2004 Fruit and Vegetable Crops Research Report

Edited by Brent Rowell, John Snyder, and Chris Smigell

Acknowledgment

Grants from the Agricultural Development Board through the Kentucky Horticulture Council have allowed an expansion of the field research and demonstration program to meet the informational and educational needs of our growing vegetable and fruit industries.

Important note to readers

The majority of research reports in this volume do not include treatments with experimental pesticides. It should be understood that any experimental pesticide must first be labeled for the crop in question before it can be used by growers, regardless of how it might have been used in research trials. The most recent product label is the final authority concerning application rates, precautions, harvest intervals, and other relevant information. Contact your county's Cooperative Extension Service if you need assistance in interpreting pesticide labels.

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Fruit and Vegetable Program Overview

Dewayne Ingram, Chair Department of Horticulture

Teams of faculty, staff, and students from several departments in the University of Kentucky College of Agriculture conduct multidisciplinary research and Cooperative Extension activities to benefit Kentucky's fruit and vegetable industries. These teams are pleased to provide this 2004 Research Report for your information and use. The research areas on which we have concentrated reflect stated industry needs, expertise available at the University of Kentucky, and the nature of research programs in neighboring states and around the world generating information applicable to Kentucky. If you have questions and/or suggestions about a particular research project, please do not hesitate to contact us.

We gratefully acknowledge the support of the Kentucky Horticulture Council's second grant that was made possible through Master Tobacco Settlement Funds and the Agricultural Development Board. These funds, along with U.S. Department of Agriculture funds through the New Crop Opportunities Center and other grant funds have allowed us to significantly expand our field research and Extension programs again this year. We will be able to continue support for the Extension Associates working with vegetable and fruit crops throughout the state for two more growing seasons from this funding source. Please note in this report the information generated from on-farm demonstrations and trials conducted by our regional Extension Associates working with commercial vegetable and fruit crops.

We are also happy to report on further development of our research infrastructure for horticulture. There have been significant developments at the Horticulture Research Farm (South Farm) in Lexington including a new and safer entrance and a new cooler room. A new greenhouse complex is currently under construction.

An exciting new development is the expansion of research on organic production systems. We set aside 11 acres for certified organic research in 2003 and are now only a season away from full certification. Several M.S. and Ph.D. projects have already begun using this part of the farm, and preliminary results can be found elsewhere in this volume. In addition, an "extreme makeover" of an old storage building is under way at the farm; this redesigned structure will serve as a field house and storage facility for the organic section of the farm. This was made possible though a collaborative effort between the College of Agriculture (Horticulture) and an enthusiastic group of students from the College of Design (Architecture) together with a gift from the Kentucky Vegetable Growers Association.

In addition to reporting our research and Extension activities and accomplishments, we use this research report to update you on the UK undergraduate and graduate degree programs. Please find program highlights below.

Undergraduate Program Highlights

The department offers areas of emphasis in Horticultural Enterprise Management and Horticultural Science within a Plant and Soil Science Bachelor of Science degree. Following are a few highlights of our undergraduate program in 2003-2004.

The Plant and Soil Science degree program had nearly 100 students in the fall semester of 2004, of which almost one-half were horticulture students. Thirteen horticulture students graduated in the 2003-2004 academic year.

We believe that a significant portion of an undergraduate education in horticulture must come outside the classroom. In addition to the local activities of the Horticulture Club and field trips during course laboratories, students have excellent off-campus learning experiences. Here are the highlights of such opportunities in 2004:

- A 13-day study tour in mid-Atlantic and northeast states was led by Drs. McNiel, Dunwell, and Geneve involving six students.
- Horticulture students competed in the 2004 Associated Landscape Contractors of America (ALCA) Career Day competition at Columbus State University in March (Drs. Robert McNiel and Mark Williams, faculty advisors).
- Students accompanied faculty to the following regional/national/international meetings, including the American Society for Horticultural Science Annual Conference, the Kentucky Landscape Industries Conference and Trade Show, the Southern Nursery Association Trade Show, and the Green Industry Conference.

Graduate Program Highlights

The demand for graduates with M.S. or Ph.D. degrees in Horticulture, Entomology, Plant Pathology, Agricultural Economics, and Agricultural Engineering is high. Our M.S. graduates are being employed in the industry, Cooperative Extension Service, secondary and postsecondary education, and governmental agencies. Last year, there were seven graduate students in these degree programs conducting research directly related to the Kentucky fruit and vegetable industries. Graduate students are active participants in the University of Kentucky fruit and vegetable production/marketing systems research program and contribute significantly to our ability to address problems and opportunities important to Kentucky.

Getting the Most Out of Research Reports

Brent Rowell, Department of Horticulture

The *2003 Fruit and Vegetable Crops Research Report* includes results of more than 25 field research trials that were conducted in six counties in Kentucky (see map below). In addition, producers statewide were surveyed about their marketing intentions. Research was conducted by faculty and staff from several departments within the University of Kentucky College of Agriculture, including Horticulture, Entomology, Plant Pathology, and Agricultural Economics. Most of these reports are of crop variety (cultivar) trials.

Growers usually put variety trials at the top of the list when rating projects at a public institution's research station. These trials provide a wealth of information not only to growers but also to Extension agents, researchers, and seed companies. The reports also provide us with much of the information we need in order to include varieties in our *Vegetable Production Guide for Commercial Growers* (Extension Publication ID-36).

The main purpose of variety evaluation is to provide growers with practical information to assist them in selecting the most suitable variety for a given location or market. Here are some guidelines for interpreting the results of fruit and vegetable variety trials:

Our Yields vs. Your Yields

Yields reported in variety trial results are extrapolated from small plots. Depending on the crop, our trial plot sizes range anywhere from 50 to 500 square feet. Yields per acre are calculated by multiplying these small plot yields by correction factors ranging from 100 to 1,000. These yields per acre may not be realistic, and small errors can be amplified when correction factors are used. For example, the calculations may overestimate yields because the plots harvested do not include empty spaces normally occupied by things such as drive rows in a grower's field. These empty spaces may result in a higher per acre yield from the research plots compared to a grower's yield.

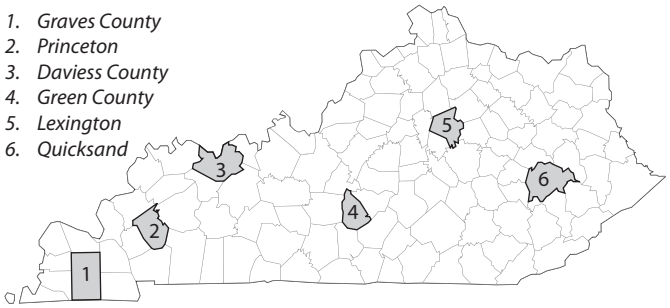
In some cases, research plots may be harvested more often than is economically feasible in a grower's field. So do not feel inadequate if our yields are higher than yours. You should be concerned, however, if our yields are *lower* than yours. In that case, there may be good reason to suspect that the trial was conducted improperly.

It is best not to compare the yield of a variety at one location to the yield of a different variety at another location. The differences in performance among all varieties grown at the same location, however, can and should be used to identify the best varieties for growers nearest that locality. Results vary widely from one location or geographical region to another; a variety may perform well in one location and poorly in another for many reasons. Different locations may have different climates, microclimates, soil types, fertility regimes, and pest problems. Different trials at different locations are also subject to differing management practices. Only a select few varieties seem to perform well over a wide range of environmental conditions, and these varieties usually become top sellers.

Climatic conditions obviously differ considerably from one season to the next, and it follows that some varieties perform well one year and poorly the next. For this reason, we prefer to have at least two years of trial data before coming to any hard and fast conclusions about a variety's performance. In other cases, we may conduct a preliminary trial to eliminate the worst varieties and let growers make the final choices regarding the best varieties for their farm and market conditions (see Rapid Action Cultivar Evaluation [RACE] trial description on page 8).

Fruit and vegetable research sites in 2004.

1. *Graves County*
2. *Princeton*
3. *Daviess County*
4. *Green County*
5. *Lexington*
6. *Quicksand*



Making Sense of Statistics

Most trial results use statistical techniques to determine if there are any real (versus accidental) differences in performance among varieties or treatments. Statistical jargon is often a source of confusion, and we hope this discussion will help. In many cases, our trials are replicated, which simply means that instead of taking data from only one plot from one spot in the trial field, we plant that variety (or repeat the spray or fertilizer treatments) in other small plots in several spots in a field. If we test 20 pepper varieties, for example, we will have a small plot for each variety (20 separate plots) and then repeat this planting in two or three additional sets of 20 plots in the same trial field. These repeated sets of the same varieties are called replications or blocks. The result is a trial field with 20 varieties x 4 replications = 80 small plots. The yield for a variety is reported as the average (also called the *mean*) of yields from the four separate small plots of that variety. The average per acre yields reported in the tables are calculated by multiplying these average small plot yields by a correction factor.

In most reports, we list the results in tables with varieties ranked from highest to lowest yielding (see Table A). Small differences in yield are often of little importance, and it is sometimes difficult to separate differences due to chance or error from actual differences in performance of varieties. The last line at the bottom of most data tables will usually contain a number that is labeled LSD, or *Waller-Duncan LSD*. LSD is a statistical measure that stands for "Least Significant Difference."

Table A. Yields, gross returns, and appearance of bell pepper cultivars under bacterial spot-free conditions in Lexington, Kentucky; yield and returns data are means of four replications.

Cultivar	Seed Source	Tot. Mkt. Yield[1] (tons/A)	% XL +Large[2]	Income[3] ($/acre)	Shape Unif.[4]	Overall Appear.[5]	No. Lobes[6]	Fruit Color	Comments
X3R Aristotle	S	25	89	10180	4	7	3	dk green	most fruits longer than wide
King Arthur	S	22.5	88	9079	3	5	4	light-med green	deep blossom-end cavities
4 Star	RG	22.2	86	9111	3.5	6	4	light-med green	
Boynton Bell	HM	21.7	92	9003	3	5	3	med-dk green	~15% of fruits 2-lobed (pointed)
Corvette	S	20.6	88	8407	3	6	3&4	med-dk green	~10% elongated (2-lobed)
X3R Red Knight	S	20.5	90	8428	3	5	4	med-dk green	
SP 6112	SW	20.2	78	8087	4	6	3	med green	
Conquest	HM	20	85	8021	2	5	3&4	light-med green	deep stem-end cavities, many misshapen
Orion	EZ	20	93	8219	4	6	4	med-dk green	
Lexington	S	19.8	87	8022	3.5	6	3	dk green	
PR99Y-3	PR	19.5	87	7947	3	5	3&4	med green	many misshapen fruits
Defiance	S	18.7	87	7568	4	7	3&4	dk green	
X3R Ironsides	S	18.4	92	7585	4	6	3	med green	~5% w/deep stem-end cavities
X3R Wizard	S	18	92	7447	3	6	3&4	dk green	
RPP 9430	RG	17.3	89	7029	3	6	4	med-dk green	~10% of fruits elongated
ACX 209	AC	17.2	89	7035	3.5	6	3	med green	
Waller-Duncan LSD (P< 0.05)		5.2	7	2133					

1 Total marketable yield included yields of U.S. Fancy and No. 1 fruits of medium (greater than 2.5 in. diameter) size and larger plus misshapen but sound fruit that could be sold as "choppers" to foodservice buyers.
2 Percentage of total yield that was extra-large (greater than 3.5 in. diameter) and large (between 3 and 3.5 in. diameter).
3 Income = gross returns per acre; average 2000 season local wholesale prices were multiplied by yields from different size/grade categories: $0.21/lb for extra-large and large, $0.16/lb for mediums, and $0.13/lb for "choppers," i.e., misshapen fruits.
4 Average visual uniformity of fruit shape where 1 = least uniform, 5 = completely uniform.
5 Visual fruit appearance rating where 1 = worst, 9 = best, taking into account overall attractiveness, shape, smoothness, degree of flattening, color, and shape uniformity; all fruits from all four replications observed at the second harvest (July 19).
6 3&4 = about half and half 3- and 4-lobed; 3 = mostly 3-lobed; 4 = mostly 4-lobed.

The LSD is the minimum yield difference that is required between two varieties before we can conclude that one actually performed better than another. This number enables us to separate real differences among the varieties from chance differences. When the difference in yields of two varieties is less than the LSD value, we cannot say with any certainty that there's any real yield difference. In other words, we conclude that the yields are the same. For example, in Table A cited above, variety 'X3R Aristotle' yielded 25 tons per acre and 'Boynton Bell' yielded 21.7 tons per acre. Since the difference in their yields (25 - 21.7 = 3.3 tons per acre) is less than the LSD value of 5.2 tons per acre, there was no real difference between these two yields. The difference between 'X3R Aristotle' and 'X3R Wizard' (25 - 18 = 7), however, is greater than the LSD, indicating that the difference between the yields of these two varieties is real.

Sometimes these calculations have already been made, and statistical comparisons among varieties are indicated by one or more letters (a, b, c or A, B, C, etc.) listed after the yields in the tables (see Table B). If yields of two varieties are followed by one or more of the same letters, they are considered to be the same (statistically speaking, that is). Yields of two varieties are different if they have no letters in common. In this example, the average muskmelon fruit weight of 'Eclipse' and that of 'Vienna' are both followed by an "a," so they are not different, while values for 'Eclipse' and 'Athena' have no letters in common, indicating that the difference between them is real (that is, statistically significant).

What is most important to growers is to identify the best varieties in a trial. What we usually recommend is that you identify a group of best performing varieties rather than a single variety. This is easily accomplished for yields by subtracting the LSD from the yield of the top yielding variety in the trial. Varieties in the table having yields equal to or greater than the result of this calculation will belong in the group of highest yielding varieties. If we take the highest yielding pepper variety, 'X3R Aristotle,' in Table A and subtract the LSD from its yield (25 - 5.2 = 19.8), this means that any variety yielding 19.8 tons per acre or more will not be statistically different from 'X3R Aristotle.' The group of highest yielding varieties in this case will include the 10 varieties from 'X3R Aristotle' down the column through variety 'Lexington.'

In some cases, there may be a large difference between the yields of two varieties, but this difference is not real (not statistically significant) according to the statistical procedure used. Such a difference can be due to chance, but often it occurs if there is a lot of variability in the trial. An insect infestation, for example, could affect only those varieties nearest the field's edge where the infestation began.

It is also true that our customary standard for declaring a statistically significant difference is quite high, or stringent. Most of the trial reports use a standard of 95% probability (expressed in the tables together with the LSD as $P < 0.05$ or $P = 0.05$). This means that there is a 95% probability that the difference between two yields is real and not due to chance or error. When many varieties

Table B. Yields and quality of muskmelon cultivars at Quicksand, Kentucky, 2001; data are means of four replications.

Cultivar	Avg. Wt./ Fruit[1] (lb)	Fruit/A[1]	Pounds/A	Rind Thickness (mm)	% Soluble Solids	Comments *(shape and appearance)*	
Eclipse	8.8 a	5,601	ab	49,036	7.0	11.5	nice
Odyssey	8.8 a	6,016	ab	53,039	-	9.0	nice, elongated
Vienna	9.0 a	5,083	b	46,230	-	8.6	nice, plts showed MO deficiency
RAL 8793VP	8.7 a	5,601	ab	48,735	-	10.2	nice, good flesh color
Athena	6.4 b	6,846	a	43,440	2.6	8.8	small looking
Minerva	9.7 a	4,771	b	45,349	3.4	13.5	nice, melon chosen by customers first
LSD (P = 0.05)		1.5		1,636	ns		

[1] Means followed by the same letter are not significantly different.

are compared (as in the pepper example above), the differences between yields of two varieties must often be quite large before we can conclude that they are really different.

After the group of highest yielding, or in some cases, highest income[1], varieties (see Table A cited above) has been identified, growers should select varieties within this group that have the best fruit quality (often the primary consideration), best disease resistance, or other desirable trait for the particular farm environment and market outlet. One or more of these varieties can then be grown on a trial basis on your farm using your cultural practices.

Producers should also ask around to find out if other growers have had experience with the varieties in question. Growers who belong to a marketing cooperative should first ask the co-op manager about varieties because in some cases buyers have specified the variety to be grown and packed by the co-op. *Good marketing plans start with the customer's (market) requirements and work backward to determine variety and production practices.*

RACE Trials

In cases where there are too many new varieties to test economically or when we suspect that some varieties will likely perform poorly in Kentucky, we may decide to grow each variety in only a single plot for observation. In this case, we cannot make any statistical comparisons but can use the information obtained to eliminate the worst varieties from further testing. We can often save a lot of time and money in the process. We can also provide useful preliminary information to growers who want to try some of these varieties in their own fields.

Since there are so many new marketing opportunities these days for such a wide variety of specialty crops, we have decided that this single-plot approach for varieties unlikely to perform well in Kentucky is better than providing no information at all. We hope that RACE trials, described on this page, will help fill a need and best use limited resources at the research farms. See the 2000 and 2001 hot and specialty pepper reports for examples of such trials.

Rapid Action Cultivar Evaluation (RACE) trials are:

- a means of getting new information to growers in the least amount of time.
- a cultivar (variety) or cultural practice trial without replication or with a maximum of two replications.
  trials in which preferably the same set of cultivars can be replicated by location (Lexington and Quicksand stations, for example). Cultivars can be grown on station and/or in growers' fields.
- trials that can be applied to vegetables, small fruits, herbs, cut flowers, or other annual ornamentals.
- appropriate for new crops for which the market potential is unknown or, in some cases, for existing crops with small niche market potential.
- appropriate for screening a large number of cultivars (not breeding lines) of unknown adaptation.
- appropriate for home garden cultivars (expensive replicated trials are not appropriate for home garden cultivars in most cases).
- a means of addressing new questions about specialty crops without compromising replicated trials of priority crops.
- a good demonstration site for growers to get a general idea of cultivar's performance.

How do RACE trials differ from "observation trials" conducted in the past?

- RACE trials are planted on the best and most uniform plot ground and are well maintained, sprayed, irrigated, etc. They do not serve as guard rows in other replicated trials.
- Crops are harvested at the appropriate time, with accurate record keeping, yield data, and quality information. Results are reported/published, as are replicated trial results.
- Whenever possible, products are evaluated with assistance from knowledgeable marketers, interested produce buyers, and growers.
- Information obtained should not be used to identify one or two best cultivars but to eliminate the worst from further testing and make recommendations about a group of cultivars that can be put into further trials by growers themselves.

[1] It is often desirable to calculate a gross "income" or gross return variable for vegetable crop varieties that will receive different market prices based on pack-out of different fruit sizes and grades (bell peppers, tomatoes, cucumbers). In these cases, yields in each size class/grade are multiplied by their respective wholesale market prices to determine gross returns (= income) for each cultivar in the trial.

Hybrid vs. Open Pollinated

In general, hybrid varieties (also referred to as F1) mature earlier and produce a more uniform crop. They often have improved horticultural qualities as well as tolerance and/or resistance to diseases. Hybrid seed is usually more expensive than is seed of open-pollinated (OP) varieties. With hybrid varieties, seeds cannot be collected and saved for planting next year's crop. Hybrid seed is now available for most vegetable crops that are grown in the United States.

Despite the advantages of hybrids, there are some crops for which few hybrids have been developed (poblano peppers, for example) or for which hybrids offer no particular advantages (most bean varieties). Interest in OP varieties has resurged among home gardeners and market gardeners who wish to save their own seed or who want to grow heirloom varieties for which only OP seed is available. Lower prices for produce in traditional wholesale market channels, however, may dictate that growers use hybrids to obtain the highest possible yields and product uniformity. Selecting a hybrid variety as a component in a package of improved cultural practices is often the first step toward improved crop quality and uniformity.

Where to Get Seeds

A seed source is listed for each variety reported in the trials. Seed source abbreviations with company names and addresses are found in Appendix A at the end of this publication. Because seeds are alive, their performance and germination rate depend on how old they are, where and how they were produced, and how they have been handled and stored. It is always preferable to purchase certified, disease-free seeds from a reputable seed dealer and to ask about treatments available for prevention of seed-borne diseases.

Many factors are considered when making a final choice of variety, including type, fruit quality, resistance or tolerance to pests, how early the variety is harvested, and cost. Keep in mind that some varieties may perform differently from our trials, especially under different management systems. Producers should test varieties for themselves by trying two to three varieties on a small scale before making a large planting of a single variety. This method will be the best means of determining how well suited a particular variety is for your farm and market.

Variety Information Online

This publication is available online at http://www.uky.edu/Ag/Horticulture/comveggie.html. Other useful sources of information for commercial vegetable growers can be found by following the links at www.uky.edu/Agriculture/Horticulture/veglinks.htm. In addition, results of some pepper and blackberry trials are posted on UK's New Crop Opportunities Center Web site under current research at www.uky.edu/Ag/NewCrops.

Auburn University publishes a variety trial report twice a year in cooperation with several other universities. The 2004 reports have been posted in PDF (Acrobat) format at www.ag.auburn.edu/aaes/communications/publications/fruitsnutsvegs.html.

2004 Produce Buyers Survey

Tim Woods and Matt Ernst, Department of Agriculture Economics

Introduction

During early summer 2004, 52 produce buyers from Kentucky and five surrounding states responded to a mail survey. The purpose of the survey was to measure produce buyer perceptions of demand for specific produce items.

Survey results show buyers having favorable outlooks for expansion of mainline vegetable crops, especially fresh-cut products, peppers, and melons. Buyer outlooks for specialty lines were strongest for grape tomatoes, melons, and greens. Interestingly, these results closely correlate with results from a 2000 North Carolina study that measured expected buyer demand on the East Coast for 2000-2004 (1).

Significantly, 63% of surveyed buyers indicated that they handle Kentucky produce. This is probably due to expansion of Kentucky's wholesale produce deal since 2000. Interestingly, expansion has occurred in crops viewed as having strong future growth by buyers in this survey (peppers, tomatoes, sweet corn, melons). The survey results suggest that Kentucky growers and marketing groups who pay attention to industry trends while developing strategic marketing relationships with produce wholesalers could further increase Kentucky's regional market share of an expanding fresh produce industry.

Information was sought on other marketing questions and perceptions of industry trends. These included buyer outlooks for direct-store deliveries, promotion of locally grown product, imported produce, number of items carried, RFID tag use, prepackaged products, slotting fees, and supplier consolidation.

Methods

Produce buyers in Kentucky, Ohio, Indiana, Illinois, Missouri, and Tennessee were identified through Red Book Credit Services listings. A two-page survey was mailed to 319 business addresses in these states, focusing primarily on buyers for produce wholesalers and retail groceries. A thank you/reminder postcard was mailed to every address three weeks after the initial mailing.

An adequate response of 52 buyers (16% of mailed surveys) was obtained through the single survey mailing. This sample represented shippers, wholesalers, and retailers selling produce throughout the region.

Table 1. Surveys mailed and responses by state.

State	Number Mailed	Percent of Surveys Mailed	Surveys Returned	Percent of Surveys Returned
Illinois	85	27	10	19
Indiana	38	12	10	19
Kentucky	30	9	6	12
Missouri	39	12	5	10
Ohio	86	27	16	31
Tennessee	41	13	5	10
Total	**319**		52	**16%**

Table 2. Respondent characteristics.

Business Practices	Yes	No	No Response
Handle fresh-cut produce	77%	19%	4%
Market organic products	35%	61%	4%
Source produce from Kentucky	63%	31%	6%
Number of items handled:			
Less than 100	21%		
100-250	35%		
250-999	20%		
Over 1,000	10%		
No response	14%		

Respondent Demographics

Returned surveys included 22 produce wholesalers and 13 buyers for retail groceries. There were also five brokers, three grower/shippers, and eight respondents who either marked "other" or did not indicate their classification in the industry. Responding buyers represented the distribution of surveys sent to each state (Table 1).

Most of the buyers (40, or 78%) included some fresh-cut produce among their product lines. One-third replied that they handled organic products. This correlates with uncertainty about future growth of organic produce by wholesalers expressed in the North Carolina study, as well as in current produce industry reporting (2). Finally, two-thirds of the buyers indicated they carried less than 250 items, while 10% carried more than 1,000 items (Table 2).

Mainline Demand Increases

Buyers were asked to rank their expectations for mainline produce items based on interactions with their customers and perceptions of the market. A scale of 1 through 7 (1 = cutting back; 4 = maintaining; 7 = significant expansion) was provided for their response.

Table 3 shows the distribution of buyers who responded with ratings greater than "4" on the scale. This indicates those buyers expecting market growth for these products. This reporting method was used in the North Carolina study; these responses correlate closely with the observations of that study.

Only okra (3.34) and pumpkins (3.95) showed an overall average rating of less than 4.0, indicating a slight majority of buyers expecting softer future markets for these two crops. The remaining 19 products all had average scores higher than 4, indicating buyer expectations for expansion. This is consistent with reports of across-the-board increases in produce consumption and demand from 2000-2004 (3).

It should be noted that some items were not rated by individual buyers. More than 20% of buyers surveyed indicated that they had "no opinion" or failed to rate expected demand for premium pack and greenhouse tomatoes, okra, organic produce, and ethnic-related products.

Table 3. Mainline produce items expected to increase (percent of respondents expecting increases).

	Response[1]		
Item	5	6	7
Ethnic-oriented produce	19%	21%	13%
Organic produce	23%	10%	6%
Other fresh cut products	15%	38%	19%
Packaged salads	19%	31%	27%
Strawberries	42%	19%	12%
Blackberries	17%	15%	4%
Blueberries	19%	23%	6%
Watermelon	33%	23%	8%
Cantaloupes	33%	35%	4%
Pumpkins	23%	2%	2%
Cucumbers	38%	10%	2%
Okra	12%	4%	0%
Sweet Corn	40%	10%	8%
Cabbage	23%	8%	4%
Squash, summer	19%	15%	0%
Squash, winter	17%	6%	0%
Peppers (colored)	31%	38%	10%
Peppers (green)	33%	15%	4%
Tomatoes (greenhouse)	21%	12%	6%
Tomatoes (premium packs)	29%	15%	0%
Tomatoes (vine ripe)	29%	15%	12%

[1] Response scale: 1=cutting back; 4=maintaining; 7=significant expansion

Table 4. Specialty produce items expected to increase (percent of respondents expecting increases).

	Response[1]		
Item	5	6	7
Edamame	12%	2%	0%
Sprite Melons	8%	4%	0%
Kabocha Squash	10%	0%	0%
Asian Melons	6%	2%	2%
Asian Vegetables	8%	6%	2%
Golden Raspberries	8%	10%	0%
Black Raspberries	14%	8%	0%
Other Greens	25%	24%	10%
Romaine	33%	22%	8%
Watermelon, Seedless	29%	33%	22%
Peppers, Specialty	27%	27%	2%
Peppers, Chili	31%	27%	2%
Tomatoes, Grape	18%	49%	22%

[1] Response scale: 1=cutting back; 4=maintaining; 7=significant expansion

Specialty Produce

There has been a trend among produce buyers to carry more produce items, including specialty products. A national study completed in 1999 indicated produce buyers of every size expected to see a substantial expansion of warehouse and retail store produce SKUs by 2004 (4). The average retail store carried 312 items in 1994, grew to 430 items in 1999, and was projected to grow to 521 items by 2004.

Buyer expectations for several items were fairly strong and in line with their expectations for some of the mainline items (Table 4). Many items, however, appear to be viewed as having a narrow niche. Responses for many of the specialty items may be difficult to interpret since buyers were given the opportunity to simply indicate "no opinion" for a particular item. This resulted in a majority of respondents answering "no opinion" for some products like sprite melons and edamame. It is likely that retailers would have a greater sense of demand for a wider variety of items, while wholesalers would tend to specialize more in the mainline items.

There were not enough observations in this sample to adequately test these differences.

An important marketing principle for specialty produce should be emphasized here. There are generally only a few wholesalers dealing in more specialized products. Retail demand for these products may be increasing. However, it is important for growers and other distributors to develop a clear understanding of volume and product demands with the retailers who are actually marketing the product.

The lack of response for other specialties does not necessarily indicate a lack of demand. Many specialty items are in high demand but only among a few retailers. For those willing to explore niches for Asian melons and vegetables, for example, demand may be good with the right retailers in certain markets. These results simply represent perspectives averaged across wholesalers and retailers in this region.

Industry Trends

Respondents were also asked to provide their perspectives on a scale of 1 through 5 (1 = diminishing, 3 = same; 5 = increasing) for certain industry trends. Their responses show the produce industry as dynamic, employing many new trading and marketing practices.

Direct Store Deliveries

The practice of direct store delivery has diminished within the last 20 years, corresponding to rapid and significant retailer consolidation. Retailers have set up their own warehousing system and have organized much of their produce buying to fit with this system.

Buyers in this sample generally (71%) indicated they expected to see the practice of direct store deliveries maintaining or cutting back. There is some resurgence of this practice among some of the larger retailers in Kentucky, but the trend generally is for growers to adapt to retailers' central distribution systems.

Promotion of Local Products

Many states have invested substantially in promoting locally grown products in partnership with major retailers. The majority of buyers (28) in this survey see this practice continuing to increase. Most retailers indicated a desire to promote local products when they can get the quality and volume. Retailers have worked with state departments of agriculture to develop a variety of in-store promotion schemes.

Imported Produce

Much growth in produce volume and variety has come through international sources. They account for about 15% of the produce annually consumed in the U.S., or about $2.5 billion in imports. This is about twice the level of 20 years ago (5). Most buyers (92%) in this survey expect this import trend to continue or increase.

Number of Items Carried

The increase in the number of items carried is a driving force in the industry. Retailers are generally under a greater demand by the public to carry more items than wholesalers or shippers. Although retailers have to carry many products, they have tended to place a lower importance on their suppliers carrying lots of items (6).

This survey found no difference between the average rating that retailers placed on the importance of increasing the number of items they carried (4.1 on a scale of 1 through 5) and the rating given by non-retailers (4.0 of 1 through 5). Industry consolidation and other market forces continue to drive suppliers toward expanding the number of items they carry.

Pre-Packaged Fixed Weight Produce

The random weight nature of the products sold in the produce industry has been a source of management difficulty. Packaged foods with fixed weights can be managed in distribution and sale much more easily than bulk produce. Some retailers have called on their suppliers to work with them to develop pre-packaged, fixed-weight produce products that make checkout and inventory control easier.

With an average rating of 3.60, there seemed to be a slight trend observed across these buyers toward an increase in pre-packaged fixed-weight produce. The practice certainly requires significant adjustments in the packing stage of the distribution process; such requirements can make it difficult for small packer-shippers to compete.

Conclusion

This survey confirms buyer demand for a number of mainline and specialty produce items. These buyers in the Ohio Valley Region also confirm many of the trends driving today's produce industry. This survey is intended to provide members of the trade with current buyer perspectives on a number of issues, recognizing that these issues can change and that demand can change. The produce industry in the region remains dynamic like the industry nationally.

Acknowledgments

We thank the buyers who participated in this survey and recognize that they contribute valuable information through their responses to all those participating in the produce industry in our region. Thanks to Brent Rowell (Horticulture) and Kenny Burdine (Agricultural Economics) of the University of Kentucky who reviewed this publication and offered helpful suggestions for revision prior to publication.

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2004 Kentucky Produce Planting and Marketing Intentions Survey

Matt Ernst and Tim Woods, Department of Agricultural Economics

Introduction

The Kentucky Produce Planting and Marketing Intentions Survey was conducted for the third consecutive year in 2004. The results of the survey allow producers, researchers, and others involved in Kentucky's produce industry to acquire a general sense of the trends in individual crop acreage and marketing methods.

Significant expansion has occurred in Kentucky's produce industry since 1998. The U.S. Census of Agriculture reported a 31% increase in the number of farms growing vegetables in Kentucky between 1997 and 2002 and a 53% increase in the number of acres marketed. This was the second largest percentage increase in marketed vegetable acreage of any state.

The number of farms marketing fruit, tree nuts, and berries increased similarly (34%) according to Census of Agriculture estimates. The census estimated that the value of fruit sales more than doubled between 1997 and 2002, from $2.7 million to nearly $6 million.

Responses to the 2004 Kentucky Produce Planting and Marketing Intentions Survey, combined with a decrease in acreage contracted by Kentucky's four vegetable marketing co-ops, indicated that direct marketing drove modest growth in Kentucky's produce industry in 2004. Gross sales of Kentucky fruits and vegetables increased by about 5% in 2004 with total sales projected to fall between $28 and $35 million in grower receipts.

Materials and Methods

More than 1,200 surveys were mailed in February 2004, with a second reminder mailing following in March. The survey again returned a strong response rate from Kentucky's growers, with 34% of the surveys returned. This accounted for 401 produce growers, 2,917 commercial vegetable acres, and 886 commercial fruit acres across Kentucky. An additional 5% of surveys were returned from addresses that did not market produce in 2003 or were unusable.

Producer Demographics and Marketing Trends

Age and Experience

Responses to this survey suggest much of Kentucky's produce industry growth has occurred among producers new to produce. Half of these respondents (48%) indicated that they have been growing produce for six years or less. This is nearly identical to the percentage in the 2003 survey. Producers also reflect similar age demographics as in past surveys, with only one-fifth of respondents 40 years old or younger (Table 1).

Tobacco Production

For the past three years, this survey has asked producers if they also grow tobacco. Responses have been similar in each year. In 2002, 44% of respondents replied that they produced tobacco, and

in 2003, 46% respondents said they produced tobacco. This year, 41% of respondents replied that they had grown tobacco in 2003.

This trend may be due to significant updating of the producer database for this year's survey, but a similar decrease in 2005 could quantify the exit of some tobacco producers in favor of alternative enterprises. The tobacco buyout will undoubtedly affect the number of producers planting both tobacco and produce crops for harvest in 2005.

Table 1. Age of producers surveyed (to nearest percent).

	2002	2003	2004
Under 31	7%	5%	6%
31-40	17%	14%	10%
41-50	31%	29%	30%
51-60	22%	27%	26%
Over 60	23%	25%	27%

Table 2. Do you grow tobacco on your farm?

	2002	2003	2004
Yes	44%	46%	41%
No	56%	54%	59%

County Agricultural Diversification Programs

In 2002 and 2003, similar proportions of fruit and vegetable growers reported having participated in County Agricultural Diversification Programs. About 40% of producers report participating in these programs in 2003. Furthermore, a number of respondents to this year's survey indicated that they had applied for County Agricultural Diversification Funds but had been turned down or had not yet received funding.

Organic Production

In last year's survey, a significant number of producers (20%) reported that they were interested in future organic production. Only 2% of producers this year responded that they had future plans to grow organic produce.

This sharp decline in organic interest appears to be related to changes in certified organic production guidelines and producer perception of difficulty to enter certified production. In addition, since many producers are marketing locally, the economic premium for certified organic production may not be great enough to warrant going through the certification process.

Direct Marketing

Farmers' Markets

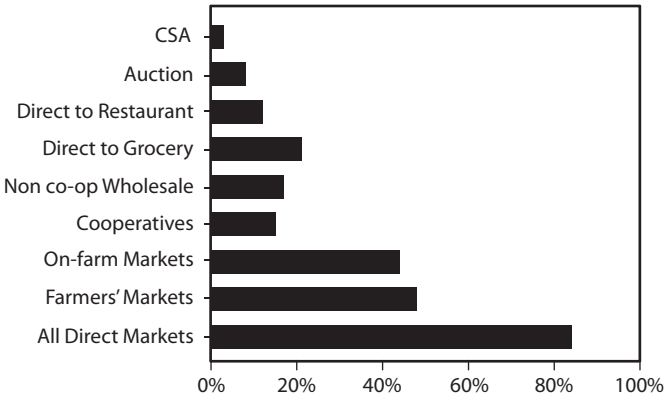
The number of community farmers' markets has nearly tripled in Kentucky over the past 10 years. More than 95 farmers' markets operated in Kentucky during 2004 with projected sales of $5 to $6 million.

More than 50% of the respondents to this survey indicated that they used farmers' markets to sell some of their produce; 47% indicated that 10% or more of their sales occurred at farmers' markets (Figure 1).

On-Farm Markets

The next most frequently used market is the on-farm market, used by half the respondents. These markets, including roadside stands and Pick-Your-Own (PYO), will account for $7 to $10 million of commercial produce sales in 2004. PYO marketing is generating much interest in Kentucky. Of the 401 producers surveyed, 63 (16%) reported they are currently using PYO. Twice this many producers (31%) said they are interested in using PYO marketing in the future.

Figure 1. Percent of producers selling 10% or more produce into market channels, 2003.



Other Direct Markets

Selling directly to local restaurants is also popular with some produce growers in Kentucky; 12% of respondents indicated they had done so in 2003. Community Supported Agriculture (CSA) was used by 3% of respondents. Both these market channels are popular with certified organic producers, but such production has decreased in popularity with Kentucky producers in 2004. This decrease is primarily due to changes in federal organic certification guidelines.

There continues to be a lack of enthusiasm among growers about future organic production; only 2% of the growers surveyed said they had plans to grow organic produce, while the same number said that they might be interested in organic production. In 2003, due to changes in the organic certification process, a number of Kentucky producers switched from certified organic production to marketing their produce as "sustainably grown" or using other similar descriptions.

Wholesale Marketing

Direct to Local Grocer

Behind farmers' markets and roadside stands, wholesaling directly to a retailer was the third most common market channel that Kentucky produce growers used in 2003. This channel was used by 21% of the survey respondents.

Other Wholesale Channels

Other wholesale channels, excluding sales to co-ops, were used by 17% of respondents. These include direct sales to grocery chains. Developing wholesale markets accessible to an individual grower or group of growers is a growing market channel for produce sales in Kentucky.

Co-ops

Co-ops were used by 15% of the respondents to this survey. Co-op acreage and sales leveled out in 2003 after rapid expansion from 2000-2002. Co-op production, while used by a relative minority of Kentucky's fruit and vegetable growers, still accounts for a major portion of Kentucky's commercial vegetable sales–approximately $6 million in 2004.

Auctions

Nine percent of respondents indicate that they use auctions to market some of their produce. Kentucky's sole produce auction until 2004 has been the Fairview Produce Auction in Christian County. This auction, which also sells hay, straw, and small-scale farm equipment, grossed over $1 million in sales during 2003.

Additional auctions opened in Kentucky during 2004 in Lincoln, Bath, and Mason counties. They operated at different times and volumes during their first season. It is quite possible that the market environment in Kentucky can support some additional produce auctions to increase market channels for wholesale produce.

Acreage Changes

Because this survey does not include all produce growers in Kentucky, responses indicating change in specific produce acreages must not be taken as sole indicators in annual increases or decreases in specific crop acreage around the state. Rather, this survey serves as a general indicator of what crops may be viewed favorably or not by growers for expansion opportunities.

Survey respondents indicated aggressive increases in specialty and jalapeño pepper acreage for 2004; this increase was confirmed by increases in wholesale production of these peppers. Growers may also be harvesting more winter squash in 2004, a crop viewed by some as having marketing potential for Kentucky growers.

The survey also indicated increases in bearing blueberry acreage, which has increased from 15 acres in 1997 to 60 to 65 acres in 2004. Strawberries may also be regaining some popularity in Kentucky. All of the small fruits have outstanding market potential for producers willing to invest the necessary time and management into their marketing and production.

Summary

Producers using direct markets comprise the vast majority of produce growers in Kentucky. While some co-op and wholesale producers continue acreage expansion, expansion in 2004 came from Kentucky's direct marketers. This is a shift from recent trends and can best be explained by the profits producers made by marketing directly to a variety of consumers desiring fresh, locally grown produce.

On-Farm Commercial Vegetable Demonstrations in Central and South-Central Kentucky

Dave Spalding and Brent Rowell, Department of Horticulture

Introduction

Eight on-farm commercial vegetable demonstrations were conducted in central and south-central Kentucky in 2004. Grower/cooperators were from Adair, Anderson, Bourbon, Harrison, Marion, Powell and Taylor counties. There were two growers from Harrison County: one grew four acres of bell peppers, and the other grew four acres of slicing cucumbers with both early and late production. A portion of the late slicing cucumber production was devoted to looking at trellising versus conventionally grown slicing cucumbers. The grower/cooperators in Bourbon and Marion counties each grew two acres of bell peppers, while the grower/cooperators in Adair, Anderson, and Taylor counties each grew one acre of mixed vegetables (tomatoes, peppers, squash, green beans, melons, and sweet corn) for local farmers' markets. The grower/cooperator in Powell County had a 0.5 acre plot of mixed vegetables (tomatoes, peppers, squash, green beans, sweet corn, and herbs) for the local farmers' market.

Materials and Methods

As in previous years, grower/cooperators were provided with black plastic mulch and drip irrigation lines for up to one acre and the use of the Horticulture Department's equipment for raised bed preparation and transplanting. The cooperators supplied all other inputs including labor and management of the crop. In addition to identifying and working closely with cooperators, county Extension agents took soil samples from each plot and scheduled, promoted, and coordinated field days at each site. The Extension Associate made weekly visits to each plot to scout the crop and make appropriate recommendations.

The bell pepper demonstration plots were transplanted using bacterial spot-resistant varieties 'Aristotle,' 'X3R Wizard' and 'Commandant.' Peppers were transplanted into 6-inch-high raised beds covered with black plastic and drip lines under the plastic. Plants were set 12 inches apart in an offset manner in double rows that were 15 inches apart. Raised beds were 6 feet from center to center. Plots were sprayed with the appropriate fungicides and insecticides on an as-needed basis, and cooperators were asked to follow the fertigation schedules provided.

The slicing cucumber plots were established to look at trellising vines versus rowing of the vines as has been the conventional production practice. The plots were planted using the slicing cucumber variety 'Speedway.' The cucumbers were planted into 6-inch-high raised beds covered with black plastic and drip lines under the plastic. The plants were transplanted in double rows 12 inches apart in the row and 15 inches between rows, and the beds were 6 feet apart. A portion of the plot was trellised using stakes spaced 3 feet apart in the center of each bed with strings running from stake to stake at 6- to 8-inch intervals. In the trellised plot, the two rows of plants were trained to the center trellis as the vines grew, while vines in the conventional method were trained (rowed) to keep them lying on the plastic mulch.

Results and Discussion

As in 2003, the 2004 growing season was very wet. Bell pepper producers generally were able to get the crop transplanted in a timely manner despite the wet conditions. The early-season slicing cucumbers were planted in a timely manner but heavy rains in late May and early June flooded out some of the production in low-lying fields.

Despite wetter than normal growing conditions, bell pepper yields were good with production running a week or more ahead of normal. Bell pepper prices were a little low for the early harvest but remained fairly constant for the season and averaged about normal for the whole harvest season. Because of the wet conditions, weeds were a bigger problem than usual for most growers, and bacterial spot was somewhat of a problem, particularly for growers using the 'X3R Wizard' variety. This variety is known to have greater susceptibility to bacterial spot than most other spot-resistant varieties. The combination of good yields and average prices resulted in a moderately profitable year for most bell pepper growers in the area (Table 1). The Bourbon County plot was hampered by heavy weed pressure and major European corn borer damage. In addition, it could only be harvested twice before the co-op discontinued receiving bell peppers.

The pepper grower in Marion County sowed annual ryegrass in the middles shortly after laying the plastic and drip lines in early April. In one field, the ryegrass was sown at the rate of 40 lb per acre, while the other field was seeded at the rate of 60 lb per acre. Though there was not a significant difference in yields, the heavier-seeded field had substantially fewer weeds and required less labor and inputs to control the existing weeds.

Growers with mixed vegetable plots in Adair and Taylor counties (Table 2) used a portion of their plots to look at specialty melon performance (Solitaire, Mohican, Vanessa, HA 5109, Sancho, Sprite, Golden Beauty, HSR 4208, Serenade, and Creme de la Creme) and to try to determine if there was a market for these melons. Because the growers were unfamiliar with these types of melons, a number of them were overripe when sampled and generated little interest. Taste sampling at the field day did indicate some enthusiasm for the varieties 'Sprite,' 'Solitaire' and 'Serenade.'

The plot in Powell County was essentially abandoned early in the season due to time constraints on the cooperator. The plots in Anderson and Taylor counties were harvested into late October, which was unusually late for the crops they were growing. Nearly all of the Anderson County production was marketed at retail prices, resulting in a very high income (Table 2). The Adair County plot had a half acre of 'X3R Wizard' bell pepper that suffered from a very heavy infection of bacterial spot that substantially diminished production.

An attempt to look at trellised versus conventional early production of slicing cucumbers was abandoned when most of the plots were lost to the flooding rains of late May and early June. For the late-season crop there was only one cooperator with enough yield

Table 1. Bell pepper production costs and returns of grower/cooperators.

Inputs	Harrison County (4 acres)	Marion County (2 acres)	Bourbon County (2 acres)
Plants and seeds	$3,985.00	$1,560.00	$1,640.00
Fertilizer	60	351.75	100
Black plastic	435.9	240	240
Drip lines	485.8	285.5	285
Fertilizer injector	65.00[1]	65.00[1]	65.00[1]
Herbicide	65	99.4	20
Insecticide	160	136	80
Fungicide	140	84	-------
Water	440.00[2] (640,000 gal)	340.00[2] (310,000 gal)	260.00[2] (410,250 gal)
Labor	5,173.00[3] (1,460.0 hrs)	1,760.00[3] (460.0 hrs)	1,664.00[3] (256.0 hrs)
Machine	157.40 (26.5 hrs)	86.13 (14.5 hrs)	285.12 (48.0 hrs)
Marketing	10436.32	1410.5	717.24
Total expenses	21601.32	5926.15	5359.36
Income	26433.46	13833.75	2517.36
Net income	4832.14	7907.6	-2841.83
Net income (loss)/acre	**1208.35**	**3953.8**	**-1420.92**
Dollar return/Dollar input	1.2	2.3	0.5

[1] Cost amortized over three years.
[2] Includes cost of water and five-year amortization of irrigation system.
[3] Does not include unpaid family labor.

Table 2. Mixed vegetable production costs and returns of grower/cooperators.

Inputs	Adair County (1 acre)	Anderson County (1 acre)	Taylor County (1 acre)
Plants and seeds	$558.00	$400.00	$550.00
Fertilizer	46	60	225
Black plastic	120	120	120
Drip lines	165	165	165
Fertilizer injector	65.00[1]	65.00[1]	65.00[1]
Herbicide	------	12	30
Insecticide	15	36	85
Fungicide	35	------	260
Water	58.00 (60,000 gal)	1,400.00[2] (110,000 gal)	300.00[2] (160,000 gal)
Labor	82.00[3] (66.5 hrs)	610.00[3] (1,440.0 hrs)	2,000.00[3] (390.0 hrs)
Machine	47.52 (8.0 hrs)	47.52 (8.0 hrs)	68.31 (11.5 hrs)
Total expenses	1191.52	2915.52	3868.31
Income	637.05	13000	6700
Net income	-554.47	10084.48	2831.69
Net income (loss) /acre	**-554.47**	**10084.48**	**2831.69**
Dollar return/Dollar input	0.5	4.5	1.7

[1] Cost amortized over three years.
[2] Includes cost of water and five-year amortization of irrigation system.
[3] Does not include unpaid family labor.

to evaluate trellising versus conventional production. As shown in Table 3, trellising more than offset the additional cost (estimated at $350 to $420 per acre) with substantially higher marketable yields. An important observation from this demonstration was that more disease problems occurred in the conventional plots without trellises. A more detailed evaluation of these production methods for the late-season crop is warranted in light of this year's experience.

Table 3. Yield and income for trellised versus no-trellis production of slicing cucumbers.

Treatment	Unmarketable (boxes/acre)	Marketable (boxes/acre)	Income (gross return/acre)
Double row conventional	95	308	$2,772.00
Double row trellised	69	539	$4,851.00

On-Farm Commercial Vegetable Demonstrations in Southeastern Kentucky

Bonnie Sigmon, Department of Horticulture

Introduction

Two on-farm commercial vegetable demonstrations were conducted in southeastern Kentucky together with two tomato observation plots. Grower/cooperators were located in Laurel and Rockcastle counties. The grower/cooperator in Laurel County grew approximately 0.25 acre of tomatoes that were marketed through the Laurel County Farmers' Market. In Rockcastle County, the cooperator grew approximately 0.5 acres of mixed vegetables (tomatoes, peppers, squash, cucumbers, and beans). This grower sold through the Rockcastle County Farmers' Market.

Materials and Methods

Grower/cooperators were provided with black plastic mulch and drip irrigation lines and the use of the Southeastern Vegetable Growers Cooperative's equipment for raised-bed preparation and transplanting. For those cooperators participating in observation plots, only the plastic mulch was provided. Field preparation was followed by a pre-plant fertilizer application according to University of Kentucky soil test results and recommendations. The growers purchased all supplies such as pesticides, fertilizers, and irrigation supplies other than drip tape and plastic mulch. Plastic was laid in late April with transplanting the last of April and first part of May. Transplants were grown by the cooperators themselves or contract grown by a local greenhouse. A starter

fertilizer was used at transplanting and imidacloprid (Admire 2F) was applied as a soil drench after transplanting for squash, peppers, and tomatoes.

Beginning after transplanting, the grower/cooperator in Laurel County followed a University of Kentucky recommended weekly spray schedule for tomatoes that alternated between mancozeb, Bravo Weather Stik, Quadris, and copper along with alternating insecticides when needed. Plant irrigation needs were determined by use of tensiometers. Plants were fertigated according to University of Kentucky recommendations in ID-36, *Vegetable Production Guide for Commercial Growers*.

The mixed vegetable demonstration consisted of black plastic mulch and drip irrigation with drip line connectors that could be shut off and on so that the grower/cooperator could control which rows were irrigated at any point in time. The cooperator used tensiometers to manage irrigation and fertigated tomatoes as recommended in ID-36. The cooperator used insecticides and fungicides as needed.

Table 1. Costs and returns from on-farm demonstrations of mixed vegetable crops and staked tomatoes in Rockcastle and Laurel counties, 2004.

Inputs	Rockcastle County Mixed Vegetables (0.5 acre)	Laurel County Tomatoes (0.25 acre)
Transplants [1]	$286.00	$125.00
Fertilizer	$224.00	$78.75
Fertilizer injector	$15.35	$15.35
Black plastic/Dripline	$176.57	$91.25
Pesticides	$334.69	$133.50
Irrigation water	$0.00	$90.00
Stakes and twine	$35.00	$35.00
Market fees	$25.00	$50.00
Labor[2]	$0.00	$712.50
Machinery[3]	$142.50	$142.50
Total expenses	$1,239.11	$1,473.85
Yield		6250 lb
Income—retail	$3,427.00	
Income @ $0.75/lb		$4,687.50
Net income	$2,187.89	$3,213.65
Net income per acre	**$4,375.78**	**$12,854.60**
Dollar return/Dollar input	$2.76	$3.18

[1] Transplants produced by grower.
[2] Does not include grower's labor.
[3] Machinery depreciation, fuel and lube, and repair.

Results and Discussion

Demonstration cooperators and other growers in Laurel County hosted an area field day on each of their farms to help promote vegetable production. The plasticulture system and farmers' markets were highlighted at each field day event.

The growing season was mild and very wet. Grower/cooperators had a difficult year controlling fungal diseases as well as weeds. Nutrient deficiencies became a problem as nutrients leached out of the soil due to heavy rainfall. Spray schedules and fertigation schedules were often difficult to maintain due to frequent rainfall and wet soil conditions.

Laurel County. This grower followed recommendations to the letter and experienced the largest tomato crop she had ever grown. The grower harvested from the last of June until October. The grower was so pleased with the plasticulture production system that she purchased her own equipment to use next year. The grower stated that her production tripled using the same number of tomato plants grown last year on bare ground. The grower's costs and returns are listed in Table 1.

Rockcastle County. This was the first year for the cooperator to grow commercial vegetables. The grower was very pleased with the results using the plasticulture method but had a difficult time controlling fungal diseases on several crops, especially tomatoes. The grower is very interested in the early marketing of vegetables in that it better fits their operation than later markets and plans to try it again next growing season. The grower's cost and returns are listed in Table 1.

On-Farm Commercial Vegetable Demonstrations in South-Central Kentucky with Observations on Ryegrass Mulches and Specialty Melons

Nathan Howell, Department of Horticulture

Introduction

Three on-farm commercial vegetable demonstrations were conducted in south-central Kentucky, along with three specialty melon observation plots in 2004. Grower/cooperators for the demonstrations were located in Green, Hardin, and Larue counties; all participants grew the Athena cantaloupe variety and marketed commercial melons through the Green River Produce Marketing Cooperative located in Horse Cave, Kentucky. The demonstration plots in Green and Larue counties were approximately one acre in size, while the Hardin County demonstration plot was 0.6 acre.

Specialty melon observation plots were conducted in Barren, Hart, and Warren counties. These plots ranged from 20 plants to a few hundred plants. Varieties included Crème de la Crème, Sprite, Serenade, Golden Beauty, and Dorado. The cooperator in Barren and Warren counties sold through local farmers' markets, while the Hart County cooperator sold through an established roadside market.

Materials and Methods

Grower/cooperators for the demonstration plots were provided with black plastic mulch and drip irrigation lines for up to one acre and the use of the University of Kentucky Horticulture Department's equipment for raised-bed preparation and transplanting. For those cooperators participating in specialty melon observation plots, only the transplants were provided.

Field preparation was followed by fertilizer application according to soil test results and recommendations provided by local fertilizer dealers and/or the University of Kentucky. Plastic for the demonstrations was laid in late April, a few weeks before transplanting. The timing was critical because if producers had waited until transplanting time, the fields would have been too wet to lay plastic. The plastic was laid in rows with irrigation runs no longer than 400 feet; each producer used 7,200 linear feet of plastic on about an acre and a half. The drip irrigation systems used city water, well water, or groundwater.

All demonstration cooperators provided their own transplants. The cooperator or local greenhouse managers in the region grew the transplants. Plants were set during the first two weeks of May, with three- to four- week-old plants spaced 24 inches apart in the row with 5 feet between bed centers. These spacings allowed each cooperator to attain a plant population of 3,600 plants per acre.

After plants were established, insecticides were applied to prevent damage from cucumber beetles and other insects. Imidacloprid, endosulfan, and permethrin were used for cucumber beetle control. Imidacloprid (Admire) was used as a soil drench and was effective for nearly four weeks; the remaining control was achieved by alternating insecticides on a weekly basis until harvest. Bravo Weather Stik, Mancozeb, and Quadris were applied on alternating weekly schedules for disease control after vines ran off the plastic. The University of Kentucky's recommendations from *Vegetable Production Guide for Commercial Growers* (ID-36) were used for insecticides and fungicides. Plants were irrigated/fertigated weekly, using 50 to 60 pounds per acre of calcium nitrate each time. Harvest began in early July, nearly a week earlier than previous years. Melons were harvested daily during that period. Melons were not harvested by the "slip" technique but by observing a subtle color change, referred to as the "breaker" stage (when the skin under the netting turns a light cream while the skin beneath the sutures area is still a greenish color).

Specialty Melon Observations

In addition to the on-farm demonstrations, three specialty melon observation trials were planted in south-central Kentucky. Trials were grown by experienced cantaloupe producers, and all plots were planted on plastic mulch with drip irrigation and planted at 24- or 36-inch in-row spacings. Plots were sprayed with appropriate fungicides and insecticides on an as-needed basis, and each cooperator followed a weekly fertigation schedule.

Results and Discussion

The 2004 season was yet another poor season for commercial cantaloupe production and marketing. The month of May was the fourth warmest and the third wettest on record. Kentucky also experienced the eleventh coolest June-August on record, and record precipitation continued through this period. This was the second year in a row of difficult growing conditions. Furthermore, a second year of low prices (and returns) made it a very difficult season for even the most experienced producers in the area.

The 2004 grower/cooperators encountered the lowest commercial cantaloupe prices that Green River Produce Cooperative has experienced during its six years of operation. Cantaloupe returns for the growers before production and marketing costs were $0.61 for large and $0.08 for mediums. The market price for large cantaloupes was unchanged from 2003, which was a record low at the time. Medium cantaloupes, however, dropped in price by nearly $0.40 from last year. This price decline was due to weak market demand for this grade, resulting in the rejection of nearly 80% of all the loads of medium cantaloupes shipped by Green River Produce.

The grower/cooperators averaged a modest yield of 5,005 marketable melons per acre. However, this yield may have been reduced due to the poor growing conditions ranging from record high temperatures in May to record low temperatures in the months of June and July during fruit growth. The growers were able to market 75% of their crop as No. 1 large cantaloupes; however, this was also down from last season by nearly 4%. The following budgets (Table 1) reflect the market and production challenges the growers faced this season and the economic impact they had on

Table 1. Costs and returns of three commercial muskmelon (cantaloupe) demonstration plots conducted in south-central Kentucky, 2004.

Inputs	Hardin County (0.6 acre)	Larue County (1 acre)	Green County (1 acre)
Plants/Transplants	210.00	350.00	270.00
Fertilizer/Lime	158.00	134.00	95.00
Black plastic	80.00	144.00	144.00
Drip line	68.00	127.00	127.00
Herbicides[1]	37.00[1]	50.00	100.00[1]
Insecticides	115.00	150.00	185.00
Fungicides	130.00	175.00	150.00
Pollination	free service	free service	free service
Machine[2]	125.00	75.00	75.00
Irrigation/Water[3]	150.00	281.00	50.00
Labor[4]	520.00[4]	150.00	560.00[4]
Co-op 15% commission	283.00	295.00	345.00
Box/Pallet fee	457.00	483.00	535.00
Co-op labor expense	237.00	254.00	338.00
Co-op membership	50.00	50.00	50.00
Harvest bin rental	30.00	80.00	190.00
Total expenses	2,650.00	2,798.00	3,214.00
Co-op yield	3,716 melons	4,329 melons	4,966 melons
Farmers' market yield	400 melons	------	------
Co-op income	1,884.00	1,970.00	2,297.00
Farmers' market income	370.00	------	------
Total income	2,254.00	1,970.00	2,297.00
Net income (loss)	**(396.00)**	**(828.00)**	**(917.00)**
Dollar return/dollar input	0.85	0.71	0.71

[1] Includes cost of annual ryegrass.
[2] Machine rental, fuel and lube, repairs, and depreciation.
[3] Five-year amortization of irrigation system and pump plus surface water cost or city water cost.
[4] Includes all unpaid family labor.

family farms. None of these grower/cooperators are planning to produce cantaloupe on a commercial scale next season.

In spite of the poor returns, the demonstrations did provide a second year of useful data on the use of annual ryegrass sown between beds of plastic mulch. Using a seeding rate of 60 to 70 lb per acre (higher than had been recommended last season) resulted in adequate weed suppression and also provided a clean mulch base for fruit that set in between beds. The ryegrass was sown before holes were made in the plastic for transplanting and was killed back with Poast once it grew to 7 to 10 inches. The best results for weed suppression were obtained from the demonstration in Hardin County (this was most likely due to the fact that it was the only sod field among the three demonstrations and therefore had a lower initial weed seed population).

Specialty melons were a great item for all the grower/cooperators again this season. Each cooperator had his or her own unique marketing method (farmers' market, roadside stand, and area state parks). All growers reported that they had to provide samples of the fruit before customers would purchase a melon. The cooperators also noted that among those who tried the melons, most would buy them, and many would return for additional melons. Dorado, Golden Beauty, and Sprite melons were the top producers and sellers this year. Serenade was also very popular with growers in Warren County; however, they reported this melon did not hold in storage as well as the above- named melons.

It was difficult for growers to properly harvest these melons, especially those that did not slip at harvest. Each melon has its own characteristics of maturity, and by the end of the production season growers were getting better at identifying the proper stage for harvest (see pages 73-77, *2003 Fruit and Vegetable Crops Research and Report* available online at www.uky.edu/Ag/Horticulture/comveggie.html). The grower/cooperators also reported extremely high cull rates with these varieties, which is characteristic of many specialty melons. But with prices between $2.50 for the larger melons and $1.00 for the smaller varieties such as Sprite, all these producers plan to plant them next season.

On-Farm Commercial Vegetable Demonstrations in Western Kentucky

Shane Bogle and Joseph Masabni, Department of Horticulture

Introduction

Four on-farm commercial vegetable demonstrations were conducted in Western Kentucky to attract tobacco growers to opportunities in vegetable production. Grower cooperators were located in Crittenden, Hopkins, and Todd counties.

Materials and Methods

In Crittenden County, the grower planted 0.8 acre of bell peppers and 0.5 acre of pumpkins. There were two cooperators in Hopkins County. One grower planted one acre of mixed vegetables (tomato, cantaloupe, cucumber, watermelon, okra, green bean, and squash), and the other planted 0.5 acre of mixed vegetables. In Todd County, the cooperator planted 0.5 acre of mixed vegetables including cucumber, pepper, staked tomato, watermelon, and cantaloupe.

As in previous years, the cooperators were provided with black plastic mulch and drip irrigation lines for up to one acre and the supervised use of University of Kentucky Department of Horticulture field equipment for raised bed preparation and transplanting. Soil fertility was tested at the University of Kentucky Research and Education Center (UKREC) at Princeton and fertilizer was applied according to soil test results and recommendations. The growers acquired their own transplants and provided labor for pesticide sprays and crop harvests. Growers used pond, well, or county water for their drip irrigation. In addition to the equipment and material provided, the Extension Associate visited each plot weekly to scout for insects and diseases, to address growers' concerns, and to make site-specific recommendations. The county Extension agents assisted by working closely with the growers. The Extension agents were helpful in scheduling, promoting, and coordinating field days.

In those demonstration plots with tomatoes, two to three different planting times were needed to meet sales demands early and then late in the season. Plots were transplanted from mid-April to early June; Fabulous and Mt. Fresh were the most common varieties used. Tomatoes were transplanted on raised beds spaced on 6 ft centers with in-row spacing of 18 inches between plants. Tomato plants were trellised with stakes placed every three plants (with one metal "T" post every 30 feet) and were pruned and tied according to current recommendations in *Vegetable Production Guide for Commercial Growers* (ID-36).

Watermelons were planted at 36-inch in-row spacings. Crimson Sweet, Sangria, and Sangria Seedless were the most widely used varieties. Cantaloupes were planted at 24- to 36-inch in-row spacings with Athena being the number one choice of all growers. Peppers and cucumbers were transplanted at 12-inch in-row spacings in an offset manner in double rows 15 inches apart with Aristotle the choice for most growers. All plots were sprayed with appropriate fungicides and insecticides on an as-needed basis, and each cooperator followed a weekly fertigation schedule suggested by the University of Kentucky.

Results and Discussion

The 2004 growing season was one of the coolest and wettest on record for Kentucky. Wholesale market prices and reliability were consistently low, and wet field conditions delayed maturity and severely lowered yields in most locations. These conditions made for a frustrating year for vegetable production in western Kentucky.

The grower in Crittenden County marketed his peppers through the West Kentucky Growers Cooperative and received low prices and severe cull rates during the entire season. Poor transplant quality, marginal plant growth, and lower-than-expected yields in fields that stayed wet most of the season were contributing factors to the problem. Later in the season, the same grower who used the raised bed system produced a pumpkin crop that was marketed through local channels, which kept the season from being a complete loss (Table 1). The grower is excited about the use of plastic mulch and drip irrigation. This season experiences have led the grower to look at an alternative market to sell produce next year.

Weather conditions for one Hopkins County cooperator also resulted in poor crop growth. Pepper plants showed no sign of growth for almost two weeks because of four consecutive, 2- to 3-inch rains after transplanting. Squash and cucumber seemed to be more forgiving under these wet conditions and produced average quality produce. Disease and insect pressures were extremely high at this location, which led to yield losses. The cooperator marketed through local farmers' markets, on-farm sales, Fairview Produce Auction, and delivered to Pennyrile State Park and Outwood Hospital. By planting diverse crops and by using several different marketing outlets, this grower obtained a good net income in spite of disease and other weather-related problems (Table 1).

The second Hopkins County grower had excellent production and did a good job of marketing (Table 1). The raised beds were located on gentle slopes well above flooding areas and far exceeded expected yields. Tomatoes and watermelons were of excellent quality and were the best-selling items this year. The grower marketed his produce through farmers' markets in Madisonville, Dawson Springs, Greenville, and at the Greenville Flea Market. Due to multiple plantings, his produce was available for sale until the first heavy frost. Producers were impressed with the raised bed system in conjunction with drip irrigation, which allowed the grower to sell at an earlier market.

The Todd County cooperator experienced the same wet conditions as other growers in the state. However, because of his produce diversification and marketing skills, the season was very profitable (Table1). Several areas of the field flooded multiple times and caused irregular plant growth in all crops. The grower experienced early blight in tomatoes soon after the season began, deer damage to melons, and some minimal herbicide injury in tomatoes but reported no major production problems. The cooperator marketed produce from a roadside stand at his home in Elkton and at the Hopkinsville Farmers' Market. Selling prices were high all season and he quickly gained a reputation for delivering high quality produce.

As in past years, the biggest concern of most growers was weed pressure in the planting hole and between the beds of plastic. Also, first-time commercial growers learned that variety selection and timeliness of planting were two important factors in delivering high quality produce. Finally, with high disease pressure and heavy insect infestation due to the cool, wet season, growers sprayed insecticides and fungicides frequently to keep insects and disease pressure at manageable levels. All growers had positive comments about the use of plasticulture systems and all four plan on producing again next season.

Table 1. Costs and returns of four commercial vegetable demonstrations in western Kentucky, 2004.

Inputs	Crittenden County (1.2 acre)	Hopkins County (1 acre)	Hopkins County (0.5 acre)	Todd County (0.5 acre)
Plants	1,700	375	504	226
Fertilizer/lime	240	400	230	238
Black plastic	145	121	60	60
Drip lines	129	108	54	54
Fertilizer Injector	22[1]	23[1]	22[1]	57[1]
Herbicide	----	412	----	68
Insecticide	----	150	60	124
Fungicide	75	115	----	80
Water	190[2]	55[2]	60[2]	200[2]
Labor	1,340[3] (167 hrs)	2,000[3] (200 hrs)	(280 hrs)	(700 hrs)
Machine	40	168 (15 hrs)	102 (6 hrs)	115 (7.5 hrs)
Marketing	[4]	800 (230 hrs)	450	304 (40 hrs)
Misc. Expenses	----	----	398	1,131
Total Expenses	3,841	4,727	1,940	2,657
Income	1,908	9,400	2,700	5,811
Net Income (Loss)	(1,933)	4,673	760	3,154
Net Income (Loss)/acre	**(1,610)**	**4,673**	**1,520**	**6,308**
Dollar return/Dollar input	0.5	2.0	1.4	2.2

[1] Costs amortized over 3 years
[2] Includes the cost of fuel and 5-year amortization of irrigation system.
[3] Does not include unpaid family labor
[4] Marketing expenses not accounted for

On-Farm Vegetable Demonstrations in Northwestern Kentucky

Nathan Howard, Department of Horticulture

Introduction

Four on-farm commercial vegetable demonstrations were conduced in northwestern Kentucky in 2004. Grower/cooperators were located in Daviess, McLean, and Henderson counties. The grower/cooperator in Henderson County planted 0.5 acre of mixed vegetables (tomatoes, squash, cucumbers, and peppers). The grower/cooperator in McLean County also raised mixed vegetables (tomatoes, squash, peppers, cucumbers, and potatoes.) There were two grower/cooperators in Daviess County, one raising 10 acres of bell peppers, and the other raising 0.5 acres of mixed vegetables, (tomatoes, squash, green beans, peppers, and okra). Most of these growers were looking for a way to replace or supplement lost tobacco income.

Materials and Methods

As in previous years, grower/cooperators were provided with up to an acre of black plastic mulch and drip irrigation lines plus the use of the University of Kentucky Horticulture Department's plastic mulch layer, water wheel setter, and plastic mulch lifter. An Extension Associate made weekly visits and helped growers with any questions and problems as needed. County extension agents for agriculture and horticulture also assisted in each county to coordinate visits and field days. The three grower/cooperators raising mixed vegetables chose tomatoes as their main crop because of the marketing potential. One grower raised primarily yellow tomatoes ('Carolina Gold' variety) for direct sales to a wholesale buyer. The other two growers raised vegetables for farmers' markets in Owensboro and Henderson. They used Mt. Fresh, Mt. Spring, and other varieties to satisfy their markets. The bell pepper grower chose to plant X3R Wizard and included one acre of this field for the demonstration program. All of his peppers were marketed through the West Kentucky Growers Cooperative in Owensboro.

Results and Discussion

The 2004 growing season started out mild, and a lot of plastic was laid in March and early April before rains set in during May, which delayed further plastic laying and other planting operations. Despite the wet conditions, all growers were able to plant the majority of their crops the first two weeks of May. The McLean County grower had a nice crop of mixed vegetables, and his direct sales of yellow tomatoes were successful. The other mixed vegetables were marketed through roadside stands and were not as profitable as anticipated and did not justify the associated marketing costs (Table 1). The grower/cooperator was pleased with the returns and the new technology of the plasticulture system and plans to continue production next year, concentrating on tomatoes for direct sales.

The grower/cooperator in Henderson County had a tough season due to the early rains. Two heavy rains occurred within days of each other after transplanting, causing flooding in the field. Standing water caused plant loss throughout the field. The grower/cooperator reset some plants in late May and early June, but the production was limited. The grower was able to make a marginal gain from this plot (Table 1), as the first harvests were later than anticipated. The marketing potential was still very good for this grower/cooperator through the Henderson Farmers' Market, and he plans to continue production next year.

Table 1. Costs and returns of three commercial vegetable demonstration plots conducted in northwestern Kentucky in 2004.

Inputs	McLean County (0.5 acre)	Henderson County (0.5 acre)	Daviess County (0.5 acre)
Plants	$298	$406	$380
Fertilizer/Lime	81	216	200
Black plastic	75	75	75
Drip line and fittings[1]	101	63	68
Fertilizer injector	15	38	--
Tomato stakes[1]	43	--	--
Insectside	44	55	16
Fungicide[1]	265	37	281
Herbicide	--	77	--
Water	275	--	90
Labor	1302	1050	1025
Machinery	95	110	--
Marketing expenses	71	250	454
Total expenses	1493	2377	2499
Income	2006	2844	6586
Net income (loss)	513	467	4087
Net income/acre	**1026**	**934**	**8174**
Dollar return/Dollar input[3]	1.34	1.19	2.63

[1] Costs amortized over three years.
[2] Does not include unpaid family labor.
[3] Dollar return/Dollar input = Income/Total expenses.

The grower/cooperator in eastern Daviess County raised mixed vegetables for sales at the Owensboro Regional Farmers' Market and through a roadside stand. He had a good season, as wet weather did not affect him as much. Good production and a very good market made this grower have higher than expected profits from the half-acre plot (Table 1). This grower intends on expanding production next year to meet market demands and was pleased with the profitability from the plasticulture production system.

The fourth grower/cooperator was located in western Daviess County and raised 10 acres of fresh market bell peppers for sales at the West Kentucky Growers Cooperative. This grower experienced a rough season as a result of an outbreak of phytophthora blight in late July after the first harvest. The grower harvested two more times but experienced a net loss overall. The records from this plot were not yet available at the time of this writing.

2004 Regional Wine Grape Price Survey

Matt Ernst and Tim Woods, Department of Agricultural Economics

Introduction

Responses to a survey of 110 wineries in Illinois, Indiana, Kentucky, Missouri, Ohio, Tennessee, and Virginia indicate that grape prices paid in these states would remain steady in 2004, with some price increases expected for certain *vinifera* varieties.

The survey, conducted by the University of Kentucky New Crop Opportunities Center, also indicates that wine production in these states will continue to increase, with more than two-thirds (70%) of the respondents indicating increased production in 2004. This is uniformly noted among the wineries surveyed, regardless of location or winery size (Figure 1).

While this increase could create market opportunities for grape growers in the region, significant plantings in the Midwest could create a future market glut for some wine grape varieties.

Materials/Methods

Winery addresses were obtained from state winery association lists, and surveys were mailed to 281 wineries in June 2004. A second reminder mailing followed in early July. The survey had a 39% response rate, with 110 wineries returning usable surveys. An additional four wineries returned incomplete surveys. This represents a total response rate of 40%, a commendable rate for a mail survey. The percentages of surveys returned by state (Figure 2) were nearly identical to the proportion of surveys mailed by state; there was no significant difference in the response rates from state to state.

Results and Discussion

Production Demographics/Trends

Sizes of the 110 wineries surveyed were evenly distributed between wineries producing less than 1,000 cases of wine in 2003 (31%), those producing 1,000 to 2,999 cases (34%), and those producing 3,000 or more cases (32%).

Three-quarters (78%) of respondents indicated that they purchased wine grapes in 2003. More than half these respondents said that they purchased 100% of their grapes from growers in their state. An additional 22% said that 50 to 99% of their purchases were made in-state.

Average prices paid for the most commonly purchased varieties did not differ significantly between the 62 wineries purchasing 50% or more of their grapes from in-state sources and the 23 wineries purchasing less than 50% of their grapes in-state. In fact, both mean and median prices paid by variety are nearly identical between these two groups of wineries. This suggests that the prices reported here are sound indicators of prices paid in this region and are not skewed by prices paid for out-of-state or out-of-region grapes.

Those surveyed were also asked if they used concentrated juice to produce wine. Twenty wineries (18%) indicated that they did. While the use of concentrate may be making it easier for wineries to expand production, several respondents noted that they only use concentrate for flavoring or to increase Brix (sweetness).

Price Reports

Grape price ranges, as well as median and average prices paid, are reported in Table 1. The most frequent price range reported for each variety is also noted where applicable. Wineries surveyed expected most grape prices to remain steady from 2003 to 2004.

Price increases for Cabernet Sauvignon, Merlot, and Riesling were expected by more than 20% of the wineries purchasing these *vinifera* varieties, which command higher prices than American or French-American varieties. Prices for Traminette, a French-American variety, were also anticipated to increase by 20% of the wineries purchasing it; however, an equal percentage of wineries expected Traminette prices to decrease.

The most common varieties purchased by the wineries responding to this survey were Chambourcin and Vidal Blanc, both French-American varieties. There was also a strong overall demand reported for *vinifera* varieties in all states except Missouri.

Figure 1. 2004 Wine production intentions by winery size.

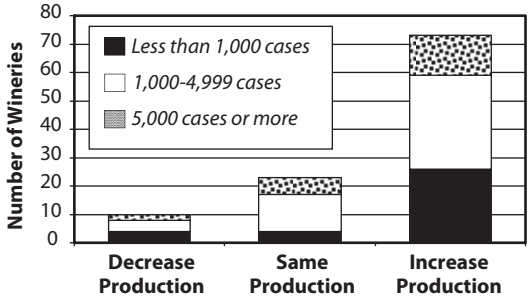
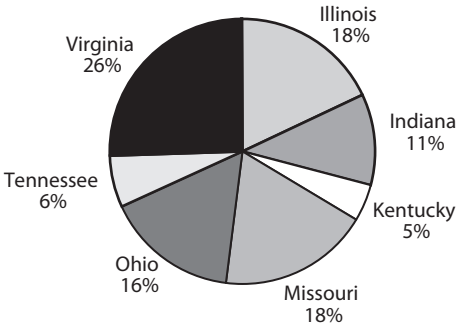


Figure 2. Survey Respondents, by State (110 responses)



Prices by State

The price ranges for varieties reported by 25 or more wineries are listed by state in Table 2. These varieties are also those most frequently reported as being purchased in Kentucky. The prices reported suggest that wine grape prices in the westernmost states (Illinois, Indiana, and Missouri) were generally slightly lower than in the states farther east (Virginia, Ohio, and Kentucky/Tennessee). Kentucky and Tennessee are grouped together because there are fewer wineries in these states.

Conclusion

This price survey gives grape growers and buyers in the region a sample of prices paid for wine grapes. The results indicate that wine grape prices will hold steady from 2003 levels, while wine production in the states surveyed (Illinois, Indiana, Kentucky, Missouri, Ohio, Tennessee, and Virginia) will increase in 2004. Continued expansion of grape-bearing acreage in these states will probably contribute to steady, if not lower, prices paid by wineries for most grape varieties in coming seasons.

Acknowledgments

The authors express their thanks to all the wineries that responded to this survey. Bruce Bordelon, Purdue University, and John Strang, University of Kentucky, reviewed and contributed to the design of this survey.

Table 1. Price paid per ton in 2003, by variety for 110 wineries surveyed in Illinois, Indiana, Kentucky, Missouri, Ohio, Tennessee, and Virginia.

Variety	No. Responding	Min. Price	Max. Price	Median Price	Average Price	Most Frequent Range Reported per Pound	Most Frequent Range Reported per Ton
American							
Concord	30	200	1000	450	**504**	$0.15-$0.30	$300-$600
Niagara	20	275	1000	475	**548**	$0.15-$0.40	$300-$800
Norton/Cynthiana	22	600	1300	1000	**945**	$0.40-$0.50	$800-$1000
Hybrid							
Cayuga White	18	400	1000	625	**654**	$0.22-$0.40	$450-$800
Chambourcin	38	450	1300	863	**876**	$0.40-$0.50	$800-$1000
Chardonel	25	700	1200	850	**889**	$0.35-$0.50	$700-$1000
Foch	16	400	1300	800	**799**	N/A	N/A
Traminette	20	700	1455	925	**955**	$0.35-$0.50	$700-$1000
Seyval	31	300	1000	797	**755**	$0.30-$0.45	$600-$900
Vidal Blanc	39	500	1300	800	**761**	$0.30-$0.45	$600-$900
Vignoles	17	620	1500	900	**931**	$0.45-$0.50	$900-$1000
Vinifera							
Cabernet Franc	28	850	2500	1280	**1350**	$0.60-$0.75	$1200-$1500
Cabernet Sauvignon	27	655	2500	1300	**1250**	$0.60-$0.75	$1200-$1500
Chardonnay	29	650	2000	1300	**1293**	$0.65-$0.75	$1300-$1500

Prices for Varieties Reported by 10 or Fewer Wineries

Varieties	Price Range per Ton	Comments
Catawba	$340-$1,000; most $340-$425	
Merlot	$825-$1,600; most $1,200-$1,600	Some increases expected in 2004
Riesling	$650-$1,400; most $1,200-$1,400	Some increases expected in 2004
Syrah	$650-$1,500; most $900-$1,200	
Viognier	$1,400-$2,000	

Table 2. Price range paid ($/ton) by state for the seven most frequently reported wine grape varieties in 2003.

Variety	Illinois	Indiana	Kentucky/ Tennessee	Missouri	Ohio	Virginia
Concord	300-900	250-500	300-1000	350-600	200-550	500-550
Chambourcin	650-1100	700-850	900-1300	800-1300	450-850	650-900
Seyval	300-900	600-775	840-1000	500-650	500-900	650-900
Vidal Blanc	500-900	600-800	600-1300	600-950	500-800	550-1200
Cabernet Franc	850-1200	950-1700	--	--	950-1600	1100-2500
Cabernet Sauvignon	900-950	750-1700	850-1400	--	750-1600	655-2500
Chardonnay	900-2000	650-1800	900-2000	--	1000-1400	1000-1800

Evaluation of Eastern European Wine Grape Cultivars for Kentucky

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Introduction

Interest in producing grapes for wine in Kentucky has increased dramatically, as the number of wineries has increased from six to 16 in the last seven years. This was partially due to the cost-share program initiated by the Grape Industry Advisory Committee to help tobacco growers diversify their operations into other agricultural crops.

There are four types of grapes grown in the U.S. for wine: American (*Vitis labrusca*), Muscadine (*Vitis rotundifolia*), European (*Vitis vinifera*), and American-French hybrids (*Vitis labrusca x V. vinifera*). Generally, Muscadine grapes are not well adapted to Kentucky's climate, and European grapes can survive Kentucky weather only with extra care in vine management. American grapes grow well, but fruit quality for wine is usually substandard. Many American-French hybrids grow well, and fruit quality for wine is intermediate between the American and French parents. The majority of wines from Europe and the West Coast of the U.S. are made from European grapes.

European grapes are not well suited for the cold climate of northern Europe. Vines are usually buried with soil or mulch to prevent winter injury, a very labor-intensive operation. Northern Europeans have crossed the *vinifera* with different *Vitis* species, including some from China. The resulting cultivars have shown improved hardiness as well as outstanding fruit quality in Eastern Europe. The late Dr. Bob Goodman of the University of Missouri evaluated these cultivars in Eastern Europe and selected several, based on winter-hardiness, disease resistance, and fruit quality. These selections were brought to the U.S. and grown in Missouri under post-entry quarantine. In 1998, the first of these selections were distributed to selected land-grant institutions in the U.S., including the University of Kentucky. This project is being conducted in cooperation with the Missouri State Fruit Experiment Station of Southern Missouri State University, Mountain Grove, Missouri.

The objective of the project is to evaluate these selections in different regions of the U.S. To participate in this project, the University of Kentucky signed an agreement specifying that no one could collect bud wood from this planting.

Table 1. 2003 yield and fruit quality results from the 1998 Eastern European wine grape cultivar trial at UKREC, Princeton, Kentucky.

Cultivar[1]	Harvest Date	No. Vines	Pruning Wt./Vine (lb)	Yield (T/A)[2]	Cluster Wt. (g)	Berry Wt. (g)	Soluble Solids (%)	pH
Toldi	8/19	14	2	10.5	287	1.7	16	3.1
Rubin Tairovski	9/5	15	2.2	10.3	228	1.9	20	3.4
Malverina	8/25	11	2.7	9.7	405	2	19	3.2
Bianca	8/14	30	2	8.1	112	2.3	18	3.1
XIV-11-57	8/26	11	2	6.8	228	1.3	18	3.3
Liza	9/8	14	2.9	6.2	171	1.3	21	3.3
Laurot	9/5	15	1.6	6.2	161	3.2	19	3.2
XX-15-51	8/7	15	1.4	6.1	138	0.3	18	3.2
Kozma 525	9/5	14	2.9	6.1	193	1.8	19	3.3
XIV-1-86	8/13	14	2.3	5.1	151	1.9	17	3.3
M39-9/74	8/19	14	1.8	5	265	2.4	18	3.1
34-4-49	9/10	14	0.7	4.9	208	1.7	20	3.2
Rani Riesling	9/5	14	2	4.3	128	1.5	23	3.3
Kozma 55	8/21	26	1.1	3.5	160	1.4	19	3.2
I 31/67	8/7	12	0.6	3.5	214	0.4	17	3.2
Petra	8/13	13	1.4	1.6	94	1.4	21	3.4
Iskorka	8/7	14	0.9	1.5	235	0.3	22	3.4

[1] Cultivars are arranged in descending order of yield.
[2] Tons per acre, calculated based on an 8 x 12 ft. vine spacing, equivalent to 454 vines per acre.

Table 2. 2004 yield and fruit quality results from the 1998 Eastern European wine grape cultivar trial at UKREC, Princeton, Kentucky

Cultivar[1]	Harvest Date	No. Vines	Pruning Wt./Vine (lb)	Yield (T/A)[2]	Cluster Wt. (g)	Berry Wt. (g)	Soluble Solids (%)	pH
Rubin Tairovski	8/18	15	0.9	3.8	161	1.4	22	3.3
Malverina	9/8	11	2.2	3.7	277	2.2	19	3.4
Toldi	9/7	14	1.7	3.5	293	3.7	18	3.5
Liza	9/8	11	2	2.9	213	1.2	21	3.3
XIV-1-86	8/18	13	1.5	2.8	161	2.1	20	3.5
Bianca	8/19	30	1.1	2.7	153	2.2	20	3.3
34-4-49	9/8	14	0.5	2.3	258	1.2	19	3.3
XX-15-51	7/28	15	0.9	2.3	230	1.2	20	3.3
Rani Riesling	8/26	14	1.6	2	127	1.8	21	3.4
XIV-11-57	9/8	14	1.6	1.9	230	1.2	18	3.4
Kozma 55	8/18	26	0.3	1.5	91	1.4	21	3.5
I 31/67	7/28	12	0.3	1.4	300	2	16	3.3
Kozma 525	9/8	14	1.6	1.1	314	2	20	3.5
M39-9/74	9/8	14	1.5	0.9	282	2.5	19	3.4
Laurot	9/8	12	0.7	0.8	155	1.3	19	3.3
Petra	8/9	13	0.7	0.5	135	1.1	21	3.3
Iskorka	7/28	14	0.3	0.3	197	1.8	19	3.3

[1] Cultivars are arranged in descending order of yield.
[2] Tons per acre, calculated based on an 8 x 12 ft. vine spacing, equivalent to 454 vines per acre.

Material and Methods

Eighteen advanced selections were released from post-entry quarantine in the spring of 1998 and planted at the University of Kentucky Research and Education Center, Princeton, Kentucky. The vines were set 8 ft within rows spaced at 12 ft apart. The planting stock was small-potted cuttings. These were trained to two trunks and tied to 5 ft bamboo canes during the first year. During the second year, vines were trained to a high bilateral cordon system. The planting is trickle irrigated, and a 4 ft wide herbicide strip is maintained beneath the vines with mowed sod alleyways.

Beginning in 2000, the yield, cluster weight, berry weight, pH, and Brix (% soluble solids) were recorded for each selection. The vines were balance-pruned according to the previous year's yields. In brief, when balance pruning, the number of buds left on a vine is determined by the vine vigor and growth in the previous season, as measured by the weight of the wood removed. The harvested grapes were then distributed to cooperating wine makers, and the quality of the wines produced from these selections was evaluated beginning in 2001.

During the spring of 2001, an additional advanced selection of nine varieties was released from post-entry quarantine and planted at the University of Kentucky Research and Education Center, Princeton, Kentucky. The planting was established in an area previously used for a high-density apple planting. The remaining end posts were left in place and used for the grape trellising. Consequently, vines were spaced 8 ft apart in rows 16 ft apart. Other aspects of planting and training were similar to those of the 1998 planting described above. A number of the vines were killed during a late spring freeze. The surviving plants were trained to two trunks and tied to 5 ft bamboo canes during the first year. Vines were not balance-pruned in 2003 because they did not have a crop in the previous season due to their poor growth after the late spring freeze.

In 2004, the same variables of yield and berry measurements were recorded as described for the vines planted in 1998. A few varieties yielded enough grapes to make wine. These grapes were distributed to cooperating wine makers, and the quality of wines produced from these selections is being evaluated.

Table 3. 2004 yield and fruit quality results from the 2001 Eastern European wine grape cultivar trial at UKREC, Princeton, Kentucky.

Cultivar[1]	Harvest Date	No. Vines	Yield (T/A)[2]	Cluster Wt. (g)	Berry Wt. (g)	Soluble Solids (%)	pH
Il 70/20	8/30	11	2.3	368	2.7	20	3.4
Bromariu	9/7	11	1.4	190	1.7	21	3.5
Ir 26/5	8/31	9	0.8	157	1.3	21	3.3
I 55/8	7/28	8	0.5	147	1.6	17	2.9
Golubok	7/28	10	0.2	140	1.5	18	3.4
Nero	7/28	12	0.1	127	2.3	18	3.3
L4-9-18	-	11	-	-	-	-	-
Demetra	-	8	-	-	-	-	-
Plai	-	8	-	-	-	-	-

[1] Cultivars are arranged in descending order of yield. Crops were lost to bird feeding for cultivars L4-9-18, Demetra, and Plai.
[2] Tons per acre, calculated based on an 8 x 16 ft. vine spacing, equivalent to 340 vines per acre.

Results and Discussion

Yield and fruit quality components for grapes harvested in 2003 and 2004 are listed in Tables 1 and 2 (1998 planting) and 3 (2001 planting). Table 4 compares the fruit yields, % soluble solids and pH for the years 2002-2004 of the 1998 planting. Malverina,

Table 4. Yield summary, 2002-2004.

	Yield (T/A)[1]				Soluble Solids (%)				pH			
Cultivar	**2002[2]**	**2003**	**2004**	Avg	**2002**	**2003**	**2004**	**Avg**	**2002**	**2003**	**2004**	Avg
Whites												
Bianca	1.5	8.1	2.7	4.1	18	18	20	18	3.1	3.1	3.3	3.1
Iskorka	0.1	1.5	0.3	0.6	22	22	19	21	3.1	3.4	3.3	3.3
Liza	2.0	6.2	2.9	3.7	21	21	21	21	3.1	3.3	3.3	3.2
Malverina	5.7	9.7	3.7	6.4	21	19	19	19	3.3	3.2	3.4	3.3
Petra	0.5	1.6	0.5	0.9	19	21	21	20	3.1	3.3	3.3	3.2
Rani Riesling	2.3	10.3	1.9	4.8	18	18	21	19	3.1	3.2	3.4	3.2
Toldi	4.7	10.5	3.5	6.2	18	16	19	18	3.3	3.1	3.5	3.2
XIV-1-86	2.4	5.1	2.8	3.4	18	17	20	19	3.3	3.3	3.5	3.3
XX-15-51	0.1	6.1	2.3	2.8	20	18	20	19	3.3	3.2	3.3	3.3
34-4-49	1.3	4.9	2.3	2.8	19	20	19	19	3.0	3.2	3.3	3.1
Reds												
Kozma 55	0.3	3.5	1.5	1.8	21	19	21	20	3.2	3.2	3.5	3.2
Kozma 525	4.0	6.1	1.1	3.7	19	19	20	19	3.4	3.3	3.5	3.4
Laurot	2.6	6.2	0.8	3.2	21	19	19	20	3.1	3.2	3.3	3.2
Rubin Tairovski	2.7	10.3	3.8	5.6	23	20	22	21	3.2	3.4	3.3	3.3
I 31/67	0.8	3.5	1.4	1.9	19	17	16	17	3.3	3.2	3.3	3.3
M 39-9/74	0.4	5.0	0.9	2.1	14	18	19	17	2.7	3.1	3.4	2.9
XIV-11-57	3.1	6.8	1.7	3.9	15	18	18	17	3.1	3.3	3.4	3.2
Overall Average	2.0	6.2	2.0	3.4	19	19	20	19	3.2	3.2	3.4	3.3

[1] Tons per acre, calculated based on an 8 x 12 ft. vine spacing, equivalent to 454 vines per acre.
[2] Yields in 2002 were low due to a late spring frost, split fruit set, and severe Japanese beetle infestation.

Toldi, and Rubin Tairovski, averaged the highest yields for the last three years. The average fruit sugar content in 2003 was slightly lower with 18.8% soluble solids at harvest compared with 19.2 and 19.6 for the years 2002 and 2004, respectively. The rainfall totals at Princeton for the week preceding harvest through the end of harvest for 2002-2004 were roughly 2, 9, and 5 inches, respectively. The average fruit pH at harvest was 3.1, 3.3, and 3.4, for 2001, 2002 and 2003, respectively.

Table 5 lists all the wine tasting results. The 2000 vintage wines were tasted in 2001, 2002, and 2004, the 2001 vintages were tasted in 2002 and 2004, and the 2002 vintages were tasted in 2004. Wines made from the 2000 harvest were evaluated on 23 June 2001 and 20 October 2001. Members of the Kentucky Vineyard Society evaluated wine from the 2000 and 2001 harvests on 6 January 2003 and from the 2000-2002 harvests on 5 January 2004. Wine makers for each variety are listed as well as the range of ratings between tasters and the comments from the most recent tasting. Comments for previous tasting evaluations are found in last year's report.

Table 6 summarizes the wine evaluations. The two French-American hybrid wine standards, Chambourcin and Vidal Blanc, and the American Norton standard received the highest average cumulative rankings so far. They have been included for comparison, as they are some of the better non-*vinifera* grapes grown in Kentucky. They are followed by 34-4-49, Laurot, XIV-186, XX-15-51, Petra, Kozma 55, and Kozma 525. In this year's evaluation, the three highest-rated white wines were of the 2001 vintage (Rani Riesling, Malverina, 34-4-49). The three highest-rated reds were the 2002 Norton and the 2001 and 2002 Laurot. Most red wines have gotten lower ratings as they have aged.

After three evaluations, the four highest-rated white wines are Vidal Blanc, 34-4-49, XIV-1-86, and XX-15-51 (Table 6). The four highest-rated red wines are Chambourcin, Laurot, Kozma 55, and Kozma 525 (Table 6). Kozma 525 rates just under Kozma 55, and both have the same parentage. Vintages that do not rate well are omitted from future wine evaluations.

The people who made these wines—and some other professional winemakers—believe that some of the varieties could make decent wines, or at least good blenders.

Acknowledgments

The authors would like to express their appreciation for all the help that they received in this study from the many Kentucky Vineyard Society members who cooperated in making and evaluating these wines.

Table 5. Wine tasting evaluation results for the 2000 through 2002 vintage years.

Vintage Year and Cultivar[1]	Wine Maker	2001 Tasting Average Rating[2]	2002 Tasting Average Rating[2,3]	2004 Tasting Average Rating[2,3]	Range of Ratings[4]	Comments from most recent tasting
2000 Whites						
Bianca	D. Miller	9.7	9.0		6-14	Good body; some sugar would help balance
Iskorka	D. Miller	11.1	9.9		6-13	None
Liza	B. Meyer	15	8.5		2-13	Nice color, off aroma; disagreeable odor; lack of free nitrogen in must
Malverina	B. Meyer	12.7	10.4		7-14	None
Malverina	D. Miller	11.2	6.4		0-11	Unpleasant aroma, taste, aftertaste; not indicative of grapes
Petra	G. Thompson	12.8	10.2		6-15	High alcohol; too sweet; unbalanced
Toldi	B. Meyer	10.8	11.1		6-15	Good balance
XIV-1-86	B. Meyer	15.2			12-17	Sweet, spicy, cleansing sweet
XIV-1-86	G. Thompson	9.4	7.6		5-11	No taste
XIV-1-86	D. Miller	14.2	10.8		2-15	Good balance; unpleasant aroma; unpleasant taste; no aftertaste; short aftertaste
XX-15-51	G. Thompson	13	10.4		6-14	Needs sugar; citrus taste; sulfur aroma; good acidity, high alcohol
34-4-49	B. Meyer	11.6	11.9		5-15	Acid and sugar not balanced; best of the 2000 whites
Cayuga White (std) 2001 tasting only	B. Wilson	8.8			6-11	The best white from this trial, good acid, crisp, very pleasant, good for the long haul
Vidal Blanc (std) 2001 tasting only	C. Nelson	14.8			11-17	Well made, great balance; a "ringer" for a nice Vidal Blanc
2001 Whites						
Bianca (sweet)	K. Georgiev		9.0	9.4	8-13	None
Bianca (dry)	K. Georgiev		9.2	8.8	6-11	Nail polish aroma; slight oxidation
Iskorka	M. Dudley		3.1			
Liza, (Cote des Blanc Yeast)	E. Durbin		5.4			
Liza, (Montrachet Yeast)	E. Durbin		5.1			
Malverina	G. Thompson		10.9	12.4	6-17	None

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Table 5. Wine tasting evaluation results for the 2000 through 2002 vintage years.

Vintage Year and Cultivar[1]	Wine Maker	2001 Tasting Average Rating[2]	2002 Tasting Average Rating[2,3]	2004 Tasting Average Rating[2,3]	Range of Ratings[4]	Comments from most recent tasting
Rani Riesling	B. Meyer		10.5	12.5	3-18	Good aroma, acids; extremely poor
XIV-1-86	B. Meyer		15.6	11.8	3-17	Slightly musty; good acid; heavy sulfur; nitrogen deficient
XX-15-51	M. Dudley		2.8			
34-4-49	G. Thompson		14.1	12.2	6-18	
Vidal Blanc (std) 2002 tasting only	C. Nelson		10.4			
2002 Whites						
Bianca	K. Georgiev			4.3	2-10	Poorly made; off taste
Liza	J. Solomon			8.4	5-10	Sweet
Rani Riesling	D. Miller			9.7	5-13	Dark; long aftertaste
Toldi	K. Georgiev			7.6	5-12.5	None
Toldi	Z. Burton			4.0	1-7	None
Traminette (std) 2004 tasting only	C. Nelson			6.2	1-11	High volatile acidity; off aroma; off odor
Vidal/Seyval blend (std) >04 tasting only	B. Meyer			10.7	3-17.5	Nice fruit; good balance; brilliantly clear; high total and volatile acidity
2000 Reds						
I31/67	E. O'Daniel	8.6	3.2			
Kozma 55	C. Nelson	8.8	12.2	12.1	5-14	Very dark; almost too much aroma
Kozma 525	C. Nelson	11.2	10.5	11.0	8-13	Light color, thin body
Laurot	E. Durbin	12.8	12.2	10.7	8-14	Lacks fruit; very dark (2), nice tannin
M39-9/74	E. Durbin	11.5	11.9	9.5	2-13	Dark; cloudy and spoiled; bitter aftertaste; flat—no tannins
Rubin Tairovski	E. O'Daniel	11.2	10.2	8.7	7-12	Brownish
XIV-11-57	E. O'Daniel	10.4	7.2			
Chambourcin (std) 2001 tasting only	B. Wilson	14.3				
2001 Reds						
I 31/67	C. Nelson		9.3	10.4	6-14	None
Kozma 55	B. Meyer		12.5	10.1	2-14	Madeira-ized (undrinkable); off odors; barnyard smell
Kozma 525	E. Durbin		13.0	11.3	7-13	None
Laurot	G. Thompson		12.3	13.1	10-17.5	Very dark
M 39-9/74	C. Nelson		11.7	12.0	7-19	None
Rubin Tairovski	E. O'Daniel		9.5	7.7	3-12	Poor density
Rubin Tairovski (blended)	K. Georgiev		9.8	8.8	6.5-13	
XIV-11-57	E. O'Daniel		11.5	7.7	4-11	Thin appearance; very light
Chambourcin (std) 2002 tasting only	C. Nelson		13.4			
2002 Reds						
Kozma 55	B. Meyer			12.7	6-18	Good; high acidity; very dark
Kozma 525	M. Willman			9.7	6-17	None
Laurot	G. Thompson			13.4	10-16	Very dark; high acidity
M 39-9/74	K. Georgiev			8.2	4-11.5	High total and volatile acidity; vanilla taste; slight off odors
Rubin Tairovski	K. Georgiev			4.6	1-7.5	Oxidized taste
XIV-11-57	G. Thompson			10.2	5-13	Vegetative aroma (2); needs aging
Chambourcin (std) 2004 tasting only	J. Solomon			11.5	6.5-16	Perfume aroma; slight phenolic instability; good fruit, too sweet; a bit too high acidity
Norton (std) 2004 tasting only	B. O'Daniel			14.9	12-18	None

[1] Cayuga White, Chambourcin, Norton, Traminette, Vidal/Seyval blend, and Vidal Blanc were included as quality American and French-American wine standards for comparison.

[2] Average rating: 0-5 = poor or objectionable, 6-8 = acceptable, 9-11 = pleasant, 12-14 = good, 15-17 = excellent, 18-20 = extraordinary. Each wine was evaluated by 8 to 10 tasters: (2001) Jim Bravard, Danny Buechele, Dave Miller, Bud Mirus, Mickey Mirus, Butch Meyer, Dr. Chris Nelson, Eddie O'Daniel, Jay Pruce, Gina Pruce, Gari Thompson, and George Wessel; (2002) Lynda Hogan, Elmer Klaber, Tom Kohler, Jerry Kushner, Marilyn Kushner, Butch Meyer, Dave Miller, Ben O'Daniel, Gari Thompson, and James Wight; (2004) Jerry Kushner, Marilyn Kushner, Butch Meyer, Dave Miller, Frances Miller, Ben O'Daniel, Gari Thompson, and James Wight.

[3] 2000 whites were not rated in 2004, due to their age. The 2001 Iskorka, Liza, XX-15-51, and the 2000 I-31/67, and XIV-1157 were not rated in 2002 due to very low scores in previous evaluations. All standard comparison wines were only evaluated once.

[4] Range: 1st number = lowest score received, 2nd number = highest score received from most recent tasting.

Table 6. Wine evaluation summary.

Cultivar[1]	2000 Vintage Average Rating[5] 2001 Tasting	2002 Tasting	2004 Tasting[2]	2001 Vintage Average Rating[5] 2002 Tasting	2004 Tasting	2002 Vintage Average Rating[5] 2004 Tasting	Cumulative Average[6]
Whites							
Bianca	9.7	9.0		9.0	9.4	4.3	
Bianca (dry)				9.2	8.8		9.2
Iskorka	11.1	9.9		3.1			10.5
Liza	15	8.5		5.4		8.4	9.3
Malverina	12.7	10.4		10.9	12.4		
Malverina	11.2	6.4					10.7
Petra	12.8	10.2					11.5
Rani Riesling				10.5	12.5	9.7	10.9
Toldi	10.8	11.1				7.6	9.8
Toldi						4.0	
XIV-1-86	15.2						
XIV-1-86	9.4	7.6					
XIV-1-86	14.2	10.8		15.6	11.8		12.1
XX-15-51	13	10.4		2.8			11.7
34-4-49	11.6	11.9		14.1	12.2		12.5
Cayuga White (std) [3]	8.8						
Vidal Blanc (std)	14.8			10.4			12.6
Vidal/Seyval Blend (std)						10.7	
Traminette (std)						6.2	
Reds							
I 31/67	8.6	3.2		9.3	10.4		9.4
Kozma 55	8.8	12.2	12.1	12.5	10.1	12.7	11.4
Kozma 525	11.2	10.5	11	13	11.3	9.7	11.1
Laurot	12.8	12.2	10.7	12.3	13.1	13.4	12.4
M 39-9/74	11.5	11.9	9.5	11.7	12	8.2	10.8
Rubin Tairovski	11.2	10.2	8.7	9.5	7.7	4.6	9.5
Rubin Tairovski (blended)[4]				9.8	8.8		9.3
XIV-11-57	10.4	7.2		11.5	7.7	10.2	9.4
Chambourcin (std.)	14.3			13.4		11.5	13.1
Norton (std)						14.9	

[1] Where a variety is listed twice, it was either vinted by more than one winemaker in one year, or produced in more than one style. Cayuga White, Chambourcin, Norton, Traminette, Vidal/Seyval blend, and Vidal Blanc were included as high-quality American and French-American wine standards for comparison.

[2] Missing ratings are due to vintages being unsatisfactory and therefore not bottled; insufficient quantity of grapes to make wine; the 2000 whites were not rated in 2004 due to their age.

[3] All standard comparison wines were only evaluated once.

[4] The small Rubin Tairovski yield was not sufficient to make wine and thus was blended with Chambourcin.

[5] Rating scale: 0-5 = poor or objectionable, 6-8 = acceptable, 9-11 = pleasant, 12-14 = good, 15-17 = excellent, 18-20 = extraordinary.

[6] Cumulative average: Mean of all average ratings for a variety; however, very low ratings were not included in the cumulative average (i.e., where wine had obviously spoiled or where there was a winemaking problem).

2000 Wine Grape Cultivar Trial

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Introduction

There is increasing interest in growing grapes for wine production in Kentucky. Grapes have a potential for high income per acre on upland sites. Kentucky grape growers need varieties that are adapted to Kentucky's varied climates and are capable of sufficiently yielding high-quality grapes.

There are four types of wine grapes grown in the U.S.: American (*Vitis labrusca*), Muscadine (*Vitis rotundifolia*), European (*Vitis vinifera*), and American-French hybrids (*Vitis labrusca x V. vinifera*). Generally, Muscadine and European grapes are not adapted to Kentucky's environment. On the other hand, American grapes grow well, but the wine is usually not to par with European wines. Many American-French hybrids grow well, and wine qual-

ity is intermediate between that of the American and French parents. The majority of the wine from Europe and the West Coast of the U.S. is made from European grapes.

The objectives of this project are to evaluate wine grape cultivars grown in different regions of the U.S. and to establish a baseline of performance by which other wine grape cultivars may be compared.

Material and Methods

Eight cultivars were planted in the spring of 2000 at the University of Kentucky Research and Education Center (UKREC), Princeton, Kentucky. These included two American cultivars (Niagara and Norton), two American-French hybrids, (Chambourcin and Vidal Blanc), one recently released interspecific hybrid (Traminette), and three *vinifera* selections (Cabernet Franc, Pinot Noir, and Chardonnay). The planting was established in an area previously used for a high-density apple planting. Consequently, rows were set at 16 ft apart in order to use the end posts left from the apple planting. Vines were set at 8 ft spacing within rows. Vines were grown with two trunks and tied to 5 ft bamboo canes during the first year. During the second year, vines were trained to a high bilateral cordon system. The planting was set up with trickle irrigation and a 4 ft wide herbicide strip beneath the vines with mowed sod alleyways.

During the spring of 2002, the *vinifera* cultivars were converted to the vertical shoot positioning system (VSP). This system typically conforms more appropriately to the vertical growth habit of *vinifera* cultivars. The trellis was changed to accommodate both training systems in the spring of 2003. The experimental design is a randomized block design with six replications.

The second harvest year for this trial was 2004. Pruning data were collected for each vine, while yield data were collected for each cultivar within each replication. Cluster weight, berry size and weight, Brix (percent soluble solids), and pH were recorded for each cultivar.

Table 1. Yield and fruit quality measurements for the year 2004 from the 2000 wine grape cultivar trial at UKREC, Princeton, Kentucky.

Cultivar[1]	Harvest Date	No. Vines	Pruning Wt. per Vine (lb)	Yield (T/A)[2]	Cluster Wt. (g)[3]	Berry Wt. (g)[3]	Soluble Solids (%)[3]	pH[3]
Vidal Blanc	9-7	18	2.4	4.4	295	1.7	21	3.3
Niagara	8-31	18	1.9	4.2	283	3.8	17	3.6
Chardonnay	8-23	18	2.5	2.3	238	1.7	21	3.2
Traminette	8-30	14	3.9	2.2	243	2.2	19	3.3
Pinot Noir	8-23	16	3.5	2.2	113	1.1	21	3.4
Cabernet Franc	9-7	16	3.7	2.1	155	1.5	20	3.4
Chambourcin	9-8	17	1.3	1.8	302	2.3	20	3.3
Norton[4]	-	18	1.4	-	-	-	-	-
LSD 5%	NA	NA	0.9	1.0	NA	NA	NA	NA

[1] Cultivars are listed in decreasing order of yield.
[2] Tons per acre, calculated based on an 8 x 16 ft vine spacing, equivalent to 340 vines per acre.
[3] Cluster and berry weight, % soluble solids and pH were sampled across all replications and not analyzed statistically.
[4] Norton did not bear fruit in 2004 due to a defoliation problem in 2003.

Results and Discussion

The leaves on all Norton vines became scorched in June 2003, most likely due to sulfur residue left in the spray tank. Most leaves dropped, and all grapes from this cultivar were removed, and yield data were not collected in 2003. The defoliation problem in 2003 also resulted in this cultivar not bearing fruit in 2004. Consequently, there has been no yield data yet for Norton in this test vineyard.

Vidal Blanc and Niagara yielded significantly more fruit than the other cultivars in this trial in 2004 (Table 1). Conversely, they had significantly lower pruning weights than two of the *vinifera*, Cabernet Franc and Pinot Noir. In 2003, Vidal Blanc and Niagara also had significantly lower pruning weights than Cabernet Franc and Pinot Noir, but the Cabernet was the second highest yielding variety tested.

Pinot Noir and Chardonnay, the first to ripen in 2004, were harvested August 23. Vidal Blanc and Cabernet Franc were harvested September 7, and Chambourcin was harvested September 8. As this is preliminary data, it will take several years to fully evaluate these selections for vine adaptation to the Princeton area climate.

Vinifera Grape Training Trial

Chris Smigell, April Satanek, John Strang, and John Snyder, Department of Horticulture

Introduction

Kentucky growers have planted extensive acreages of grapes for wine production over the last seven years. Roughly 37% of these grapes are *vinifera,* or European, cultivars that can sustain extensive damage in very cold winters. Additionally, most of the hardier *vinifera* grapes are particularly prone to crown gall, a bacterial disease that infects the vines through wounds, severely weakening and often killing the vines. This study was initiated to compare survival, yield, and fruit quality between the vertical shoot positioning (VSP) and fan training systems for wine grapes.

Materials and Methods

One-year-old, dormant, bare root vines of the *vinifera* cultivars, Cabernet Franc (fairly hardy), Chardonnay (moderately hardy), Shiraz (least hardy), and the American-French hybrid variety Vidal Blanc (very hardy) were set the spring of 2002 at the University of Kentucky Horticultural Research Farm in Lexington, Kentucky. All varieties were grafted onto the C-3309 rootstock, and one treatment of Vidal Blanc was on its own roots. Vines were spaced 8 ft within the row and 12 ft between rows in a randomized block factorial design with six

replications. The plot was surrounded by one row of guard plants.

Half the vines were trained using the vertical shoot positioning (VSP) system. With this system, vines are developed with two trunks, as two cordons on the lowest wire. From these cordons, fruiting shoots are trained vertically between two sets of catch wires. The remaining vines were trained to a fan system, which consisted of up to six canes radiating out from the rootstock in a fan pattern and tied to the trellis. Normally a two-wire vertical trellis is used for the fan system. However, due to engineering constraints, a trellis for the VSP was built for the entire planting, and the vines for the fan system were fanned out and tied to the lower wire and between the two sets of catch wires.

Vines were watered as needed until established, and weeds were controlled in a 3 ft wide herbicide strip down the row beneath the vines. Mowed sod middles were maintained between rows. Graft unions were covered with soil annually in late fall to protect unions from freeze injury. Vines were pruned and trained during the first two seasons and balance pruned in 2004 to adjust fruit load to vine vigor. Additional cluster and shoot thinning were performed on vines that had excessive crops and vigor, respectively. Insecticide, fungicide, and herbicide applications were made in accordance with the Midwest Grape and Small Fruit Spray Guide.

Vines were fruited for the first time in 2004. Yield, cluster weight, berry weight, percent soluble solids, and pH were recorded.

Table 1. Grape yield and fruit quality characteristics, 2004.

Variety/Rootstock	Harvest Date	No. Vines	Pruning Wt./Vine[1] (lb)	Yield[1] (T/A)	Cluster Wt.[1] (oz)	Berry Wt.[1] (oz)	Soluble Solids (%)	pH
Vidal Blanc/ Own roots	Sept. 13	12	1.6 b	3.1 a	7.0 a	0.068 b	21.3	3.29
Vidal Blanc/C-3309	Sept. 13	11	1.3 bc	2.7 ab	6.0 ab	0.069 b	22.1	3.39
Shiraz/C-3309	Sept. 13	12	2.7 a	2.3 ab	5.6 b	0.073 a	18.3	3.52
Cabernet Franc/ C-3309	Sept. 14	12	1.7 b	2.0 bc	6.0 ab	0.059 c	19.4	3.39
Chardonnay/C-3309	Aug. 31	10	0.84 c	1.1 c	4.0 c	0.054 d	20.7	3.24

[1] Means within a column followed by the same letter are not significantly different (Duncan Waller LSD P = 0.05.

Results and Discussion

There were no statistical differences between the VSP and fan training system treatments; however, there were varietal differences. Vidal Blanc on its own roots yielded more than Cabernet Franc and Chardonnay but did not differ from Vidal Blanc/C-3309 and Shiraz (Table 1). Shiraz had the greatest pruning weight and vigor, while Vidal Blanc/C-3309 and Chardonnay tended to have the lowest pruning weights. As expected, Chardonnay had the smallest cluster weights, while Shiraz had the largest berry weights and Cabernet Franc the smallest. These vines are very young, and consequently these results should be considered preliminary.

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The authors would like to thank the following for their hard work and assistance in this trial: Todor Angelov, Daniel Bastin, Larry Blandford, Eric Bowman, David Bundrick, Jinsong Chen, Annie Coleman, Monica Combs, Martin Crowley, Chris Fuehr, Curtis Gregory, Courtney Hart, Chelsea Kear, Kevin King, Yanin Laisupanwong (Nan), Dave Lowry, Anurak Pokpingmuang (Net), Scott Pfeiffer, Kevin Taylor, Bonka Vaneva, Wei Wen, and Alicia Wingate.

Blueberry Cultivar Trial–Eastern Kentucky

Charles T. Back, R. Terry Jones, and John C. Snyder, Department of Horticulture

Introduction

Although blueberries (*Vaccinium* spp.) are native fruits, Kentucky has limited commercial acreage. Blueberries have an excellent potential for local sales and U-pick operations. Recent research into the health benefits of small fruits, including blueberries, may help increase sales. Pharmaceutical companies are conducting more research on *Vaccinium*. Scientists attribute the blueberry's healing powers to the flavonoid compound anthocyanin. It is responsible for the blue color and is found only in the peel. Anthocyanins and other flavonoids could help limit cancer development, cardiovascular disease, and glaucoma and poor night vision. As consumers become more food-conscious, they may eat more blueberries.

The high start-up cost for blueberries, approximately $4,000/A, is mainly due to land preparation, plant, and labor costs. However, after the plants reach maturity in approximately five years, the profits should steadily increase to as high as $6,000/A per year. The longevity of a properly managed blueberry field is similar to that of a well-managed apple orchard. Blueberries require acidic soils with a pH of 4.5 to 5.2, with good drainage and high organic matter. It is best to plant more than one cultivar to ensure good pollination and a continuous harvest. Harvest usually begins in early June and lasts well into July.

Materials and Methods

Two blueberry plantings were established in the fall of 1996 at the University of Kentucky Robinson Station in Quicksand and at the Laurel Fork Demonstration Site. Cultivar growth, yield, and survival were compared between a normal silt loam site and a

disturbed mine site. The plantings consisted of 8 to12 rows of various cultivars in a randomized block design. Plants were 4 ft. apart in raised beds 14 ft. apart. Drip irrigation with point source emitters (2 gph/plant) was installed shortly after planting. Plants were fertilized beginning in the spring of 1997. In 2004 one application of 5-20-20 (5 lb/50 ft. of row) was followed by one sidedressing of ammonium sulfate (5 lb/50 ft. of row) at bloom and sulfur-coated urea (5 lb/50 ft. of row) two weeks later. Two applications of urea (0.2 lb/50 ft. of row) were applied in mid- and late July. Netting was used at both sites to prevent loss due to birds.

Table 1. Harvest measurements and berry measurements and characteristics of blueberry cultivars, Quicksand 2004.

Cultivar[1]	Fruit Yield (lb/bush)[2]	Berry Size (oz/berry)[2]	Berry Size Rating[3]	Taste[4]	Appearance[5]	First Harvest Date	% Harvested[6] (first two harvests)
Sampson*	10.96 A	0.036 A	L	S	A+	6/8	4.4
Bluejay	6.79 B	0.028 ABCDE	ML	S	A	6/3	8.9
Bluegold	6.62 BC	0.028 ABCDE	ML	S	A	6/8	3.2
NC1827*	6.58 BC	0.014 FGH	M	S	A	6/21	0
Duke	6.34 BC	0.027 ABCDE	L	S	A+	6/1	59.8
NC1832*	5.89 BC	0.013 GH	ML	S	A	6/21	0
Spartan	5.56 BC	0.036 AB	L	S	A	6/1	35.4
Blueray	5.52 BC	0.030 ABCD	L	SB	A	6/8	4.9
O'Neal*	5.34 BCD	0.032 ABC	L	ST	A+	6/1	57.9
Brigitta	5.06 BCDE	0.026 ABCDEF	L	ST	A+	6/14	1.4
Ozarkblue	4.83 BCDE	0.027 ABCDE	L	ST	A+	6/8	0
Bluecrop	4.63 BCDE	0.028 ABCDE	L	ST	A+	6/3	5.9
NC2852*	4.58 BCDE	0.021 CDEFGH	M	ST	A	6/8	1.5
Nelson	4.54 BCDE	0.030 ABCD	L	ST	A	6/1	1.1
Reka	4.52 BCDE	0.027 ABCDE	M	ST	A+	6/3	41.1
Jersey	3.96 BCDEF	0.014 GH	M	ST	A	6/8	2.1
Sierra	3.86 BCDEF	0.020 CDEFGH	L	ST	A	6/3	2.8
Ornablue	3.61 BCDEF	0.017 FGH	SM	TB	A	6/8	6.4
Patriot	3.18 CDEF	0.025 BCDEFG	L	ST	A+	6/1	28.1
Duplin*	1.87 DEF	0.011 H	L	T	A	6/8	9.6
Toro	0.75 F	0.020 DEFGH	ML	ST	A	6/8	2.5
LSD[7]	3.56	0.12					

* These cultivars are one year younger than other ones in the trial. Some cultivars were furnished by Hartman's Plant Company, P.O. Box 100, Lacota, MI 49063. Other cultivars were purchased from Fall Creek Farm & Nursery Inc. 39318 Jasper-Lowell Rd., Lowell, OR 97452.

1 In descending order of yield.

2 Means within a group followed by the same letter are not significantly different, LSD (P = 0.05).

3 Size rated visually; S = small, M = medium, L = large.

4 S = sweet, T = tart, B = bland.

5 A- = below average, A = average, A+ = above average.

6 Harvest dates were 6/1, 6/3, 6/8, 6/14, 6/21, 6/28, 7/1, 7/7, 7/12 , over a 42-day harvest season.

7 Least significant difference (P = 0.05).

Results

Twenty-one cultivars at Quicksand and 19 at Laurel Fork were tested, and results are shown in Tables 1 and 2, respectively. This year there were no late freezes, but Quicksand experienced heavy rain and cloudy weather throughout the bloom period and much of the growing season. For the fourth year in a row, the blueberry plants at Laurel Fork outyielded those at Quicksand. The Laurel Fork reclamation site is about 500 ft. higher in elevation than Quicksand and has much better air drainage. Normally apple tree bloom and plant development at Laurel Fork is about 7 to 10 days behind Quicksand. However, this year the apples, grapes, and blueberries were more advanced than those at Quicksand (see Tables 1 and 2, the % harvested during first two harvests). The reason that the Laurel Fork blueberry site has outyielded the Quicksand site is probably more complex than just an elevation difference. The soil pH of 5.1 at Laurel Fork is actually higher than that at Quicksand (pH of 4.4). However, the plants at Quicksand have shown iron chlorosis symptoms following harvest. Chelated iron has been used at Quicksand and Laurel Fork to reduce possible deficiency problems. The blueberries at Quicksand are irrigated from the Kentucky River, and there are some Phytophthora problems there that are not at Laurel Fork.

The five top-yielding blueberry cultivars at Quicksand were Sampson, Bluejay, Bluegold, NC1827, and Duke, while the five top yielders at Laurel Fork were Brigitta, Patriot, Toro, Blueray, and Nelson. There were no common cultivars among the five best at either site. At Laurel Fork, Toro and Blueray produced the largest berries, while Sampson, NC2675, and Spartan were the largest berries at Quicksand (Tables 1 and 2).

The blueberries judged to be the most attractive at Quicksand were Sampson, Duke, O'Neal, Brigitta, Ozarkblue, Bluecrop, Reka, and Patriot. The most attractive at Laurel Fork were Patriot, Toro, Blueray, Nelson, Bluegold, Sierra, and Sampson (Tables 1 and 2). Duke and O'Neal were the earliest-maturing cultivars at both sites.

The two North Carolina cultivars, NC1832 and NC1827, have medium-sized berries with a pleasant but distinctive taste. NC1832 tends to flower and set fruit in the fall. Plants of all five North Carolina selections grew rapidly this summer and are now much larger than the named highbush cultivars planted earlier. They have not shown the iron chlorosis that occurred in many of the other cultivars. Late-maturing Kentucky blueberries will require protective sprays to prevent Japanese beetle damage.

These results represent the fifth harvest of these cultivars after 6½ to 7½ years growth. Additional tests and observations will be directed toward improved harvesting techniques.

Table 2. Harvest measurements and berry measurements and characteristics of blueberry cultivars, Laurel Fork, 2004.

Cultivar[1]	Fruit Yield (lb/bush)[2]	Berry Size (oz/berry)[2]	Berry Size Rating[3]	Taste[4]	Appearance[5]	Date of First Harvest	% Harvested[6] (first two harvests)
Brigitta	14.16 A	0.042 CDE	L	ST	A	6/10	3.2
Patriot	12.49 AB	0.052 ABC	L	ST	A+	6/2	46.6
Toro	12.24 AB	0.056 AB	L	T	A+	6/7	14.9
Blueray	12.11 AB	0.059 A	L	ST	A+	6/2	16.6
Nelson	12.11 AB	0.047 ABCD	L	ST	A+	6/7	17.1
Bluegold	11.15 ABC	0.049 ABC	L	ST	A+	6/2	29.6
Bluecrop	11.11 ABC	0.041 CDE	L	S	A	6/7	9.4
Reka	10.93 BC	0.046 ABCD	ML	T	A-	6/2	23.8
Bluejay	10.35 BC	0.043 BCD	ML	S	A	6/2	39.2
Sierra	9.71 BCD	0.050 ABC	L	ST	A+	6/7	22.4
Duke	8.86 CDE	0.041 CDEF	L	S	A	6/2	70.6
Ornablue	8.45 CDE	0.039 CDEF	SM	T	A	6/7	33
O'Neal*	6.85 DEF	0.045 BCD	L	S	A	6/2	59.8
Ozarkblue	6.18 EF	0.028 FG	L	S	A	6/18	0
Sampson*	6.13 EF	0.039 CDEF	M	S	A+	6/7	23
Duplin*	4.45 FG	0.033 DEF	ML	S	A	6/7	29.8
NC2852*	4.42 FG	0.029 EFG	M	S	A	6/7	20.7
NC1827*	2.81 G	0.018 G	M	S	A	6/1	6.1
NC1832*	1.87 G	0.018 G	M	S	A	6/10	17.3
LSD[7]	3.1	0.014					

* These cultivars are one year younger than other ones in the trial. Some cultivars were furnished by Hartman's Plant Company, P.O. Box 100, Lacota, MI 49063. Other cultivars were purchased from Fall Creek Farm & Nursery Inc. 39318 Jasper-Lowell Rd., Lowell, OR 97452.

[1] In descending order of yield.

[2] Means within a group followed by the same letter are not significantly different, LSD (P = 0.05).

[3] Size rated visually; S = small, M = medium, L = large.

[4] S = sweet, T = tart, B = bland.

[5] A- = below average, A = average, A+ = above average.

[6] Harvest dates 6/2, 6/7, 6/10, 6/18, 6/23, 6/28, 7/6, a 34-day harvest season.

[7] Minimum significant difference (P = 0.05).

Highbush Blueberry Cultivar Trial in Western Kentucky

Joe Masabni, Dwight Wolfe, June Johnston, Hilda Rogers, and Gerald R. Brown (Professor Emeritus), Department of Horticulture

Introduction

Blueberries are native to North America. They have recently been touted for their health benefits because of their high antioxidant concentrations. Highbush blueberries have been a good supplemental crop for Kentucky growers who want to use land not suitable for tillage. Kentucky has a small acreage of commercial blueberry production. This study was initiated in order to evaluate highbush blueberry varieties for adaptability to Kentucky soils and climatic conditions. This report updates earlier results, presented in previous issues of the Fruit and Vegetable Research Reports (1).

Materials and Methods

This trial was established in the spring of 1993 at the University of Kentucky College of Agriculture Research and Education Center in Princeton. It consists of eight cultivars spaced 4 ft apart within rows spaced 14 ft apart. There are three bushes of each cultivar per replication. Prior to planting, the pH was reduced from above 6.0 to 5.4 with elemental sulfur. The planting is mulched yearly with sawdust and trickle-irrigated with 1 gal./hr.vortex emitters when necessary. The planting is netted during the last week of May, and fruit is harvested from the first week of June through the first week of July.

Results

Cumulative yield from 1995 through 2004, 2004 yield, and average percent ripe fruit by the end of the second week of June 2004 are shown in Table 1. Toro, Duke, and Blue Gold have yielded the most to date. For all varieties except Nelson and Sierra, between 80 and 100% of the fruit was ripe halfway through June in 2004. Nelson and Sierra were the last to ripen with 66 and 76%, respectively, of their fruit ripe by that time. In general, blueberry fruit harvest is finished for most cultivars by the end of June in western Kentucky. Nelson is typically an exception, being harvested through the first

week of July. However, this year the harvest season began about a week earlier than normal, and all blueberries in this trial were harvested by the end of June.

These findings can help growers who need to choose between the highest-yielding blueberry cultivars and ones that, during their peak harvest time, do not conflict with harvesting and/or managing other crops.

Literature Cited

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Table 1. Yield parameters of the highbush blueberry cultivar trial established in 1993 at UKREC, Princeton, Kentucky.

Cultivar[1]	Cumulative Yield 1995-2004 (lb/bush)	Yield in 2004 lb/bush	Yield in 2004 T/A[2]	Percent Fruit Harvested by Mid-June
Toro	91.2	15.5	6.0	84
Duke	89.3	13.6	5.3	97
Blue Gold	89.0	16.0	6.2	83
Bluecrop	87.8	13.0	5.1	85
Sierra	87.5	9.0	3.5	76
Nelson	87.4	11.1	4.3	66
Sunrise	67.6	15.0	5.8	98
Patriot	61.4	11.3	4.4	96
LSD (5%)	--	5.2	2	11

[1] Arranged in descending order of "Cumulative Yield" column.
[2] Experiment was established in April 1993. Plant spacing is 4 ft between bushes in rows 14 ft apart equivalent to 777 plants/A. There are three bushes per cultivar-rep combination.

Blackberry Cultivar Trial

Joe Masabni, Dwight Wolfe, June Johnston, and Hilda Rogers, Department of Horticulture

Introduction

Blackberry (*Rubus* spp.), a native plant, grows well in Kentucky. Improved blackberry cultivars offer a high income-per-acre crop for Kentucky agricultural producers looking to diversify production. Blackberries have lower establishment and labor costs than many horticultural enterprises. This experiment was begun to evaluate the performance of newer blackberry cultivars in western Kentucky's climate.

Materials and Methods

In the spring of 2000, a blackberry cultivar trial was established at the University of Kentucky Research and Education Center (UKREC), Princeton, Kentucky. The experimental design consisted of five cultivars (Apache, Arapaho, Chickasaw, Kiowa, and Navaho) and five replications arranged in a randomized complete block design. Five rows or replications, each consisting of five cultivars per row, were spaced 14 ft apart. Rows were 70 ft long with 10 ft for each cultivar and 5 ft grass buffer areas between cultivars. Six plants were spaced 2 ft apart within each plot. Plants looked fine throughout the 2000 season. In the spring of 2001, all Navaho plants started to develop symptoms of tobacco ring spot virus. These plants were removed that fall after laboratory confirmation of the virus infection. Chickasaw plants developed systems of impatiens necrotic spot virus in 2002 and were removed that fall, after harvest.

Plots were harvested from 18 June through 1 August in 2002, from 26 June through 4 August in 2003, and from17 June to 30 July in 2004. Harvesting was every two to six days, depending on berry ripeness. Yields and berry weights (weight of 25 berries) were measured at each harvest, and the total yields and average berry weights calculated (Table 1).

Results and Discussion

All cultivars ripened a couple of weeks earlier in 2004 than in 2003. In addition, yields in 2004 were more than double those observed in 2003 for Apache and Kiowa (Table 1). In general, the plants were healthy and grew well. The drop in yields in 2003 compared to 2002 could be attributed to excessive fall pruning of canes infested with the rednecked cane borer.

Arapaho ripened early but yielded significantly less fruit with significantly small berry size (as measured by average weight per berry) than Apache and Kiowa for all three years that fruit has been harvested from this trial. Conversely, Apache tended to be the last to ripen but yielded the most fruit. Kiowa and Chickasaw were intermediate between Apache and Arapaho in yield and ripening date in 2002, and Kiowa was intermediate in yield in 2003 and 2004.

Table 1. Yield parameters of the blackberry cultivar trial established in 2000 at UKREC, Princeton, Kentucky.

Cultivar[1]	Yield (lb/acre) 2002	2003	2004	Berry Weight (g) 2002	2003	2004	Harvest Period 2002	2003	2004
Apache	9801	3525	8179	7.6	7	7.2	6/27-8/1	7/9-8/4	6/25-7/30
Kiowa	7499	3194	7309	8.7	6.7	8	6/18-8/1	6/26-8/4	6/17-7/30
Chickasaw[2]	6192	-	-	7	-	-	6/18-7/26	-	-
Arapaho	3454	807	641	3.5	2.6	3.3	6/18-7/12	6/26-8/4	6/17-7/30
LSD (5%)	2987	1130	1668	0.9	1.6	0.9	-	-	-

[1] Cultivars listed in descending order of yield.
[2] Chickasaw variety was eliminated in 2003.

Evaluation of Thornless Semi-Erect and Erect Blackberry Varieties and Training Systems

John Strang, April Satanek, John Snyder, Courtney Hart, Chris Smigell, and Darrell Slone, Department of Horticulture

Introduction

Blackberries continue to be popular with Kentucky consumers, and most growers find that high-quality blackberries are readily marketable. This study was initiated as part of the New Crops Opportunities Fruit Project at the Horticultural Research Farm in Lexington, Kentucky. One portion of the study has been designed to evaluate two cane training systems using a double-T four-wire trellis for three thornless, semi-erect blackberry varieties. The second portion of the study is to evaluate plastic baling twine trellis for cane stabilization versus no trellis for two thornless, erect blackberry varieties.

Materials and Methods

Semi-erect thornless blackberry plants were set in spring, 2000 into black plastic-mulched beds. Each plot consisted of three plants of either the Hull Thornless, Triple Crown or Chester varieties, spaced 8 ft apart in the row with 12 ft between rows. Each plot was replicated three times in a randomized block design. All plants were trained on a double-T four wire trellis with the lower two wires 2 ft apart and the top two wires 4 ft apart. Two training systems were used, a conventional system and the Oregon system. One plant of the three in each plot was harvested for yield.

In the conventional system, primocanes were tipped when they had extended one foot above the top of the trellis. Dead fruiting canes that had cropped were removed in the fall. During early spring dormant pruning, spindly canes and/or those that had red-necked cane borer swellings were removed. Lateral branches were pruned to 18 inches in length and those that were within 18 inches of the ground were removed completely.

Primocanes were not summer tipped for the Oregon system. In the spring, floricanes were not thinned, although those with red-necked cane borer swellings were removed. Low laterals, within 18 inches of the ground, were removed. Laterals above this were not cut back and were wound around and sometimes loosely tied to the closest trellis wire, extending away from the plant.

Arapaho and Apache erect blackberry plants were set 3 ft apart in the guard rows on the north and south sides of the semi-erect blackberry plot. Trellising treatments (supported and unsupported) and varieties were each replicated three times in a completely randomized design. Plots consisted of three plants of the same variety of which two plants were harvested for yield. Metal fence posts were set every 9 ft. and plastic baler twine was run on both sides of the supported treatment at a height of 3.5 ft.

During the 2000 growing season, canes were allowed to trail and grow as much as possible. In the spring of 2001, the erect blackberry floricanes were pruned severely to encourage development of more vigorous shoots for the following season. During the summers (2001-2004), primocanes were tipped at a height of about 3 ft. Spindly canes and those with red-necked cane borer swellings were removed in the spring. Laterals were cut back to 16 to 18 inches in length.

Plants were fertilized in February 2004 with calcium nitrate at the rate of 8 lb/100 ft row (44 lb N/A). Irrigation was not needed in 2004. Weeds were controlled with a preemergent application of simazine, spot treatment with glyphosate, and hand weeding. Nova was used for disease control. Japanese and green June beetles were controlled with malathion. Raspberry crown borers were noted in a number of plants in 2004, and guthion was applied as a soil drench in October 2004. Bird pressure was severe early in 2002 and 2003 and moderate in 2004. An avian alarm was used to reduce bird losses.

Plants were harvested in 2001, 2002, 2003, and 2004. Data were collected for yield, fruit size, and fruit soluble solids. The 2002 season was hot and dry, while the 2003 and 2004 seasons were cool and wet. Data are shown for the 2004 season.

Results and Discussion

In 2004 the Chester semi-erect blackberry significantly outyielded both the Hull Thornless and Triple Crown varieties (Table 1), while in 2003 both Chester and Hull Thornless significantly out yielded Triple Crown. Triple Crown has produced the largest berries for the last three years, and these had a higher sugar content than those of Chester, which had a higher sugar content than Hull Thornless berries.

The Oregon training system outyielded the conventional training system for the first time in 2004 (Table 2). More detailed analysis (data not shown) shows that the significant increase in

Table 1. Thornless semi-erect blackberry variety yield, average berry weight and soluble solids, 2004 harvest.

Variety	Yield[1] (lb/A)	Avg. berry wt.[1] (oz.)	Soluble solids[1] (%)
Chester	31,939 a	0.20 b	8.4 b
Hull Thornless	26,216 b	0.21 b	7.8 c
Triple Crown	19,546 b	0.31 a	10.0 a

[1] Means within a column followed by the same letter are not significantly different (Duncan Waller LSD P=0.05).

Table 2. Thornless semi-erect blackberry yield, average berry weight and soluble solids based on training system, 2004 harvest.

Training System	Yield[1] (lb/A)	Avg. berry wt.[1] (oz.)	Soluble solids[1] (%)
Conventional	22,405 b	0.24 a	8.6 b
Oregon system	29,396 a	0.22 b	8.9 a

[1] Means within a column followed by the same letter are not significantly different (Duncan Waller LSD P=0.05).

yield for the Oregon system was due to the yield increase for the Chester variety, although yields for the other varieties also showed this trend. This year, unlike in previous seasons, berry soluble solids were slightly higher in the Oregon training system than in the conventional system (Table 2). This is surprising, because the yields were also higher for the Oregon system, and lower sugar contents usually accompany higher yields. Further evaluation of the data shows that this trend existed for all three varieties. Average berry weight was slightly greater with conventional training as in 2003. This increase in berry weight with the conventional system existed across all varieties and was not due to one variety (data not shown). Yields have continued to increase substantially for all three varieties over the three years of evaluation.

The Apache thornless erect variety far outyielded the Arapaho variety in 2003 and 2004 (Table 3). It also produced considerably larger berries with higher soluble solids contents than Arapaho. Berry weight for Apache thornless erect berries averaged 0.26 oz., while that of Triple Crown, the largest of the semi-erect berries, averaged 0.31 oz.

There were no significant differences in yield, average berry weight, or soluble solids between the no-trellis and string trellis treatments for the erect thornless varieties (Table 4). However, there was a trend toward a higher yield for the string trellis treatment. The 2004 growing season was a mild one, and there was very little cane breakage in the no-trellis plot. Apache had the more attractive fruit of the two varieties. The first, mid-, and last harvest dates in 2003 for all the varieties can be found in Table 5.

Table 3. Thornless erect blackberry variety yield, average berry weight and soluble solids, 2004 harvest.

Variety	Yield[1] (lb/A)	Avg. berry wt.[1] (oz.)	Soluble solids[1] (%)
Apache	9,435 a	0.26 a	10.0 a
Arapaho	1,935 b	0.14 b	9.4 b

[1] Means within a column followed by the same letter are not significantly different (Duncan Waller LSD P=0.05).

Table 4. Thornless erect blackberry yield, average berry weight and soluble solids based on training system, 2004 harvest.

Training system	Yield[1] (lb/A)	Avg. berry wt.[1] (oz.)	Soluble solids[1] (%)
No trellis	5,278 a	0.23 a	9.8 a
String trellis	6,093 a	0.24 a	9.9 a

[1] Means within a column followed by the same letter are not significantly different (Duncan Waller LSD P=0.05).

Table 5. Harvest date data, 2004 harvest.

Variety	First harvest	Mid-point[1]	Last harvest
Arapaho	June 16	June 30	July 19
Apache	June 29	July 20	Aug. 9
Triple Crown	June 29	July 20	Aug. 30
Hull Thornless	June 29	July 24	Aug. 26
Chester	July 6	Aug. 5	Sept. 3

[1] Date on which half of the berries were harvested, based on total yield weight.

Acknowledgments

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Rootstock and Interstem Effects on Pome Fruit Trees

Joe Masabni, Dwight Wolfe, and Gerald R. Brown (Professor Emeritus), Department of Horticulture

Introduction

Apple is the principal tree fruit grown in Kentucky because of generally favorable weather and other growing conditions. Still, the hot and humid summers and heavy clay soils make apple production more difficult for Kentucky growers than for growers in apple-producing regions with more favorable conditions. The hot and humid summers are also a factor in high disease and insect pressure in Kentucky orchards.

In spite of these challenges, productive orchards are a high per-acre income enterprise, suitable for rolling hills and upland soil. Furthermore, orchards in these sites have less soil erosion potential. Unfortunately, Kentucky imports more apples than it produces.

Identification of improved rootstocks and cultivars is fundamental for advancing the Kentucky apple industry. For this reason, Kentucky cooperates with 39 other states and three Canadian provinces in the Cooperative Regional NC-140 Project titled, "Rootstocks and Interstem Effects on Pome Fruit."

The NC-140 trials are critical to Kentucky growers, allowing them to gain access to and test new rootstocks from around the world. The detailed and objective evaluations allow growers to select the most appropriate rootstocks for Kentucky when they become commercially available.

The 1999 apple rootstock trial was designed to compare the adaptability of the slender-spindle and the French vertical-axe systems in orchards on Kentucky soils. In addition, the semi-dwarf rootstocks in the 1999 apple rootstock trial will evaluate the rootstocks' abilities to support trees without a trellis. The 2002 apple rootstock trial will provide information on performance differences among newly released rootstock clones. The 2003 apple rootstock trial will evaluate the adaptability of some new rootstocks to Kentucky climates and soils. The 2003 apple rootstock physiology trial will primarily evaluate the relationship between different environment sites and crop load and fruit size.

The NC-140 orchard trials are used as demonstration plots for visiting fruit growers, Extension personnel, and researchers. The data collected from these trials will help establish base-line production and economic records for the various orchard system/rootstock combinations that can be used later by Kentucky apple growers.

Materials and Methods

Scions of known cultivars on various rootstocks were produced by nurseries and distributed to cooperators for each planting. The University of Kentucky has three NC-140 rootstock plantings at the University of Kentucky Research and Education Center at Princeton (UKREC):

I. The 1999 dwarf and semi-dwarf apple rootstock trial consists of two groups (both have 'Fuji' as the scion cultivar):
   i) 11 dwarfing rootstocks with six replications per rootstock. Trees are planted on a 10 by 16 ft spacing.
   ii) Six semi-dwarfing rootstocks with six replications per rootstock. Trees are planted on a 13 by 20 ft spacing.

II. The 2002 apple rootstock trial consists of 'Buckeye Gala' on nine rootstocks with seven replications per rootstock. Trees are spaced 8 ft apart within rows 15 ft apart.

III. The 2003 apple rootstock and 2003 apple physiology trials consist of two groups (both have 'Golden Delicious' as the scion cultivar):
   i) 11 rootstocks with four replications with two of each rootstock per replication. Trees are planted on an 8 by 15 ft spacing.
   ii) Five rootstocks with six replications per rootstock. Trees are planted on an 8 by 15 ft spacing.

All trials were laid out as a randomized block design, except for the 2003 apple rootstock/physiology trial, which was laid out in a completely randomized design. Orchard floor management consisted of a 6.5 ft herbicide strip with mowed sod alleyways.

Table 1. 2004 results for the 1999 NC-140 dwarf and semi-dwarf apple rootstock trial, UKREC, Princeton, Kentucky.

Rootstock	Tree Mortality (no.trees lost)	Cumulative Yield (lb/tree)	2004 Yield (lb/tree)	Fruit Weight (oz)	Trunk Cross-Sectional Area (sq. in.)	No. Root Suckers
Dwarfing[1]						
CG.4013	0	340	172	6.3	10.4	4.8
G.16T	0	268	123	6.3	7.6	1.6
CG.5202	1	262	164	6.2	6.5	1.3
M.9NAKBT337	1	251	163	7.1	5.6	1.6
CG.5179	1	225	139	6.6	7.1	2.8
G.16N	0	222	69	6.4	7.6	0.5
Supporter 2	0	201	87	5.9	5.8	0
M.26 EMLA	1	197	127	6.0	5.5	0.8
CG.3041	1	179	24	5.9	7.3	0
Supporter 1	0	168	41	6.0	5.1	2
Supporter 3	0	163	22	6.1	5.1	0.2
Mean	-	223	104	6.3	6.5	1.4
LSD (5%)	NS	75	100	NS	1.9	NS
Semi-Dwarfing[1]						
CG.30N	0	412	237	7.6	8.7	3.5
CG.7707	2	365	235	6.9	8.5	1
CG.4814	1	265	171	7.0	7.3	1.5
M.7 EMLA	0	244	140	6.9	6.9	9.3
M.26 EMLA	1	185	102	7.5	6.3	0.2
Supporter 4	3	84	5	-	3.5	13.0
Mean	-	251	147	7.1	7.0	4.3
LSD (5%)	NS	155	NS	NS	NS	7.8

[1] Within groups, arranged in descending order by "Cumulative Yield" column.

Trees were fertilized and sprayed with pesticides according to local recommendations (1, 2). Trunk circumference, and number of root suckers were measured for all of the rootstock trials. Yield was measured for the 1999 and 2002 apple rootstock trials only.

Results and Discussion

The winter of 2004 was mild, followed by a wet spring and normal rainfall from June through August. Summer temperatures were generally below normal for July and August. Rainfall was below normal throughout the remainder of the growing season with 11 in. below average by end of October.

I. 1999 Dwarf and Semi-Dwarf Apple Rootstock Trial

This trial consists of two groups of apple rootstocks, a dwarfing group with 11 rootstocks and a semi-dwarfing one with six rootstocks. Eight of the dwarfing and three of the semi-dwarfing rootstocks had not been tested previously at UKREC. At planting time, we received 90 trees of a possible 102 for this trial because 12 trees were not available for our site (one each of G.16N, CG.4814, and CG.5202, two CG.4013, three CG.3041, and four CG.30N). Furthermore, three trees never leafed out after planting (one G.16T, one G.16N, and one CG.3041).

For both groups, significant differences were observed for cumulative yield (Table 1). Among the dwarfing rootstock, trees on CG.4013, G.16T, and CG.5202 had the greatest cumulative yields. Among the semi-dwarf group, trees on CG.30N and CG.7707 had the greatest cumulative yields.

The yield in 2004 and trunk cross-sectional area varied significantly only among the dwarf rootstocks, while the number of root suckers varied significantly only among the semi-dwarf group. Average fruit weight and tree mortality (number of trees lost) did not vary significantly by rootstock for either the dwarf or semi-dwarf group.

II. 2002 Apple Rootstock Trial

This trial compares nine rootstocks consisting of three clones of M.9, two clones each of B.9 and M.26, and one clone each of Supporter 4 and of P.14. Sixty-three trees of 'Buckeye Gala,' nine different rootstocks and seven replications per rootstock, were planted in a randomized complete block design. The planting has seven rows with a pollenizer tree at the ends of each row. A trellis was constructed and trickle irrigation installed a month after planting.

A few trees were lost to fire blight, but significant differences in tree mortality have not been observed to date (Table 2). Significant differences were observed for yield, fall trunk cross-sectional area, and number of root suckers, but no difference was observed in fruit size as measured by average fruit weight (Table 2). Trees on M.26 NAKB and M.26 EMLA yielded the most fruit in 2004, the first year that trees in this trial were harvested. M.26 NAKB and M.26 EMLA also had the largest fruit size, although differences were not statistically significant.

Table 2. 2004 results for the 2002 NC-140 apple rootstock trial, UKREC, Princeton, Kentucky.

Rootstock[1]	Tree Mortality (no. trees lost)	2004 Yield (lb/tree)	Fruit Weight (oz)	Fall Trunk Cross-Sectional Area (sq. in.)	No. Root Suckers
M.26 NAKB	0	37	6.3	3.47	0.0
M.26 EMLA	2	35	6.3	3.23	0.2
M.9 Nic29	0	30	5.7	2.64	6.9
B.9 Treco	1	27	5.9	1.81	0.3
Supporter 4	0	24	5.7	3.21	2.6
M.9 T337	1	23	5.2	3.07	3.2
M.9 Burg 756	1	21	5.4	3	1.8
B.9 Europe	0	21	5.5	1.85	2.3
P.14	1	17	4.3	4.30	0.2
Mean	-	26	5.6	2.94	2
LSD (5%)	-	10	NS	0.8	2.7

[1] Arranged in descending order by "2004 Yield" column.

Table 3. 2004 results for the 2003 NC-140 apple rootstock trial, UKREC, Princeton, Kentucky.

Rootstock[1]	No. Flower Clusters	No. Root Suckers	Fall Trunk Cross-Sectional Area (sq. in.)	Growth[2] (sq. in.)
PiAu56-83	10.1	0	3.11	2.72
PiAu51-4	6.0	0.0	2.71	2.28
CG.5935	19.5	0.2	2.09	1.76
J-TE-H	18.0	0.0	2.06	1.72
Bud.62-3	14.3	0.0	1.86	1.57
G.16	6.1	0.0	1.74	1.50
M.9T337	20.8	0.5	1.68	1.37
CG.3041	13.9	0.0	1.58	1.27
M.9Pajam	13.3	0.0	1.57	1.26
M.26	6.4	0.0	1.29	1.10
B.9	5.4	0.3	0.69	0.55
Mean	12	0.1	1.84	1.54
LSD (5%)	10.9	NS	0.32	0.31

[1] Arranged in descending order by "Fall Trunk Cross-Sectional Area" column.
[2] Difference in trunk cross-sectional area from spring 2003 to fall 2004.

Table 4. 2004 results for the 2003 NC-140 apple physiology trial, UKREC, Princeton, Kentucky.

Rootstock[1]	Spring 2003 Trunk Cross-Sectional Area (sq. in.)	Fall 2004 Trunk Cross-Sectional Area (sq. in.)	Growth[2] (sq. in.)
G.16	0.25	1.55	1.3
M.26	0.20	1.39	1.19
M.9 T337	0.2	1.21	1.02
Mean	0.21	1.38	1.17
LSD (5%)	0.04	0.34	NS

[1] Arranged in descending order by "Fall Trunk Cross-Sectional Area" column.
[2] Difference in trunk cross-sectional area from spring 2003 to fall 2004.

III. 2003 Apple Rootstock and Physiology Trials

Tree survival is almost 100% with one tree dead on G.16 rootstock and two trees dead on CG.5935 rootstock, all of them in the rootstock trial. Fall trunk cross-sectional area varied significantly for both the 2003 rootstock and the 2003 physiology trials (Tables 3 and 4, respectively). Trees on PiAu56-83 have grown the most and are the biggest trees in the rootstock trial. The flower cluster count, but not the root sucker count, varied significantly among rootstocks in the rootstock trial. The number of flower clusters and the number of root suckers were not observed in the physiology trial.

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Pome Fruit Variety Trial

Joseph Masabni, Dwight Wolfe, June Johnston, and Hilda Rogers, Department of Horticulture, University of Kentucky Research and Education Center

Introduction

One of the many decisions every fruit producer must struggle with is the choice of cultivars.

Although cultivar performance and fruit quality information is very useful, obtaining this information is time-consuming, due to the time required for fruit trees to start production. This is also expensive due to the large number of cultivars available. One way of reducing this cost is to incorporate a variety trial of the most recent cultivars with potential of performing well in Kentucky as part of another study.

Materials and Methods

In the spring of 1997, a training/pruning trial consisting of 36 trees per row was planted in the orchard of the University of Kentucky Research and Education Center (UKREC) at Princeton, Kentucky (1). Guard rows of various apple cultivars (two trees per cultivar) were planted on the east and west sides of the trial. Four Asian pear cultivars (eight trees) were also included in the east side guard row. Spacing and cultural practices were the same as described previously for the optimal training trial (1).

Phenological data were recorded in the spring of 2004, and yield, fruit size (as measured by average weight per fruit), flesh firmness, and the percent soluble solids (Brix) were recorded at harvest.

Table 1. Dates of phenological stages for apple and pear cultivars at Princeton, Kentucky, 2004.

Asian Pear Cultivars	Green Tip	Half-Inch Green	Tight Cluster	Pink	Bloom	Petal Fall	Fruit Set
Chojuro /OHxF97 (RM)	-	3/25	-	-	3/29	4/7	4/9
Korean Giant /OHxF97 (RM)	-	3/25	-	-	3/29	4/7	4/9
Niitaka /OHxF333 (RM)	-	3/25	-	-	3/29	4/7	4/9
Apple Cultivars							
Jonagold De Coster /M.9 (ACN)	-	3/25	-	3/29	4/5	4/16	4/19
Rubinstar Jonagold /M.9 (Wafler's)	-	3/25	3/29	3/30	4/7	4/16	4/19
Morren's Jonagored /B.9 (Stark's)	-	3/25	3/29	3/31	4/7	4/16	4/19
Shizuka /B.9 (RM)	-	3/25	3/29	3/31	4/7	4/16	4/19
Florina /CG.10 (RM)	-	3/25	3/29	3/31	4/7	-	4/19
Enterprise 'PP9193' /CG.10 (RM)	-	3/25	-	3/29	4/7	-	4/19
Sun Fuji /M.9 (ACN)	-	3/25	3/29	3/31	4/7	-	4/19
Yataka /M.9 (Starks)	-	3/25	3/29	4/2	4/7	4/19	4/22
Senshu /M.9 (Starks)	-	3/25	3/29	3/31	4/7	4/19	4/22
GoldRush /M.9 (Starks)	-	3/25	3/29	3/31	4/7	4/19	4/19
Pristine 'PPAF' /M.9 (RM)	-	3/25	3/29	-	3/31	4/12	4/16
Monark /B.9 (RM)	-	-	3/25	3/29	3/31	4/12	4/19
William's Pride 'PP6268' /O.3 (RM)	-	3/25	3/29	3/31	4/5	4/14	4/22
Redfree 'PP4322' /CG.10 (RM)	3/25	-	3/29	3/31	4/7	4/19	4/22
Ginger Gold 'PP7063' /M.9 (ACN)	3/25	-	-	3/29	4/5	4/19	4/22
Sansa 'PP 6519' /M.9 (ACN)	-	3/25	3/29	3/29	4/7	4/19	4/22
Coop 39 /CG.10 (RM)	3/25		-	3/31	4/7	-	4/22
Big Red 'BJ 45' Gala /CG10 (RM)	-	-	3/25	3/29	4/5	4/16	4/19
Liberty /M.9 (Starks)	-	3/25	-	3/29	4/5	4/14	4/19
Scarlet O'Hara-Coop25 /B9 (RM)	-	3/25	3/29	3/31	4/7	4/19	4/22

Results and Discussion

Phenological and harvest and fruit quality data are presented in Tables 1 and 2 and are the first evaluations of the listed varieties. Yield comparison between any two varieties should not be viewed as concrete evidence that one variety is a better yielder than the other. We will continue evaluating these varieties over a few years to get a better picture of how they perform over time.

The following comments reflect observations for the 2004 season only. The top three producers were Yataka, Enterprise, and Liberty, each yielding at least 200 lb/tree. All the early-season varieties (harvested by end of July) had low yields in 2004. They ranked in the bottom 50% of the list, based on yields/tree and fruit size. On the other hand, most late-season varieties had large yields and large fruit size.

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Table 2. Harvest data from the 1997 apple and pear cultivar trial.

Asian Pear Cultivars	Harvest Date	2004 Yield (lb/tree)	Fruit Weight (oz)	Flesh Firmness (lb)	Brix (%)
Chojuro /OHxF97 (RM)	9/1	9	4.9	-	-
Korean Giant /OHxF97 (RM)	10/5	70	9.4	12.0	14.4
Niitaka /OHxF333 (RM)	9/1	47	7.7	14.1	10.2
Apple Cultivars					
Jonagold De Coster /M.9 (ACN)	9/14	51	6.4	14.2	16.5
Rubinstar Jonagold /M.9 (Wafler's)	9/14	20	4.6	18.8	16.5
Morren's Jonagored /B.9 (Stark's)	9/14	46	6.8	16.2	16.8
Shizuka /B.9 (RM)	9/22	24	8.1	15.0	14.5
Florina /CG.10 (RM)	9/13, 9/22	126	6.2	16.8	13.7
Enterprise 'PP9193' /CG.10 (RM)	10/5	202	8.0	17.0	14.3
Sun Fuji /M.9 (ACN)	9/13, 10/6	166	5.0	16.9	13.0
Yataka /M.9 (Starks)	10/6	244	7.1	16.0	13.8
Senshu /M.9 (Starks)	9/2	130	5.6	14.0	11.4
GoldRush /M.9 (Starks)	10/6	130	8.0	23.4	16.6
Pristine 'PPAF' /M.9 (RM)	7/13	71	4.1	13.4	11.6
Monark /B.9 (RM)	7/13	42	5.3	16.4	11.0
William's Pride 'PP6268' /O.3 (RM)	7/13	37	4.6	17.3	10.7
Redfree 'PP4322' /CG.10 (RM)	7/20	94	5.6	16.3	8.9
Ginger Gold 'PP7063' /M.9 (ACN)	9/1	87	3.7	17.9	9.9
Sansa 'PP 6519' /M.9 (ACN)	7/20	59	5.5	16.1	14.1
Coop 39 /CG.10 (RM)	9/13	177	6.6	20.3	13.5
Big Red 'BJ 45' Gala /CG10 (RM)	9/13	72	8.3	-	-
Liberty /M.9 (Starks)	9/13	196	5.4	19.7	12.5
Scarlet O'Hara-Coop25 /B9 (RM)	9/13	137	7.1	22.2	15.1

Gourmet and Fingerling Potato Cultivar Trial

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Introduction

Gourmet or small grade potatoes are of growing interest to certain markets around the world and in parts of the U.S. Although small-sized potatoes could be sorted out of a regular potato harvest, cultural practices can be used to purposefully grow a higher percentage of smaller potatoes for this market. Early harvest and spacing were used to determine the possibility of gourmet potato production for 16 cultivars in a replicated trial in 2004. The cultivars Kennebec, Dark Red Norland, and Yukon Gold were included as checks.

Materials and Methods

Potatoes were cut for seed on 16 April. Only seed larger than 2 ounces were cut; the seed of the fingerling cultivars were not cut. On 19 April, seed of each cultivar were planted in two rows spaced 42 inches apart and 12 feet long with seed spaced 9 inches apart in the rows. A 3 ft space between plots was planted with contrasting colored potatoes. The plots were replicated four times. Admire 2F was applied after seed potatoes were laid in the furrows but before covering with soil.

Fertilizer was applied prior to planting at a rate of 84 lb of nitrogen per acre as 19-19-19. On 6 June, the potatoes were sidedressed with ammonium nitrate at a rate of 81 pounds of nitrogen per acre. The potatoes were then cultivated and hilled. Because of the wet season, only one fertigation of ammonium nitrate was made (10 lb N/acre) through the drip system.

A tank mix of Gramoxone and Dual Magnum was used for weed control after planting but before the majority of potatoes emerged. Sprays of Quadris, NuCop, and Bravo were applied for disease control throughout the season. Baythroid was used when pest management scouting indicated the need for Colorado potato beetle control.

One row of each cultivar was sprayed with the dessicant diquat on 1 July; these rows were dug by hand for the early harvest on 9 July. Three cultivars that were too small to be harvested on 9 July were sprayed with dessicant on 13 July and dug on 21 July. After potatoes were harvested, they were washed and graded into three marketable grades and culls. The grades, based on tuber diameter, included large (> 2¼" dia.), medium (1¾" to 2¼"), small or creamers (1" to 1¾"), and culls (unmarketable). The two fingerling potato cultivars were graded based on length, including long (> 3½"), medium (2" to 3½), short (< 2"), and culls (unmarketable). These are market grades, not USDA grades.

The remaining rows of potatoes in each plot were sprayed with diquat on 10 August and harvested, washed, and graded on 23 August (late harvest). The above grades were used again. At both harvests, representative samples from all four replications of the 16 cultivars were laid out on tables in order to rate the tubers for shape and size uniformity and overall appearance. The late-harvested potatoes were also rated for tuber smoothness and eye depth.

Results

Early harvest. The early-harvested potatoes were dug approximately 80 days after planting. Because the vines were sprayed with a dessicant a week before harvest, the skins of most potatoes in the early harvest were intact after harvesting and washing.

Within the red-skinned group, Rose Gold and Red Gold had the highest yields of smaller-sized potatoes, while Reddale had the lowest yield of small potatoes (Figure 1). Butte and Corola had significantly higher yields of small-sized potatoes among the five white-skinned cultivars (Figure 1). All Blue had significantly higher yields of gourmet or small-sized potatoes than Caribe (Figure 1); this was largely because tubers were graded based on diameter, and the majority of All Blue tubers were very long and thin (more like a large fingerling type).

The red-skinned cultivars with the highest total marketable yield from the early harvest were Red Gold, Red Pontiac, and Reddale (Table 1). All Red, Red Norland, and Red Cloud had relatively low yields at the first harvest. Butte, Superior, and Corola had the highest total marketable yields in the white potato group. Caribe and All Blue had similar total marketable yields in the early harvest (Table 1).

Late harvest. The late-harvested potatoes were dug with a commercial potato digger approximately 120 days after planting. Skin set was good on most cultivars. Although yields of smaller tubers were low for the second harvest, Rose Gold had the highest yield of small grade tubers (Figure 2). Red Gold and All Red also had fairly high yields of small-sized tubers while Reddale had the lowest yield of this size class among the pink/red cultivars. Butte and Corola had significantly higher yields of small-sized tubers among the white cultivars at the late harvest, while Kennebec, Yukon Gold, and Superior had low yields of this size class. All Blue yielded significantly more small-sized tubers than Caribe although, as with the early harvest, the tubers were thin and very long, unlike all the other cultivars (Figure 2).

Although no red potato had significantly higher total marketable yields than others, Red Pontiac, Red Cloud, and Reddale were at the top of the list (Table 1). Kennebec, Corola, and Butte had significantly higher total marketable yields than Superior or Yukon Gold in the white potato group. Caribe and All Blue had similar total yields (Table 1).

Tuber characteristics. Red Gold, Rose Gold, and Red Norland were rated the highest in overall appearance among all cultivars and also received high ratings for shape uniformity. Red Gold and Corola rated high in size uniformity. All Red and Red Norland exhibited very good red skin color in both harvests. None of the white cultivars were outstanding in appearance, although Butte was rated the best among them. The tuber shape of All Blue (2003 seed obtained from Johnny's Selected Seeds) was round-oval in last year's RACE trial, while this year's All Blue (from Pinetree Garden Seeds) was long and cylindrical. It is possible that two somewhat

different types are being sold by different companies under the same cultivar name.

Fingerlings. There was no significant difference between the total marketable yields of the two fingerling cultivars, Swedish Peanut and Russian Banana, in the early or late harvests (Table 1, Figure 3). In the late harvest, Russian Banana had significantly higher yield of long tubers than Swedish Peanut (Figure 3). Swedish Peanut, however, had very thick vines, hindering spray coverage for sufficient vine-killing, thus leading to moderate skin damage for the early harvest. Russian Banana had a higher number of culls than Swedish Peanut. Russian Banana appeared cylindrical, while Swedish Peanut appeared more rounded. It had shallower eyes than Russian Banana. Both cultivars grew secondary tubers at the late harvest.

Discussion

Early harvest results in a larger percentage of smaller potatoes, although the overall yield is lower compared to the later harvests. In this trial, cultivars were identified that responded well to close spacing and early harvest by yielding more small-sized tubers. In both harvests, All Blue, Corola, Butte, and Rose Gold had relatively high yields of small grade potatoes; however, tubers in this size class were a small percentage of total marketable yields. Superior, Reddale, and the controls Red Norland, Kennebec, and Yukon Gold had low yields of small-sized potatoes in the early and late harvests and appear unlikely to produce many small tubers under any cultural practices (Figures 1 and 2). Some of the cultivars were outstanding in appearance and merit small-scale grower trials (especially Rose Gold but also Red Gold, Butte, and Red Norland).

Other cultural practices that could promote a larger percentage of small-sized potatoes include closer spacings, smaller seed size, and planting dates. As these trials have shown, cultivar choice plays a large part in producing small-sized "gourmet" potatoes.

Figure 1. Early-harvest yields of small, medium, large, and cull tubers, Lexington, Kentucky, 2004.

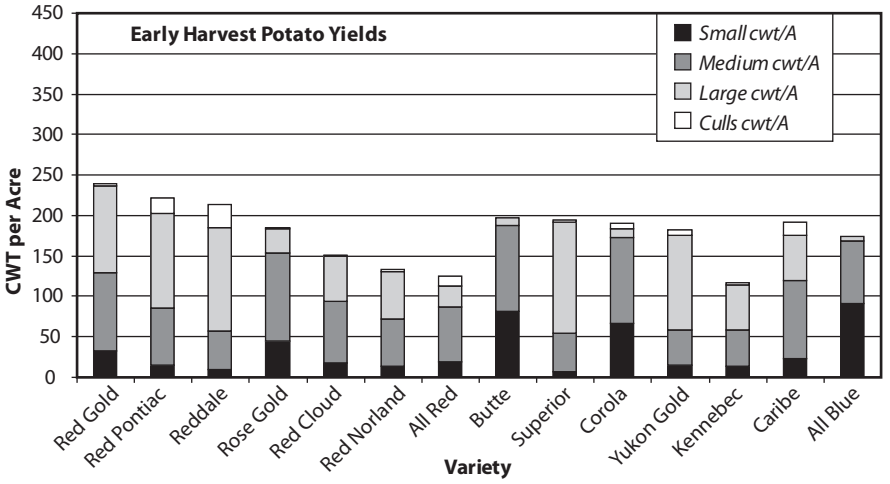

Figure 2. Late-harvest yields of small, medium, large, and cull tubers, Lexington, Kentucky, 2004.

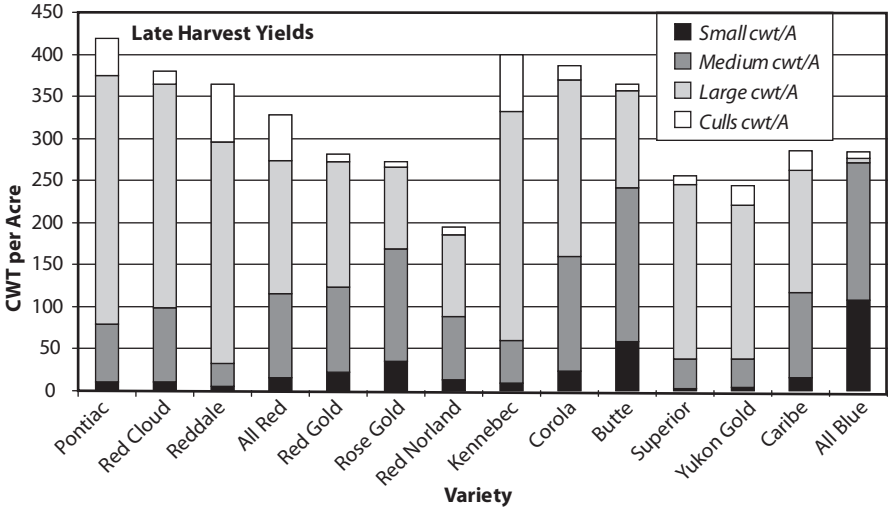

Figure 3. Fingerling yields of short, medium, long, and cull tubers for early and late harvests, Lexington, Kentucky, 2004.

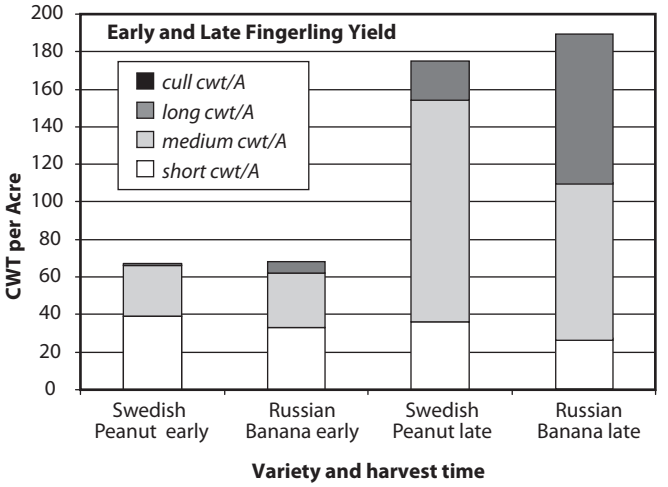

Table 1. Early- and late-harvest yields and physical characteristics of gourmet potato cultivars, Lexington, Kentucky, 2004.

Cultivar	Seed Source	Late Total Mkt. Yield (cwt/A)[1]	Early Total Mkt. Yield (cwt/A)[1]	Flesh Color[2]	Skin Color[2]	Shape
Red Pontiac	SS	419 a	222 ab	white	pale red	oval
Red Cloud	WP	380 ab	152 def	white	pale red	oval, somewhat flat
Reddale	WP	365 ab	213 abc	white	pale red	round/oval
All Red	PT	328 bc	125 f	pink	dk red	oval
Red Gold	JS	281 cd	239 a	yellow	pink	round
Rose Gold	WP	272 cd	185 bcd	yellow	lt pink	round/oval
Red Norland	SS	194 e	133 ef	white	red	oval
Kennebec	PT	400 a	116 f	white	white	oval/long
Corola	PT	387 ab	190 bcd	yellow	white	oval/blocky
Butte	WP	365 ab	197 abc	white	russet	oval/long/blocky
Superior	JS	255 de	194 bc	white	white	round/oval
Yukon Gold	PT	244 de	182 bcd	yellow	white-lt yellow	round/oval
Caribe	WP	286 cd	192 bcd	white	purple	round/oval/long
All Blue	PT	284 cd	174 cde	violet	dk purple	oval/very long
Fingerlings						
Russian Banana	WP	191 a	68 a	lt yellow	beige	long
Swedish Peanut	WP	175 a	68 a	lt yellow	beige	oval/long

[1] Numbers followed by the same letter are not significantly different (Duncan Waller LSD P = 0.05).
[2] Color: lt = light, dk = dark.

Table 2. Appearance ratings for potato cultivars, Lexington, Kentucky, 2004.

Cultivar	Skin Color	Smoothness (1-5)[1]	Eye Depth (1-5)[2]	Shape Uniform. (1-5)[3]	Size Uniform. (1-5)[3]	Overall Appearance (1-9)[4]	Comments
Red Pontiac	lt red	4	4	2.8	3	5.5	Some skinning in early harvest, rough looking tuber.
Red Cloud	red	3	4	3.5	3.5	6.5	Irregular larger tubers, skin well developed at early harvest.
Reddale	lt red	3	3	3.5	3	6.5	Some growth cracks, skin well developed at early harvest.
All Red	red	3	3	2.8	3	6	Very nice skin color, slightly rough looking, some growth cracks.
Red Gold	pink	4	3	4	4	7.5	Very nice color, slight skinning, attractive shape.
Rose Gold	white-pink	4	4	4	3.3	7.5	Attractive, pinkish cast on white skin, some skinning at early harvest.
Red Norland	dk red	4	3	4.3	3.5	8	Attractive, smooth, nice red skin color, skin well developed at early harvest.
Kennebec	white	2	3	2.5	3	4	Largest tubers are ugly with secondary tubers, peeling skin, somewhat rough appearance.
Corola	white	3	5	3	4	4.5	Many blocky shaped, knobby textured russet.
Butte	brown	3	4	3	3.8	6	Somewhat knobby, long and rough, nice skin.
Superior	white	2	2	3	3	5.5	Largest tubers are ugly and cracked.
Yukon Gold	white	3	3	3.3	3	5	Largest tubers are ugly and cracked, some skinning at first harvest, light pink eyes.
Caribe	purple	3	4	2.5	3	4.5	Some growth cracks, rough appearance, skin peeled badly at first harvest.
All Blue	dk purple	2	3	2.8	2.5	4	Long and rough, nice skin, irregular, long and knobby, like scabby russet tuber.
Fingerlings							
Russian Banana	white-brown	2	3	2.5	3	4	Skin well developed at first harvest, some secondary tuber growth at second harvest.
Swedish Peanut	white-brown	3	4	2.5	3	3.5	Skinned badly at first harvest, very thick vines, some secondary tuber growth at second harvest.

[1] Smoothness: 1 = rough, 5 = smoothest, late-harvest rating only.
[2] Eye depth: 1 = deep eyes, 5 = shallow eye depth, late-harvest rating only.
[3] Uniformity rating: 1 = least uniform, most variable, 5 = completely uniform.
[4] Overall appearance: These data are averages from the early-harvest (12 July) and late-harvest (Aug 27) ratings where 1 = worst, 9 = best.

Bell and Jalapeño Pepper Evaluations for Yield and Quality in Eastern Kentucky

R. Terry Jones, Charles T. Back, and John C. Snyder, Department of Horticulture

Introduction

As a result of several multi-year studies evaluating bell pepper cultivars for resistance to bacterial leaf spot (*Xanthomonas campestris* pv. *vesicatoria* or Xcv) and fruit quality, nearly 100% of Kentucky's pepper acreage is planted to resistant bell pepper cultivars with high fruit quality. As new pepper cultivars are released we try to test them for leaf spot resistance, as well as fruit yield and quality under Kentucky conditions. Because Kentucky farmers are planting more vegetable crop acreage, new disease problems like Phytophthora blight (*Phytophthora capsici*) and tomato spotted wilt virus (TSWV) are becoming more prevalent. Past studies have shown that some pepper cultivars with leaf spot resistance to at least three races of Xcv (races 1, 2, and 3) perform well even under high disease pressure. Several of the cultivars in this study contain resistance or tolerance to TSWV or Phytophthora blight in addition to bacterial spot resistance.

In addition to the bell peppers, we evaluated two jalapeno pepper cultivars. Bell pepper cultivars were tested in replicated trials at three Kentucky locations in 2004 (western, central, and eastern). See the reports for western and central Kentucky elsewhere in this publication.

Materials and Methods

Eight new bell cultivars with the Bs2 gene for bacterial spot resistance were compared with main season and early-season control varieties, Aristotle and Red Knight, respectively (Table 1). Mature green fruit were harvested four times from late June to mid-August. Fruit were graded and weighed according to class size (U.S. No. 1 extra large, large, medium). Yields in each size class were multiplied by their respective wholesale market prices to determine gross returns (income) for each cultivar. Wholesale prices from Cumberland Farm Products Cooperative for 2004 were used to calculate incomes for the different varieties. The income variable has been a good indicator of a cultivar's overall performance, taking into account time of harvest as well as yields of the different size classes and their price differentials.

The eight bell and two jalapeno peppers were seeded in 72-cell trays in the greenhouse at the Robinson Station on 18 March and were transplanted to the field on 7 May. Revolution (HMX 1660) was also seeded in 72-cell trays at the Robinson Station greenhouse on 6 May and was planted on 6 June. Excursion II transplants were seeded in 128-cell trays on 2 March near Owensboro. After we received them in early May, they were fertilized and grown for one week in 72-cell trays at Quicksand before transplanting on 15 May.

Based on the soil test results shown in Table 2, 50 lb of actual nitrogen along with 70 lb of P_2O_5 and 60 lb of K_2O/A were applied the day before planting. Ninety additional pounds of nitrogen/A were applied to the peppers during the growing season for a total of 140 lb actual N/A.

Each plot contained 16 plants in double rows with eight plants/row. The in-row spacing was 14 in. with 20 in. between rows. One empty space/row was left between plots. Plots were replicated four times in a randomized complete block design.

Fruit appearance ratings. All pepper cultivars harvested on two separate occasions (7/01 and 7/08) were laid out on the ground and evaluated for fruit appearance. Overall appearance ratings were the result of several factors listed in order of decreasing importance: overall attractiveness, shape, smoothness, degree of flattening, color, and uniformity of shape.

Table 1. Seed company descriptions of bell cultivars tested at Quicksand and Lexington, 2004.

Cultivar	Source	Days to Maturity	Comments
Socrates	SW	64	Very early, blocky, green to red, sturdy, medium-sized plants, BLS 1,2,3
Patriot	HM	70	Early red, blocky concentrated fruit, BLS 1,2,3,5, and PVY
Conquest	HM	70	Blocky, green to red fruit, phytophthora tolerant
Red Knight X3R	Ru	63	Large, blocky, green to red fruit, medium-tall plants, BLS 1,2,3, PVY
Heritage	HM	75	Green to red fruit, tall plant, TSWV resistant, BLS 1,2,3,5
Alliance (HMX2643)	HM	70?	Blocky, green to red fruit; BLS 1,2,3,5, "intermediate resitance" to phytophthora, PVY, PepMoV, CMV
Aristotle (X3R)	Ru	72	Very large green to red, BLS 1,2,3 and PVY, TMV
Olympus	SW	71	Sturdy plants, heavy yield dark green to red fruit. BLS 1,2,3, some phytophthora resistance
Jalapeno P109	PF		BLS 1,2,3
Ixtapa X3R	Ru	75	Thick, dark green to red jalapeno fruit, BLS 1,2,3
Excursion II	Ru	75?	Large blocky fruit; BLS 1,2,3, TSWV, PVY, and TMV
Revolution (HMX 1660)	HM	72	Large to XL blocky fruit, tall plants. BLS 1,2,3,5, CMV and phytophthora tolerant, cool tolerant

Table 2. Soil test results for pepper trial plot at Quicksand, Kentucky, 2004.

pH	Buf-pH	P	K	Ca	Mg	Zn
6.42	6.88	20	308	2426	517	15.2

Results and Discussion

Total marketable yields, gross incomes, and fruit quality characteristics are shown in Table 3. Total marketable yields based on four harvests ranged from 10.4 to 14.7 tons/acre. The growing season was very wet, and temperatures were cool with overcast skies on many days. Incomes were lower than in previous years and ranged from around $3,100 to $4,500 per acre. Aristotle was once again the top yielding and income return-per-acre pepper. However, it was only significantly better than Red Knight and Patriot. Yields and returns for Excursion II and Revolution were not significantly different from Aristotle but were not included in the analysis because of differences in transplant production methods and planting date.

Aristotle produced significantly more pounds of extra large peppers than six of the other cultivars (Olympus, Conquest, Patriot, Heritage Socrates, and Red Knight). It was similar to Alliance and Revolution in pounds of extra large fruit.

Fruit quality ratings showed that Aristotle, Patriot, Heritage, and Excursion II fruit had the best overall appearance. Conquest had the lowest overall fruit quality rating.

All of the bell peppers except Excursion II had 80% or better extra large or large fruit. One difference between Excursion II and the other nine bell peppers was the cell size used to produce the transplants.

Growers should also see results from similar trials in 2004 from central and western Kentucky found elsewhere in this publication. Results of previous Kentucky research on pepper cultivars can be viewed on the Web at: www.uky.edu/Ag/Horticulture/comveggie.html

Table 3. Yields, gross returns and appearance ratings of bell and jalapeno pepper cultivars in Quicksand, Kentucky

Cultivar	Seed Source[1]	Tot. Mkt. Yield[2] (tons/A)	Lb XL Fruit/A[2]	% XL + Large[4]	Income ($/A[5]	Overall Appearance[6]	No Lobes[7]	Fruit Color	Comments
Aristotle	S	14.75	20,710	84.9	$4510	6	3-4	Dk green	Good yield
Alliance	HM	12.7	19,304	88.7	$4165	5	3-4	Pale-med green	High yielder, some misshapen fruit
Olympus	EZ	12.46	15,635	94.1	$3900	4.3	3-4	Mostly dk green	Pale green on shaded side of fruit
Heritage	HM	12.2	14,923	82.9	$3461	5.5	4	Med green	
Conquest	HM	11.32	14,933	82.6	$3323	3.5	3		numerous misshapen fruit
Socrates	S	11.1	14,187	82.9	$3289	5	3-4	Pale med. green	Some misshapen fruit
Patriot	HM	10.4	14,923	86.5	$3164	5.5	3-4	Mostly dk green	Shaded side of fruit pale green
Red Knight	S	10.5	12,635	78.9	$3129	4.5	3-4	Pale green	Low yield
Waller-Duncan LSD (P< 0.05)		2.95	4,952	-	1344				
Revolution	HM	12.7	17,087	87.5	$3184	-	-	-	Did not evaluate because of late planting
Excursion II	AC	12.7	13,398	65.3	$3222	6	4	Dk green	Attractive

Jalapenos:	Seed Source[1]	Tons/A	Fruit weight avg. (oz)	Fruit no./A	Fruit length (in.)	Fruit width (in.)	Comments
Ixtapa X3R	S	16.9	1.34	408,960	3.3	1.5	Smooth, many purple colored
Pace 109	PF	13.2	1.28	335,195	3.6	1.2	Cracked
Waller-Duncan LSD (P< 0.05)		ns	ns	ns	ns	ns	

[1] Seed source identification and address information are listed in Appendix A of this publication.
[2] Pounds of extra large peppers (> 3.5 in. diameter).
[3] Total marketable yield includes the yields of U.S. Fancy and No. 1 fruits of medium (> 2.5 in. diameter) size and larger misshapen but sound fruit that could be sold as "choppers" (i.e., misshapen fruits) to foodservice buyers.
[4] Percentage of total yield that was extra large (> 3.5 in. diameter) and large (> 3 in. diameter but < 3.5 in.).
[5] Income + gross returns per acre: average 2004 season local wholesale prices were multiplied by yields from the different size/grade categories: $0.17 to 0.19/lb for extra large; $0.09 to 0.14/lb for large and mediums, and $0.05 to 0.11/lb for "choppers."
[6] Visual rating: 1-9 scale where 1 = worst, 9 = best, taking into account overall attractiveness, shape, smoothness, degree of flattening, color, and shape uniformity; all fruit from two separate replications were observed on 7/01 and 7/08 respectively. A rating of 5 was considered commercially acceptable.

Bell and Jalapeño Pepper Evaluations for Yield and Quality in Central Kentucky

Brent Rowell, April Satanek, and John C. Snyder, Department of Horticulture

Introduction

After completing a two-year (2000-01) evaluation of bell pepper cultivars under induced bacterial spot (*Xanthomonas campestris* pv. *vesicatoria* or Xcv) and bacterial spot-free environments, we began a new series of trials in 2003 (western Kentucky) to compare some new cultivars with a previously recommended, highly resistant cultivar with very attractive fruits (Aristotle). While nearly 100% of the pepper acreage in the state is planted with spot-resistant cultivars having the *Bs2* gene (resistance to Xcv races 1, 2, and 3), several new resistant cultivars have been released since 2001. One of the cultivars in this trial (Conquest), supposedly has high tolerance to *Phytophthora capsici*, which is becoming more of a problem in the state. The variety unfortunately does not have bacterial spot resistance. Two new cultivars (Heritage and Excursion II) reportedly have resistance to bacterial spot and tomato spotted wilt virus (TSWV). This thrips-transmitted disease has become economically important in Illinois and in some southern states in the last few years.

In addition to bells, we also observed performance of a jalapeno cultivar from Pace Foods (non-bacterial spot resistant) and compared it with a recommended bacterial spot resistant cultivar (X3R Ixtapa). Bell cultivars were tested in replicated trials at three locations in 2004 (central Kentucky at Lexington, eastern Kentucky at Quicksand, and western Kentucky in Owensboro). See the other reports from eastern and western Kentucky in this publication.

Materials and Methods

This trial was planted at the Horticultural Crops Research Station in Lexington (LEX). Eight of the ten bell and two jalapeno pepper cultivars were seeded in the greenhouse in eastern Kentucky at the Robinson Station at Quicksand on 18 March. Seedlings were grown in 72-cell plastic trays and transplanted to the field at LEX on 25 May. Two cultivars, Revolution and Excursion II, were obtained from the West Kentucky Growers Cooperative. These had been seeded earlier than the other cultivars and the transplants were older and in poorer condition at transplanting. For this reason, these two cultivars were not included in the statistical analyses, and growers should use caution interpreting their yields.

The trial field received 64 lb N/acre prior to planting, supplemented by an additional 58 lb N/acre divided into nine weekly fertigations (122 lb N/acre season total). Phosphorus and potassium were applied prior to planting according to soil test recommendations. Plots consisted of 20 plants in double rows with four (bells) and two (jalapenos) replications in a randomized complete block design. All were planted on raised beds with black plastic mulch and drip irrigation. Plants of all cultivars were spaced 12 in. apart in the row with 15 in. between the two rows on each bed. Beds were 6 ft apart from center to center. A tank mix of maneb plus fixed copper was applied weekly until 23 July for bacterial spot protection. A pheromone trap for adult male European corn borers was placed adjacent to the trial field. Only two applications of synthetic pyrethroid insecticides were made in August for corn borer control.

Eight new bell cultivars with the *Bs2* gene were compared with main season and early-season controls Aristotle and Red Knight, respectively (Table 1). Mature green fruits were harvested five times from 2 July to 8 Sept. Marketable fruits were graded and weighed according to size class (U.S. No. 1 extra large, large, medium). We also weighed misshapen fruits that could be marketed to foodservice as "choppers." Yields in each size class were multiplied by their respective wholesale market prices to determine gross returns (income) for each cultivar. Weekly wholesale prices from Cumberland Farm Products Cooperative for 2004 were used to calculate incomes from the different cultivars. The income variable has been a good indicator of a cultivar's overall performance, taking into account yields of the different size classes and their price differentials.

Fruit appearance ratings. All pepper fruits harvested from all four replications at the fourth harvest (Aug. 17) were laid out on tables for careful examination and quality ratings on Aug. 20. Overall appearance ratings took several things into account including, in order of importance: overall attractiveness, shape, smoothness, degree of "flattening," color, and uniformity of shape.

Results and Discussion

Bell cultivars. Total marketable yields, gross incomes, and fruit quality characteristics are shown in Table 1. Although the 2004 growing season was unusually cool, cloudy and wet, total marketable yields were relatively high, ranging from 17 to 30 tons/acre. Incomes, however, were considerably lower than in previous years because of low wholesale prices. In addition, unexplained plant losses in some of the plots made it necessary to use correction factors to equalize the number of plants per plot; this made it more difficult to detect statistical differences among the cultivars tested.

Aristotle was once again the top-yielding (total marketable yield) cultivar, although yields of Red Knight were not statistically different from Aristotle (Table 1). Yields of Revolution and Excursion II, although not included in the statistical analyses, appeared to be as high as Aristotle, in spite of the older transplants used for these cultivars.

Fruit quality characteristics for bell cultivars are also shown in Table 1. Aristotle, Patriot, Heritage, Revolution, and Excursion II received the highest fruit appearance ratings. The other cultivars received marginal ratings with Olympus receiving the worst rating of 4.5. Aristotle and Excursion II had the darkest green fruits among cultivars in the trial.

Table 1. Yields, gross returns, and appearance of bell and jalapeno pepper cultivars in Lexington, Kentucky; yield and income data are means of four replications.

Cultivar[1]	Seed Source	Tot. Mkt. Yield[2] (tons/A)	% XL +Large[3]	Income[4] ($/A)	Shape Unif.[5]	Overall Appear.[6]	No. Lobes[7]	Fruit Color	Comments
Aristotle	S	29.8	83	4359	4	6	3	dk green	
Red Knight	S	27.4	76	4197	2.5	5	4	med green	some silvering and 'pumpkin' shapes
Patriot	HM	24.1	80	4007	2	6	3-4	med dk green	
Socrates	S	22.6	78	3680	2	5	3-4	lt-med green	
Conquest	HM	24.0	76	3671	2	5	3	lt-med green	many "apple"-shaped
Alliance	HM	21.6	77	3458	2	5.5	3-4	med green	
Heritage	HM	22.2	83	3870	3	6	4	med green	
Olympus	EZ	17.5	78	2802	2.5	4.5	4	med-dk green	
Waller-Duncan LSD (P<0.05)		5.0	13	974					
Revolution	HM	26.8	79	3525	3	6	3-4	med green	nice blocky shape
Excursion II	AC	28.5	83	3407	3	6	4	dk green	
Jalapenos:									
Ixtapa	S	32.7	50% of fruits with purple coloring; very little cracking compared with Pace 109; very uniform						
Pace 109	PF	26.8	Most fruits showing extensive cracking, very uniform. Longer (3.4 in.) than Ixtapa (3.0 in.)						

[1] Cultivars Revolution and Excursion II were from older transplants and were not included in statistical analyses.
[2] Total marketable yields of U.S. Fancy and No. 1 fruits of medium (> 2.5 in. diameter) size and larger plus misshapen, but sound fruit that could be sold as "choppers" to foodservice buyers.
[3] Percentage of total yield that was extra-large (> 3.5 in. diameter) and large (> 3 in. diameter but < 3.5 in. diameter).
[4] Income = gross returns per acre; average 2004 season local wholesale prices were multiplied by yields from different size/grade categories: $0.17 to 0.19/lb for extra-large; $0.09 to 0.14/lb for large and mediums, and $0.05-0.11/lb for "choppers" (i.e., misshapen fruits).
[5] Average visual uniformity of fruit shape where 1 = least uniform, 5 = completely uniform.
[6] Visual fruit appearance rating where 1 = worst, 9 = best, taking into account overall attractiveness, shape, smoothness, degree of flattening, color, and shape uniformity; all fruits from all four replications observed at the fourth harvest (Aug 17).
[7] 3-4 = about half and half 3- and 4-lobed; 3 = mostly 3-lobed; 4 = mostly 4-lobed.

Cultivars that had the highest yields *and* acceptable or better fruit quality ratings were Aristotle, Patriot, Revolution, and Excursion II. Growers should consider these results together with results reported from the other trials in eastern and western Kentucky in 2004. In contrast to our results, Olympus was the highest yielding cultivar in the 2003 trial in western Kentucky. Revolution was also among the top yielding/highest income cultivars in that trial.

Jalapeños. Yields of the Pace Foods cultivar (Pace 109) were acceptable under our conditions, although not as high as from the bacterial leaf spot-resistant Ixtapa. Fruits of the Pace cultivar were longer and thinner but cracked more than Ixtapa. Ixtapa had many fruits with purple coloring, especially when temperatures were cooler. These cultivars were not exposed to bacterial spot in this trial. Many other jalapeño pepper cultivars were tested at LEX and in eastern Kentucky in 2000-2001. Earlier *Fruit and Vegetable Crops Research Reports* can be viewed on the Web at: www.uky.edu/Ag/Horticulture/comveggie.html.

Acknowledgment

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Bell Pepper Cultivar Trial, Western Kentucky

Nathan Howard and John C. Snyder, Department of Horticulture

Introduction

Bell pepper is one of the major vegetable crops marketed through the West Kentucky Growers Cooperative in Owensboro, Kentucky. For the past five years, growers in western Kentucky have marketed peppers and other fresh vegetables through the new cooperative. As a follow-up to the 2003 study, we conducted another bell pepper cultivar trial in this area to evaluate quality and yield among different varieties.

Materials and Methods

The trial was conducted in cooperation with a vegetable grower in Daviess County. Eight varieties were tested. Seven varieties were obtained from the Seedway Company, and the other cultivar (Excursion II) was obtained from Rupp Seeds. Each variety was seeded in the greenhouse on 2 March into 200 cell trays. The plants were transplanted onto raised beds with black plastic mulch and drip irrigation on 26 April. The grower

managed the trial plot in the same way as the rest of his field. Phosphorus and potassium fertilizer was applied pre-plant according to soil test results and current University of Kentucky recommendations. Nitrogen was applied at the rate of 75 lb/acre prior to planting with an additional 140 lb/acre (total) applied in weekly fertigations through the drip system after the peppers were established. Fungicides were applied on a weekly basis for prevention of diseases; maneb and copper were the two main chemicals applied. The insecticide Mustang Max was applied as needed. The trial was arranged in a randomized complete block design with four replications. Each treatment had 20 plants in 18-in.-wide double rows with 15 in. between plants within the rows. Beds were 66 inches apart from center to center.

Results and Discussion

Many pepper plants were transplanted in late April because of the warm spring weather. May began with above-normal precipitation and below-normal temperatures, which continued throughout the summer. Growers had to stay on a tight spray schedule because disease pressure was elevated. Yields were below those from 2003, when the weather was ideal for vegetable production.

Wholesale pepper prices through the cooperative ranged from average to a little below average during the entire harvest period (Table 1). Trial plots were harvested five times between 29 June and 4 August. Peppers were sorted and graded according to market standards: extra large, large, medium, and chopper. Each grade was weighed, and these weights were extrapolated to a per acre basis for yield comparisons. In this year's trial, Aristotle, a favorite of many growers in this area, yielded more than the other varieties, with more than 1,200 boxes per acre (Table 2). In last year's trial, Aristotle was not the best producer overall but still yielded about 1,300 boxes per acre. This illustrates typical yield differences experienced by growers from the two seasons. The average yield from the 2003 trial was 1,362 boxes per acre, while the 2004 average was only 961 boxes per acre. The top performer from 2003 was the worst in the 2004 trial: Olympus yielded only 738 boxes per acre. The most consistent performers in the trial were Revolution and Brigadier. Revolution is a new variety that was recommended in this area for small acreage trials in 2003. From two years' of data, it looks to be a good-yielding pepper with good quality as well. Brigadier has always been a high-yielding pepper, but quality seems to be an issue. This variety had a lot of choppers and does not seem to hold a dark green color. Excursion II looks promising for this area as it had a respectable quality rating and yielded third highest in the trial.

In conclusion, these two years of trials gave us the opportunity to compare the same varieties under two very different sets of weather conditions. Aristotle continues to be a workhorse variety that yields consistently. Revolution also performed well in both years and looks dependable. Excursion II also looks promising and, as with any new varieties, should be tried on a small scale in growers' fields to determine if it works well for their production. These results should also be compared to results from similar trials conducted in eastern and central Kentucky in 2004.

Table 1. Average weekly wholesale prices (per 32-lb box) for bell peppers from June 29-August 4, 2004 at West Kentucky Growers Cooperative.

Harvest Date	XLG	LG	Med.	Chopper
Jun 29	$8.23	$7.28	$6.58	$4.86
Jul 9	$6.96	$7.27	$6.00	$4.91
Jul 15	$7.87	$6.59	$6.12	$4.92
Jul 28	$7.28	$7.67	$6.59	$5.46
Aug 4	$8.31	$7.76	$6.42	$5.68

Table 2. Maturity, marketable yields (boxes/A), percent XL and Large, net income, and appearance ratings for bell pepper variety trial conducted in Daviess County, Kentucky, 2004. Yield and income data are means of four replications.

Variety[1]	Maturity (days)	Mkt. Yield (boxes/A[2])	% XL+ Large	Net Income[4] ($/A)	Shape Unif.[5]	Overall Appear.[6]	No. Lobes[7]
Aristotle X3R	72	1242 a	57	4,143	4	6	3
Revolution	74	1069 ab	55	3,645	4	7	3
Excursion II	73	1065 ab	54	3,637	3	7	3&4
Brigadier	71	981 ab	45	3,194	3	4	3&4
X3R Wizard	75	938 ab	49	3,102	3	4	4
Patriot	70	845 b	49	2,770	4	6	3&4
Crusader	74	818 b	46	2,747	3	6	3
Olympus	71	738 b	48	2,319	4	7	3&4

[1] Ranked by total yield.
[2] Means followed by the same letter are not significantly different as determined by LSD ($P < 0.05$).
[3] % fruit graded extra large (> 3.5 in. diameter) and large (> 3 in. diameter but < 3.5 in. diam.).
[4] Net income returned to grower from cooperative before production expenses.
[5] Average visual uniformity of fruit shape where 1 = least uniform, 5 = completely uniform.
[6] Visual fruit appearance rating where 1 = worst, 9 = best, taking into account overall attractiveness, shape, smoothness, degree of flattening, color, and shape uniformity; all fruits from two replications on July 28, by USDA vegetable inspector.
[7] 3&4 = about half and half 3- and 4-lobed; 3 = mostly 3-lobed, 4 = mostly 4-lobed.

Weed Management Systems for Organically Grown Bell Peppers

Derek Law, Mark Williams, and Brent Rowell, Department of Horticulture

Introduction

Organic agriculture continues to grow rapidly nationwide. According to the Organic Trade Association's 2004 Manufacturer Survey, total sales of organically labeled products expanded to nearly $11 billion, and the annual growth rate was a robust 20% making organically produced foods the fastest-growing segment of American agriculture. Opportunities exist in Kentucky for farmers to adopt this method of production, especially in the area of vegetable production.

Bell peppers are one of the most profitable and widely grown vegetable crops in Kentucky and are an ideal crop for farmers seeking to diversify from tobacco production, particularly for wholesale fresh vegetable sales. To encourage Kentucky farmers to consider converting to organic production, research on organic methods for bell pepper production has continued into a second year at the University of Kentucky Horticulture Farm in Lexington. While we compared the general effectiveness of various mulch materials for weed control in the first year, year two was used to study the best way of using mulches in an organic production *system* to achieve high yields.

Methods and Materials

Five different mulch treatments were applied to bell peppers grown on plastic-covered raised beds and flat ground plots in 2003. The mulches were applied at planting, and records were kept to show how long the mulches provided good weed suppression. The three best weed control treatments (straw, wood chips, and compost) were used again in 2004. None of the mulch materials were effective for the entire growing season in 2003, so we decided to include shallow cultivation in the plots for the first month and a half after planting in 2004.

Bell peppers (cv. Red Knight) were sown on 29 March and transferred to cells filled with Sunshine Organic Gro-mix on 16 April. This variety was chosen because of its high yields and resistance to bacterial leaf spot and because untreated seed was readily available. Difficulties were experienced with nutrient availability and water retention in small-celled planting trays (Styrofoam, 253 cells per tray) when fish emulsion (Maxicrop Liquid Fish Fertilizer 5-1-1) was used as the primary nitrogen source. This combination seemed to induce an impermeable layer or film on the media surface in the cells, limiting water penetration and therefore nutrient availability to the roots. Threatened with the loss of all the transplants, we applied conventional 20-10-20 soluble fertilizer twice as a rescue treatment for the seedlings. Although this is unacceptable for certified organic production, we did it to ensure that the entire experiment would not be lost. Organic pepper transplants were grown successfully in 2003 using larger cell sizes (72 cells/tray) and Omega 6-6-6 organic liquid fertilizer. Future transplant production will focus on using larger cell sizes and an organic potting media pre-amended with either compost or a balanced organic fertilizer.

In 2003, peppers were planted into a field that previously contained a winter wheat cover crop. Peppers in 2004 were planted into ground that had been cover cropped for over a year. During the preceding summer the plot had been planted with a sudex/cowpea cover that was plowed down in the fall and followed with rye and hairy vetch winter cover. This was plowed down on 23 May 2004 and was estimated to provide approximately 50 lb of N/A to the incoming pepper crop. An additional 45 lb N/A in the form of dry pelleted Nature Safe fine 10-2-8 fertilizer was applied to the plot and disked in on 7 June. An additional 30 lb N/A was fertigated in two doses at mid-season through the drip irrigation system using the liquid organic fertilizer Phytamin 7-0-0. *Trichograma ostriniae* wasps were released as a precautionary measure on 16 July and 14 August at a rate of 150,000/A as a biological control for European corn borer; no excessive insect or disease problems were observed during the growth of the crop.

Field plots were 75 ft long flat or raised beds with pepper plants spaced every 12 inches in the rows. Each combination of either raised or flat ground beds was then separated into 5 five subplots that were 12 ft long by 12 ft wide. The mulch treatments were randomly assigned to the subplots. Thus, within each main plot, each mulch treatment was applied to one raised bed section and one flat ground section. The plots were replicated four times in a split plot design with raised or flat beds as the main plots and mulch treatments as the subplots. Black plastic mulch and drip irrigation was used solely on the raised bed treatments, and the mulch treatments were placed in-between the beds. Drip irrigation was used on the flat ground treatments, and the mulch treatments were spread evenly over the entire 144 sq ft area. Prior to mulch application, three shallow cultivations were performed on the plots at approximately two-week intervals following planting.

The compost, wood chips, and straw treatments were applied on 20 July. The compost was obtained from Creech Compost Company, a local producer of bulk compost derived from used horse muck. The straw mulch was baled wheat straw obtained from a local farm supply store, while the wood chips were from materials brought to the University of Kentucky Horticulture Farm by regional tree trimming businesses. Cultivated plots were treated as all other plots prior to the application of mulch; however, following 20 July, they were cultivated five more times until final harvest on Oct 11. Control plots were cultivated as the other plots, but after 20 July, weeds were allowed to grow and compete with the crop. Wood chips and compost were applied to a depth of 3 inches, while the wheat straw was spread to a depth of 6 inches. A tensiometer was placed in one black plastic subplot and one flat ground subplot, and water was applied when necessary.

Weed density was recorded on 30 August and 8 October, using objective visual analysis and a 1 to 10 scale. A weed species list was compiled through regular observation during the growing season.

These data will be presented in subsequent reports. Peppers were harvested on 5, 16, and 30 August, 16 September, and 11 October. Fruits were graded as marketable or culls and then counted and weighed. Marketable fruits were sorted into USDA X-Large, Large, and Medium grades.

Results and Discussion

The primary purpose of this research is to develop a practical commercial organic production system for bell peppers. There are several critical components of this system. These are the use of mixed leguminous and grass cover crops as nitrogen and carbon sources, planting disease-resistant varieties, releasing biocontrol agents as part of an insect and disease management program, and using shallow rather than deep cultivation. Both flat ground and plastic-mulched raised beds are allowed and used regularly in certified organic systems; however, the effects of inclusion of different organic mulch materials into these production systems is less well known.

While the 2003 objective was to ascertain which mulches controlled weeds best, the primary objective in 2004 was to maximize yields. By combining cultivation with the most promising mulches from 2003, the major yield-limiting problem of weed competition was solved. Each of the three mulch types tested provided very good to excellent weed control from the time they were applied until final harvest two months later. Total marketable yield of the organic peppers grown on raised beds with plastic mulch and drip irrigation was comparable to the highest yielding conventionally grown varieties in a nearby variety trial conducted this year on the same farm.

Yields from plastic-covered raised beds were substantially higher than from any of the flat ground treatments. The addition of mulches between the plastic-mulched beds did not affect overall yields in these plots. Although the addition of three cultivations between the beds in the plastic-covered raised bed system reduced weed competition, it is likely that less cultivation could be used prior to applying a mulch and high yields could still be expected.

Bare ground treatments exhibited more variability among mulches with compost outperforming the others; however, none of the differences were statistically significant. Both the use of mulch and continued cultivation throughout the season produced higher total yields than the control. The treatments on bare ground may have required additional nitrogen, which could have explained the slightly higher yields from bare ground plots treated with compost mulch. The compost may have provided a small amount of additional nitrogen.

Any of the organic mulches, (compost, straw, or wood chips) could be incorporated in a large field production operation; however, given the data from last year, it is clear that post-transplanting cultivation is required to ensure good yields. While the three cultivations in this experiment resulted in good weed control for bare ground treatments, it seems likely that at least one less cultivation could have been used in between the black plastic raised beds since mulch application did not affect total yields. This combination of shallow cultivation following planting coupled with mid-season mulch application was capable of producing high yields in an organically managed system.

Table 1. Yields of organically grown peppers from 10 weed management treatments at the Horticulture Research Farm, Lexington, Kentucky, 2004. All data are means from four replications.

	Pepper Yields				Total Marketable Yield Lb/A
	X-Large & Large		Medium		
Treatments	No./Plot	Wt./Plot	No./Plot	Wt./Plot	
Bare ground					
Compost	809	333	379	97	34062
Wood chips	735	318	363	96	31375
Straw	732	304	298	78	28249
Cultivated	739	308	273	74	29278
Control	666	279	294	78	25562
Average	736	308	321	85	29705
Black plastic					
Compost	1097	449	377	102	46345
Wood chips	1079	444	303	77	42516
Straw	976	398	323	82	38511
Cultivated	1149	478	352	91	46258
Control	1021	419	313	79	40949
Average	1064	438	334	86	42916

Synergistic Sweet Corn Evaluations in Eastern Kentucky

Terry Jones and Charles T. Back, Department of Horticulture

Introduction

Sweet corn remains a very popular item at roadside markets. This research was undertaken to evaluate synergistic sweet corn varieties that might be suitable for production in eastern Kentucky.

Methods

Sixteen synergistic sweet corn cultivars were planted by hand on 9 June (early planting) and 1 July (late planting) 2004. Plots consisted of a 20 foot row of each cultivar replicated four times in a randomized block design. Rows were spaced 3 feet apart, and 100 seeds were planted for each plot of a cultivar. One day after planting, 2 pints per acre of Dual Magnum was applied preemergence to control weeds.

Soil test results (Table 1) showed that additional lime, phosphorus, and potassium were needed. Therefore 2 T lime, 50 lb N, 60 lb P_2O_5, and 250 lb K_2O (all rates per acre) were applied prior to planting. The plots were sidedressed (50 lb N) when plants were approximately 14 inches tall and again when plants were 30 inches tall. Supplemental

Table 1. 2004 Sweet corn cultivar trial soil test results.

pH	Buffer pH	P	K	Ca	Mg	Zn
6.32	6.78	65	185	3054	249	3.9

overhead irrigation was not needed. Pounce 3.2 EC was applied every five days during silking to reduce worm problems.

In evaluating and ranking cultivars, points were awarded based on plant stand, husk coverage, tip fill, commercial acceptability, yield, and disease tolerance.

Results

This was a good year to evaluate sweet corn cultivars for pollination and ear fill under extremely humid and wet weather. Cool, wet weather prevailed during most of the 2004 growing season. Quicksand was among the wettest locations in the state, having 24 inches of rain between 1 May and 31 August.

Excessive rain occurred shortly after planting, and some synergistic cultivars had poor germination and reduced stands (Tables 2 and 3). Despite wetness, the earlier sweet corn crop did very well. The early planting was harvested between 11 and 25 August. Northern and southern corn leaf blights, yellow leaf spot, and gray leaf spot were severe during late summer. The various leaf blights were so severe that it was very difficult to detect virus in the late-planted corn. It was harvested between 7 and 14 September. We were able to determine which cultivars had some disease tolerance and thus were better suited for late-season production in disease prone areas. Any sweet corn cultivar with a disease rating of 3 or above suffered significant yield and quality loss. Some synergistic sweet corn cultivars performed well in both the early and late plantings (Tables 2 and 3). However, synergistic sweet corn cultivars with improved disease resistance are needed for successful fall production in areas like eastern Kentucky. One week after the last harvest all the sweet corn stalks in the late planting were dead or dying from the leaf spots.

Argent and Sugar Ace were the two top-yielding, best quality, early-planted yellow sweet corn cultivars (Table 2). The three best-yielding late-planted yellow cultivars were Sugar Ace, Argent, and Honey Select (Table 3).

BC0805 and Providence were the best early bicolor varieties (Table 2). BC0805 was the only acceptable late-planted bicolor (Table 3). The late-planted Providence had pollination problems.

Avalon, Sweet Ice, and Sweet Satin were the three best early-planted white cultivars, giving commercially acceptable yields of attractive, high-quality ears (Table 2). The best late-planted white cultivars were Avalon and Sweet Satin (Table 3). Leaf spot diseases were severe on the late-planted Sweet Ice.

Based on total points earned from performance in the earlier and late plantings, the top five cultivars were Avalon (W), Sweet Satin, Sugar Ace, (Y), Argent, and BC0805 (BC). Sweet corn cultivar selection should take into consideration the cultivar's ability to produce over an extended planting season where weather and changes in disease pressure may drastically affect performance.

Table 2. 2004 early sweet corn plant characteristics and yield components, Robinson Station, Quicksand, Kentucky.

Cultivar Name[1]	Seed Source	Plant Stand[2]	Husk Coverage[3]	Tip Fill[4,7]	Disease Rating[5]	Commercial Acceptability[6,7]	Dozen Ears/A	Early Points[8]	Rank Based on Points
Avalon (W)	SY	90	10	9.5	1	5	1785	3428	1
Sweet Ice (W)	H	88	10	9.8	1.3	5	1755	3400	2
Argent (Y)	H	81	10	9.4	1.5	5	1634	3266	3
BC0805 (BC)	SY	81	10	9.3	1.8	5	1876	3248	4
Sweet Satin (W)	H	94	10	8.6	1.3	4	1664	3241	5
Sugar Ace (Y)	HM	91	10	9.1	1.8	3	1921	3142	6
Providence (BC)	SY	92	10	8.5	1.5	3.5	1634	3136	7
Cameo (BC)	SW	80	9.8	8.4	1	4	1830	3093	8
Sweet Symphony (W)	H	84	10	9.3	1.5	2	1664	2978	9
Serendipity (BC)	SY	81	10	8.3	2.7	4	1129	2892	10
Renaissance (BC)	HM	89	10	9.3	2.7	2	1482	2886	11
Charmed (BC)	SW	89	9	8.5	1.7	2	1210	2792	12
Sweet Riser (Y)	HM	74	10	7.5	1	2	1497	2735	13
Sweet Rhythm (BC)	HM	76	9.5	7.8	1.3	2	1739	2731	14
Honey Select (Y)	SY	76	10	8	2	1	1129	2568	15
Sweet Chorus (BC)	H	90	9	6.3	3.7	3	1392	2506	16

[1] BC = bicolor, W = White, Y = Yellow.
[2] Plant stand is percent emergence of 100 seeds.
[3] Husk coverage: 1 = poor, 10 = excellent.
[4] Number of ears out of 10 that had good tip fill.
[5] Disease rating (made at time of harvest): 0 = no disease, 1 = mild, 2 = slight-moderate (infected to just below ear level), 3 = moderate (infected above ear level), 4 = moderate-severe (infected to flag leaf), 5 = severe (plant dead).
[6] Commercial acceptability: 1 = poor, 5 = excellent.
[7] Based on 10 ears of corn.
[8] Points obtained (rank) = (10 x stand) + (100 x husk coverage) + (100 x tip fill) + (100 x commercial acceptability) + (yield/10) - (disease rating x 100).

Table 3. 2004 late sweet corn plant characteristics and yield components, Robinson Station, Quicksand, Kentucky.

Cultivar Name[1]	Seed Source	Plant Stand[2]	Husk Coverage[3]	Tip Fill[4,7]	Disease Rating[5]	Commercial Acceptability[6,7]	Dozen Ears/A	Points[8]	Rank Based on Points
Avalon (W)	SY	96	10	7.9	1.8	2.5	1755	2993	1
Sugar Ace (Y)	HM	97	10	8.3	2.8	3	1270	2945	2
Sweet Satin (W)	H	94	10	7.1	2.8	2.5	1528	2775	3
Argent (Y)	H	90	10	7.1	2.8	2.5	877	2680	4
BC0805 (BC)	SY	90	10	6.3	2.3	2.5	1089	2662	5
Honey Select (Y)	SY	90	9.8	6.3	2.8	3	953	2615	6
Providence (BC)	SY	95	10	5.8	2.8	2	1119	2564	7
Sweet Chorus (BC)	H	95	10	7.8	3.3	1	439	2544	8
Cameo (BC)	SW	85	8.8	5.8	2.3	2	1255	2403	9
Charmed (BC)	SW	93	9	7.5	3.8	1	424	2345	10
Sweet Symphony (W)	H	87	10	7.5	4.8	1	227	2265	11
Sweet Ice (W)	H	90	10	6	3.5	1	333	2281	12
Serendipity (BC)	SY	88	9.5	60	4	1	227	2153	13
Sweet Rhythm (BC)	HM	84	10	5.5	4.5	1	348	2072	14
Renaissance (BC)	HM	90	0	0	5	1	0	500	15
Sweet Riser (Y)	HM	79	0	0	4.8	1	0	415	16

[1] BC = bicolor, W = White, Y = Yellow.
[2] Plant stand is percent emergence of 100 seeds.
[3] Husk coverage: 1 = poor, 10 = excellent.
[4] Number of ears out of 10 that had good tip fill.
[5] Disease rating (made at time of harvest): 0 = no disease, 1 = mild, 2 = slight-moderate (infected to just below ear level), 3 = moderate (infected above ear level), 4 = moderate-severe (infected to flag leaf), 5 = severe (plant dead).
[6] Commercial acceptability: 1 = poor, 5 = excellent.
[7] Based on 10 ears of corn.
[8] Points obtained (rank) = (10 x stand) + (100 x husk coverage) + (100 x tip fill) + (100 x commercial acceptability) + (yield/10) - (disease rating x 100).

Effects of Blue, Green, and Black Plastic Mulches on Muskmelon Yields and Returns

Nathan N. Howell, Department of Horticulture

Introduction

Athena has been the cantaloupe variety of choice for nearly 75% of the commercial producers in the eastern U.S. and is required by most major melon brokers. However, many producers in south-central Kentucky have been unable to profitably produce Athena. This study compares the effects of blue, green, and black plastic mulches on marketable yield, pack-out percentages (large versus medium grade fruits), and cull rates of Athena cantaloupes.

This experimental field was located in Green County, Kentucky, and follows up on a preliminary study conducted in 2003 in Warren County. The 2003 report can be found on page 71 of the *2003 Fruit and Vegetable Crops Research Report,* which can be viewed at: www.uky.edu/Ag/Horticulture/comveggie.html.

Materials and Methods

Black, blue, or green plastic mulches were laid in late April; rows were layed in three blocks with each block including one bed (one row) of each mulch color. The mulch colors were arranged within each block so that each color was placed on the outside or on the center bed without repeating the arrangements of the previous blocks. The experimental plots (beds of plastic) were each 740 feet long, for a total of 2,200 linear feet of plastic for each treatment.

After the plastic was laid, annual ryegrass was sown at a rate of 60 lb/acre to provide a vegetative mulch between beds. The ryegrass was sprayed with Gramaxone Extra (2pt/A) and Curbit 3E (1qt/A) just prior to the vines running from the plastic edges, being careful to avoid spray drift.

Muskmelon transplants were grown in 48-count plug trays and were four weeks old at transplanting in mid-May. Plant spacing was 2 ft. between plants in the row, and rows were 6 ft. apart from center to center. Each mulch treatment had a total of 1,110 plants from which data were collected. Admire 2 F (20 fl oz./A) was used as a soil drench after transplanting; this provided protection for four weeks after which time Endosulfan 3 EC (1 1/3 pt/A, and Pounce 3.2 EC (8 oz/A) were alternated weekly for insect control. Chlorothalonil 6F was used as needed for disease prevention.

Preplant fertilizer was used according to soil test results provided by the University of Kentucky. In addition, 50 to 60 lb/A of calcium nitrate was fertigated weekly after vines began to run off the plastic. The crop was drip irrigated at a rate of 13,500 gallons per week, equivalent to one acre inch per week. All sprays and irrigation were stopped the day harvest began.

Harvest ran from 7-16 July. The cantaloupes were harvested by looking for the "breaker" stage, a subtle color change when the skin under the netting turns light cream, while the skin near the sutures is still greenish. The Green River Produce Marketing Cooperative mechanically sorted melons from the mulch treatments into large and medium grades. The cooperative also provided a cull count. A USDA inspector, an East Coast broker, and representative graders from the Green River Produce Marketing Cooperative sorted and graded the melons. Therefore, all melons in this trial were sorted and graded for market exactly as if they were from commercial growers' fields.

Results and Discussion

Ryegrass was effective in smothering out weed competition between beds. A high seeding rate (at least 60 lb/acre) and a second spot spray of herbicide to kill the grass will be required in most situations. Laying plastic mulch at least three weeks before transplanting is also important in order to kill, by solarization, any weeds that may germinate under the plastic mulch before holes are made for transplanting. This is critical for the green (IRT, or infrared transmitting) mulch, as it permits some light to pass through, resulting in more weed seed germination.

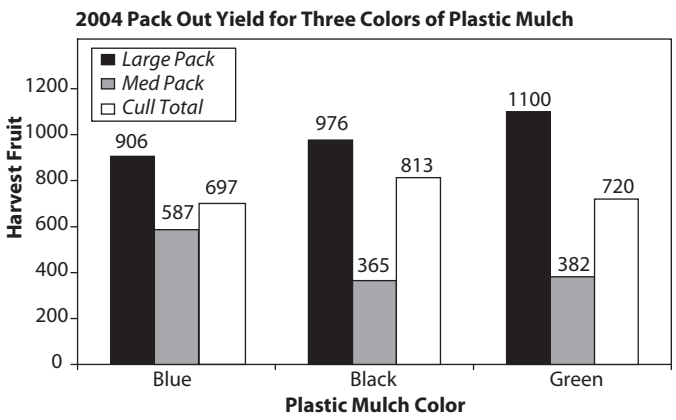
The pack-out of large, medium, and cull cantaloupes harvested from each mulch treatment is shown in Figure 1. This graph shows the total number of large, medium, and cull melons from the 1,110 plants on the 2,220 linear feet (total from three blocks) for each mulch color. The green IRT mulch produced the highest pack-out of large cantaloupe, nearly 11% more than from black mulch and 17% more than from blue mulch. Blue mulch resulted in nearly 35% more marketable medium-grade fruits than the green mulch and 38% more marketable mediums than black mulch. The black mulch resulted in 11% more cull fruit than green mulch and 14% more than blue mulch (Figure 1).

The pack-out data were used to calculate costs and returns. The co-op received on average $0.61 per large cantaloupe and $0.10 for mediums, and it charged $0.05 for handling culls. Green IRT mulch returned $673.00, black mulch returned $591.00, and blue mulch returned $576.00. Even though the blue mulch produced less culls, the number of mediums produced at $0.10/melon lowered the overall return compared to the other two mulches.

There is also a cost difference among the plastic mulches that must be considered. Blue plastic was the most expensive at $0.039 per linear foot, green mulch cost $0.035 per foot, while black plastic was the least expensive at $0.027 per foot. Since blue mulch was the most expensive and resulted in the lowest returns, it is safe to conclude that it is a poor choice for commercial cantaloupe production under these conditions in Kentucky.

Up-front costs for green mulch (2,200 linear feet) were $18.00 more than black; however, after deducting the mulch cost from the returns, the green mulch returned $64.00 more than black mulch in this trial. Although up-front costs are higher, these data indicate an opportunity for higher profits using green plastic mulch. Growers interested in looking at green mulch should do comparisons on a small scale under their own farm conditions before choosing green plastic mulch.

Figure 1. Number of marketable and cull melons from three plastic mulch treatments in south-central Kentucky, 2004. Data are totals from three replications (2,220 linear ft per treatment).



Harvest patterns for the number of large, medium, and cull cantaloupes from each mulch treatment were also documented. The number of large cantaloupes (Figure 2) show a typical harvest pattern. The majority of fruit was harvested the first week followed by a decline and leveling out of numbers harvested daily during the second week. The harvest patterns for all mulch colors were similar except for an unexplained increase from green mulch at the third harvest (Figure 2). Such a spike in melons would significantly increase labor demands for producers during this time. Figure 3 depicts daily harvest patterns for medium cantaloupes from different mulch treatments. Harvest patterns were similar except for a large unexplained increase during one late-season harvest from blue mulch.

Figure 4 illustrates a typical pattern for the occurrence of culls in commercial cantaloupe production: there was a steady increase in cull rate as the season progressed from all mulch colors. This is due to the fruit quality decreasing as the harvest progresses. The last harvest has the largest number of culls due to a harvesting of all remaining fruit.

Figure 2. Daily large melon harvest from three mulch treatments in south-central Kentucky, 2004. Data are totals from three replications (2,220 linear ft).

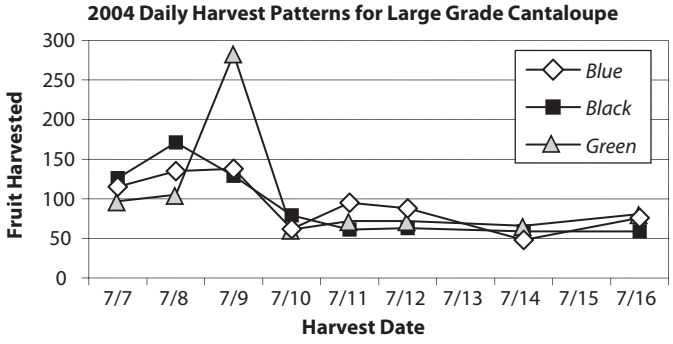


Figure 3. Daily medium melon harvest from three mulch treatments in south-central Kentucky, 2004. Data are totals from three replications (2,220 linear ft).

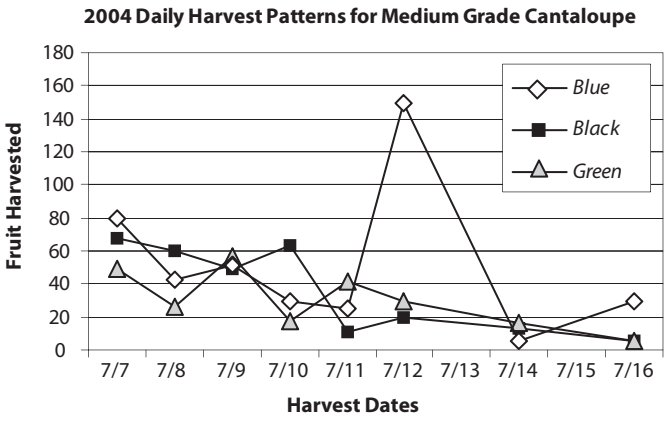
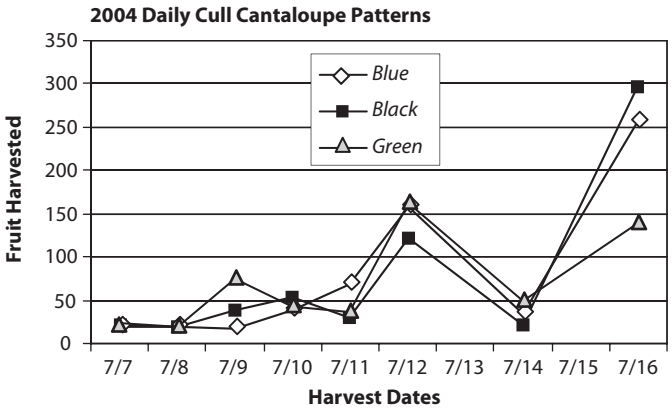


Figure 4. Daily cull melon harvest from three mulch treatments in south-central Kentucky, 2004. Data are totals from three replications (2,220 linear ft).



Specialty Melon Variety Evaluation

John Strang, April Satanek, John Snyder, and Chris Smigell, Department of Horticulture

Introduction

Nineteen specialty melon varieties were evaluated in this trial, for their performance under Kentucky conditions. These included honeydew, canary, galia, ananas, charentais, Piel de Sapo, and Asian types of melons.

Materials and Methods

Most varieties were seeded on 26 April into cell packs (72 cells per tray) at the Horticulture Research Farm in Lexington. Vicar, Galileo, and Orange Blossom were seeded on 24 May. Cell packs were set on a mist bench with bottom heat until seeds germinated, then moved to a drier, cooler bench in the greenhouse, where the seedlings were thinned to one per cell. Plants were set into black plastic-mulched, raised beds using a waterwheel setter on 24 May, and the three later-planted varieties were set in the field on 10 June. Each plot was 21 feet long, with seven plants set 3 feet apart within the row and 6 feet between rows. Each plot was replicated four times in a randomized complete block design with 9 feet between replications. Drip irrigation was used to provide water and fertilizer as needed.

Seventy pounds N/A from ammonium nitrate and 42 lb K from potassium chloride were applied and incorporated into the field prior to bed shaping and planting. The plot was fertigated with a total of 57 lbs N/A from ammonium nitrate divided into six applications over the season. The systemic insecticide Platinum 2 SC was applied with a hand sprayer as a drench to the base of each plant after planting, using the maximum rate of 8 fl oz/A. Foliar insecticide applications included Sevin, Pounce, and Asana. Weekly foliar fungicide applications included Bravo, fixed copper, Cabrio, and Quadris. Curbit preemergent herbicide was applied and incorporated between the rows just as the vines began to grow off the plastic mulch. One fruit from each replication was measured and evaluated for flavor, soluble solids, interior color, rind color, and net type.

Results

The growing season was cool with many rainy periods, resulting in intense disease pressure. Very little virus was observed. Early in the season, some plants showed slight glyphosate damage, most likely due to dripping following wick application along the plastic mulch edges, but the vines grew out of the symptoms. Vine cover was thick, with little plant death in the first three replications. The fourth replication was in a poorly drained area, resulting in significant plant losses. This replication was removed from the statistical analysis. Magnesium deficiency became apparent on most of the galia melon plants later in the season.

Fruit were generally harvested twice a week. Despite the rain, melon sugar contents were high, probably due to the cool weather. Harvest and evaluation data are in Tables 1 and 2. Most melon varieties performed well because they had been tested previously and selected as top varieties.

Honeydew. Honey Orange and Honey Pearl were the top-performing varieties of the three honeydews tested. When comparing the two orange-fleshed honeydews, Honey Orange yielded better than Orange Blossom and had a higher flavor rating, although it had a few more culls. Honey Pearl is an excellent smaller honeydew with a cream or white flesh. Honeydews are harvested when the skin exhibits a cream blush and the ground spot is a cream color.

Canary. In the larger size category, Golden Beauty again performed exceptionally well, producing high yields of high-quality, attractive melons with no culls. In the smaller size category, Sugar Nut was the top performer because of its quality and yield. Amy,

an All-American Selections winner with a rounder shape than HMX 1602, also performed very well. Generally, canary melons have very low cull numbers and are harvested when they develop a golden yellow skin.

Galia. Vicar and Galileo were the best galia melons based on quality, yield, low cull numbers, and ease of harvest. Both varieties have a longer ideal harvest period than most of the other varieties, and catalogues advertise these two as having a longer storage life. Galileo had a slightly stronger but pleasant musk flavor. Crème de la Crème is a very high quality melon, but it is very difficult to harvest at the right stage of development because it matures so rapidly. Arava and HSR 4238 also performed very well. They had a few more culls than the other varieties and HSR 4238 showed some cracking, but it was rated as the best-tasting variety in these trials. Galia melons are harvested when the skin shows the first signs of yellowing.

Ananas. All three of the ananas selections (HSR 4238, HSR 4220, and HSR 2528) performed well. Quality was very good, but yields trended lower this year for HSR 4220 and HSR 2528 than in 2003. Both of these varieties yielded at least 21,000 lb/acre more in 2003. Like galia melons, ananas melons have a short period to harvest at the correct stage of maturity and a fairly short storage life. Ananas melons are harvested when skin shows the first signs of yellowing.

Piel de Sapo. Sancho is a very large melon with an excellent taste that seemed to appeal to just about everyone who tasted it. The fruit has a dark green exterior, which is very attractive. There was very little rind cracking this season in comparison to 2003. Sancho is harvested when the ground spot turns dark yellow and the skin shows considerable longitudinal checking.

Asian. Sprite performed exceptionally well. Yields were high, melons were of very high quality, and there were few culls. The flesh is crisp, white, and crunchy, and the melon is small. Sprite produced the largest number of fruit per acre of the varieties evaluated (42,400 fruit/acre). Harvest when the blossom end on some melons shows slight concentric russet marks and when the rind develops a yellowish tinge.

Charentais type. Serenade is the variety that has quality closest to that of any charentais melons that we have been able to grow without excessive fruit splitting. Serenade was outstanding in taste and had the highest sugar content of all the varieties in this trial. Yields were relatively low and 8.3% of the fruit were culled due to splitting. Harvest when the ground spot is light orange and yellowish-green spots begin to develop on the skin.

Acknowledgment

The authors would like to thank the following for their hard work and assistance in the successful completion of this trial: Todor Angelov, Daniel Bastin, Larry Blandford, Eric Bowman, David Bundrick, Jinsong Chen, Annie Coleman, Monica Combs, Martin Crowley, Chris Fuehr, Curtis Gregory, Courtney Hart, Chelsea Kear, Kevin King, Yanin Laisupanwong (Nan), Dave Lowry, Anurak Pokpingmuang (Net), Scott Pfeiffer, Kevin Taylor, Bonka Vaneva, Wei Wen, and Alicia Wingate.

Table 1. Specialty melon yield and fruit characteristics, Lexington, Kentucky, 2004.

Variety	Melon Type[1]	Seed Source	Days to Harvest	Yield (cwt/A)[2]	Avg. No. Melons/A	Avg Wt./ Fruit (lb)	Culls (%)	Outside Measurements Length (in.)	Width (in.)	Flesh Thickness (in.)	Seed Cavity Length (in.)	Seed Cavity Width (in.)
Honey Orange	HD	JS	80	695 ab	13944	5.0	4	7.5	6.7	4.6	5.0	3.4
Honey Pearl	HD	JS	80	532 abcd	12330	4.3	3	7.8	6.5	1.6	5.1	3.3
Orange Blossom	HD	HR	82	449 dc	11178	4.0	0	7.3	5.9	1.8	4.6	2.4
Sugar Nut	CA	JS	77	627 abc	19245	3.3	1	6.3	5.4	1.6	3.7	2.1
Amy	CA	HR	70	615 abc	14520	4.2	2	7.3	6.3	1.7	5.4	2.9
Golden Beauty	CA	JS	80	574 abcd	8412	6.8	0	11.0	7.0	1.7	8.0	3.8
HMX 1602	CA	HM	82	424 cd	8873	4.8	3	9.2	6.5	1.7	6.5	2.9
SMX 7057	CA	SW	82	387 d	5416	7.1	10	8.7	6.3	1.6	5.8	3.2
Vicar	GA	SY	86	613 abc	15442	4.0	1	5.8	6.2	1.9	3.4	2.5
Galileo	GA	SY	86	563 abcd	14981	3.6	0	5.7	6.0	1.6	3.3	2.9
Crème de la Crème	GA	BU	75	517 bcd	12791	4.1	9	6.8	6.3	1.7	4.0	2.8
Arava	GA	JS	77	514 bcd	10717	4.8	5	6.6	6.5	1.8	4.1	3.1
HSR 4238	GA	HL	75	490 bcd	11524	4.3	9	7.5	6.2	2.0	4.7	2.4
HSR 4220	AN	HL	100	510 bcd	7721	6.6	0	8.1	6.5	1.7	4.9	3.0
HSR 4208	AN	HL	100	441 cd	7721	5.7	0	8.8	6.6	1.5	6.2	3.3
HSR 2528	AN	HL	95	366 d	6914	5.4	2	7.8	5.6	1.5	5.1	2.9
Sancho	PD	SY/SW	90	740 a	8412	8.8	0	12.0	7.0	1.9	8.5	3.2
Sprite	AS	CF	90	561 abcd	42408	1.3	1	4.9	4.1	0.9	3.3	2.2
Serenade	CH	JS	78	378 d	22587	1.7	8	4.5	4.7	1.3	2.6	2.0

[1] Melon type: HD = honeydew, CA = canary, GA = galia, AN = ananas, PD = Piel de Sapo, AS = Asian melon, CH = charentais type.
[2] Numbers followed by the same letter are not significantly different (Waller-Duncan LSD P = 0.05). Cwt/A = hundred weights (100 lb units) per acre.

Table 2. Specialty melon fruit characteristics, Lexington, Kentucky, 2004.

Variety	Flavor (1-5)[1]	Sugar (%)	Interior Color[2]	Rind Color[3]	Fruit Shape	Cracking (1-4)[4]	Net Type[5]	Comments
Honey Orange	4.6	13.4	or	cr	oval	1.0	none	Excellent taste, attractive smooth skin and flesh, develops light orange ground spot when ripe
Honey Pearl	3.9	12.4	wh	cr	oval	1.0	none	Small brown spots at harvest sometimes
Orange Blossom	4.0	13.0	dk or	cr	oval	1.0	none	Develops light orange ground spot when ripe
Sugar Nut	4.4	15.0	cr to lt gr	gd	oval	1.0	none	Very sweet, some longitudinal checking when ripe
Amy	4.2	14.1	cr	gd	oval	1.0	none	Attractive, some checking when ripe
Golden Beauty	4.2	13.4	cr to lt gr	gd	almond	1.0	none	Largest canary in trial, attractive exterior and interior.
HMX 1602	4.3	14.4	cr to lt gr	gd	almond	1.0	none	Attractive, harvest when golden yellow
SMX 7057	4.0	14.1	cr to lt gr	gd	almond	1.0	none	Attractive, harvest when golden yellow
Vicar	4.5	14.4	lt. gr	yl/gr	round	1.0	med	Dense fruit, good taste, soft flesh harvest at first sign of yellow, longer period for optimum harvest
Galileo	4.2	14.1	lt gr	yl/gr	round	1.0	med	Dense, squat fruit, good taste, harvest at first sign of yellow, longer period for optimum harvest
Crème de la Crème	4.3	12.6	cr to lt or	yl/gr	round	1.0	med	Excellent flavor, harvest at first sign of yellow, difficult to harvest at correct maturity
Arava	4.3	11.4	cr to lt gr	yl/gr	oval	1.0	med	Large fruit, harvest at first sign of yellow
HSR 4238	4.9	12.4	lt gr	yl/gr	oblong	1.3	med	Harvest when light green, ripens quickly
HSR 4220	4.1	11.9	cr	yl/gr	oval	1.0	med	Harvest at first sign of yellow, ripens quickly
HSR 4208	4.3	11.6	cr to lt gr	cr	oblong	1.0	lt	Harvest at first sign of yellow, ripens quickly
HSR 2528	4.4	10.9	cr to or	yl/gr	oblong	1.2	lt	Excellent taste, harvest at first sign of yellow
Sancho	4.4	12.6	wh	lt gr w/ dk gre	almond	1.0	none	Excellent flavor, harvest when ground spot is dark yellow, some longitudinal checking when ripe
Sprite	4.1	15.1	wh	wh	oval	1.0	none	Good taste, harvest when rind gets yellowish tinge
Serenade	4.5	16.8	or	cr	round	1.6	none	Good taste, harvest when rind ground spot is light orange and yellowish-green spots develop

[1] Flavor: 1 = poor, 5 = excellent, sweet taste, pleasant texture.
[2] Interior color: lo = light orange, cr = cream, lg = light green, wh = white.
[3] Rind color: lg = light green, gr = green, dg = dark green, yl = yellow, dy = dark yellow, tn = tan.
[4] Cracking: 1= little or no cracking, 4 = severe cracking & fruit splitting.
[5] Net type: lt = light netting, md = medium netting, na = none

Specialty Melon Variety Observation Trial

John Strang, April Satanek, John Snyder, and Chris Smigell, Department of Horticulture

Introduction

This trial was designed to screen 18 specialty melon varieties under Kentucky growing conditions. Asian, galia, muskmelon, canary, gourmet, and heirloom melons were evaluated in this trial.

Materials and Methods

All varieties were seeded on 26 April into cell packs (72 cells per tray) at the Horticulture Research Farm in Lexington. Cell packs were set on a mist bench with bottom heat until seeds germinated, then moved to a drier, cooler bench in the greenhouse, where the seedlings were thinned to one per cell. Plants were set into black plastic-mulched, raised beds using a waterwheel setter on 24 May. A single plot of each variety was planted. Each was 36 feet long, with 12 plants set 3 feet apart within the row and 6 feet between rows. Drip irrigation provided water and fertilizer as needed.

Seventy pounds N/A as ammonium nitrate and 42 lb K as potassium chloride were applied and incorporated into the field prior to bed shaping and planting. The plot was fertigated with a total of 57 lb N/A as ammonium nitrate divided into six applications. The systemic insecticide Platinum 2 SC was applied with a hand sprayer as a drench to the base of each plant after planting, using the maximum rate of 8 fl oz/A. Foliar insecticide applications during the season included Sevin, Pounce, and Asana. Weekly foliar fungicide applications included applications of Bravo, fixed copper, Cabrio, and Quadris. Curbit preemergent herbicide was applied and incorporated between the rows, just as the vines began to grow off the plastic mulch. Glyphosate was used to control weeds along the plastic edge early in the season. Two average-sized fruit of each variety were measured and evaluated for flavor, soluble solids, interior color, and rind color as each variety reached maturity.

Results and Discussion

The growing season was cool, with many rainy periods, providing intense disease pressure. Early in the season some plants showed slight glyphosate damage, most likely due to dripping following wick application along the plastic mulch edges, but the vines grew out of the symptoms. Very little virus was observed.

Vine cover was thick, with little plant death. Fruit were generally harvested twice a week. Despite the rain, melon sugar contents were high, probably due to the cool weather. Variety evaluation results can be found in Tables 1 and 2.

Asian melons. Sunrise, Napoli, and Golden Liner were the best Asian melons. Napoli and Sunrise both looked like small, heavily netted muskmelons. Neither tasted like a muskmelon, and both had outstanding eating quality. The flesh of Napoli was a cream to light green, while Sunrise had an orange flesh. Both melons should be harvested at first slip and ripened slowly, providing a fairly long harvest window. Golden Liner was judged to have the best quality of the elongated yellow, thin, crisp-fleshed Asian melons (others being Korean Star, Golden King, and Golden Sweet). Many of these had high sugar contents but did not taste that sweet. Jade King had a squat rounded shape and a distinct taste. Hami Sweet was a large melon that yielded well and tasted good, but the coarse textured flesh reduced its desirability.

Galia melons. HSR 4278 was judged to be the best galia melon of the four evaluated because of its flavor and yield. Galia melons must be harvested as soon as the rind starts to turn yellow. Otherwise, the melons rapidly become overripe and unmarketable. Galia melons do not have a long shelf life.

Muskmelons. HSR 4121 was the best of the three traditional varieties evaluated in terms of eating quality, while HSR 4227 yielded a little better. Both of these muskmelons needed to be harvested at first slip because eating quality severely deteriorated by full slip. Jenny Lind, an heirloom muskmelon with direct market potential, has a round shape, coarse heavy netting, and excellent quality. All of these varieties had very low cull numbers.

Canary. Dorado was the one canary melon evaluated in this trial, used as a standard. Dorado performed exceptionally well, as expected, yielding many quality melons with no culls. This variety was very attractive.

Gourmet. Sensation was an exceptional melon. It had an excellent flavor, looked good, yielded well, and had a slightly firmer flesh than the ananas melons. Sensation should be harvested when it just begins turning yellow. It is worthy of further trials.

Acknowledgments

The authors would like to thank the following for their hard work and assistance in the successful completion of this trial: Todor Angelov, Daniel Bastin, Larry Blandford, Eric Bowman, David Bundrick, Jinsong Chen, Annie Coleman, Monica Combs, Martin Crowley, Chris Fuehr, Curtis Gregory, Courtney Hart, Chelsea Kear, Kevin King, Yanin Laisupanwong (Nan), Dave Lowry, Anurak Pokpingmuang (Net), Scott Pfeiffer, Kevin Taylor, Bonka Vaneva, Wei Wen, and Alicia Wingate.

Table 1. Specialty melon fruit characteristics from single plots, Lexington, Kentucky, 2004.

								Exterior Fruit			Seed Cavity	
Variety	Melon Type[1]	Seed Source	Days to Harvest	Yield (cwt/A)[2]	Avg. No. Melons/A	Avg. Wt./ Fruit (lb)	Culls (%)	Length (in.)	Width (in.)	Flesh Thickness (in.)	Length (in.)	Width (in.)
Sunrise	AS	EG	72	731	22897	3.2	1	6	5.7	1.6	3.9	2.7
Hami Sweet	AS	EG	85	723	13589	5.3	0	9.3	6.8	1.7	6.5	2.8
Korean Star	AS	EG	60	470	26992	1.7	7	6.4	3.8	0.9	4.7	2.5
Napoli	AS	EG	72	455	18615	2.4	2	4.5	4.5	1.4	2.6	2.1
Golden King	AS	EG	60	371	27364	1.4	9	6.5	3.6	0.8	5	2
Golden Liner	AS	EG	65	359	22525	1.6	17	6.8	3.7	0.9	5.3	2
Golden Sweet	AS	EG	40	293	27923	1.1	6	5.4	3.9	0.8	4	2.9
Jade King	AS	EG	70	227	21594	1	13	3.9	4.2	0.8	2.7	2.7
HSR 4090	GA	HL	75	722	9680	7.5	0	9.6	7.6	2.3	6.2	3
HSR 4278	GA	HL	75	647	13403	4.8	5	7.4	6.4	2	4.1	2.4
Passport	GA	HL	75	604	9494	6.4	7	6.9	7	2.1	3.7	3
HSR 4261	GA	HL	80	190	6702	2.8	0	5.2	5.3	1.6	3.1	2.1
HSR 4227	MM	HL	88	749	10052	7.5	4	8.1	6.4	1.9	5.3	2.6
HSR 4121	MM	HL	81	620	15078	4.1	0	6.5	6.2	1.6	4.1	2.9
Jenny Lind	MM	PT	70	515	24386	2.1	2	6.4	5.6	1.4	4.2	2.9
HSR 4222	MM	HL	88	203	4095	5	0	8.1	6	1.8	5	2.5
Dorado	CA	HR	85	554	9308	6	0	9	6.7	2	5.9	2.8
Sensation	GO	HL	80	529	9866	5.4	2	6.7	6.4	1.7	3.7	2.9

[1] Melon type: AS = Asian melon, GA = galia, MM = muskmelon, CA = canary, GO = gourmet.
[2] cwt/A = hundred weight per acre.

Table 2. Specialty melon fruit and vine characteristics from single plots, Lexington, Kentucky, 2004.

Variety	Flavor[1] (1-5)	Sugar (%)	Interior Color[2]	Rind Color[3]	Fruit Shape	Cracking[4] (1-4)	Net Type[5]	Comments
Sunrise	4.8	12.5	or	cr	round	1	hv	Excellent flavor, ripens slowly, harvest at first slip
Hami Sweet	4.2	12.9	lt or	cr/gr	oblong	1.3	lt	Very crisp, coarse, watermelon-like flesh texture, harvest when fruit rind begins developing a cream color
Korean Star	2.8	12.8	wh	gd w/sutures	oblong	1.3	none	Attractive, uniform fruit, harvest when golden yellow
Napoli	5	14.8	cr/lt gr	cr	round	1	hv	Excellent flavor, ripens slowly, harvest before full slip
Golden King	3	12.1	wh	gd	oval	1	none	Crisp flesh, harvest when golden yellow
Golden Liner	3.5	14.5	wh	gd w/sutures	oblong	1	none	Good taste, crisp flesh, harvest when golden yellow
Golden Sweet	2.5	14	wh	gd	oval	1.5	none	Variable shape, harvest when golden yellow
Jade King	3.5	13.5	lt gr	yl/gr	round	1	none	Distinct taste
HSR 4090	3	12.3	lt gr	lt gr/cr	oval	1	med	Firm flesh, distinct taste, harvest when just turning yellow
HSR 4278	4.5	13.9	wh/lt gr	yl/gr	oval	1	med	Harvest when just turning yellow
Passport	2.8	10.7	cr/lt gr	yl/lt gr	oval	1	med	Harvest when just turning yellow.
HSR 4261	1.5	12	lt gr	cr/gr	round	1	lt	Small fruit, lush vine
HSR 4227	3.6	11.5	or	cr w/sutures	oval	1	hv	Attractive firm flesh, excellent flesh color, harvest at half slip
HSR 4121	4	9.8	dk or	cr	round	1	med	Musky taste, harvest at half slip
Jenny Lind	4.3	13.1	or/gr	cr	round	1	hv	Prolific, harvest at slip
HSR 4222	2.5	12	or	cr	oval	1	med	Harvest at half slip
Dorado	4.5	13.1	cr/lt gr	gd	almond	1	none	Harvest when golden yellow
Sensation	4.5	11.8	wh	lt yl	round	1	med	Excellent taste, attractive, harvest when just turning yellow

[1] Flavor: 1 = poor, 5 = excellent, sweet taste, pleasant texture.
[2] Interior color: lt = light, gr = green, cr = cream, or = orange, dk = dark, wh = white.
[3] Rind color: yl = yellow, gd = golden, gr = green, or = orange, cr = cream, lt = light, med = medium, dk = dark.
[4] Cracking: l = little or no cracking, 4 = severe cracking and fruit splitting.
[5] Net type: lt = light netting, med = medium netting, hv = heavy raised netting, none = no netting.

Triploid Mini-Watermelon Variety Trial

John Strang, April Satanek, John Snyder, Courtney Hart, and Chris Smigell, Department of Horticulture

Introduction

Considerable interest has recently been shown in triploid seedless mini-watermelons, or palm melons. Eight mini-watermelons were evaluated for performance under Kentucky conditions.

Materials and Methods

All varieties were sown in cell packs (72 cells/tray) on 28 April. Trays were placed on a bench with bottom heat in a warm greenhouse. The seedlings were counted to obtain a germination percentage. The seedlings were then thinned to one per cell, and the trays moved to a slightly cooler house. On 8 June, the plants were set into raised, plastic-mulched beds using a waterwheel setter. Each plot was 20 feet long, containing nine plants, with 2.5 feet between plants within the row and 3.75 feet between plots. Between-row spacing was 6 feet, providing 15 sq ft per plant. Each plot was replicated four times in a randomized complete block design. Drip irrigation was used to irrigate and fertigate as needed.

Sixty-eight pounds N/A as ammonium nitrate was applied preplant. A total of 61 lb N/A as ammonium nitrate was fertigated over nine applications throughout the season. A systemic insecticide, Platinum 2 SC, was applied with a hand sprayer as a drench to the base of each plant soon after planting, at the high rate of 7 fl oz/A. The foliar insecticides Sevin, Capture, Pounce, and Asana were also used. Foliar fungicide sprays included fixed copper, Quadris, Cabrio, and Bravo. The preemergent herbicide Curbit was applied between rows before vine coverage. One fruit from each replication was measured and evaluated for soluble solids, flavor, hollowheart, average seed number per fruit, and interior color.

Results and Discussion

Researchers are still trying to determine the best plant spacing for mini-watermelons to obtain small fruit size. Last season's melons were planted using 20 sq ft per plant, and most of the watermelons were too large to be considered mini-watermelons. This season a density of 15 sq ft per plant was used with better success. In commercial triploid watermelon production pollination is assured by planting pollinator plants within the rows, often between every third and fourth mini-watermelon plant. Pollinator plants do not produce edible fruit. We were unable to obtain pollinator plant seeds, so conventional, seeded watermelons were

Table 1. Seedless mini-watermelon variety trial yield and fruit characteristics, Lexington, Kentucky, 2004.

Cultivar	Seed Source[1]	Germ. Rate (%)	Melon Shape	Days to Harvest	Yield (cwt/A)[2]	Avg. No. Mkt. Fruit/A	Avg. Wt/Fruit (lb)	Outside Measurements Length (in.)	Outside Measurements Width (in.)
Vanessa	SS	93	round	85	1013 a	13552	7.5	7.8	7.7
Solitaire	SW	63	round	85	1010 a	12342	8.2	7.8	7.7
Valdora	SS	83	round	85	931 a	10406	9	7.9	7.6
Mohican	SO	65	round	85	928 a	11132	8.4	8.2	8
HA 5109	SI, HZ	68	round	85	831 a	10164	8.2	8.1	7.9
Black Box	SS	83	round	82	819 a	11455	7.1	7.5	7.3
RWT 8149	SY	19	round	80	697 a	10540	6.7	7.9	7.4
SR 8101 WM[3]	SS	13	round	83	831	12906	6.4	7.4	7.6

[1] See Appendix A for seed company addresses.
[2] Numbers followed by the same letter are not significantly different (Waller-Duncan LSD P = 0.05).
[3] Statistics were not calculated for SR 8191 WM because there were only enough plants for one replication, but data are included.

Table 2. Seedless mini-watermelon variety trial fruit characteristics, Lexington, Kentucky, 2004.

Variety	Soluble Solids (%)	Flavor (1-5)[1]	Hollow-heart (1-2)[2]	Interior Color[3]	Avg. Seed No./fruit	Rind Thickness (in.)	Rind Toughness (1-5)[4]	Rind Type[5]	Comments
Vanessa	11.8	4.1	2	dk pnk	1	0.6	3.6	BK	Dark seed traces
Solitaire	10.7	4.4	2	pnk	5	0.6	4.5	RS	Very firm flesh, attractive rind
Valdora	11.4	4.5	2	dk pnk	3	0.6	3	BK	Medium tender flesh, very small seeds
Mohican	11.4	4.4	1.8	dk pnk	5	0.8	4.3	AS	Slightly chewy flesh, attractive
HA 5109	11.5	4.4	2	red	2	0.7	4.8	BK	Firm, attractive flesh
Black Box	10.3	3.8	2	dk pnk	0	0.5	3.5	BK	Dark seed traces, slightly firm flesh, has Sugar-Baby taste
RWT 8149	11.9	4.5	1.9	dk pnk	1	0.3	1	BK	Very thin rind, tender flesh
SR 8101WM	12	4.2	2	pnk	2	0.6	2.3	JU	Attractive rind, firm flesh

[1] Flavor rating: 1 = poor, 5 = excellent.
[2] Hollow heart rating: 1 = hollow heart, 2 = no hollow heart.
[3] Interior color: dk = dark, pnk = pink.
[4] Rind toughness: 1 = tender, 5 = very tough.
[5] Rind type: JU = Jubilee, light green rind w/distinct, narrow, dark green stripes; BK = Black, solid dark green rind, RS = Royal Sweet, light green rind with wide, mottled, dark green stripes; AS = Allsweet, medium green rind with dark green, broad mottled stripes.

used for pollination. These were planted in solid rows on the plot borders and through the center of the plot, leaving two rows of mini-watermelons between rows of seeded watermelon plants. Most Kentucky growers have a market for seeded watermelons, and this pollination scheme is often preferred.

Overall, watermelon quality was very good. However, the first harvest followed a rainy period, and fruit flavor and sugar contents were reduced. Consequently, flavor was evaluated only in subsequent harvests. All varieties had relatively few seeds per fruit. Due to poor germination, there were only enough plants of SR 8101WM for one replication, so this variety was not included in the statistical analysis, but data are included in tables.

There were no statistical differences in total yield or number of marketable fruit per acre between any of the varieties (Table 1). Mini-watermelon fruit characteristics may be found in Table 2. Melon flavor was very good for all varieties. Some varieties had extremely tough rinds. There was little or no hollow heart in any variety.

The best-performing mini-watermelons were RWT 8149, Solitaire, and Mohican. RWT 8149 had the largest percentage of fruit in the 8 lb or less category (82.3%) (Table 3). Melon flavor was excellent, the flesh was tender, and RWT 8149 had a very thin solid black or dark green rind. It has become apparent that consumers prefer melons with a striped rind over those with a dark green or black rind. Consequently, RWT 8149, with its solid dark green rind, may not be the best marketing choice, particularly if it will

Table 3. Fruit size class evaluation by fruit number.

Variety	% < 6 lbs[2]	% 6-8 lbs[2]	% ≤ 8 lbs[2]	% > 8 lbs[2]
RWT 8149	33 a	50 a	82 a	18 c
Black Box	31 a	38 ab	70 ab	30 bc
HA 5109	16 a	36 abc	52 bc	48 ab
Solitare	17 a	36 abc	53 bc	47 ab
Mohican	16 a	34 abc	50 bc	50 ab
Vanessa	24 a	33 bc	57 bc	43 ab
Valdora	18 a	22 c	40 c	60 a
SR 8101 WM[1]	43	37	80	20

[1] Statistics were not done on this variety because there were only enough plants for one replication.
[2] Numbers followed by the same letter are not significantly different (Waller-Duncan LSD P = 0.05).

be shipped or handled excessively, which would damage its thin rind. Solitaire has a Royal Sweet rind type, while Mohican has an Allsweet rind type. Both varieties have very attractive tough rinds and excellent flavor and are very close in the percentage of fruit produced in the 8 lb or less category, 53 and 50% respectively.

Additional work is required with these melons to increase the proportion of smaller melons by increasing plant density. Solitaire has a very firm flesh, which may enhance its shipping durability and storage life. The one replication of the SR 8101 WM variety looked good and needs further evaluation. This variety had an attractive Jubilee type rind and firm flesh; 80% of the melons were in the less than or equal to 8 lb category, and both rind thickness and toughness were greater than that of RWT 8149.

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Squash Bug Control and Its Impact on Cucurbit Yellow Vine Decline in Acorn Squash

Ric Bessin, Department of Entomology, and Brent Rowell, Department of Horticulture

Introduction

The squash bug (*Anasa tristis)* can cause serious losses in summer squash, winter squash, and pumpkins in Kentucky. While all of the melon and squash crops can be attacked, the pest prefers squash and pumpkins. This insect can be very difficult to control when populations are allowed to build during the summer. Squash bugs damage plants by removing sap and causing leaves to wilt and collapse; young plants and infested leaves on older plants may be killed directly. Typically, squash bugs begin to colonize fields about the time the plants begin to run. Soon after beginning to feed, they start to lay eggs, primarily on the undersides of leaves in the angle between veins. The bronze eggs are football-shaped and lie on their sides in groups of 12 or more. Eggs hatch in one to two weeks. At first the nymphs are green with black legs while older nymphs are light gray in color.

During the past decade, a disease causing yellowing and sudden decline of cucurbit vines (called cucurbit yellow vine decline) has been identified mainly in the south-central states. Recently, cucurbit yellow vine decline (CYVD) was confirmed from several locations in Kentucky on squash, pumpkin, watermelon, and muskmelon. It is important to appreciate that this is a newly diagnosed disease in Kentucky, rather than a new disease. It is now known that the causal agent is a phloem-limited bacterium, *Serratia marcescens*, and it appears to survive in, and be transferred to, cucurbit plants by the squash bug.

Symptoms of CYVD vary depending on plant species involved, age of plant at the time of infection, and other factors. Some plants show considerable stunting and yellowing (probably those infected early), while young, fast-growing plants (that probably became infected later) may suddenly collapse with or without yellowing. Other plants (apparently infected later) develop striking yellow vines and decline slowly as the fruit approach maturity.

A study was conducted at the University of Kentucky Horticultural Research Farm in Lexington during the summer of 2004 to evaluate the effectiveness of three control methods for squash bug on acorn squash and to measure the impact of these controls on the incidence of cucurbit yellow vine decline.

Materials and Methods

Four-week-old 'Table Ace' acorn squash plants were transplanted into raised black plastic mulched beds with trickle irrigation on June 9 using a waterwheel setter. Plants were spaced 18 inches apart in single rows; beds were 6 feet from center to center. Each experimental plot consisted of one row of 24 squash plants.

The labeled, commercially available squash bug treatments examined were an untreated control, Admire 2F applied as a post-transplant drench at 16 or 24 fl oz/acre, and Platinum 2 SC applied as a post-transplant drench at 5 or 8 fl oz/acre. The Admire and Platinum treatments were applied directly to the soil at the base of the plants in one-third ounce of water on June 11, two days after transplanting. The post-transplant drench method was used to minimize worker exposure to insecticide residues while trying to maximize rapid uptake of the insecticide for squash bug and cucumber beetle control. *The Admire and Platinum were intentionally not mixed with the transplant water because this type of application is prohibited and will increase worker exposure.*

Squash bug and cucumber beetle numbers were monitored on three dates on five plants in each plot. Plants within the plots were examined on four dates for the occurrence of symptoms of cucurbit yellow vine decline (yellowing, wilting, and plant loss) until harvest. Data were subjected to analysis of variance, and means were compared using least significant difference mean separation.

Results and Discussion

Although squash bug numbers were low, they moved into the plots quickly and were observed in the untreated plots on the first sampling date, June 21 (Table 1). Squash bugs increased during the sampling dates, with the greatest number observed on July 6. Because numbers were low, no significant population differences were observed among treatments. During the second sampling date, more cucumber beetles (both striped and spotted) were found in untreated plots than in any of the insecticide-treated plots.

On the first sampling date for symptoms of yellow vine decline, only the Admire treatments and the low rate of Platinum showed significantly reduced numbers of plants with symptoms as compared to the untreated control (Table 2). By the second sampling date four days later and on the third and fourth disease sampling dates, only the Admire-treated plots had significantly fewer plants with disease symptoms. To ensure that we were correctly identifying plants with symptoms of yellow vine decline, five suspected plants from border rows were tested in the lab using PCR on July 30. All of the suspected plants tested positive for the bacteria that causes the disease.

Yields and number of fruit harvested per plot were significantly higher in each of the insecticide treated plots, except the low rate of Platinum, as compared with the untreated control (Table 3). There were no differences in vine length among treatments.

Unlike previous studies, the numbers of squash bugs was very low this year, and consequently the level of disease pressure in the plots was low as well. Previous studies have indicated that yellow vine decline is an important disease that can limit squash production when not effectively controlled. We know that this disease is vectored by the squash bug and that management of the disease is dependent on squash bug management. Neither Admire 2F or Platinum 2SC list squash bug on their labels, and given the low squash bug numbers in this study, it cannot be concluded that either provided significant squash bug control. Both Admire and Platinum are approved for soil application to squash for other insect pests. In general, the insecticide treatments did marginally increase plot yields and each 1 pound increase in these small plots represented a 200 pound per acre yield increase.

Table 1. Numbers of insects per five acorn squash plants.

	Squash Bugs			Cucumber Beetles		
Treatment	**Jun 21**	**Jun 24**	**Jul 6**	**Jun 21**	**Jun 24[1]**	**Jul 6**
Admire 2F @ 24 fl oz/A	0	0.3	0.4	0	0.0 b	1.3
Admire 2F @ 16 fl oz/A	0	0	0	0.5	0.8 b	0.8
Platinum 2SC @ 8 fl oz/A	0.3	0.8	0	0.3	0.3 b	1.3
Platinum 2 SC @ 5 fl oz/A	0	0	0.8	0.3	0.5 b	2.5
Untreated	0.3	0.3	0.8	1.5	4.0 a	3.8
	ns	ns	ns	ns		ns

[1] Means in the same column followed by the same letter are not significantly different (LSD $p < 0.05$); ns = no significant differences within column.

Table 2. Number of plants per plot with yellow vine decline symptoms or dead.

	No. Plants/Plot with CYVD[1]			
Treatment	**Jul 15[2]**	**Jul 19**	**Jul 2**	**Aug 9[3]**
Admire 2F @ 24 fl oz/A	0.5 b	0.5 b	1.3 ab	1.5 b
Admire 2F @ 16 fl oz/A	0.3 b	0.3 b	0.5 b	1.3 b
Platinum 2SC @ 8 fl oz/A	1.0 ab	1.3 ab	2.0 ab	3.5 ab
Platinum 2 SC @ 5 fl oz/A	0.8 b	1.0 ab	2.0 ab	2.8 ab
Untreated	2.5 a	2.5 a	3.3 a	5.0 a

[1] Out of 24 plants per plot.
[2] Means in the same column followed by the same letter are not significantly different (LSD $p < 0.05$).
[3] Yellow vine decline was confirmed in five of five suspect plants using PCR.

Table 3. Acorn squash yields and plant vigor.

Treatment	Weight of Fruit (lb)[1]	Fruit Number	Vine Length (in.)
Admire 2F @ 24 fl oz /A	149.9 a	90.3 a	116.7
Admire 2F @ 16 fl oz /A	150.5 a	91.8 a	112.6
Platinum 2SC @ 8 fl oz /A	146.1 a	90.8 a	113.6
Platinum 2 SC @ 5 fl oz /A	143.6 ab	85.8 ab	112.7
Untreated	126.4 b	80.5 b	115.1
			ns

[1] Means in the same column followed by the same letter are not significantly different (LSD $p< 0.05$); ns = no significant differences within column.

Tomato Cultivar Trial, Eastern Kentucky

R. Terry Jones, Charles T. Back and John C. Snyder, Department of Horticulture

Introduction

Kentucky growers produce approximately 1,200 acres of staked, vine-ripe tomatoes for local and national sales. Kentucky tomatoes have an excellent reputation for quality among produce buyers. This trial evaluated new and existing cultivars to identify those that might produce a premium tomato with resistance to a potentially serious virus problem (tomato spotted wilt virus, TSWV). Cultivars were evaluated for yield and potential returns to growers. We wanted to see if two new tomato cultivars with resistance to TSWV would also produce high yields of attractive fruit.

Materials and Methods

Eleven fresh market red fruited tomato cultivars were evaluated at the Robinson Station at Quicksand, Kentucky (Table 1). According to soil test results (Table 2) the plot received 100 lb P_2O_5 , 60 lb of K_2O, and 50 lb N/A preplant. An additional 50 lb of N/A (half from ammonium nitrate and half from potassium nitrate) was applied through the drip irrigation lines during the growing season. Potassium nitrate was included to reduce risk of ripening disorders. Pest control was based on recommendations from ID-36, *Vegetable Production Guide*

Table 1. Tomato cultivars, their descriptions and reported disease resistance, planted at Quicksand, Kentucky in 2004.

Variety Name (Company)	Comments/Description[1]
Amelia VR (SW,HM)	Determinate, red, 80 days, resistant to 1,2,3,12
BHN444 (SW)	Determinate, red, 80 days, resistant to 1,2,3,12
Sunchief (SW)	Determinate, red, 68 days, resistant to 1,2,3,6,7
Sunguard (SW)	Determinate, red, 77 days, resistant to 1,2,3,6,7,9
BHN591 (SW)	Determinate, red, 71 days, resistant to 1,2,3,4
Mt. Spring (SW)	Determinate, red, 72 days, resistant to 1,2,3
Mt. Fresh (SW)	Determinate, red, 78 days, resistant to 1,2, early blight tolerance
Mt. Crest (Ru)	Determinate, red, 75 days, crack resistant, resistant to 1,2,3
Sebring (Ru)	Determinate, 75 days, resistant to 1,2,3
Florida 7514 (SW)	Determinate, red, 72 days, resistant to 1,2,3,4
BHN 543 (SW)	Determinate, red, 72 days, resistant to 1,2,3,4

[1] 1-Verticillium Wilt, 2-Fusarium Wilt R1, 3-Fusarium Wilt R2, 4-Nematode tolerant, 6-Alternaria Stem Canker Tolerant, 7-Stemphylium Tolerant, 9-Fusarium Wilt R3, 12- Tomato Spotted Wilt Virus.

for Commercial Growers. Fungicides were applied weekly and insecticides as needed.

Trays were seeded in the greenhouse at Quicksand on March 28. Black plastic mulch and drip tape were laid on May 5 and the tomatoes were planted the same day. Cultivars were replicated four times using 10 plants of each cultivar per replication. Plants were spaced 18 in. in the row and rows were 7 ft. apart on center. This spacing between bed centers was to allow our sprayer to be driven between beds.

Ten harvests were made during this trial from July 12 to August 12. The tomato cultivars were harvested when the fruit was at the breaker stage. Data collected included grade, weight, and count for jumbo and extra large (> 3.0 in.), large (> 2.5, < 3.0 in.), No. 2, small (> 2.0, < 2.5 in.). Reasons for culling included catfacing, concentric or radial cracks, disease, scars, blossom end rot, and uneven ripening.

Prices received at Cumberland Farm Products Cooperative were extremely low in 2004 compared to the previous five years, and 2004 prices were not available after 29 July; in addition, there were few differences in prices among early and later harvest dates. For these reasons, we used 2003 prices (Table 4), which were similar to those from 1999-2002. These weekly tomato market prices were multiplied by yields from the different size classes for each variety. Higher prices used for the first three weeks of harvests favor earlier-maturing varieties. Higher prices were also obtained for the extra large and larger size class. Yields of No. 2 fruits were also used in these calculations but usually with lower prices than No. 1 fruits. We consider the incomes per acre together with fruit quality observations to provide the best indications of overall variety performance.

Table 2. Results from soil test, Robinson Station, Quicksand, Kentucky.

PH	Buffer pH	P	K	Ca	Mg	Zn
6.5	6.92	93	372	2965	167	7.2

Results and Discussion

The 2004 growing season was wetter and slightly cooler than normal. Rainfall totals for May through August were 5.9, 8.2, 4.4, and 5.5 inches. Heavy rains and high humidity in late May and June led to reduced fruit set in the first cluster in many cultivars. Replication I was slightly lower in elevation than the other replications, and even though the plants looked normal, tomato fruit yield was lower in this block throughout the harvest season. The appearance of fruit harvested in 2004 was better than it was in 2003.

In 2003 and 2004, BHN 444 had the highest full season marketable yield, but it was not significantly different from the yields of the other 10 large-fruited cultivars in 2004 (Table 3). Cash return for BHN 444 was significantly higher than those of three other cultivars (Sebring, Sunchief, and Mt. Crest). BHN 444 did not perform well in a similar trial located in Lexington. The largest average tomato fruit size in 2004 was 8.7 oz. This was much smaller than the 13.9 oz/fruit. in 2003. All the cultivars that were tested both years had smaller fruit in 2004 (Table 3).

Table 3. 2004 staked tomato full season yield.

Cultivar	Jumbo & Extra Large (boxes/acre)	% Jumbo & Extra Large	Total Marketable Yield (lb)[1]	Income ($)	Average Fruit Wt. (oz.)[1]	Comments
BHN 444	2431	98 A[3]	62069	14423 A	8.7 A	nice fruit, green shoulders until ripe
Amelia	2399	98 A	61272	12353 AB	8 ABC	nice looking some blotchy ripening[2] late season
Mt. Spring	2367	98 AB	61254	12499 AB	8.5 AB	nice looking fruit
BHN 543	2349	98 A	60213	12063 ABC	8.4 AB	
BHN 591	2238	97 AB	57590	12013 ABC	7.6 CD	
Mt. Fresh	2218	96 ABC	57489	12784 AB	8.3 ABC	some blotchy ripening on fruit late in season
Mt. Crest	2165	91 D	59208	11240 BC	6.2 E	attractive but smaller fruit than others
Sunguard	2164	95 C	57071	11843 ABC	7.1 D	nice looking fruit
Sunchief	1902	97 AB	49198	10637 BC	8.4 ABC	green shoulders at breaker
Florida 7514	1816	97 AB	46967	11589 ABC	7.8 BCD	
Sebring	1721	95 BC	45345	9114 C	8.4 ABC	not very attractive
Duncan-Waller LSD (P = 0.05)	ns	1.9	ns	3106	0.8	

[1] Includes all grades except culls.
[2] A small amount of blotchy ripening was seen in two cultivars during the last two harvests in August.
[3] Numbers followed by the same letter are not statistically different.

There were no significant differences in total marketable yield or yield of jumbo/extra large tomatoes among the cultivars tested (Table 3). There were, however, significant differences among varieties in the percentages of total marketable yields that were jumbo and extra large (Table 3). Mountain Crest and Sunguard had significantly lower percentages than the other eight cultivars. Sebring's percent of jumbo/extra large was significantly lower than BHN 444, Amelia, and BHN 543 but significantly more than Mt. Crest. The summer of 2004 at the Robinson Station was cooler than normal (second coolest ever recorded) with excessive rain and many cloudy, overcast days. This weather increased tomato yield variability in our plots.

Growers should use caution when selecting any vegetable cultivar based on one year's results at one location and should also examine results (also in this *Research Report*) from a similar trial of the same varieties in central Kentucky at Lexington.

Table 4. Actual farm gate prices received by Cumberland Farm Products Cooperative growers in 2003. Yields of each size class/grade were multiplied by these prices for the appropriate harvest dates to calculate "income per acre" for each cultivar.

	Price per Pound		
Week Ending	No. 1 Jumbo & X-large	No. 1 Large	No. 2s (Jum, XL, Lg, Med)
22 Jul	$0.34	$0.21	$0.22
29 Jul	0.30	0.17	0.22
5 Aug	0.29	0.15	0.19
12 Aug	0.20	0.11	0.09
19 Aug	0.12	0.09	0.08
20 Aug-28 Sep[z]	0.10	0.05	0.06

[z] Cumberland Farm Products Cooperative discontinued packing on 19 August. We used prices slightly lower than their 19 August prices for income calculations for all trial harvests after that date.

Yield, Income, Quality, and Blotchy Ripening Susceptibility of Staked Tomato Cultivars in Central Kentucky

Brent Rowell, April Satanek, and John C. Snyder, Department of Horticulture

Introduction

Kentucky growers currently produce about 1,200 acres of staked, vine-ripe tomatoes for local and national markets. Kentucky tomatoes have an excellent quality reputation among buyers in several Midwestern states. We last tested fresh market tomatoes in 1998-99 to evaluate new and existing commercial cultivars and to identify any that might be featured in supermarkets as a premium "Kentucky Tomato." We evaluated cultivars for yields, appearance, firmness, and taste and compared them with well-established cultivars like Mountain Spring and Mountain Fresh. We were looking specifically for the following characteristics in the "Kentucky Tomato":

1. large slicer that tastes good.
2. ships reasonably well (firm, but not necessarily the firmest among cultivars).
3. high yields of extra-large and jumbo size classes.
4. low frequency of fruit defects.

Varieties in that trial were again evaluated for these traits (except for taste) in 2004. Two varieties were included with resistance to tomato spotted wilt virus (TSWV), which has become a major problem in some neighboring states. See the tomato cultivar trial report from eastern Kentucky in this issue of the *Research Report* for detailed descriptions of the varieties tested.

In recent years growers in some parts of the state have had more blotchy ripening (BR) and related ripening disorders. An abnormally wet, cool and cloudy spring and summer in 2004 resulted in extensive BR among some of the cultivars in the trial. This provided a rare opportunity to compare occurrence of the disorder among varieties.

Materials and Methods

A carefully selected group of 12 determinate tomato varieties from several seed companies was evaluated at Lexington in central Kentucky and at Quicksand in eastern Kentucky (see separate report). Two popular cultivars, Mountain Spring and Mountain Fresh, were included for comparison with new cultivars. All trial entries were seeded in the greenhouse at the Horticultural Research Farm on 16 April and subsequently transferred to 72-cell plastic trays. Cultivars were transplanted to the field on 25 May. Cultivars were planted in a randomized complete block design with four replications. Plots consisted of eight plants spaced 18 in. apart in single rows on 6-in. high raised beds spaced 6 ft. apart with black plastic mulch and trickle irrigation.

Drip irrigation was applied as needed according to tensiometers used to monitor soil moisture. Plants were staked and tied using the Florida weave system and pruned to two main stems. Sixty pounds/acre of nitrogen, no phosphorus, and 108 lb/acre of potassium (K_2O) were applied prior to bed formation. A total of 54 lb/acre of supplemental N (from ammonium nitrate) was fertigated in 11 applications during the season. Plots were sprayed weekly with protectant fungicides (copper plus Maneb, alternated with copper plus either Bravo or Quadris). Three insecticide sprays (Asana or Baythroid) were required during the season.

Ten harvests were made from 28 July until 28 September. Fruit were graded into the following size classes prior to counting and weighing: Jumbo (> 3.5 in. diameter), extra-large (> 3 in. but < 3.5 in.), large (> 2.5 in. but < 3 in.), medium and small (< 2.5 in) and cull. Fruits were also sorted according to U.S. No. 1 or U.S. No. 2 grades. In order to approximate the present marketing situation in Kentucky, "marketable yield" included only the "large" and above size classes. Yields of the "medium" size class are reported together with the small class as

they are not considered worth marketing by most grower/shippers in the state. All yields reported are of U.S. No. 1 fruit unless otherwise indicated. Yields of No. 2 fruit, although marketable in most years, were not included in "marketable yield" and are reported in separate columns in the tables. Means of all variables were compared using Waller-Duncan's K-ratio T-test (P = 0.05).

Income per acre. In addition to reporting yields in pounds or cartons per acre, variety performance is also expressed as income per acre. The 2004 prices received at Cumberland Farm Products Cooperative were very low compared to the previous five years, and prices were not available after 29 July. In addition, there were few differences in prices among early and later harvest dates. For these reasons we used 2003 prices (Table 1), similar to those from 1999-2002. These weekly market prices were multiplied by yields from the different size classes for each variety. Higher prices used for the first three weeks of harvests favor earlier-maturing varieties. Higher prices were also obtained for the "extra large/jumbo" size class. Yields of No. 2 fruits were also used in these calculations but usually with lower prices than No. 1 fruits. We consider the incomes per acre together with fruit quality observations to provide the best indication of overall variety performance.

Fruit quality ratings. A representative sample of about 100 ripe fruits of each variety harvested on 11 August (fourth harvest) were laid out for careful examination and quality ratings on 18 August. All cultivars were rated for smoothness, blossom scar size, extent of cracking, firmness, and internal color. The overall appearance rating took most of these factors into account.

Blotchy ripening. BR was observed in most varieties, especially during the first five harvests. In order to compare varieties for susceptibility to BR, all fruits from four replications were combined after grading and the numbers of fruits with BR symptoms were recorded. Prior to counting, fruits were held at room temperature for 7 to12 days after harvest in commercial 25-lb tomato boxes.

Table 1. Actual farm gate prices paid by Cumberland Farm Products Cooperative in 2003. Yields of each size class/grade were multiplied by these prices for the appropriate harvest dates to calculate "income per acre" for each cultivar.

	Price per Pound		
Week Ending	No. 1 Jumbo & X-Large	No. 1 Large	No. 2s (Jumbo, XL, Lg, Med)
22 Jul	$0.34	$0.21	$0.22
29 Jul	0.3	0.17	0.22
5 Aug	0.29	0.15	0.19
12 Aug	0.2	0.11	0.09
12 Aug	0.2	0.11	0.09
19 Aug	0.12	0.09	0.08
20 Aug-28 Sep[z]	0.1	0.05	0.06

[z] Cumberland Farm Products Cooperative discontinued packing on 19 August. We used prices slightly lower than their 19 August prices for income calculations for all trial harvests after that date.

The pre-plant soil potassium levels were high (310 lb/acre), and soil P levels were very high (95 lb/acre). Calcium and magnesium levels were also high (3,046 and 385 lb/acre, respectively). Lime (1 ton/acre) and 108 lb K_2O/acre (from KCl) were applied prior to transplanting. The Hartz ratio (see www.oardc.ohio-state.edu/tomato/ysd/newhartzratio.htm), used as an indicator of soil conditions that might result in tomato ripening disorders, was calculated based on our pre-plant soil test results. The ratio was 0.37 (prior to the potassium application), which is slightly over the 0.35 threshold level (soils in the Midwest may be prone to ripening disorders when Hartz ratios are *less than* 0.35). The extremely long cloudy period was probably the most significant factor contributing to blotchy ripening in the trial. The disorder was also widely reported statewide in 2003 and 2004. Foliar disease control was excellent, and there were no significant disease problems.

Results and Discussion

The 2004 growing season was abnormally wet, cool, and cloudy. The trial was planted later than usual because of rains and seed germination problems with some varieties. We believe the unusual weather led to a greater than normal amount of cull fruit (26 to 63%), due to catfacing and other defects, in the earlier harvests. In addition, many fruit were culled because of a significant amount of BR. It is a poorly understood disorder but often occurs after long periods of cloudy weather. BR has also been associated with nutrient imbalances (especially low potassium relative to nitrogen in mineral soils) that can occur as a result of nutrient uptake problems.

Table 2. Yields, fruit size, and income from staked tomato cultivars at Lexington, Kentucky, 2004; all data are means of four replications.

	#1 Jumbo+XL[1]		Thousand lbs/acre				
Entry (Seed Source)	boxes/acre	%	Tot. mkt[2]	# 2's[3]	Culls%[4]	Avg. fruit wt. oz.[5]	Income $/acre
Mtn. Fresh (HM)	1321	55	59.7	24.9	26	9.8	7989
Mtn. Spring (RG)	1289	60	54.2	18.2	36	10.3	8260
BHN 591 (B)	1283	60	52.9	28.6	36	10.3	8808
Sunguard (S)	1278	61	52.5	21.0	38	10.4	8992
Mtn. Crest (SU/RU)	1261	61	52.1	20.6	38	10.4	8912
BHN 543 (B)	1252	76	41.7	27.2	48	11.6	7949
Amelia (HM)	1207	65	46.2	22.3	41	10.5	7946
BHN 641 (yellow, B)	983	60	41.5	28.8	41	10.4	7989
Sebring (RG)	901	70	32.1	23.3	49	10.6	6035
FL 7514	875	50	43.5	19.2	38	9.4	7376
BHN 444 (B)	843	70	30.1	24.3	53	11.1	7276
Sunchief (S)	527	67	20.0	18.0	63	10.7	5947
Waller-Duncan LSD (P = 0.05)	277	12	9.3	5.1	7.5	0.9	1156

[1] Yields of USDA No. 1 fruit of jumbo (> 3.5 in. diameter) *plus* extra large (> 2.75 in. but < 3.5 in.) size classes; boxes/acre = number of 25 lb cartons per acre; "%" = percentage of the total of these two size classes of the *total marketable yield*.

[2] Total marketable yield = yield of No. 1 fruit of jumbo + extra large + large size classes; mediums not included.

[3] Yield of USDA No. 2 fruit from all size classes.

[4] Percentage of culled fruit in total yield.

[5] Average fruit weight; includes jumbo, extra large, and large only.

Table 3. Fruit quality characteristics; observations from all red-ripe fruits harvested from one replication on 11 August 2004. Cultivars ranked in order of yield of No. 1 Jumbo + Extra Large fruits.

Cultivar (Seed Co.)	Shape	Blossom scar[2]	Smooth-ness[3]	Crack-ing[4]	Appear-ance[5]	Firm-Ness[6]	Internal Color[7]	Comments
Mtn. Fresh	do	s	2	2	7	m	4	
Mtn. Spring	o-do	s	3	2	7	f	3	
BHN 591	o-do	m	3	2.5	5	m	4	rough; large stem end scar
Sunguard	do	m	2.5	1.5	8	f	4	very attractive; nice internal color
Mtn. Crest	do	m	2	1.5	7	f	4	smooth; nice internal color
BHN 543	do-g	m	2.5	3	6.5	m	3	large stem end scar
Amelia	do	s	2.5	1.5	7	m	3	
BHN 641 (yellow)	do-g	m	2	2.5	6.5	f	3	
Sebring	do-g	s	2	1.5	4	f	3	serious blotchy ripening this harvest date
FL 7514	do	m	3	2	6	s	3	some internal white tissue
BHN 444	g	m	2	3	6	m	2	
Sunchief	o	s	4	3	3	m	3	rough; blotchy ripening this harvest date

[1] Fruit shape: o = oblate; do = deep oblate (diameter somewhat greater than height); g = globe (spherical); dg = deep globe.
[2] Blossom scar size: s = small (< 1/8 in. diameter), m = medium (1/8 to 1/4 in.), lg = large (5/16 to 7/16 in.).
[3] Smoothness of fruit shoulders: 1 = smooth, 5 = rough (ribbed on top of fruit).
[4] Fruit cracking: 1 = none, 5 = severe.
[5] Overall fruit appearance rating: 1 = worst, 9 = best.
[6] Fruit firmness by feel: s = soft, m = medium firm, f = very firm.
[7] Internal fruit color: 1 = whitish (worst), 5 = uniformly deep red (best).

Yields and incomes. The highest-yielding cultivars were Mountain Fresh, Mountain Spring, BHN 591, Sunguard, Mountain Crest, BHN 543, and Amelia (Table 2). Incomes per acre were lower this year than in 1998-99 because of unfavorable weather and lower yields. Incomes ranged from $8,992/acre for Sunguard to $5,947/acre for Sunchief (Table 2). Among the highest yielders, Sunguard and Mountain Crest had the highest per-acre incomes followed by BHN 591, Mountain Spring, BHN 641 (yellow-fruited), Mountain Fresh, BHN 543, and Amelia (Table 2).

Fruit quality. Among the highest yielding and highest income varieties, Sunguard, Mountain Crest, Amelia, and BHN 641 (yellow) had the best fruit appearance scores (Table 3). BHN 543 also had a relatively high appearance score although it had more radial cracking than most varieties tested; Mountain Fresh also had more fruit than usual with radial cracking. Sunchief, Sebring, and BHN 591 had the worst appearance scores in the trial (Table 3).

Blotchy ripening. Although BR occurred in all cultivars, some were much more susceptible than others (Table 4). The average percentage of fruit affected over five harvests ranged from 59% (Sebring) to 4% (Sunguard and Mountain Crest), while the overall trial average was 16%. Sebring and Sunchief were the worst affected and will not be tested further. Most varieties appeared to be moderately susceptible (7 to 12%), while Mountain Crest and Sunguard were the least susceptible (Table 4).

All things considered. Sunguard was one of the most promising cultivars in this trial and in trials conducted in south-central Kentucky in 2003 (see 2003 Research Report). Mountain Crest, a new variety with extended shelf life and dark red internal color, rated very well for yields, quality, and BR tolerance. These two varieties, Amelia, BHN 543, and BHN 641 (yellow) will be tested again in 2005. Sunguard and Mountain Crest deserve on-farm testing alongside well-established varieties like Mountain Fresh or Mountain Spring.

Table 4. Percentages of fruits with blotchy ripening from first five harvests; observations from red-ripe fruits combined from all four replications, 28 July to 18 August 2004. Cultivars ranked from worst (most blotchy ripening) to best (least blotchy ripening).

Cultivar (Seed Co.)	Harvest dates					
	7/28	8/2	8/5	8/11	8/18	Average
	% of fruits with blotchy ripening symptoms					
Sebring	73	37	45	43	95	59
Sunchief	48	12	43	73	44	44
BHN 444	27	1	0	0	32	12
BHN 543	22	0	0	0	39	12
FL 7514	39	0	0	0	19	11
Amelia	46	1	0	0	8	11
BHN 641 (yellow)	37	9	2	0	0	10
BHN 591	14	0	0	0	30	9
Mtn. Spring	12	2	0	0	29	9
Mtn. Fresh	29	0	0	0	8	7
Mtn. Crest	4	3	0	0	16	4
Sunguard	13	0	0	0	8	4

Acknowledgments

The authors would especially like to thank Darrell Slone and the farm crew for their hard work and assistance with this trial.

Sap Tests and Blotchy Ripening Incidence in Staked Tomatoes in Western Kentucky

Shane Bogle, Brent Rowell, and Joe Masabni, Department of Horticulture

Introduction

In recent years, tomato growers across the state have reported increased cull rates due to a fruit ripening disorder commonly known as blotchy ripening (BR) or yellow shoulder disorder (YSD). BR/YSD is a physiological problem that varies in symptoms but is generally characterized by yellow or green areas under the fruit peel that affect both appearance and nutritional quality. The disorder begins early in fruit development and cannot be remedied because the yellow or green areas never ripen to a uniform red color.

The causes of the problem are poorly understood. Recent research has indicated that certain environmental and soil conditions are associated with it, including long periods of cloudy weather, low soil K in relation to N, and imbalances of secondary nutrients in soils and subsequently in plant tissue. We monitored nitrate (NO_3) and potassium (K) levels in leaf petioles weekly in a 50-acre staked tomato field in western Kentucky that has experienced extensive BR/YSD. These measurements were made in order to see if there was any association between sap nitrate and K levels as determined by Cardy meters and the occurrence of BR/YSD in the field.

Materials and Methods

The tomato grower had his soils tested and then used the "Hartz Ratio Calculator" to determine the relative susceptibilities of his fields to BR/YSD (Ohio State University, www.oardc.ohio-state.edu/tomato/HartzRatioCalculator.htm). All of his fields were designated as being at risk for BR/YSD according to the Hartz ratio. These soils have low cation exchange capacities (CEC), which have been associated with the disorder.

The grower applied preplant N, P, and K according to University of Kentucky recommendations (*Vegetable Production Guide for Commercial Growers*, ID-36). A season-long total of approximately 150 lb/acre of N was applied including preplant and weekly fertigated N. In order to prevent or reduce BR, he made weekly fertigations of 50 lb/acre of potassium nitrate (22 lb/acre K_2O) starting during the last week of May and continued through the second week of August (242 lb/acre total K_2O applied). Even higher rates of K were fertigated in another field, but this did not appear to result in any noticeable reduction in BR compared to the field that received the recommended rates.

Cardy meters (Spectrum Technologies, Plainfield, IL) were used to measure sap nitrate and potassium levels. Samples of 15 to 20 tomato leaves were collected, stripped and the petioles crushed for sap extraction. The petioles were selected from the youngest fully matured leaves. For each potassium and nitrate measurement, samples were collected from three sites within the field representing different varieties and growing conditions. Results were compared to standard sufficiency levels of potassium and nitrate published by the University of Florida for staked tomatoes at each growth stage and at harvest (Table 1). Operation managers and skilled crop harvesters kept close watch on the percentage of BR/YSD fruit that was either culled in the field or that came through the initial grading line in the packing facility.

Results and Discussion

Based on our experience, the 2004 growing season (cool overcast days and above average rainfall) should have provided ideal conditions for the occurrence of BR/YSD in this western Kentucky field. However, the grower reported a dramatic 30 to 40% reduction in the amount of BR/YSD fruit compared with last year. The incidence of BR in 2004 was less than 5% in most of the grower's fields. Figures 1 and 2 show potassium and nitrate levels as measured by Cardy meters during the tomato harvest period. *It appears that weekly fertigations of potassium nitrate may have significantly reduced the problem in 2004 compared to previous years.*

One two-acre section of the 50-acre field consistently had above average amounts of BR/YSD in previous years; this section was a trouble spot again in 2004 in spite of potassium fertigation. This

Table 1. Petiole potassium and nitrogen sufficiency levels for tomato (University of Florida).

Growth Stage	Potassium (ppm)	Nitrate (ppm)
First buds	3500-4000	1000-1200
First open flowers	3500-4000	600-800
Fruit 1-inch diameter	3000-3500	400-600
Fruit 2-inch diameter	3000-3500	400-600
First harvest	2500-3000	300-400
Second harvest	2000-2500	200-400

Table 2. Potassium and nitrate concentrations in tomato leaf petiole sap (cv. Mountain Fresh) from two sections of a 50-acre tomato field during harvest in western Kentucky, 30 July 2004.

	Poor Location*		Good Location	
	Potassium	Nitrate	Potassium	Nitrate
	2700	810	5400	880
	3300	840	5200	880
	2900	840	5200	880
Average	2967	830	5267	880

* Low-lying ground with top soil eroded, shallow fragipan, and low CEC.

location has some erosion potential, a lower CEC, and a much shallower fragipan layer than the Granada-based soil in the rest of the field. Our Cardy meter measurements determined that the potassium levels in tomato leaf petioles from this area were as much as 2700 ppm lower than from other sites within the same field that had better soil quality (Table 2). However, potassium nitrate was applied uniformly to the whole 50-acre field.

The amount of BR/YSD found in this poor section of the field could be attributed to restricted root growth and reduced nutrient uptake due to the shallow fragipan, and to the overall lower nutrient availability due to the lower CEC. Petiole sample measurements from this section of the field showed that potassium and nitrate levels were still above or within the published sufficiency ranges for the entire growing season (Tables 1, 2) indicating that potassium that is deemed "sufficient" in tomato petiole sap may not be sufficient to prevent ripening disorders on soils prone to the problem. It could also be that BR in this part of the field was caused by other factors (not K insufficiency) that may have been associated with the lower K levels. In any case, K levels lower than published sufficiency ranges could indicate to growers that a crop is at risk of having ripening problems. Boosting potassium nitrate fertigation levels beyond the recommended 50 lb/acre rates may also help prevent BR/YSD in problem fields.

As a result of experiences gained this season, the grower plans to continue using weekly potassium nitrate applications to reduce yield losses from BR/YSD. The results from our observations are encouraging but more testing needs to done at this and other locations.

Figure 1. Potassium concentrations (ppm) in leaf petiole sap from three tomato varieties during tomato harvest.

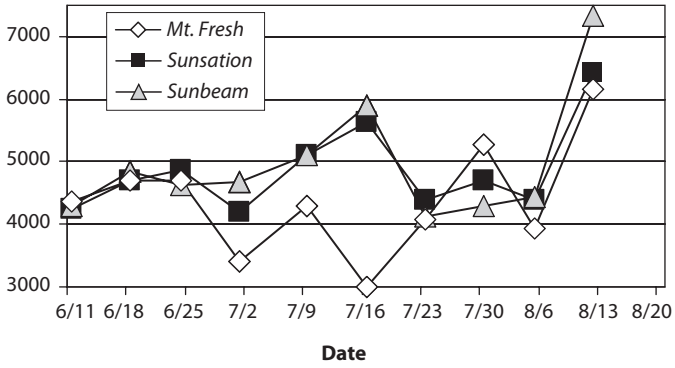
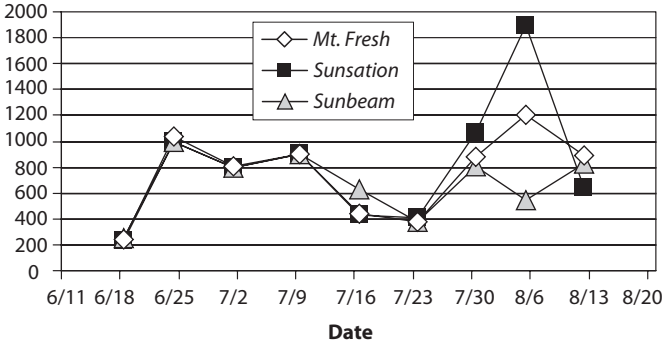


Figure 2. Nitrate concentrations (ppm) in leaf petiole sap from three tomato varieties during tomato harvest period.



Notes on Tomato Production in High Tunnels

Bonnie Sigmon, Department of Horticulture

Introduction

High tunnel vegetable production is becoming more popular as a season extender in Kentucky. High tunnels are plastic-covered hoop houses with no heat or ventilation. The frame can be made from almost any material including metal pipe, PVC, or wood. The frame is covered with clear plastic. Sunlight warms the tunnel in March and April, which allows earlier production of warm-season crops such as tomatoes and cucumbers. In October and November, the tunnel can help retain heat and protect against cold damage at night. This can make tomato production more profitable for farmers by allowing them to produce earlier and later than the normal growing season and thus receive premium prices.

Materials and Methods

A single high tunnel was constructed from an old PVC pipe greenhouse in late March at the farm of a grower/cooperator in Rockcastle County. The tunnel was 100 ft long by 10 ft wide and was covered by 8-mil clear plastic. The tunnel was constructed over two 100 ft rows of black plastic mulch with drip irrigation. Both ends of the tunnel were left uncovered for ventilation. Better Boy tomatoes were transplanted by hand on April 6 with plants spaced 18 inches apart in the rows. Transplants were treated with 10-52-17 starter fertilizer and with Admire 2F as a soil drench after transplanting.

One of the two rows was also covered by a white canvas row cover for additional protection. As a control, two 100 ft rows were planted outside the high tunnel; one was protected by a white canvas row cover while the other was left unprotected. High and low temperatures were recorded daily with a high/low thermometer in the center of each row. Tomatoes were irrigated as needed and kept on a weekly spray schedule for foliar diseases with insecticides added as necessary. Plants were staked, tied, and pruned at appropriate times.

Results

The canvas-covered row inside the high tunnel consistently averaged two to three degrees cooler during the day and three degrees warmer at night than the uncovered row in the tunnel. The canvas-covered row outside the tunnel was cooler than those

inside the tunnel during the day and a few degrees cooler at night, although the canvas kept the plants considerably warmer than the uncovered outside row at night. During sunny days, the uncovered outside row was cooler than the two rows in the high tunnel due to better ventilation. The uncovered outside row was warmer than the outside canvas-covered row, probably because of direct exposure of the black plastic mulch to the sun.

Despite the heat produced by the black mulch, the uncovered outside row was killed by frost on April 15, while the other tomatoes were undamaged. The tunnel and row cover protected the plants from cold damage on several other occasions. The high tunnel and row cover were removed after the threat of frost had passed on May 8. The first ripe tomato was harvested on June 21 from the canvas-covered row outside the high tunnel. The first ripe tomato inside the high tunnel was harvested two days later. Although there were essentially no differences in early maturity, the grower hopes the high tunnel will permit earlier tomato plantings next year.

As a result of this demonstration, a total of 567 lb of tomatoes were harvested and sold at local farmer markets and from home at $1.65/lb. There appeared to be no difference in quality or quantity of tomatoes harvested from the three remaining rows, so it seems that pollination and quality were not affected by the tunnel or row covers. Harvest was cut short by a strong storm with hail that destroyed the crop in mid-July.

The grower was excited by the results of the demonstration and plans to experiment on his own next year. He is considering using high tunnels to protect tomatoes planted in early March and canvas row covers to protect plants transplanted in early April. The grower hopes to have good quality tomatoes by the first of June and receive premium prices.

High Tunnel Winter Spinach Production in Central Kentucky

Amanda Ferguson, Darrell Slone, Robert Houtz, and Brent Rowell, Department of Horticulture

Introduction

Dr. E. M. Emmert developed high tunnel plasticulture over 50 years ago at the University of Kentucky. Although the use of plastic tunnels has spread all over the world, this research is being revitalized at the University of Kentucky Horticultural Research Farm in Lexington. A high tunnel is a plastic-covered house, usually "Quonset-hut" in shape. There is no electricity for heating or ventilation, and the only external link is irrigation. Other universities are doing similar research while publishing plans and guidelines for large-scale high tunnels. The University of Kentucky high tunnels are low-cost and rely on commonly available materials. Kentucky's mild winter enables the use of simpler tunnels than those used in other parts of the country. The goal of our research was to develop and test a low-cost production system that allows Kentucky farmers to produce high quality produce off-season for local markets.

Materials and Methods

Four high tunnels were constructed in early November 2002 and December 2003 at the Horticulture Research Farm in Lexington. Each tunnel was built with a single layer of 6-mil clear plastic supported by painted PVC pipe and wooden endwalls. The tunnels measured 10 feet wide by 40 feet long by 6 feet high. Two beds were formed that ran the length of the each tunnel. One of the beds inside the tunnel was also protected by another tunnel (more like a row cover). These inner tunnels were made by bending PVC pipes into 4-foot diameter half circles and covering them with clear 6-mil plastic.

Each of the beds contained spinach, lettuce, and kale. These cool-season crops were seeded in mid-October in the greenhouse. The plants were transplanted (prior to tunnel construction) on black plastic mulch with trickle irrigation on December 15 (2002) and November 10 (2003) using a waterwheel setter with a custom-made waterwheel. Spinach and lettuce were planted at 8 inches between plants and 4 inches between rows. There were three rows of both spinach and lettuce in each main bed. The kale was spaced 1foot between rows and 17 inches between plants. There were two rows of kale in each main bed. These crops were also planted outside the high tunnels to provide an uncovered control. For each treatment (none, one cover, or two covers), ground and air temperatures were recorded, as well as photosynthetic active radiation at 30-minute intervals.

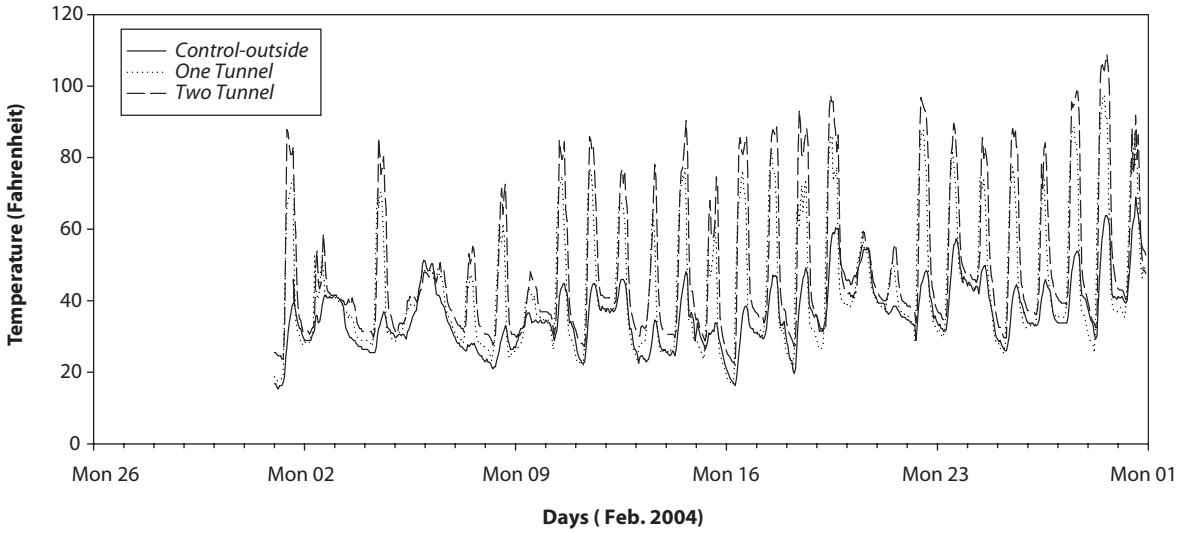
Results and Discussion

Air and soil temperatures. Although air and soil temperatures were measured in 2003 and 2004, only 2004 data are reported here because of sensor errors in 2003. Air temperatures (February 2004) among the two treatments and the control are shown in Table 1 and Figure 1. Air temperature was highest (maximum 109°F) in the tunnel-within-tunnel (two-tunnel) treatment, followed by the single-tunnel treatment (98°F) with the coolest temperatures from the outside control (69°F). Overall, the tunnel-within-tunnel treatment was 6°F higher than the one-tunnel treatment, which was 7°F higher than the outside control.

Table 1. High tunnel air temperatures (in degrees Fahrenheit) in 2004.

	Overall Average	Absolute High	Absolute Low
Control (outside)	36	69	15
One-tunnel	43	98	16
Two-tunnel	49	109	22

Figure 1. Air temperature for February 1-29, 2004, for three treatments (control, one-tunnel, and two-tunnel).



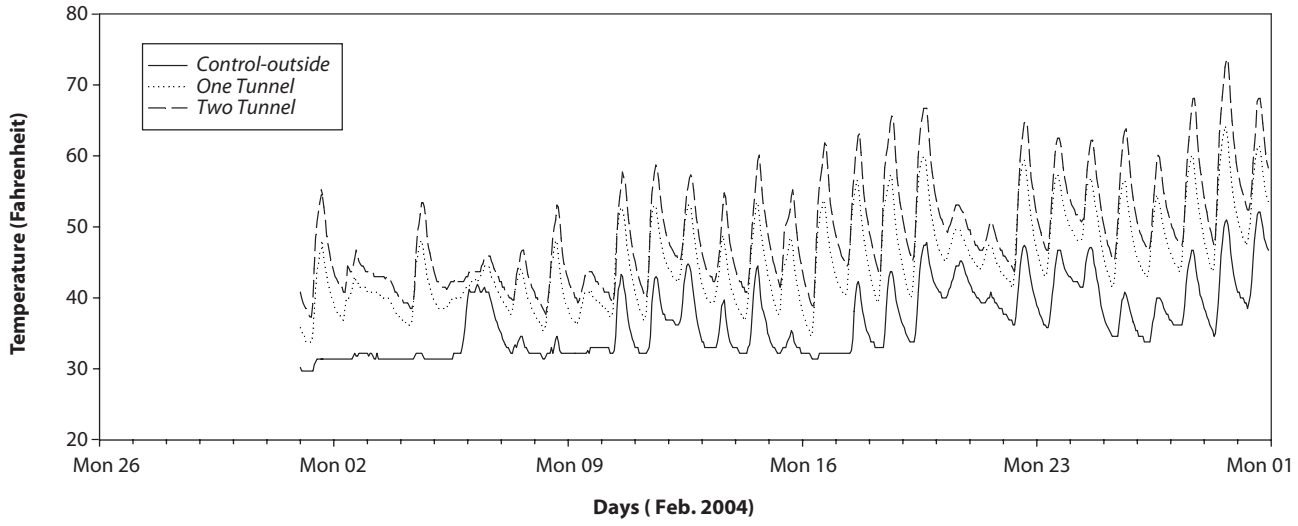
Soil temperatures did not fluctuate as much or as quickly as the air temperatures (Table 2 and Figure 2). The highest temperatures were in the tunnel-within-tunnel treatment, followed by the one-tunnel. The coolest 2004 soil temperatures occurred in the outside control with a low of 29°F. In the tunnels, the lowest soil temperatures were in the mid- to high 30s. The highest soil temperature in the control was just above 50°F, while the highest temperature in the two-tunnel treatment was over 70°F. High temperatures reached the mid-60s in the single-tunnel treatment. The soil temperatures averaged 8 and 12 degrees higher in the single-tunnel and tunnel-within-tunnel treatments, respectively, compared to the control plot (Table 2).

Table 2. High tunnel soil temperatures (in degrees Fahrenheit) in 2004.

	Overall Average	Absolute High	Absolute Low
Control	37	52	30
One-tunnel	45	64	34
Two-tunnel	49	74	37

Yields. The only crop that yielded marketable produce during this experiment was spinach. Lettuce and kale proved unsatisfactory for this type of growing environment during the months they were tested. The optimal growing temperatures for lettuce range from the 60s to lower 70s with night temperatures in the mid-40s. The average air temperature in our tunnels ranged from the upper 30s to the lower 40s. This most likely led to the poor growth of the lettuce crop. Kale has similar growing temperature requirements. Another problem experienced with kale was that it bolted (began

Figure 2. Soil temperatures for February 1-29, 2004, for three treatments (control, one-tunnel, and two-tunnel).



to flower) quite suddenly as spring approached. Bolting occurs during periods of warmer temperatures as spring approaches. It may be possible to plant kale earlier to avoid bolting, which would allow it to reach a marketable stage. A hardier cultivar of lettuce may also work better in this environment.

Harvest dates for spinach grown within tunnels and outside are shown in Table 3. The average spinach yields over the two years of the experiment revealed a significant difference between the control and the tunnel treatments (Table 4). The average plant weight from the outside (uncovered) plots was only 18 grams, while the average weight of spinach plants from the one-tunnel and tunnel-within-tunnel treatments was over 90 grams. Both the one-tunnel and the tunnel-within-tunnel yields were significantly different from the control. The outside control plots yielded just over 3 lb of spinach per 10 feet of row over three harvests. The one-tunnel treatment, yielded 9 lb/10 ft row, while the two-tunnel treatment yielded 11 lb/10 ft over three harvests (Table 4). This difference was not statistically significant.

Table 3. Harvest dates of spinach in high tunnels in 2003 and 2004.

	Harvest Date	Days after Transplanting
1st	3 Mar '03	77
2nd	15 Mar '03	89
3rd	26 Mar '03	100
1st	6 Feb '04	88
2nd	10 Mar '04	120
3rd	2 Apr '04	143

Table 4. Average plant weight (in grams) and spinach yields, 2003 and 2004.

Treatment	Avg. Plant Weight	Total Marketable Yield (lb/10 ft row) Over Three Harvests
Control (outside)	17.8	3.2
One-tunnel	92.1	9.1
Tunnel-within- tunnel	99	11.1
LSD (P = 0.05)	16.2	2.1

Fruit and Vegetable Disease Observations from the Plant Disease Diagnostic Laboratory

Julie Beale, Paul Bachi, William Nesmith, and John Hartman, Department of Plant Pathology

Introduction

Diagnosis of plant diseases and providing recommendations for their control are the result of the University of Kentucky College of Agriculture research (Agricultural Experiment Station) and Cooperative Extension Service activities through the Department of Plant Pathology. We maintain two branches of the Plant Disease Diagnostic Laboratory, one on the University of Kentucky campus in Lexington and one at the University of Kentucky Research and Education Center (UKREC) in Princeton. Of the more than 4,000 plant specimens examined annually, approximately 10 to 15% are commercial fruit and vegetable plant specimens (1). Moreover, the annual number of such specimens diagnosed has more than doubled in recent years—but because of their complexity and diversity, the time needed to diagnose them has more than just doubled. Although the growers are not charged for plant disease diagnoses at UK, the estimated direct annual expenditure to support diagnosis of fruit and vegetable specimens by the laboratory is $25,000, excluding UK physical plant overhead costs. During recent years we have acquired Kentucky Integrated Pest Management funds to help defray some of these additional laboratory operating costs. We have greatly increased the use of consulting on plant disease problems, including solving fruit and vegetable disease problems through our Web-based digital consulting system. Of the nearly 700 digital consulting cases, approximately 18% involved fruit and vegetable diseases and disorders.

Materials and Methods

Diagnosing fruit and vegetable diseases involves a great deal of research into the possible causes of the problems. Most visual diagnoses include microscopy to determine what plant parts are affected and to identify the microbe involved. In addition, many specimens require special tests such as moist chamber incubation, culturing, enzyme-linked immunosorbant assay (ELISA), polymerase chain reaction (PCR) assay, electron microscopy, nematode extraction, or soil pH and soluble salts tests. Diagnoses that require consultation with UK faculty plant pathologists and horticulturists and that need culturing, PCR, and ELISA are common for commercial fruits and vegetables. The Extension plant pathology group has tested, in our laboratory, protocols for PCR detection of several pathogens of interest to fruit and vegetable growers. These include the difficult-to-diagnose pathogens causing bacterial wilt, bacterial leaf spot, yellow vine decline, and Pierce's disease. The laboratory also has a role in monitoring pathogen resistance to fungicides and bactericides. These exceptional measures are efforts well spent because fruits and vegetables are high-value crops. Computer-based laboratory records are maintained to provide information used for conducting plant disease surveys, identifying new disease outbreaks, and formulating educational programs. New homeland security rules now require reporting of all diagnoses of plant diseases to USDA-APHIS on a real-time basis, and our laboratories are working to meet that requirement.

The 2004 growing season in Kentucky provided mostly cooler-than-normal temperatures and above-normal rainfall; however, these observations varied by location. The coldest temperatures occurred in January and ranged from -12°F in northern Kentucky to 4°F in the west. There were few significant late spring frosts. In central Kentucky, normal temperatures prevailed most months except for above-normal temperatures in March and May and cooler-than-normal temperatures in July and August. Indeed, in this region there were no days with 90°F or greater temperatures (normal is 17 days). Rainfall in central Kentucky was normal during most months but was above-normal during May-August. In western Kentucky, except for a wet May, rainfall was mostly normal until starting in August, when very dry late summer and fall weather prevailed. In eastern Kentucky, May, June, and September were wet, but July and August were dry. With wetness affecting disease development, the percentage of days with rain in Kentucky averaged about 35% statewide during April (43% in some regions), 45% in May (52%), 38% in June (60%), and 38% in July (58%). Thus, there were ample opportunities for rain-based plant disease development.

Results and Discussion

New, Emerging, and Problematic Fruit and Vegetable Diseases in Kentucky

- Pierce's disease of grapes caused by *Xylella fastidiosa*.
- Grape crown gall caused by *Agrobacterium vitis* emerges with more grapes grown.
- Peach fruit rot caused by a species of *Colletotrichum*.
- Cucurbit yellow vine disease caused by *Serratia marsescens.*
- Root, stem and fruit diseases of solanaceous and cucurbit vegetables caused by *Phytophthora* spp.
- Bacterial canker of peppers caused by *Clavibacter michiganensis* subsp. *michiganensis.*
- Copper-resistant bacterial speck of tomatoes caused by *Pseudomonas syringae* pv. *tomato.*
- Bacterial fruit blotch of melons caused by *Acidovorax avenae* subsp. *citrulli*.
- Root knot nematode (*Meloidogyne* spp.) is becoming a major problem on several crops due to reduced crop rotation and use of old tobacco fields as vegetable sites.
- Virus disease incidence, especially in legume crops, could change significantly with recent introduction of the soybean aphid, a virus vector.
- Soybean rust arrived in the U.S. this fall, and many vegetable legumes are also hosts.

Tree Fruit Diseases

Pome Fruits: High levels of apple scab (*Venturia inaequalis*); cedar rusts of apple (*Gymnosporangium juniperi-virginianae, G. clavipes,* and *G. globosum*); and frogeye leaf spot (*Botryosphaeria obtusa*) were observed. With warm spring temperatures, fire blight (*Erwinia amylovora*) was observed frequently but was not thought to be severe. Sooty blotch (*Peltaster fructicola, Geastrumia polystigmatis, Leptodontium elatius*, and other fungi) and flyspeck (*Zygophiala jamaicensis*) appeared early in the season. Powdery mildew (*Podosphaera leucotricha*) was also frequently observed. Pears were observed with fire blight, leaf spot (*Diplocarpon mespili*), and thread blight (*Corticium stevensii*).

Stone Fruits: Peach leaf curl (*Taphrina deformans*), brown rot (*Monilinia fructicola*), and scab (*Cladosporium carpophilum*) were common. A new and difficult-to-manage peach fruit rot caused by a species of *Colletotrichum* continues to expand in western Kentucky, appearing more frequently and in more orchards. Brown rot of plums and cherries and cherry leaf spots (*Blumeriella jaapii*) were observed frequently.

Pawpaw: Phyllosticta leaf spot (*Phyllosticta asiminae*) was common, and a twig canker (*Fusarium* sp.) associated with ambrosia beetles was observed. A fungal fruit rot was observed late in the season; experiments are currently being conducted to identify the causal fungus.

Small Fruit Diseases

Grapes: Black rot (*Guignardia bidwellii*) and anthracnose (*Elsinoe ampelina*), favored by wet spring weather, were widespread, especially in vineyards managed by inexperienced growers. Grape downy mildew (*Plasmopara viticola*) was observed, especially late in the season. No new cases of Pierce's disease (*Xylella fastidiosa*) were found.

Brambles: Blackberry rosette (*Cercosporella rubi*) appeared in most regions of the state. Raspberry Phytophthora root and crown rot (*Phytophthora* spp.) was commonly found and could be attributed to the added wetness of the season.

Blueberrries: Several kinds of stem canker diseases (*Fusicoccum, Phomopsis, Botryosphaeria*) were diagnosed on blueberries.

Strawberries: Leaf spot (*Mycosphaerella fragariae*) was frequently observed. Fruit and crown anthracnose (*Colletotrichum acutatum*) was also problematic.

Vegetable Diseases

In accord with a wet spring and a cool, moist summer in most of the state, infectious diseases played a significant role in hindering production of commercial vegetable crops.

Vegetable Transplants. Pythium root rot diseases (*Pythium* spp.) appeared in tomato, cantaloupe, squash, and pepper fields this year and may have originated in transplant production.

Cole Crops. Cabbage black rot (*Xanthomonas campestris* pv. *campestris*) and head rot (*Rhizoctonia solani*) were observed.

Tomatoes. Commercial tomato plantings were infected by several bacterial diseases including bacterial canker (*Clavibacter michiganensis* pv. *michiganensis*), bacterial spot (*Xanthomonas campestris* pv. *vesicatoria*), and bacterial speck (*Pseudomonas syringae* pv. *tomato*). Septoria leaf spot (*Septoria lycopersici*), favored by cool, wet weather was especially widespread this year as was early blight (*Alternaria solani*). Leaf molds (*Cladosporium fulvum, Pseudocercospora fuligena*) also occurred in warm, humid environments. Fruit maladies in addition to blossom end rot included the fruit infection stages of the fungal and bacterial leaf diseases listed above and also buckeye rot (*Phytophthora cactorum*) and gray mold (*Botrytis cinerea*). Tomato fruit also experienced other physiological disorders such as stem-end internal greening. Fusarium wilt (*Fusarium oxysporum* f.sp. *lycopercici*), southern stem blight (*Sclerotium rolfsii*) and root knot nematode (*Meloydogyne* sp.) were problems in some fields.

Peppers. Bacterial leaf spot (*Xanthomonas campestris* pv. *vesicatoria*) remains an important problem. Phytophthora stem and fruit rot (*Phytophthora capsici*) was also important this wet season.

Cucurbits. Cucurbits are popular in Kentucky, and their diseases are economically important. Phytophthora root rot, stem rot, leaf blight, and fruit rot (*Phytophthora capsici*) are widespread in the state and cause losses in pumpkin, watermelon, squash, and cucumber. Anthrancnose (*Colletotrichum* spp.), gummy stem blight/black rot (*Mycosphaerella melonis*), Alternaria leaf spot (*Alternaria cucumerina*), and Microdochium blight (*Plectosporium* sp.) were found at serious levels in fields of several different cucurbit crops. Pumpkin and squash powdery mildew (*Erysiphe cichoracearum*) also caused losses. Bacterial diseases of cucurbits included bacterial wilt (*Erwinia tracheiphila*) and cucurbit yellow vine decline caused by *Serratia marsescens*. However, incidence of the latter was lower than in previous years. Foliar disease in cucurbits is often attributed to poor spraying techniques. The causes of poor spraying are poor timing, poor coverage, or use of the wrong fungicides, even if being sprayed regularly.

Other Vegetables. Bean root and stem rot (*Rhizoctonia solani, Pythium* spp.), anthracnose (*Colletotrichum lindemuthianum*), and angular leaf spot (*Phaeoisariopsis griseola*) were observed this year.

Growers are urged to notify their county extension agent of new outbreaks and disease trends in their fields. We want to be especially watchful of the new spectrum of microbes and diseases that may occur with changes in fungicide use patterns, from broad-spectrum protectant fungicides such as Manzate and Bravo, to new chemicals such as Quadris, Sovran, and Abound. These three present a greater risk of pathogen resistance to the fungicide while incurring reduced risks to human health and the environment. For example, we have noted increased bacterial diseases in tomatoes and want to know if this is due to use of new chemicals or how we raise our crops, manage other diseases, or import seeds and transplants.

Because fruits and vegetables are high-value crops, the Plant Disease Diagnostic Laboratory should be a great value to commercial growers. However, many growers are not using the laboratory often enough, or they are waiting until their disease problems become well established. By then, it may be too late to do anything about them, or in some cases to correctly diagnose the sequence of diseases that may have led to the final outcome. Growers need

to consult consistently with their county Extension agents so that appropriate plant specimens are sent to the laboratory quickly. We are urging county Extension agents to stress in their Extension programming the need for accurate diagnosis of diseases of high-value crops. Growers can work with their agents so that Kentucky growers have the best possible information on fruit and vegetable diseases.

Literature Cited

1. Bachi, P.R., J.W. Beale, J.R. Hartman, D.E. Hershman, W.C. Nesmith, and P.C. Vincelli. 2005. Plant Diseases in Kentucky—Plant Disease Diagnostic Laboratory Summary, 2004. University of Kentucky Department of Plant Pathology (in press).

Appendix A: Sources of Vegetable Seeds

We would like to express our appreciation to these companies for providing seeds at no charge for vegetable variety trials. The abbreviations used in this appendix correspond to those listed after the variety names in tables of individual trial reports.

AAS ..... All America Selection Trials, 1311 Butterfield Road, Suite 310, Downers Grove, IL 60515
AS/ASG ..... Formerly Asgrow Seed Co., now Seminis (see "S" below)
AC ..... Abbott and Cobb Inc., Box 307, Feasterville, PA 19047
AG ..... Agway Inc., P.O. Box 1333, Syracuse, NY 13201
AM ..... American Sunmelon, P.O. Box 153, Hinton, OK 73047
AR ..... Aristogenes Inc., 23723 Fargo Road, Parma, ID 83660
AT ..... American Takii Inc., 301 Natividad Road, Salinas, CA 93906

B ..... BHN Seed, Division of Gargiulo, Inc., 16750 Bonita Beach Rd., Bonita Springs, FL 34135
BBS ..... Baer's Best Seed, 154 Green St., Reading, MA 01867
BK ..... Bakker Brothers of Idaho Inc., P.O. Box 1964, Twin Falls, ID 83303
BR ..... Bruinsma Seeds B.V., P.O. Box 1463, High River, Alberta, Canada, TOL 1B0
BS ..... Bodger Seed Ltd., 1800 North Tyler Ave., South El Monte, CA 91733
BU ..... W. Atlee Burpee & Co., P.O. Box 6929, Philadelphia, PA 19132
BZ ..... Bejo Zaden B.V., 1722 ZG Noordscharwoude, P.O. Box 9, the Netherlands

CA ..... Castle Inc., 190 Mast St., Morgan Hill, CA 95037
CF ..... Cliftons Seed Co., 2586 NC 43 West, Faison, NC 28341
CH ..... Alf Christianson, P.O. Box 98, Mt. Vernon, WA 98273
CIRT ..... Campbell Inst. for Res. and Tech., P-152 R5 Rd 12, Napoleon, OH 43545
CL ..... Clause Semences Professionnelles, 100 Breen Road, San Juan Bautista, CA 95045
CN ..... Canners Seed Corp., (Nunhems) Lewisville, ID 83431
CR ..... Crookham Co., P.O. Box 520, Caldwell, ID 83605
CS ..... Chesmore Seed Co., P.O. Box 8368, St. Joseph, MO 64508

D ..... Daehnfeldt Inc., P.O. Box 947, Albany, OR 97321
DN ..... Denholm Seeds, P.O. Box 1150, Lompoc, CA 93438-1150
DR ..... DeRuiter Seeds Inc., P.O. Box 20228, Columbus, OH 43320

EB ..... Ernest Benery, P.O. Box 1127, Muenden, Germany
EV ..... Evergreen Seeds, Evergreen YH Enterprises, PO Box 17538, Anaheim, CA 92817
EX ..... Express Seed, 300 Artino Drive, Oberlin, OH 44074
EW ..... East/West Seed International Limited, P. O. Box 3, Bang Bua Thong, Nonthaburi 1110, Thailand
EZ ..... ENZA Zaden, P.O. Box 7, 1600 AA, Enkhuisen, Netherlands 02280-15844

FM ..... Ferry-Morse Seed Co., P.O. Box 4938, Modesto, CA 95352

G ..... German Seeds Inc., Box 398, Smithport, PA 16749-9990
GB ..... Green Barn Seed, 18855 Park Ave., Deephaven, MN 55391
GL ..... Gloeckner, 15 East 26th St., New York, NY 10010
GO ..... Goldsmith Seeds Inc., 2280 Hecker Pass Highway, P.O. Box 1349, Gilroy, CA 95020

HL/HOL ..... Hollar & Co. Inc., P.O. Box 106, Rocky Ford, CO 81067
H/HM ..... Harris Moran Seed Co., 3670 Buffalo Rd., Rochester, NY 14624, Ph: (716) 442-0424
HN ..... HungNong Seed America Inc., 3065 Pacheco Pass Hwy., Gilroy, CA 95020
HO ..... Holmes Seed Co., 2125-46th St., N.W., Canton, OH 44709
HR ..... Harris Seeds, 60 Saginaw Dr., P.O. Box 22960, Rochester, NY 14692-2960
HZ ..... Hazera Seed, Ltd., P.O.B. 1565, Haifa, Israel

JU ..... J. W. Jung Seed Co., 335 High St., Randolf, WI 53957
JS/JSS ..... Johnny's Selected Seeds, Foss Hill Road, Albion, MA 04910-9731

KS ..... Krummrey & Sons Inc., P.O. 158, Stockbridge, MI 49285
KY ..... Known-You Seed Co., Ltd. 26 Chung Cheng Second Rd., Kaohsiung, Taiwan, R.O.C. 07-2919106

LI ..... Liberty Seed, P.O. Box 806, New Philadelphia, OH 44663
LSL ..... LSL Plant Science, 1200 North El Dorado Place, Suite D-440, Tucson, AZ 85715

MB ..... Malmborg's Inc., 5120 N. Lilac Dr. Brooklyn Center, MN 55429
MK ..... Mikado Seed Growers Co., Ltd., 1208 Hoshikuki, Chiba City 280, Japan 0472 65-4847
ML ..... J. Mollema & Sons Inc., Grand Rapids, MI 49507
MM ..... MarketMore Inc., 4305 32nd St. W., Bradenton, FL 34205
MN ..... Dr. Dave Davis, U of MN Hort Dept., 305 Alderman Hall, St. Paul, MN 55108
MR ..... Martin Rispins & Son Inc., 3332 Ridge Rd., P.O. Box 5, Lansing, IL 60438
MS ..... Musser Seed Co. Inc., Twin Falls, ID 83301
MWS ..... Midwestern Seed Growers, 10559 Lackman Road, Lenexa, Kansas 66219

NE ..... Neuman Seed Co., 202 E. Main St., P.O. Box 1530, El Centro, CA 92244
NI ..... Clark Nicklow, Box 457, Ashland, MA 01721
NU ..... Nunhems (see Canners Seed Corp.)
NZ..... Nickerson-Zwaan, P.O. Box 19, 2990 AA Barendrecht, Netherlands

OE..... OhIsens-Enke, NY Munkegard, DK-2630, Taastrup, Denmark
OS..... L.L. Olds Seed Co., P.O. Box 7790, Madison, WI 53707-7790

P ..... Pacific Seed Production Co., P.O. Box 947, Albany, OR 97321
PA/PK..... Park Seed Co., 1 Parkton Ave., Greenwood, SC 29647-0002
PE..... Peter-Edward Seed Co. Inc., 302 South Center St., Eustis, FL 32726
PF..... Pace Foods, PO Box 9200, Paris, TX 75460

PG..... The Pepper Gal, P.O. Box 23006, Ft. Lauderdale, FL 33307-3006
PL..... Pure Line Seeds Inc., Box 8866, Moscow, ID
PM ..... Pan American Seed Company, P.O. Box 438, West Chicago, IL 60185
PR ..... Pepper Research Inc., 980 SE 4 St., Belle Glade, FL 33430
PT..... Pinetree Garden Seeds, PO Box 300, New Gloucester, ME 04260

R..... Reed's Seeds, R.D. #2, Virgil Road, S. Cortland, NY 13045
RB/ROB ..... Robson Seed Farms, P.O. Box 270, Hall, NY 14463
RC ..... Rio Colorado Seeds Inc., 47801 Gila Ridge Rd., Yuma, AZ 85365
RG..... Rogers Seed Co., P.O. Box 4727, Boise, ID 83711-4727
RI/RIS ..... Rispens Seeds Inc., 3332 Ridge Rd., P.O. Box 5, Lansing, IL 60438
RS..... Royal Sluis, 1293 Harkins Road, Salinas, CA 93901
RU/RP/RUP ..... Rupp Seeds Inc., 17919 Co. Rd. B, Wauseon, OH 43567

S ..... Seminis Inc. (may include former Asgrow and Peto cultivars), 2700 Camino del Sol, Oxnard, California 93030-7967
SI ..... Siegers Seed Co., 8265 Felch St., Zeeland, MI 49464-9503
SK ..... Sakata Seed America Inc., P.O. Box 880, Morgan Hill, CA 95038
SO ..... Southwestern Seeds, 5023 Hammock Trail, Lake Park, GA 31636
ST..... Stokes Seeds Inc., 737 Main St., Box 548, Buffalo, NY 14240
SU/SS..... Sunseeds, 18640 Sutter Blvd., P.O. Box 2078, Morgan Hill, CA 95038
SW ..... Seedway Inc., 1225 Zeager Rd., Elizabethtown, PA 17022
SY..... Syngenta/Rogers, 600 North Armstrong Place (83704), P.O. Box 4188, Boise, ID 83711-4188

T/TR ..... Territorial Seed Company, P.O. Box 158, Cottage Grove, OR 97424
TGS..... Tomato Growers Supply Co., P.O. Box 2237, Ft. Myers, FL 33902
TS..... Tokita Seed Company, Ltd., Nakagawa, Omiya-shi, Saitama-ken 300, Japan
TT..... Totally Tomatoes, PO Box 1626, Augusta, GA 30903
TW..... Twilley Seeds Co. Inc., P.O. Box 65, Trevose, PA 19047

UA..... US Agriseeds, San Luis Obispo, CA 93401.
UG ..... United Genetics, 8000 Fairview Road, Hollister CA 95023
US ..... US Seedless, 12812 Westbrook Dr., Fairfax, VA 22030

V..... Vesey's Seed Limited, York, Prince Edward Island, Canada
VL..... Vilmorin Inc., 6104 Yorkshire Ter., Bethesda, MD 20814
VS ..... Vaughans Seed Co., 5300 Katrine Ave., Downers Grove, IL 60515-4095
VTR..... VTR Seeds, P.O. Box 2392, Hollister, CA 95024

WI ..... Willhite Seed Co., P.O. Box 23, Poolville, TX 76076
WP ..... Woodpraire Farms, 49 Kinney Road, Bridgewater, ME 04735

ZR ..... Zeraim Seed Growers Company, Ltd., P.O. Box 103, Gedera 70 700, Israel