EFFECTS OF REGISTERED AND EXPERIMENTAL INSECTICIDES ON *LYGUS HESPERUS* AND ON SELECTED BENEFICIAL ARTHROPODS IN CALIFORNIA COTTON

K. E. Keillor and L. D. Godfrey
Department of Entomology
University of California
Davis, CA

Abstract

Selected registered and experimental insecticides were compared in terms of efficacy on *Lygus hesperus*, effects on beneficials, and potential to flare secondary arthropod pests in 1998 and 1999. Of the registered materials, the pyrethroids provided excellent Lygus bug control; however, the residual was only between 7 and 14 days. The organophosphate products and Provado gave good, but short-term control. Vydate, (tested in 1999 only), performed well. Regent appears to provide Lygus bug control in the same range as the pyrethroids. Provado had the least effects of the tested materials on natural enemies. The pyrethroid insecticides effected natural enemies severely for the first several days following application. The relatively small plot size and effects of the materials on populations of other arthropods, i.e., potential prey, made it difficult to evaluate long-term effects. The organophosphate insecticidal effects on natural enemies were erratic. Regent had a moderate to severe effect on beneficials. In addition, populations of spider mites increased significantly following Regent application in 1998; these effects in 1999 were more moderate. Regent appears to have potential to flare secondary pests such as spider mites. Several other tested materials also increased spider mite densities, especially in 1998, and to a reduced extent, in 1999.

Introduction

The western tarnished plant bug, *Lygus hesperus* Knight, is a key pest of cotton in the San Joaquin Valley of California, damaging both the fruit and the vegetative parts of the plant. Lygus bugs attack the terminal meristem of the cotton plant causing the plant to become bushy. Lygus bugs pierce young squares, which is the primary concern, causing them to terminate and fall off the plant. They also damage young cotton bolls by piercing the wall of the boll and feeding on immature seeds. The seeds then fail to mature or the lint surrounding the seed can become stained yellow and may not mature.

The density of lygus bugs during the cotton growing season depends on the amount and pattern of winter precipitation, which facilitates the growth of native vegetation on the foothills (a primary overwintering site for this pest). However, even in years with limited winter rainfall, localized lygus bug infestations occur in cotton fields adjacent to areas of lush, broadleaf weedy growth. Lygus bug populations also reside in and originate from vegetation within the valley floor, such as the understory plants within perennial crops. 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. However, crop losses have occurred annually during the 1990's ranging from an estimated 4.5% to less than 1%.

Insecticides are a primary means used to manage Lygus bug populations. Cultural controls such as strip cutting of alfalfa fields, interplanted alfalfa strips, and buffer strips can aid in Lygus management (Godfrey and Leigh 1994, Goodell1998, Goodell and Eckert 1998); however, these methods may not provide acceptable control with heavy lygus pressure. Natural enemies, at this time, provide only minimal control of lygus bugs. During most years, an average of one foliar insecticide application is made for lygus bugs. In addition, many fields are treated with a systemic insecticide, a sidedress application, which provides partial protection against lygus bugs and other arthropod pests. Two challenges exist with using insecticides for Lygus control, A.) maintaining effective products with the ability of Lygus bugs to develop resistance and B.) finding selective materials that can control Lygus bugs without destroying populations of natural enemies.

L. hesperus has a long history of the development of insecticide resistance in California and other areas in the western U.S. 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). Spider mites, cotton aphids, silverleaf whiteflies, and lepidopterious larvae are other important arthropod pests of cotton in California. Natural enemies, including generalist predators and parasitoids, are of utmost importance for managing other key cotton pests such as spider mites and cotton aphids. Materials used for lygus control, with broad-spectrum activity, can decimate populations of beneficials and effect biological control. Godfrey et al. (1998) reviewed the relative efficacy of materials from various insecticide classes against lygus bugs and effects on natural enemies.

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Methods

Replicated field plots were established to evaluate the fit of registered and experimental insecticides for lygus bug control in the California cotton IPM system. The efficacy on lygus bugs, effects on natural enemies, and indirect effects on populations of other arthropod pests were the primary criteria used for evaluation. Studies were conducted at the UC Shafter Research and Extension Center in 1998 and the UC West Side Research and Extension Center in 1999 in irrigated acala cotton planted on 23 April 1998 and 16 April 1999. Treatments were applied on 9 July 1998 and on 13 July 1999. These dates are later then the grower standard practice. However, our goal was to have high levels of lygus bugs so as to more clearly separate treatments, instead of maximizing yield. Applications were made to plots 6 rows by 70 feet with 3 replicates (1998) and 12 rows by 95 feet with 3 replicates (1999). Treatments were applied with tractor powered CO_2 propelled sprayer at 15 GPA (3 nozzles per row in 1998 and 5 nozzles per row in 1999). A total of 12 and 15 treatments were compared in 1998 and 1999, respectively. A subset of the treatments will be discussed herein.

Treatments were evaluated at 1, 4, 7, 14, and 21 days after treatment (DAT). The standard sweep net (15 inch diameter) was used with the number of lygus bugs 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. Populations of other arthropod pests, primarily spider mites and cotton aphids were determined from a 20-leaf sample (5th main stem node leaf from terminal) from each plot. A leaf washing technique, which was a modification of Leigh et al. (1984), was used to recover insects and mites; specimens were counted with aid of microscope.

Results

1998: Pretreatment Lygus bug populations averaged 11.7 Lygus per 50 sweeps. The population was slightly weighted toward adults compared with nymphs. Pretreatment populations of generalist natural enemies were 39.0 per 50 sweeps; populations remained fairly high in the untreated plots at 1, 4, 7, and 14 DAT.

At 1 DAT, Capture numerically provided the best Lygus bug control, although there were no statistical differences among the treatments (Fig. 1). Control was statistically better in all treated plots compared with the untreated. Regent 6.2 provided an intermediate level of control and all the other treatments were similar in efficacy. At 7 DAT, there were no significant differences, but the same trends were generally seen. Lygus control with several products (Regent 2.5EC, Capture, and Monitor) had declined (but were still efficacious) relative to the previous sample date. At 14 DAT, no effective Lygus bug control was seen with any treatment.

Beneficial populations were 83% *Geocoris* (big-eyed bugs), with *Orius* (minute pirate bugs), *Zelus* (assassin bugs), *Nabis* (damsel bugs), lacewings, and lady beetles comprising the remainder. Populations of beneficials were significantly reduced by all treatments at 1 DAT, except Provado (Fig. 2). Regent and Mustang had moderate effects on beneficials and plots treated with Capture had a ~95% reduction. Similar results were seen at 4 DAT; natural enemy populations had started to bounce back in the Monitor treatment and conversely Provado treatment effects were more evident. These data must be considered in light of the small plot size, given the mobility of the beneficials, and build-up of populations of other pests (spider mites) in some plots.

At 14 DAT, populations of mites were noticeably higher (~3X) in the Regent and Baythroid treatments (Fig. 3).

1999: Pretreatment Lygus bug populations averaged 5.9 Lygus per 50 sweeps and 22.2 generalist natural enemies per 50 sweeps.

At 1 DAT, Regent, all three formulations, provided Lygus control equal to the pyrethroids (Fig. 4). Efficacy with Vydate increased at 3 DAT and that with Provado peaked at 7 DAT. Lygus bug control with all treatments persisted for only 7 days; at 14 DAT the control greatly waned with all treatments. Of the Regent formulations, the 80WDG provided the best residual control.

Regent reduced populations of beneficials moderately, i.e., more then Provado but slightly less then pyrethroids (Fig. 5). Provado had the least effects on natural enemy populations, whereas Monitor had a surprisingly severe effect on beneficials. Vydate reduced levels of natural enemies at 1 and 3 DAT.

Regent (2.5EC and 6.2) slightly flared spider mite levels at 7 DAT, but not as severely as in 1998 (Fig. 6). The 80WDG formulation did not have any effect on spider mites. Among the other treatments, mite levels were slightly, but not statistically significantly higher in Provado, Mustang and Vydate.

Summary

Of the registered materials, the pyrethroids provided excellent Lygus bug control; however, the residual was only between 7 and 14 days. The organophosphate products and Provado gave good, but short-term control. Vydate, (1999 only), performed well. Regent appears to provide Lygus bug control in the same range as the pyrethroids. Regent appears to have potential to flare secondary pests such as spider mites.

Acknowledgments

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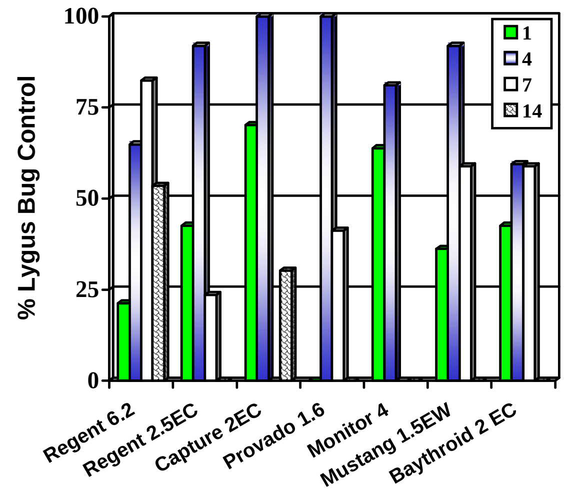

Figure 1. Efficacy of selected insecticidal products against lygus bugs, 1998 at 1, 4, 7, and 14 days after treatment.

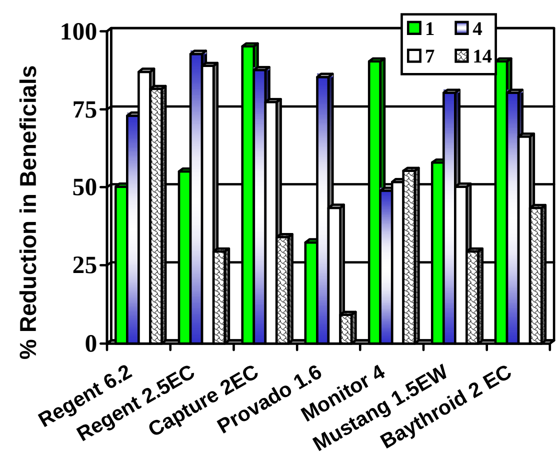

Figure 2. Effects of selected insecticidal products, targeted against lygus bugs, on natural enemies, 1998 at 1, 4, 7, and 14 days after treatment.

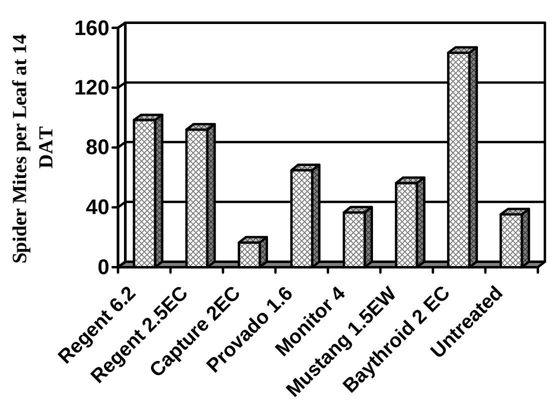

Figure 3. Effects of selected insecticidal products, targeted against lygus bugs, on spider mite populations at 14 days after treatment, 1998.

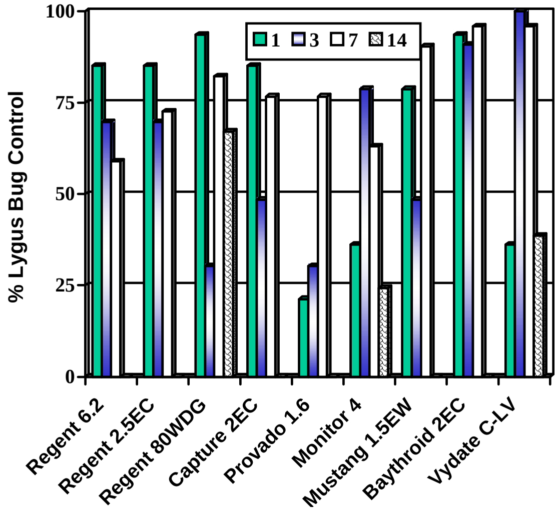

Figure 4. Efficacy of selected insecticidal products against lygus bugs, 1999 at 1, 3, 7, and 14 days after treatment.

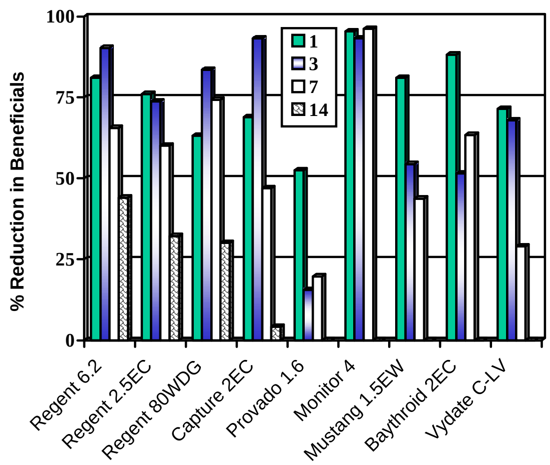

Figure 5. Effects of selected insecticidal products, targeted against lygus bugs, on natural enemies, 1999 at 1, 3, 7, and 14 days after treatment.

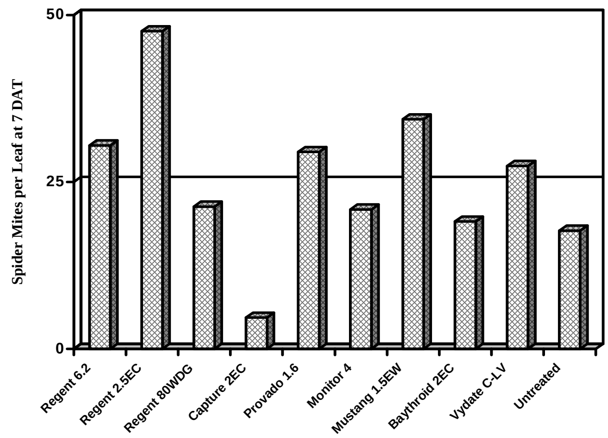

Figure 6. Effects of selected insecticidal products, targeted against lygus bugs, on spider mite populations at 7 days after treatment, 1999.