SALT-AFFECTED SOILS FOR ULTRA-NARROW ROW COTTON PRODUCTION
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Abstract

Much interest has been generated in ultra-narrow row (UNR) cotton production recently within the cotton (Gossypium hirsutum L.) belt. Because of shrinking profit margins, producers across the belt are looking for production systems that may improve their economic return. UNR cotton production has usually shown the greatest promise on marginal lands compared to conventional, or wide row spacing. This paper explores the use of UNR production under conditions of elevated soil salinity in West Texas.

Introduction

Ultra-narrow row (UNR) cotton production is not a new idea, having been tried with some success beginning in the late 1960's. Yields were good but there were other problems with weed and cotton plant height control that seemed insurmountable. Renewed interest has been generated in UNR production throughout the cotton belt with the advent of herbicide resistant varieties, and other over-the-top herbicide technologies. These provide weed control options for UNR production that were previously unavailable. Plant growth regulators to limit vegetative growth are now widely used in conventional systems so their use in an UNR system to maintain a "harvestable" plant height is understood. Harvesting UNR cotton currently requires the use of a finger header attached to a cotton stripper. Finger headers have changed little since they became commercially available in the early 1970's. Brashears, (1998), indicates that finger strippers were designed to strip cotton that is no more than 22-inches tall. Our experience is that plants 12 to 18 inches tall are ideal for maximum harvest efficiency. Because of this, there will naturally be a limit to cotton yield that can be attained with UNR cotton under irrigated conditions.

Shrinking profit margins have caused producers across the cotton belt to look for production systems that improve their economic return. Compelling results have been presented to indicate that UNR cotton production can maintain or boost yields while reducing inputs (Atwell et al., 1996; Belcher et al, 1999; Gerik, et al., 1998; Prince, et al., 1999). Over the past few years much has been presented on the "how-to" of UNR production (Atwell, et al., 1996; Belcher et al, 1999; Delaney et al, 2000; Gwathmey, 1998; McFarland et al, 2000; Molin, 2000; Perkins, 1998; Reeves et al., 1998; Reeves et al., 2000). Even so, many producers still question whether their situation lends itself to implementing some, or all, UNR cotton production.

One point that needs to be remembered is that UNR cotton production has been most successful where soil conditions limit plant growth and yield using conventional row spacing (Kerby, 1998), otherwise referred to as marginal lands (Delaney et al, 2000; Perkins, 1998; Reeves et al., 1998). The objectives of this paper are to show (1) that it is primarily when soil conditions limit cotton growth and yield using conventional systems that UNR cotton production is advantageous, and (2) that salt-affected soils may be compatible for irrigated UNR cotton production.

Materials and Methods

In 1999 two cotton variety trials were established on the Braden Brother's farm in Coyanosa, Pecos County, Texas. One trial was established in 15-inch rows under center-pivot irrigation, the other in 40-inch rows using furrow irrigation. Though there are regional variations, in west Texas 20-inch or narrower rows are generally accepted as UNR (Perkins, 1998). Varieties in the conventional trial were planted on 15 May in large plots (six 40-inch rows wide by 1164 ft long). The UNR trial was planted within two spans of half of a center-pivot irrigation system on 27 May. Because of this arrangement, plot lengths varied from 479 to 1119 ft depending on its location within the study. Each semi-circular plot was seven 15-inch rows wide. Both studies were arranged as a randomized complete block design with three replications. The varieties common to both were Sure Grow SG501BRR, Deltapine DP655BRR, DP458BRR, DP409BRR, and Paymaster PM1560BGRR. The conventional study was harvested on 4 Nov. using a John-Deere spindle-picker. On 10 Nov. the UNR study was harvested using a John-Deere 7455 stripper equipped with a field cleaner and an S&H finger header. Seedcotton from each plot was weighed using a weigh wagon. The variety trials at the Braden Brother's farm in Coyanosa represent a location were soil and irrigation water salinity did not limit yield.

The Texas A&M University Research Station located near Pecos in Reeves County, Texas is a location where soil salinity generally limits cotton growth and yield. The predominant soil is a Hoban silty clay loam (fine-silty, mixed, thermic, Ustallic Calciorthid) that is both saline, $EC_e > 4$ mmhos/cm, pH < 8.5, and sodic, where the $SAR_e >= 13$ (Brady, 1984). Actual values vary depending on soil depth and location within the field (head or tail of the irrigation runs) but in the surface 8 inches the values are approximately $EC_e = 5.4$ mmhos/cm, pH = 8.0, and $SAR_e = 13.3$. The conventional furrow irrigated system uses an average 38-inch row width, with 34-inches between water furrows and 42-inches between non-irrigated furrows. The water furrow is narrower to help move salt beyond each planted-row and into the "dry-middle." Alternate furrow irrigation (English et al., 1992) is common in the Trans-Pecos region. In 2000, a 31-acre block of Deltapine NuCOTN 35B was planted in this row configuration, which represents the conventional furrow irrigation system at this location. Cotton was planted into dry soil and irrigated (watered-up) on 11 May. The total amount of furrow irrigation applied was 35.5 inches. A small 12-acre center-pivot irrigation system was split and half planted in 24-inch, and the other half planted in 16-inch rows (6 acres of each). This center-pivot is fitted with low-pressure sprinkler heads and trail tubes. Cotton (DP655BRR) was dry-planted and sprinkled up on 22 May. After emergence, the trail tubes were used exclusively to avoid salt burn on the foliage. The trail tubes are similar to drip irrigation tubing containing 4 gal/hr emitters spaced 12-inches apart. Total output of each trail tube corresponds to the output from the sprinkler heads and is determined by it's length, or number of emitters. Total center-pivot irrigation for the season was 29.5 inches. Irrigation water was tested from one of the three wells at the station throughout the season for another project. Average values were $EC_i = 5.0$ mmhos/cm, pH = 7.0, and $SAR_i = 10$, which represents a high salinity, and low to medium sodium hazard for irrigation water, according to Texas A&M University guidelines. Cotton from each block (38, 24, and 16-inch rows) was bulk harvested, placed in modules and commercially ginned.

Discussion

At Coyanosa, where salinity did not limit yields of either type of production system, the yields of UNR and conventional cotton were similar (Table 1). In one case UNR production seems to favor SG 501BRR, and in another case DP 655BRR appears to excel in conventional rows. Overall though, it appears that UNR cotton and conventional rows produced similar yields at Coyanosa in 1999.

At the Pecos Station in 2000, the yield of the 38, 24, and 16-inch rows was 429, 783, and 798 lb lint/acre, respectively. Even with 35.5 inches of water applied to the conventional furrow irrigated cotton, the yield was less than

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a bale per acre and the crop was only about 12-inches tall, indicating that salinity definitely had a major affect on growth and yield. Though it's not possible to test these differences statistically there does appear to be a significant yield advantage for the UNR cotton. Practically speaking, the gross return was $198, $376, and $384/acre for the 38, 24, and 16-inch, respectively.

Summary

Granted, these data do not provide for strict testing by standard statistical analysis and may be only slightly better than anecdotal. However, we believe they are instructive and lead one to the general conclusion that the greatest benefit of UNR cotton production comes when there are soil conditions that limit cotton growth and yield in conventional row spacing. This is easy to recognize in west Texas, since plants are short (12 to 18 inches), even though they are fully irrigated. Cotton is classified as a salt tolerant crop (U. S. Salinity Lab. Staff, 1954; Ayers and Westcot, 1977), having a threshold value of EC_e = 7.7 mmhos/cm before excessive yield decline (U. S. Salinity Lab. Staff, 1954). According to Fowler (1986), salt-affected plants usually appear normal, although they are stunted, and may have darker green leaves, with top growth suppressed more than root growth. Assuming that soil salinity is below the threshold value, this general stunting is an advantage for UNR cotton production. There is generally no need to apply any plant growth regulators under these conditions to limit plant height. The only limitation may be an irrigation system that could be employed for UNR production. If level basin flood irrigation is possible, this should improve soil salinity conditions since the entire soil surface is leached. This is especially true when the wide, or conventional, production system includes alternate-furrow irrigation, which does not leach the entire soil area.

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Table 1. Average lint yield from two separate variety trials, one in UNR (15-in) and the other in conventional cotton (40-in) rows, Coyanosa, Texas 1999. UNR cotton was produced under center-pivot irrigation and the conventional cotton was produced with alternate furrow surge-irrigation

	Cotton Variety †				
Row Width	**SG 501**	**DP 655**	**DP 458**	**DP 409**	**PM 1560**
	lb/acre				
15-in.	1817	1521	1522	1540	1347
40-in.	1537	1718	1470	1470	1453

† *All cotton varieties contain both the Bollgard® (BG, or B) and Roundup Ready® (RR) genes, listed by their appropriate number only.*