverage policy. At the 65% coverage level, the base premium ranges from 6.7% to 8.2%. At the 50% coverage level, the base premium rates range from 2.3 to 3.1%.

SUMMARY FOR ESTABLISHMENT YEAR ENERGY CANE YIELD DISTRIBUTION

The yield distribution has a mean of 18.4 tons/acre and a range of 5.3 tons/acre to 28.5 tons/acre. Simulation results for eight possible yield insurance policies indicate high fully loaded premiums (greater than $21/acre) for insured yield equal to 70 percent of an APH equal to 18.4 tons/acre and a price election of $16.25/ wet ton. At the highest levels of yield coverage (85 percent of APH), the insurance premiums range from $46.69 to $38.69/acre, or 15.2 percent to 18.3 percent of liability.

The biggest problem with insuring energy cane production for the establishment year is the lack of information to calculate the farmer's APH. By definition of an establishment year there is no yield history for the farmer to calculate the APH on that field. Using the average yield from the EPIC model will have to suffice until sufficient results across years and fields are accumulated to develop a more appropriate estimate of the APH and its distribution.

Plant Cane Year Energy Cane Yield Distribution

The summary statistics in Table 52 report that the average energy cane yield for a plant year cane (year 2) stand is 45.99 tons/acre and the minimum expected yield is 33.18 tons/acre. The distribution is slightly skewed to the right given a skewness statistic of 0.11. This shape is confirmed in the PDF and CDF charts for the plant year cane crop yield distribution (Figure 45 and Figure 46).

Table 52: Summary Statistics for Base Yield Distribution of Plant Year Cane Energy Cane in Louisiana

	Base Yield
Mean	45.99
Standard Deviation	5.91
Min	33.18
Median	46.21
Max	65.12
Skewness	0.11
Kurtosis	0.51

Five statistical tests for normality were performed: Shapiro-Wilks, Anderson-Darling, Cramer von Mises, Kolmagarov-Smiroff, and Chi-Square (Table 53). All five tests reported that statically we cannot reject the null hypothesis that the distribution is distributed normal at the alpha equal 5 percent level of significance.

Table 53: Normality Test for the Yield Distribution of Plant Year Cane Energy Cane in Louisiana

Confidence Level		95.000%	
Procedure	Test Value	p-Value	
Shapiro-Wilks	0.985	0.306	*Fail to Reject the Ho that the Distribution is Normally Distributed**
Anderson-Darling	0.339	0.494	*Fail to Reject the Ho that the Distribution is Normally Distributed**
Cramer von Mises	0.039	0.705	*Fail to Reject the Ho that the Distribution is Normally Distributed**
Kolmogorov-Smirnov	0.054	NA	*Consult Critical Value Table*
Chi-Squared	17.600	0.549	*Fail to Reject the Ho that the Distribution is Normally Distributed**
			**Based on approximate p-values*

Parameters for the 15 parametric distributions reported in Table 54 were simulated for 500 iterations using a common uniform standard deviate to insure the results are directly comparable. The summary statistics for these distributions and the goodness of fit criteria (CDFDEV) for the 15 distributions and the empirical distribution are summarized in Table 54. The 16 distributions were simulated 500 iterations and the resulting summary statistics are reported beside the parameters. All of the distributions reproduce the mean, as expected but a number of them fail to reproduce the range of the distribution. The CDFDEV criteria indicate the four best distributions for simulating the distribution are empirical, gamma, normal, and lognormal; with the empirical distribution being best.

Table 54: Univariate Parameter Estimation for the Yield Distribution of Plant Year Cane Energy Cane in Louisiana

		MLEs		Statisitcs				Goodness of Fit	
Distribution	Parameters	Parm. 1	Parm. 2	Mean	Std. Dev.	Min	Max	CDFDEV Coefficient	Rank
Beta	***α, β*** ; A≤x≤B, α,β>0	2.021	3.066	45.87	6.34	33.58	63.10	2.2398	
Double Exponential	***α, β*** ; α≤x<∞, -∞<α<∞, β>0	46.212	4.583	46.21	6.48	17.22	75.52	12.9588	
Exponential	***μ, σ*** ; -∞<x<∞, -∞<μ<∞, σ>0	33.178	12.811	45.99	12.81	33.19	123.99	203.0698	
Gamma	***α, β*** ; 0≤x<∞, α,β>0	60.243	0.763	45.99	5.93	29.68	66.89	1.3845	Second
Logistic	***μ, σ*** ; 0≤x<∞, -∞<μ<∞, σ>0	46.041	3.296	46.04	5.98	22.91	69.40	4.3479	
Log-Log	***μ, σ*** ; -∞<x<∞, -∞<μ<∞, σ>0	43.056	5.724	46.36	7.34	31.90	83.63	19.5668	
Log-Logistic	***μ, σ*** ; 0≤x<∞, -∞<μ<∞, σ>0	13.689	45.974	46.38	6.21	27.53	77.15	7.4599	
Lognormal	***μ, σ*** ; 0≤x<∞, -∞<μ<∞, σ>0	3.820	0.130	45.99	6.01	30.40	68.61	1.8447	Fourth
Normal	***μ, σ*** ; -∞<x<∞, -∞<μ<∞, σ>0	45.989	5.880	45.99	5.89	27.63	64.47	1.5265	Third
Pareto	***α, β*** ; α≤x<∞, α,β>0	33.178	3.143	48.61	23.53	33.19	316.53	2,324.9090	
Uniform	***a, b*** ; a≤x≤b	33.178	65.122	49.15	9.23	33.21	65.09	33.3208	
Weibull	***α, β*** ; 0≤x<∞, α,β>0	8.068	4.033020E+13	45.76	6.75	20.35	61.92	7.8436	
Geometric	***p*** ; x=1,2,...; 0≤p≤1	0.022		46.52	46.02	1.00	327.00	4,838.7948	
Poisson	***λ*** ; x=0,1,...; 0≤λ<∞	45.510		45.51	6.75	26.00	68.00	4.0444	
Empirical	Si, F(x)			45.95	5.56	33.28	64.66	0.2161	Best

INSURANCE PREMIUMS FOR PLANT YEAR CANE ENERGY CANE

Eight yield loss insurance policies were simulated for stochastic yields using the four best probability distributions. The eight policies are expressed as a fraction of the average yield of 46 tons/acre (APH) assuming a price guarantee of $65/ton. The eight policies are defined in terms of fraction from the APH and are: 0.50, 0.55, 0.60, 0.65, 0.70, 0.75, 0.80, and 0.85. APH yield was assumed to equal the average for the base yield distributions from the EPIC runs.

The calculated fully loaded insurance premiums are reported in Table 55. Based on the assumption that the yield for a Plant Year Cane stand of energy cane is distributed empirically, the premiums are less than $20.00/acre for policies that insure 50 percent-65 percent of the APH. The fully loaded premium at 70 percent APH is $26.41/acre. It increases rapidly thereafter with a $33.86/acre premium for 75 percent APH coverage, $42.96/acre for 80 percent APH coverage, and reaches $54.30/acre for 85 percent APH coverage. The fully loaded insurance premiums for the normal probability distribution are higher than those for the empirical distribution. For example, for the 85 percent APH policy, the normal distribution indicates a $54.41 premium per acre versus $54.30 for the empirical distribution. Overall, the premium rates are very close for each distribution.

The difference in premiums for each yield insurance policy differ due to the weight the distribution places on the insured range of the distribution. This relationship is illustrated in Figure 50, a PDF of the original yield distribution and the four selected distributions. The normal distribution is associated with the highest premiums for the 65 percent - 85 percent APH policies because it has more weight in the low yield values over the range of 27 to 37 tons/acre.

Base Premium Rates for Plant Year Cane Year 2 Energy Cane

The base premiums calculated for the fully loaded premium range from 8.3% to 8.6% for the 85% APH yield coverage policy. At the 65 percent APH coverage level, the base premium is 4.1% for all four distributions. At the 50% level of coverage, the base premium for the empirical distribution ranges between 0.8% and 0.9%.

Table 55: Yield Insurance Premiums for Plant Year Cane Energy Cane in Louisiana; Assuming Alternative Yield Coverage Levels and Yield Distributions, an APH Yield of 46 Tons Per Acre, and Guaranteed Price of $16.25 Per Wet Ton

	0.5 of APH	0.55 of APH	0.6 of APH	0.65 of APH	0.7 of APH	0.75 of APH	0.8 of APH	0.85 of APH
Liability								
($/acre)	373.66	411.02	448.39	485.76	523.12	560.49	597.85	635.22
No Load Fair Premium ($/acre)								
Empirical	1.90	4.50	8.16	12.09	16.09	20.33	26.17	33.08
Gamma	2.02	4.67	8.18	12.08	16.16	20.53	25.65	32.39
Normal	2.00	4.61	8.15	12.12	16.33	20.88	26.24	33.15
Lognormal	2.03	4.70	8.21	12.08	16.13	20.43	25.44	32.12
Fully Loaded Premium ($/acre)								
Empirical	3.12	7.39	13.39	19.85	26.41	33.36	42.96	54.30
Gamma	3.31	7.66	13.43	19.83	26.53	33.71	42.10	53.17
Normal	3.29	7.56	13.38	19.90	26.80	34.28	43.07	54.41
Lognormal	3.34	7.72	13.47	19.83	26.47	33.53	41.76	52.72
Loss Cost (%)								
Empirical	0.51%	1.10%	1.82%	2.49%	3.08%	3.63%	4.38%	5.21%
Gamma	0.54%	1.14%	1.82%	2.49%	3.09%	3.66%	4.29%	5.10%
Normal	0.54%	1.12%	1.82%	2.50%	3.12%	3.73%	4.39%	5.22%
Lognormal	0.54%	1.14%	1.83%	2.49%	3.08%	3.64%	4.26%	5.06%
Fully Loaded Base Premium (%)								
Empirical	0.8%	1.8%	3.0%	4.1%	5.0%	6.0%	7.2%	8.5%
Gamma	0.9%	1.9%	3.0%	4.1%	5.1%	6.0%	7.0%	8.4%
Normal	0.9%	1.8%	3.0%	4.1%	5.1%	6.1%	7.2%	8.6%
Lognormal	0.9%	1.9%	3.0%	4.1%	5.1%	6.0%	7.0%	8.3%

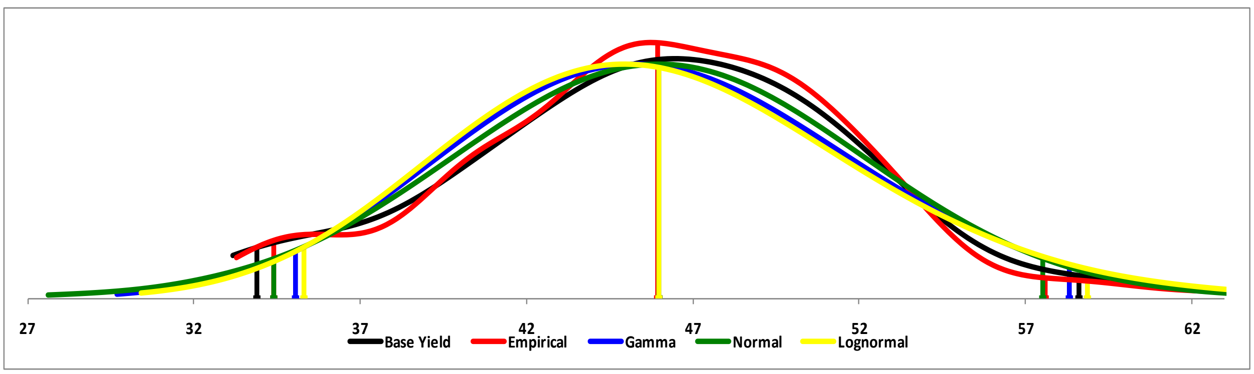

Figure 50: PDF of Alternative Distributions of Plant Year Cane Year 2 Energy Cane Yields in Louisiana

SUMMARY FOR PLANT YEAR CANE YEAR 2 ENERGY CANE YIELD DISTRIBUTION

The yield distribution has a mean of 46 tons/acre and a range of 33.18 tons/acre to 65.12 tons/acre. We fail to reject that the yield distribution is distributed normal and it is the third best distribution for simulating the EPIC generated yield distribution. Simulation results for eight possible yield insurance policies indicate high fully loaded premium rates (less than 5%) for insured yield less than 70 percent of an APH equal to 46 tons per acre and a price election of $65/ dry ton. At the highest levels of yield coverage (85 percent of APH), the fully loaded insurance premiums range from 8.3 percent to 8.6 percent of liability.

The biggest problem with insuring energy cane production for a Plant Year Cane stand is the lack of information to calculate the farmer's APH. Producers do not have sufficient years of experience growing energy cane to have 10 years of yields for establishing an APH. Using the average yield from the EPIC model will have to suffice until sufficient results across years and fields are accumulated to develop a more appropriate estimate of the APH and its distribution.

Ratoon Crop Energy Cane Yield Distribution

The summary statistics in Table 56 report that the average energy cane yield for a ratoon crop stand is 42.94 tons/acre and the minimum expected yield is 12.71 tons/acre. The distribution is slightly skewed to the left given a skewness statistic of -0.56. This shape is confirmed in the PDF and CDF charts for the ratoon crop yield distribution (Figure 47 and Figure 48).

Table 56: Summary Statistics for Base Yield Distribution of Ratoon Crop Energy Cane in Louisiana

	Base Yield
Mean	42.94
Standard Deviation	5.82
Min	12.71
Median	43.25
Max	63.80
Skewness	-0.56
Kurtosis	4.08

Five statistical tests for normality were performed: Shapiro-Wilks, Anderson-Darling, Cramer von Mises, Kolmagarov-Smiroff, and Chi-Square (Table 57). All five normality tests reported that statically the distribution is not distributed normal.

Table 57: Normality Test for the Yield Distribution of Ratoon Crop Energy Cane in Louisiana

Confidence Level		95.000%	
Procedure	Test Value	p-Value	
Shapiro-Wilks	0.941	0.000	*Reject the Ho that the Distribution is Normally Distributed**
Anderson-Darling	4.942	0.000	*Reject the Ho that the Distribution is Normally Distributed**
Cramer von Mises	0.821	0.000	*Reject the Ho that the Distribution is Normally Distributed**
Kolmogorov-Smirnov	0.075	NA	*Consult Critical Value Table*
Chi-Squared	39.650	0.004	*Reject the Ho that the Distribution is Normally Distributed**
			**Based on approximate p-values*

Parameters for the 15 parametric distributions reported in Table 58 were simulated for 500 iterations using a common uniform standard deviate to insure the results are directly comparable. The summary statistics for these distributions and the goodness of fit criteria (CDFDEV) for the 15 distributions and the empirical distribution are summarized in Table 58. The 16 distributions were simulated 500 iterations and the resulting summary statistics are reported beside the parameters. All of the distributions reproduce the mean, as expected but a number of them fail to reproduce the range of the distribution. The CDFDEV criteria indicate the four best distributions for simulating the distribution are Weibull, empirical, beta, and normal; with the Weibull distribution being best.

Table 58: Univariate Parameter Estimation for the Yield Distribution of Ratoon Crop Energy Cane in Louisiana

		MLEs		Statisitcs				Goodness of Fit	
Distribution	Parameters	Parm. 1	Parm. 2	Mean	Std. Dev.	Min	Max	CDFDEV	Rank
Beta	***α, β*** ; A≤x≤B, α,β>0	7.685	5.491	42.51	6.70	22.43	59.41	80.97	Third
Double Exponential	***α, β*** ; α≤x<∞, -∞<α<∞, β>0	43.251	4.070	43.25	5.76	17.51	69.28	99.65	
Exponential	***μ, σ*** ; -∞<x<∞, -∞<μ<∞, σ>0	12.708	30.237	42.95	30.23	12.73	227.04	2,461.04	
Gamma	***α, β*** ; 0≤x<∞, α,β>0	47.522	0.904	42.94	6.24	26.09	65.23	100.62	
Logistic	***μ, σ*** ; 0≤x<∞, -∞<μ<∞, σ>0	43.107	2.984	43.11	5.42	22.16	64.26	87.86	
Log-Log	***μ, σ*** ; -∞<x<∞, -∞<μ<∞, σ>0	39.878	7.731	44.34	9.92	24.81	94.67	277.63	
Log-Logistic	***μ, σ*** ; 0≤x<∞, -∞<μ<∞, σ>0	13.543	42.909	43.30	5.86	25.56	72.42	116.08	
Lognormal	***μ, σ*** ; 0≤x<∞, -∞<μ<∞, σ>0	3.749	0.153	42.99	6.62	26.37	68.70	114.38	
Normal	***μ, σ*** ; -∞<x<∞, -∞<μ<∞, σ>0	42.944	5.814	42.94	5.82	24.79	61.22	85.60	Fourth
Pareto	***α, β*** ; α≤x<∞, α,β>0	12.708	0.828	293.42	3,061.34	12.72	66,104.93	1.312158E+08	
Uniform	***a, b*** ; a≤x≤b	12.708	63.801	38.25	14.77	12.75	63.76	233.23	
Weibull	***α, β*** ; 0≤x<∞, α,β>0	7.708	5.885879E+12	42.65	6.56	18.25	58.50	73.05	First
Binomial	***n, p*** ; x=0,1,2,…,n; 0≤p≤1	13300.000	0.003	42.44	6.51	24.00	64.00	91.25	
Geometric	***p*** ; x=1,2,…; 0≤p≤1	0.023		43.45	42.95	1.00	305.00	5,008.14	
Poisson	***λ*** ; x=0,1,…; 0≤λ<∞	42.445		42.44	6.52	24.00	64.00	91.11	
Empirical	***Si, F(x)***			42.96	5.58	15.50	63.67	79.91	Second

Insurance Premiums for Ratoon Crop Energy Cane

Eight yield loss insurance policies were simulated for stochastic yields using the four best probability distributions. The eight policies are expressed as a fraction of the average yield of 43.0 tons/acre (APH) assuming a price guarantee of $65/ton. The eight policies are defined in terms of fraction from the APH and are 0.50, 0.55, 0.60, 0.65, 0.70, 0.75, 0.80, and 0.85. APH yield was assumed to equal the average for the base yield distributions from the EPIC runs.

The calculated insurance premiums are reported in Table 59. Based on the assumption that the yield for a ratoon crop of energy cane is distributed via the Weibull distribution, the premiums are less than $21.00/acre for policies that insure less than 65 percent of the APH. The fully loaded premium at 70 percent APH is $28.41/acre. It increases rapidly thereafter with a $37.32/acre premium for 75 percent APH coverage, $47.98/acre for 80 percent APH coverage, and reaches $61.26/acre for 85 percent APH coverage.

The calculated insurance premiums for the Weibull probability distribution are higher than those for the other distributions for five of the eight coverage levels. For example at the 70 percent APH coverage level the Weibull's fully loaded premium is $28.41/acre while the next highest premium is from the beta distribution with a $27.29/acre premium.

The difference in premiums for each yield insurance policy differ due to the weight the distribution places on the insured range of the distribution. This relationship is illustrated in Figure 51 , a CDF of the original yield distribution and the four selected distributions. The Weibull distribution is associated with the highest premiums for the 60 percent-70 percent and 80 percent-85 percent APH policies because it has more weight in the low yield values less than 38 tons/acre.

Base Premium for Ratoon Crop Energy Cane

The base premiums calculated for the fully loaded premium range from 8.8% to 10.3% for the 85% APH yield coverage policy. At the 65% APH coverage level, the base premium ranges from 4.1% to 4.6%. At the 50 percent level of coverage, the base premium for the Weibull distribution is 1.2% of liability.

Table 59: Yield Insurance Premiums for Ratoon Crop Energy Cane in Louisiana; Assuming Alternative Yield Coverage Levels and Yield Distributions, an APH Yield of 43 Tons Per Acre, and Guaranteed Price of $65 Per Ton

	0.5 of APH	0.55 of APH	0.6 of APH	0.65 of APH	0.7 of APH	0.75 of APH	0.8 of APH	0.85 of APH
Liability								
($/acre)	348.92	383.81	418.70	453.60	488.49	523.38	558.27	593.16
No Load Fair Premium ($/acre)								
Weibull	2.45	4.90	8.39	12.58	17.31	22.74	29.23	37.32
Empirical	1.87	4.48	8.21	12.34	16.61	21.06	26.17	32.23
Beta	2.51	4.91	8.18	12.11	16.63	21.97	28.61	37.20
Normal	1.98	4.39	7.66	11.38	15.39	19.81	25.09	31.93
Fully Loaded Premium ($/acre)								
Weibull	4.02	8.04	13.77	20.65	28.41	37.32	47.98	61.26
Empirical	3.08	7.36	13.47	20.26	27.27	34.56	42.96	52.90
Beta	4.12	8.06	13.42	19.87	27.29	36.06	46.97	61.06
Normal	3.25	7.21	12.58	18.68	25.25	32.52	41.19	52.41
Loss Cost (%)								
Weibull	0.70%	1.28%	2.00%	2.77%	3.54%	4.34%	5.24%	6.29%
Empirical	0.54%	1.17%	1.96%	2.72%	3.40%	4.02%	4.69%	5.43%
Beta	0.72%	1.28%	1.95%	2.67%	3.40%	4.20%	5.13%	6.27%
Normal	0.57%	1.14%	1.83%	2.51%	3.15%	3.79%	4.49%	5.38%
Fully Loaded Base Premium (%)								
Weibull	1.2%	2.1%	3.3%	4.6%	5.8%	7.1%	8.6%	10.3%
Empirical	0.9%	1.9%	3.2%	4.5%	5.6%	6.6%	7.7%	8.9%
Beta	1.2%	2.1%	3.2%	4.4%	5.6%	6.9%	8.4%	10.3%
Normal	0.9%	1.9%	3.0%	4.1%	5.2%	6.2%	7.4%	8.8%

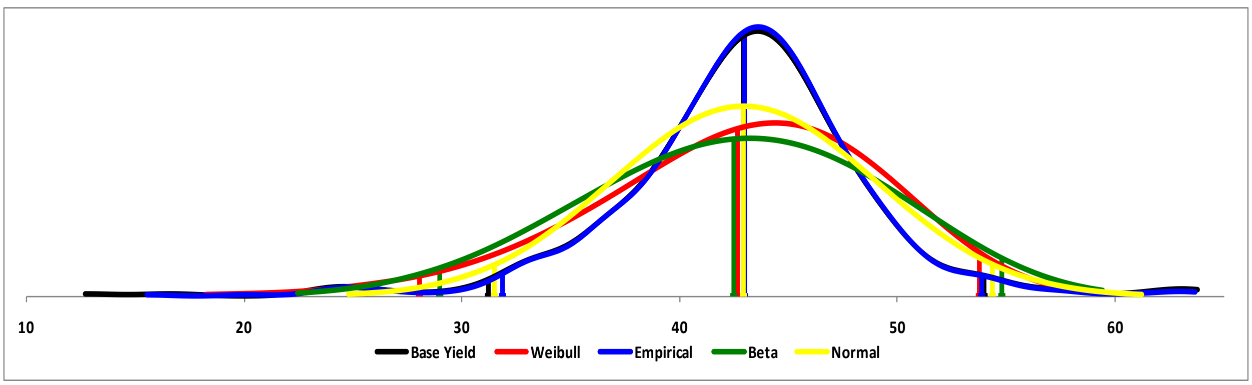

Figure 51: PDF of Alternative Distributions of Ratoon Crop Energy Cane Yields in Louisiana

As illustrated in Table 60, the calculated premiums for energy cane are compared to those from sugarcane in Jefferson Davis parish Louisiana. RMA's Cost Estimator for 2011 was utilized to determine the estimated liability and total premium for sugarcane. Parameters used for the sugarcane estimate included an APH equivalent to the reference yield, 100 percent price election, and a basic unit. The base rate for each crop is illustrated in the table and is calculated by dividing the total premium by the liability for each coverage level. The results demonstrate that estimated premiums for the Weibull distribution of sugarcane at the higher coverage levels track very close to those of sugarcane. Specifically for the Weibull distribution, the difference in the estimated base rates at the 75 percent coverage level is 75.26 percent higher for energy cane. At the 75 percent coverage level, the total base rate for 2011sugarcane is 4.07% while the Weibull premium estimate for energy cane is 7.13%. The estimate for the empirical distribution is 62.30 percent higher for energy cane at the 75 percent coverage level. These results suggest that the EPIC model and a proxy crop such as sugarcane may prove useful in establishing rates for energy cane.

Table 60: Comparison of Energy Cane Premium Estimates to Sugarcane Premium Estimates

Sugarcane: Louisiana, Jefferson Davis Parish APH						
Parameters: APH 5170, Reference Yield 5170, Basic Unit, Price Election 100% @ $0.1205						
Sugarcane	**75%**	**70%**	**65%**	**60%**	**55%**	**50%**
Liability Amount	$467.00	$436.00	$405.00	$374.00	$343.00	$311.00
Total Premium Amount	$19.00	$15.00	$11.00	$9.00	$7.00	$5.00
Calculated Base Premium Rate	4.07%	3.44%	2.72%	2.41%	2.04%	1.61%
Ratoon Energy Cane: Louisiana, Jefferson Davis Parish APH						
Parameters: Non-Irrigated APH 43 tons, Basic Unit, Price Election 100% @$65/dry ton ($16.25/wet ton)						
Energy Cane	**75%**	**70%**	**65%**	**60%**	**55%**	**50%**
Liability Amount	$523.38	$488.49	$453.60	$418.70	$383.81	$348.92
Total Premium Amount:						
Weibull	$37.32	$28.41	$20.65	$13.77	$8.04	$4.02
Empirical	$34.56	$27.27	$20.26	$13.47	$7.36	$3.08
Beta	$36.06	$27.29	$19.87	$13.42	$8.06	$4.12
Normal	$32.52	$25.25	$18.68	$12.58	$7.21	$3.25
Calculated Base Premium Rate:						
Weibull	7.13%	5.82%	4.55%	3.29%	2.09%	1.15%
Empirical	6.60%	5.58%	4.47%	3.22%	1.92%	0.88%
Beta	6.89%	5.59%	4.38%	3.21%	2.10%	1.18%
Normal	6.21%	5.17%	4.12%	3.00%	1.88%	0.93%
% Difference from Proxy Crop:						
Weibull	75.26%	69.05%	67.61%	36.67%	2.64%	-28.34%
Empirical	62.30%	62.26%	64.45%	33.69%	-6.04%	-45.09%
Beta	69.34%	62.38%	61.28%	33.19%	2.90%	-26.56%
Normal	52.72%	50.25%	51.62%	24.86%	-7.95%	-42.06%

Summary for Ratoon Crop Energy Cane Yield Distribution

The ratoon crop energy cane yield distribution has a mean of 42.94 tons/acre and a range of 12.7 tons/acre to 63.8 tons/acre. Statistically the yield distribution is not distributed normal yet it is the fourth best distribution for simulating the EPIC generated ratoon crop yield distribution. Simulation results for eight possible yield insurance policies indicate fully loaded premium rates greater than those of sugarcane. At the highest levels of sugarcane yield coverage (75 percent of APH) the fully loaded insurance premium rates for energy cane range from 6.21 percent to 7.13 percent of liability versus 4.07 percent for sugarcane. While estimated rates are higher for energy cane than those of sugarcane, the results of EPIC yield modeling suggest that the methodology may prove useful for developing rates and transitional yields for areas with limited data sets.

Feasibility Recommendation

Currently there are only two producers and less than 1,000 acres of energy cane grown for a demonstration scale bio-refinery in Jennings, LA (Musial, 2011). While demand drivers for energy cane suggest that an acceptable demand for energy cane insurance is present, the lack of a potential market may cause concerns for program acceptance by RMA, due to the lack of geographic diversity and the lack of current producers to spread risk over an acceptable pool of insureds.

Further, the RMA Program Evaluation Tool Decision Tree results for energy cane in Louisiana indicate that no action is required or no new product be developed. See Appendix M for a graphical representation of the decision tree process for Louisiana. The decision tree path is marked by highlighted red arrows. Because there are currently few commercial producers of energy cane (no significant market), the decision tree suggests that no insurance policy needs to be developed.

Recommendation

Based on the research and analysis of energy cane, it is determined that the development of a crop insurance product for commercially grown energy cane for dedicated energy is not feasible at this time. The recommended course of action is to not develop a crop insurance program for energy cane. While this recommendation is based solely on the lack of current commercial production, potential may exist for a crop insurance program for commercial production of energy cane in the future.

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APPENDIX A: WILLAMETTE BIOMASS PROCESSORS, INC.- CAMELINA PRODUCTION CONTRACT FOR OREGON 2008

Camelina Program - Partnering with Willamette Biomass Processors, Inc. (WBP) will require the planting of camelina during 2008 and committing all production yield from those acres to WBP. All WBP camelina must be contracted before March 1, 2008 and will be planted between March 1 and no later than April 15, 2008 unless otherwise approved in writing by WBP.

Camelina Production – The grower must purchase all camelina seed necessary to satisfy the terms of this agreement from either WBP or its agent at $1.00/lb. Once harvested, Grower agrees to store seed product on farm or to deliver seed product to a designated point for transportation or storage. Other non-WBP designated storage must be agreed to by WBP in writing and available for pickup by a date to be determined on a case by case basis. WBP will reimburse or take responsibility for all shipping costs to a designated storage or processing facility with a WBP written approved load minimum. Seed Product is to be stored in a manner that will result in its moisture content not exceeding 8% based upon a canola scale in a grain moisture meter.

Planting - WBP asks that planting should occur between February 1, 2008 and April 15, 2008 unless a written deviation is approved. Grower must notify WBP within 10 days of planting. Notification can be made through WBP's website at www.willamettebiomass.com or by calling WBP directly at 503.559.3513. Grower must also confirm the exact location of where the seed product has been planted (Field ID). Grower may use either a grain drill or broadcast method depending upon their available seeding equipment. Grower agrees to give Willamette Biomass Processors, Inc. and its' agents access to fields where seed product is being grown and locations where seed product is being stored.

Payment – WBP will pay Grower $ .11/per pound of seed product grown under this contract plus early incentives. The $.11/lb. will be paid as $.055/lb. at harvest and $.055/lb. when delivered to the WBP processing facility in Rickreall, Oregon. Also, all Oregon Growers are eligible to receive an additional $.05/lb. Oregon Tax Credit as part of Oregon HB-2210*. Additionally, all growers that contract for the 2008 planting season will receive a $15/acre sign-on incentive to front the cost of planting. This $15/acre planting incentive will be paid out as $10/acre at contract signing plus an additional $5/acre at emergence when confirmed by a WBP agent/service representative. WBP will pay unpaid balance to grower within 30 days after delivery to a WBP processing facility.

Please see example of payment schedule attached at the end of the contract

Market Sharing Partnership - WBP makes this contract offer assuming a predetermined raw vegetable oil and crushed meal target price. This contract price of $.11/lb. is the minimum per lb. price that WBP will offer. WBP will offer to share in the increase in price margin should the raw vegetable oil and/or meal price market price increase after the signing of this contract. The starting market price for vegetable oil and meal will be set on April 15, 2008. The market price will be again assessed August 1, 2008. The new paid contract price/lb. to the grower will be the average between the April 15, 2008 market pricing and the August 1, 2008 market pricing.

$.11/LB PLUS 33% OF THE DIFFERENCE BETWEEN THE PRICE ON APRIL 15, 2008 AND AUGUST 1, 2008.

Storage - If WBP and the Grower agree that Camelina seed will be stored on the farm instead of a WBP elevator, WBP agrees to pay the Grower a storage fee of $.025/bushel (50lbs per bushel) for every month on, a prorated basis, of needed storage. This agreement makes the Grower responsible for the quality of the stored Camelina Seed.

Camelina Quality After Screening – The Grower and WBP will take a representative sample of seed when the Grower delivers the seed to WBP for processing to determine dockage. All seed received will have a moisture content of <11% (based on canola moisture standard) with additional moisture weight deducted from calculated seed weight.

All seed will be received with 40% oil content and 98% pure, no stones or rocks, dockage will be assessed for all other seed quality based on the attached following schedule a:

Other - Grower agrees in good farmer like manner to mature, harvest, and deliver said crop and cooperate with company to deliver crop on a timely basis to WBP. Disputes will be settled by a three man board consisting of a representative of the Grower, a representative of WBP and a representative selected by the representatives of the Grower and WBP.

______________________ Grower Signature	______________________ Willamette Biomass Processors, Inc. Officer
______________________ Grower Name (Print)	______________________ Date
______________________ ______________________ Grower Address	______________________ Grower Phone#
______________________ Grower Email Address	______________________ Grower Cell Phone#
______________________ Fax Number (if available)	______________________ Acres Contracted

Fax Number (if available) Acres Contracted **Example:** Grower agrees to plant 100 acres of camelina in 2008 assuming a 1500lb. yield. He would be paid as follows:

Paid to Grower

1. At Contract Signing $10/acre $ 1,000.00

2. At Emergence in approx. May 2008 $5/acre $ 500.00

3. Harvest $.055 x (1,500lb yield x 100 acres) $ 8,250.00

4. Delivery to WBP Processing Facility $.055 x (1500lb.yield x 100 acres) $ 8,250.00

*5. $.05/lb. Oregon Tax Credit $ 7,500.00

Sub-Total $25,500.00

6. Transportation Reimbursement $??

7. Storage Reimbursement $??

Total $25,500.00+

========

* Grower must apply with Oregon Department of Energy

APPENDIX B: SUSTAINABLE OILS 2011 CAMELINA PRODUCTION CONTRACT

Camelina Production Services Contract

Sustainable Oils, LLC

2815 Eastlake Ave. E, Suite 300

Seattle, WA 98102

Producer: _________________________ Effective Date: _________

Farm Name _____________________________ Contract No: ____________

Contact Name _____________________________

Address _________________________________

City and State ____________________________

Phone __________________________________

E-mail address ___________________________

("Producer")

NOW, THEREFORE, in consideration of the payments by Sustainable Oils and the Services to be provided, and other good and valuable consideration, the receipt and adequacy all of which is acknowledged, and in consideration of the mutual agreements, covenants and obligations hereinafter set forth, the parties agree as follows:

This Camelina Production Contract ("Contract"), and the Exhibit A Protocol, which is a part of this Contract, describes the production agreement between Sustainable Oils, LLC, a Delaware limited liability company ("Sustainable Oils"), and Producer.

1. Planting Seed Payment. Producer agrees to plant, produce and maintain with acceptable agronomic practices, to harvest and deliver a Camelina grain crop ("Crop") on behalf of Sustainable Oils (the "Services"). The Services shall include costs of all pesticide and fertilizer inputs into the production of the Crop: the cost of the Seed

planted; herbicide treatments prior to planting, during the growing period, and one post-harvest, plus fertilizer applied up to the levels recommended by the production Protocol. Sustainable Oils, or its designated agent, agrees to Sell ________ pounds of Camelina Planting Seed ("Seed") to Producer for the sole purpose of the Services. Producer shall deliver the Crop at a date and place designated by Sustainable Oils. Producer agrees that the Services to be provided are a "work for hire." Producer agrees that this Contract is a contract for services. Payments shall be made in US Dollars.

2. Planting Acreage. Producer agrees to plant Seed prior to April 30, 2011 for Crop production, on _________ acres located in ___________________ County, State of ________________. Producer agrees to notify Sustainable Oils, or its designee, within 30 days after planting 1) the planting date; 2) the total number of acres planted; 3) the amount of Seed planted per acre; and 4) the precise planting location. Any unused Seed after planting will be returned to Sustainable Oils at Producer's expense or will be disposed of in a manner expressly approved by Sustainable Oils.

3 Limited Use of Seed and Crop. Producer agrees that Producer will not use, or permit to be used, the Seed to produce Crop for any person or entity other than Sustainable Oils. The Producer will not sell, transfer, or distribute any Seed, or any portion of the Crop, including seed pods, cuttings, volunteer Seed, or other genetic material that grows or is harvested from the Seed to any person or entity other than Sustainable Oils. Producer will not save any portion of the Seed or Crop for any future use unless approved in writing by Sustainable Oils.

4. Producer Responsibility. Producer will be solely responsible for the Services and the cost and management of the planting, maintenance, agronomy practices, and harvesting, except for the payments to be made under this Contract.. Producer agrees to complete the agronomic practices form "Exhibit B" and return to Sustainable Oils.

5. Ownership of Seed and Crop.

A. Producer acknowledges and agrees that Sustainable Oils is the owner of all right, title and interest in and to the Seed, and to the intellectual property related to the Seed and to any subsequent Crop and that this Contract is not a license or grant of any right in or to the Seed or Crop, except for the right to provide the Services.

B. Producer acknowledges and agrees that it will not acquire any property rights in or to the Seed or the Crop.

C. Producer agrees and acknowledges that Producer is being paid a fee for Services to produce a Crop from the Seed.

D. Producer acknowledges that Sustainable Oils is the owner of all right, title and interest in and to the Crop and to any Seed form or embodiment thereof and is also the owner of the goodwill attached and which shall become attached to the Seed.

E. Producer will not challenge Sustainable Oils' ownership of or the validity of the Seed or any intellectual property right or grant thereof, or any copyright or trademark relating thereto, or any other rights to the Seed.

F. Producer will not knowingly, at any time, do or suffer to be done any act or thing which will in any way jeopardize, dilute or adversely affect any registration of the Seed or Sustainable Oils' ownership of the Seed.

G. Producer expressly covenants and agrees to maintain the Seed and the Crop free and clear of any and all liens and encumbrances, and will indemnify and hold harmless Sustainable Oils from a breach of this provision.

H. Producer expressly represents and warrants that no other party or person has any claim or right in the Seed or the Crop.

I. Producer grants to Sustainable Oils a security interest in the Seeds and the Crop.

6. Crop Payment for Services and Quality Parameters

Sustainable Oils will pay the Producer $0.15/lb. for all delivered crop that meets Sustainable Oils standards. Crop will be delivered, at its or his sole cost and expense, to designated collection point _______________________.

Upon verification by Sustainable Oils of a commercial stand of at least 12 plants per sq. ft. avg., and delivery of Exhibit B (Sustainable Oils Grower Information Sheet), Producer will qualify for the $50 per acre "shared risk" that will be paid at crop settlement time. . After a stand has been established and confirmed, if the grower should lose the crop by an "Act of God", the farmer is guaranteed the fifty dollars as part of the " Shared risk " program.

Sustainable Oils will take delivery from the Producer before March 1, 2012, or will "Advance" 80 percent of the projected bin total as determined by Sustainable Oils, not later than March 30, 2012.

Protocol. Exhibit "A" describes the Protocol that a Camelina Producer shall follow to participate in this Contract.

Crop Rejection. The Crop may be rejected by Sustainable Oils in part or in whole if moisture is greater than 8%, or for any reason that the Crop is not merchantable, including a Crop or any part that is sprouting, heated, or spoiled. Sustainable Oils may then dispose of the rejected Crop, in whole or in part, as it deems necessary.

Crop Dockage. Normal dockage is screening dockage over 1% and will be deducted by weight for Services' payment calculations.

7. Crop Storage Fees. If Producer and Sustainable Oils agree that the Crop will be stored by the Producer after harvest, Sustainable Oils will pay Producer 3 cents ($0.03) per fifty-pound (50 lb.) bushel for each 30 days of storage, prorated, starting October 1, 2011 The Producer agrees to be responsible for Crop insurance, quality maintenance, and loss of Crop during storage. Producer shall not dispose of or transfer the Crop other than in accordance with this Contract by delivery to Sustainable Oils.

8. Term. This Contract shall be effective as of the Effective Date after execution and delivery, and will continue for an initial Term of one Crop season ("Initial Term"). This Contract may be renewed at the end of the Initial Term and any subsequent Term for a renewal Term of one Crop season upon the written agreement of the parties. Notwithstanding the foregoing, this Contract may be terminated earlier as provided herein.

9. Termination by Sustainable Oils. In addition to any other remedies available to Sustainable Oils, Sustainable Oils may, by written notice to Producer, terminate this Contract upon the occurrence of any one of the following events ("Event of Default"): (1) Producer breaches any material provision of this Contract which breach is not cured within ten (10) days after Sustainable Oils gives notice to Producer of such breach; (2) Producer (a) terminates or suspends its business activities, (b) becomes insolvent, admits in writing its inability to pay its debts as they mature, makes an assignment for the benefit of creditors, or becomes subject to control of a trustee, receiver or similar authority, or (c) becomes subject to any bankruptcy or insolvency proceeding which is not rescinded within ten (10) days.

10. Effect of Termination. Upon termination of this Contract, all rights granted to Producer shall immediately cease and terminate; provided, however, that unfulfilled obligations shall not terminate.

11. Replant / Crop Destruction. The Producer shall not plow down or reseed the acreages planted with Seed without the prior consent of Sustainable Oils, which consent shall not be unreasonably withheld; provided, however, that Producer shall not harvest any volunteer Seed Crop produced from the Seed.

Non-Assignment. This Contract and the Services are unique and personal and may not be transferred, conveyed, assigned or delegated by Producer, in whole or in part, whether by (1) independent agreement, (2) acquisition by another party of a Producer's stock or assets, (3) lease, (4) mortgage, pledge or other assignment as security, (5) merger, consolidation or other reorganization, or (6) the succession by another party to the Producer's business by operation of law, or whether as a consequence of any transaction that results in a change in the ownership of or right to control the management of Producer, or otherwise, unless Sustainable Oils has expressly consented in writing. The occurrence of any of the foregoing events shall be grounds for immediate termination of this Contract by Sustainable Oils.

Grant of Access. Producer grants Sustainable Oils or its designee the right of access to the Crop, to land on which the Crop is grown, and the location in which the Crop is stored after harvest. Producer will maintain Seed planting, Crop harvesting, and production records, including pesticide and fertilizer application records in sufficient detail and appropriate for purposes of confirming Producer's compliance with this Contract. Sustainable Oils will have the right, during normal business hours and upon reasonable notice, to inspect and copy all such records of Producer to the extent reasonably required in order for Sustainable Oils to confirm Producer's obligations.

Indemnity. Each party will indemnify, defend, and hold the other party, its directors, officers, employees, and affiliates harmless from and against all claims, demands, liabilities, damages and expenses, including reasonable attorneys' fees and costs ("Liabilities") arising out of (i) the negligence, recklessness or intentional wrongful acts or omissions of such indemnifying party, in connection with the performance of any work or Services for or in connection with this Contract; or (ii) breach of this Contract.

Force Majeure. A party may be excused from the performance of this Contract if performance is hindered by Acts of God, strikes, embargoes, earthquakes, war, terrorism, or events beyond the reasonable control of such party. The party claiming force majeure shall give notice to the other party as soon as reasonably practicable. In the event that a force majeure event exists for more than 30 days, Sustainable Oils may terminate this Contract and have no further obligations to Producer.

Confidentiality. The terms of this Contract shall be kept confidential by Producer.

Applicable Law. Any disputes between the parties relating to this Contract shall be determined by the laws and Courts in the State of Montana, notwithstanding Montana's conflicts of laws rules. The parties agree that only courts located in the state of Montana shall have jurisdiction to settle any dispute between them arising under this Contract.

Entire Agreement. This Contract, including all exhibits and attachments, is the entire agreement between Producer and Sustainable Oils relating to the subject matter hereof, and may not be altered, changed, or amended unless in writing and signed by both Producer and Sustainable Oils. This Contract many not be amended by course of dealing, course of performance or usage of trade.

Non-Waiver. Any waiver by a party of any condition, or of the breach of any provision, term, covenant, representation or warranty contained in this Contract, in any one or more instance, shall not be deemed to be nor construed as a further or continuing waiver of any such condition, or of the breach of any other provision, term, covenant, representation or warranty of this Contract. No failure or delay on the part of a party in exercising any right under this Contract will operate as or be deemed to be a waiver of or limitation on any such right, and no single or partial exercise of any such right will preclude any other or further exercise thereof or the exercise of any other right.

No Agency or Joint Venture Relationship. Except for Sustainable Oils' accrued and owing obligations for payment for the Services, Producer shall perform all its undertakings and obligations under this Contract strictly as an independent contractor and at Producer's own risk and expense, and shall exercise control over the Services. Except for Liabilities retained by Sustainable Oils and Producer, respectively, Producer assumes and discharges, and shall indemnify Sustainable Oils and hold it harmless from, all Liabilities arising from or relating to all Servicers and activities by and of Producer. Nothing in this Contract shall be construed as constituting either party as the legal representative, agent, franchisee, or partner of or a joint venture with the other party or any of its affiliates, or as constituting either party liable for any debts or obligations of the other party, except as otherwise provided by indemnity obligations.

Severability. If any provision of this Contract, or the application of such provision to any person or circumstance, is declared by a court of competent jurisdiction to be invalid or unenforceable, such invalidity or unenforceability shall not affect the remaining provisions of this Contract or the application of such provisions to persons or circumstances other than those to which it is held invalid or unenforceable; and if such invalidity or unenforceability is due to the court's determination that the provision's scope is excessively broad or restrictive under applicable law then in effect, then such court shall construe such provision by modifying its scope so as to be enforceable to the fullest extent compatible with applicable law then in effect.

SUSTAINABLE OILS DOES NOT MAKE ANY EXPRESS OR IMPLIED WARRANTIES TO PRODUCER REGARDING THE SEED, ITS VIABILITY OR ABILITY TO THRIVE, ITS FITNESS FOR ANY PURPOSE,

OR ITS MERCHANTABILITY, OR ELIGIBILITY OF SEED PRODUCTS FOR COMMERCE. UNINTENDED CONSEQUENCES, INCLUDING FAILURE TO GERMINATE, OR INABILITY TO THRIVE, MAY RESULT BECAUSE OF SUCH FACTORS AS THE PRESENCE OR ABSENCE OF CHEMICALS USED IN PLANTING AND GROWING, OR PRODUCER'S AGRONOMIC PRACTICES, PEST INFESTATION, OR THE WEATHER, ALL OF WHICH ARE BEYOND THE CONTROL OF SUSTAINABLE OILS AND ASSUMED BY PRODUCER.

Authorized Producer Signature

____

Printed Name____________________________

Date ____________________________

Authorized Sustainable Oils, LLC Signature

Printed Name___________________________

Date ____________________________

NOTICE: Only designated employees of Sustainable Oils are authorized to execute contracts or make any representation or warranty in the name of Sustainable Oils, LLC. Any purported execution, representation, or warranty on behalf of Sustainable Oils, LLC by any other person shall be null and void.

APPENDIX C: THE UNIVERSITY OF TENNESSEE – FIXED PRICE CONTRACT WITH SWITCHGRASS PRODUCERS

THE UNIVERSITY OF TENNESSEE CONTRACT

This Contract, made and entered into on ________________, documents the agreement between The University of Tennessee (hereinafter University) and ____ (hereinafter Contractor).

This Contract consists of this cover page, two pages containing the University's Standard Terms and Conditions and two pages of Additional Terms and Conditions. Terms contained on this cover page and the University's Standard Terms and Conditions shall prevail over those of any attachment unless otherwise stated under "Other terms" below.

Contractor agrees to grow and harvest switchgrass for the University to be used in the University's Biofuels Initiative, such switchgrass to be grown on that portion of real property located at ____________________________, in _______________ County ("Contractor's Property"), indicated on the field layout map attached hereto and incorporated herein as Exhibit A, and which is comprised of ___________ acres (the "Switchgrass Contract Acreage"), for the term of this Contract pursuant to both the Standard and the Additional Terms and Conditions attached hereto and incorporated herein, and using management practices defined by University of Tennessee Extension.

The period of performance under this contract is from March 15, 2009 through March 15, 2012. However, the University may terminate this Contract, in its discretion, with or without cause, by giving the Contractor at least thirty (30) days written notice before the effective termination date. If the Contract is terminated by University for cause, including but not limited to breach by the Contractor, all obligations of the University, including payment obligations in excess of fair compensation for completed services, shall be terminated. If the Contract is terminated by the University other than for cause, the Contractor shall be entitled to receive equitable compensation for satisfactory authorized work completed as of the termination date.

During the term hereof, the University will compensate Contractor $450 per acre of Switchgrass Contract Acreage per year for three consecutive switchgrass production years. For the purposes of calculating payments due to Contractor under this Contract, the University shall use a global positioning system (GPS) to calculate the number of acres (to the nearest tenth of an acre) included in the Switchgrass Contract Acreage. The level of Switchgrass Contract Acreage payments may be adjusted each year. Current guideline University Extension switchgrass budgets were based on farm diesel prices as of October 1, 2007. An annual adjustment to the Switchgrass Contract Acreage compensation rate will be based on the change in the U.S. Gulf Coast No. 2 Diesel Low Sulfur average price FOB (cents per gallon) for the first week in October. The Contractor will be notified of the adjustment by November 1 for the current year of the contract. The first year adjustment will be based on 40.65 gallons of diesel equivalents per acre. Contract year 2 and 3 adjustments will be based on 32.4 gallons of diesel equivalents per acre each year. Payments will not be adjusted below $450 per acre.

The Energy Company will be responsible for pick-up of switchgrass on the Contractor's Property and delivery to the point of intermediate or end use. The Energy Company may negotiate a mutually agreeable switchgrass storage arrangement and compensation with the Contractor in the second and third production years. University assumes no responsibility for switchgrass not picked up by the Energy Company within 12 months of harvest, and Contractor shall be free to dispose of switchgrass remaining on the Contractor's Property after 12 months.

Other payment terms: All such payments shall be made no later than sixty (60) days after receipt of invoice from Contractor. Contractor shall send University a single invoice each year following certification by University Extension that the grower followed production and harvesting management practices defined by University of Tennessee Extension. In the event the Contractor followed prescribed management practices and did not establish an acceptable stand of switchgrass on all or part of the acreage in any production year, $450 per acre of Switchgrass

Contract Acres will be paid to the Contractor and the Contractor will replant the affected acreage during the next following production year.

The University's maximum liability under this Contract is $___________________________.

Other terms: See Additional Terms and Conditions and Field Layout Map, Exhibit A, attached hereto and incorporated herein. I have reviewed and agree to all requirements in the Request for Contract Proposal for the 2009 Biofuels Program and, knowing the University of Tennessee will rely upon my responses to questions, certify that my responses to the questions are true and correct to the best of my knowledge. The Request for Contract Proposal is attached as Exhibit B hereto and incorporated herein.

authorized representatives.

FOR CONTRACTOR: FOR UNIVERSITY:

Signature Office of Bioenergy Programs

Name (Printed) ___________________________________ ___________________________________
Responsible Account Address

Administrative Signature (Optional)

___________________________________ Authorized Official Telephone Number

1. The University is not bound by this Contract until it is approved by the appropriate University official(s) indicated on the signature page of this Contract.
2. This Contract may be modified only by a written amendment which has been executed and approved by the appropriate parties as indicated on the signature page of this Contract.
3. The Contractor shall not assign this Contract or enter into a subcontract for any of the services performed under this Contract without obtaining the prior written approval of the University.
4. Unless otherwise indicated on the reverse, if this Contract provides for reimbursement for travel, meals or lodging, such reimbursement must be made in accordance with University travel policies.
5. The Contractor warrants that no part of the total Contract amount shall be paid directly or indirectly to an employee or official of the State of Tennessee as wages, compensation, or gifts in exchange for acting as officer, agent, employee, subcontractor, or consultant to Contractor in connection with any work contemplated or performed relative to this Contract, and that no employee or official of the State of Tennessee holds a controlling interest in the Contractor. If the Contractor is an individual, the Contractor certifies that he/she is not presently employed by the University or any other agency or institution of the State of Tennessee; that he/she has not retired from or terminated such employment within the past six months; and that he/she will not be so employed during the term of this Contract.
6. The Contractor shall maintain documentation for all charges against the University under this Contract. The books, records and documents of the Contractor, insofar as they relate to work performed or money received under this Contract, shall be maintained for a period of three (3) full years from the date of the final payment, and shall be subject to audit, at any reasonable time and upon reasonable notice, by the University or the Comptroller of the Treasury, or their duly appointed representatives. These records shall be maintained in accordance with generally accepted accounting principles.
7. No person on the grounds of disability, age, race, color, religion, sex, national origin, veteran status or any other classification protected by Federal and/or Tennessee State constitutional and/or statutory law shall be excluded from participation in, or be denied benefits of, or be otherwise subjected to discrimination in the performance of this Contract. The Contractor shall, upon request, show proof of such non-discrimination, and shall post in conspicuous places, available to all employees and applicants, notice of nondiscrimination.

8. The Contractor, being an independent contractor, agrees to carry adequate public liability and other appropriate forms of insurance, and to pay all taxes incident to this Contract. The University shall have no liability except as specifically provided in this Contract.
9. The Contractor shall comply with all applicable Federal and State laws and regulations in the performance of this Contract.
10. This Contract shall be governed by the laws of the State of Tennessee, which provide that the University has liability coverage solely under the terms and limits of the Tennessee Claims Commission Act.
11. The Contractor shall avoid at all times any conflict of interests between his/her duties and responsibilities as a Contractor and his/her interests outside the scope of any current or future Contracts. The following principles define the general parameters of a conflict of interests prohibited by the University:
    a. A Contractor=s outside interests shall not interfere with or compromise his/her judgment and objectivity with respect to his/her duties and responsibilities to the University.
    b. A Contractor shall not make or influence University decisions or use University resources in a manner that results in: $ Financial gain outside any current or future Contracts for either the Contractor or his/her relatives or $ Unfair advantage to or favored treatment for a third party outside the University.
    c. A Contractor=s outside financial interests shall not affect the design, conduct, or reporting of research.

The Contractor certifies that he/she has no conflicts of interests and has disclosed in writing the following:

A. Any partners or employees of the Contractor who are also employees of the University.

B. Any relatives of the Contractor=s partners or employees who work for the University.

C. Any outside interest that may interfere with or compromise his/her judgment and objectivity with respect to his/her responsibilities to the University.

1. If the Contractor fails to perform properly its obligations under this Contract or violates any term of this Contract, the University shall have the right to terminate this Contract immediately and withhold payments in excess of fair compensation for completed services. The Contractor shall not be relieved of liability to the University for damages sustained by breach of this Contract by the Contractor.
2. It is understood by the Contractor that the University will possess all rights to any creations, inventions, other intellectual property, and materials, including copyright or patents in the same, which arise out of, are prepared by, or are developed in the course of the Contractor’s performance under this Contract. The Contractor and the University acknowledge and agree that the Contractor=s work under this Contract shall belong to the University as "work-made-for-hire" (as such term is defined in U.S. Copyright Law).
3. The Contractor hereby attests that the Contractor shall not knowingly utilize the services of any illegal immigrant in the United States in the performance of this contract and shall not knowingly utilize the services of any subcontractor who will utilize the services of an illegal immigrant in the United States in the performance of this Contract.

WHEREAS, the University is performing scientific research on the production of biofuels from switchgrass as part of Tennessee’s Biofuels Initiative and the production of switchgrass by a select number of Tennessee farmers for use in research to be performed by or at the discretion of the University is a necessary component of this research; and

WHEREAS, Contractor has agreed to participate in this research by growing switchgrass on the Switchgrass Contract Acreage pursuant to the terms and conditions hereof.

1. The University shall furnish Contractor with a quantity of seed sufficient to sow the acreage under contract. While the University agrees to use every reasonable effort to obtain reliable seed, THE UNIVERSITY GIVES NO WARRANTY, EXPRESS OR IMPLIED, AS TO THE QUALITY OR PRODUCTIVENESS OF THE SEED FURNISHED. This is a research project. Therefore, UNIVERSITY MAKES NO

WARRANTY, EXPRESS OR IMPLIED, AS TO THE VALIDITY OR EFFICACY OF MANAGEMENT PRACTICES DEFINED BY UNIVERSITY EXTENSION. The Energy Company will be responsible for loading and hauling the contract switchgrass from the Contractor's farm to the biorefinery.

a) Contractor agrees to:

b) Prepare all the land within the Switchgrass Contract Acreage and plant the switchgrass on all such land in a timely fashion, as weather conditions permit. In the event the University determines that the Switchgrass Contract Acreage needs to be re-seeded in the second or third year, the University shall furnish such seed and Contractor shall plant such seed in a timely fashion, as weather conditions permit.

c) Manage carefully and in a timely manner the growing switchgrass, including weed control, fertilizing and all other matters relating to the production of switchgrass, at the proper season and in the best manner possible, in consultation with, and subject to the approval and satisfaction of, University Extension or the University's designated representatives. Contractor specifically agrees to use reasonable efforts to control weeds in the Switchgrass Contract Acreage, including such methods as are recommended by University Extension or the University's designated representatives. Contractor specifically agrees to use soil samples that are collected, processed, analyzed, and interpreted according to guidelines recommended by University Extension or the University's designated representatives.

d) Refrain from using the Switchgrass Contract Acreage for any other purposes during the term of this Contract without the University's prior written consent, which consent shall not be unreasonably withheld.

e) Harvest and bale the switchgrass, using mesh wrap or triple tying the bales and otherwise, at a time and in a manner mutually agreeable to the University and the Contractor.

f) Assemble the bales of switchgrass at a place on or near Contractor's Property, mutually agreed upon by the parties. Switchgrass bales must be assembled in a manner mutually agreed upon by the parties, and located near an all-weather road that can be accessed by an over-the-road semi tractor trailer pulling a 53' trailer or low-boy trailer.

g) Comply with all local, state, and federal laws and regulations related to groundwater contamination, the application of herbicides, fungicides, pesticides and fertilizers, hazardous waste storage or disposal, and the cultivation of crops. Contractor shall also follow label directions and all applicators' licensing requirements in the handling and application of all chemicals.

h) Keep records of the dates and amounts of any and all applications of seed, fertilizers, pesticides, herbicides, fungicides or other chemicals or materials to the Switchgrass Contract Acreage, and allow use of the records submitted by Contractor and all such other information pertaining to Contractor's Property and the production of switchgrass thereon as is reasonably necessary to perform the research and publish and otherwise disseminate the results of such research.

i) Permit the University or its representatives to enter upon Contractor's Property at any reasonable time for the purpose of (i) consulting with Contractor, (ii) viewing, monitoring, measuring, inspecting or analyzing the Switchgrass Contract Acreage, the switchgrass growing thereon or the switchgrass harvested wherefrom, (iii) ensure that Contractor is fulfilling the terms and conditions of this Contract, and (iv) for such other purposes as are reasonably necessary to complete work outlined in the contract, and conduct research, provided that such entry does not interfere with Contractor's ability to carry out regular farming operations on Contractor's Property.

    a. Permit the Energy Company and its representatives and contract haulers to enter upon Contractor's Property at any reasonable time for the purpose of (i) loading and transporting harvested switchgrass, (ii) consulting with Contractor, (iii) viewing, monitoring, measuring, inspecting or analyzing the switchgrass harvested, and (iv) for such other purposes as are reasonably necessary to complete work outlined in the contract, provided that such entry does not interfere with Contractor's ability to carry out regular farming operations on Contractor's Property.

1. In the event Contractor fails to properly manage or harvest the switchgrass being grown on the Switchgrass Contract Acreage, the University reserves the right, personally or through its designated agents, to enter upon Contractor's Property and properly care for and harvest the switchgrass, deducting the costs of such care and harvest from any amounts payable to Contractor under this Contract. Neither this reservation of right, nor the exercise thereof, shall limit any other remedies provided by this Contract or that the University may have at law or in equity. Nothing in the contract creates any obligation on the part of University to care for or harvest Contractor's switchgrass.
2. Contractor certifies that he/she is not presently debarred, proposed for debarment, suspended or declared ineligible for covered transactions by any federal agency or department. Contractor also certifies that within the past three years he/she has not been convicted of or had civil judgment rendered against them for a fraudulent contract or transaction, violation of federal or state antitrust laws, or the commission of embezzlement, theft, forgery, bribery, falsifying or destroying records, receiving stolen property, or making false statements.
3. University reserves the right to substitute varieties of switchgrass, as it determines appropriate for its demonstration purposes.
4. CONTRACTOR MAKES NO WARRANTY, EXPRESS OR IMPLIED, AS TO THE PRODUCTIVITY, QUALITY OR SUITABILITY OF THE SWITCHGRASS FOR USE IN THE UT BIOFUELS INITIATIVE.

Contractor agrees to use the management practices defined by University Extension, but CONTRACTOR MAKES NO WARRANTY, EXPRESS OR IMPLIED, AS TO THE VALIDITY OR EFFICACY OF MANAGEMENT PRACTICES OR CONTRACTOR'S AGRICULTURAL PRACTICES IN PRODUCING SWITCHGRASS UNDER THIS RESEARCH PROGRAM.

APPENDIX D: SUSTAINABLE OILS PLANT BACK REQUIREMENTS FOR CAMELINA

Table 61: Sustainable Oils Plant Back Requirements for Camelina

Crop Rotation Restrictions For Camelina	
Product	**Months**
Accent	18
Acetochlor	Next Cropping Season
Ally Extra	22
Amber	Bioassay
Assert	15
Atrazine	22
Balance Pro	18
Basis	18
Beacon	18
Callisto	Next Cropping Season
Camix	18
Celebrity Plus	18
Chlopyralid	0
Chlopyralid, 2,4-D	5
Dicamba	4
Everest	9
Far-Go	Next Cropping Season
Glean/Finesse	Bioassay
Matrix	18
Maverick	Bioassay
Metribuzin	12
Metsulfuron	34
Milestone	24
Olympus	22
Option	2
Paramount	10
Peak	22
Permit	15
Plateau	48
Prowl	0
Pursuit	26
Raptor	18
Rave	Bioassay
Rimfire	10
Silverado	10
Sonalan	0
Spartan	24

Status/Distinct	1
Tordon	24
Trifluralin	0
Valor/Chateau	8
Widematch	4

APPENDIX E: SASKATCHEWAN CROP INSURANCE CORPORATION: 2010 TERMS AND CONDITIONS FOR CAMELINA

This program was developed as a result of co-operative efforts between the Saskatchewan Crop Insurance Corporation (SCIC), industry specialists, Saskatchewan Ministry of Agriculture, Agriculture and Agri-Food Canada and individual camelina producers.

These terms and conditions set out special conditions of camelina insurance to help you understand the coverage provided. Unless otherwise described below, all other aspects of the multi-peril Crop Insurance program also apply. Please refer to your endorsement, coverage detail, and statement of insurance forms for specific premium and production guarantee information.

Insurance Features:

Insurance is provided on established stands only. There is no establishment benefit. All fields will be inspected to determine eligibility based on SCIC criteria. **Minimum of 120 plants per square yard**.

- Coverage of 50, 60, or 70 per cent is available.
- Production guarantees for all producers are determined using the provincial average yield with no distinction for soil class, risk zone, or individual yield histories.
- Insurance coverage is for yield loss only and no coverage is provided for quality loss. Premium discounts and surcharges do not apply.
- Camelina seeded in the brown soil zone will have a seeding deadline of May 21. See Your Complete Guide to Understanding Crop Insurance for a soil zone map.
- Areas outside the brown soil zone must consider the average days to maturity and the normal first fall frost for the area when determining the final seeding date for the variety seeded
- Liability will not be accepted on camelina seeded after June 20.

Agronomic Practices:

Producers are advised to consult Saskatchewan Ministry of Agriculture Camelina Farm Facts for detailed agronomic practices, including weed control, seed rate, crop rotations, and other agronomic considerations. Failure to follow recommended practices may result in the reduction or denial of any claim, should a loss occur. Producers are advised of the following specific consideration:

- Pre-seed weed control is important to establishing a good camelina stand. If weed pressure is a cause of loss and no method of pre-seed weed control was implemented, claims may be reduced or denied.
- Camelina is susceptible to herbicide residues in the soil. Do not seed on land where herbicide residue could be an issue.
- Seed at five pounds an acre to target a plant population greater than 150 plants per square yard.
- Camelina should be seeded shallow (¼ to ½ inch depth) with good seed-to-soil contact .Insurance will not be available to camelina stands that do not have an adequate plant population.

The Saskatchewan Crop Insurance Corporation is committed to developing a financially sound insurance package to meet the needs of camelina producers. Producer input and co-operation is essential to the growth of this insurance program. SCIC encourages all camelina producers to discuss their needs and concerns with the Corporation.

01/10

APPENDIX F: UNITED STATES STANDARDS FOR CANOLA

Grades and Grade Requirements **§ 810.304 Grades and grade requirements for canola.**

Grading factors	Grades, U.S. Nos. 1	2	3
Damaged kernels:			
Heat damaged	0.1	0.5	2.0
Distinctly green	2.0	6.0	20.0
Total	3.0	10.0	20.0
Conspicuous admixture:			
Ergot	0.05	0.05	0.05
Sclerotinia	0.05	0.10	0.15
Stones	0.05	0.05	0.05
Total	1.0	1.5	2.0
Inconspicuous admixture	5.0	5.0	5.0
Maximum count limits of:			
Other material:			
Animal filth	3	3	3
Glass	0	0	0
Unknown foreign substance	1	1	1

U.S. Sample grade Canola that:
(a) Does not meet the requirements for U.S. Nos. 1, 2, or 3; or
(b) Has a musty, sour, or commercially objectionable foreign odor; or
(c) Is heating or otherwise of distinctly low quality.

Special Grades and Special Grade Requirements

§ 810.305 Special grades and special grade requirements.
Garlicky canola. Canola that contains more than two green garlic bulblets or an equivalent quantity of dry or partly dry bulblets in approximately a 500 gram portion.

Nongrade Requirements

§ 810.306 Nongrade requirements.
Glucosinolates. Content of glucosinolates in canola is determined according to procedures prescribed in FGIS instructions.

Source: (USDA; Grain Inspection, Packers, and Stockyards Administration, 1992)

APPENDIX G: MONTANA STATE HAIL INSURANCE RATES

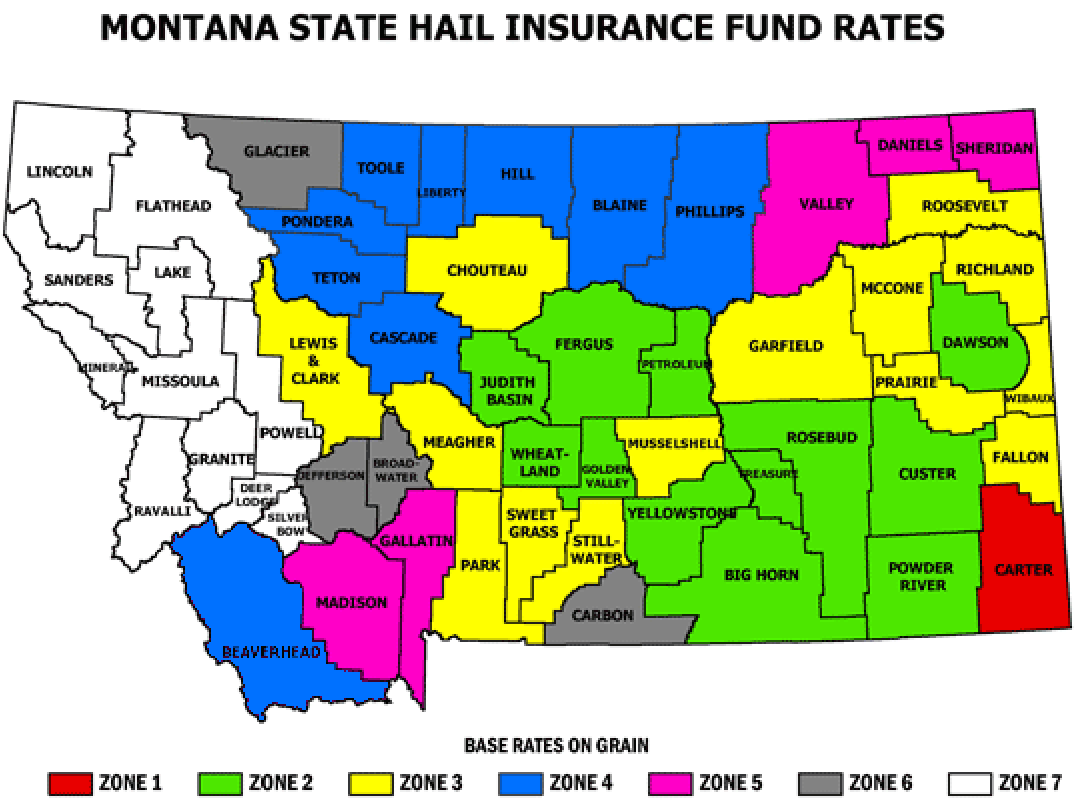

Figure 52: Montana State Hail Insurance Rates

Source: (Montana Department of Agriculture, n.d.)

Table 62: Montana State Hail Insurance Rates by Zone

Crops	Rate as a percentage of coverage						
	Zone 1	**Zone 2**	**Zone 3**	**Zone 4**	**Zone 5**	**Zone 6**	**Zone 7**
Wheat, barley, rye, oats, flax, durum, safflower, sunflowers, triticale, sorghum, speltz, corn, hay and millet	11 %	10 %	9 %	8 %	7 %	6 %	5 %
Lentils, peas, beans, canary seed, grass seed and alfalfa seed	14 %	13 %	12 %	11 %	10 %	9 %	6 %
Canola, mustard, rape, sainfoin and alfalfa seed	16 %	15 %	14 %	13 %	12 %	11 %	7 %
Potatoes and sugar beets (Up to maximum coverage of $100/acre)	6.6 %	6 %	5.4 %	4.8 %	4.2 %	3.6 %	3 %
Mixed fields	Charge for mixed fields is the highest rate crop in the mix						

APPENDIX H: MATHEMATICAL DESCRIPTION OF CDFDEV

For random variable X with i.i.d. observations X_i for $i = 1, \dots, n$, let $F_n(X)$ be the empirical distribution function and $F_0(Z)$ be a known cumulative distribution function (possibly based on estimated parameters) hypothesized to be the true underlying distribution for X. Let $x_{(i)}$ be the i[th] order statistic in the observed data series and let z_p be the corresponding P_i- quantile from the hypothesized distribution where $P_i \approx i/(n+1)$ (if a sample of size n from the hypothesized distribution is provided, then z_p would be the i[th] order statistic). The CDFDEV criterion is defined as

$$CDFDEV = \frac{3}{n^3 + 2n} \sum_{i=1}^{n} (2i + n)^2 \left(x_{(i)} - z_p\right)^2$$

For a group of *J* alternative hypothesized distributions, or variations on parameterizations of these distributions, with respective cumulative distribution functions $F_0(z_j)$, the alternative which the minimum CDFDEV value should be considered the best hypothesized distribution among the given alternatives. In the case where two or more alternatives produce the same minimum value CDFDEV, the distribution with the smallest moment bias should be considered the better of the two. Note that if $\left|x_i - z_p\right| = c \; \forall \, i$ then $CDFDEV = c^2$

APPENDIX I: PROGRAM EVALUATION TOOL DECISION TREE

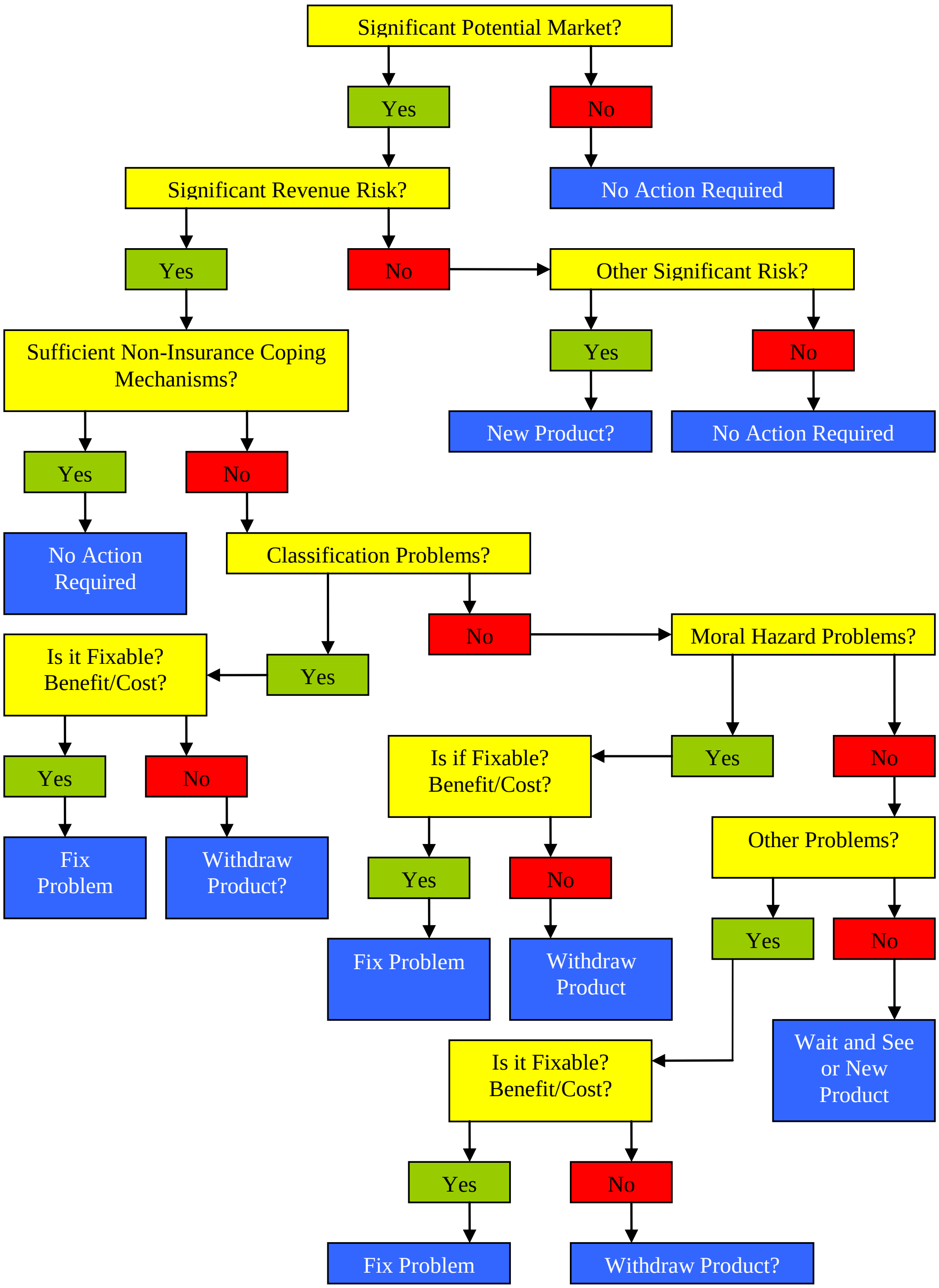

Figure 53: Program Evaluation Tool Decision Tree

Source: (USDA; RMA, 2005)

APPENDIX J: MONTANA CAMELINA PROGRAM EVALUATION TOOL DECISION TREE

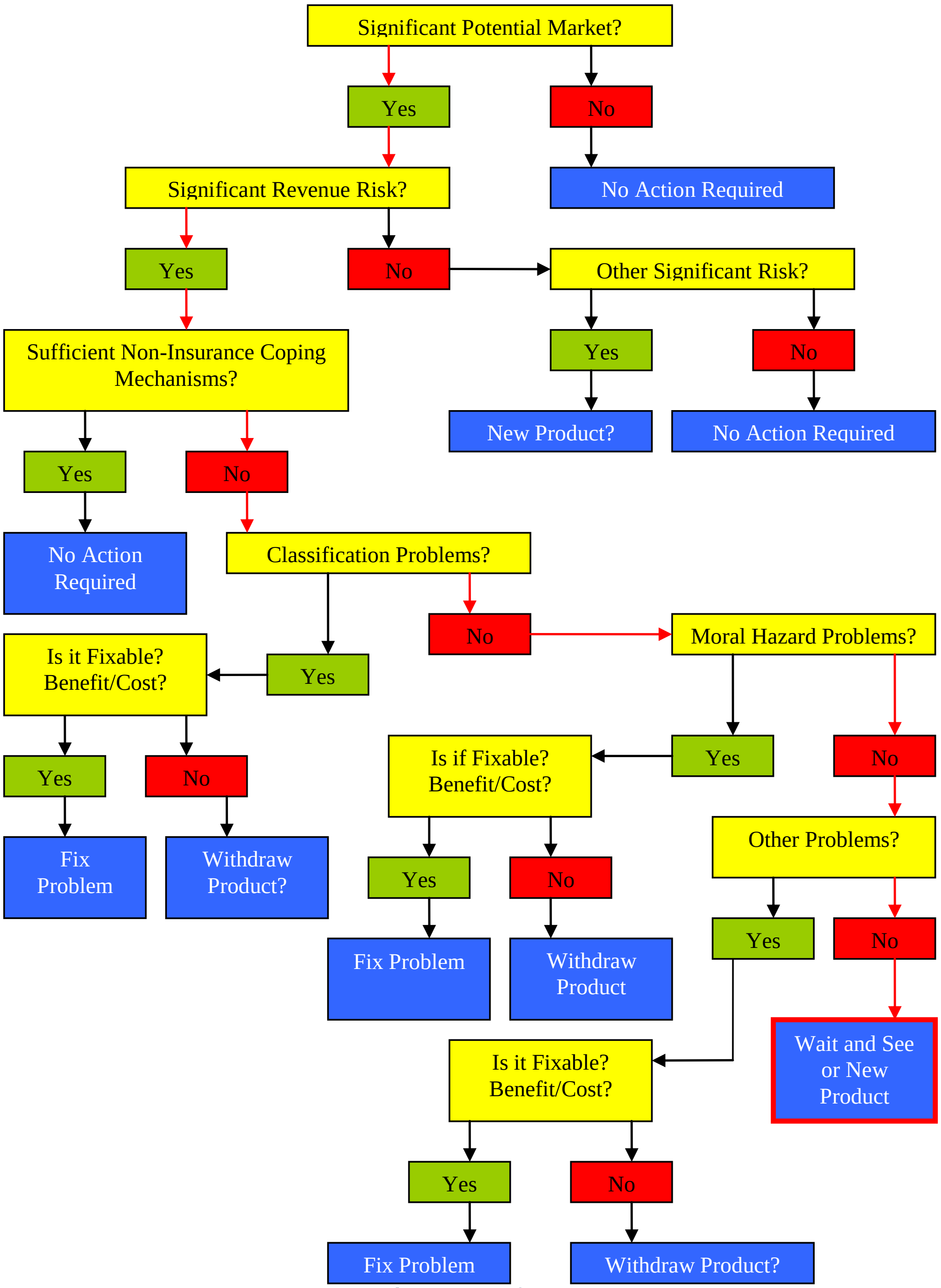

Figure 54: Montana Camelina Decision Tree

APPENDIX K: OREGON/WASHINGTON CAMELINA PROGRAM EVALUATION TOOL DECISION TREE

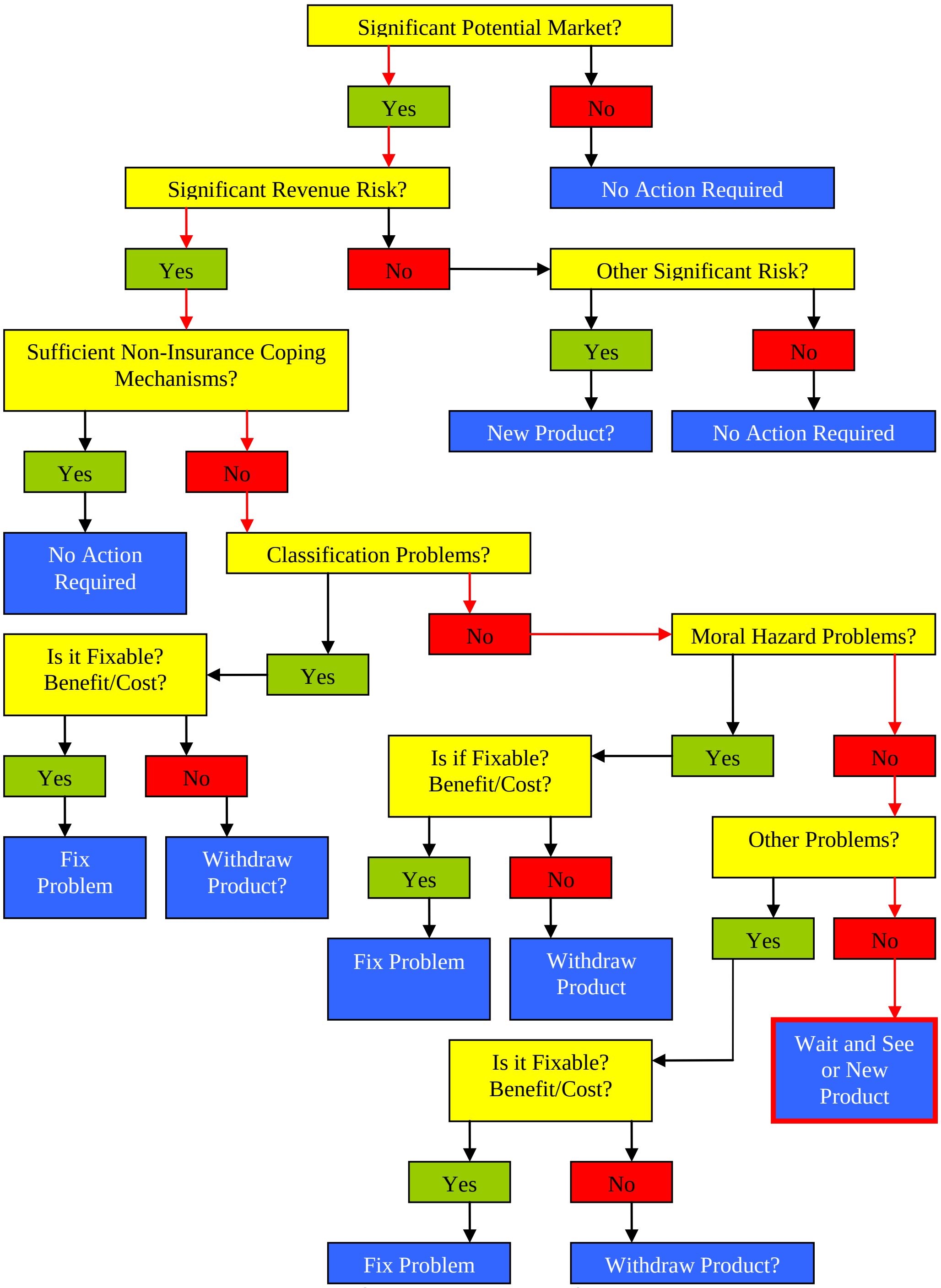

Figure 55: Oregon/Washington Camelina Decision Tree

APPENDIX L: TENNESSEE SWITCHGRASS PROGRAM EVALUATION TOOL DECISION TREE

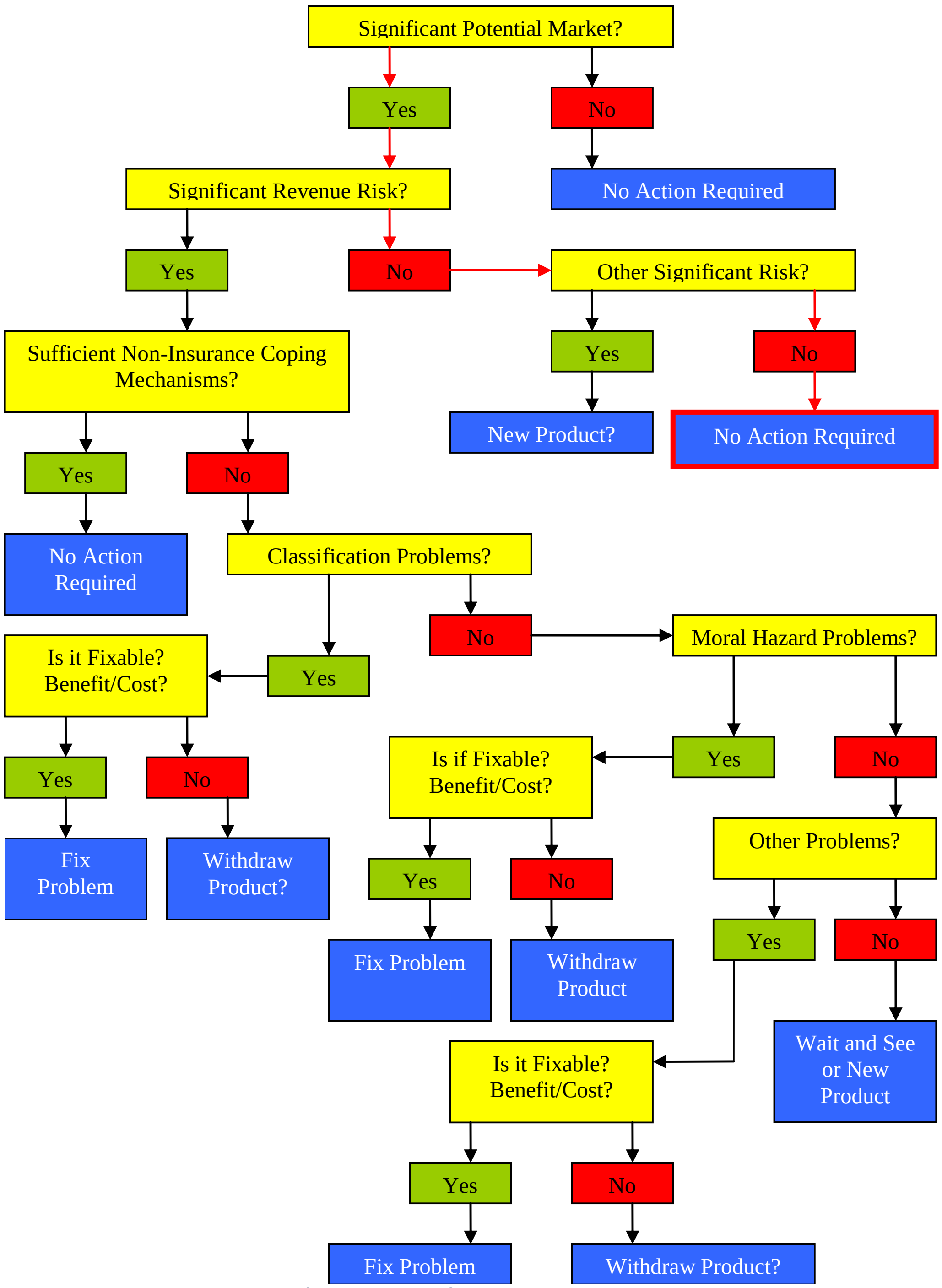

Figure 56: Tennessee Switchgrass Decision Tree

APPENDIX M: LOUISIANA ENERGY CANE PROGRAM EVALUATION TOOL DECISION TREE

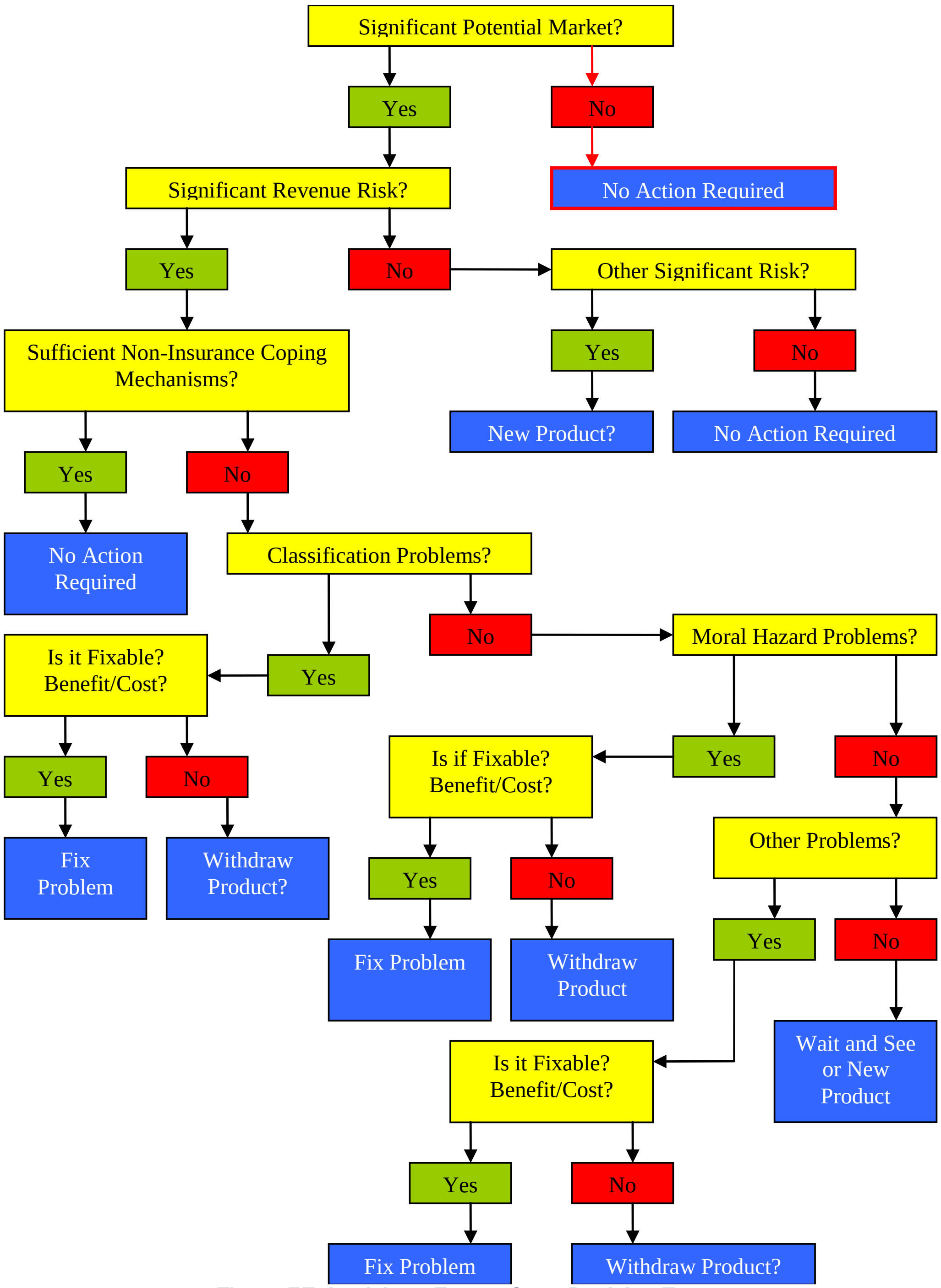

Figure 57: Louisiana Energy Cane Decision Tree

APPENDIX N: PROGRAM EVALUATION TOOL DIAGNOSTIC INSTRUMENTS

Program Evaluation Diagnostic Questions

Region **Montana**

Crop **Camelina**

Market
(fresh, processed, sold for animal feed, etc.) **Sold for Dedicated Energy**

Background Information

Production Processes

Annuals

1. Is the crop planted multiple times during a crop production year? If yes, explain:	*Yes*	*No*
2. For a single planting, is the crop harvested multiple times during a crop production year? If yes, explain:	*Yes*	*No*

3. Describe distinguishing characteristics of prevailing production system(s) for this crop (e.g., practices such as double crop, fallow, irrigation, regional differences in climate or soils, etc.). Discuss, particularly, features that are critical in assessing potential demand including potential issues with practices and types.

Camelina is planted as a rotation crop and typically follows a wheat, wheat, fallow rotation with 2-3 years between Camelina crops. Rotation is essential and camelina should not follow camelina or other brassica crops. In addition, growers should not use wheat herbicides with residual action which may cause carry-over damage. These include those in the ALS-inhibitor type herbicides. Avoid SU's and Imy-family herbicides. Common brand names to avoid include: Glean, Finesse, Ally, Amber, Rave, Maverick, Olympus.

Biennials

4. Is the crop harvested multiple times during a crop production year?	*Yes*	*No*

5. Describe distinguishing characteristics of prevailing production system(s) for this crop (e.g., practices such as irrigation, regional differences in climate or soils, etc.). Discuss, particularly, features that are critical in assessing potential demand including potential issues with practices and types.

N/A

Perennials		
6. Is the crop harvested multiple times during a crop production year? If yes, explain:	*Yes*	*No*
7. Is the crop alternate bearing?	*Yes*	*No*
8. Describe distinguishing characteristics of prevailing production system(s) for this crop (e.g., practices such as irrigation, regional differences in climate or soils, etc.). Discuss, particularly, features that are critical in assessing potential demand including potential issues with practices and types.		
9. What is the economic life of the capital stock (trees, vines, etc.)?	*N/A___years*	
10. Over its economic life, what is the likelihood that 10 percent or more of the capital stock would be lost due to natural causes? Describe:	*N/A_____%* *(probability of loss)*	
11. If capital stock is lost, how long will it take to reestablish the capital stock to a point where it starts producing salable output?	*N/A___years*	
12. If capital stock is lost, how long will it take to reestablish the capital stock to a point where it is at peak production?	*N/A___years*	

Nursery

13. Describe distinguishing characteristics of prevailing production system(s) for nursery crops in this region. Discuss, particularly, features that are critical in assessing potential demand including potential issues with practices and types.

N/A

Marketing

14. Describe typical marketing channels and/or contracting structures for this crop.

Producers in Montana are under a production contract that pays $0.15/lb.

15. In this region are there critical time periods (i.e., marketing windows) when producers hope to market this crop? If so, describe.

No, because camelina production is contracted with a fixed price. Therefore, there is no price risk in marketing camelina.

16. Within the marketing channels and/or contracting structures mentioned above describe how quality variations are handled (e.g., off-grade apples in a fresh market system may be processed for juice).

The crop is rejected if the moisture is greater than 8%. The crop can also be used as a meal for livestock feed.

17. In this region, do federal supply control marketing orders exist for production of this crop? Describe:	*Yes*	*No*
18. In this region, do state quality marketing orders exist for production of this crop? Describe:	*Yes*	*No*

RMA–Facilitated Insurance Products

19. In this region, what RMA-facilitated insurance products are currently available for this crop? List all:

None

Yield Risk

20. In this region what are examples of crops with very ***low** relative* yield risk? Relative risk is used to adjust absolute magnitudes that vary across crops to a relative level to facilitate comparability (roughly, a measure of variation divided by the mean level).

Hay, Oats

21. In this region what are examples of crops with very ***high** relative* yield risk?

Canola, Peas

22. Is this crop exposed to catastrophic risks that would reduce yields by 50 percent or more?	*Yes*	*No*

23. If the answer to the previous question is yes, describe these risks. If no, proceed to the next question. Over 25 years (or crop cycles) approximately how often would you expect such catastrophic losses to occur?

Description	***Years (or crop cycles) out of 25***
Cold Wet Weather, Cold Winter, Other (Snow-Lightning, Etc.), Plant Disease	2, 10, 2. 4. 2
Failure of Irrigation Supply, Hot Wind, Wind/Excess Wind, Freeze, Frost	15, 4, 2, 6, 8
Excess Moisture/Precip/Rain, Insects, Hail, Heat, Drought	7,7,8,8,13
This analysis is based on canola, which is the closest related crop.	

24. Characterize yield risk for this crop *ignoring the catastrophic yield risk(s) described earlier*. On a scale from one to five, if the low relative yield risk crops identified earlier were one, and the high relative yield risk crops identified earlier were five, what number would you assign to the non-catastrophic yield risk associated with this crop in this region?

1 very low relative yield risk	***2***	***3***	***4***	***5*** very high relative yield risk

25. In this region, do producers tend to experience multiple-year sequences of good yields or bad yields for this crop? If yes, describe what causes these multiple-year sequences. There is not enough yield data to determine.	*Yes*	*No*

26. On a scale from one to five, where one is very low yield risk and five is very high yield risk, provide an overall assessment of yield risk faced by producers of this crop in this region.

1 very low yield risk	***2***	***3***	***4***	***5*** very high yield risk

Quality Risk

27. In this region what are examples of crops with very **low** quality risk?
Hay, Oats, Wheat

28. In this region what are examples of crops with very **high** quality risk?
Peas, Barley, Alfalfa

29. Is this crop exposed to catastrophic quality risks that would reduce the average price received by 20 percent or more?	*Yes*	*No*

30. If the answer to the previous question is yes, describe these risks. If no, proceed to the next question. Over 25 years (or crop cycles) approximately how often would you expect such catastrophic quality losses to occur?

Description	***Years (or crop cycles) out of 25***

31. We now want to characterize quality risk for this crop *ignoring the catastrophic quality risk(s) described earlier*. On a scale from one to five, if the crops with very low risk of quality problems identified earlier were one, and the crops with very high risk of quality problems identified earlier were five, what number would you assign to the quality risk associated with this crop in this region?

1 very low quality risk	***2***	***3***	***4***	***5*** very high quality risk

32. On a scale from one to five, if one is very low quality risk and five is very high quality risk, provide an overall assessment of quality risk faced by producers of this crop in this region.

1 very low quality risk	***2***	***3***	***4***	***5*** very high quality risk

Price Risk

33. In this region what are examples of crops with very ***low*** *relative* price risk *within the production cycle*? That is, variation in price between pre-plant for annuals (or equivalent for perennials) and sale. (Similar concept to IP and RA for crops with futures markets).

Alfalfa, Hay

34. In this region what are examples of crops with very ***high*** *relative* price risk *within the production cycle*? That is, variation in price between pre-plant for annuals (or, equivalent for perennials) and sale. (Similar concept to IP and RA for crops with futures markets).

Peas, Soybeans, Wheat

35. On a scale from one to five, if the low price risk crops identified earlier were one and the high price risk crops identified earlier were five, what number would you assign to the relative price risk (within the production cycle) associated with this crop in this region?

1 low price risk crop	***2***	***3***	***4***	***5*** high price risk crop

36. In this region, do producers tend to experience multiple-year sequences of high prices or low prices for this crop? If yes, describe. No established market.	*Yes*	*No*

37. On a scale from one to five, where one is very low price risk and five is very high price risk, provide an overall assessment of price risk (within the production cycle) faced by producers of this crop in this region.

1 very low price risk	***2***	***3***	***4***	***5*** very high price risk

Other Sources of Revenue Risk

38. For this region, describe other factors that affect revenue risk for this crop (e.g., prevented planting).
The Camelina seed is very small and planting should be less than a 1/4 inch in depth. Because of this it is tough to get the seed in good moisture and tough to get good seed to soil contact causing problems for good stand establishment. Therefore drought during planting periods or during stand establishment are problematic and may cause losses. Prevented planting does not seem to be as much as an issue as the planting period is very long (fall or spring seeding). The crop does not tolerate standing water so well drained soils are a requirement.

39. On a scale from one to five, where one is very low risk and five is very high risk, provide an overall assessment of risk sources other than yield, quality, and price risks faced by producers of this crop in this region.

1 very low risk	***2***	***3***	***4***	***5*** very high risk

Sufficient Non-Insurance Coping Mechanisms

40. On a scale from one to five, where one is very low and five is very high, assess the extent to which producers of this commodity in this region use risk-reducing inputs as a substitute for crop insurance.

1 very low	***2***	***3***	***4***	***5*** very high

41. Are government crop programs (e.g., marketing loans and counter-cyclical payments) available for this crop? Describe: The Biomass Crop Assistance Program (BCAP) supports establishing and producing eligible crops for the conversion to bioenergy through project areas and through contracts on land of up to 5 years for annual and non-woody perennial crops or up to 15 years for woody perennial crops. Through a matching payment program BCAP assists agricultural and forest land owners and eligible material owners with collection, harvest, storage, and transportation of eligible material for use in qualified Biomass Conversion Facilities (BCF). These payments will be available to eligible material owners at the rate of $1 for each $1 per dry ton paid by the BCF to the eligible material owners, limited to a maximum of $45 per dry ton and limited to a 2-year payment duration. No listening session attendees indicated that they utilized the program. NAP is also available.	*Yes*	*No*

42. In this region, is there a history of federal disaster payments for this crop? Describe:	*Yes*	*No*
43. Approximately what percentage of the total production of this crop is under production contract with a first handler or processor? *Describe contracts:*	*100*______%	
a. Under the terms of a typical production contract for this crop, is the grower exposed to *production risk* (i.e., the grower must deliver on the contract even if production shortfalls occur)?	*Yes*	*No*
b. Under the terms of a typical production contract for this crop, is the grower exposed to *quality risk* (i.e., there are significant price penalties if the product does not meet the quality characteristics specified in the contract).	*Yes*	*No*
c. Under the terms of a typical production contract for this crop, is the grower exposed to *price risk* (i.e., prices for specific quality characteristics are not specified in the contract)?	*Yes*	*No*
44. In this region, approximately what percentage of the total production of this crop is priced prior to harvest (may or may not be tied to a production contract)? Describe: All camelina production is contracted prior to planting	*100*_____%	

45. When corn farmers in the Midwest experience low (high) yields, they can often expect higher (lower) market prices (i.e., prices and yields are very negatively correlated). This moderates the revenue impacts of low yields. In contrast, for corn farmers in the Southeast there is very little relationship between their yields and market prices (i.e., prices and yields are independent). In this region the price and yield for this crop are (circle one):

Independent   *Somewhat Negatively Correlated*   *Highly Negatively Correlated*

Describe: It is anticipated that camelina yields and price will be Independent of each other. This is because the commercialization of camelina for bioenergy is in its infancy and in its current form, the demand is being met by the current supply. However, going forward this may change greatly.

46. On a scale from one to five, where one is "strongly disagree" and five is "strongly agree," provide your reaction to the following statement:

"In this region, producers of this crop are financially able to self-insure against production losses."

1 strongly disagree	***2***	***3***	***4***	***5*** strongly agree

Describe: Producers ranked crop insurance as the second highest priority for the industry, next to getting a higher price. They are currently exposed to production losses, but have a fixed production price.

47. For a typical grower of this crop, approximately what percentage of the total farm revenue would be attributable to this crop?	*15-25*___%

48. What other commodities would typically be produced on a farm that produces this commodity? What is the correlation between revenue from these other commodities and the revenue from this commodity? For correlation use a scale of one to five, where 1 is "strongly negatively correlated," 2 is "negatively correlated," 3 "independent," 4 is "positively correlated," and 5 is "strongly positively correlated."

List:	***Correlation*** *(assign a number between 1-5)*
Winter Wheat, Spring Wheat	4,4
Canola	4
Barley	4
Peas	4

49. In this region, approximately what percentage of the total production of this crop is produced by part-time farmers who have full-time employment off the farm?	*0*______%

50. On a scale from one to five, where one is "strongly disagree" and five is "strongly agree," provide your reaction to the following statement:

"In this region, producers of this crop attempt to manage production risk by spreading their production over several geographic locations."

1 strongly disagree	***2***	***3***	***4***	***5*** strongly agree

Describe: One producer stated that he was not spread over several geographic locations, while another producer stated that he was spread over several geographic locations.

51. In this region, what private-sector insurance products (if any) are currently available for this crop?

List all: Prairie Mountain Insurance Agency in Great Falls Montana offers a hail and transit policy for camelina producers.

52. Characterize how agricultural lenders in this region view the available RMA-facilitated insurance products for this crop. "Unfavorable" implies that lenders actually discourage borrowers from purchasing the product while "favorable" implies that lenders strongly encourage and often require borrowers to purchase the product. If multiple insurance products are offered, answer for each product.

Unfavorable *Indifferent* *Favorable*

Describe: Hard to determine as no lenders were present at the listening sessions. Yet, listening session attendees typically say that their lenders prefer they have crop insurance for production loans.

53. On a scale from one to five, where one is very high and five is very low, assess the sufficiency of non-insurance coping mechanisms for producers of this crop in this region.

1 high availability	***2***	***3***	***4***	***5*** low availability

Risk Classification

54. On a scale from one to five, where one is strongly disagree and five is strongly agree, provide your reaction to the following statement:

"In this region, no producers of this crop are really any more or less risky than any others. They all face about the same risk of loss."

1 strongly disagree	***2***	***3***	***4***	***5*** strongly agree

Describe: Listening session feedback indicated that they all faced about the same risks of loss, with the exception of those closer to the mountain region. These producers stated that they face more harsh weather conditions due to wind and precipitation caused by the mountains.

55. In this region, *for those who are currently **not** insured*, would you say that premium rate on the existing RMA-facilitated insurance products for this crop are "much too low," "about right," or "much too high"? If more than one RMA insurance product is offered, answer for each product.

Much Too Low *About Right* *Much Too High*

If you answered that premium rates are "much too high," explain why (or how) you think this happened.

N/A

56. In this region, *for those who currently are insured,* would you say that premium rate on the existing RMA-facilitated insurance products for this crop are "much too low," "about right," or "much too high"? If more than one RMA insurance product is offered, answer for each product.

Much Too Low *About Right* *Much Too High*

If you answered that premium rates are "much too high," explain why (or how) you think this happened.

N/A

57. For this region, to what extent does the system used to establish the guarantee (e.g., APH yield or expected revenue) for this crop match the true value of the production at risk? An answer of one indicates that the system used to establish the guarantee does a very poor job of matching the true value of the production at risk. An answer of five indicates that the system used to establish the guarantee does a very good job of matching the true value of the production at risk.

1 very poor job	***2***	***3***	***4***	***5*** very good job

58. On a scale from one to five, where one is very low and five is very high, assess the effectiveness of existing RMA-facilitated insurance products in accurately classifying potential policyholders according to their loss exposure (i.e., higher risk growers pay higher premiums while lower risk growers pay lower premiums).

1 very low	***2***	***3***	***4***	***5*** very high

Moral Hazard and Monitoring

59. Yield variation can be caused by unavoidable "*acts of nature*" or avoidable "*acts of management*." In practical parlance, what is the potential for "gaming" the insurance product? Evaluate the potential for gaming the RMA-facilitated crop insurance product for this crop on a scale from one to five, where one implies that variation in yield is almost exclusively due to "acts of nature" (potential for gaming is low) and five implies that yield variation is almost exclusively due to "acts of management" (potential for gaming is high). If multiple insurance products are offered, answer for each product.

1 very low	*2*	*3*	*4*	*5* very high

60. To the extent that management affects yield loss risk exposure, how difficult is it to monitor the insured's behavior?

Extremely Difficult *Difficult* *Not too Difficult*

Explain: It is not too hard to monitor the insured's behavior in growing camelina; however, it may be challenging to monitor the producers practices in relation to chemical residuals from previous crops.

61. Quality variation can be caused by unavoidable "acts of nature" or avoidable "acts of management." In practical parlance, what is the potential for "gaming" the insurance product? Evaluate the potential for gaming the RMA-facilitated insurance product for this crop on a scale from one to five, where one implies that variation in quality is almost exclusively due to "acts of nature" (potential for gaming is low) and five implies that quality variation is almost exclusively due to "acts of management" (potential for gaming is high). If multiple insurance products are offered, answer for each product.

1 very low	*2*	*3*	*4*	*5* very high

62. To the extent that management affects quality loss risk exposure, how difficult is it to monitor the insured's behavior?

Extremely Difficult Difficult Not too Difficult

Explain: Producers cannot change the quality characteristics of the oil; therefore, it is not difficult.

63. On a scale from one to five, where one is very large and five is very small, assess the extent of moral hazard problems with existing RMA-facilitated insurance products for this crop.

1 very large	*2*	*3*	*4*	*5* very small

Problems Affecting Insurance Participation		
64. Have *significant* problems occurred (either past or current) with policy provisions on existing RMA-facilitated insurance products for the crop? If multiple insurance products are offered, answer for each product.	*Yes*	*No*

65. If the answer to the previous question is no, go to next question. If yes, for each significant problem:

a. Briefly describe the problem.

b. What has been the impact of the problem (e.g., high loss ratios, reduced demand, etc.)?

c. Have policy provisions since been changed to adequately address the problem?

d. If policy provisions have not been changed, what changes in policy provisions do you think would increase insurance demand for this crop?

66. In this region, do reinsured companies have sufficient incentives to aggressively market existing RMA-facilitated insurance products for the crop? If yes, go to next question. If no, explain. N/A	*Yes*	*No*
67. In this region, do agents have sufficient incentives to aggressively market existing RMA-facilitated insurance products for the crop? If yes, go to next question. If no, explain. N/A	*Yes*	*No*

68. List any perils that concern growers of this crop but are not covered by the existing RMA-facilitated insurance products (e.g., business interruption due to unavailability of irrigation water, disease quarantines, etc.). For each peril assess the extent of growers' concerns about this peril on a scale from one to five where one is minor concern and five is major concern.

List all:	***1*** minor concern	***2***	***3***	***4***	***5*** major concern

69. Briefly describe the potential for insuring these currently uninsured perils? In answering this, consider the following questions:

Can hidden action/moral hazard and classification/adverse selection problems be avoided?

Can clearly stated policy provisions be developed and accurate premium rates established?

N/A

70. On a scale from one to five, where one is very high and five is very low, assess the likelihood that problems affecting participation can be adequately addressed by product or policy modifications.

1 very low	***2***	***3***	***4***	***5*** very high

Program Evaluation Diagnostic Questions

Region **Oregon/Washington**

Crop **Camelina**

Market
(fresh, processed, sold for animal feed, etc.) **Sold for Dedicated Energy**

Background Information

Production Processes

Annuals

1. Is the crop planted multiple times during a crop production year? If yes, explain:	*Yes*	*No*
2. For a single planting, is the crop harvested multiple times during a crop production year? If yes, explain:	*Yes*	*No*

3. Describe distinguishing characteristics of prevailing production system(s) for this crop (e.g., practices such as double crop, fallow, irrigation, regional differences in climate or soils, etc.). Discuss, particularly, features that are critical in assessing potential demand including potential issues with practices and types.

Camelina is grown as a rotation crop and typically follow a hard red winter wheat, camelina, spring wheat, summer fallow rotation with two to three years between camelina crops. Rotation is essential and camelina should not follow camelina or other brassica crops. In addition, growers should not use wheat herbicides with residual action which may cause carry-over damage. These include those in the ALS-inhibitor type herbicides. Avoid SU's and Imy-family herbicides. Common brand names to avoid include: Glean, Finesse, Ally, Amber, Rave, Maverick, Olympus.

Biennials

4. Is the crop harvested multiple times during a crop production year?	*Yes*	*No*

5. Describe distinguishing characteristics of prevailing production system(s) for this crop (e.g., practices such as irrigation, regional differences in climate or soils, etc.). Discuss, particularly, features that are critical in assessing potential demand including potential issues with practices and types.

N/A

Perennials		
6. Is the crop harvested multiple times during a crop production year? If yes, explain:	*Yes*	*No*
7. Is the crop alternate bearing?	*Yes*	*No*
8. Describe distinguishing characteristics of prevailing production system(s) for this crop (e.g., practices such as irrigation, regional differences in climate or soils, etc.). Discuss, particularly, features that are critical in assessing potential demand including potential issues with practices and types.		
9. What is the economic life of the capital stock (trees, vines, etc.)?	*N/A ___years*	
10. Over its economic life, what is the likelihood that 10 percent or more of the capital stock would be lost due to natural causes? Describe:	*N/A______%* *(probability of loss)*	
11. If capital stock is lost, how long will it take to reestablish the capital stock to a point where it starts producing salable output?	*N/A___years*	
12. If capital stock is lost, how long will it take to reestablish the capital stock to a point where it is at peak production?	*N/A___years*	

Nursery

13. Describe distinguishing characteristics of prevailing production system(s) for nursery crops in this region. Discuss, particularly, features that are critical in assessing potential demand including potential issues with practices and types.

N/A

Marketing

14. Describe typical marketing channels and/or contracting structures for this crop.

Great Plains Oil & Exploration (Great Plains – The Camelina Company) is a renewable fuels energy company founded with the purpose of manufacturing and marketing biodiesel produced from camelina. Great Plains currently contracts with producers in Oregon. Also the Willamette Biomass Processors, Inc. currently contracts with producers of camelina in Oregon.

15. In this region are there critical time periods (i.e., marketing windows) when producers hope to market this crop? If so, describe.

No, because camelina production is contracted with a fixed price. Therefore, there is no price risk in marketing camelina.

16. Within the marketing channels and/or contracting structures mentioned above describe how quality variations are handled (e.g., off-grade apples in a fresh market system may be processed for juice).

Currently there are no quality concerns.

17. In this region, do federal supply control marketing orders exist for production of this crop? Describe:	*Yes*	*No*
18. In this region, do state quality marketing orders exist for production of this crop? Describe:	*Yes*	*No*

RMA–Facilitated Insurance Products

19. In this region, what RMA-facilitated insurance products are currently available for this crop? List all:

None

Yield Risk

20. In this region what are examples of crops with very ***low*** *relative* yield risk? Relative risk is used to adjust absolute magnitudes that vary across crops to a relative level to facilitate comparability (roughly, a measure of variation divided by the mean level).

Alfalfa, Barley, Sugarbeets, Potatoes

21. In this region what are examples of crops with very ***high*** *relative* yield risk?

Winter Wheat, Spring Wheat, Corn for Grain, Oats

22. Is this crop exposed to catastrophic risks that would reduce yields by 50 percent or more?	*Yes*	*No*

23. If the answer to the previous question is yes, describe these risks. If no, proceed to the next question. Over 25 years (or crop cycles) approximately how often would you expect such catastrophic losses to occur?

Description	***Years (or crop cycles) out of 25***
Cold Wet Weather, Drought, Excessive Moisture/Precip/Rain, Hail, Hot Wind	2, 10, 2. 4. 2
Freeze, Frost, Insects, Cold Winter, Heat	15, 4, 2, 6, 8
This analysis is based on canola which is the most closely related insurable crop.	

24. Characterize yield risk for this crop *ignoring the catastrophic yield risk(s) described earlier*. On a scale from one to five, if the low relative yield risk crops identified earlier were one, and the high relative yield risk crops identified earlier were five, what number would you assign to the non-catastrophic yield risk associated with this crop in this region?

1 very low relative yield risk	***2***	***3***	***4***	***5*** very high relative yield risk

25. In this region, do producers tend to experience multiple-year sequences of good yields or bad yields for this crop? If yes, describe what causes these multiple-year sequences.	*Yes*	*No*

26. On a scale from one to five, where one is very low yield risk and five is very high yield risk, provide an overall assessment of yield risk faced by producers of this crop in this region.

1 very low yield risk	***2***	***3***	***4***	***5*** very high yield risk

Quality Risk

27. In this region what are examples of crops with very **low** quality risk?

Alfalfa, Wheat

28. In this region what are examples of crops with very **high** quality risk?

Barley, Sugarbeets, Potatoes

29. Is this crop exposed to catastrophic quality risks that would reduce the average price received by 20 percent or more?	*Yes*	*No*

30. If the answer to the previous question is yes, describe these risks. If no, proceed to the next question. Over 25 years (or crop cycles) approximately how often would you expect such catastrophic quality losses to occur?

Description	***Years (or crop cycles) out of 25***

31. We now want to characterize quality risk for this crop *ignoring the catastrophic quality risk(s) described earlier*. On a scale from one to five, if the crops with very low risk of quality problems identified earlier were one, and the crops with very high risk of quality problems identified earlier were five, what number would you assign to the quality risk associated with this crop in this region?

1 very low quality risk	***2***	***3***	***4***	***5*** very high quality risk

32. On a scale from one to five, if one is very low quality risk and five is very high quality risk, provide an overall assessment of quality risk faced by producers of this crop in this region.

1 very low quality risk	***2***	***3***	***4***	***5*** very high quality risk

Price Risk

33. In this region what are examples of crops with very ***low*** *relative* price risk *within the production cycle*? That is, variation in price between pre-plant for annuals (or equivalent for perennials) and sale. (Similar concept to IP and RA for crops with futures markets).

Alfalfa, Hay Other

34. In this region what are examples of crops with very ***high*** *relative* price risk *within the production cycle*? That is, variation in price between pre-plant for annuals (or, equivalent for perennials) and sale. (Similar concept to IP and RA for crops with futures markets).

Corn for Grain, Soybeans, Hard Red Winter Wheat, Spring Wheat

35. On a scale from one to five, if the low price risk crops identified earlier were one and the high price risk crops identified earlier were five, what number would you assign to the relative price risk (within the production cycle) associated with this crop in this region?

1 low price risk crop	***2***	***3***	***4***	***5*** high price risk crop

36. In this region, do producers tend to experience multiple-year sequences of high prices or low prices for this crop? If yes, describe.	*Yes*	*No*

37. On a scale from one to five, where one is very low price risk and five is very high price risk, provide an overall assessment of price risk (within the production cycle) faced by producers of this crop in this region.

1 very low price risk	***2***	***3***	***4***	***5*** very high price risk

Other Sources of Revenue Risk

38. For this region, describe other factors that affect revenue risk for this crop (e.g., prevented planting).

The Camelina seed is very small and planting should be less than a 1/4 inch in depth. Because of this it is tough to get the seed in good moisture and tough to get good seed to soil contact causing problems for good stand establishment. Therefore drought during planting periods or during stand establishment are problematic and may cause losses. Prevented planting does not seem to be as much as an issue as the planting period is very long (fall or spring seeding). The crop does not tolerate standing water so well drained soils are a requirement.

39. On a scale from one to five, where one is very low risk and five is very high risk, provide an overall assessment of risk sources other than yield, quality, and price risks faced by producers of this crop in this region.

1 very low risk	*2*	*3*	*4*	*5* very high risk

Sufficient Non-Insurance Coping Mechanisms

40. On a scale from one to five, where one is very low and five is very high, assess the extent to which producers of this commodity in this region use risk-reducing inputs as a substitute for crop insurance.

1 very low	*2*	*3*	*4*	*5* very high

41. Are government crop programs (e.g., marketing loans and counter-cyclical payments) available for this crop? Describe: The Biomass Crop Assistance Program (BCAP) supports establishing and producing eligible crops for the conversion to bioenergy through project areas and through contracts on land of up to 5 years for annual and non-woody perennial crops or up to 15 years for woody perennial crops. Through a matching payment program BCAP assists agricultural and forest land owners and eligible material owners with collection, harvest, storage, and transportation of eligible material for use in qualified Biomass Conversion Facilities (BCF). These payments will be available to eligible material owners at the rate of $1 for each $1 per dry ton paid by the BCF to the eligible material owners, limited to a maximum of $45 per dry ton and limited to a 2-year payment duration. No listening session attendees indicated that they utilized the program. NAP is also available.	*Yes*	*No*
42. In this region, is there a history of federal disaster payments for this crop? Describe:	*Yes*	*No*
43. Approximately what percentage of the total production of this crop is under production contract with a first handler or processor? *Describe contracts:*	*100* ______%	
d. Under the terms of a typical production contract for this crop, is the grower exposed to *production risk* (i.e., the grower must deliver on the contract even if production shortfalls occur)?	*Yes*	*No*
e. Under the terms of a typical production contract for this crop, is the grower exposed to *quality risk* (i.e., there are significant price penalties if the product does not meet the quality characteristics specified in the contract).	*Yes*	*No*
f. Under the terms of a typical production contract for this crop, is the grower exposed to *price risk* (i.e., prices for specific quality characteristics are not specified in the contract)?	*Yes*	*No*

44. In this region, approximately what percentage of the total production of this crop is priced prior to harvest (may or may not be tied to a production contract)? Describe: All camelina production is contracted prior to planting	100_____%

45. When corn farmers in the Midwest experience low (high) yields, they can often expect higher (lower) market prices (i.e., prices and yields are very negatively correlated). This moderates the revenue impacts of low yields. In contrast, for corn farmers in the Southeast there is very little relationship between their yields and market prices (i.e., prices and yields are independent). In this region the price and yield for this crop are (circle one):

Independent *Somewhat Negatively Correlated* *Highly Negatively Correlated*

Describe: It is anticipated that camelina yields and price will be Independent of each other. This is because the commercialization of camelina for bioenergy is in its infancy and in its current form, the demand is being met by the current supply. However, going forward this may change greatly.

46. On a scale from one to five, where one is "strongly disagree" and five is "strongly agree," provide your reaction to the following statement:

"In this region, producers of this crop are financially able to self-insure against production losses."

1 strongly disagree	*2*	*3*	*4*	*5* strongly agree

Describe: Indications from the listening session meeting suggest that most producers wanted crop insurance on camelina so they are not exposed to large production losses, even though most producers had assistance in establishing the crop and were being paid a fixed price for their production.

47. For a typical grower of this crop, approximately what percentage of the total farm revenue would be attributable to this crop?	15-25____%

48. What other commodities would typically be produced on a farm that produces this commodity? What is the correlation between revenue from these other commodities and the revenue from this commodity? For correlation use a scale of one to five, where 1 is "strongly negatively correlated," 2 is "negatively correlated," 3 "independent," 4 is "positively correlated," and 5 is "strongly positively correlated."

List:	***Correlation*** *(assign a number between 1-5)*
Hard Red Winter Wheat, Spring Wheat	4,4
Alfalfa	3
Barley	4

49. In this region, approximately what percentage of the total production of this crop is produced by part-time farmers who have full-time employment off the farm?	0_______%

50. On a scale from one to five, where one is “strongly disagree“ and five is “strongly agree,“ provide your reaction to the following statement:

“In this region, producers of this crop attempt to manage production risk by spreading their production over several geographic locations.”

1 strongly disagree	2	3	4	5 strongly agree

Describe: Most producers stated that they were not spread over several geographic locations.

51. In this region, what private-sector insurance products (if any) are currently available for this crop?

List all:

52. Characterize how agricultural lenders in this region view the available RMA-facilitated insurance products for this crop. “Unfavorable” implies that lenders actually discourage borrowers from purchasing the product while “favorable” implies that lenders strongly encourage and often require borrowers to purchase the product. If multiple insurance products are offered, answer for each product.

Unfavorable *Indifferent* *Favorable*

Describe: Hard to determine as no lenders were present at the listening sessions. Yet, listening session attendees typically say that their lenders prefer they have crop insurance for production loans.

53. On a scale from one to five, where one is very high and five is very low, assess the sufficiency of non-insurance coping mechanisms for producers of this crop in this region.

1 high availability	2	3	4	5 low availability

Risk Classification

54. On a scale from one to five, where one is strongly disagree and five is strongly agree, provide your reaction to the following statement:

"In this region, no producers of this crop are really any more or less risky than any others. They all face about the same risk of loss."

1 strongly disagree	2	3	4	5 strongly agree

Describe: Most producers attending the listening sessions indicated that those producers further to the west were probably less at risk due to drought, while those further east are more exposed to less rainfall and higher risk.

55. In this region, *for those who are currently **not** insured*, would you say that premium rate on the existing RMA-facilitated insurance products for this crop are "much too low," "about right," or "much too high"? If more than one RMA insurance product is offered, answer for each product.

Much Too Low *About Right* *Much Too High*

If you answered that premium rates are "much too high," explain why (or how) you think this happened.

N/A

56. In this region, *for those who currently are insured,* would you say that premium rate on the existing RMA-facilitated insurance products for this crop are "much too low," "about right," or "much too high"? If more than one RMA insurance product is offered, answer for each product.

Much Too Low *About Right* *Much Too High*

If you answered that premium rates are "much too high," explain why (or how) you think this happened.

N/A

57. For this region, to what extent does the system used to establish the guarantee (e.g., APH yield or expected revenue) for this crop match the true value of the production at risk? An answer of one indicates that the system used to establish the guarantee does a very poor job of matching the true value of the production at risk. An answer of five indicates that the system used to establish the guarantee does a very good job of matching the true value of the production at risk.

1 very poor job	2	3	4	5 very good job

58. On a scale from one to five, where one is very low and five is very high, assess the effectiveness of existing RMA-facilitated insurance products in accurately classifying potential policyholders according to their loss exposure (i.e., higher risk growers pay higher premiums while lower risk growers pay lower premiums).

1 very low	2	3	4	5 very high

Moral Hazard and Monitoring

59. Yield variation can be caused by unavoidable "*acts of nature*" or avoidable "*acts of management*." In practical parlance, what is the potential for "gaming" the insurance product? Evaluate the potential for gaming the RMA-facilitated crop insurance product for this crop on a scale from one to five, where one implies that variation in yield is almost exclusively due to "acts of nature" (potential for gaming is low) and five implies that yield variation is almost exclusively due to "acts of management" (potential for gaming is high). If multiple insurance products are offered, answer for each product.

1 very low	***2***	***3***	***4***	***5*** very high

60. To the extent that management affects yield loss risk exposure, how difficult is it to monitor the insured's behavior?

Extremely Difficult *Difficult* *Not too Difficult*

Explain: It is not too hard to monitor the insured's behavior in growing camelina; however, it may be challenging to monitor the producers practices in relation to chemical residuals from previous crops.

61. Quality variation can be caused by unavoidable "acts of nature" or avoidable "acts of management." In practical parlance, what is the potential for "gaming" the insurance product? Evaluate the potential for gaming the RMA-facilitated insurance product for this crop on a scale from one to five, where one implies that variation in quality is almost exclusively due to "acts of nature" (potential for gaming is low) and five implies that quality variation is almost exclusively due to "acts of management" (potential for gaming is high). If multiple insurance products are offered, answer for each product.

1 very low	***2***	***3***	***4***	***5*** very high

62. To the extent that management affects quality loss risk exposure, how difficult is it to monitor the insured's behavior?

Extremely Difficult Difficult Not too Difficult

Explain: Producers cannot change the quality characteristics of the oil; therefore, it is not difficult.

63. On a scale from one to five, where one is very large and five is very small, assess the extent of moral hazard problems with existing RMA-facilitated insurance products for this crop.

1 very large	***2***	***3***	***4***	***5*** very small

Problems Affecting Insurance Participation		
64. Have *significant* problems occurred (either past or current) with policy provisions on existing RMA-facilitated insurance products for the crop? If multiple insurance products are offered, answer for each product.	*Yes*	*No*

65. If the answer to the previous question is no, go to next question. If yes, for each significant problem:

a. Briefly describe the problem.

b. What has been the impact of the problem (e.g., high loss ratios, reduced demand, etc.)?

c. Have policy provisions since been changed to adequately address the problem?

d. If policy provisions have not been changed, what changes in policy provisions do you think would increase insurance demand for this crop?

66. In this region, do reinsured companies have sufficient incentives to aggressively market existing RMA-facilitated insurance products for the crop? If yes, go to next question. If no, explain. N/A	*Yes*	*No*
67. In this region, do agents have sufficient incentives to aggressively market existing RMA-facilitated insurance products for the crop? If yes, go to next question. If no, explain. N/A	*Yes*	*No*

68. List any perils that concern growers of this crop but are not covered by the existing RMA-facilitated insurance products (e.g., business interruption due to unavailability of irrigation water, disease quarantines, etc.). For each peril assess the extent of growers' concerns about this peril on a scale from one to five where one is minor concern and five is major concern.

List all:	***1*** minor concern	***2***	***3***	***4***	***5*** major concern

69. Briefly describe the potential for insuring these currently uninsured perils? In answering this, consider the following questions:

    Can hidden action/moral hazard and classification/adverse selection problems be avoided?

    Can clearly stated policy provisions be developed and accurate premium rates established?

N/A

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70. On a scale from one to five, where one is very high and five is very low, assess the likelihood that problems affecting participation can be adequately addressed by product or policy modifications.

1 very low	***2***	***3***	***4***	***5*** very high

Program Evaluation Diagnostic Questions

Region **Tennessee**

Crop **Switchgrass**
Market
(fresh, processed, sold for animal feed, etc.) **Sold for Dedicated Energy**

Background Information

Production Processes

Annuals		
1. Is the crop planted multiple times during a crop production year? If yes, explain: N/A	*Yes*	*No*
2. For a single planting, is the crop harvested multiple times during a crop production year? If yes, explain: N/A	*Yes*	*No*

3. Describe distinguishing characteristics of prevailing production system(s) for this crop (e.g., practices such as double crop, fallow, irrigation, regional differences in climate or soils, etc.). Discuss, particularly, features that are critical in assessing potential demand including potential issues with practices and types.
N/A

Biennials		
4. Is the crop harvested multiple times during a crop production year?	*Yes*	*No*

5. Describe distinguishing characteristics of prevailing production system(s) for this crop (e.g., practices such as irrigation, regional differences in climate or soils, etc.). Discuss, particularly, features that are critical in assessing potential demand including potential issues with practices and types.
N/A

Perennials		
6. Is the crop harvested multiple times during a crop production year? If yes, explain: This is uncommon but it has been done. The most common practice would be to wait until after November 1 or 2 to 3 hard freezes to get crop dried down as much as possible. One cutting would be the common cultural practice.	*Yes*	*No*
7. Is the crop alternate bearing?	*Yes*	*No*
8. Describe distinguishing characteristics of prevailing production system(s) for this crop (e.g., practices such as irrigation, regional differences in climate or soils, etc.). Discuss, particularly, features that are critical in assessing potential demand including potential issues with practices and types. Currently much of the switchgrass is grown on marginal soils land that was taken away from pasture production and put into switchgrass; however, some was converted from cropland. Switchgrass is determined to be easy to grow and the need for intensive management is unnecessary, yet it does respond well to fertility.		
9. What is the economic life of the capital stock (trees, vines, etc.)?	*10 ____years*	
10. Over its economic life, what is the likelihood that 10 percent or more of the capital stock would be lost due to natural causes? Describe: Hard to determine, as this is a very hardy grass that thrives natively. Introduced high yielding cultivars have been developed for regions such as Tennessee and no pest or disease issues have been prevalent. However, the crop has only been in commercial production for 3 years specifically for dedicated energy purposes.	*0 _______%* *(probability of loss)*	
11. If capital stock is lost, how long will it take to reestablish the capital stock to a point where it starts producing salable output?	*1____years*	
12. If capital stock is lost, how long will it take to reestablish the capital stock to a point where it is at peak production?	*3____years*	

Nursery

13. Describe distinguishing characteristics of prevailing production system(s) for nursery crops in this region. Discuss, particularly, features that are critical in assessing potential demand including potential issues with practices and types.

N/A

Marketing

14. Describe typical marketing channels and/or contracting structures for this crop.

Genera energy was formed to execute the capital construction projects and business elements of the Tennessee Biofuels Initiative. Genera energy partnered with DuPont Danisco Cellulosic Ethanol to jointly construct and operate a demonstration scale cellulosic biorefinery. As part of the Tennessee Biofuels Initiative, the University of Tennessee developed a local farm-based switchgrass energy crop industry. Currently the University of Tennessee provides acre contracts to farmers for $450/acre which began in 2009 and will run for 3 years; however a yield based component will be added in 2010. Genera energy will then provide a yield based production contract for $50-$75 per ton going forward.

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15. In this region are there critical time periods (i.e., marketing windows) when producers hope to market this crop? If so, describe.

No, there are not really critical time periods because the harvest window is large and it is anticipated that switchgrass will be stored. The producers are also paid based on contract price, so there is no price variability or market timing to be concerned with.

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16. Within the marketing channels and/or contracting structures mentioned above describe how quality variations are handled (e.g., off-grade apples in a fresh market system may be processed for juice).

Currently there are no quality concerns.

17. In this region, do federal supply control marketing orders exist for production of this crop? Describe:	*Yes*	*No*
18. In this region, do state quality marketing orders exist for production of this crop? Describe:	*Yes*	*No*

RMA–Facilitated Insurance Products

19. In this region, what RMA-facilitated insurance products are currently available for this crop? List all:

None

Yield Risk

20. In this region what are examples of crops with very ***low** relative* yield risk? Relative risk is used to adjust absolute magnitudes that vary across crops to a relative level to facilitate comparability (roughly, a measure of variation divided by the mean level).

All Dry Hay, Tobacco

21. In this region what are examples of crops with very ***high** relative* yield risk?

Alfalfa, Corn for Grain, Soybeans

22. Is this crop exposed to catastrophic risks that would reduce yields by 50 percent or more?	*Yes*	*No*

23. If the answer to the previous question is yes, describe these risks. If no, proceed to the next question. Over 25 years (or crop cycles) approximately how often would you expect such catastrophic losses to occur?

Description	***Years (or crop cycles) out of 25***
Hard to quantify, but RMA insurance cause of loss experience from 1985-2009 presents 2	2
causes of loss from fire for tobacco. Although it is significantly different from switchgrass, it	
may be the best quantitative measure available.	

24. Characterize yield risk for this crop *ignoring the catastrophic yield risk(s) described earlier*. On a scale from one to five, if the low relative yield risk crops identified earlier were one, and the high relative yield risk crops identified earlier were five, what number would you assign to the non-catastrophic yield risk associated with this crop in this region?

1 very low relative yield risk	***2***	***3***	***4***	***5*** very high relative yield risk

25. In this region, do producers tend to experience multiple-year sequences of good yields or bad yields for this crop? If yes, describe what causes these multiple-year sequences. Based on NASS estimates of All Dry Hay yields back to 1990, it appears that for the counties in which DuPont Danisco Ethanol will source their switchgrass, data indicates that yields are above the 17 year average 25 times and below average 20 times, with a sequence of 9 consecutive years above average and 2 consecutive years below average.	*Yes*	*No*

26. On a scale from one to five, where one is very low yield risk and five is very high yield risk, provide an overall assessment of yield risk faced by producers of this crop in this region.

1 very low yield risk	*2*	*3*	*4*	*5* very high yield risk

Quality Risk

27. In this region what are examples of crops with very **low** quality risk?
Corn, Wheat

28. In this region what are examples of crops with very **high** quality risk?
Alfalfa, Tobacco

29. Is this crop exposed to catastrophic quality risks that would reduce the average price received by 20 percent or more?	*Yes*	*No*

30. If the answer to the previous question is yes, describe these risks. If no, proceed to the next question. Over 25 years (or crop cycles) approximately how often would you expect such catastrophic quality losses to occur?

Description	***Years (or crop cycles) out of 25***

31. We now want to characterize quality risk for this crop *ignoring the catastrophic quality risk(s) described earlier*. On a scale from one to five, if the crops with very low risk of quality problems identified earlier were one, and the crops with very high risk of quality problems identified earlier were five, what number would you assign to the quality risk associated with this crop in this region?

1 very low quality risk	*2*	*3*	*4*	*5* very high quality risk

32. On a scale from one to five, if one is very low quality risk and five is very high quality risk, provide an overall assessment of quality risk faced by producers of this crop in this region.

1 very low quality risk	*2*	*3*	*4*	*5* very high quality risk

Price Risk

33. In this region what are examples of crops with very ***low*** *relative* price risk *within the production cycle*? That is, variation in price between pre-plant for annuals (or equivalent for perennials) and sale. (Similar concept to IP and RA for crops with futures markets).

Alfalfa, All Hay

34. In this region what are examples of crops with very ***high*** *relative* price risk *within the production cycle*? That is, variation in price between pre-plant for annuals (or, equivalent for perennials) and sale. (Similar concept to IP and RA for crops with futures markets).

Corn for Grain, Soybeans

35. On a scale from one to five, if the low price risk crops identified earlier were one and the high price risk crops identified earlier were five, what number would you assign to the relative price risk (within the production cycle) associated with this crop in this region?

1 low price risk crop	***2***	***3***	***4***	***5*** high price risk crop

	Yes	*No*
36. In this region, do producers tend to experience multiple-year sequences of high prices or low prices for this crop? If yes, describe.		

37. On a scale from one to five, where one is very low price risk and five is very high price risk, provide an overall assessment of price risk (within the production cycle) faced by producers of this crop in this region.

1 very low price risk	***2***	***3***	***4***	***5*** very high price risk

Other Sources of Revenue Risk

38. For this region, describe other factors that affect revenue risk for this crop (e.g., prevented planting).
Switchgrass is a perennial crop that is planted in May or June at the rate of 5-6 lbs of Pure Live Seed per acre. Seed cost $15/lbs; therefore seeding cost run $75-$90 per acre. Drought in this region caused 20% of producers to replant in 2009. Drought presents challenges for establishment; so replant payments may be needed; however, no indication of prevented planting issues were mentioned. Other revenue risks for switchgrass are production loss from storage, and risk of fire in storage.

39. On a scale from one to five, where one is very low risk and five is very high risk, provide an overall assessment of risk sources other than yield, quality, and price risks faced by producers of this crop in this region.

1 very low risk	*2*	*3*	*4*	*5* very high risk

Sufficient Non-Insurance Coping Mechanisms

40. On a scale from one to five, where one is very low and five is very high, assess the extent to which producers of this commodity in this region use risk-reducing inputs as a substitute for crop insurance.

1 very low	*2*	*3*	*4*	*5* very high

41. Are government crop programs (e.g., marketing loans and counter-cyclical payments) available for this crop? Describe: The Biomass Crop Assistance Program (BCAP) supports establishing and producing eligible crops for the conversion to bioenergy through project areas and through contracts on land of up to 5 years for annual and non-woody perennial crops or up to 15 years for woody perennial crops. Through a matching payment program BCAP assists agricultural and forest land owners and eligible material owners with collection, harvest, storage, and transportation of eligible material for use in qualified Biomass Conversion Facilities (BCF). These payments will be available to eligible material owners at the rate of $1 for each $1 per dry ton paid by the BCF to the eligible material owners, limited to a maximum of $45 per dry ton and limited to a 2-year payment duration. No listening session attendees indicated that they utilized the program. NAP is not available.	*Yes*	*No*

42. In this region, is there a history of federal disaster payments for this crop? Describe:	*Yes*	*No*
43. Approximately what percentage of the total production of this crop is under production contract with a first handler or processor? *Describe contracts:*	*100* ______%	
g. Under the terms of a typical production contract for this crop, is the grower exposed to *production risk* (i.e., the grower must deliver on the contract even if production shortfalls occur)?	*Yes*	*No*
h. Under the terms of a typical production contract for this crop, is the grower exposed to *quality risk* (i.e., there are significant price penalties if the product does not meet the quality characteristics specified in the contract).	*Yes*	*No*
i. Under the terms of a typical production contract for this crop, is the grower exposed to *price risk* (i.e., prices for specific quality characteristics are not specified in the contract)?	*Yes*	*No*
44. In this region, approximately what percentage of the total production of this crop is priced prior to harvest (may or may not be tied to a production contract)? Describe:	*100* ______%	

45. When corn farmers in the Midwest experience low (high) yields, they can often expect higher (lower) market prices (i.e., prices and yields are very negatively correlated). This moderates the revenue impacts of low yields. In contrast, for corn farmers in the Southeast there is very little relationship between their yields and market prices (i.e., prices and yields are independent). In this region the price and yield for this crop are (circle one):

Independent *Somewhat Negatively Correlated* *Highly Negatively Correlated*

Describe: It is anticipated that switchgrass yields and price will be Independent of each other. This is because the commercialization of switchgrass for bioenergy is in its infancy and in its current form, the demand is being met be the current supply and it is anticipated that it will continue to be met going forward.

46. On a scale from one to five, where one is "strongly disagree" and five is "strongly agree," provide your reaction to the following statement:

"In this region, producers of this crop are financially able to self-insure against production losses."

1 strongly disagree	*2*	*3*	*4*	*5* strongly agree

Describe: Only 2-3 listening session attendees have ever purchased federal crop insurance. Indications from the meeting suggest that most producers were comfortable with their level of risk suggesting that they are willing and able to self-insure their crop. Although most producers had assistance in establishing the crop and were being paid a fixed contract amount for their production.

47. For a typical grower of this crop, approximately what percentage of the total farm revenue would be attributable to this crop?	*15-25*____%

48. What other commodities would typically be produced on a farm that produces this commodity? What is the correlation between revenue from these other commodities and the revenue from this commodity? For correlation use a scale of one to five, where 1 is "strongly negatively correlated," 2 is "negatively correlated," 3 "independent," 4 is "positively correlated," and 5 is "strongly positively correlated."

List:	***Correlation*** *(assign a number between 1-5)*
Alfalfa, Other Hay	4,4
Corn	4
Soybeans	4
Livestock	3

49. In this region, approximately what percentage of the total production of this crop is produced by part-time farmers who have full-time employment off the farm?	*0*_______%

50. On a scale from one to five, where one is "strongly disagree" and five is "strongly agree," provide your reaction to the following statement:

"In this region, producers of this crop attempt to manage production risk by spreading their production over several geographic locations."

1 strongly disagree	***2***	***3***	***4***	***5*** strongly agree

Describe: Currently in a 50 mile radius there are only 5,200 acres of switchgrass devoted to being grown for commercial production of bioenergy. Each producer typically has 1 or 2 fields in or near the same region.

51. In this region, what private-sector insurance products (if any) are currently available for this crop?

List all: *None*

52. Characterize how agricultural lenders in this region view the available RMA-facilitated insurance products for this crop. "Unfavorable" implies that lenders actually discourage borrowers from purchasing the product while "favorable" implies that lenders strongly encourage and often require borrowers to purchase the product. If multiple insurance products are offered, answer for each product.

Unfavorable *Indifferent* *Favorable*

Describe: Hard to determine as no lenders were present at the listening sessions. Yet, since the amount of revenue per acre currently exceeds the production cost, lenders would probably be indifferent to an insurance program for switchgrass.

53. On a scale from one to five, where one is very high and five is very low, assess the sufficiency of non-insurance coping mechanisms for producers of this crop in this region.

1 high availability	***2***	***3***	***4***	***5*** low availability

Risk Classification

54. On a scale from one to five, where one is strongly disagree and five is strongly agree, provide your reaction to the following statement:

"In this region, no producers of this crop are really any more or less risky than any others. They all face about the same risk of loss."

1 strongly disagree	***2***	***3***	***4***	***5*** strongly agree

Describe: Most producers attending listening sessions thought that they all faced about the same risks of loss.

55. In this region, *for those who are currently* ***not*** *insured*, would you say that premium rate on the existing RMA-facilitated insurance products for this crop are "much too low," "about right," or "much too high"? If more than one RMA insurance product is offered, answer for each product.

Much Too Low *About Right* *Much Too High*

If you answered that premium rates are "much too high," explain why (or how) you think this happened.

N/A

56. In this region, *for those who currently are insured,* would you say that premium rate on the existing RMA-facilitated insurance products for this crop are "much too low," "about right," or "much too high"? If more than one RMA insurance product is offered, answer for each product.

Much Too Low *About Right* *Much Too High*

If you answered that premium rates are "much too high," explain why (or how) you think this happened.

N/A

57. For this region, to what extent does the system used to establish the guarantee (e.g., APH yield or expected revenue) for this crop match the true value of the production at risk? An answer of one indicates that the system used to establish the guarantee does a very poor job of matching the true value of the production at risk. An answer of five indicates that the system used to establish the guarantee does a very good job of matching the true value of the production at risk.

1 very poor job	***2***	***3***	***4***	***5*** very good job

58. On a scale from one to five, where one is very low and five is very high, assess the effectiveness of existing RMA-facilitated insurance products in accurately classifying potential policyholders according to their loss exposure (i.e., higher risk growers pay higher premiums while lower risk growers pay lower premiums).

1 very low	***2***	***3***	***4***	***5*** very high

Moral Hazard and Monitoring

59. Yield variation can be caused by unavoidable "*acts of nature*" or avoidable "*acts of management*." In practical parlance, what is the potential for "gaming" the insurance product? Evaluate the potential for gaming the RMA-facilitated crop insurance product for this crop on a scale from one to five, where one implies that variation in yield is almost exclusively due to "acts of nature" (potential for gaming is low) and five implies that yield variation is almost exclusively due to "acts of management" (potential for gaming is high). If multiple insurance products are offered, answer for each product.

1 very low	*2*	*3*	*4*	*5* very high

60. To the extent that management affects yield loss risk exposure, how difficult is it to monitor the insured's behavior?

Extremely Difficult *Difficult* *Not too Difficult*

Explain: It is not too hard to monitor the insured's behavior. Most producers should have receipts for any chemical management practices that could influence yield one way or the other. However, it may be hard to monitor yield risk exposure from intentional fire.

61. Quality variation can be caused by unavoidable "acts of nature" or avoidable "acts of management." In practical parlance, what is the potential for "gaming" the insurance product? Evaluate the potential for gaming the RMA-facilitated insurance product for this crop on a scale from one to five, where one implies that variation in quality is almost exclusively due to "acts of nature" (potential for gaming is low) and five implies that quality variation is almost exclusively due to "acts of management" (potential for gaming is high). If multiple insurance products are offered, answer for each product.

1 very low	*2*	*3*	*4*	*5* very high

62. To the extent that management affects quality loss risk exposure, how difficult is it to monitor the insured's behavior?

Extremely Difficult Difficult Not too Difficult

Explain: The impact of quality of switchgrass for ethanol is measured via enzymatic hydrolysis (EtOH). Variation of EtOH during production is very small and would only be caused by acts of nature; although, in storage acts of management could affect biomass losses and EtOH potential. However, it would be easy to monitor storage of switchgrass bales.

63. On a scale from one to five, where one is very large and five is very small, assess the extent of moral hazard problems with existing RMA-facilitated insurance products for this crop.

1 very large	*2*	*3*	*4*	*5* very small

Problems Affecting Insurance Participation		
64. Have *significant* problems occurred (either past or current) with policy provisions on existing RMA-facilitated insurance products for the crop? If multiple insurance products are offered, answer for each product.	*Yes*	*No*

65. If the answer to the previous question is no, go to next question. If yes, for each significant problem:

a. Briefly describe the problem.

b. What has been the impact of the problem (e.g., high loss ratios, reduced demand, etc.)?

c. Have policy provisions since been changed to adequately address the problem?

d. If policy provisions have not been changed, what changes in policy provisions do you think would increase insurance demand for this crop?

66. In this region, do reinsured companies have sufficient incentives to aggressively market existing RMA-facilitated insurance products for the crop? If yes, go to next question. If no, explain. N/A	*Yes*	*No*
67. In this region, do agents have sufficient incentives to aggressively market existing RMA-facilitated insurance products for the crop? If yes, go to next question. If no, explain. N/A	*Yes*	*No*

68. List any perils that concern growers of this crop but are not covered by the existing RMA-facilitated insurance products (e.g., business interruption due to unavailability of irrigation water, disease quarantines, etc.). For each peril assess the extent of growers' concerns about this peril on a scale from one to five where one is minor concern and five is major concern.

List all:	***1*** minor concern	***2***	***3***	***4***	***5*** major concern

69. Briefly describe the potential for insuring these currently uninsured perils? In answering this, consider the following questions:

    Can hidden action/moral hazard and classification/adverse selection problems be avoided?

    Can clearly stated policy provisions be developed and accurate premium rates established?

N/A

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70. On a scale from one to five, where one is very high and five is very low, assess the likelihood that problems affecting participation can be adequately addressed by product or policy modifications.

1 very low	***2***	***3***	***4***	***5*** very high

Program Evaluation Diagnostic Questions

Region **Louisiana**

Crop **Energy Cane**

Market
(fresh, processed, sold for animal feed, etc.) **Sold for Dedicated Energy**

Background Information

Production Processes

Annuals

1. Is the crop planted multiple times during a crop production year? If yes, explain: N/A	*Yes*	*No*
2. For a single planting, is the crop harvested multiple times during a crop production year? If yes, explain: N/A	*Yes*	*No*

3. Describe distinguishing characteristics of prevailing production system(s) for this crop (e.g., practices such as double crop, fallow, irrigation, regional differences in climate or soils, etc.). Discuss, particularly, features that are critical in assessing potential demand including potential issues with practices and types.
N/A

Biennials

4. Is the crop harvested multiple times during a crop production year?	*Yes*	*No*

5. Describe distinguishing characteristics of prevailing production system(s) for this crop (e.g., practices such as irrigation, regional differences in climate or soils, etc.). Discuss, particularly, features that are critical in assessing potential demand including potential issues with practices and types.
N/A

Perennials

6. Is the crop harvested multiple times during a crop production year? If yes, explain: During the establishment year, the energy cane is cut in January or after approximately six of growth as a cultural practice. This first cutting can be harvested if per acre yields are high enough. Once the stand is established, the crop is harvested once per production year.	*Yes*	*No*
7. Is the crop alternate bearing?	*Yes*	*No*

8. Describe distinguishing characteristics of prevailing production system(s) for this crop (e.g., practices such as irrigation, regional differences in climate or soils, etc.). Discuss, particularly, features that are critical in assessing potential demand including potential issues with practices and types.
Planted in sandy soils in southern Louisiana. Test plots do not use irrigation, but water is essential during the grand growth phase so irrigation would potentially reduce yield variability.

9. What is the economic life of the capital stock (trees, vines, etc.)?	*4th ratoon years*
10. Over its economic life, what is the likelihood that 10 percent or more of the capital stock would be lost due to natural causes? Describe: Using sugarcane as a comparable crop, NASS data shows that sugarcane in Louisiana has an 11% probability of a yield loss over 10% from the previous year.	*11______%* *(probability of loss)*
11. If capital stock is lost, how long will it take to reestablish the capital stock to a point where it starts producing salable output?	*1____years*
12. If capital stock is lost, how long will it take to reestablish the capital stock to a point where it is at peak production?	*NA___years*

Nursery

13. Describe distinguishing characteristics of prevailing production system(s) for nursery crops in this region. Discuss, particularly, features that are critical in assessing potential demand including potential issues with practices and types.

N/A

Marketing

14. Describe typical marketing channels and/or contracting structures for this crop.

To date there is not an established market for energy cane, although 200 acres of cane are under a production contract in Louisiana by a refinery previously owned by Verenium and now British Petroleum (BP). The details of the contracts and current status of production is not known at this time.

15. In this region are there critical time periods (i.e., marketing windows) when producers hope to market this crop? If so, describe.

The marketing window for energy cane is at harvest, which is typically between November and January to allow for the cane to dry. During the establishment year the cane is cut twice as a cultural practice, giving producers an additional window to market their crop. The yield from the first cut must be high enough to cover logistics costs for farmers to sell the cutting.

16. Within the marketing channels and/or contracting structures mentioned above describe how quality variations are handled (e.g., off-grade apples in a fresh market system may be processed for juice).

Long freezes have an unknown effect on the chemical composition of the cane. This could potentially be a quality issue for processors. Also, the stalk must be free of mud for processors.

17. In this region, do federal supply control marketing orders exist for production of this crop? Describe:	*Yes*	*No*
18. In this region, do state quality marketing orders exist for production of this crop? Describe:	*Yes*	*No*

RMA–Facilitated Insurance Products

19. In this region, what RMA-facilitated insurance products are currently available for this crop? List all:

None

Yield Risk

20. In this region what are examples of crops with very ***low*** *relative* yield risk? Relative risk is used to adjust absolute magnitudes that vary across crops to a relative level to facilitate comparability (roughly, a measure of variation divided by the mean level).

Rice and sugarcane have a low yield risk in the State of Louisiana, but historic sugarcane yields have lower risk than both.

21. In this region what are examples of crops with very ***high*** *relative* yield risk?

Corn, Cotton, Grain Sorghum, Wheat

22. Is this crop exposed to catastrophic risks that would reduce yields by 50 percent or more?	*Yes*	*No*

23. If the answer to the previous question is yes, describe these risks. If no, proceed to the next question. Over 25 years (or crop cycles) approximately how often would you expect such catastrophic losses to occur?

Description	***Years (or crop cycles) out of 25***
Cold Wet Weather, Drought, Excess Moisture/Precip/Rain, Flood, Freeze and Frost	3,10,11,1,7
Hail, Heat, Hurricane/Tropical Depression, Insects, Other (Snow-Lightning-Etc.)	0,1,2,2,2
Plant Disease, Wind/Excess Wind	1,0

24. Characterize yield risk for this crop *ignoring the catastrophic yield risk(s) described earlier*. On a scale from one to five, if the low relative yield risk crops identified earlier were one, and the high relative yield risk crops identified earlier were five, what number would you assign to the non-catastrophic yield risk associated with this crop in this region?

1 very low relative yield risk	***2***	***3***	***4***	***5*** very high relative yield risk

25. In this region, do producers tend to experience multiple-year sequences of good yields or bad yields for this crop? If yes, describe what causes these multiple-year sequences.	*Yes*	*No*

26. On a scale from one to five, where one is very low yield risk and five is very high yield risk, provide an overall assessment of yield risk faced by producers of this crop in this region.

1 very low yield	***2***	***3***	***4***	***5*** very high yield

risk				risk

Quality Risk

27. In this region what are examples of crops with very **low** quality risk?
Corn, Oats, Wheat, Grain Sorghum

28. In this region what are examples of crops with very **high** quality risk?
Peaches, Sweet potatoes

29. Is this crop exposed to catastrophic quality risks that would reduce the average price received by 20 percent or more?	*Yes*	*No*

30. If the answer to the previous question is yes, describe these risks. If no, proceed to the next question. Over 25 years (or crop cycles) approximately how often would you expect such catastrophic quality losses to occur?

Description	***Years (or crop cycles) out of 25***

31. We now want to characterize quality risk for this crop *ignoring the catastrophic quality risk(s) described earlier*. On a scale from one to five, if the crops with very low risk of quality problems identified earlier were one, and the crops with very high risk of quality problems identified earlier were five, what number would you assign to the quality risk associated with this crop in this region?

1 very low quality risk	***2***	***3***	***4***	***5*** very high quality risk

32. On a scale from one to five, if one is very low quality risk and five is very high quality risk, provide an overall assessment of quality risk faced by producers of this crop in this region.

1 very low quality risk	***2***	***3***	***4***	***5*** very high quality risk

Price Risk

33. In this region what are examples of crops with very ***low*** *relative* price risk *within the production cycle*? That is, variation in price between pre-plant for annuals (or equivalent for perennials) and sale. (Similar concept to IP and RA for crops with futures markets).
Sugarcane, Cotton

34. In this region what are examples of crops with very ***high*** *relative* price risk *within the production cycle*? That is, variation in price between pre-plant for annuals (or, equivalent for perennials) and sale.

(Similar concept to IP and RA for crops with futures markets).
Corn, Rice, Sorghum, Soybeans, Wheat

35. On a scale from one to five, if the low price risk crops identified earlier were one and the high price risk crops identified earlier were five, what number would you assign to the relative price risk (within the production cycle) associated with this crop in this region?

1 low price risk crop	***2***	***3***	***4***	***5*** high price risk crop

36. In this region, do producers tend to experience multiple-year sequences of high prices or low prices for this crop? If yes, describe. No established market.	*Yes*	*No*

37. On a scale from one to five, where one is very low price risk and five is very high price risk, provide an overall assessment of price risk (within the production cycle) faced by producers of this crop in this region.

1 very low price risk	***2***	***3***	***4***	***5*** very high price risk

Other Sources of Revenue Risk

38. For this region, describe other factors that affect revenue risk for this crop (e.g., prevented planting).
None

39. On a scale from one to five, where one is very low risk and five is very high risk, provide an overall assessment of risk sources other than yield, quality, and price risks faced by producers of this crop in this region.

1 very low risk	***2***	***3***	***4***	***5*** very high risk

Sufficient Non-Insurance Coping Mechanisms

40. On a scale from one to five, where one is very low and five is very high, assess the extent to which producers of this commodity in this region use risk-reducing inputs as a substitute for crop insurance.

1	***2***	***3***	***4***	***5***

very low				very high

41. Are government crop programs (e.g., marketing loans and counter-cyclical payments) available for this crop? Describe: The Biomass Crop Assistance Program (BCAP) supports establishing and producing eligible crops for the conversion to bioenergy through project areas and through contracts on land of up to 5 years for annual and non-woody perennial crops or up to 15 years for woody perennial crops. Through a matching payment program BCAP assists agricultural and forest land owners and eligible material owners with collection, harvest, storage, and transportation of eligible material for use in qualified Biomass Conversion Facilities (BCF). These payments will be available to eligible material owners at the rate of $1 for each $1 per dry ton paid by the BCF to the eligible material owners, limited to a maximum of $45 per dry ton and limited to a 2-year payment duration.	*Yes*	*No*
42. In this region, is there a history of federal disaster payments for this crop? Describe:	*Yes*	*No*
43. Approximately what percentage of the total production of this crop is under production contract with a first handler or processor? *Describe contracts:*	*100______%*	
j. Under the terms of a typical production contract for this crop, is the grower exposed to *production risk* (i.e., the grower must deliver on the contract even if production shortfalls occur)?	*Yes*	*No*
k. Under the terms of a typical production contract for this crop, is the grower exposed to *quality risk* (i.e., there are significant price penalties if the product does not meet the quality characteristics specified in the contract).	*Yes*	*No*
l. Under the terms of a typical production contract for this crop, is the grower exposed to *price risk* (i.e., prices for specific quality characteristics are not specified in the contract)?	*Yes*	*No*
44. In this region, approximately what percentage of the total production of this crop is priced prior to harvest (may or may not be tied to a production contract)? Describe:	*100______%*	

45. When corn farmers in the Midwest experience low (high) yields, they can often expect higher (lower) market prices (i.e., prices and yields are very negatively correlated). This moderates the revenue impacts of low yields. In contrast, for corn farmers in the Southeast there is very little relationship between their yields and market prices (i.e., prices and yields are independent). In this region the price and yield for this crop are (circle one):

Independent *Somewhat Negatively Correlated* *Highly Negatively Correlated*

Describe: There is no established market, but it is expected that prices and yields will be independent.

46. On a scale from one to five, where one is "strongly disagree" and five is "strongly agree," provide your reaction to the following statement:

"In this region, producers of this crop are financially able to self-insure against production losses."

1 strongly disagree	***2***	***3***	***4***	***5*** strongly agree

Describe: Data is not available for production loss, as the crop is not yet commercially produced.

47. For a typical grower of this crop, approximately what percentage of the total farm revenue would be attributable to this crop?	*0*____%

48. What other commodities would typically be produced on a farm that produces this commodity? What is the correlation between revenue from these other commodities and the revenue from this commodity? For correlation use a scale of one to five, where 1 is "strongly negatively correlated," 2 is "negatively correlated," 3 "independent," 4 is "positively correlated," and 5 is "strongly positively correlated."

List:	***Correlation*** *(assign a number between 1-5)*
Sugarcane	5

49. In this region, approximately what percentage of the total production of this crop is produced by part-time farmers who have full-time employment off the farm?	*0*______%

50. On a scale from one to five, where one is "strongly disagree" and five is "strongly agree," provide your reaction to the following statement:

"In this region, producers of this crop attempt to manage production risk by spreading their production over several geographic locations."

1 strongly disagree	***2***	***3***	***4***	***5*** strongly agree

Describe: Not enough data to strongly disagree or strongly agree.

51. In this region, what private-sector insurance products (if any) are currently available for this crop?

List all: None

52. Characterize how agricultural lenders in this region view the available RMA-facilitated insurance products for this crop. "Unfavorable" implies that lenders actually discourage borrowers from purchasing the product while "favorable" implies that lenders strongly encourage and often require borrowers to purchase the product. If multiple insurance products are offered, answer for each product.

Unfavorable *Indifferent* *Favorable*

Describe: The views of lenders cannot be determined as there is no established market for producers. Lenders would be indifferent to insurance for producers under contract because revenue would be guaranteed.

53. On a scale from one to five, where one is very high and five is very low, assess the sufficiency of non-insurance coping mechanisms for producers of this crop in this region.

1 high availability	***2***	***3***	***4***	***5*** low availability

Risk Classification

54. On a scale from one to five, where one is strongly disagree and five is strongly agree, provide your reaction to the following statement:

"In this region, no producers of this crop are really any more or less risky than any others. They all face about the same risk of loss."

1 strongly disagree	2	3	4	5 strongly agree

Describe: Listening session feedback indicated that they all faced about the same risks of loss.

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55. In this region, *for those who are currently **not** insured*, would you say that premium rate on the existing RMA-facilitated insurance products for this crop are "much too low," "about right," or "much too high"? If more than one RMA insurance product is offered, answer for each product.

Much Too Low *About Right* *Much Too High*

If you answered that premium rates are "much too high," explain why (or how) you think this happened.

N/A

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56. In this region, *for those who currently are insured*, would you say that premium rate on the existing RMA-facilitated insurance products for this crop are "much too low," "about right," or "much too high"? If more than one RMA insurance product is offered, answer for each product.

Much Too Low *About Right* *Much Too High*

If you answered that premium rates are "much too high," explain why (or how) you think this happened.

N/A

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57. For this region, to what extent does the system used to establish the guarantee (e.g., APH yield or expected revenue) for this crop match the true value of the production at risk? An answer of one indicates that the system used to establish the guarantee does a very poor job of matching the true value of the production at risk. An answer of five indicates that the system used to establish the guarantee does a very good job of matching the true value of the production at risk.

1 very poor job	2	3	4	5 very good job

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58. On a scale from one to five, where one is very low and five is very high, assess the effectiveness of existing RMA-facilitated insurance products in accurately classifying potential policyholders according to their loss exposure (i.e., higher risk growers pay higher premiums while lower risk growers pay lower premiums).

1 very low	2	3	4	5 very high

Moral Hazard and Monitoring

59. Yield variation can be caused by unavoidable "*acts of nature*" or avoidable "*acts of management*." In practical parlance, what is the potential for "gaming" the insurance product? Evaluate the potential for gaming the RMA-facilitated crop insurance product for this crop on a scale from one to five, where one implies that variation in yield is almost exclusively due to "acts of nature" (potential for gaming is low) and five implies that yield variation is almost exclusively due to "acts of management" (potential for gaming is high). If multiple insurance products are offered, answer for each product.

1 very low	*2*	*3*	*4*	*5* very high

60. To the extent that management affects yield loss risk exposure, how difficult is it to monitor the insured's behavior?

Extremely Difficult *Difficult* *Not too Difficult*

Explain: It is not too hard to monitor the insured's behavior. The first harvest of the establishment year could be difficult to monitor as it is typically a small yield and may or may not be sold.

61. Quality variation can be caused by unavoidable "acts of nature" or avoidable "acts of management." In practical parlance, what is the potential for "gaming" the insurance product? Evaluate the potential for gaming the RMA-facilitated insurance product for this crop on a scale from one to five, where one implies that variation in quality is almost exclusively due to "acts of nature" (potential for gaming is low) and five implies that quality variation is almost exclusively due to "acts of management" (potential for gaming is high). If multiple insurance products are offered, answer for each product.

1 very low	*2*	*3*	*4*	*5* very high

62. To the extent that management affects quality loss risk exposure, how difficult is it to monitor the insured's behavior?

Extremely Difficult Difficult Not too Difficult

Explain: Management affects quality loss risk exposure in terms of not applying proper control measures for insects or disease; however, an act of nature such as hail can lead to quality loss which is easy to identify. Receipts should be available for control measures in the case of proper management; therefore, it would not be too difficult to monitor.

63. On a scale from one to five, where one is very large and five is very small, assess the extent of moral hazard problems with existing RMA-facilitated insurance products for this crop.

1 very large	*2*	*3*	*4*	*5* very small

Problems Affecting Insurance Participation

64. Have *significant* problems occurred (either past or current) with policy provisions on existing RMA-facilitated insurance products for the crop? If multiple insurance products are offered, answer for each product.	*Yes*	*No*

65. If the answer to the previous question is no, go to next question. If yes, for each significant problem:

a. Briefly describe the problem.

b. What has been the impact of the problem (e.g., high loss ratios, reduced demand, etc.)?

c. Have policy provisions since been changed to adequately address the problem?

d. If policy provisions have not been changed, what changes in policy provisions do you think would increase insurance demand for this crop?

66. In this region, do reinsured companies have sufficient incentives to aggressively market existing RMA-facilitated insurance products for the crop? If yes, go to next question. If no, explain. N/A	*Yes*	*No*
67. In this region, do agents have sufficient incentives to aggressively market existing RMA-facilitated insurance products for the crop? If yes, go to next question. If no, explain. N/A	*Yes*	*No*

68. List any perils that concern growers of this crop but are not covered by the existing RMA-facilitated insurance products (e.g., business interruption due to unavailability of irrigation water, disease quarantines, etc.). For each peril assess the extent of growers' concerns about this peril on a scale from one to five where one is minor concern and five is major concern.

List all:	***1*** minor concern	***2***	***3***	***4***	***5*** major concern

69. Briefly describe the potential for insuring these currently uninsured perils? In answering this, consider the following questions:

    Can hidden action/moral hazard and classification/adverse selection problems be avoided?

    Can clearly stated policy provisions be developed and accurate premium rates established?

N/A

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70. On a scale from one to five, where one is very high and five is very low, assess the likelihood that problems affecting participation can be adequately addressed by product or policy modifications.

1 very low	***2***	***3***	***4***	***5*** very high