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No-Till Soybeans

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Soybean acreage in Kentucky more than tripled during the 1970s from less than 500,000 acres in 1969 to more than 1.6 million acres by 1979. Currently, 1.2 million acres or more of soybeans are planted annually. A great concern for soil erosion developed due to this expansion onto marginal erodible land. Notill systems of soybean production make it possible to maintain productivity on erodible land while keeping erosion losses within tolerable levels.

Notill soybean production has become a successful practice in Kentucky for these reasons:

1. Notill is a less expensive and capital-intensive means of controlling erosion.
2. Soils readily adapt to notill.
3. Improved planting equipment and herbicides have made notill production more effective.
4. Notill has several advantages for doublecropping.

Soybeans rank first in Kentucky in acres of notill planted crops, with nearly 850,000 acres (or 2 of every 3 soybean acres in the state) planted notill in 1998. lt is estimated that more than 80 percent of the soybean acreage will be notill planted in the next 10 years.

NoTill Versus Conventional Tillage

Compared with conventional tillage, notill:

1. produces equivalent yields with good management,
2. reduces soil erosion 75 to 100 percent,
3. makes available 20 to 25 percent more soil moisture for crop use due to reduced water runoff and soil evaporation and increased water infiltration,
4. can save from 1/2 to 1 1/2 hours per acre in total production time,
5. can reduce energy requirements 50 to 75 percent,
6. intensifies land use through continuous production, multicropping, and the use of marginal land for row crop production, and
7. helps doublecropping succeed.

Soil and Moisture Conservation

Research has shown that the production of soybeans poses a greater risk of soil erosion than the other major grain crops. In an Illinois study, soil loss from conventional seedbeds was greater following soybeans (11.4 tons/acre) than following corn (5.7 tons/acre). Using notill reduced the soil loss from soybeans to 1.7 tons per acre. The serious problem of soil erosion in soybean production was noted in Tennessee in 1979 when it was estimated that 35 bushels of soil were lost for every bushel of soybeans produced on more marginal upland soils. Multiyear tillage studies in Mississippi using continuous soybeans on a highly erodible soil with a 5 percent slope provided further evidence that notill production reduces soil losses and water runoff (Figure 1).

Notill production also helps retain 90 percent or more of the crop residue. This protects the soil, reduces water runoff and soil evaporation, and allows more water infiltration. For every inch of water conserved, estimates indicate the yield potential for soybeans is increased by two bushels.

Planting Systems

Various types of residues, mulches, and cropping system rotations can be used for notill soybeans in Kentucky. A good mulch is of great value in producing successful notill soybeans. Effective management of the mulch requires knowledge of notill farming methods and effective use of herbicides to convert crop residues, cover crops, and sod crops into a mulch. Four commonly used notill soybean systems include planting in: 1) small grain stubble (doublecropping), 2) previous crop residues (corn, sorghum, and soybeans), 3) winter cover crops, and 4) a forage crop or sod.

Small Grain Stubble—This doublecrop combination of either wheat or barley followed by soybeans is a popular notill soybean production system in Kentucky. Nearly 90 percent of the double-cropped soybean acreage is no-till planted. A commonly used rotation that produces three grain crops in two years is corn followed by small grain and doublecropped soybeans.

Notill planting of soybeans reduces risks associated with double-cropping. Advantages of notill soybeans for doublecropping include:

1. immediate planting after small grain harvest,
2. lower labor, fuel, field operations, and machinery costs,
3. conserved soil moisture, and
4. nearly yearround surface cover. (If the small grain is aerial seeded into the previous crop prior to harvest or if it is notill drilled into the crop residues after harvest, the soil surface is never left without protective cover.)

Previous Crop Residues—Notill planting into the residue of a previous crop is a satisfactory method and is used mainly in a cornsoybean rotation system. Crop rotation is also effective in managing crop residues and controlling disease, insects, and weeds. No-till full-season soybean acreage has rapidly increased in recent years. In 1998, more than 50 percent of the full-season soybean acreage was no-till planted in Kentucky.

Winter Cover Crops—A variety of winter cover crops can be successfully fallseeded to provide a suitable mulch for notill soybeans. Perennial cover crops generally take more time and expense to produce a mulch than do annual cover crops. Small grains are the most commonly used cover crops in Kentucky since they can be seeded later in the fall, provide better cover during the winter, supply more growth in early spring, and are less expensive to establish. Wheat or barley is commonly used because of their value in doublecropping. Small grain cover crops can be used for fall and early spring grazing, converted to a mulch, cut for hay or silage, or allowed to mature for grain harvest. The small grain can be established by drilling, broadcast seeding followed by disking, or aerial seeding. Aerial seeding of small grain into standing crops provides a quick method for establishing a cover crop, but its success is weather dependent.

Forage Crop or Sod—Notill planting of soybeans into a perennial grass or legume sod is presently limited in Kentucky. This system has presented more risks since herbicides for notill soybeans in sod have not been as successful and consistent as desired.

Production Techniques

Production of notill soybeans requires better managerial skills than conventional tillage. The following production factors are important.

Soil Adaptability—Notill has had the most success on welldrained and moderately welldrained, medium- textured soils in Kentucky. Poorly drained, heavier-textured soils are not as well adapted to notill and require more skillful management.

Planting Date—In Kentucky, you will obtain your best results when soybeans are planted between May 1 and June 15 with soil temperatures at planting depth above 65°F. Since yields decline rapidly after midJune, doublecropped soybeans should be planted as soon as possible. Besides using notill, you can plant early by: 1) using earlier-maturing wheat varieties, 2) removing small grain as silage or hay, 3) using barley, which matures earlier than wheat, 4)

harvesting wheat at high moisture (18 to 24 percent) and drying it down, and 5) swathing the wheat.

Planting Equipment—Notill planters require: 1) a coulter mounted ahead of the seed opener to cut through residue and penetrate the soil, 2) a seed opener to place seed in the soil, and 3) a press wheel to firm the soil over the seed to ensure good soilseed contact.

Planter adjustment is important for notill planting. The most frequent problems with coulters are failure to cut through residue cleanly and inadequate soil penetration. Proper coulter selection, sharp coulters, and sufficient weight can overcome these problems. Adding additional weight to the planter under dry conditions or heavy residue may be necessary.

Generally, the coulter should run slightly deeper than the desired seeding depth. Under wet soil conditions, coulter depth may need to be adjusted so that the seed is not planted too deep. If the coulter throws soil out of the furrow, the soil is too wet, driving speed is too fast, or the coulter is inappropriate for the soil moisture and texture. The speed of planting should not exceed 3 to 4 miles per hour under most soil conditions.

Doubledisk seed openers are preferred because they cut through residue and disturb the soil less. The ribbed type is the most frequently used press wheel, but units that firm the soil from the side also work well.

Planting Depth—The soybean seed should be planted 1 to 2 inches deep, depending on soil moisture and condition. A uniform planting depth is vital, and depth control units next to the seed openers are helpful.

Seeding Rate and Row Width—Increasing the seed rate by 10 percent for notill helps ensure adequate stands, since emergence tends to be lower than with conventional tillage. Recommended seeding rates for notill soybeans are
30inch rows = 9 to10 seeds/foot,
20inch rows = 7 to 8 seeds/foot, and
10inch rows = 3 to 4 seeds/foot.

Recent research has shown that planting soybeans in rows narrower than 30 inches may produce greater yields under certain conditions. Doublecropped soybeans should be planted in rows that are 20 inches or narrower because of the later planting date and shorter growing season. Narrow rows allow earlier canopy closure, which also aids in shading out weeds and volunteer small grain. Research in Kentucky has shown a 3 to 8 bushel per acre yield advantage for notill doublecropped soybeans in 20inch or narrower rows as compared to 30inch rows.

Variety Selection—Soybean varieties recommended for conventional tillage will perform satisfactorily for notill plantings as well. For notill doublecropped soybeans, select a variety that will mature late enough to take advantage of the remaining growing season but will safely mature before the normal frost date. Medium to fullseason varieties commonly used for normal planting dates in an area will give the most vegetative growth, height, weed suppression, and yield. When planting after July 1, select a variety that is one maturity group earlier than normally used to ensure maturity before frost.

Fertilization—A soil pH of 6.2 to 6.8 and medium to high soil test levels for phosphorus and potassium are recommended for optimum growth and yield. Broadcasting applications of nutrients ahead of planting or to other crops in the rotation has proven satisfactory for notill if soil fertility levels are medium or above. When using notill for several successive crops, it is best to incorporate lime and fertilizer on soils of low fertility and pH prior to the start of notill. In a doublecropping system, lime and fertilizer for the soybeans can be applied to the small grain crop. No nitrogen is recommended for soybeans. Soybean seed should be inoculated with nitrogenfixing bacteria if soybeans have not been grown in the last 3 to 5 years.

Wheat Straw Management—Straw serves as a mulch and provides maximum moisture conservation and protection from soil erosion. However, straw can also present problems with doublecropping by complicating planting and stand establishment. It is also often blamed for poor herbicide performance. However, both of these problems can be overcome by:

1. leaving an 8- to 10-inch stubble when harvesting the small grain,

2. chopping the straw with a shredder attachment on the combine, and
3. uniformly distributing the straw back on the land with a spreader.

Another alternative is to bale the straw if there is a market. However, this eliminates some of the mulching effect and does require labor and time.

Weed Control—Failure to control weeds is one of the major reasons for unsuccessful results with notill. An effective weed control program for notill depends largely on herbicides since cultivation is usually impossible. Two types of herbicides are needed: 1) a "contact" or "burndown" herbicide to kill existing vegetation and 2) a residual herbicide to provide control throughout the growing season. Postemergence herbicides may also be needed later in the season to control escaped weeds. A minimum of 10 to 30 gallons of water per acre with 30 to 60 pounds of pressure is recommended to ensure spray coverage and penetration. Avoid notill in problem weed fields, particularly those with perennial weeds. Crop rotation will allow different herbicides to be used that can control a broader spectrum of weeds. In a notill doublecropping program, successful weed control begins with a good stand of wheat that will help suppress weeds.

Disease and Insect Control—It is important to examine fields frequently for any insect and disease problems. Leaving crop residues under proper weather and crop conditions may increase disease and insect problems. However, observations and limited research have not yet proven this to be a greater problem than with conventional tillage. Crop rotation and good agronomic practices are still very beneficial for reducing pest problems.

Yields

Yields for notill soybeans have been equal to or better than those with conventional tillage if good stands are obtained and weeds are controlled. Most failures in notill soybean production can be attributed to inadequate plant stands, poor weed control, heavier textured soils, or producer inexperience, all of which can be overcome through proper management.

Yield results for notill soybeans in Kentucky and Tennessee have been very comparable to those for conventional tillage (Table 1). In years of limited rainfall, notill yields were higher.

Table 1. Yield Comparisons of No-till and Conventional Tillage Soybeans.

Tillage System[1]	Tennessee[2] (1979-80)	Tennessee[3] (1976-80)	Kentucky[4] (1968-69)	Kentucky[3] (1976-78)	Kentucky[3,4] (1980-85)
	Soybean Yield (bu/A)				
No-Till S.C.	35		42		36
Conventional S.C.	33		39		35
No-Till D.C.		29		35	27
Conventional D.C.		26		33	24

[1]S.C. = single-crop and D.C. = double-crop.
[2]Planted following wheat cover crop.
[3]Planted following wheat stubble.
[4]Planted following previous crop residue.

Summary

Notill soybean production may not fit every situation; special weed problems, soil conditions, proper planting equipment, management skill, and other factors need to be considered. But using notill, along with other agronomic practices such as residue management, cover crops, sod waterways, and contour cropping, will provide adequate erosion control, maintain soil productivity, and still make it possible to produce large soybean acreages in Kentucky.

Figure 1. Soil and water loss as influenced by soybean cropping and tillage systems (graphed from data taken from "Summary of Reduced-Till Research." Miss. Ag. and For. Exp. Sta. Research Highlights. April 1982).

Soil losses can be severe with conventional tillage soybeans on sloping land.

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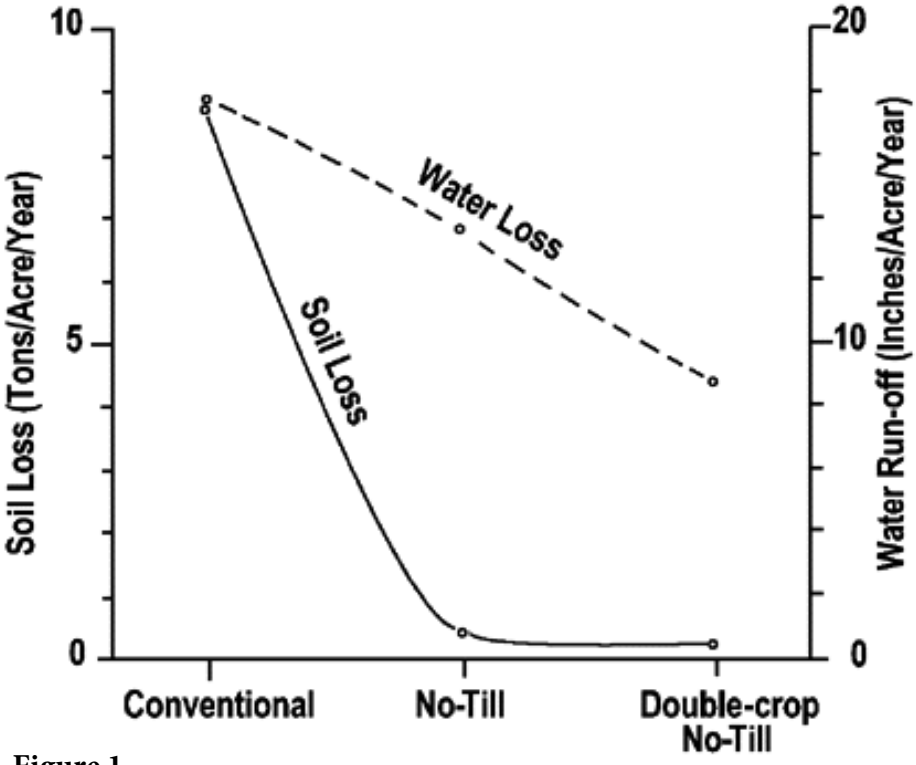

Figure 1