Effect of Plant Growth Regulators Under Short-Season Conditions on Pink Bollworm Populations, Cotton Yields and Defoliation

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Abstract

Plant growth regulators (PGR's) [thidiazuron (Dropp®) N-phenyl-N' -1,2,3-thiadiazol-5-ylurea, 50% wettable powder, Nor-Am Agricultural Products, Inc., Naperville, IL, and ethephon (Prep®) α-chloroethyl phosphonic acid, Rhone-Poulenc Ag Co., Research Triangle Park, NC] were applied to reduce late-season fruiting forms as a source of host material for developing overwintering PBW populations. Combinations of ethephon and thidiazuron or thidiazuron alone were more effective than ethephon alone for reducing late-season immature green bolls. None of the PGR's alone or in combination affected yields. Highest rates of defoliation occurred after applications of thidiazuron. The data suggest that temperature thresholds for highest plant growth regulator activity occur.

Introduction

The pink bollworm, *Pectinophora gossypiella* (Saunders) (PBW), has been an economic factor in cotton, *Gossypium* spp. production in the irrigated southwestern desert growing areas of Arizona and California since 1966 (Burrows et al., 1982). The PBW is particularly vulnerable during development of the diapause generation in the fall and while the population overwinters in the soil, trash and cotton bolls (Watson, 1980, Henneberry, 1986). The "chemical termination" technique using plant growth regulators (PGR's) has been developed to selectively remove squares, flowers and small bolls late in the season that do not contribute to yield but serve as host material for development of the diapause generation (Kittock et al., 1973, Bariola et al., 1990). Studies were conducted in 1987 and 1988 at the Imperial Valley, Irrigated Desert Research Center, Brawley, CA, to determine the effects of thidiazuron and ethephon on cotton plant fruiting, yield and PBW populations under shortened growing season conditions.

Materials and Methods

Seed was planted in a Holtville silty clay soil type on 24 March 1987 and 21 March 1988. Plots were irrigated (57 mm) on 28 March in both years to germinate the seed, and again about three weeks after plant emergence. Additional irrigations (95 mm) were applied at 10-20-day intervals throughout the season. Last irrigations were applied on 7 August and 5 August in 1987 and 1988, respectively. The four chemical termination treatments each year were an untreated control, ethephon applied at 1.12 kg [AI]/ha, ethephon at 1.12 kg [AI]/ha, followed by thidiazuron at 0.056 kg [AI]/ha 7 days later, and 0.056 kg [AI]/ha thidiazuron alone. Ethephon applications were made 17 and 15 August in 1987 and 1988, respectively. Thidiazuron was applied on 24 August 1987 and 22 August in 1988. Treatments were applied with ground equipment in 30 gal/ac of water. The effect of the

chemical termination treatments on cotton defoliation were determined one week after the applications were made. Plants were rated on a scale of 0 to 10, with 10 defined as complete defoliation. The effect of the treatments on cotton yields was determined by hand-harvesting all open cotton bolls in 4 m of row in each subplot on 15 September 1987 and 7 September 1988. Also, the numbers of immature green bolls were counted in the harvest rows to determine the effectiveness of the PGR's for reducing numbers of immature green bolls.

Results and Discussion

In 1987, ethephon alone, ethephon plus thidiazuron and thidiazuron alone significantly reduced numbers of immature green bolls and estimated numbers of PBW larvae/ha when compared to the untreated control (Table 1). In 1988, ethephon alone did not effectively reduce the numbers of immature green bolls, but the numbers in ethephon plus thidiazuron and thidiazuron alone treated plots were reduced more than 90% as compared to the untreated controls. Temperature patterns in 1987 were normal for the Imperial Valley. However, in 1988 alternate patterns of cool and hot temperatures occurred from April to September compared to the same periods in 1987. Lower than average cotton yields occurred throughout the Imperial Valley in 1988, as well as in our experimental plots. The unusual weather conditions might have masked the effectiveness of ethephon in that year for accelerating mature boll opening, and/or for inducing abscision of small immature bolls and squares, resulting in higher numbers of green bolls at harvest time. Further research is needed to define the effects of temperature and the interaction with ethephon/thidiazuron alone or in combinations for eliminating late-season fruiting forms to prevent development of high overwintering PBW populations.

Applications of thidiazuron or ethephon did not affect cotton lint yields (Table 2). Cotton lint yields were higher in 1987 than in 1988. Thidiazuron induced the highest levels of defoliation as would be expected.

Conclusions

Short-season, PBW-resistant cottons, early irrigation termination and the use of PGR's are desirable management components in cotton production systems in the irrigated southwest desert growing areas. The results of our studies show that the PGR's ethephon and thidiazuron reduced late-season fruiting forms as hosts for development of diapausing PBW. Our data suggest that additional research needs to be done to define more closely the most effective temperature ranges for optimum efficiency of PGR's for chemical termination and PBW management.

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Table 1. Mean[1] Numbers of Immature Green Cotton Bolls and Pink Bollworm Infestations at Harvest Following Treatment with Ethephon and Thidiazuron. Imperial Valley, CA. 1987 and 1988.

Chemical termination (kg [AI]/ha)	Green bolls (1000/ha)	Pink bollworm larvae[2] /1000 bolls	/hectare
	1987		
Untreated control	41.8a	306a	12791
Ethephon 1.12	11.9b	120b	1428
Ethephon 1.12 + Thidiazuron 0.056	3.7c	236ab	873
Thidiazuron 0.056	2.1c	130b	273
	1988		
Untreated control	90.4a	61a	5514
Ethephon 1.12	85.6a	41a	3510
Ethephon 1.12 + thidiazuron 0.112	4.6b	65a	299
Thidiazuron 0.056	5.6b	41a	230

[1] Means of 4 replications, 2 samples/replication in a column not followed by the same letter are significantly different (Duncan's Multiple Range Test, $p \leq 0.05$).
[2] Derived from number of green bolls per hectare and number of pink bollworm per boll and was not statistically analyzed.

Table 2. Effect[1] of Chemical Termination on Lint Yield and Defoliation. Imperial Valley, CA, 1987 and 1988.

Chemical termination (kg [AI]/ha)[2]	Lint yield (kg/ha)	Defoliation (%)
	1987	
Untreated control	1197a	30c
Ethephon 1.12	1236a	38b
Ethephon 1.12 + Thidiazuron 0.056	1176a	81a
Thidiazuron 0.056	1211a	82a
	1988	
Untreated control	816a	10b
Ethephon 1.12	787a	10b
Ethephon 1.12 + Thidiazuron 0.112	820a	84a
Thidiazuron 0.112	827a	80a

[1] Means of 8 replications each year in a column not followed by the same letter are significantly different (Duncan's Multiple Range Test, $p \leq 0.05$).
[2] Ethephon applied 17 August in 1987, 15 August in 1988, and thidiazuron applied 24 August in 1987 and 22 August in 1988.

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