AGRICULTURAL
GUIDE
Published by the University of Missouri-Columbia Extension Division

Wheat-soybean double crop management in Missouri

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Double cropping soybeans after winter wheat has grown in popularity and feasibility in much of Missouri. This cropping system has several advantages. A crop, growing on the land all year, provides control of soil erosion. If you spread annual fixed costs such as land, taxes, and machinery over two crops instead of one, you increase gross returns per acre with relatively low increases in production costs. Thus, you can increase profits per acre.

A successful wheat-soybean double crop depends on management and weather conditions. Establishing an adequate soybean stand and effective weed control are critical. In north Missouri, there are few days left in the season after wheat harvest for planting soybeans, and that's a constraint. So knowing the conditions to which doublecropping is best adapted will provide for a successful second crop. Also, it will enable you to avoid those years of high risk.

Double crop wheat management

A successful double crop system begins with proper management of winter wheat. A good, fully tillered, and adequately fertilized wheat stand usually suppresses weeds until harvest. The smaller the weeds in the wheat, the more easily they can be controlled in the soybeans. Where weeds are a problem in wheat, several herbicides are available to control broadleaved weeds and grasses. In selecting a herbicide, give consideration to both the type of weed problem and the potential residual effect of the chemical on the soybeans. Guide 4346 "Chemical Weed Control in Small Grains" outlines alternatives.

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Variety. An ideal wheat variety in a double crop system consistently produces high yields of high quality grain yet matures early enough to permit timely establishment of soybeans. In Missouri, high yield and quality are usually associated with early maturity. However, avoid very early flowering varieties because of the danger of frost damage.

Fertilization. Fertilizing for both crops at once is more practical than trying to make an additional application after wheat harvest. You'll save time at a critical period. Also, if you're not tilling the soybeans, the fertilizer will already be in the soil where it's needed. The higher fertility level may benefit the wheat. If the soybean double crop cannot be planted, the extra phosphorus and potassium applied remains in the soil to benefit subsequent crops.

Base the amount of fertilizer to be supplied on the soil fertility status and the crop yield expectations of both crops. Determine the soil fertility status with a reliable soil test, and base expected crop yield on past experience. Most Missouri soils require the application of both phosphorus and potassium to provide for the two crops in this system (see table 1).

Planting date. Wheat is a cool-season crop that grows at temperatures as low as 37 degrees F, although best growth is between 70 and 77 degrees F. It can be planted from early September to mid-November. But it's preferable to plant it in late September or early October in north Missouri and by mid-October in south Missouri.

If a variety is susceptible to the Hessian fly, delay planting until after the *fly-free date*. The *fly-free date*

Table 1. Fertilizer application rates for double crop wheat-soybeans as determined by crop yield and soil test values.

Double crop yield		Fertilizer recommended (pounds/acre)					
		Phosphorus Soil test level[1]			Potassium Soil test level[2]		
Wheat	Soybeans	low	med	high	low	med	high
— Yield(bu/A) —							
40	20	90	60	20	85	50	20
	30	100	65	20	95	70	25
	40	105	75	20	110	80	40
60	20	100	70	20	90	55	25
	30	110	80	20	105	75	30
	40	120	85	25	120	85	45
80	20	115	80	20	95	60	25
	30	120	90	25	110	80	35
	40	130	100	30	125	90	45

[1]Low, medium, and high Bray I phosphorus soil test levels are 10, 30, and 60 pounds phosphorus per acre, respectively.
[2]Low, medium, and high potassium soil test levels are 150, 250, and 350 pounds potassium per acre, respectively, for a soil with a cation exchange capacity (CEC) of 12. (See Guide 9111, "Using Your Soil Test Results.")

ranges from September 28 at the Iowa line to October 17 at the Arkansas line (see figure 1).

The best wheat yields often result from plantings made just after the *fly-free date.* Very early planting subjects the plants to attack by insects and certain diseases. Late planting results in less tillering, more chance of winter injury, and a lower yield. To compensate for the reduced tillering associated with late planting, increase the seeding rate. The planting date has little effect on when wheat matures unless emergence is delayed until spring.

Seeding rates. When you plant wheat at the recommended time, a seeding rate of 1½ bushels per acre is normally adequate. This amount may be adjusted up or down depending on the date of seeding and on seed size. If seed is excessively large, more bushels per acre will be needed to obtain the same plant population. Because wheat tillers well under favorable environmental conditions, higher than recommended seeding rates seldom result in yield increases, unless you plant very late in the fall.

Normally, wheat is planted into a prepared seedbed. Drilling into rows gives higher yields than broadcasting followed by incorporation. Tillage practices that leave some plant residue on the surface help retard erosion and reduce surface crusting, although these practices may increase insects and disease survival. Use a no-till system if you can achieve good weed control and seed placement in the soil. With the no-till operation, you must uniformly plant the proper number of seeds about 1 inch deep and cover them well.

Harvest. The yield of full-season soybean varieties decreases slightly more than 1 bushel per week as planting is delayed from early to late June. In July, yields decrease 3 to 5 bushels per week. The figures are greater in the north than in the south. Thus, it is important to harvest the wheat and plant the soybeans as early as possible, especially in northern areas of the state.

If you have grain drying facilities, consider harvesting the wheat at 19 to 22 percent moisture and drying it down. Besides permitting earlier planting of the double crop, early harvest results in less field loss from shattering and lodging.

Don't dry wheat at temperatures above 110 degrees F if it's to be used for seed or above 140 degrees F if it's to be milled.

Windrowing wheat is another alternative that permits early soybean planting. Wheat can be windrowed at moisture up to 40 percent. Generally, drying occurs more rapidly with windrowing than if it's left standing. Some home-made attachments move the windrows to allow planting immediately after cutting. But in either case, a windrower and pick-up attachment for the combine may be too costly to offset any gains made by earlier planting.

Straw management. Wheat straw can act as a surface mulch to conserve moisture, impede runoff, and prevent surface crusting. No-till practices are valuable in situations where moisture for germination is limited, as is normally the case at wheat harvest, and especially when planting is delayed after the wheat has been removed from the field.

However, residues can complicate planting and interfere with herbicides. These problems can be overcome with proper equipment and straw management.

In a no-till system, small grain residue should not be bunched or windrowed, unless it's to be baled and

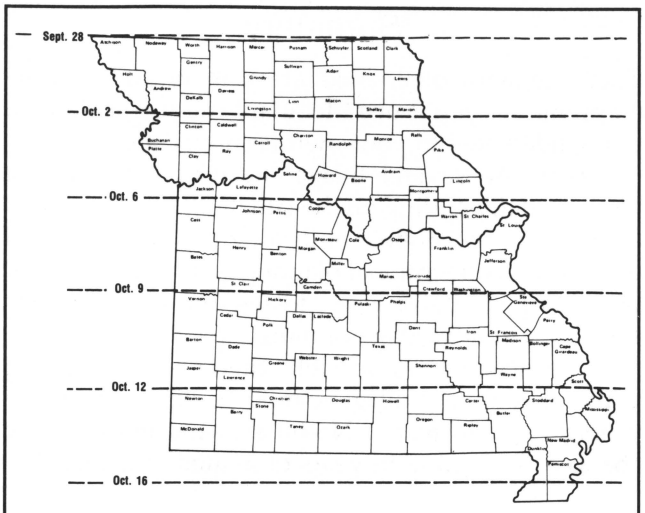

Figure 1. The map shows *fly-free* dates for Missouri.

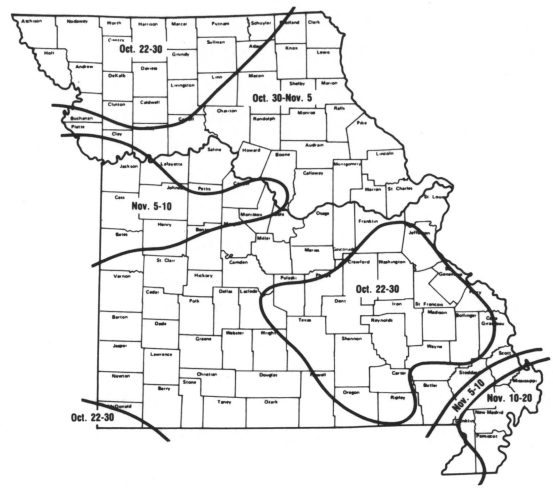

Figure 2. The map shows the average first occurance of 28 degrees F in the fall.

removed. Planters cannot penetrate such residue and still place seed at the proper depth. A simple way to manage wheat straw in a no-till system is to cut the wheat at normal height, shred the straw with a shredder attachment on the combine, and distribute it evenly on the field. If you can't do this, then one or two passes with a rotary chopper, set at 6 to 12 inches high, will shred and spread the straw.

Shade provided by standing stubble stimulates elongation of soybean stems and causes a higher first pod height. This makes harvest of the soybeans easier and reduces harvest losses. Yet, too high of a stubble height will produce spindly plants susceptible to lodging.

With no-till systems, burning the wheat straw to eliminate residue seldom produces yields greater than those achieved by chopping and spreading the straw.

Double crop soybean management

In many years, you should decide whether to double crop soybeans only after wheat harvest. Ask these questions: Is there enough moisture to germinate the soybeans? Is there enough of the season left for a reasonable crop to mature before first frost? Can other problems such as weeds be controlled? Avoiding problems greatly improves the long-term profitability of double cropping.

The planting decision. When double cropping, rapid germination and emergence of a uniform stand of soybeans is a key to success. Soil moisture is the critical environmental factor in determining whether or not you get a good stand. If the soil is too dry for prompt emergence, many seeds may die or emergence may be so late that the remaining season is too short for the crop to complete growth. So, if the top 2 inches of soil are dry, and if the soybeans would not germinate and emerge without additional water, then wait. If you don't get sufficient rainfall for stand establishment by the latest safe date to plant, then abandon double cropping for that year. The low probability of rainfall during late June and July (table 2) means that you won't double crop soybeans in some years, particularly in central and north Missouri.

The need to conserve available moisture through practices such as no-till is obvious. More importantly, however, following these practices also means that you eliminate the major source of failures in double cropping before you incur most variable costs associated with the soybeans.

If adequate moisture is available immediately below the 2-inch depth, an alternative is to use furrow openers or similar devices to move the dry top soil. Plant into the moist soil. However, do not plant deep to moisture without moving the dry top soil.

The last safe date to plant soybeans is determined by the amount of remaining growing season at a location. *At least 90 frost-free days* are needed for double crop soybeans to reach physiological maturity. Going back 90 days from the average date of the first killing frost in the fall gives you the last, average *safe* date to get double crop soybeans out of the ground.

Figure 2 shows the average dates of killing frosts in Missouri. In this figure, the temperature designating killing frost is 28 degrees F because soybean plants normally do not freeze until temperatures reach 28 to 29 degrees F. Even then, the effects that freezing has on the crop depend on its growth stage. When freezing occurs before physiological maturity, yield and quality are reduced. Physiological maturity coincides with maximum dry weight accumulation in the seeds and occurs when seed moisture is still 50 to 60 percent. A visible indicator is yellowing of the pod walls. After the beans have reached physiological

Table 2. Probability of rainfall during one-week periods in June and July in Missouri.

Location	Rainfall (inches)	Percent probability for the week ending: June 7	14	21	28	July 5	12	19	26	Aug 2
					%					
Clinton	0.6	78.2	58.4	57.5	40.8	45.2	35.7	39.9	36.5	46.0
	1.0	64.0	44.4	46.3	27.0	31.6	24.8	27.0	20.4	30.1
	1.2	56.1	38.1	41.5	22.1	26.5	20.7	22.0	15.1	24.3
Columbia	0.6	55.2	48.8	57.7	44.5	38.4	37.8	39.6	37.1	54.2
	1.0	38.8	35.5	41.7	30.9	25.8	24.1	24.7	23.2	37.5
	1.2	32.5	30.4	35.2	25.8	21.3	19.3	19.6	18.5	31.1
Hannibal	0.6	59.0	52.1	48.1	38.9	36.9	35.9	36.2	36.7	47.5
	1.0	40.4	39.2	33.3	20.0	23.7	24.1	25.6	23.9	32.8
	1.2	33.3	34.2	27.9	14.2	19.0	20.0	21.7	19.5	27.4
Kirksville	0.6	63.4	58.3	47.5	51.3	35.7	41.2	44.7	36.1	54.7
	1.0	46.2	45.8	34.5	35.3	23.1	28.7	35.0	22.8	39.2
	1.2	39.2	40.8	29.7	29.3	18.7	24.0	31.1	18.3	32.9
Poplar Bluff	0.6	53.8	46.7	48.5	47.6	32.0	36.0	42.4	40.2	37.3
	1.0	41.8	33.0	30.1	36.5	18.6	23.1	24.5	27.3	25.8
	1.2	36.8	27.7	23.3	32.0	14.3	18.6	18.3	22.6	21.6
St. Louis	0.6	53.6	46.6	43.6	36.6	36.5	33.8	36.4	33.4	46.0
	1.0	37.1	31.5	26.6	22.7	25.8	21.3	23.8	19.9	31.5
	1.2	30.8	26.0	20.8	18.0	21.9	17.1	19.4	15.3	26.2
Springfield	0.6	58.6	52.5	53.5	49.7	41.1	40.5	39.0	32.1	44.2
	1.0	42.1	40.9	39.6	34.1	28.4	27.0	26.9	19.9	30.6
	1.2	35.4	36.3	34.1	28.1	23.7	22.1	22.5	15.8	25.7
Trenton	0.6	61.2	60.5	57.9	57.8	45.8	42.1	21.4	45.2	50.3
	1.0	46.6	46.2	42.9	42.0	31.6	31.0	09.9	30.0	36.1
	1.2	40.8	40.2	37.0	35.7	26.4	26.8	06.8	24.5	30.7

maturity, moderate freezing does not affect soybean yield or industrial quality.

There is ample growing season in southeast Missouri for double cropping because of the relatively early wheat harvest (by June 20 to 25, 75 percent is harvested) and the late fall frosts. However, farther north, the interval between wheat harvest and fall frost narrows to just over 100 days. So while double cropping soybeans after wheat should be possible over much of Missouri, it is more difficult in the north than in the south.

Choosing a variety. When choosing a soybean variety for double cropping, maturity date is a primary consideration. Desirable varieties use as much of the remaining season as possible, yet they mature soon enough to avoid losses due to frost. Generally, they are medium-season varieties for the normal planting time in an area. These varieties should produce adequate vegetative growth to form the closed canopy needed for shading out weeds.

Varieties maturing too early are short, have pods closer to the soil surface, are more difficult to harvest, and are lower yielding. On the other hand, late varieties may have favorable growth but will still be green at the time a killing freeze is likely.

Because of their low height and short flowering period, the new determinate semi-dwarf and semi-determinate varieties should not be used for double cropping.

Research data have shown that when double cropping wheat-soybeans, a late Group 2 variety is well adapted to north Missouri, a late Group 3 to the central part of the state, and a Group 4 to southwest Missouri. Varieties of maturity Group 5 can be grown in the Delta Region.

In south Missouri, it is usually possible to double crop soybeans after winter wheat on a regular basis. However, in much of the state, it may be possible to grow only three crops in two years because of the shorter growing season.

After reaching physiological maturity, soybeans require about two weeks of field drying time. For example, in north Missouri, wheat should be seeded by the end of October. But double crop beans are not likely to be harvested by that date. So if you waited to plant wheat, it would be too late for wheat to gain

Table 3. Suggested plant populations and seeding rates for no-till, double crop soybeans planted at various row widths.

Row width	Final stand desired	Seeding rate required[1]
inches	plants/ft.	lbs/acre
30[2]	9-10	85
20	7-8	100
15	5-6	100
7-10	3-4	135

[1]Assumes 60 percent emergence rate and approximately 3,200 seeds per pound.
[2]Avoid if possible.

This field has an excellent stand and residue cover in a no-till wheat-soybean double crop rotation.

sufficient winter hardiness. Therefore, it would be necessary to choose an alternate crop, such as corn the second year.

An alternative is to overseed wheat from an airplane or a highboy just before soybean leaf-drop. Then, the falling leaves form a mulch over the seeds. Except on light soils which dry out quickly, good wheat establishment has been obtained with this practice.

Row width. When soybeans are planted late into the normal growing season, there is less time for vegetative growth to take place. Less branching occurs in double crop beans; therefore, canopy development seldom fills the space between wide rows. According to research in Missouri, drilled or narrow rows (less than 20 inches) result in a 15 to 20 percent increase in yield over wider rows.

Doubling back with a row planter to split 30-inch middles is a useful technique for getting narrow rows. In a no-till system, being a little off center doesn't make much difference because there's no cultivation.

Seeding rates. In full-season soybeans, plant population can vary widely without affecting yield. However, in double cropped soybeans, an above average plant population may increase yield. Also, higher seeding rates are recommended (see table 3) where soybeans are planted in no-till fields and there is difficulty in controlling depth or getting good slot closure. A rate of seven to eight seeds per foot is suggested for 20-inch rows. This normally requires 80 to 100 pounds of seed per acre. Table 3 shows that as row width decreases, the number of plants per foot of row should also decrease for better plant distribution.

Pest control. Most often in no-till, double crop soybean production, herbicides are required to control existing weeds and those emerging later. Herbicides such as Paraquat or Roundup can be used to control existing vegetation after harvest. Paraquat can be used on small annual weeds. Roundup can be used on most all weeds but would be preferable to Paraquat on large or perennial weeds. On heavy straw residue, getting herbicides to penetrate through the straw to the small weeds underneath is sometimes difficult. Some growers have found it useful to mount a spray bar under the combine to spray this small vegetation before spreading the straw.

Pre-emergence grass and broadleaf herbicides are often needed to control weeds which emerge after planting. Many of the pre-emergence chemicals labeled for conventional planting are labeled for no-till application with Paraquat and Roundup. Although heavy straw cover may reduce the amount of herbicides that reach the soil, a rain a few days after planting often washes most of the chemical off the straw and into the soil. Using the higher end of the range of herbicide rates recommended for your soil type may also help get more herbicide on to the soil surface. When available, granular formulations could be used because they are not as easily intercepted by straw.

When there is some question as to the success of establishing a stand of soybeans or where residues are heavy and there are few weeds, some growers rely on postemergence herbicides. If a poor stand results or only certain weeds are a problem, then you won't be spending money on unnecessary herbicides. The problems with relying entirely on postemergence chemicals are:

- they may be more expensive in the end,
- weeds may be too large when treatment is initiated for effective control, and
- weeds already growing continue to compete for scarce moisture until they are suppressed or killed.

First, determine your weed problems and existing conditons, and then *read herbicide labels* for the proper usage and application recommendations. See Guide

4905, "Herbicides for Conservation Tillage," and Guides 4436 and 4437 "Chemical Weed Control for Soybeans" for help with these decisions.

Double crop soybeans often escape some of the pests that cause problems on full-season beans. However, severe pest damage can be more serious to double crop beans because plant foliage is minimal and all available leaf area is needed for good production. So what may be minor damage on large full-season beans may be serious damage on double crop beans and thus require treatment earlier. Be aware that because expected double crop yields are lower, you'll have to give serious consideration to the potential productivity and economics of the double crop beans before initiating any expensive treatments.

Summary

There are many diversified factors involved in double cropping. So you'll need to adapt the suggestions in this guide sheet to your own farming conditons.

There are several tillage practices that may be successful depending on the situation. Such methods as chiseling the stubble or disking may open the soil enough for conventional planting equipment without permitting excessive water losses. But no tillage has the clear cut advantage of moisture conservation.

If no tillage is not feasible, then double cropping with conventional tillage should be limited to those years of ample water. No-till systems improve the chances of planting in years of limited moisture.

■ Issued in furtherance of Cooperative Extension Work Acts of May 8 and June 30, 1914 in cooperation with the United States Department of Agriculture. Leonard C. Douglas, Director, Cooperative Extension Service, University of Missouri and Lincoln University, Columbia, Missouri 65211. ■ An equal opportunity institution.