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YIELD AND NET REVENUE RESPONSE TO PLANT POPULATION FOR UNR COTTON

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Abstract

Data from an ultra-narrow row cotton plant population density study at Milan, TN, were used to evaluate the influence of plant population density on net revenues. Partial budgeting and marginal analysis techniques were used to determine the profit maximizing plant population density using North Delta Spot Cotton Quotations for the 1997/1998 marketing year. Results indicate a seeding rate considerably lower than the rate required to maximize yields can be used to maximize profits in UNRC production.

Introduction

Impeding the potential profitability of ultra-narrow row cotton (UNRC) production are the substantially higher seeding costs associated with the high plant populations densities (PPDs) used in UNRC production. Information is needed by cotton farmers about PPD tradeoffs as influenced by PPD effects on lint yield response, PPD influences on lint prices adjusted for fiber quality, and transgenic seed prices, to evaluate the economic feasibility of UNRC. The objective of this study is to determine the profit maximizing PPD for UNRC production.

Data and Methods

Data from a 1998 through 2000 UNRC PPD study at Milan, TN, were used to evaluate the influence of PPD on net revenues. A Roundup Ready cotton variety was planted in 25.4 cm rows in a non-irrigated, no-tilled Loring silt loam. At the 1- to 2-leaf growth stage, plots were hand thinned to four target PPD levels in 1998 and five target PPD levels in 1999 and 2000. PPD treatments were arranged in a randomized complete block design with five replications. Average PPDs actually achieved for each treatment level were 66,618, 115,958, 198,703, 287,628, and 382,177 plants ha^{-1}. Plots were harvested once each year with a finger stripper equipped with a bur extractor. After harvest, seedcotton samples were ginned on a saw gin equipped with a stick machine, incline cleaners, and dual lint cleaners. Lint yields were calculated, and a subsample of lint was analyzed by HVI testing and hand-classing procedures at the USDA-AMS Cotton Classing Office in Memphis, TN.

Partial budgeting and marginal analysis techniques were used to evaluate the UNRC PPD decision. UNRC lint yield was modeled as a quadratic function of PPD using the mixed model procedure in SAS to account for heterogeneous variances among the plots in the experiment (Littell et al., 1996; SAS Institute, 1997). Lint prices adjusted for fiber quality were calculated using North Delta Spot Cotton Quotations and the UNRC PPD fiber quality data. Season average prices for the 1997/1998 marketing year were used to estimate net revenues (U.S. Department of Agriculture, Agricultural Marketing Service Staff, 1998). The base quality price of \$1.52 kg^{-1} for 1997/1998 represents the median price farmers received for cotton for the 1993/1994 though 2001/2002 marketing years. Price differences for the combination of color grade, staple, and leaf grade (P^{cls}), micronaire (P^{m}); and fiber strength (P^{s}) were used to calculate total price differences: $TPD=P^{cls}+P^{m}+P^{s}$. TPD was modeled as a linear function of PPD using the mixed model procedure in SAS to account for heterogeneous variances in lint quality among the plots in the experiment (Littell et al., 1996; SAS Institute, 1997). A seed price \$2.51 kg^{-1} and a technology fee of \$79 ha^{-1} under a UNRC exemption for PM 1218 BR were assumed for calculating seeding costs (personal communication, R. Montgomery, Monsanto Corporation, 2002). For the purpose of calculating seeding cost as a function of PPD, plant population survival was assumed to be the average ratio of 0.64 plants established to seeds planted prior to thinning in the experiment.

Results

The PPD coefficients in the UNRC quadratic lint yield response function were significant at $p = 0.01$ and had the hypothesized signs. While yield response to PPD was parabolic, the yield gains with increasing PPDs were relatively small. The compensation ability of the cotton plant to produce more bolls $plant^{-1}$ at lower PPDs was the primary factor explaining the relatively flat yield response with increasing PPDs. The maximum lint yield of 1,044 kg ha^{-1} was produced at a PPD of 266,206 ha^{-1}. In addition, total price discounts became larger with increasing PPDs. The PPD coefficient in the TPD equation was significant at $p = 0.05$. A combination of higher leaf grade and extraneous matter values and lower micronaire values with increasing PPDs were the primary factors influencing the larger price discounts. Low micronaire discounts were incurred at PPDs of 200,000 ha^{-1} or more in the 2000 experiment. The PPD that maximizes profit at a base lint price of \$1.52 kg^{-1} and a PM 1218 BR seed price of \$2.51 kg^{-1} was 133,848 ha^{-1}. Net revenue at the profit maximizing PPD of 133,848 ha^{-1} was \$1,329 ha^{-1} compared with a net revenue of \$1,285 ha^{-1} for the yield maximizing PPD of 266,206 ha^{-1}. The most important factor contributing to the gain in net revenue was the substantially lower seeding cost— \$135 ha^{-1} at the profit maximum compared with \$199 ha^{-1} at the yield maximum. The estimated seeding rate to maximize profits is 24 kg ha^{-1}, which compares with the yield maximizing seeding rate of 48 kg ha^{-1}.

Discussion

Cotton farmers may be able to increase the profitability of UNRC production by using a PPD that is considerably smaller than what is required to maximize lint yields. However, farmers may encounter agronomic constraints that limit the effectiveness of planting UNRC at lower PPDs, including ability to plant to a target stand with available UNR planter or drill, avoidance of large skips in the stand, control of weed escapes with available herbicide technologies, and suppression of large branches that interfere with stripper harvesting. Thus the agronomic minimum PPD in UNRC may vary considerably by producer. Farmers should consider the potential impacts that a lower PPD may have on these factors before choosing what PPD is appropriate for their situation.

References

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