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Production of Ultra-Narrow-Row Cotton[1]

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Shorter-season cotton varieties have allowed growers to start harvesting cotton sooner with fewer problems with "hardlocked" cotton bolls. Stripper harvesting of cotton is an effort to reduce the amount of cotton that is left in the field during harvest with conventional spindle cotton pickers, especially in years when hardlock is a major problem. Seed costs will be higher for planting narrow-row cotton, while harvest costs and higher yields may make it more profitable. However, only a small part of the crop is currently grown in this manner since planting and harvest operations are quite different from conventional-row-width cotton. Farmers who grow row crops generally have their equipment set up to plant several crops with the same equipment with only minor adjustments made when changing crops. Most of the Florida cotton is grown in 30- to 38-inch rows for weed and insect control purposes, as well as for harvesting with conventional pickers. However, incorporation of genetic technology into cotton varieties (*Bacillus thuringiensis* or Bt for insect resistance, and Roundup Ready, Liberty Link, and others for herbicide resistance) has resulted in the ability to produce cotton in 7- to 10-inch rows and as wide as 15 inches for harvest with a cotton stripper. This production system is called **ultra-narrow-row** (UNR) production, which started in Florida due to hardlock of cotton bolls that could not be harvested with a conventional spindle picker. Stripper harvesters will harvest all bolls, including the hardlocked bolls and those that are poorly opened. These pickers are widely used in the High Plains of Texas since cotton is bred for staying in the boll better due to high winds. However, cotton quality is usually a little lower since everything is stripped from the cotton plant if all leaves are not off, this can end up in the picker basket and will require more cleaning at the gin; which often results in slightly lower fiber quality.

There are still many concerns about uniformity of stands in UNR systems (since cotton is often planted with a grain drill or no-till drill), seed costs, plant populations, fertilizer rates and timing, ginning costs, marketability, bark or trash content in the lint, spinning problems, and availability of planting and harvesting equipment. These have been addressed throughout the years. This article presents the most up-to-date findings of research that has been conducted in Florida and other universities in the Southeast on UNR cotton. It is not intended to be a definite recommendation but may help those who are interested in this type of production system and often have fields of cotton that hardlock each year.

Variety Selection for UNR Cotton

On-farm variety trials are conducted each year by research and extension people across the southeast. When combined the data shows the stability from low-yielding to high-yielding environments. It is a good idea to use those varieties that are the top yielders across low- and high-yield locations, as they fare best under stress and without stress.

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Research data from the Southeast shows that many of the early- to mid-season varieties used in wide-row production will also work in a UNR system. Stripper-type or "stormproof" varieties are often used for stripper harvest in Texas, but generally have not performed well in the humid Southeast and may contribute to excess trash due to tight burs. Observations indicate that most common varieties, when planted at high densities and managed properly, will not branch excessively and will make stripper harvest more efficient.

Plant Population

Thick, uniform stands are critical to force cotton into compact plants with few side branches for efficient and clean harvesting with a cotton stripper. Cotton planted in 10-inch rows with 2–3 plants per row foot has resulted in plant types that harvest well with a stripper harvester. Dense canopies early in the season will also reduce weed competition. Recommendations vary widely, but most researchers recommend from 80,000 to 150,000 plants per acre. Some of our best yields in Florida have come from final stands of 100,000 to 110,000 plants per acre. Planting with twin row equipment with 22-inch row middles should also produce similar plant structure.

Investigations at Auburn University evaluated time of planting and plant density in UNR cotton. At 150,000 plants per acre, 3–4 bolls per plant set at the first or second fruiting position can yield 2–2.5 bales per acre. On sandy soils, or when moisture stress occurs late in the season, high plant densities may result in competition for moisture, which could cause yield reductions (Figure 1).

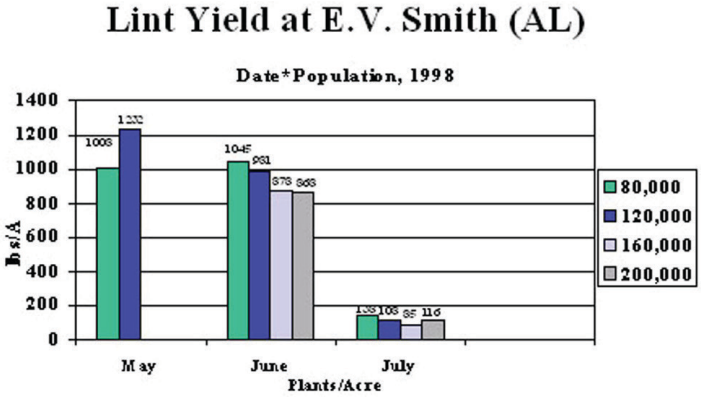

Figure 1. Effect of planting date and plant population on yield.

Fertilization of UNR Cotton

In the last few years many questions about fertilization of UNR cotton have been asked. The questions most often asked are the following:

1. Will demand for nutrients be greater since plant populations are higher?
2. Should one cut back on nitrogen fertilizer so that cotton will not grow too tall?
3. What effect will a shorter fruiting period have on cotton fertilizer needs?

The following are suggestions based on current research findings and observations.

Nitrogen Fertilization

In Florida, nitrogen (N) fertilizer recommendations for cotton vary from 60 pounds per acre (on the heavier textured soils and behind winter grazing) to 90 pounds per acre (on the sandy soils). Nitrogen fertilizer recommendations are reduced by 30 pounds of N when soils have a history of producing rank growth. With conservation tillage or strip till planting of cotton into small-grain cover crop residues, add an additional 30 pounds of N to help decompose the straw residue so that N is not limited. Current research and farmer experience have shown that these N fertilizer recommendations provide the basis for N fertilizer rates needed for UNR cotton. Huge reductions in N rates will reduce stalk growth and can limit yield potential, especially during dry growing seasons. The nitrogen provided by a previous crop, especially if it was winter grazing, or additional N needed to decompose a small-grain cover crop will be important considerations on total N needs. Our research has shown that 60 lbs/ac of N is adequate for high cotton yields after winter grazing due to recycling of nutrients.

Potassium Fertilization

Research with potassium (K) fertilizer rates on UNR cotton is limited. However, unpublished research by Mullins in central Alabama has indicated UNR cotton may require a greater amount of potassium fertilizer compared to cotton grown in a standard row spacing (Table 1). This study also showed lower micronaire with UNR cotton as compared to cotton in standard rows. Potassium plays an important part in increasing cotton micronaire. Some of these differences observed in the study may have been due to the later planting date (June 4th). However, with the high plant population of UNR cotton and heavy potassium demand during boll fill, there may be a need to increase K fertilization for UNR cotton. But remember, soil tests for cotton are still the best indicator of nutrient needs.

Other Nutrients

Other nutrients needed in UNR cotton production, such as phosphorus (P), sulfur (S), magnesium (Mg), and boron (B), should follow standard soil test recommendations for conventional cotton production.

Plant Growth Regulators

Current harvesters for UNR cotton do better with fairly short non-branched cotton for efficient and clean harvesting. Many adapted varieties will grow very tall with good growing conditions; therefore, growth regulators will be needed to keep vegetative growth down.

Mepiquat chloride (Pix and other formulations) should be applied beginning at pinhead to matchhead square, which is earlier than normal for conventional planted cotton. Because it is important to control cotton growth as it occurs, one or two early applications will likely be more effective than trying to apply larger amounts later. Since UNR cotton has a short window of fruiting, growers will need to be timely in monitoring and applying treatments.

Depending on rainfall, fruit load, fertility, and other factors, UNR cotton may require anywhere from 8 to 24 oz/ac of mepiquat chloride to control growth. Some varieties may require higher rates of growth regulators to reduce excessive growth. Current approaches are shown below.

The standard program should begin by applying 8 oz/ac between pinhead and matchhead square stages, then applying another 8–16 oz within 10–14 days depending upon crop growth, using low rates to maintain desired growth and the higher rates as cotton becomes very large or vigorous. In studies, a total of 16–24 oz/ac have been used in Florida. If cotton retains fruit early and the weather is dry, less mepiquat chloride may be needed.

Monitoring of the top 5 nodes can also be used as a guide to the use of mepiquat chloride, with maximum internode distance kept to 2 inches or less. Growers need to be careful monitoring at least once a week, especially during periods of high rainfall or good soil moisture.

Weed Management in Ultra-Narrow-Row Cotton

Optimum cotton yield and quality for UNR cotton requires good weed control throughout the growing season. Follow normal weed control procatices for cotton in Florida found at http://edis.ifas.ufl.edu/wg003. Standard cotton varieties will require the use of residual herbicides such as trifluralin (e.g., Treflan), Prowl, Cotoran, and Staple. Transgenic varieties, such as those with glyphosate, gluphosinate, dicamba, 2,4-D, etc. tolerance genes, allow over-the-top use of products, but residual herbicides should be part of any weed control program to combat weed resistance. Conventional-row cotton allows mechanical cultivation and post-directed spraying between rows to manage weeds after the crop emerges, but UNR cotton will not allow the use of cultivators or post-directed sprayers. **All herbicide treatments in UNR cotton must be applied on a broadcast basis.** Most studies show that narrow-row cotton will provide a soil canopy in about 30 days as compared to 60-75 days for conventional-row widths, which will shade out weeds and reduce their competitiveness. It is very important to use residual herbicide with resistant palmer amaranth.

UNR cotton should receive trifluralin or pendimethalin incorporated or preemergent to the UNR cotton grown using conservation tillage (no-till, strip till, minimum till, etc.) should receive a residual preemergence broadcast application of appropriate herbicides. Complete burn-down of emerged winter vegetation is extremely important before planting UNR cotton. The same herbicide treatments used in conventional-tillage UNR cotton can be used in conservation-tillage UNR cotton. With Florida's weed spectrum, using a postemergent-only weed program is not recommended.

Insect Control in Ultra-Narrow-Row Cotton Production

Thrips control in UNR production is one area of insect management that most farmers have felt compelled to alter. Good thrips control is essential to a good stand, and without an adequate stand, management of UNR cotton is difficult. Thrips control based on a row foot or per seed basis becomes quite expensive. If in-furrow and seed treatment applications are eliminated as control options, the choices become very limited. Orthene as a hopper-box treatment or foliar applications at the first true leaf stage can be used. Subsequent applications can be applied as necessary. The biggest risk associated with foliar applications for thrips is poor control due to poor timing and the possibility of rapid buildup of aphids and possibly even spider mites due to the disruption of naturally occurring predators.

Most farmers who have eliminated in-furrow controls as an option have done so by comparing UNR and conventional cotton rate-for-rate. In other words, if row feet per acre increases by 5X, then the conventional thrips control cost of $12 per acre is calculated as $60 per acre for UNR production. This rate-for-rate transfer may not be necessary. Preliminary data are available to show that a 2X rate of an in-furrow insecticide may be enough to provide adequate control. More studies need to be made in this area.

Insect pests such as plant bugs, stink bugs, and the many caterpillar species are a potential problem for UNR cotton just as they are for conventionally planted cotton. Most of the thresholds for these insects are based on damage or a number of insects per so many plants or so many row feet. Thresholds based on insects per 100 plants do not need to be changed regardless of row spacing. These thresholds are based on the fact that an individual worm will damage a certain number of squares and/or bolls during its feeding period. Individual plant samples would not require much modification between UNR and conventional-row widths. However, a sweep net and shake cloth sampling procedure would need to be modified, and a shake cloth method may not even be feasible.

Pests such as aphids, whiteflies, and two-spotted spider mites should not present any additional difficulty due to reduced row widths. All pests can be indirectly impacted by UNR production if the crop is very late or if it differs dramatically in any other way.

Insects usually come in generations; they are either very abundant or virtually absent. Except for the occasional "close call," insect control decisions in UNR cotton production have not presented any insurmountable problem.

Impact of Ultra-Narrow Rows on Diseases and Nematodes

Seedling diseases on cotton are caused by a wide range of organisms, mostly plant pathogenic fungi. They can be extremely devastating when poor seed is used, or when seed is planted too deep or in soil that is too cold and wet. The best way to avoid seedling disease problems is to plant good seed when the soil is warm. One method is to plant when the soil at 4 inches deep has reached at least 65°F by 8 a.m. This cultural practice, combined with appropriate fungicides, if warranted, should be practiced for UNR and conventional cotton plantings. Since UNR cotton requires greater seed costs (more seed used per acre), it is extremely important to establish a good stand initially. Seedling spacing should not increase the chance of seedling diseases spreading, because the seedling rapidly "hardens off" to infection if soil is warm enough.

Boll rots may increase due to rank growth if UNR cotton is over-fertilized and/or growth regulators are not used correctly. However, higher-density plantings often naturally reduce foliar growth of the plant due to the high level of competition.

UNR cotton has an advantage at harvest. Cotton grown in Florida often has some degree of hardlocked bolls. Plants as well as root systems are smaller when grown in narrow-rows with bolls near the top of the canopy. Bolls that are hardlocked can be harvested with a UNR finger stripper header while spindle pickers often knock the locks off the plant. Over a four-year period, studies in Florida have shown an increase in lint yields of 100 to 200 lb/acre. Much of this increase is due to increased efficiency of harvesting the hardlocked bolls instead of knocking them to the ground.

The incidence of nematode and disease problems in cotton has grown in Florida due to increased acreage and little or no rotation in some fields. The major nematodes causing disease include southern root-knot, reniform, and sting. Studies have not found major differences in nematode population densities between UNR and conventionally planted cotton. Studies to date indicate a similar percentage loss from threshold nematode population levels in both UNR and conventional cotton when planted at recommended seeding rates. Increasing seeding rates in UNR cotton may be useful to reduce overall nematode damage. It is suspected that plants less severely affected by nematodes compensated for those more severely infected. The use of nematicides in UNR cotton requires higher rates and different application methods than conventional cotton and there are materials that can be applied as seed treatments. Telone II is the most effective nematicide labeled for cotton and is typically applied in-row with a single chisel in conventional cotton, but this chemical must be applied as a broadcast treatment in UNR cotton. Chisel spacing should be no further apart than 18 inches. Research has shown that the rate of Telone II should be doubled in UNR as compared to conventional cotton. This may make application of the material uneconomical. Thus in the absence of good crop rotations, nematode management of UNR cotton will likely cost more than that of conventionally planted cotton.

Harvest Preparation

Harvest aides registered for standard row cotton are also used in UNR cotton and can be found at http://edis.ifas.ufl.edu/ag188. The primary difference is that some researchers have suggested that UNR cotton must also be desiccated after defoliants and boll-opening chemicals are used. All green material must be dried down before harvest to avoid staining the lint. The timing of applications is important. Defoliants and/or boll openers should be applied when the topmost boll to be harvested is mature. Since UNR cotton bolls are set in a short period of time, the "60% open" rule of thumb may not apply. The timing on when to apply

defoliants can be determined by slicing a few bolls and assessing the maturity of the lint and seed coat. If the boll is hard to slice with a sharp knife and the seed coat is dark brown, then a defoliant or defoliant/boll opener combination can be applied. This application should be followed within 8 to 11 days with a desiccant such as paraquat, sodium chlorate, Quickpick, or combinations thereof. Harvest should be scheduled 3 to 5 days after the desiccant application. Delaying harvest several days after desiccation will increase the likelihood bark and trash contamination.

Key Production Factors

1. Choose best varieties for the location.

2. Apply proper rates and kinds of fertilizer and lime (soil test).

3. Plant on a timely basis (April to mid-May).

4. Use conservation tillage planting methods where possible.

5. Ensure a proper seedbed to establish uniform stands.

6. Sidedress with N at early squaring and no later than second week of bloom for additional applications.

7. Apply growth regulators to keep plants compact.

8. Use IPM procedures for pests.

9. Defoliate on a timely basis (60% open bolls) and then dessicate 8–10 days later.

10. Harvest 3–5 days later.

Table 1. Effect of potassium fertilizer rates on cotton lint yield and micronaire at the Prattville Experiment Station.

K Rates (lb K_2O/acre)	Ultra-Narrow-Row Cotton		40-Inch Cotton	
	Lint lb/acre	Micronaire	Lint lb/acre	Micronaire
0	554	2.83	386	3.42
30	784	3.20	435	3.63
50	862	3.20	482	3.84

Source: Unpublished data by Mullins, Auburn University. Cotton planted on June 4.