Cotton Yields: Nitrogen and Harvest Aid Effects

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Abstract

The results of field studies with N rates from 0 to 336 kg/ha, in combination with two growth regulators, ethephon (Prep®, α-chloroethyl phosphonic acid, Rhone-Poulenc Ag Co., Research Triangle Park, NC) and thidiazuron (Dropp®, N-phenyl-N' -1,2,3-thiadiazol-5-ylurea, Nor-Am Ag Prod. Inc., Naperville, IL). Results showed that sidedress applications of N (ammonium nitrate) to cotton did not influence the defoliation effects of ethephon and thidiazuron, or reduce number of immature green bolls at harvest. Under short-season conditions, sidedress N applications did not effect yields. Ethephon and thidiazuron at the rates tested did not affect cotton lint yields. Thidiazuron alone or in combination with ethephon resulted in high percentages of cotton defoliation.

Introduction

Cotton crop management practices such as planting date, cultivar grown, and water management have a significant impact on pink bollworm, *Pectinophora gossypiella* (Saunders), population development during the season as well as the magnitude of overwintering populations (Henneberry et al., 1980; Henneberry, 1986). Ethephon (Prep®, α-chloroethyl phosphonic acid, Rhone-Poulenc Ag Co., Research Triangle Park, NC) is a harvest aid that accelerates mature cotton boll opening, and thidiazuron (Dropp®, N-phenyl-N' -1,2,3-thiadiazol-5-ylurea, Nor-Am Ag Prod. Inc., Naperville, IL) is a cotton defoliant. Both chemicals are effective for abscising late-season cotton fruiting forms that serve as host material for development of overwintering pink bollworm populations (Bariola et al., 1987; Bariola et al., 1990).

Objectives of our present studies were to evaluate whether rates of nitrogen (N) fertilization may influence the effectiveness of the two harvest-aid chemicals for (1) reducing immature green bolls and (2) cotton defoliation. These studies were also designed to test the effect of the two growth regulators on cotton yields under rates of N applied and short-season growing conditions.

Materials and Methods

The study was conducted at Brawley, CA. 'Deltapine 61', cotton seed was planted in Holtville silty clay soil on 23-24 March 1988, and irrigated (57 mm) a week later to induce germination. Additional irrigations (95 mm) were applied about 3 weeks after plant emergence and thereafter at 10- to 20-day intervals as needed throughout the season. Plant stands were thinned to 72,600 plants/ha in mid-April. Treatments were sidedress applications of nitrogen (N, ammonium nitrate) in combination with applications of ethephon and thidiazuron. Plots were eight rows wide with 1.01-m spacing and 12.2-m long. Ethephon and thidiazuron were applied in 280 liters of water/ha with a high clearance ground sprayer at 6.44 km/h. The treatments were arranged in a randomized

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complete block design with four replicates. Four N rates were 0, 112, 224 and 336 kg/ ha. The first sidedress applications of 112 kg/ha of each treatment were made on 19 April, followed by second applications of 112 and 224 kg/ha on 15 May, respectively, for the 224 and 336 kg/ha of N. Thidiazuron was applied at rates of 0.0224 and 0.0448 kg (AI)/ha, ethephon at 1.12 kg (AI)/ha. Thidiazuron was also applied at 0.0672 kg (AI)/ha alone or mixed with 1.12 (AI) kg/ha of ethephon. Cotton was hand-picked 5 days later in 4-m of row of each plot. Treatments were made on 15 August after the last irrigation on 27 July. Plots were defoliated 31 August and cotton hand-harvested 8 September from 4-m of row in each plot, and immature green bolls were counted and recorded. Defoliation ratings were made 29 August.

Data were analyzed using analysis of variance and means were separated according to Duncan's multiple range test (Duncan, 1955).

Results and Discussion

There were no interactions between N applications and thidiazuron or ethephon treatments with regard to cotton lint yields, numbers of immature green bolls at harvest, or defoliation.

No benefits occurred from N fertilization when lint yields of untreated plots ranged from 715 to 728 kg/ha. Nitrogen applications of 224 and 336 kg/ha did not result in increased yields as compared to sidedress applications of 112 kg/ha or the untreated control. Nitrogen applications also had no significant effect on the number of immature green bolls at harvest. Applications of thidiazuron or ethephon did not affect cotton yields (Table 1). Thidiazuron and ethephon alone or in combination, reduced the number of immature green bolls at harvest. Cooler than normal weather resulted in low cotton lint yields. These conditions may also have reduced the effect of ethephon on accelerating mature boll opening, resulting in higher numbers of green bolls at harvest.

Applications of thidiazuron at 0.0448 or 0.0672 kg (AI)/ha, or thidiazuron (0.0672 kg (AI)/ha) tank-mixed with ethephon (1.12 kg (AI)/ha) resulted in 73 to 88% defoliation (Table 1). The tank mix of thidiazuron and ethephon was not significantly different from thidiazuron (0.0672 kg (AI)/ha) alone. Additional studies need to be conducted to further define the effects of tank mix combinations of the two chemicals.

The use of chemicals to selectively remove late-season cotton fruiting forms that do not contribute to yield but serve as host material for developing high overwintering pink bollworm populations can be a key component of pink bollworm management systems. This approach can be particularly important under the mandated short-season cotton program in the Imperial Valley, CA because, even though defoliation or application of a plant growth regulator must be completed by 1 September, cotton plowdown is not mandatory until 1 November. The amount of host material available between 15 September and 1 November is the critical period when 85-90% of the numbers of overwintering diapause larvae develop (Henneberry and Chu, 1989). Studies by Rice et al. (1971) in the Imperial Valley showed a 90% reduction in emerging pink bollworm moths the following spring when cotton was defoliated in September vs. October, but cotton yields were reduced under long-season cotton production systems. Defoliated cotton may be a less suitable habitat for pink bollworm moths and/or the defoliants used probably reduced cotton fruiting forms. A chemical or combination of chemicals that selectively remove pink bollworm hostable fruiting forms and efficiently defoliate the plants in short-season cotton systems without reducing yields would be extremely desirable and cost efficient. Defoliation as a result of thidiazuron and ethephon treatments in the present studies ranged from 11% with ethephon alone to 88% when plants were treated with 0.0672 kg (AI)/ha of thidiazuron. Our results indicate a potential for developing combinations of the two chemicals that could effectively accomplish both purposes.

Acknowledgment

The authors thank Mr. Richard Y. Reynoso for his assistance in the field experiments.

References

Bariola, L.A., C.C. Chu, and T.J. Henneberry. 1990. Timing applications of plant growth regulators and last irrigation for pink bollworm (Lepidoptera: Gelechiidae) control. J. Econ. Ent. 83: 1074-1079.

Bariola, L.A., T.J. Henneberry, and C.C. Chu. 1987. Prep and Dropp for pink bollworm and boll weevil control in Arizona and Southern California, p. 340, In J.M. Brown (ed.) Proc. Beltwide Cotton Prod. Res. Conf., January 4-8, 1987, Dallas, TX. National Cotton Counc., Memphis, TN.

Duncan, D.B. 1955. Multiple range and multiple F tests. Biometrics. 11: 1-42.

Henneberry, T.J., L.A. Bariola, and D.L. Kittock. 1980. Integrating methods for control of the pink bollworm and other cotton insects in the southwestern United States. U.S. Dept. Agric. Tech. Bull. 1610, 45 pp.

Henneberry, T.J. 1986. Pink bollworm management in cotton in the southwestern United States. U.S. Dept. Agric., Agric. Res. Serv. ARS-51, 45 pp.

Henneberry, T.J., and C.C. Chu. 1989. Short-season Management Systems for pink bollworm in the Imperial Valley, CA. International Cotton Pest Work Committee. Nov. 2-3, 1989, San Jose del Cabo, Baja Calif., Mexico. (in press)

Rice, R.E., A.J. Mueller, H.T. Reynolds, H.S. Meister, D.W. Cudney, and R.M. Hannibal. 1971. Reduction of pink bollworm moths in southern California by early crop termination. Calif. Agri. 25: 6-7.

Table 1. Effect of thidiazuron, ethephon and nitrogen rates on cotton lint yields, number of immature green bolls and defoliation.

Main effects of N and plant growth regulators	Lint yield (kg/ha)	Green bolls (1000/ha)	Defoliation (%)
Nitrogen rate (kg/ha)			
0	728a*	19a	57a
112	715a	19a	55a
112 + 112	725a	22a	53a
112 + 224	723a	22a	54a
Growth regulator (kg [AI]/ha)			
Untreated control	704a	52a	10d
Thidiazuron 0.0224	741a	19c	61c
Thidiazuron 0.0448	723a	9cd	73b
Thidiazuron 0.0672	732a	3d	88a
Thidiazuron 0.0672 + Ethephon 1.12	722a	5d	84a
Ethephon 1.12	713a	36b	11d

* Means of 4 replications. Means in a column and year followed by different letters are significantly different (Duncan's multiple range test, $P \leq 0.05$).