THE OHIO STATE UNIVERSITY EXTENSION

Extension FactSheet

AGF-106-01

Horticulture and Crop Science, 2001 Fyffe Court, Columbus, OH 43210-1096

Relay Cropping Wheat and Soybeans

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Winter wheat is harvested in late June through mid-July in Ohio. With the first killing frost occurring in mid-October most years, there is often time to produce a second crop following wheat harvest. Producing a second crop allows for the increased use of machinery, labor, and land during the year and a lowering of fixed cost on a per-acre basis, resulting in a more profitable farming operation.

There are two forms of multiple cropping: double cropping and relay cropping. With double cropping the second crop is planted following harvest of the first. Relay cropping consists of interseeding the second crop into the first crop well before it is harvested. Both systems are employed in Ohio, with double cropping being the preferred system south of I-70 and relay cropping to the north. The relay technique enables the production of a second crop in areas where time for a second crop following wheat harvest is inadequate.

Requirements

There are two primary requirements for profitable multiple cropping: 1) There must be adequate time for the production of a second crop. 2) There must be adequate water to produce two crops, whether from stored soil moisture, rainfall, or irrigation.

Because the soybean is photoperiod sensitive and matures in response to day length, it is ideally suited for multiple cropping systems where planting dates for the second crop can be variable due to weather and/or delayed wheat harvest. Currently, most multiple cropping systems depend solely on a combination of rainfall and stored soil moisture to supply adequate water for two crops. Irrigation can be used as a supplement for soils with a less-than-adequate water-supplying capacity and/or inadequate rainfall.

While irrigation can greatly increase the consistency of crop yields, it also increases the cost of production. In the eastern Corn Belt, the wheat crop generally removes water from only the top foot of soil and rainfall is typically greater than three inches per month. If the top three inches of soil are dry when the second crop is planted, germination and early plant growth are either prevented or greatly slowed until the receipt of adequate rainfall. There must be adequate surface soil moisture to enable the root system to grow into the subsoil where water availability is more consistent.

Because the water requirement is so large for multiple cropping, it is generally most successful on soils with large water-supplying capacities that are sometimes referred to as “good corn soils.” These soils are typically deep (54" to 72"), with loamy textures throughout the soil profile, and have high water-supplying capacities in the range of 0.15 – 0.25 inches of available water per inch of soil. They also have good internal drainage (either natural or artificial) and little restriction to root development and water movement such as zones where the soil bulk density is greater than 1.6.

Depending on the weather during the growing season, we can produce about 2.5 bushels of soybean for each inch of rainfall and water removed from the soil. A wheat crop will usually use about six to eight inches of rainfall/soil water. The receipt of 18 inches of rainfall during May through September will usually allow the production of a 70-bushel wheat crop followed by a 30- to 40-bushel soybean crop.

Soil pH throughout the rooting zone should be in the range of 5.8 to 7.2 (plow layer 6.5 to 7.0) to allow for maximum root growth and water uptake. Soil permeability should be greater than 0.6 inches per hour to allow rainfall to move into and through the soil. The shrink-swell potential should be low to moderate to reduce damage to the root system as the soil dries and cracks.

Assuming that the two primary requirements discussed previously are met, the secondary requirements for successful multiple cropping are the same as those needed for successful full-season crop production. Early planting; narrow rows; appropriate seeding rates; weed, disease and insect control; selection of appropriate varieties; and providing adequate nutrition must all be part of an integrated, well-balanced production system. However, the profitability of a multiple cropping system is more influenced by the adequacy of the water supply for the second crop than by any other factor.

The Relay Cropping Cultural System

Wheat

Select a medium to early-maturing variety with tolerance and/or resistance to the common diseases of the area, excellent winter hardiness, and standability. Seed in rows spaced 15 inches apart as soon after the fly-safe date as possible at the recommended 25 seeds per foot of row. This row spacing and seeding rate cuts the seed cost in half. The yield reduction due to the use of 15-inch rows is typically 5% to 15%, which is offset by a reduction in seed cost and reduced severity of foliar disease. No-till seeding is recommended as a means of getting the crop established in a timely manner and will also reduce the severity of spring heaving by about 90 percent.

Soil phosphorous and potassium levels should be greater than 30 and 150 ppm, respectively. Twenty to 40 pounds of nitrogen should be applied at planting to encourage increased fall growth and earlier jointing and heading in the spring. Spring nitrogen applications should be made between March 1

and April 15 at the rate of 1.35 pounds per bushel of yield goal less eight pounds for each percent of soil organic matter. If the previous crop was a legume, then the nitrogen application rate should be reduced another 20 pounds per acre. The seeding and nitrogen application rates described previously should not be exceeded to ensure that lodging of the wheat does not occur. The least amount of wheat lodging slows harvest, reduces grain quality, and increases the potential of damaging the soybean plants during wheat harvest.

Broadleaf weeds should be controlled with the application of appropriate rates of 2,4-D or other materials. Spring applications before jointing (usually April 15 – May 15) are preferred.

The wheat should be harvested at 17 to 20 percent grain moisture and dried. Test weights are highest when harvested at that moisture. Early wheat harvest removes competition with the soybean crop sooner and leads to greater soybean yields (typically 0.5 bu/ac/day). The combine cutter bar should be low enough to collect most of the wheat heads but high enough to miss the terminal growing point of the soybean plants. When the soybean growing point is removed, the yield potential of the affected soybean plants is reduced by 30 to 50 percent.

Soybean

A full-season soybean variety should be selected for use in relay cropping systems and coated with the new, patented, Intellicoat Polymer Seed Coating to delay germination until the head emergence stage of wheat. The Intellicoat polymer seed coating is a new product that is available from only one company, Fielders Choice at Monticello, Indiana. This seed should be inoculated at the time of planting between May 1 and May 15 and seeded at the rate of 6.0 seeds per foot of row and at a depth of 0.75 to 1.25 inches. At that time, the wheat plants are relatively small, and there is little chance of plant damage while planting the soybeans.

The tractor should have narrow tires (10 to 13 inches) so as not to run over rows of wheat plants. The planter may have row sensing and guidance equipment to guarantee proper row placement midway between wheat rows. Both grain drills and planters are satisfactory if the row-spacing is 15 inches, and the seed is metered uniformly and placed midway between the wheat rows at the desired depth of planting.

The relative maturity of the soybean should be classified as full season for a mid-May date of planting. If the exact maturity is not available, it is better to select a variety that is one or two days later, rather than earlier. The variety should have resistance or tolerance to the root-rot diseases common to the area and especially to Sclerotinia White Mold disease since it is usually found in the more productive fields which are ideal for relay cropping. The variety may be tolerant to Roundup to make weed control flexible, easy, and affordable.

The soil fertility levels described for wheat are also satisfactory for the soybean crop, so additional fertilizer is not required during the relay cropping sequence. Harvest of the relay crop soybeans will usually be the last harvested since they start flowering later than monocrop soybeans and have relatively late maturities. The use of short-season varieties for relay cropping is not recommended, because soybean yields are greatly reduced when short season varieties are used.

Table 1 shows the yield of wheat and soybean in monocrop and relay-crop production systems. Table 2 contains the combined costs and returns for one acre of wheat plus one acre of soybeans, compared to two acres of relay-cropping. In this example, the relay-cropping system produced $54.50 per acre more profit than the monocropping system.

Table 1. Three-Year Average Yield of Becker Wheat and Union, Regal, and Williams-82 Soybeans, Wooster, Ohio.

Row Arrangement	Wheat		Soybean	
	Bu/Ac	Percent	Bu/Ac	Percent
Monocrop*	71	100	48	100
14" rows, both crops	65	91	36	74
21" rows, both crops	60	84	38	79

* Wheat in 7" rows; soybean in 14" rows.

Table 2. Comparison of the Production Budgets of Monocrop Wheat and Soybeans with a Relay Crop System.

		Monoculture		Intercrop	
Item	**Unit Price**	**Wheat**	**Soybean**	**Wheat**	**Soybean**
Crop Yields		75	50	68	35
Receipts	**$3.00 $6.25**	**$225**	**$312**	**$204**	**$219**
Variable costs					
Seed		20	24	10	20
Fertilizer		35	19	31	13
Herbicides		4	24	4	12
Trucking, Fuel		11	11	10	9
Lub., Repairs, Misc.		31	38	30	33
Interest on Operating $		7	8	6	6
Total Variable Costs		**108**	**124**	**91**	**93**
Fixed Costs					
Labor (3 hrs)	$8.00	24	24	24	24
Machinery & Equip.		48	48	24	24
Land Ownership/Rent		80	80	40	40
Management (5% of Gross)		11	15	10	11
Total Fixed Costs		**163**	**167**	**98**	**99**
Total Costs		**271**	**291**	**189**	**192**
Return Above Costs		**(46)**	**21**	**15**	**27**
Net Return / 2 Acres		**($25)**		**$42**	**X 2 ac = $84**
Advantage for Relay Cropping 2 Ac.			**$109.00**		

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