STATUS OF LYGUS BUG AND COTTON APHID RESISTANCE IN THE SAN JOAQUIN VALLEY

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Abstract

Various populations of *Lygus* bugs, *Lygus hesperus*, and cotton aphid, *Aphis gossypii*, were collected during 1996 from cotton fields and alfalfa fields next to cotton throughout the San Joaquin Valley and bioassayed for insecticide resistance. Significant resistance was found in 52% and 39% of *Lygus* populations for Capture (pyrethroid) and Metasystox-R (organophosphate), respectively. Significant resistance was also found in cotton aphids, 83% of populations resistant to Capture, 71% of populations resistant to Thiodan (chlorinated hydrocarbon), and 42% of populations resistant to Lorsban (organophosphate). These three categories of insecticides have been used for many years for control of cotton pests in the San Joaquin Valley and so it is not surprising that insecticide resistance is increasing. This explains in part the erratic control growers are achieving and points out the need for greater dependence on nonchemical methods of cotton pest control to extend the useful life of insecticides.

Introduction

For many years, cotton growers have depended upon just a few classes of insecticides for control of insect pests of cotton *Lygus* bugs (*Lygus hesperus*) and cotton aphids (*Aphis gossypii*) in the San Joaquin Valley of California. The major insecticide classes used have been chlorinated hydrocarbons, organophosphate insecticides, carbamate insecticides, and more recently pyrethroids. For many years, *Lygus* and aphids were rarely key pests and insecticides were fairly effective, keeping the number of pesticide applications and the selection pressure fairly low (1-2 per season). More recently, varieties of cotton, agronomic practices, and environmental conditions have changed resulting in an increase in the pest status of these insects (Goodell and Narbeth 1996). Growers have responded with increasing insecticide use and have obtained inconsistent control. For example, in 1995, 3-7 applications of pesticides were applied for spider mite, cotton aphid, and *Lygus* control in many San Joaquin Valley cotton fields (Goodell and Narbeth 1996). We initiated an insecticide resistance monitoring program in the San Joaquin Valley in 1996 to determine to what extent the efficacy problems were due to insecticide resistance.

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Materials and Methods

Insecticide resistance bioassays for aphids were prepared by treating plastic petri dishes with discriminating concentrations of insecticides mixed in ethanol (McKenzie et al. 1993, Fuson and Godfrey 1995). We expected to observe greater than 80% mean mortality of individuals placed in these dishes if the population was susceptible to the insecticide. For aphids, the insecticides included 510 ppm chlorpyrifos (Lorsban), 270 ppm endosulfan (Thiodan), and 5 ppm bifenthrin (Capture). The inside of the petri dishes were treated with 0.7 ml of formulated insecticide in ethanol and allowed to air dry. Dishes were stored in a freezer and used within 4 weeks of preparation. Twenty adult aphids were placed in each dish and mortality of aphids was assessed after 3 hours. Two to three replications were completed for each insecticide. For the *Lygus* bugs, we treated 50 x 90 mm, plastic ziploc bags with 5 µl technical grade insecticide in acetone (Xu and Brindley 1993). The discriminating concentrations for *Lygus* bugs were 200 µg/bag bifenthrin (Capture) and 100 µg/bag oxydemeton- methyl (Metasystox R). Five adult *Lygus* bugs were placed in each bag and mortality was assessed after 8 hours. Four replications were completed for each insecticide tested.

Results and Discussion

Table 1 shows the insecticide resistance data for the *Lygus* bug populations sampled during June and July and again in August and September. Five counties were sampled for a total of 28 and 15 fields during the two sampling periods. *Lygus* were too difficult to collect from cotton in sufficient numbers for insecticide bioassays. We collected the majority of these populations from the border of alfalfa fields located to the north of each cotton field. The populations that were collected in August and September were the same sites we collected earlier in the year. We found populations of *Lygus* that were resistant to Capture (47-57% of populations) and Metasystox-R (32-47% of populations). There was no consistent trend in the change in *Lygus* bug resistance between the June-July period and the August-September period.

Table 2 shows the insecticide resistance data for the cotton aphid populations sampled during July and August 1996. Five counties were sampled for a total of 36 fields. We found aphid populations that were resistant to Capture, Lorsban, and/or Thiodan. Resistance to Capture (82.8%)

was more common than resistance to Thiodan (71.4%) or Lorsban (41.7%). Growers no longer use Capture for aphid control because of its lack of efficacy, whereas in the late 1980's it was fully effective (Grafton-Cardwell 1991). We repeated aphid bioassays in four locations in September and in some cases resistance declined and in some cases resistance increased. Thus, during 1996 we did not see any specific seasonal pattern in resistance. This confirms our 1995 observations that cotton aphid resistance to insecticides fluctuates widely as the season progresses, often not in response to insecticide applications (Grafton-Cardwell and Goodell 1996).

Bioassays of San Joaquin Valley insect pests have demonstrated significant numbers of populations of *Lygus* with resistance to a pyrethroid and an organophosphate, and cotton aphids with resistance to a pyrethroid, an organophosphate, and a chlorinated hydrocarbon insecticide. While insecticide resistance is not yet an areawide problem for most insecticides and fluctuates during the field season, it does exist in many *Lygus* and cotton aphid populations and is likely to increase. In response to this problem, cotton growers are being advised to practice the basic principles of IPM. That is, avoid use of these broad spectrum pesticides and depend on natural enemies in the spring (Wilhoit et al. 1992), spray only when economic thresholds have been reached, and use the different classes of insecticides in rotation in order to extend their useful life.

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Table 1. Response of *Lygus* bug populations to insecticides during June-July and Aug.-Sept. 1996.

County	Number of Fields Visited	% Fields with resistant *Lygus* bugs: Capture (200 µg/bag)	Metasystox-R (100 µg/bag)
Madera			
June-July	4	1/4=25%	0/4=0%
August-Sept	2	0/2=0%	0/2=0%
Fresno			
June-July	3	2/3=67%	2/3=67%
August-Sept	3	2/3=67%	1/3=33%
Kings			
June-July	7	4/7=57%	2/7=28%
August-Sept	2	1/2=50%	1/2=50%
Tulare			
June-July	6	4/6=67%	3/6=50%
August-Sept	5	4/5=80%	3/5=60%
Kern			
June-July	8	5/8=63%	2/8=25%
August-Sept	3	0/3=0%	2/3=66%
Valley Average			
June-July	28	16/28=57.1%	9/28=32.1%
August-Sept	15	7/15=46.7%	7/15=46.7%

Table 2. Response of cotton aphid populations to insecticides during July-August 1996.

County	No. of Fields	% Fields with resistant cotton aphids: Capture (5 ppm)	Lorsban (510 ppm)	Thiodan (270 ppm)
Madera	2	2/2 = 100%	0/2 = 0%	2/2 = 100%
Fresno	12	7/11 = 64%	2/12 = 17%	8/11 = 72%
Kings	9	8/9 = 89%	7/9 = 78%	6/9 = 69%
Tulare	3	3/3 = 100%	1/3 = 33%	3/3 = 100%
Kern	10	9/10 = 90%	5/10 = 50%	6/10 = 60%
Valley Average	36	29/35 = 82.8%	15/36 = 41.7%	25/35 = 71.4%