Interaction of Pima Cotton Defoliation And Crop Water Stress Index

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ABSTRACT

A single field experiment was conducted in 1989 to evaluate the relationship of crop water status on Pima cotton defoliation by use of a crop water stress index (CWSI) as estimated by infrared thermometry. The entire study area was given the last irrigation uniformly on 24 August, and 20 row plots were outlined for the arrangement of three treatments in a randomized complete block design with three replications. Treatments consisted of making defoliant chemical application at three different targeted CWSI levels (0.40, 0.60, and 0.85). All defoliant treatments consisted of Dropp plus Accelerate (0.4 lb. and 1.5 pt. of material/acre, respectively) applied with a ground rig applicator. Results indicated no distinct advantage in terms of percent defoliation as a function of lower CWSI levels at which defoliants were applied. The defoliations made at 0.40 CWSI did result in more regrowth after 14 and 21 days. It appears from this test that Pima plants will defoliate satisfactorily with proper chemical treatments up to CWSI levels of 0.80. Further desiccation of the crop results in very erratic CWSI readings, resulting in difficulties in applying this technique to defoliation management. It does appear, though, that Pima cotton defoliation can be accomplished when CWSI readings are between 0.5 and 0.8 without substantial regrowth problems, providing precipitation or irrigation events do not occur.

INTRODUCTION

One of the difficult aspects of Pima cotton (Gossypium barbadense L.) production is achieving satisfactory defoliation from a single application of defoliant chemical. Complete removal of the leaves is desired in an effort to prepare the crop for mechanical picking, which is a very critical step in harvesting high quality lint from a field. Defoliation is often attributed to the chemical defoliant alone. With a more indeterminate crop such as Pima, which has a strong vegetative character naturally, the agronomic management of the crop in the late season becomes very important with regard to defoliation efforts. The late season nitrogen (N) fertility status should not be excessive (<2,000 ppm petiole NO_3^--N), which could otherwise promote undesired vegetative growth, and reduce senescence. Also, it is recognized that a plant that is very dry may not respond well to defoliant treatments since defoliant chemicals require physiological activity to function properly. In addition, leaf drop is hindered when leaves are excessively dry and fresh leaf weight is reduced, which retards the actual breaking of the leaf petiole abscission zone and the removal of the leaf (Silvertooth and Howell, 1988; Silvertooth, et al, 1989).

In an attempt to assess the actual plant water status at this time of defoliation, the measurement of plant water status by use of the crop water stress index (CWSI) has been considered as a possible useful tool. The CWSI ranges from 0.0 to 1.0 (from high water content to low) based upon the crop canopy temperature, ambient air temperature, relative humidity (vapor pressure deficit) and solar radiation. The CWSI is also dependent upon accurate baselines that should be specific for each crop and each distinct stage of growth. Recent work by Garrot, et al (1989) indicates that Pima cotton requires additional irrigation at about CWSI 0.30 to 0.36 for maintaining optimum yield potential.

Therefore, a single field experiment was designed to evaluate the relationships of plant water status by use of the CWSI, on the defoliation of Pima cotton.

METHODS

A field experiment was established in 1989 on a Mohall sandy loam soil in Pinal County, near Coolidge, AZ, in a field of Pima S-6 cotton. The crop was given the last irrigation on 24 August and 20 row plots (full length of the field) were identified for the management of three treatments in a randomized complete block design with three replications. The CWSI levels at which a common chemical defoliant was applied are shown in Table 1. All plots received a treatment of Dropp plus Accelerate at 0.4 lbs. and 1.5 pts./acre of material, respectively. All applications were made by use of a ground rig applicator with 15 gallons per acre total output. Estimates of CWSI values were made every two to three days during the experimental period, within two hours of solar noon. Estimates of percent leaf drop (defoliation) and regrowth control (1 = poor, 10 = excellent) were made on each plot on 15 September, 21 September, 27 September, and 3 October.

RESULTS

Final estimates for defoliation and regrowth results from each treatment are shown in Table 2. Satisfactory defoliation was obtained from one application at all CWSI levels, with the driest application treatment (treatment #3, CWSI 0.80) providing the best defoliation overall. The first defoliation treatment (CWSI 0.43) resulted in adequate defoliation, but the regrowth and topgrowth control in the top five to eight nodes of the plants was a persistent problem throughout the study period.

The use of the infrared gun for determining optimum points for Pima cotton defoliation appears, after this brief experience, to have limited application. Most growers will wait the length of a regular irrigation interval (at least) after the last irrigation before attempting defoliation. For example, usually a minimum of two and often four weeks will be allowed to pass after the last irrigation to provide for gradual canopy drying and senescence before applying defoliants. In the case of these experiments, the regular irrigation interval of approximately 14 days provided sufficient crop drying to encourage defoliation, but still allowed for rank topgrowth. In this experiment, further delay to four weeks (treatment #3) resulted in good defoliation and regrowth control. Such a delay period after final irrigation is common among Pima growers.

Efforts to obtain CWSI readings above 0.60 were difficult in terms of consistency. In this experiment, readings made 21 days after irrigation termination were very erratic, ranging from 0.60 to 0.85 and 0.90 from day to day. The CWSI does not seem sensitive to such changes at the higher end of the scale (CWSI > 0.60) which would be needed in this case. In a general sense, a grower could monitor CWSI on a crop to reinforce plans for defoliation. The CWSI readings indicating excessive crop drying past the point of good chemical defoliant activity would be difficult to establish. In a more practical sense, this could be determined visually more easily at a point where the crop was severely desiccated. As most cotton growers know, a crop that is dried to a severe extent will often result in a lot of leaf burn upon any defoliation attempts.

General recommendations for timing defoliant applications concerning plant water conditions on Pima cotton could be simply stated as allowing two times the regular irrigation interval prior to defoliation. Also, manage fertilizer N so that petiole levels are less than 2,000 ppm NO_3^--N late in the season, and use a chemical defoliant treatment that has a good consistent record with Pima cotton, such as that used in this experiment.

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Table 1. Target and actual CWSI levels used for chemical defoliation application, Coolidge, AZ, 1989.*

Treatment No.	CWSI Values		Application Date
	Target	Actual	
1	0.35	0.43	6 September
2	0.60	0.60	12 September
3.	0.85	0.80	21 September

*Final irrigation on 24 August.

Table 2. Final application and regrowth control estimates from three CWSI levels for defoliant application on Pima S-6 cotton, Coolidge, AZ, 1989.*

	Treatment	Defoliation Estimate	Regrowth Control
No.	CWSI at Defoliation	--------- % ----------	
1	0.43	70	3
2	0.60	70	5
3	0.80	83	7

*Final estimates made on 3 October.