

Effect of Plant Nitrogen Status on Defoliation of Short-Season Upland Cotton

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Abstract

Field studies have been conducted over a four year period at the Maricopa Agricultural Center to determine the influence of nitrogen (N) fertility level on the effectiveness of chemical defoliant for short-season cotton production. Excessive N resulted in dense foliage and cotton that was difficult to defoliate. When plants were deficient in N from mid-season to termination, defoliant were very effective, but lint yields were reduced. The effectiveness of defoliant decreased as the petiole NO₃-N content increased. The optimum fertility program for short-season cotton is one that provides sufficient N during the season to produce maximum lint yields, but allows the crop to become deficient in N at the end of the season, prior to chemical defoliation.

Introduction

An area of concern for growers in the management of cotton for short-season production is preparing the crop for harvest. The short-season crop must be defoliated in late August or September when conditions are generally favorable for vegetative growth and foliage is often very dense.

The two important production factors, water management and N fertility, can also have dramatic effects on defoliation results. In the tests reported here, we have focused on N fertility and how it impacts defoliation. It is generally known that excessive N fertility can result in heavy vegetative growth and delay leaf senescence. What is needed, then, is a N fertility program that provides adequate N for good yields, but allows the plants to become N deficient prior to termination.

Research at the Maricopa Agricultural Center in 1988-90 has shown that excessive N can retard defoliation (Nelson et al., 1989; Nelson et al., 1990; Nelson and Hart, 1991.). In two of three years there was a linear decrease in the effectiveness of defoliant as the petiole NO₃-N content increased. The objective of this 1991 test was to gather additional information on the effect of N fertility level on defoliation of cotton for short-season production. An important aspect of this work was to again evaluate the use of petiole nitrate monitoring as a guide to defoliant time of application.

Materials and Methods

Seeds of DPL 90 were planted on 4 April 1991 in moist soil at the Maricopa Agricultural Center. The plot area did not receive preplant N fertilizer. Nitrogen treatments were: 1) 34 lbs. N/A, 2) 69 lbs. N/A and 3) 129 lbs. N/A. Nitrogen fertilizer was applied in the water on 3 June to all treatments and was sidedressed on plots of treatments 2 and 3 on 1 July and plots of treatment 3 on 30 July. The NO₃-N content of the petioles was monitored throughout the season for all N treatments. At the time the defoliant was applied, petioles were collected from all plots. Each nitrogen treatment plot was divided into 6 subplots for petiole sampling and

defoliation estimates. The final irrigation for this cotton was 10 September.

The cotton was defoliated using a tank mix of Dropp at 0.2 lbs. a.i./A, Def at 0.75 lbs. a.i./A and Agri-dex at 1 pt/A. These defoliant were applied on 26 September with a HiBoy sprayer using a boom with 7 nozzles/row and spray volume of 29 GPA. Plots were rated visually for defoliation 7 and 14 days after chemicals were applied. The cotton from 30 feet of the center 2 rows in each plot was harvested by machine on 17 October. Experimental design was a randomized complete block with 4 replications.

Results and Discussion

The cotton in this test was grown as a short-season crop, although the 175 day season was longer than the desired 135-150 day season. This growing season, 4 April to 26 September, had 3,728 heat units ($86^{\circ}/55^{\circ}\text{F}$ thresholds) and resulted in the production of three bales of lint/A in the plot area.

The N fertility levels did not have an effect on lint yield. Residual soil N was high and 34 lbs. of N/A was adequate for high yields. The two higher N levels resulted in excessive vegetative growth at the end of the season but did not reduce yields.

Estimated defoliation was 71,65 and 55% for the 34, 69, and 129 lbs. N/A fertility levels, respectively, at 14 days after application. Although these differences in defoliation percentages were not statistically significant because of large variation among plots, there was a definite trend toward better defoliation at the lower N levels. There was a significant ($R^2 = 0.34$, $P = <0.01$) decrease in the effectiveness of the defoliation treatment as the petiole $\text{NO}_3\text{-N}$ content increased. This relationship was determined by comparing the estimated defoliation percentage and petiole $\text{NO}_3\text{-N}$ content for all 72 plots in this test. The $\text{NO}_3\text{-N}$ values ranged from 783 to 4945 ppm and defoliation estimates ranged from 40 to 93%.

Summary of Four Years Tests

In a test in which upland cotton became deficient in N by mid-season, natural defoliation was promoted and defoliation with chemicals was very effective. However, under these conditions cotton yields were reduced.

Excessive N, either as residual N or as early season applications, resulted in dense foliage at the end of the season that was difficult to defoliate. Under conditions where N is excessive throughout the season, lint yields can be reduced.

Excessive N applied late in the season did not reduce lint yields, but did result in vegetative plants at termination that were difficult to defoliate.

These tests have shown that the effectiveness of defoliants decreases as the petiole $\text{NO}_3\text{-N}$ content increases. This relationship has been studied over a wide range of $\text{NO}_3\text{-N}$ and defoliation values. There is some evidence that there are differences in defoliation percentages, even at the lower petiole $\text{NO}_3\text{-N}$ values. For example, cotton with less than 1000 ppm $\text{NO}_3\text{-N}$ had a higher percentage of leaf drop after defoliation than cotton with 1800 ppm petiole $\text{NO}_3\text{-N}$.

References

Nelson, J.M., R.E. Briggs and G. Hart. 1989. Effect of plant nitrogen status and growth regulators on earliness, effectiveness of defoliants, and yield of upland cotton. Cotton, A College of Agriculture Report. University of Arizona, Series P-77:65-68.

Nelson, J.M., R.E. Briggs and G. Hart. 1990. Effect of plant nitrogen status on effectiveness of Pix and defoliant for short-season cotton. Cotton, A College of Agriculture Report. University of Arizona, Series P-81:39-42.

Nelson, J.M. and G. Hart. 1991. Effect of plant nitrogen status on effectiveness of defoliant for short-season cotton production. Cotton, A College of Agriculture Report. University of Arizona, Series P-87:39-41.