PB1514

Cotton

Production

in

Tennessee

Contents

Cotton Production in Tennessee

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Cotton is an important crop in Tennessee and ranks third in terms of cash receipts from crops. For the last five years, cotton harvests have ranged from 445,000 to 660,000 acres. The lint yields per acre for the same time period varied from a high of 662 pounds of lint in 1997 to a low of 501 pounds in 1999.

The 1997 yield was 662 pounds of lint on 480,000 acres. The total number of bales ginned exceeded 660,600. In 1997, the total value of cotton including lint and cottonseed was $237.4 million.

Tennessee cotton production is hampered by a short growing season and frequent cool, wet weather in both spring and fall seasons. To produce and harvest more cotton per acre, follow recommended production practices in all phases of cotton production.

Field Selection

Cotton can be grown in many areas of the state on a wide range of soils. It is best adapted to soils that are moderately deep to deep with good drainage and high moisture-supplying capacity in the drier summer months. Cotton requires a large amount of moisture during flowering and fruiting stages (July and August) for high yields of lint. Well-drained soils will also tend to warm up early in the spring. Selecting longer fields will allow for more efficient use of equipment.

Seedbed Preparation

Good cotton stands may be obtained from different methods of seedbed preparation and planting methods where weeds are controlled. A firm, well-prepared seedbed is important for fast seedling emergence and uniform stands. On soils with erosion problems, delay tillage until late winter or early spring. However, prepare seedbeds early enough so they will settle and firm up before planting. To prepare a seedbed on heavy-textured Delta soils, bed the land in the fall or winter. At planting, till or use burndown herbicides to kill weeds, shape rows to the desired height and plant.

Lime and Fertilizer

The cotton plant is very sensitive to soil fertility and production level. It is important to supply all the nutrients that may be needed in each field. Many problems can be related either directly or indirectly to acid soils and low levels of plant nutrients.

Fertilization and liming programs should be based on the fertility of the soil. A good soil test is the first step in a sound fertility program. Samples should be taken during fall or early winter and sent to The University of Tennessee Soil Testing Laboratory for analysis and recommendations.

Lime

Soil test summaries from The University of Tennessee Soil Testing Laboratory indicate that many of the samples tested are too acid for best yields without adequate application of lime.

Yields will be highest and fertilizers used most efficiently when the pH is 6.0 to 6.5. Calcium supplied by ground limestone aids in setting fruit and proper maturing of bolls. Soil acidity will also influence the availability of some plant nutrients, herbicide activity, seedling development and seedling diseases.

Applying high rates of acid-forming fertilizers will gradually lower the soil pH. A 100-pound per acre application of nitrogen in the form of anhydrous ammonia, ammonium nitrate or urea would require approximately 400 pounds of limestone to neutralize the acidity resulting from the nitrogen application.

Nitrogen

General nitrogen recommendations are based on research by The University of Tennessee Agricultural Experiment Station. The amount of nitrogen needed depends on the soil and its previous cropping history. Generally, 60 to 80 pounds of nitrogen are needed on upland soils where excessive growth and late maturity are not a problem. On bottom soils, or sites where excessive growth is a problem, 45- to 60-pound rates should be considered.

The various nitrogen sources are similar in supplying nitrogen for plant growth. Nitrogen can be applied at or just prior to planting or may be split with sidedressing applications no later than early square stage. Anhydrous ammonia should only be used at planting time and placed 4 to 6 inches to the side and 6 inches below the level of the seed. Very low concentrations of ammonia can greatly reduce seed germination. Nitrogen deficiency symptoms first appear on the lower leaves. The leaves of nitrogen-deficient plants become light green to pale yellow. As they age, shades of red develop and then they turn to brown. Leaves then dry out and shed from the plant. The entire plant will be stunted and unthrifty in appearance and fruit set will be reduced.

Under nitrogen-deficient conditions, nitrogen can be applied to the soil as a sidedressing until about the third week of blooming. Applications of nitrogen to the soil may increase the risk of late-season growth.

Phosphorous (P_20_5)

The amount of phosphorous in a cotton plant is low compared to levels of nitrogen and potassium. Phosphorus fertilization is important to cotton production because it is essential for root development and early growth. Some cotton soils tend to be low in available phosphorus. Phosphorous is an immobile nutrient, so it must be available in the rooting zone for root contact and uptake into the plant.

Low phosphorous levels in the soil result in stunted plants. The leaves will be smaller than normal and dark green. Fruiting and maturity may be delayed, making the plant more vulnerable to insects and diseases. Low levels of phosphorous may reduce lint yield, fiber strength and micronaire.

The availability of phosphate to the cotton plant is dependent on a good liming program, as pH levels below 6.0 or above 7.0 result in reduced availability.

Potassium (K_2O)

Many soils on which cotton is grown are low in available potassium. It is not uncommon to see potash-deficient plants. Low levels of potassium cause stunted plants and leaves that fail to develop a normal green color. Mature leaves are often mottled after turning light yellowish-green, then reddish-brown between the veins of the leaf, before the discoloration spreads to the leaf margins. The tips and edges of the leaves curl downward. The leaves become reddish-brown, and are scorched and blackened by the time they are prematurely shed. Bolls are small, immature and may fail to open or only partially open. Lint yield and fiber properties are reduced.

The availability of potassium is influenced by the soil pH. Soil tests are necessary to determine both the lime and potassium needed for productive yields.

Over the last 10 years there has been an increase in potassium deficiency symptoms in cotton grown in West Tennessee. Problem fields may have adequate levels of potassium in the top 6 inches, but a low level in the subsoil. In some cases the pH level was also low, helping to create the deficiency.

Boron (B)

Boron deficiency on cotton is more likely to occur on limed soil, particularly after heavy lime applications. Apply boron at the rate of 0.5 pound per acre when soil pH is above 6.0 or where lime is used. Boron can be applied in mixed fertilizer or preemergence herbicides. To obtain .5 pound per acre of boron, apply 2.44 pounds "Solubor" per acre. For foliar application, apply 0.1 pound boron beginning at early bloom making three to five applications at weekly intervals.

Some boron deficiency symptoms may be:

- Abnormal shedding of squares and young bolls.
- Ruptures at the base of squares or blooms or on the stem (peduncle) that supports the squares.
- A darkened area at the base of bolls, extending inside the boll. (can be detected by cutting across the base of the boll.)
- Mature bolls that are small, deformed and do not fluff normally.
- Death of the terminal bud and shortened internodes near the top of the plant.
- Dark green rings on leaf petioles ("coon -tail" petioles). When petioles are sliced, a discoloration of the pith can be seen in conjunction with the rings.
- Dark green, often thicker leaves. Leaves remain until frost and may also be difficult to chemically defoliate.
- Poor response to nitrogen and potassium.

Fertilizer Placement

Research has shown that where soil fertility is high, broadcast application of fertilizer is just as effective as band application. If the soil fertility is low, best results would be obtained by broadcasting about one-half and banding one-half of the fertilizer. As the fertilizer rate increases, distance of the band placement from the seed should also be increased.

Starter Fertilizer

Response to starter fertilizer has not been very predictable. Most responses have been to nitrogen fertilizer alone or to nitrogen and phosphorous fertilizer combinations. Responses have been greater where cotton was planted no-till. Liquid fertilizers such as 10-34-0 or 11-37-0 can be used as starter fertilizers. An application of 12 gallons per acre of 10-34-0 would provide about 15 pounds per acre of N and 50 pounds per acre of P_20_5.

Caution: Fertilizer placed in direct contact with the seed may reduce seed germination.

Fertilizer Recommendations

Soil Test Level	**Phosphate (P_20_5) lbs./a**	**Potash(K_20) lbs./a**
Low	90	120
Medium	60	90
High	30	60

General fertilizer recommendations: In absence of a soil test, apply 60 to 80 pounds of nitrogen, 60 pounds phosphate (P_20_5), 90 pounds of potash (K_20) and .5 pound of boron (B) per acre at planting. Nitrogen may be split-applied one-half at planting and one half as side-dress.

Table 1: Ten Top-Yielding Cotton Varieties - 1998-99 Average[1]

Variety	Lint Yield lbs./A[1]	First Harvest %	Gin Turnout %
Paymaster PM 1220 BG/RR	1064	85.2	37.8
Sure-Grow SG 105	1039	78.9	34.4
Stoneville ST 474	1012	80.8	36.8
Paymaster PM 1220 RR	1003	82.3	37.0
Sure-Grow SG 747	999	80.3	36.1
Paymaster PM 1560 BG	990	82.3	35.0
Deltapine DP 5111	974	85.1	33.6
Deltapine DP 5409	969	81.7	34.8
Stoneville BXN 47	943	80.2	35.7
Sure-Grow SG 125	931	80.9	35.0

[1]Data from The University of Tennessee, Agricultural Experiment Stations located at Jackson, Milan and Ames Plantation.

Table 2: Top Ten Yielding Cotton Varieties - 1999 Average[1]

Variety	Lint Yield Lbs./A	First Harvest %	Gin Turnout %
Paymaster PM 1218 BG/RR	985	82.6	38.1
Paymaster PM 1220 BG/RR	904	85.2	37.1
Sure-Grow SG 747	876	82.1	36.4
Paymaster PM 1220 RR	863	84.2	36.5
Sure-Grow SG 105	858	80.9	34.5
Stoneville ST 474	857	83.8	37.4
Phytogen PSC 355	854	84.8	35.7
Deltapine DP 388	848	83.8	35.4
Paymaster PM 1560 BG	840	83.1	34.7
Sure-Grow SG 125 BR	838	80.4	35.0

[1]Data from The University of Tennessee, Agricultural Experiment Stations located at Milan, Jackson, Ames Plantation and Memphis Agri-center.

Variety Selection

Cotton variety tests are conducted each year at three locations in Tennessee to obtain performance information, which is then used to assist the producer in selecting varieties to grow. Varieties that perform above average for a number of years will be recommended to producers when seed are available.

Lint yield is the most important consideration in selecting a variety. Increased emphasis is being placed on fiber strength, length, length uniformity and micronaire.

The relative yield of a variety is influenced by a number of conditions such as soil type, fertility, cultural practices, insect control, weather, etc.

Recommended varieties and some of their characteristics are given in Tables 1 and 2. For more information see The University of Tennessee Agricultural Experiment Station Research Report, on "Performance of Cotton Varieties."

Early maturity of varieties is important in Tennessee because of the relatively short growing season. Early maturity helps reduce the losses from extended control of insects, especially the boll weevil. Early maturity may also help in reducing losses from diseases such as Verticillium Wilt and boll rot.

Planting

Many cotton producers find obtaining and maintaining a good stand of vigorous plants a problem each year in at least some fields. Seed quality may help determine the rate of emergence, vigor and even the yield of a crop of cotton.

Obtain all available information when selecting cotton seed. Make sure the seed has at least 80 percent germination and a cool test rating of at least 50. Seed with a good vigor rating will germinate and grow under a wide range of soil and field conditions. Also make sure the seed are treated with a good fungicide. The use of pure seed of recommended varieties enables producers to take full advantage of genetic improvements made in cotton by federal, state and commercial cotton breeders. When you plant certified seed, you are assured of high-quality seed with known germination and purity of variety.

Time of Planting

Satisfactory planting dates in Tennessee are April 20 to May 10. Weather conditions, soil type, the use of fungicides, etc. will help determine whether to plant early or late. Planting after May 20 will tend to reduce yields, require more insecticide applications and result in delayed harvest. The minimum temperature necessary for cotton seed germination is near 60 degrees, while optimum germination temperatures range from 85-95 degrees. With seed of average quality, the soil temperature should be 65 degrees or higher for good rate of emergence of healthy vigorous plants. Check soil temperature at a 2-3 inch depth at 8:00 - 10:00 a.m. for three to five days to make sure the seedbed has reached 65 degrees and warm dry weather is predicted for the next five to seven days.

DD-60's accumulated may be used to determine when to plant. Normally, emergence can be expected after 50 DD-60s have accumulated. Always delay planting when predicted temperatures will be below 50 degrees for the next two to three nights following planting.

Rate and Spacing

For maximum efficiency in weed and disease control, harvesting, etc., establish a population of 30,000 to 60,000 plants per acre. Excessive plant populations will cause higher fruiting on the plants, shorter limbs, smaller bolls and fewer bolls per plant. A stand of three to five plants per foot of row will require four to six seeds per foot of row under normal conditions.

The following table will help determine the row spacing required to obtain a desired plant population.

Estimated Plant Population Per Acre for
Various Row Widths and Plants Per ft. of Row

Plants Per foot of row	Various Row Widths and Plants Per Acre 30"	38"	40"
1	17,400	13,800	13,100
2	34,800	27,500	26,100
3	52,200	41,300	39,200
4	69,700	55,000	52,300
5	87,100	68,800	65,300
6	104,500	82,500	78,400
7	121,900	96,300	91,500
8	139,400	110,000	104,500

Depth of Planting

After carefully calibrating the cotton planter to plant the desired number of seed, check the depth seed are placed. Set the planter to place seed ½ to 1 inch deep. The depth will have to be rechecked when soil conditions change. Factors such as moisture, soil temperature, soil texture, crusting potential and type of seedbed should be considered. When planting ½ to 3/4 inch deep, take care to insure the seed are covered to prevent injury from surface-applied herbicides. As the soil warms and moisture is lost, the seed may be planted 1 to 1½ inches deep to allow planting in moist soil. Never plant cotton seed deeper than 1½ inches.

No-till Cotton Production

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Interest in no-till cotton production is increasing in Tennessee. Soil erosion, particularly in West Tennessee, is a problem that cotton producers must deal with to continue to grow cotton. Growers have conservation farm plans that require soil conserving measures to reduce soil loss. No-till cotton production is the most effective method to reduce soil loss and maintain production. In some fields, planting in last year's crop stubble may reduce soil losses to desired or required levels, while other fields may need cover crops, waterways, etc. to reduce soil losses to acceptable levels.

Research and farm demonstrations have proven that cotton can be grown without yield loss and reduced soil loss through no-till production. (See Tables 1 and 2.)

Field Selection

Soil and field selection for no-tillage cotton should be the same as for conventional-tillage cotton. Erosion problems should be controlled using waterways, rows arranged on contour and filter strips. Subsoiling would be beneficial only if tillage pans exist and/or extreme traffic has occurred. However, three or four years with no-tilling has been found to eliminate traffic pans. Heavy infestations of perennial grasses and vines should be avoided for no-tillage or the producer should plan for multiple herbicide applications during the growing season.

Vegetative Covers

Crop residues from cotton, corn, soybeans or grain sorghum may provide sufficient cover on some fields for erosion control. Where crop residues are not adequate, cover crops may be needed.

Cover crops that have been used in Tennessee include small grain (wheat and rye) and legumes (vetch, crimson clover or Austrian winter peas).

Small grains, especially wheat, are usually preferred for no-till cotton. Small grains have a fibrous root system and will do a better job of binding the soil particles together than clovers, thereby reducing soil erosion. Rye tends to grow tall and produce more ground cover. Excessive growth can interfere with planting, cause slow cotton emergence and could also produce tall, thin cotton plants. Legumes can be more difficult to manage. They are usually more difficult to kill and the nitrogen produced may cause the cotton to be difficult to manage in late season. Do not plant until cover crops and weeds are killed.

Planting Equipment

Use only planters designed for no-till. Planters should be equipped with heavy-duty down pressure springs for each unit. Planters without offset double-disk-openers should be equipped with a ripple or bubble coulter from 3/4 inch to 1 inch wide positioned in front of the double disc openers. The double disc openers should be followed by heavy-duty press wheels with adequate pressure to cover the seed firmly and insure good seed-to-soil contact. In extremely moist or dry conditions, cast iron press wheels may be necessary to insure proper seed coverage.

Additional weight may be added to the planter when soil conditions are dry or hard. The purpose of a coulter is to run directly in front of the double-disc opener, cut through the residue and prepare an immediate soil zone for seed placement. Coulters are tools that will help in most no-tillage situations; however, during much of the cotton planting season they may not be needed. This situation includes normal to above-normal moisture conditions. Offset double-disc openers perform well in all circumstances except dry conditions.

Stand failures in no-tillage were most often the result of planting in saturated soil conditions (too wet) or planting at a high rate or speed (too fast). Rules of thumb include "if it's too wet to disc, it's too wet to no-till." Modern planters may be operated at speeds of 5 to 6 miles per hour with proper soil conditions. Growers should evaluate field conditions as to residue and soil moisture and set the planter accordingly.

Weed Control

Kill vegetation prior to planting. Waiting until planting time can cause problems if you fail to get a complete kill of all plants.

Try to kill cover crop and weeds at least two weeks prior to planting. This will allow time for additional burndown applications if needed. The second burndown may be tank-mixed with the preemergence herbicides.

Roundup and Gramoxone Extra applied to row middles through a hooded sprayer have shown good results for control or suppression of various annual and perennial weeds in no-till cotton. Take care to avoid contact with cotton plants. See the Roundup and Gramoxone Extra labels for use rates on specific weeds. This treatment is not a replacement for a good post-directed herbicide program.

Herbicide tolerant varieties may be used to good advantage followed by timely overtop herbicides. Refer to the weed control section for more information.

Fertilizer and Lime

A sound fertility program is always necessary. Soil test and apply lime, phosphate or potash as needed in the fall or spring. Nitrogen should be applied just prior to, or at, planting at the rate of 60 to 80 pounds per acre. Use recommended rates and adjust according to field history, i.e. if cotton grows rank and is hard to manage, reduce the nitrogen rate.

Extensive research has been conducted evaluating starter fertilizer for no-till cotton. Results are inconsistent for 2-inch x 2-inch banding. Similar results were obtained for banding liquid starters over the planted row of cotton. Leguminous cover crops such as hairy vetch delay maturity and reduce yields. Hairy vetch is also difficult to kill. Uniform stands are more difficult to obtain in legume cover crop residues. The best winter cover is non-fertilized wheat, which should be killed up to 30 days prior to planting no-till cotton.

Sidedress or split applications of urea forms of nitrogen should be injected into the top 1 to 2 inches of soil.

Planting Date

For rapid emergence and good stands of cotton, soil temperatures for germination and emergence should be above 65 degrees at a depth of 2 inches below the soil surface at 8:00 a.m. for three consecutive days, with warm weather predicted for the next three to five days. There should be no delay when planting into old cotton stalks. As the ground cover increases, some delay may be needed for soil to warm and dry. Heavy vetch cover will cause more problems than small grains.

Variety Selection

Choose recommended varieties proven to have good emergence and seedling vigor. The quality of cotton fiber produced by no-till has been no different from conventionally grown crops.

Seeding Rate

Uniform stands are important for weed control, plant size management and harvesting efficiency. Three to five plants per foot of row are sufficient. When planting seed with 80 percent germination, four to six seed per foot of row are needed under good planting conditions.

Seedling Disease

Soil-borne diseases have potential to cause more problems in no-till production. Where heavy cover exists, cooler, wetter conditions will tend to increase the chances of damage from seedling diseases.

All no-tilled cotton should receive in-furrow applications of fungicides. (See discussion on fungicides on in the *Disease* section of this publication.

Insect Control

Research and field observations have shown no difference in insect populations due to tillage. This includes boll weevils, thrips, aphids, bollworm and stink bugs. However, there have been increased incidents of cutworms in seedling cotton when planted into leguminous cover crops such as hairy vetch and winter peas. Cutworms can easily be prevented or controlled by including an insecticide with the preemergence herbicide tank mix. A good scouting program throughout the growing season always pays, regardless of tillage system.

Table 1: Cotton Lint Yields in Variety Trials Planted Into Wheat or Rye
Milan Experiment Station

Year	**No-Till - Lb/Acre**	**Conventional - Lb/Acre**
1981	273	382
1982	940	937
1983	508	336
1984	1071	1146
1985	1040	1048
1986	854	853
1987	919	987
1988	767	690
1989	902	949
1990	992	889
1991	941	767
1992	1194	1181
12-year average	**867**	**847**

Table 2: Lint Yield of Varieties No-tilled into Old Cotton Stubble
Milan Experiment Station

Year	No-Till - Lb/Acre	Conventional - Lb/Acre
1983	535	529
1984	1034	1321
1985	1058	1028
1986	798	781
1987	1065	986
1988	767	690
1989	842	690
1990	657	813
1991	1021	873
1992	1320	1233
10-year average	**910**	**894**

Using Growth Regulators on Cotton

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Cotton is much harder to manage than corn and soybeans because it is a perennial plant grown as an annual crop fruiting over a long period of time.

Mepiquant choloride (Pix) plant growth regulator is recommended for use in Tennessee cotton production for the management of boll rot and excessive vegetative growth. The use of mepiquant chloride may result in one or more of the following: **height reduction, shorter limbs, more open canopy, better boll retention, less boll rot, improved defoliation and a darker green leaf color.**

The producer has the option of a single, dual, or up to four low-rate multiple applications of mepiquant chloride. When cotton is under stress from dry soil conditions, insect or mite pressure, disease, herbicide injury or fertility stress, the application of mepiquant chloride should be avoided. Wait for rain to reduce plant stress or treat to reduce insects before treating with mepiquant chloride.

Mepiquant chloride can be applied using either water or oil as a diluent. When using water, apply at least three gallons per acre by air or 10 gallons with ground equipment. Thorough coverage of the cotton foliage is required.

When using oil as a diluent for ultra low volume (ULV) aerial application be sure to use a nonphytotoxic oil concentrate with either a petroleum or vegetable oil base. Follow the mepiquant chloride label closely for purchasing oil and mixing instructions. The use of a good quality surfactant with mepiquant chloride application can reduce the rain-safe period from eight to four hours.

Mepiquant chloride has an aqueous base and is compatible with most insecticides and miticides. Compatibility can be checked by adding a teaspoon of insecticide or miticide to one pint of ready-to-use spray solution of mepiquant chloride.

Restrictions and Limitations

Insect or mite damage before, at or after application of mepiquant chloride can lead to yield decreases.

- Do not make a single application of ½ to 1 pint of mepiquant chloride to cotton that is drought stressed.

If using the low rate multiple option, discontinue use until the moisture stress is alleviated.

- Do not apply more than 1½ pints of mepiquant chloride per acre per season.
- Do not apply mepiquant chloride within 30 days of harvest.
- Do not graze or feed cotton foliage to livestock within 30 days of application, or after applying mepiquant chloride in oil as a ULV application by air.
- Do not tank mix with other products other than mentioned on label.
- Do not apply mepiquant chloride through any type of irrigation system.

Time and Rate of Mepiquant Chloride Application

Single or Dual Application	Rate Per Acre	
First Application Apply when cotton is actively growing and is between 20" and 30" tall, provided cotton is not more than 7 days beyond early bloom stage (5-6 blooms per 25 row feet). If cotton is 24" tall and has no blooms apply **Mepiquant chloride**[R] **plant regulator**. Use ½ pint per acre on cotton where excessive vegetative growth is not likely to be a problem, and 1 pint per acre in areas tending to have excessive vegetative growth.	½ to 1 pint	
Second Application If the cotton field has a history of excessive growth, and/or conditions after the first application are favorable for excessive growth, apply a second application 3 to 4 weeks after the first application.	½ pint	
Low-Rate Multiple Applications	**Use Rate** **½ pt. rate**	**Use Rate** **1 pt. rate irrig.**
First Application: Optimal results will be achieved when plants are in the matchhead square stage of growth.	1/8 pt.	1/4 pt.
Second Application: 7-14 days later, or when regrowth occurs.	1/8 to 1/4 pt.*	1/4 to ½ pt.*
Third Application: 7-14 days later, or when regrowth occurs.	1/8 to 1/4 pt.*	1/4 to ½ pt.*
Fourth Application: 7-14 days later, or when regrowth occurs.	1/8 to 1/4 pt.*	1/4 to ½ pt.*

***Use higher rate if previous application was not made or if growing conditions are conducive to excessive growth.**

Refer to label for further information.

Cotton Diseases

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Seedling Diseases

Seedling diseases are presently causing great losses to cotton producers in Tennessee. They comprise the number one disease problem. The estimated loss averages 9.3 percent annually, based on a range of 5 to 18 percent since 1989. The average seedling disease loss for the U. S. Cottonbelt is only 3 percent annually for the same period. During cool, wet planting seasons, such as 1989, 1990, 1993 and 1997, seedling diseases can become severe. Loss estimates do not include cost of replanting or losses due to lateness of replanted cotton. Table 1 gives the average loss from the major diseases over the past nine-year period.

Cause

A number of organisms are associated with cotton seedling diseases. The organisms include both seed- and soil-borne fungi and bacteria. The soil-borne fungi, ***Rhizoctonia solani*** and ***Pythium*** **spp.,** are the most important causes of seedling diseases in Tennessee. ***Rhizoctonia solani*** is the fungus most commonly associated with seedling diseases; however, during cool, wet seasons ***Pythium*** **spp.** may become more prevalent. ***Thielaviopsis basicola*** is being found to cause seedling diseases more frequently each year.

Symptoms

The various phases of seedling diseases include seed-rot, root-rot, preemergence damping-off and postemergence damping-off. The term "seed-rot" is used to describe the decay of seed before germination.

Root-rot (or black-root) may occur anytime after germination of the seed, but may not become conspicuous or cause severe damage until after the emergence of the seedling. Preemergence damping-off refers to the disease condition in which the seedling is killed between germination and emergence from the soil. The death of seedlings resulting shortly after their emergence from the soil is termed postemergence damping-off. The latter is referred to as "sore shin" when only stem girdling occurs. ***Rhizoctonia*** is usually the cause of sore shin.

Table 1. Cotton Disease Loss Estimate for Tennessee
1990-99

Disease										
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
SEEDLING DISEASES (*Rhizoctonia solani, Pythium* spp., *Fusarium* spp., etc.)	15.0	9.0	7.0	10.0	8.0	6.0	5.0	9.5	7.0	5.00
BOLL ROTS	2.0	4.0	5.0	3.0	2.0	3.0	4.0	3.0	3.0	2.0
VERTICILLIUM WILT (*Verticillium dahliae)*	0.2	0.15	0.3	0.1	2.0	1.0	1.5	1.0	1.5	0.75
FUSARIUM WILT (*F. oxysporium* **f.** sp. *vasinfectum)*	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
BACTERIAL BLIGHT (*Xanthomonas malvacearum)*	0	0	0	0	0	0	0	0	0	0
ASCHOCHYTA BLIGHT (*Ascochyta gossypi)*	0.1	0.1	.05	.05	.05	0.1	0	0.02	0.02	0.01
NEMATODES	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.4	0.80
LEAF SPOTS (*Alternaria, Cercospora, Phomopsis,* etc.)	0.5	1.0	1.0	0.5	0.75	0.75	1.0	0.5	0.5	0.25
Total Percent Loss to Disease	18.01	14.46	13.56	13.86	13.01	11.06	11.7	14.23	12.43	8.82

COMMENTS: Loss estimates were taken from research and Extension demonstrations and general observations taken across the state by Melvin A. Newman, Extension Plant Pathology, and Albert Y. Chambers, Research Plant Pathology.

Seedling Disease Control

Seed treatments: Fungicide seed treatments give control of seed-rot and some control of preemergence damping-off. However, seed treatment gives little, if any, control of post-emergence damping-off and root-rot. Seed treatment is quite effective in controlling seed-borne diseases.

Soil treatments: Postemergence damping-off and root-rot can be controlled to some extent by soil treatment. Three methods of applying soil fungicides are recommended in Tennessee. These methods are the **hopper-box method**, the **in-furrow spray method** and the **in-furrow granule method. These methods should be used in addition to the recommended seed treatments. IN FIELDS WHERE SOIL-INCORPORATED, PREPLANT HERBICIDES OR GRANULAR, SYSTEMIC INSECTICIDES ARE USED, BE SURE TO USE A SOIL FUNGICIDE. Producers are advised to use the seedling disease point system on Table 3 to determine if fungicide application is necessary.**

Hopper-Box Method: Mix recommended fungicides thoroughly with fuzzy, reginned or acid delinted seed just before planting. Mixing may be done in a container, such as a tub, or alternating layers of seed and fungicide as they are placed in the hopper. Hopper-box fungicides cannot be applied as effectively on acid-delinted seed.

Application of the fungicide in the hopper-box may change the seeding rate, and recalibration of the planter may be required. Because of handling and mixing the hopper-box materials, clogging of the planter and abrasive action of the chemical, this method is not as desirable as the in-furrow methods. Although less expensive, it is also less effective; but when used properly, gives better results than seed treatments alone, especially under lower disease pressure.

In-Furrow Spray Method: This method consists of applying a soil fungicide into the seed furrow and to the covering soil during the planting operation. Application is best accomplished with two spray nozzles mounted on the planter. A cone-pattern nozzle is suggested for applying the material into the furrow behind the planter shoe. This nozzle should be placed far enough behind the shoe to prevent wetting and clogging of the seed spout. The second nozzle should be placed so as to direct the spray into the covering soil in front of the press wheel. The recommended height for the front nozzle is 1½ inches above the original soil surface, with a TX6 tip and 2 to 3 inches above the soil for the back nozzle with a TX3 tip. Where space is limited and two nozzles cannot be used, substitute one nozzle with an TX8 or TX10 tip. Use 3-5 gallons of water per acre.

In-Furrow Granule Method: Granular fungicides or fungicide-insecticide combinations have given good control of seedling disease. They can be applied with applicators used for other granular chemicals and eliminate the need for additional spray equipment and water with the spray method. Effective control with granules depends on proper placement in the furrow between the seed spout and the covering device.

When using a single delivery tube, attach a flared baffle to the end approximately at a 45- to 90-degree angle to the row to obtain a 2-3 inch wide band. Granules then fall into the furrow from the seed drop to the covering device. If hill planting, a single delivery tube may be placed in the seed spout of some planters rather than using the baffle. If the delivery tube cannot be placed in the hill-drop attachment, a drill rate is required to be effective. When using either method, be sure the granules are well-dispersed around the seed and in the covering soil to avoid injury or ineffective disease control.

Cultural Practices: Certain cultural practices can help considerably in controlling seedling disease. Turning under crop residues as early as possible is suggested. Also, crop rotation with soybeans, corn, or grass will help prevent the buildup of organisms pathogenic to cotton seedlings. A well-prepared seedbed greatly enhances the chances of a good stand. Planting on beds has been shown to be of considerable value in some seasons by providing better drainage and warmer soil temperatures.

Use certified seed or high-quality seed with a germination of 80 percent or higher. An important practice is to plant only when soil temperatures reach 65-70 F and are expected to remain that high or higher for an extended period of time.

Table 2. Soil Fungicide Treatment for Cotton

Fungicide	*Formulation*	[3]*Rate/Acre*
		(Use higher rates where severe disease is expected)
In-furrow Granular Fungicides		
[1]Terraclor Super X	18.8G	6 - 10 lbs.
Ridomil PC 11G	11G	7 - 10 lbs.
Ridomil Gold PC	10.5G	7 - 10 lbs.
In-furrow Fungicides + Insecticides Combinations		
Terraclor Super X-Di-Syston	6.5G-1.63G-6.5G	12 - 15 lbs.
[2]Terraclor Super X + Di-Syston EC	17.5-4.3-17.5	4 - 5.5 pts. (40 inch row spacing) (5-6 3/4 fl.oz/1000 row ft.)
In-furrow Sprays		
Ridomil Gold EC + Terraclor	4 EC + 2 EC	1 - 2 ozs. + 3 - 6 pts.
Ridomil Gold EC + PCNB2-E	4EC + 2EC	1 - 2 ozs. + 2 - 4 qts.
[4]Rovral	4F	3.4-6.9 ozs.
Terraclor Super X	2.5 EC	3-6 pts.
Ridomil PC Liquid (Twin Pak)	PCNB-24% @ 2 qts./A + Ridomil-25.1% @ 5 ozs./A	2 qts. and 5 ozs. (1 jug/5 acres)
Hopper-box Dusts and Slurries (Not as Effective as In-furrow Methods under Severe Disease Conditions)		
		Rate/100 lbs. seed
Delta Coat AD (HB Slurry)	3.5% - 30%	11.75 ozs.
Prevail (HB Dust)	15%-15%-3.12%	8-16 ozs.

NOTES: In-furrow spray treatments are recommended in 3-5 gallons of water per acre. Terraclor Super X or Ridomil PC granules can be applied in-furrow with Temik 15G or Di-Syston with a split-box method. See pesticide labels for other use instructions and precautionary statement.

[1]Terraclor Super X 18.8G is a new formulation of the same chemicals as the Terraclor Super X 12.5G. Six lbs. of 18.8G is approximately equal to 9 lbs. of the 12.5G and 6.7 lbs. of 18.8G is approximately equal to 10 lbs. of the 12.5G.

[2]In-furrow liquid application: Apply the specified dosage to the soil around the seed and to the covering soil as it fills the furrow. Do not apply directly to the seed. The soil around the seed and the covering soil should be thoroughly mixed with the product. Use the higher rates when weather conditions are expected to be unfavorable for rapid germination and in fields having a history of disease problems or in no-till situations.

[3]Dosage rate at 38" row spacing.

[4]Under cold, wet conditions where *Pythium* may be a problem, tank mix Ridomil Gold 4EC or Terrazole 4EC for added control (see label for rate).

Table 3. Cotton Seedling Disease Point System

Soil Temperature: 3-Day Average at 4 Inches	Points	
		_____
A. Less than 65 F	100	
B. 65 – 72 F	50	
C. Higher than 72 F	0	
Five-Day Forecast:		_____
A. Colder and wetter	100	
B. Colder	50	
C. Wetter	50	
D. Warmer	0	
Seed Quality: Cold Germination Value.		_____
A. Less than 59%	100	
B. 60-69 %	50	
C. Higher than 70%	0	
Field History: Based on Seedling Disease in Previous Years.		_____
A. Severe	100	
B. Moderate	50	
C. Low	0	
Tillage: Based on Field Preparation		_____
A. No-till	100	
B. Minimal tillage	50	
C. Conventional	0	
Row Preparation		_____
A. Firm beds present	0	
B. Beds not firm	50	
C. Bed absent	100	
Seeding Rate: Number of Seeds Per Row Ft.		_____
A. Low: 3 and lower	100	
B. Moderate: 5-6	50	
C. High: 7 and higher	0	
In-furrow Insecticide/Nematicide Applied: Temik, Di-Syston, Thimet, etc.		_____
A. Yes	100	
B. No	0	
Total: If Point Total Exceeds 150 In-Furrow Fungicide Application is Suggested.		_____

Developed by Melvin A. Newman, Professor
University of Tennessee, Agricultural Extension Service

This point system is a modified version from a three-year regional cotton project. It should be used as a guide to determine the need for an in-furrow fungicide. It is not a guarantee of economical return.

The point system was tested in 1996 -98 by scientists, consultants and growers in most areas of the Cotton Belt. One version of the system is not likely to fit all beltwide conditions. The seedling disease complex can vary greatly from field to field, and from year to year, depending upon several cultural and environmental conditions in Tennessee. See cotton seedling diseases on the **Cotton Pickin'** web site – ipmwww.ncsu.edu/cottonpickin.

The use of soil fungicides should be determined by the **presence and intensity** of the following factors:

- **Soil Temperature**. Low soil temperatures create conditions that will slow seed germination and seedling emergence, thus extending the vulnerable period for infection. Many soil-borne pathogens are active at lower temperatures.

- **Five-Day Forecast**. Environmental conditions during the first week of planting are important to consider. A critical factor to evaluate is the combination of low soil temperatures and high soil moisture. Any condition that slows germination and growth of the seedling favors the seedling disease complex.

- **Seed Quality**. Poor quality seeds germinate and emerge more slowly than good qualify seeds under similar conditions. Slow germination and emergence extends the period seeds are vulnerable to infection.

- **Field History**. The history of each field should be evaluated to determine if it has had a stand-establishment problem, which may have been caused by factors including: soil type, drainage, soil pH and levels of organic matter.

- **Tillage**. A no-till or stale seed bed has a tendency to be slightly cooler and wetter than a conventional seed bed. This combination may be conducive to carryover of disease inoculum on the past year's crop debris.

- **Seeding Rate**. Recommended seeding rates have gradually declined in most parts of the Cotton Belt. This increases the importance of getting a high percentage of seeds to germinate, emerge and establish..

- **Insecticide/Nematicide Use**. Experience shows that the use of a soil fungicide can be a **"safening"** factory when certain soil-applied insecticides/nematicides are used.

- **Soil Moisture**. When soils are saturated with moisture for prolonged periods, seeds and seedlings are adversely affected. These conditions are ideal for the growth of several soil pathogens.

- **Planting Date**. A field planted prior to normal planing dates for its area will have conditions that **favor greater seedling disease pressure**.

Verticillium Wilt

Verticillium wilt is one of the important diseases affecting cotton in Tennessee. It is the most damaging of the two wilts which occur on cotton. This disease is widespread in the cotton-growing area and is most severe during cool, wet growing seasons.

Verticillium wilt is caused by the soil-borne fungus, **Verticillium albo-atrum**. This fungus can survive in the soil for many years, even in the absence of cotton.

Cotton seedlings infected with **Verticillium** usually turn yellow, dry out and die. Plants that become infected later in the season are stunted and exhibit a yellow condition along the leaf margins and between the major veins. This yellow imparts a mottled appearance to the plant. Severely affected plants will shed their leaves. Sprouts or new shoots may develop near the base of infected plants.

Positive diagnosis of Verticillium wilt in the field can be difficult because of its close similarity of Fusarium wilt. Both wilt diseases cause a brown discoloration of the interior of the stem. The discoloration associated with Verticillium wilt is usually more evenly distributed across the stem than that associated with Fusarium wilt. The browning of the stem tissues are also usually less intense where the wilt is caused by **Verticillium.**

The most tolerant varieties available should be planted in fields that are infested with Verticillium (see Table 4). Crop rotations will help reduce losses to Verticillium wilt, but they must be four- to six-year rotations. Any practice, such as bedding, that permits more rapid warming of the soil will also help reduce some losses.

Table 4. Reaction of Cotton Cultivars to Verticillium Wilt

	Wilt Rating (0-10)[1]				
Cultivar	**1994**	**1995**	**1996**	**1997**	**1998**
Deltapine 20	3.9	3.9	4.5	4.4	2.6
Deltapine 425 RR	-	-	-	-	3.6
Deltapine 50	4.3	3.9	4.2	4.3	2.4
Deltapine 51	5.1	4.0	4.7	5.9	-
Deltapine 5111	-	-	-	-	2.2
Deltapine 5409	-	4.2	4.0	4.6	2.0
Fibermax 989	-	-	-	-	1.0
Paymaster 1215 BG	-	-	-	-	3.0
Paymaster 1220 RR	-	-	-	-	4.0
Paymaster H1215	-	5.7	6.6	7.1	-
Paymaster H1220	-	5.6	6.8	7.3	-
Paymaster H1244	8.3	7.2	7.7	8.1	4.8
Paymaster H1277	-	-	5.6	4.5	-
Paymaster HS 26	-	-	-	-	1.0
Stone BXN 47	-	-	-	-	3.4
Stoneville 132	3.8	4.1	6.4	5.0	-
Stoneville 373	-	-	-	-	2.4
Stoneville 474	-	4.2	6.7	6.1	3.2
Stoneville 495	-	-	6.3	5.3	-
Sure-Grow 125	6.0	4.7	7.7	7.2	2.2
Sure-Grow 404	-	4.6	6.6	4.6	-
Sure-Grow 501	5.8	3.8	6.8	7.7	3.4
Terra 292	-	-	5.3	5.6	2.6

Wilt Rating: 0 = no disease, 10 = most disease possible.
Ratings made at Milan Experiment Station by Albert Y. Chambers.
(-) dash indicates variety was not tested that year.
Varieties should be compared to each other during the same year.
Varieties with high wilt ratings should not be planted in fields known to have a history of Verticillium wilt damage.

[1]Varieties with rating of 7 and above would be considered highly susceptible to wilt in most years; a rating of 4 to 7 would be considered intermediate in susceptibility; a variety rating 4 and below would be considered slightly susceptible. Weather conditions and inoculum levels in the soil greatly influence severity of wilt.

Boll Rots

Boll rots have caused heavy losses to cotton producers during wet growing seasons. Damage from boll rots is most severe in fields where rank growth occurs. Rain and high humidity during late summer and fall are optimum conditions for boll-rot development and increase the incidence of the disease.

A number of fungi and bacteria have been associated with boll rots. Some of these organisms invade the cotton bolls directly, whereas others enter through insect wounds or as secondary invaders. Boll rots cause losses by reducing yields, damaging the cotton fibers and infecting seed planted. Infected seed will result in seedling blights the following season. Boll rots usually first appear as water-soaked spots. Later, as the infection spreads, the bolls turn black and may be covered with a moldy fungus growth. Badly infected bolls may drop from the plant.

To prevent boll rots, cotton growers should avoid excessive applications of nitrogen that promotes rank growth of cotton. It has been found that skip-row cotton provides better air drainage, resulting in less boll rot. Defoliation will also help reduce boll rots. Bottom defoliation, followed by complete defoliation about two weeks later, has given good control of boll rot. A good insect-control program will prevent injuries that serve as infection sites for boll-rotting organisms.

Plant-growth regulators such as Pix can also be used where rank growth usually occurs and boll rot is likely to be a problem. Pix **should not be** used on cotton under stress, especially drought stress. Under most conditions, one half pint per acre in 20 gallons of water is all that is needed to control rank growth. See manufacturer's label for specific directions. For the last several years, one half pint per acre has performed as well as one pint in research plots.

Leaf Spots and Blights

Several leaf spot and blight diseases occur on cotton and under favorable conditions can cause considerable damage. The most important of these diseases are Ascochyta blight (wet weather blight), bacterial blight (blackarm and angular leaf spot), Cercospora leaf spot and Alternaria leaf spot. These diseases cause various types of leaf-spot and blight symptoms. The following measures will help control these minor disease problems: (1) use a recommended fungicidal seed treatment, (2) destroy crop residue by chopping and plowing it under, (3) use suitable rotations as prescribed for other diseases, (4) plant resistant varieties when they are available, and (5) keep the potassium at a high level according to soil tests.

Nematodes

For several years, reinform nematodes (*Rotylenchulus reniformis*) have been a severe problem in cotton production in several states south of Tennessee. In the fall of 1997 and 1998 the reinform nematode was found in several fields in Madison and Crockett counties. This nematode is spread very easily on farm equipment. Producers should sample their cotton land for this nematode in the fall after harvest.

No current varieties are resistant to the reniform nematode. If reniform nematode is present, producers should either rotate with a non-host crop such as corn or grain sorghum or with soybean varieties resistant to reniform. Temik 15G at 5 lb./acre applied in-furrow at planting will reduce the reniform nematode population for the early part of the season.

Cotton Disease Control Guide

1. **PLANT HIGH-QUALITY SEED** with 80 percent-plus germination.
2. **TREAT SEED** with a fungicide to avoid early losses.
3. **SOIL TEMPERATURE** should be 65-70 F before planting.
4. **IN-FURROW SOIL** fungicides should be used in addition to seed treatments, not in place of them.
5. **ROTATE** to avoid the build up of disease organisms.
6. **DISEASE-RESISTANT VARIETIES** should be planted.
7. **CULTURAL PRACTICES**, such as planting on a bed, also helps prevent disease.

COTTON INSECT CONTROL

Bt Cotton Management

More varieties of cotton containing the *Bacillus thuringiensis* (*Bt*) gene will be available for planting in Tennessee. Their use is recommended in higher risk areas of tobacco budworm and bollworm.

Bt cotton will need to be monitored on a regular basis for all insect pests, including tobacco budworm and bollworm. Scouting procedures will be the same for other insects regardless of the presence of the *Bt* toxin. Based on observations, *Bt* toxin has given good control of bollworm and excellent control of tobacco budworm. However, if a heavy bollworm or tobacco budworm egg-lay occurs, fields should be checked for the presence of surviving larvae. Larvae must feed on plant tissue to ingest a toxic dose of *Bt*. This superficial feeding will not cause economic damage. A larva that is ¼ inch or greater in length is considered to have survived or escaped the toxin. Foliar treatments should be made when **four** or more of these surviving larvae per 100 plants are present and/or **two** percent boll damage is found.

Twice a week scouting and closer examination within the plant canopy may be necessary to locate and determine survival before a treatment decision can be made. The *Bt* toxin should be given an opportunity to work, therefore a treatment based just on eggs present is not usually recommended. An exception to this general recommendation would occur if a high egg count was concentrated on fresh or dried blooms. Insecticide treatments should be applied at hatching stage and prior to larvae penetrating the small boll under the bloom. Spray coverage is critical for satisfactory control.

Resistance Management Plan – Refugia Acreage: Refugia acreage should be maintained following the selected option guidelines. This acreage will provide a source of susceptible moths for mating with resistant moths which survive the *Bt* toxin. Designated refugia or non-*Bt* acreage should be located adjacent to or in close proximity of *Bt* cotton acreage.

Current guidelines allow a producer to select between two refuge options. Option 1 requires a 20 percent or greater acreage planted to non-*Bt* cotton. This acreage can be treated with conventional insecticides, except foliar *Bt* products, to control all caterpillar type as well as other pest. Option 2 requires a minimum of 4 percent planted to non-*Bt*. This acreage should **not** be treated with insecticides which control bollworm and tobacco budworm. Other non-caterpillar pest can and should be treated according to treatment thresholds. **DO NOT** apply the following insecticides to the **4 percent non-*Bt* refuge acreage**: acephate (> ½ lb.), amitraz, chlorpyrifos, endosulfan, methomyl, methyl parathion (> ½ lb.), profenophos, pyrethroids, spinosad, thiodicarb, NPV, pyrroles, pepper spray, garlic spray, and foliar *Bt* products.

Overwintered Boll Weevil Control

Boll weevils survive the winter as diapausing adults in leaf litter and other protected places. They emerge from these sites in search of cotton from April until July. Peak emergence (the largest number) normally occurs from late May until mid June. This may vary annually due to daily temperatures, moisture and weevils survivability. Warm temperatures and frequent rains promote earlier emergence. Control measures are most effective when the majority of weevils have emerged and entered cotton fields before egg-laying size squares (¼ inch diameter) are available. If an extended emergence pattern does occur, more than one insecticide treatment will be necessary to avoid early square damage.

Pheromone traps are the best early detection method for determining boll weevil emergence. Without detection and treatment, early square damage is unavoidable. If weevils are not detected, insecticide applications are not necessary.

Pinhead Square Treatment: A single well-timed insecticide application is recommended against low overwintered boll weevil populations after match-head size squares are formed but prior to squares becoming ¼ inch in diameter. When using traps (one per 20 acres) an insecticide application should be made if **four** or more total weevils are caught in the four weeks prior to match-head size squares. A **second** treatment 5-7 days later is recommended for moderate to high populations or when traps continue to catch weevils after the first insecticide application. Always clean out traps after the first application in order to detect additional weevils. Properly timed applications should reduce overwintered boll weevil damage to low levels prior to bloom.

BOLL WEEVIL

First Square to First Bloom: Treat when 10 percent of squares are damaged by egg-laying punctures or feeding. Use this treatment threshold as a general guide. Monitor square retention and adjust threshold to maintain an 80 percent retention level from first square through early bloom stage.

The longer weevils continue to puncture squares, the longer the hatch-out period will last. Two or three applications on a 3-4 day interval may be needed if hatch-out weevils continue. Residual control beyond the time of application is limited; therefore, newly emerged weevils may be found in blooms at various times after an insecticide application.

Post Bloom until Termination: Continue to protect squares and bolls which will contribute to yield. Higher percent damage levels can be economically justified as available squares decrease in both number and value in the upper part of the plant. Use **NAWF = 5 + 350-450** DD60's as a guide to terminate insect control. Protect small bolls during this maturing period.
Most pyrethroids will give good control of boll weevils when spraying worms and/or may be used for control. Check labels for rates.

Insecticide	**Lbs. Active Ingredient per acre**	**Amount Formulation per acre**	**Acres Treated per gal.**
BOLL WEEVIL			
dicrotophos (Bidrin 8)	0.50	8 ozs.	16
endosulfan (Phaser 3, Thiodan 3)	0.375 - 0.50	16 - 21 ozs.	8 - 6
malathion (Cythion 5)	1.25	32 ozs.	4
methyl parathion 4	0.25 - 0.5	8 - 16 ozs.	16 - 8
(Penncap-M 2)	0.25 - 0.5	16 - 32 ozs.	8 - 4
oxamyl (Vydate CLV 3.77)	0.25	8 ozs.	16

BOLLWORM/TOBACCO BUDWORM

DO NOT apply a pyrethroid prior to bloom on non-*Bt* varieties. See Resistance Management Guidelines. PB387.

NON-BT COTTON: Treat when **four** or more small larvae per 100 plants are present or **5 percent** or more of the squares are damaged when worms are present.

Recommended insecticides for bollworm and tobacco budworm have changed due to continued insecticide resistance and control problems. Pyrethroid insecticides are NOT recommended against tobacco budworm infestations. Time applications to control newly hatched larvae (< ¼ inch length). Add an ovicide when bollworm/budworm moths are laying eggs. Multiple applications on a 4 - 5 day interval may be needed. Tank-mixing pyrethroids with other insecticides may improve control of pyrethroid resistant tobacco budworms and are only recommended when the budworm ratio is no more than 20%. Change insecticide chemistry if control failures occur.

BT COTTON: Treat when **four** or more larvae (> ¼ inch length) per 100 plants are present and/or **2 percent** boll damage is found. Treatment based on eggs alone is not usually recommended. (See *Bt* cotton management.)
Scout fields once each week pre-bloom and twice per week post-bloom (July-August). Whole plant examination may be necessary to find eggs and/or surviving larvae within the plant canopy, especially around blooms. Check white blooms for surviving larvae since pollen contains less toxin than other plant parts. Check bolls and bloom tags from two nodes directly below current first position white bloom. Bt toxin expression during late season when plants have a full boll load may be reduced. Scouting procedures for all other insects will remain the same.

Insecticide	**Lbs. Active Ingredient per acre**	**Amount Formulation per acre**	**Acres Treated per gal.**

Insecticide	Lbs. Active Ingredient per acre	Amount Formulation per acre	Acres Treated per gal.
BOLLWORM			
Pyrethoids:			
bifenthrin (Capture 2)	0.04 - 0.1	2.6 - 6.4 ozs.	49 - 20
cyfluthrin (Baythroid 2)	0.025 - 0.05	1.6 - 3.2 ozs.	80 - 40
cyhalothrin (Karate 2.08)	0.025 - 0.04	1.6 - 2.56 ozs.	83 - 52
cypermethrin (Ammo 2.5)	0.04 - 0.1	2.0 - 5.0 ozs.	64 - 26
deltamethrin (Decis 1.5)	0.019 - 0.03	1.62 - 2.56 ozs.	79 - 50
esfenvalerate (Asana XL 0.66)	0.03 - 0.05	5.8 - 9.6 ozs.	22 - 13
tralomethrin (Scout X-TRA 0.9)	0.018 - 0.024	2.5 - 3.4 ozs.	50 - 37
zetamethrin (Fury 1.5)	0.033 - 0.045	2.8 - 3.8 ozs.	45 - 33
TOBACCO BUDWORM			
Carbamates:			
methomyl (Lannate LV 2.4)	0.45	24 ozs.	5.3
thiodicarb (Larvin 3.2)	0.6 - 0.9	24 - 36 ozs.	5.3 - 3.6
Organophosphates:			
acephate (Orthene 90S)	0.9	1 lb.	-
profenofos (Curacron 8)	0.75 - 1	12 - 16 ozs.	12 - 8
Naturalyte:			
spinosad (Tracer 4)	.045 - .089	1.4 - 2.9 ozs.	90 - 45
Ovicides: Use for both species.			
amitraz (Ovasyn 1.5)	0.25	21 ozs.	6
methomyl (Lannate LV 2.4)	0.23	12 ozs.	10.7
profenofos (Curacron 8)	0.25	4 ozs.	32
thiodicarb (Larvin 3.2)	0.25	10 ozs.	12.8
Tank mix products + Pyrethroids (at median rates):**			
acephate (Orthene 90S)	0.50		
chlorpyrifos (Lorsban 4)	0.50		
methomyl (Lannate LV 2.4)	0.30		
profenofos (Curacron 8)	0.50		
thiodicarb (Larvin 3.2)	0.30		
Other mixtures of non-pyrethroid chemistry:			
profenofos (Curacron 8) + thiodicarb (Larvin 3.2)	0.80 + 0.30	16 + 12 ozs.	10 + 10.6
profenofos (Curacron 8) + chlorpyrifos (Lorsban 3.2)	0.67 + 0.50	12 + 08 ozs.	10.6 + 16
** When low populations of tobacco budworm are part of the infestation, a mixture of two chemistries is recommended.			

THRIPS
Thrips injury causes foliar deformity (leaves crinkle and cup upward), plant stunting, and delays in maturity.

Treat when cotton is up to a stand and thrips average one or more per plant and damage is observed. An in-furrow systemic insecticide or Gaucho seed treatment is recommended as a preventive control.

Under some conditions, in-furrow treatments may adversely affect stand. A recommended fungicide is suggested for use in fields where in-furrow systemic insecticides are used. Aphids and early spider mites are also suppressed by in-furrow systemic insecticides. When using in-furrow materials for hill-dropped cotton, refer to label for rate changes.

Insecticide	Lbs. Active Ingredient per acre	Amount Formulation per acre	Acres Treated per gal.
THRIPS			
In-furrow Systemic Granules:			
acephate (Payload 15G)	0.9 - 1.0	6.0 - 6.7 lbs.	-
aldicarb (Temik 15G)	0.525	3.5 lbs.	-
disulfoton (Di-Syston 15G)	0.75 - 1.0	5.0 - 6.7 lbs.	-
In-furrow Systemic Sprays:			
acephate (Orthene 90S)	0.9 - 1.0	1.0 - 1.1 lbs.	-
disulfoton (Di-Syston 8)	0.75 - 1.0	12 - 16 ozs.	10.7 - 7.8
Foliar Sprays:			
acephate (Orthene 90S)	0.18	3.2 ozs.	-
dicrotophos (Bidrin 8)	0.1 - 0.2	1.6 - 3.2 ozs.	80 - 40
dimethoate 4	0.1 - 0.2	4.0 - 8.0 ozs.	32 - 16
methamidophos (Monitor 4)	0.1 - 0.2	3.2 - 6.4 ozs.	40 - 20
Treated Seed:			
acephate (Orthene 90S)	-	2.5 - 3.25 ozs.	-
imidacloprid (Gaucho)	-	-	-

CUTWORMS

Cutworm damage occurs most frequently following legume cover crops or in reduced tillage systems. Cutworms may become established on existing vegetation and move to emerging cotton once this vegetation is killed. Destroying all green vegetation 21 days prior to planting reduces the likelihood of cutworm attack.

Treat when cutworms are damaging stand and plant population is less than three plants per row foot. Infestations may be spotty within a field and only require treatment where damage and live cutworms are found.

Bt cotton does not provide control of cutworms.

Insecticide	Lbs. Active Ingredient per acre	Amount Formulation per acre	Acres Treated per gal.
CUTWORMS			
chlorpyrifos (Lorsban 4)	0.75 - 1.0	24 - 32 ozs.	5.3 - 4
cyfluthrin (Baythroid 2)	0.0125 - 0.025	0.8 - 1.6 ozs.	160 - 80
cypermethrin (Ammo 2.5)	0.025 - 0.1	1.3 - 5.0 ozs.	100 - 25
esfenvalerate (Asana XL 0.66)	0.03 - 0.05	5.8 - 9.6 ozs.	22 - 13
cyhalothrin (Karate 2.08)	0.15 - 0.02	0.96 - 1.28 ozs.	133 - 100
thiodicarb (Larvin 3.2)	0.6	24 ozs.	5.3
tralomethrin (Scout X-TRA 0.9)	0.016 - 0.020	2.28 - 2.84 ozs.	56 - 45

APHIDS

Early-season: Parasites and predators usually control aphids on seedling cotton. If aphids are present on numerous plants and some leaves are curled along the edges, (signs of stress) treatment is suggested. In-furrow insecticides used for thrips control can suppress early-season aphids populations.

Mid-late season: Treat when aphids are very numerous, honeydew is present, plants are showing signs of stress and natural control agents are not affecting aphid populations. Consider the possibility of a fungal epizootic (disease) before treating.

Insecticide	Lbs. Active Ingredient per acre	Amount Formulation per acre	Acres Treated per gal.
APHIDS			
dicrotophos (Bidrin 8)			
(early-season)	0.1 - 0.2	1.6 - 3.2 ozs.	80 - 40
(mid-late season)	0.25 - 0.5	4 - 8 ozs.	32 - 16
dimethoate 4	0.125 - 0.25	4 - 8 ozs.	32 - 16
imidacloprid (Provado 1.6)	0.047	3.75 ozs.	34

PLANT BUGS

First two weeks of squaring: Treat when plant bugs number **one** or more per 6 row feet or **7.5** per 100 sweeps (standard sweep net) and square loss is occurring.

DO NOT depend on boll weevil eradication sprays to automatically control plant bugs during this period.

Third week of squaring until first bloom: Treat when plant bugs number **two** or more per 6 row feet or **15** per 100 sweeps and square damage is occurring.

From first square to first bloom: If square retention drops below **80 percent** and plant bugs are present, treatment should be considered even if numbers are subthreshold. The objective is to maintain the square retention goal. Consider if multiple pests are contributing to this square loss before selecting an insecticide.

After first bloom: Treat when plant bugs number **four** or more per 6 row feet or **30** per 100 sweeps and square damage or small boll damage is occurring.

The sweep net is a very effective tool for monitoring adult plants bugs and detecting movement into the field. The ground cloth is a more effective tool for monitoring nymphs which indicates reproduction. Thorough scouting requires the use of both tools. Visual scouting is a less reliable method anytime but may be used. Square retention counts can be a warning to plant bug problems if previously undetected, either by sampling technique, sampling error or time of day the sample was taken.

Visual sampling post-bloom should include examining terminals for adults and nymphs, and checking inside squares, blooms and small bolls for nymphs. Boll injury appears as small, dark sunken spots on the outside. Seed and lint damage is usually localized to the lock where feeding occurred. Distinguishing plant bug damage from stink bug on external symptoms is difficult. "Dirty blooms" (anthers dark and brown) are a sign of plant bug feeding .

Tarnished plant bug is the predominant species although Clouded plant bug can be observed some years, usually in lower numbers.

Insecticide	Lbs. Active Ingredient per acre	Amount Formulation per acre	Acres Treated per gal.

Insecticide	Lbs. Active Ingredient per acre	Amount Formulation per acre	Acres Treated per gal.
PLANT BUGS			
acephate (Orthene 90S)	0.23 - 0.45	0.25 - 0.5 lbs.	-
chlorpyrifos (Lorsban 4)	0.19 - 0.25	6 - 8 ozs.	21- 16
dicrotophos (Bidrin 8)	0.25 - 0.5	4 - 8 ozs.	32 - 16
dimethoate 4	0.25	8 ozs.	16
malathion (Cythion 5)	1.25	32 ozs.	4
methyl parathion 4	0.25 -0.50	8 - 16 ozs.	16 - 8
oxamyl (Vydate CLV 3.77)	0.25 - 0.31	8 - 10.6 ozs.	16 - 12

FALL ARMYWORM

Proper identification of fall armyworm larvae is critical for effective control. Look for an inverted "Y" mark on the head.

Treat when four or more larvae are found in 100 bolls and blooms. Time applications to control small larvae.

Bt cotton does not control fall armyworms.

Insecticide	Lbs. Active Ingredient per acre	Amount Formulation per acre	Acres Treated per gal.
FALL ARMYWORM			
methomyl (Lannate 2.4)	0.45	24 ozs.	5.3
profenofos (Curacron 8)	0.75 - 1	12 - 16 ozs.	10.6 - 8
thiodicarb (Larvin 3.2)	0.6 - 0.9	24 - 36 ozs.	5.3 - 3.6
spinosad (Tracer 4)	0.067 - .089	2.14 - 2.9 ozs.	60 - 45

BEET ARMYWORM

Beet armyworms can be recognized by a characteristic black dot directly above the second true leg. Established beet armyworm populations are very difficult to control with currently labeled insecticides. Production of an early crop and preservation of beneficial insects will reduce the risk of a beet armyworm outbreak.

Prior to August 15: Treat when 5-6 "hits" (egg masses and/or clusters of small larvae) are found per 300 row feet.

After August 15: Treat when 10 or more "hits" are found per 300 row feet.

Bt cotton does not control beet armyworms.

Insecticide	Lbs. Active Ingredient per acre	Amount Formulation per acre	Acres Treated per gal.
BEET ARMYWORM			
chlorpyrifos (Lorsban 4)	0.75 - 1.0	16 - 32 ozs.	5.3 - 4
thiodicarb (Larvin 3.2)	0.6 - 0.9	24 - 36 ozs.	5.3 - 3.6
spinosad (Tracer 4)	0.067 - 0.089	2.14 - 2.9 ozs.	60 - 45
Ovasyn 1.5 (amitraz) has shown improved control when tank mixed with a larvicide like Lorsban or Larvin.	0.188 - .25	16 - 21 ozs.	8 - 6

LOOPERS

Two species of loopers (cabbage looper and soybean looper) occur on cotton. Both are light green and have two pairs of prolegs; however, the soybean looper is more difficult to control with insecticides. Looper populations are often held below damaging levels by natural biological control agents.

Treat when loopers cause 25 percent defoliation or populations threaten premature defoliation prior to boll maturity.

Bt cotton will provide suppression of loopers. The amount of suppression may vary by variety.

Insecticide		Lbs. Active Ingredient per acre	Amount Formulation per acre	Acres Treated per gal.
LOOPERS				
thiodicarb (Larvin 3.2)		0.6 - 0.9	24 - 36 ozs.	5.3 - 3.6
Bacillus thuringiensis	(See product label for rates)	-	-	-

STINK BUGS

Small, dark spots about 1/16 inch in diameter on the outside of bolls are usually associated with stink bug feeding. Stink bugs have piercing, needle-like mouth parts which can penetrate even more mature bolls. Stink bugs are seed feeders and migrate from other host crops into cotton when bolls begin to develop. Examining bolls up to the size that are still soft is a visual sampling method which can alert scouts or producers that stink bugs are present.

Treat when stink bugs number one or more per 6 row feet.

Insecticide	Lbs. Active Ingredient per acre	Amount Formulation per acre	Acres Treated per gal.
STINK BUGS			
acephate (Orthene 90S)	0.72	0.8 lbs.	-
methyl parathion 4	0.5	16 ozs.	8

SPIDER MITES

Spider mites are found on the underside of leaves and close examination is required to detect their presence. Reddish or yellow speckling of leaves indicates spider mite activity. Infestations generally occur on field borders and then spread across the field.

Treat areas when 50 percent of the plants are infested. More than one application on a 4 - 5 day schedule may be required if eggs continue to hatch.

Insecticide	Lbs. Active Ingredient per acre	Amount Formulation per acre	Acres Treated per gal.
SPIDER MITES			
bifenthrin (Capture 2)	0.06 - 0.10	3.8 - 6.4 ozs.	33 - 20
dicofol (Kelthane 4)	1 - 1.5	32 - 48 ozs.	4 - 2.6
profenofos (Curacron 8)	0.5 - 1	8 - 16 ozs.	16 - 8
propargite (Comite 6.55)	0.8 - 1.6	16 - 32 ozs.	8 - 4

WHITEFLY

Treat when 50 percent of the terminals are infested with adults. These small moth-like insects feed on the underside of leaves and readily fly when disturbed. More than one application on a 4 - 5 day schedule may be required if eggs continue to hatch.

Insecticide	Lbs. Active Ingredient per acre	Amount Formulation per acre	Acres Treated per gal.
WHITEFLY			
acephate (Orthene 90S)	0.45 - 0.9	0.5 - 1 lbs.	-
methamidophos (Monitor 4)	0.25 - 0.5	8 - 16 ozs.	16 - 8

Expected Occurrence of Cotton Insect Pests: This is a generalized statement based on historical data. Conditions may vary from farm to farm in a given season.

Stage of Plant Development	Major Pests	Occasional Pests
Emergence to fifth true leaf:	Thrips, Cutworms	Aphids
Fifth true leaf to first square:	-	Aphids, Plant Bugs, Spider Mites
First square to first bloom:	Boll Weevil, Plants Bugs, Bollworm, and Tobacco Budworm	Aphids, Spider Mites
After first bloom:	Boll Weevil, Bollworm, Tobacco Budworm, Fall Armyworm	Aphids, Stink Bugs, Plant Bugs, Loopers, Beet Armyworms, Spider Mites, Whiteflies, E. corn borer

Reentry Periods for Cotton Insecticides

The reentry interval is the time period required by federal law between application of pesticides to crops and the entrance of workers into those crops without protective clothing. Reentry intervals serve to protect workers from possible pesticide poisonings.

This listing does not include all insecticides labeled for cotton. Reentry intervals for insecticides not listed may be found on the insecticide label.

Insecticide	Reentry Interval (hours)	Insecticide	Reentry Interval (hours)
Ammo (P)	12	Kelthane (OC)	12
Asana (P)	12	Lannate (C)	72
Baythroid (P)	12	Larvin (C)	12
Bidrin (OP)	48	Lorsban (OP)	24
Capture (P)	12	methyl parathion (OP)	48
Comite (OS)	48	Monitor (OP)	48
Curacron (OP)	48	Orthene (OP)	24
Cythion (OP)	12	Ovasyn (F)	24
Decis (P)	12	Payload (OP)	12
Di-Syston (OP)	48	Penncap-M (OP)	48
dimethoate (OP)	48	Provado (CN)	12
endosulfan (OC)	24	Scout X-TRA (P)	24
Fury (P)	12	Temik (C)	48
Gaucho (CN)	12	Tracer (SPN)	4
KarateZ (P)	24	Vydate (C)	48

Classes of insecticides listed above are identified by the following abbreviations:

(B)	Biological	(OP)	Organophosphate
(C)	Carbamate	(OS)	Organosulfur
(CN)	Chloro-nicotinyl	(P)	Pyrethroid
(F)	Formamidine	(SPN)	Spinosad
(OC)	Organochlorine		

Growers, scouts, and other farm laborers must effectively communicate when and where pesticides have been applied. Reentry periods vary by product; therefore, both products and date of application are needed before persons can safely enter treated fields. Scouts should not enter fields until the reentry interval has expired. Safety is of utmost importance. Be sure to establish proper communication channels with all parties involved.

INSERT WEED CONTROL FILE - *COTTON* and *COTHAR (on disk)*

Harvesting Cotton Crops Efficiently*James B. Wills, Jr., Professor*
Extension Agricultural Engineering

Repair, Adjust and Operate Picker for High Efficiency

Under favorable conditions, spindle-type pickers will harvest 95 percent or more of open cotton. Therefore, when a picker harvests less than 95 percent, there must be some conditions that adversely affect machine performance. Some adverse effects are due to weather conditions which cannot be controlled, but there are many conditions which can be controlled by the owner and operator of the picker.

Repair Picker before Harvest

Keeping the picker in good mechanical repair and adjustment is essential for high harvesting efficiency. A good job can be done only when all working parts are in good condition, aligned and properly adjusted. In many cases, older pickers can be modernized to increase efficiency. The picker should be overhauled several weeks before harvest begins. Worn parts such as spindles, moistener pads, doffers or strippers, valves, bearings, bushings, springs, rails, etc., should be replaced and adjusted to factory specifications by trained personnel. Always use replacement parts which fully meet the manufacturer's standards.

Adjust Picker before Harvest

When worn parts have been replaced, the next step is to see that all working parts are in proper adjustment. It is not uncommon for a poorly adjusted picker to lose 10 to 12 percent in efficiency. The spindle is the heart of the machine. The proper adjustment and alignment of spindles to moistening and doffing assemblies can easily make the difference between a poor job and a good one. The moistener pad should clean the spindle thoroughly with each revolution of the picker head. This prevents a decrease in picking efficiency by the buildup of plant juices, bark, dirt, etc., on the spindle.

Precise adjustment of the spindle to the doffer or stripper is necessary to remove all cotton from the spindle with each revolution. Improper adjustment allows some cotton to remain on the spindle, which not only lowers efficiency but quality as well.

These adjustments should be made according to recommendations in the operator's manual and are the same for all field and plant conditions. This yearly overhaul can help: (1) lower general repair costs, (2) reduce down-time in the field, and (3) maintain a high rate of picker efficiency by putting more cotton in the basket.

Adjust and Operate for Field Conditions

Top performance can be achieved by using a careful, step-by-step analysis of conditions in each field and making needed adjustments. Field adjustment and operation involves: (1) ensuring that all fruiting parts enter the picking zone correctly, and (2) removing cotton from the plant.

Plant Entrance into Picking Unit

The cotton plant must enter the picker properly, at the correct speed for highest efficiency. Test have found that a 2 percent difference in picking efficiency can occur between two experienced operators. This occurs if one operator has more skill in keeping the machine on the row and selecting proper speeds.

Here are some points to increase efficiency:

1. **Keep the unit centered on the row**. If the unit varies off the row, a stripping action develops which causes the spindle to lose contact with the cotton and, in severe cases, plant parts strip off cotton already on the spindle. The greater the lateral movement of the unit, the greater the field loss. Two to 4 percent loss is not uncommon. When using two-row, four-row or six-row machines, make sure that picking units are set the same width as the planter and that the picker is kept on matched rows.
2. **Guide low bolls into picking zone.**
   a. Adjust stalk lifters to the row profile of the field and the fruiting pattern of the plants. To keep droppage to a minimum, bolls should enter the unit at the same height as the second or third row of spindles.
   b. Adjust stalk lifter fingers so that low bolls near the center of the drill are lifted into the picking zone.

c. Adjust unit stop to keep unit out of the dirt.

3. **Adjust picker drum tilt.** Correct picker drum tilt increases spindle exposure to cotton, increases efficiency and reduces dirt build-up inside the unit.
4. **Synchronize picker drum speed with ground speed**. Excessive amounts of debarking and green leaf are usually good indications that the picker drum and ground travel speeds are not synchronized. To maintain desirable speed relationships, check periodically for proper air pressure of drive wheels.
5. **Operate the engine in the proper gear at full throttle.** To determine the best gear for picking, compare picking efficiency, amount of trash, green boll loss and plant damage between the available picking gears. Generally, for immature plants or extra high yields, the slower speeds are best: while on the second or last picking, higher speeds may be used.

Removal of Cotton from the Plant

Pressure plates are used to force the plant into the picking zone and hold the boll in a stationary position so the spindles can contact the lint. Here are four ways to assure proper operation.

1. **Adjust pressure or crowder plates**. The plates should be set with a high-spring tension and close spindle clearance for highest efficiency. When there are a large number of mature green bolls, tension should be light to medium with additional clearance.
2. **Keep spindles clean**. To maintain high machine efficiency, spindles must remain clean at all times. Plant stains and lint accumulation on the spindles are the primary sources of dirty spindles.

   Losses will vary depending on the amount of build-up on the spindles. First picking usually is the most critical time because plants are greener. Spindles can gum up in an hour's time to such an extent that efficiency is lowered as much as 5 percent; therefore, check often. At the first sign of built-up on the spindles, check the following:

   a. Is sufficient water in the supply tank?
   b. Is the moisture control valve set properly? Use only enough water to keep spindles clean.
   c. Is moisture getting to each pad? Are tubes stopped up?
   d. Are all pads touching the spindles?
   e. Should wetting agents be used? Top field performance can be maintained and quality preserved through the use of plain water if moistening adjustments are set properly and only enough water is used to keep spindles clean. However, wetting agents are beneficial when green leaf or hard water conditions prevail.
3. **Reduce picker drum bobbing.** Operators should keep picker unit from moving up and down any more than necessary. This movement affects the position of the spindles in relation to the bolls, is similar to driving off the row and affects efficiency in the same way.

   The picking unit vibrates when middles are rough or when high lug tires are used on firm middles. Keep the unit lift resting on the unit stop when possible and adjust unit counterbalance spring to reduce vibration caused by rough middles. It is not uncommon for only a slight vibration to reduce efficiency 1 to 2 percent.

[3] **Pick Dry Cotton**

Proper moisture conditions during harvesting can mean more cotton in the basket, higher quality and more dollars at the gin. Moisture control during picking simply involves waiting until the cotton is dry enough to harvest and then adding only enough water in the picker moistening system for satisfactory operation of the machine.

Harvesting cotton when it is too wet, or adding too much water through the moistening system can reduce the efficiency of spindle-type pickers as much as 3 to 5 percent.

Know the Sources of Moisture

For many years, cotton producers thought that excessive moisture in seed cotton was caused by adding too much water during the picking process. While it's true that too much water can be added to the spindles, studies have shown that much more of the moisture in machine-picked cotton comes from moisture in the air.

Wait until the Field Is Ready

In deciding when to begin first picking, the producer considers the amount of open cotton and green leaves on the stalks. Green leaves and other trash add considerable moisture to the seed cotton, produce lint stain and cause spindles to gum up. Leaves and trash lower picker efficiency and make more drying and cleaning necessary at the gin. On the other hand, field losses are increased and color is lost when harvesting is postponed.

The time to start mechanical pickers is a problem which must be faced each morning. Moisture varies depending upon the amount of dew, relative humidity, rainfall, amount of green leaf, cloud cover, sunlight, wind velocity and many other factors. Moisture also rises above the critical level in late afternoon at different hours on different days.

Regardless of how dry the weather, cotton in the Midsouth should never be harvested at night, early morning or late evening. Even on the driest days, cotton will rarely be dry enough to machine harvest until after 8:00 a.m. It is generally advisable to delay harvesting until the dew has dried and the relative humidity has dropped below 60 percent. Harvesting in defoliated fields can safely start one hour earlier than in undefoliated fields. Seed cotton dries more rapidly in defoliated fields because more air movement is possible with the removal of leaves.

Check Picker Performance

Close supervision of picker performance and condition and operator performance may easily mean 5 percent more cotton in the trailer.

As an example, operating the picker drum only 2 inches higher than optimum height can increase picker losses by approximately 3 percent. Thus, good operator performance in controlling drum height can mean more profit per bale of cotton.

Other areas in picker operation and performance are just as important. Here is a check-list for your use. **(Use trouble shooting section of your operator's manual for detailed information.)**

In. During Machine Operation in Field

- A. Operator Performance:
  - 1. Observe whether unit is entering row lined up and, if it is in picking position and at full throttle. Width and condition of turnrow should be carefully noted.
  - 2. Is proper speed being maintained?
  - 3. Is operator keeping unit on the row?
  - 4. Is there excessive raising and lowering of the unit in the row?
- B. Machine Operation:
  - 1. Note way in which plants enter the units.
  - 2. Observe height and tilt of unit.
  - 3. Observe the plant as it leaves the unit to determine where losses are occurring. Estimate the amount of cotton on the ground and the amount that falls after the plant is released.
  - 4. Observe green boll loss or damage and condition of plant after the machine passes.
  - 5. Listen to sound of power unit to check on uniform speed.
- C. Field Conditions:
  - 1. Observe variability in row height and shape.

2. Observe variation in plant size, shape, maturity, yield, percent open; leaf condition and amount; boll location and condition of opened bolls as to the fluffiness; stringing out, tight lock, etc.
3. Using seed count method, check efficiency of the machine in an area of the field that represents average condition.
4. Observe condition of seed cotton in trailer with respect to moisture and trash condition; fluffiness, roping or twisting of fiber.

II. When Machine Is Stopped

A. Condition and Alignment of Assemblies in Unit:
1. Check condition of spindles. Are they gummed? Is lint on tip or rear of spindle?
2. Check moistener assembly with respect to adjustment to spindle.
3. Check moistener assembly with respect to amount of water being applied to spindle.
4. Check condition of unit housing as to dirt, trash and excessive water.

B. Eliminate Low Performance:
1. Make necessary adjustments.
2. Instruct operator on points he/she may be doing wrong in the operation of the machine.
3. Point out variation in plant conditions in different parts of the field which necessitate changes in adjustments or operation of the machine.

What Are Your Losses?

Checking your losses behind each picker and each operator regularly in each field will result in greater efficiency and bigger profits. Here's how:

Select 10 feet of row
<u>Before picking</u>

Your Example		Count
______	Step 1. Count number of pickable bolls in 10 feet.	74
______	Step 2. Determine average number of locks per boll.	5
	Step 3. Determine average number of seed per lock.	7
	Step 4. Multiply - bolls x locks/boll x seed/lock.	74 x 5 x 7 =2590
______	Step 5. Pick cotton from ground and count seed. 57	
	Step 6. **Pre-harvest**	Install Equation Editor and double-click here to view equation.

Machine Cotton on 10 Feet of Row

After picking

	Step 7. Count seed knocked to the ground.	135
______	Step 8. Count seed remaining on the stalk.	96
	Step 9. Ground loss = <u>Step 7 (135)</u> x 100 = 5.2%	______

Step 4 (2590)

Step 10. Stalk loss = $\frac{\text{Step 8 (96)}}{\text{Step 4 (2590)}}$ x 100 = 3.7% _______

Step 11. Total loss = Step 6 (2.2%) + Step 9 (5.2%) + Step 10 (3.7%) =11.1% _______

Storing Seed Cotton in Modules

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The amount of seed cotton stored in modules is increasing in Tennessee. The primary advantage of using modules is that harvesting capacity is not dictated by ginning capacity. Producers can harvest cotton when the quality is high and store it in a module rather than leaving the crop exposed to weather in the field. The module system allows gins to operate more hours per year, thus reducing gin overhead costs per bale. Also, in areas where cotton production has increased, gins use module equipment to extend the ginning season rather than increasing their ginning capacity.

Feasibility of Moduling

Handling and storing seed cotton in modules can benefit both growers and ginners if their operations are large enough to justify the investment. Because module equipment is large and expensive, it requires medium-to-large producers and gins. To keep costs reasonable, each module builder should handle at least 800 bales and preferably 1200 bales each season. At least four rows and preferably six rows of picker-harvesting capacity should be matched with each builder. Extremely high or low yields will change this ratio.

Site Selection and Preparation

A well-drained module storage site is very important, because standing water or permanently wet soil will cause a layer of seed cotton to deteriorate. The following guidelines should be used when selecting a site:

- Well-drained turnrow or field road
- Free of gravel, stalks and debris such as long grass
- Smooth, firm surface and near-constant grade
- Accessible in wet weather
- Away from heavily-traveled roads and other possible sources of fire and vandalism
- Clear of overhead obstructions such as utility lines
- Field turnrows can be improved by preparing an elevated site such as the one shown in Figure 1.
- Modules should be oriented north-to-south so they can dry faster after a rain.

Building a Good Module

Seed cotton can be safely stored in modules if its moisture content is kept at 12 percent or less. Moisture contents above 12 percent cause modules to heat which increases the frequency of light-spot (or lower grades) and produces poor quality seed. Good defoliation or desiccation is essential. Excessive vegetative growth and late-season regrowth contribute to high levels of green trash in harvested material. The higher the concentration of green trash, the higher the moisture content of seed cotton.

Start building the module by placing the first and second dumps in opposite ends of the builder. The third dump should be made near the middle, and the leveling and tamping should begin immediately and continue until the module is completed (Figure 2). The tighter the module is compacted, the better it sheds rainfall on the sides and the less seed cotton is lost during storage, loading and hauling. When completed, the module should look like a giant loaf of bread. Make the top round so it will shed water when covered with a tarp. Any depression in the top in which water can collect can lead to storage problems.

Covering Modules

Cover the module with a high-quality tarp. Always purchase tarps well ahead of harvest time and select a brand that has a label showing the manufacturer's name, phone number, date manufactured and reference to a specification sheet for tarp quality. Many factors should be used in comparing different covers. Information on tests for physical properties such as tensile strength, Elmendorf tear, hydrostatic head, moisture vapor transfer rate, abrasion resistance, adhesion of coatings, UV resistance and cold-crack temperature are useful when making decisions on which cover to purchase.

Both cotton and synthetic tarps are available for covering modules. Cotton tarps are less likely to trap condensation from within the module; however, they are generally more expensive, heavier and require more care before they can be stored. Synthetic tarps can trap moisture vapor from within the module; therefore, precautions must be taken to prevent seed cotton quality losses due to condensation.

The design of form-fitted synthetic tarps allows moisture to be expelled with normal wind movement up the side of the module and under the tarp. Inspect tarps before the morning sun evaporates condensation. If condensation occurs, the module might be overheating and in need of immediate ginning. Making sure that cotton is dry enough for safe storage before moduling eliminates much of the potential for condensation problems.

Always inspect tarps before they are used. Whipping action from the wind causes the fabric to wear quickly and become unusable because it is no longer waterproof. Check each tarp for holes or rips and repair or dispose of as needed.

Managing Modules

Modules must be carefully managed to avoid damage to quality and reduced crop value. Fiber quality should not be expected to increase in modules, but it can be maintained with proper management.

Monitor internal module temperatures **daily** for the first five to seven days. A rapid and continuing temperature rise of 15 F to 20 F or more during this period indicates a high-moisture problem, and the module should be ginned as soon as possible. Furthermore, if module temperatures reach 110 F, gin immediately to avoid the possibility of major loss. Tests have shown that fiber yellowing and light-spot grades result from elevated module temperatures.

All modules should be checked for high temperature twice a week after the initial five- to seven-day storage period and after rainstorms. The temperature of modules that are harvested at safe storage moisture will not increase more than 10 F to 20 F and will then level off and cool down as the storage period is extended. High-moisture modules, especially those harvested late in the season when ambient temperatures are low, may continue to increase in temperature at a slow rate over a period of several weeks. **If at any time the temperature increases by more than 20 F from the initial temperature, gin the module immediately.**

Record Keeping

Each module should have a record (with a duplicate kept in the office) that includes the date and weather conditions when picked, the approximate number of bales contained in the module, the ASCS identification and monitoring records with temperature data. These records are essential for the following reasons:

- To substantiate insurance claims in the event of loss
- To satisfy ASCS/CCC seed cotton loan requirement
- To provide the gin with information for preparing bale records
- To aid in decisions about ginning the module

You must report the necessary data to the gin within 24 hours after building the module to be covered by the gin's insurance and to comply with CCC's seed cotton loan requirements.

Any records or numbers assigned to modules should be as permanent as possible. Permanent marker pens should be used to write on cards attached to modules. The cards should be in sealable plastic bags, although this is no guarantee against leakage. Each module should be numbered successively on the cards. The modules may be marked by spray painting, provided that the approved, non-contaminating **BRAND-A-BALE** ® spray, developed by Cotton Incorporated, is used.

Reference

Material in this section was adapted for use in Tennessee from:

Willcutt, Herb, William D. Mayfield, William F. Lalor, Robert G. Curly. *1992. Seed Cotton Storage and Handling in Modules*. Cotton Incorporated. Raleigh, NC.

Cotton Marketing in Tennessee

Charles M. Farmer, Professor
Agricultural Economics

Cotton continues to be a major crop in Tennessee. From 1994 to 1998, the value of cotton cash receipts topped $200 million annually, including both lint and seed receipts.

The cotton marketing system includes a wide variety of businesses between the cotton producer and the final consumer. Various businesses involved in marketing and processing add value to cotton by transforming the lint and seed into the desired product and at the preferred time and place.

The ginning sector provides the initial transformation of raw cotton into a marketable fiber. With the separation of the lint and cotton seed, the first step in the marketing process begins.

Gin numbers in Tennessee are much smaller than 20-30 years ago, but ginning capacity has actually increased through updating of older gins, consolidation and construction of newer, high-capacity gins. The Tennessee ginning industry is well-equipped to handle the very large crops of recent years — especially with widespread use of moduling to extend the ginning season and improve efficiency.

Cottonseed is the raw product from which cottonseed oil and cottonseed meal is obtained. The products of cottonseed compete with other edible oils and protein feeds for livestock. The fiber is the raw product for the textile industry both in the U.S. and abroad. Textile mills need fairly constant supplies through the year. Because cotton harvest and ginning are highly seasonal, storage capacity is needed. Nearly 400 cotton warehouses throughout the Cotton Belt perform the storage function. More than two thirds of the cotton crop moves from gins to these warehouses, while the remainder of the crop moves directly from gin to mill or for sale abroad during or immediately following harvest. Cotton grading (classing) also occurs at the warehousing stage. Grading is required for cotton planted under CCC price support loan. Also, most cotton moving in interstate and foreign commerce is graded.

After ginning, ownership of the cotton is often transferred to private merchantshippers. Merchants assemble cotton into larger, uniform lots and initiate sales to domestic textile mills and foreign buyers. During the 1997-99 period, about 64 percent of U.S. cotton production was used by domestic mills and 36 percent was exported. Various types of cotton brokers, agents and commission merchants act as intermediaries between growers, shippers and textile mills.

Several cotton trading centers strategically located in the Cotton Belt also play a key role in cotton marketing. Cities such as Memphis, Dallas, Lubbock, Fresno and Phoenix are equipped to store and merchandise cotton. Trading is done by local cotton exchange rules. The "spot," or cash, markets serve as focal points for the discovery of prices and for the assembly and distribution of large volumes of cotton. The New York Cotton Exchange, which regulates and provides a physical setting for trading of cotton futures contracts, also plays a valuable role in the price discovery process.

Considerable value must be added to raw seed cotton at the farm level to make it useful to consumers. Consequently, farmers receive less than 10 percent of the consumer's cotton dollar. The manufacturing and retailing functions claim about two-thirds of the cotton retail dollar. Labor is the single largest marketing cost, accounting for more than 50 percent of the spread between the farm value of cotton and retail cotton product prices.

The U.S. farm price of cotton is influenced by many factors, but especially the relationship between domestic and foreign supply and demand, stock levels and the USDA cotton program, particularly the loan program, target price level and acreage reduction policies.

Farm legislation in recent years has included provisions designed to keep U.S. cotton competitive in world markets while protecting U.S. textile mills. The U. S. share of the world export market dropped from near 28 percent in 1998 to 18 percent in 1999. It is expected to recover to near 24 percent in 2000.

Tennessee cotton producers are continually being "pushed" by economic forces to improve profitablilty. A carefully-developed production-management-marketing plan, combined with good management, is advised. Many growers have devoted too little time to marketing in the past. Because of the way the USDA cotton program operates, many growers may view cotton marketing as less demanding when compared to soybeans, corn and wheat. However, sound cotton marketing will pay good returns.

Growers should first develop a good understanding of various cotton marketing alternative and then determine which one potentially fit into their operation and in what manner or combination. The primary marketing alternatives are briefly outlined in the following section along with the major advantages and limitations of each one.

I. Cash Sale at Harvest
   A. Advantages
      1. Easy and inexpensive
      2. Eliminates any risk of "over-selling"
      3. Eliminates storage expense and allows early "wrap-up" of the crop
   B. Limitations
      1. Spot prices at harvest often near seasonal lows
      2. Involves considerable price risk since grower bears risk of price declines for many months before harvest

II. Pricing Before Harvest - Forward Sales Contract
   A. Advantages
      1. Allows a specific (and hopefully favorable) price (or basis) to be established before harvest
      2. Simplest way to forward prices
      3. Can price smaller amounts than with other forward pricing methods
   B. Limitations
      1. Pricing flexibility is sacrificed on contracted amount (acreage or bales)
      2. Some merchant default risk

III. Pricing Before Harvest - Futures Market Hedge
   A. Advantages
      1. Can lock in approximate price more than 12 months before harvest
      2. Provides more safety and flexibility than some other methods
   B. Limitations
      1. More complex than other forward pricing methods
      2. Requirements to establish margin account

IV. Pricing Before Harvest - Options
   A. Advantages
      1. Put option purchase allows grower to establish a minimum but not a maximum selling price
      2. There is no delivery requirement
   B. Limitations
      1. Premiums must be paid "up-front" and may appear expensive
      2. Effective use requires understanding of price relationships

V. Pricing After Harvest - Warehouse Storage
   A. Advantages
      1. Potential benefit from season high prices in the spring following harvest
      2. Provides tax management flexibility
   B. Limitations
      1. Unpriced cotton in storage can decline in net value
      2. Preoccupation with storage may cause growers to overlook attractive forward price offers.

As evaluation of seasonal price patterns in recent years can be helpful in improving marketing efficiency. For those considering forward pricing cotton for harvest delivery, the highest prices prior to harvest generally occurred between May 15 and August 15. Following harvest, futures prices over the last 15 years have generally moved sideways to lower until mid-February and then generally rose through late spring.

To make effective use of marketing alternatives, cotton growers need to develop a written marketing plan. This plan will take into account cash flow needs, expected production cost per pound, size of operation, risk-bearing ability, price outlook, cotton program provisions and other factors. A good plan will provide discipline, remove some frustration from marketing and are time, should help raise average net prices received by producers while reducing price risk.

To be good marketers, cotton growers will need to stay informed about changes in the marketing environment. The cotton industry has undergone considerable change in recent years. New production patterns, improved ginning and textile manufacturing technologies, changes in marketing practices, additional competition from overseas and changes in government program provisions have all influenced cotton marketing. Procedural changes regarding grades and standards continue to be made to accommodate changing consumer preferences, mill needs and production practices.

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