ALABAMA COOPERATIVE Extension SYSTEM

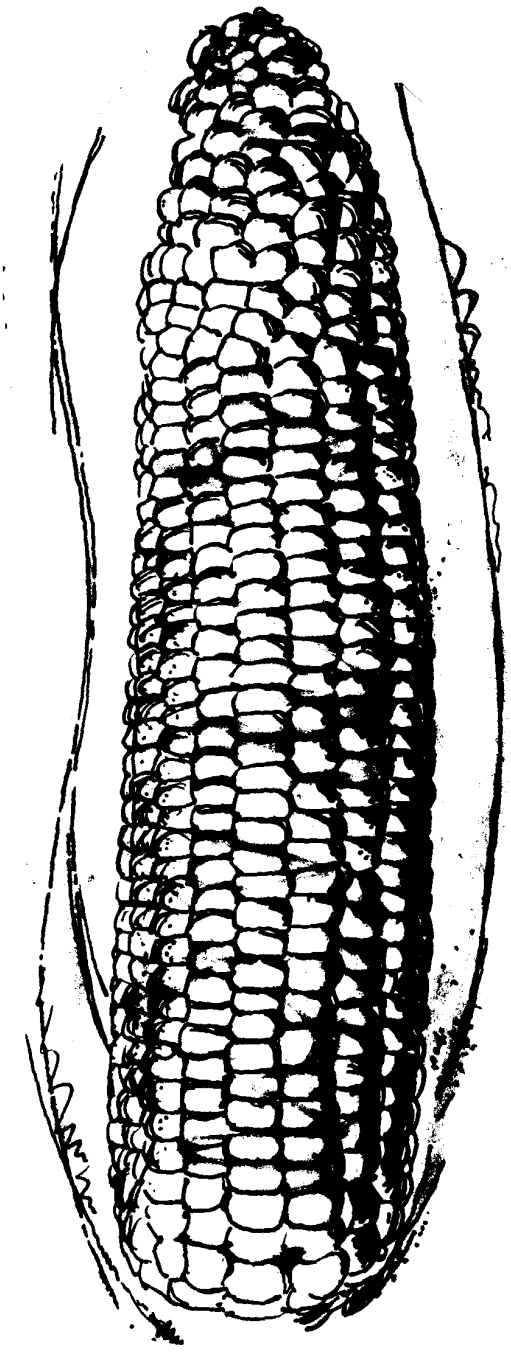
ANR-811

ALABAMA A&M AND AUBURN UNIVERSITIES

Conservation Tillage for Corn in Alabama

Conservation tillage crop production in Alabama can be traced back to attempts at mulch planting in the early 1960s. Mulch planting was done with lister planters, which tilled strips for the rows and left a crop mulch between the rows. The early systems had only limited success, however, since effective herbicides were not generally available and cultivation was difficult.

Because of greatly improved herbicides and no-till equipment, many acres of corn are being produced in Alabama today with conservation tillage. It is likely that this approach will be increasingly popular in the future.



Definitions

No-Tillage Planting. No land preparation (breaking, disking, etc.) is done before planting with this method. The planting process is accomplished in one trip over the field by opening a narrow trench in the soil into which the seed are placed. Normally, fertilizer or granular soil insecticides are applied at the time of planting. Knockdown herbicides are generally applied before planting. In most no-tillage systems, no land preparation or cultivation is done during production.

Conservation Tillage, Minimum Tillage, Or Reduced Tillage Planting. These terms may be defined in various ways, but they generally refer to any system that uses some tillage, but less than the conventional techniques of seedbed preparation. Any tillage system that maintains at least 30 percent of the soil surface covered by residue after planting is defined by the Soil Conservation Service as conservation tillage. The following refer to conservation tillage techniques.

Planting on a stale seedbed is the technique of preparing a seedbed several weeks or even months before planting time, then planting without further tillage. No-tillage equipment is preferred for this operation.

Ridge tillage is the technique of planting on ridges that are usually 4 to 6 inches higher than the row middles. At planting, only the tops of the ridges are tilled. Subsequent cultivation is used to re-build the ridges. Since the ridges are dryer and warmer than a level field, this technique allows earlier planting on clayey, wet soils.

Strip tillage allows about one-third of the soil surface to be tilled at the time of planting to prepare a narrow seedbed for the crop.

Advantages And Disadvantages

A major advantage of conservation tillage is improved conservation of soil and water. Few conservation practices are as effective as conservation tillage for preventing soil erosion. Consequently, conservation tillage can help prevent the long-term decline of a farm's productivity and yield potential because of soil erosion.

The 1985 Food Security Act specifies that farmers who have highly erodible fields must farm according to an approved conservation plan. Failure to farm in accordance with an approved conservation plan will result in the loss of all USDA farm program benefits. Therefore, a major advantage of conservation tillage is that it facilitates compliance with the 1985 Food Security Act and allows continued participation in USDA farm programs.

In Alabama, lack of adequate water is one of the greatest barriers to achieving high corn yields. An important advantage of conservation tillage is that soil moisture is conserved. Crop residues on the soil surface increase infiltration of water into the soil and decrease the amount of water that runs off. In addition, evaporation is reduced by residues on the soil surface. The minimum amount of residue required to reduce evaporation is about 31 percent groundcover; however, evaporation losses decrease steadily up to about 93 percent groundcover. To take maximum benefit of the moisture conserving advantages of conservation tillage, high levels of surface residue are required.

Conservation tillage cropping may increase yields, especially in dry years, through better moisture conservation. Root-pruning of row crops by cultivation equipment is eliminated in conservation tillage fields.

Another advantage of conservation tillage is reduced dependence on the weather at planting time. Valuable time is saved in land preparation, and labor requirements are reduced. Consequently, conservation tillage techniques make double-cropping easier.

Conservation tillage requires less energy, even though some of the fuel savings are offset by energy required for additional herbicides. In a Virginia study, 43 gallons of diesel fuel were required to produce, fertilize, and harvest an acre of corn using conventional planting plus herbicides for weed control. No-tillage production required 40 gallons, saving 3 gallons of diesel fuel per acre.

No-till planting also has disadvantages. One of the greatest of these is that specialized equipment such as a no-till planter and a shielded sprayer are required. More importantly, a producer must exercise timely management, especially in chemical weed control. Although labor and fuel are saved, a no-tillage producer's herbicide bill will likely be higher. Some weed problems may be worse with no-tillage plantings, especially in areas that are continuously no-tilled over several years. As with conventional tillage, crop rotations are highly recommended.

Soil And Site Adaptations

A fertile, well-drained soil is best for conservation tillage row-cropping. Sloping areas can be planted without tillage, but it may be difficult to keep planting depth constant if the area is extremely rough.

No-tillage planting should not be attempted on soils testing low in phosphorus, magnesium, or calcium or on soils with pH values lower than 5.8. Under reduced tillage, lime and some fertilizer nutrients cannot be incorporated into the rooting zone. Therefore, adequate fertility is necessary for successful no-till production. In addition to poor crop growth, some herbicides such as atrazine or Aatrex are much less effective on soils with low pH. Because conservation tillage cropping relies heavily on herbicides for weed control, the soil pH should be at an acceptable level before planting. It may take years for surface-applied lime to be effective in altering the pH of untilled soil.

Conservation Tillage Production Systems

Conservation tillage techniques are especially attractive in production systems that maximize land use. Double-cropping, sequential cropping, and other terms are used to describe situations in which crops are planted in close sequence. Alabama's climate is good for such cropping systems, and conservation tillage techniques make the systems easier to use.

No-tillage planting should take place in: (1) the killed sod of a cool-season perennial grass such as tall fescue; (2) the stubble of the previous crop; or (3) the stubble or killed stand of winter annuals. Winter annuals into which corn can successfully be planted by no-tillage methods include ryegrass, vetches, annual clovers, small grains (rye, wheat, oats, or barley), or some combination of these crops.

It is not advisable to use no-tillage techniques to plant into warm-season perennial crops such as bahiagrass, bermudagrass, or johnsongrass. No-tillage planting is most successful in areas where cool-season species precede the row crop. This is because cool-season species, if not completely killed, will offer little competition to the no-tilled crop. One basic idea of no-tillage planting is that the crop residue will provide benefits, including (1) conserving moisture; (2) reducing runoff and erosion; and (3) shading out weeds. In some situations, mulches can be harmful. Mulches may cause lower soil temperatures, and green mulches may rapidly reduce subsoil moisture. Except for highly erodible soils, it may be

more economical to plant into the previous year's residue instead of planting a winter cover crop. When winter cover crops are used, they should be killed 2 to 3 weeks before planting, especially if the cover crop stand is dense.

There are several possibilities for intensive land-use with conservation tillage production. If winter annual grasses or legumes are planted for forage and soil cover, they can be grazed or cut for silage, hay, or greenchop and then killed with the simultaneous planting of corn. When a legume is included in the mixture, some of the nitrogen fixed by the legume will be available for the corn crop. If winter annuals are grazed, nutrients recycled through the animals are also available for use by the following crop.

It is possible to plant winter annuals for grazing — or small grains for grain — behind early harvested no-tillage corn. Aerial seeding of winter annuals into a standing crop of corn can provide early establishment if adequate moisture is available and the timing of seeding is right.

Reseeding systems with winter legumes can reduce the cost of establishing the cover crop. For example, tropical corn can be planted late enough into crimson clover to allow the clover to mature seed. Planting soybean after crimson clover has mature seed allows corn to be planted into reseeded crimson clover the next year. This rotation only requires that the clover be seeded every other year.

Equipment Needs

No-tillage planting reduces the total equipment needed, but it requires a planter designed especially for no-tillage. Most major equipment suppliers offer no-tillage planters that will do a good job of planting in stubble or sod. No-tillage planters generally use a coulter to cut through the trash and till a narrow strip in front of the openers. Spring-loaded coulters force soil penetration and roll over rocks.

In hard, dry soil, penetration can be a problem. The weight of the planter will affect its ability to penetrate hard soil. So weight should be considered when selecting a no-tillage planter. Closure of the seed trench may also be difficult in hard dry soils. Cast iron press wheels may be useful in these situations.

When moisture is adequate in the top 2 inches of soil, penetration is not usually a problem with most no-tillage planters. Penetration in dry, hard soil is limited unless weights are added.

When planting in stubble behind a combine, a straw chopper may be necessary to keep straw from building up ahead of the coulters. The coulters will generally cut through a small amount of straw, but when the straw is windrowed, proper planting may be a problem.

No-tillage planters with in-row subsoiling capability have been successfully used in Alabama. Increased yields are likely from in-row subsoiling in fields with a hardpan that restricts root growth.

A no-tillage subsoiler planter requires 35 to 40 horsepower per row. This power requirement is a problem on many farms. Even if the power is available, planting is slow. Producers using conventional equipment can plant two or three times as many acres per day as they can with a no-tillage subsoiler planter.

Because of the increased herbicide costs usually associated with no-till, a shielded sprayer should be available. This tool permits the use of broad-spectrum herbicides at an economical cost.

Planting Practices

Planting Date. Soils with mulches tend to be cooler in the spring than bare soil. If corn is planted too early, seed germination may be reduced and seedling growth may be slowed by lower temperatures. This can be a serious problem on soils that have poor drainage, since they tend to be especially slow in warming up in the spring under no-tillage conditions.

Suitable soil temperatures for good seed germination and rapid seedling growth without tillage can usually be obtained on soils with good drainage by delaying early season planting 7 to 10 days later than conventional planting. A good guideline for corn planting into a mulch is to delay planting until the soil temperature has reached 55° to 60°F. Soils with poor drainage are less desirable for no-tillage planting.

Excessively late planting frequently results in reduced yields; thus, it is advisable to plant as early as moisture and soil temperatures permit. However, the penalty for late planting may be less with no-tillage than with conventional tillage, making it particularly attractive if corn must be planted late.

Depth Of Seed Coverage. Corn seed should be placed at a depth of 1 to 1½ inches when the soil is cold. Corn can be planted up to 2 inches deep later in the season. No-tillage planters frequently leave a trench or depression behind the press wheel. The depth of seed coverage under these conditions is the distance from the seed to the surface of the soil in this depression.

Uniform seed placement is more difficult when planting into sod or mulches under no-tillage conditions than it is when planting into a prepared seedbed. Failure to achieve the desired depth of coverage can result in poor stands. Careful planter operation at reduced speed can reduce uneven placement problems.

Planting Rates. No-tillage corn planting requires 10 to 15 percent more seed than planting under con-

ventional tillage systems. Primarily this is because of less uniform seed placement. Stand loss to insects and other pests may also be greater. Seed spacing should therefore be adjusted to compensate for the expected losses.

Varieties. Varieties suitable for conventional corn production have generally proven suitable for conservation tillage production. Conservation tillage systems that involve double-cropping usually dictate that early maturing hybrids be grown. Information on corn varieties is available from your county Extension office.

Fertilization And Liming

Soil testing to determine lime and fertilizer requirements is basic for good corn yields. Make sure soil pH is above 5.8 (by incorporating lime into the upper 8 inches of soil) before attempting reduced tillage practices.

Soil acidity may become severe near the soil surface with continuous no-tillage production systems if not corrected by liming. Yield reductions and poor weed control can be expected when this occurs. If possible, apply lime at a time in the crop rotation when it can be incorporated into the soil. Frequent surface applications of lime are effective in maintaining a favorable pH but may be slow in overcoming a low pH at depths of several inches.

Starter Fertilizer

Recent research at Auburn University indicates that conservation tillage corn responds favorably to starter fertilizers containing nitrogen and phosphorus even when soil phosphorus levels are high. Yield responses to starter fertilizers have ranged from 0 to 40 bushels per acre. For most situations, 100 pounds per acre of 20-18-0 (N-$P_2 0_5$-$K_2 0$) should be adequate. For soils testing medium in phosphorus, all of the recommended phosphate can be applied in the starter fertilizer. On sandy soils, sulfur (10 pounds per acre) and zinc (3 pounds per acre) can be included. Make sure starter fertilizers are not banded too close to the seed.

Broadcast Fertilizer

All of the phosphorus and potassium and a portion of the nitrogen can be applied at planting time with no-tillage corn. Another alternative is to apply the phosphorus and potassium in the fall to a winter cover crop that is to precede a no-tillage corn crop. Apply lime at this time if an adjustment in soil pH is needed.

The broadcast surface applications of most fertilizer materials have proven effective in no-tillage corn production. If anhydrous ammonia is used, it must be injected into the soil as it is in conventional tillage systems.

If urea or urea-based nitrogen fertilizers are surface applied in a no-till system, gaseous losses of ammonia may be substantial. These materials should not be broadcast. If they are surface applied, they should be banded. Losses of ammonia can be minimized if these materials are incorporated by irrigation immediately after they are applied or injected into the soil. Remember that 28-, 30-, and 32-percent nitrogen solutions contain approximately 50 percent urea.

Nitrogen Rates

Fertilization with adequate levels of nitrogen is required for good corn grain production on all Alabama soils. The cost of nitrogen is the largest single variable cost in corn production. Carefully consider the rates used and the method of application.

The optimum economic rates of nitrogen fertilization are usually near, but may not be identical to, the rates that result in the maximum-yield response. At high application rates, additional nitrogen may produce a slight yield response, but this may not be enough to pay for the additional expense. A worksheet for determining optimum rates of nitrogen is shown below.

Split Nitrogen Applications. Part of the nitrogen (up to one-third) may be applied at planting. Apply the rest of the nitrogen at the six-leaf to ten-leaf stage.

Standard rate	120 pounds per acre
For productive sandy soils, add 30 pounds.	_____
If crop is planted into a small grain stubble, add 30 pounds.	_____
If crop follows good soybeans (greater than 40 bushels per acre), subtract 30 pounds.	_____
If crop follows a good winter legume, subtract 30 to 60 pounds.	_____
If dryland yield potential is greater than 150 bushels per acre, or if irrigated, add 60 pounds.	_____
If starter fertilizer is used, add 20 to 30 pounds.	_____
Total nitrogen recommended for season (final rate should not exceed 200 pounds per acre).	_____

Weed Management

Weed management in no-till corn depends almost entirely on foliar and surface-applied herbicides. In most conservation tillage corn situations, corn is planted into an existing cover crop such as rye, ryegrass, small grains, clovers, or vetch. Kill actively growing cover crops 10 to 14 days before corn planting. These cover crops can be killed with either Gramoxone Extra or Roundup. Use Gramoxone, a

contact herbicide, at the rate of 1.5 to 3 pints per acre with a suitable non-ionic surfactant. Use Roundup at the rate of 1 quart per acre. Improved cover crop kill would be realized with the addition of atrazine. An additional application of Gramoxone or Roundup may be required at planting to control cover crops not killed by the earlier treatment. Failure to control the existing cover crop by planting time may result in severe competition with developing corn plants, rapid soil moisture depletion, and a reduction in corn stand.

In situations where corn will be planted into fields with a sparse cover or old crop residue, Gramoxone or Roundup can be used at planting time to control existing vegetation. The selection of either Gramoxone or Roundup and the appropriate use rate is dependent upon several factors. Gramoxone at the rate of 2 pints per acre will control many weeds that are less than 3 inches tall. The rate of 2½ to 3 pints per acre of Gramoxone must be used when weeds are between 3 and 6 inches tall. If weeds are taller than 6 inches, Gramoxone will provide less than adequate control of the weeds. Gramoxone must be used with a non-ionic surfactant (X-77) at the rate of 1 pint per 100 gallons of spray mix.

Weeds such as crabgrass, fall panicum, lambsquarters, horseweed, common ragweed, and cutleaf eveningprimrose are difficult to control with Gramoxone. Roundup is more effective in controlling these troublesome annual weeds. In no-till corn, Roundup at the rate of 2 pints per acre is used primarily to control annual weeds. This herbicide treatment will suppress the growth of some perennial weeds better than Gramoxone. The addition of a non-ionic surfactant to Roundup at the higher spray volumes (35 to 40 GPA) will improve weed control. Roundup has a labeled rate range of 2 to 8 pints per acre. However, the higher rates are very expensive and difficult to justify in most no-till plantings.

At planting time, a tank mixture of a contact herbicide plus one or more residual herbicides is frequently applied. Residual herbicides, such as Dual and Lasso, provide good preemergence control of many annual grasses and small-seeded broadleaf weeds. These herbicides offer little or no control of large seeded broadleaf weeds such as morningglory, sicklepod, and cocklebur. Residual herbicides, such as AAtrex or atrazine and Princep or simazine, provide fair to good control of many annual broadleaf weeds such as sicklepod, cocklebur, and morningglory. Mixtures of these two types of residual herbicides can provide broad spectrum control of most annual weed problems. Tables 1 through 7 provide the rates needed for the different tank mixtures labeled for no-till corn. Before using any of these tank mixtures, read the individual labels for additional application information.

Two other herbicides not listed in the tables are labeled for use with some conservation tillage corn. These herbicides are Prowl and Bladex. To use Prowl safely and effectively in conservation tillage corn, some seedbed preparation is needed before planting. Bladex can only be used safely on clay soils that contain at least 1 percent organic matter. The use of this material on sandy soils with low organic matter can cause crop injury or stand reduction.

Bladex, AAtrex, and Lasso are **RESTRICTED USE** pesticides. Before using any herbicide, read the labels carefully to determine if your planting situation is suitable.

Insects

Insect control is sometimes more difficult under conservation tillage than under conventional corn production. In some cases, plant-feeding insects may be present in the sod or in crop stubble at the time corn is planted. In other cases, the mulch may provide a more suitable habitat for the increase of some insects than would be provided by a bare seedbed. Insect control is also more difficult in situations requiring the incorporation of insecticides into the seedbed.

Experience can be helpful in anticipating insect problems. A switch to no-tillage should be gradual to allow adjustments to the new problems. Sod or crop stubble should be examined at corn planting time and recommended insecticides should be used to control problem insects. It is a good idea to apply a soil insecticide to no-tillage corn at planting to help control insects. Specific insect control recommendations are available from your county Extension office.

Table 1. Gramoxone And Surfactant Or Roundup + Atrazine + Princep.

Soil Texture	Atrazine			Princep		
	80W	4L	Nine-O	80W	4L	Caliber 90
	lb./A.	pt./A.	lb./A.	lb./A.	pt./A.	lb./A.
Coarse	1.25	2	1.1	1.25	2	1.1
Medium	1.5	2.4	1.3	1.5	2.4	1.3
Fine	1.8	2.8	1.6	1.8	2.8	1.6

Table 2. Gramoxone And Surfactant Or Roundup + Atrazine + Lasso EC.

Soil Texture	Atrazine			Lasso
	80W	4L	Nine-O	4EC
	(lb./A.)	(pt./A.)	(lb./A.)	(pt./A.)
Coarse	1.25-1.5	2-2.4	1.1-1.3	4-5
Medium	1.5-2	2.4-3.2	1.3-1.8	5-6
Fine	2-2.5	3.2-4	1.8-2.2	5-6

Table 3. Gramoxone And Surfactant Or Roundup + Atrazine + Dual 8E.

Soil Texture	Atrazine			Dual
	80W	4L	Nine-O	8E
	(lb./A.)	(pt./A.)	(lb./A.)	(pt./A.)
Coarse	1.5	2.4	1.3	1.5
Medium	2	3.2	1.8	2
Fine	2-2.5	3.2-4	1.8-2.2	2-2.5

Table 4. Gramoxone And Surfactant Or Roundup + Princep + Dual 8E.

Soil Texture	Princep			Dual
	80W	4L	Caiber 90	8E
	(lb./A.)	(pt./A.)	(lb./A.)	(pt./A.)
Coarse	1.2	2.4	1.3	1.5
Medium	2	3.2	1.8	2
Fine	2-2.5	3.2-4	1.8-2.2	2-2.5

Table 5. Gramoxone + Princep + Lasso EC

Soil Texture	Princep			Lasso
	80W	4L	Caliber 90	4EC
	(lb./A.)	(pt./A.)	(lb./A.)	(pt./A.)
Coarse	1.2-1.5	2-2.4	1.1-1.3	4-5
Medium	1.5-2	2.4-3.2	1.3-1.8	5-6
Fine	2-2.5	3.2-4	1.8-2.2	5-6

Table 6. Gramoxone And Surfactant + Atrazine.

Soil Texture	Atrazine		
	80W	4L	Nine-O
	(lb./A.)	(pt./A.)	(lb./A.)
Coarse	2.5	4	2.25
Medium	2.5	4	2.25
Fine	2.5	4	2.25

Table 7. Gramoxone And Surfactant + Princep.

Soil Texture	Princep		
	80W	4L	Caliber 90
	(lb./A.)	(pt./A.)	(lb./A.)
Coarse	2.5	4	2.25
Medium	3	4.75	2.7
Fine	3.75	6	3.4

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