LYGUS BUG MANAGEMENT WITH INSECTICIDES

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Abstract

Lygus bugs, *Lygus hesperus* Knight, are annual insect pests of cotton in the San Joaquin Valley (SJV). The lack of effective biological control or host plant resistance to this pest dictates that insecticides are a primary tool for lygus bug management. *L. hesperus* has a long history of development of resistance to insecticides. Therefore, research must be continued to evaluate the efficacy of registered insecticides and to screen new candidate insecticides. The objectives for new lygus insecticides are materials with different modes of action and that have high selectivity for natural enemies. Achieving a balance between populations/the activity of natural enemies with effective lygus bug management is a challenge in the SJV. The most effective lygus control is obtained at the cost of a significant reduction in populations of beneficials, which may contribute to higher populations of spider mites and cotton aphids.

Introduction

The lygus bug, also called the western tarnished plant bug, *Lygus hesperus* Knight, is an annual insect pest of cotton in the San Joaquin Valley (SJV). The valley with a diverse cropping structure, surrounded by foothills, provides an excellent habitat for lygus bug survival and reproduction. The density of lygus bugs in the spring depends on the amount and pattern of winter precipitation, which facilitates the growth of native vegetation on the foothills. However, even in years with limited winter rainfall, localized lygus bug infestations occur in cotton fields adjacent to streams and other lush areas. In addition, an unknown portion of the lygus bug population originates and resides in the vegetation within the valley floor. The severity of the lygus bug infestation and damage in cotton depends on several factors, including the proximity of the cotton field to significant sources of lygus bugs, the relationship of lygus bug infestation to the timing of cotton fruiting, etc. Regardless, cotton crop losses from lygus bugs occur every year, and in some years, these losses are severe.

Lygus bugs inflict several types of damage to cotton. Square shed, inhibition of seed development, lint staining, and loss of plant terminals are all damage symptoms associated with lygus bugs; however, square shed is by far the most important type of damage. Insecticides are a primary means to mitigate the damage to cotton from lygus bugs. Cultural controls can be important, but other control strategies have only a limited role in lygus bug management. Biological control does not play a significant role in lygus bug control; however, generalist predators undoubtedly inflict some natural control on lygus bugs. There is one known egg parasitoid of this pest in the SJV, but it is not believed to cause much mortality in cotton fields. Host plant resistance to lygus bugs in approved acala cotton varieties does not exist. Cultural controls, including minimizing lygus bug population development in other crops and subsequent movement into cotton, is an important IPM technique.

Research is important for maintaining effective insecticidal materials for lygus bugs. This pest has the ability to develop resistance to a variety of insecticides. Leigh reported that lygus bugs in California had developed resistance to malathion, trichlorfon, and monocrotophos and partial tolerance to other organophosphates and to carbamates (Leigh et al. 1977). Resistance bioassays on lygus bugs have been conducted in the SJV during the last several years (Knabke et al. 1997, Grafton-Cardwell et al. 1997); however, field efficacy data on registered products are useful to supplement these data. In addition, there is the need to research new candidate insecticides with activity on lygus bugs. Alternative modes of action may help to delay resistance and may be useful in resistance management programs. The need for selectivity to natural enemies is also very important. Insecticides targeted against lygus bugs are often the first applications made during the cotton growing season. Broad spectrum insecticides for lygus bugs often decimate populations of beneficials. This can lead to subsequent outbreaks of spider mites, cotton aphids, and lepidopterous larvae. Spider mites are a particular concern in the SJV and more of a threat than in other areas. Spider mites can entirely defoliate cotton plants and devastate cotton yields. In addition, outbreak spider mite populations are difficult to bring under control with miticides. Therefore, preserving natural enemies to assist with pest control is important.

Materials and Methods

Field efficacy tests against lygus bugs have been conducted in the 6 county SJV cotton production area. Treatments were generally applied as the lygus population reached the

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threshold. High clearance tractor powered sprayers were used with spray volumes ranging from 15 to 20 GPA. Granular systemic treatments were shanked into the soil. Lygus bug population densities were evaluated before treatment and at ~7 day intervals post-treatment. The standard sweep net (15 inch diameter) was used with the number of lygus per 50 sweeps determined. Beneficial insects, including lady beetles, lacewings, big-eyed bugs, minute pirate bugs, assassin bugs, and damsel bugs, were quantified from the same 50-sweep sample. Plant mapping, retention, effects on other cotton arthropod pests, and cotton yield were determined as applicable.

Results

Registered Insecticides

Efficacy tests on lygus bugs in the SJV with registered products, conducted by Univ. of California Cooperative Extension personnel, over the last 5 years, were summarized. Ten replicated tests, conducted across the cotton production area of the SJV, were examined. Treatments, lygus pressure, evaluation timings, etc. differed among the tests, but there was enough commonality across treatments to summarize efficacy for four synthetic pyrethroids, five organophosphates, one organochlorine, one nicotinyl, and two tank mixes with a diamidide insecticide. Sweep net evaluations were available to 28 days after treatment (DAT), but not every timing was available for every product.

Pyrethroid products, including Capture®, Scout®, Baythroid®, and Mustang®, provided excellent lygus bug control and long residual. Lygus bug control at 7 and 14 DAT with pyrethroid, organophosphate, organochlorine, nicotinyl, and diamidide tank mix insecticides is shown in Fig. 1. Lygus control ranging from 40 to 77% was seen at 27 DAT. Among the organophosphate products (Monitor®, Orthene®, dimethoate, Curacron®, and Metasystox-R®), efficacy ranged from 20 to 84% at the 27 day evaluation. Lygus bug percentage control peaked at 88%. Lygus bug control peaked at 80% with Provado® and remained at 71% up to 27 DAT; the Ovasyn + Provado mixture was one of the more effective of the mixtures (maximum of 90% control), but provided less residual control.

The effect of insecticides on natural enemies in cotton is an important aspect of cotton IPM. The natural enemies are particularly important for managing spider mites and cotton aphids. Certainly there may be differences in susceptibility among natural enemy species, but the entire complex will be considered for this analysis. In addition, environmental conditions, availability of prey, etc. all influence densities of natural enemies. Percentage reduction in natural enemy population density at 7 and 14 DAT with pyrethroid, organophosphate, organochlorine, nicotinyl, and diamidide tank mix insecticides is shown in Fig. 2. Pyrethroid insecticides reduced natural enemy populations by at least 50% for the initial 27 DAT. A 97.5% reduction was the most severe reduction recorded. The effect of the organophosphate insecticides on natural enemies was much less than with the pyrethroids. For the initial 7 DAT, the effect was significant (up to 80% reduction) but the effect on beneficials waned in later sample dates. These insecticides have been used in the SJV long enough that some resistance has likely developed in the common natural enemies. Endosulfan and Provado had minimal effects on natural enemies with an average 34 and 21% reduction, respectively, up to 27 DAT.

Application of a sidedress systemic insecticide, Temik®, is another approach used in the SJV to manage lygus bugs. Research has shown that this product provides long residual control and has minimal effects on beneficials. Proper application timing, i.e., applying the product and having it systemically active in the plant, before significant lygus infestation is critical with this product. A short residual, foliar treatment may be needed for lygus knockdown when using Temik. This strategy provides long lygus bug control, protection of cotton fruiting structures, and yield.

Experimental Insecticides

New lygus active products are important for maintaining effective treatments for lygus bugs. Decis®, Regent®, and Mycotrol + Provado have been tested in recent years. Decis has shown good lygus control (up to 90% control), but also substantial effects on natural enemies. Lygus bug control with Regent has been good and with long residual control. Regent had moderate effects on natural enemies (50% reduction). Mycotrol (*Beauveria bassiana*) alone reduced lygus bug populations only slightly. However, when combined with a low rate of Provado (0.024 lbs. AI/A), the activity on lygus was good (75% control at 13 DAT, 54% at 20 DAT). Steinkraus and Tugwell (1997) showed similar results on *Lygus lineolaris*. This combination also had minimal effects on natural enemies. There was a 75% reduction from 1-3 DAT, but only a ~30% reduction thereafter.

Lygus Management Strategy

Achieving a balance between populations and the activity of natural enemies with effective lygus bug management is a challenge in the SJV (Goodell et al. 1997). In many parts of the SJV, lygus bug control is critical to producing a cotton crop; this pest is the primary arthropod pest and needs to be controlled with the most effective products. However, the most effective lygus control is obtained at the cost of a significant reduction in populations of beneficials. There is considerable evidence that this approach contributes to higher populations of spider mites and cotton aphids. In addition to the reduction in natural control provided by predators, several insecticides are documented to alter the physiology of the host plant and/or pest, i.e., hormoligosis. This has been shown to directly increase populations of spider mites (Maggi and Leigh 1983, van de Vrie et al. 1972) and cotton aphids (Kidd et al. 1996, Rongai and Cerato 1996).

Several approaches for managing lygus bugs were evaluated in terms of lygus bug densities, populations of natural enemies, populations of spider mites, populations of cotton aphid, cotton plant mapping parameters, and lint yield. In one such comparison, two approaches, one using an aggressive lygus management and the other approach accepting more lygus injury, were examined in nearby fields in Kern Co. The treatments required for these two approaches, not only for lygus bugs but also for cotton aphids and spider mites, are shown in Table 1. Arthropod densities (Table 2) show the differences in average lygus density from these two approaches. The more aggressive approach resulted in fewer lygus bugs and a higher bottom crop retention. Populations of natural enemies, averaged over 8 samples from mid-June to mid-August, were slightly lower with the more aggressive approach. However, cotton aphid densities were much higher (about 12X) in areas where lygus bugs were aggressively controlled compared with areas with the less intensive lygus insecticide approach. Spider mites followed similar trends. Although this is only one comparison, the differences are significant.

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Table 1. Comparison of pesticide applications used in two fields with differing approaches to managing lygus bugs, 1997.

Lygus Bug Treatments	Miticides	Aphid Treatments
More Aggressive Approach:		
late May- ½ OP, ½ Pyrethroid	late May- Zephyr	mid-July- Provado
mid-June- OP	mid-July- Comite	late July- Ovasyn + Lorsban mid-Sept.- Curacron
Less Aggressive Approach:		
late June- ½ OP, ½ carbamate		
mid-July- Temik sidedress	mid-July- Temik sidedress	mid-July- Temik sidedress

Table 2. Comparison of the effects of lygus bug management strategies on plant development and populations of other arthropod pests, 1997.

Strategy	Avg. # of Lygus Bugs[1]	% Bottom 5 Retention	Avg. Num. of Bene.[1]	Peak Cotton Aphid Den.[2]	Peak % Infested Spider Mite[3]
more agressive	0.9	58%	6.7	115.7+	38%
less agressive	2.25	23%	8.7	9.5	5%

[1] number per 50 sweeps from mid-June to mid-August.
[2] number per cotton leaf.
[3] % infested cotton leaves.

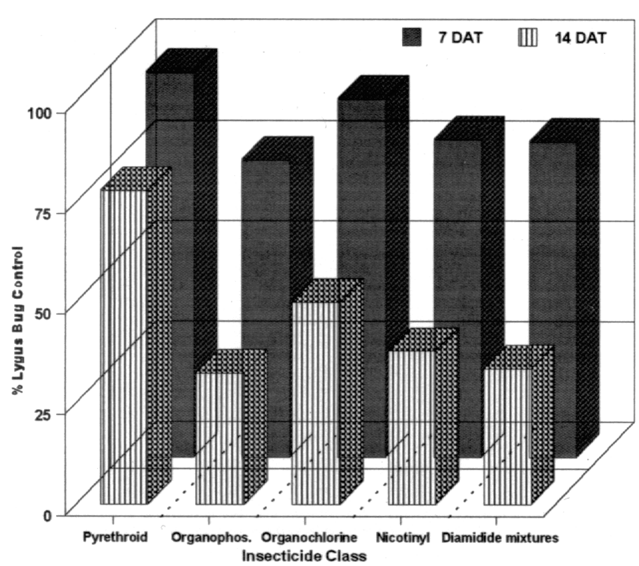

Figure 1. Comparison of lygus bug efficacy among insecticide classes, SJV, 1992-97 small plot tests.

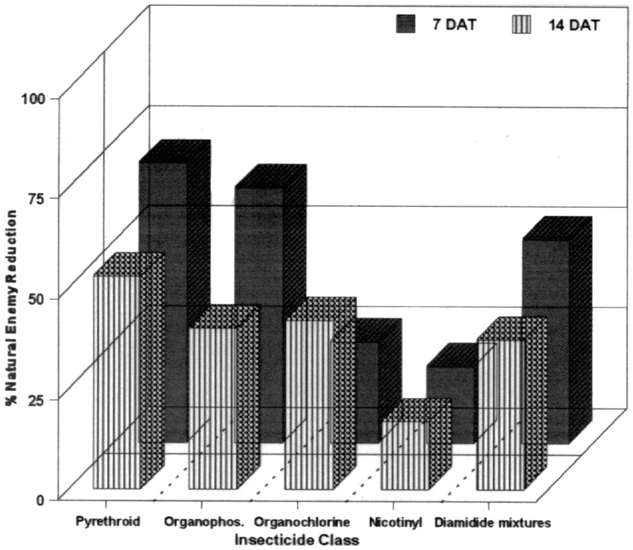

Figure 2. Comparison of reduction in natural enemy populations among insecticide classes, following application for lygus bugs, SJV, 1992-97 small plot tests.