2003 Lygus Bug Management in Dry Beans

Larry Godfrey[1], Mick Canevari[2], and Richard Lewis[1]
[1]Dept. of Entomology, UC-Davis;
[2]University of California Cooperative Extension-San Joaquin County

Introduction

The western tarnished plant bug or as it is more commonly called the lygus bug, *Lygus hesperus*, is one of the most serious insect pests of dry beans in California. This insect is extremely mobile, feeds on numerous crops, can occur in high numbers, difficult to kill with many insecticides and, moreover, can develop resistance to insecticides; these characteristics are consistent with a difficult to manage and important insect pest. Lygus bugs can quickly inflict damage to dry beans. During early bud and flowering stages, lygus bugs cause bud and flower blasting resulting in reduced set and yields. Lygus bugs feeding on young, developing seeds cause blemishes and stings which reduces bean quality and grade.

Insecticidal control is the primary means used to manage damaging lygus bug populations. This same strategy is relied upon in numerous crops for lygus bugs, including cotton, seed alfalfa, strawberries, and lettuce (just to name a few of the crops). Other strategies such as intercropping alfalfa strips, trap cropping, releases of biological control organisms for lygus bugs, irrigation management, etc. have been tried as ways to manage lygus bugs with moderate, at best, success. New, selective reduced risk insecticides have been developed for many serious agricultural pests such as aphids, lepidopterous larvae, spider mites, and whiteflies. These insecticides generally have favorable attributes in terms of protecting the environment, workers, beneficial insects, etc. Unfortunately, the development of reduced risk insecticides with high levels of activity on lygus bugs is lacking. This point was made by Brunmeier and co-workers in their study from 2001-2002 where reduced risk strategies were compared with conventional approaches for managing the key arthropod pests of dry beans. Reduced risk insecticides were available (although still experimental and not registered on beans in some cases) and performed well against aphids, thrips, spider mites, leafminers, and worms in beans in this study, but the activity against lygus bugs was only moderate (see 2002 Dry Bean Research summary report for details).

Several factors have placed an added importance on implementing reduced risk pest management strategies on beans. The high level of regulatory scrutiny recently placed on organophosphate and carbamate insecticides have threatened the continued availability of these products. In addition, lygus bug resistance to products in these chemical classes is documented in other crops such as cotton. Finally, use of insecticides with broad-spectrum activity has been shown to flare (increase) levels of other pests in beans such as leafminers, whiteflies, spider mites, and aphids. This occurs primarily because these materials kill predators and parasites along with the intended pest species but often results in additional applications to control these “secondary pest”.

Evaluation of insecticide efficacy on lygus bugs is also difficult. Given the high mobility of the lygus adults, a large size plot is required to prevent movement of bugs out of or into plots which could potentially mask the results. No one is really sure how large of a plot is needed to minimize this effect, but commonly ¼ to 1/3 acre plots are used. Working with large plots and proper replication is difficult when testing unregistered insecticides because of the needed crop destruction. We tested an alternative way to evaluate insecticide efficacy against lygus bugs in beans in 2003. This method, although with some limitations, provides useful data in this area.

Materials and Methods

Plots of Luna baby lima beans located on the UC-Davis Agronomy Farm were treated with a backpack sprayer at 30 GPA on 1 Aug. The crop at this time was in the bud stage with 5% open flowers and 95% closed flowers. The treatments were evaluated in a RCB design with each plot measuring 2 rows by 25' with 4 replications. Two untreated rows formed a buffer between each treatment. The insecticides shown in Table 1 were evaluated.

Table 1. Insecticides evaluated against lygus bugs in dry beans.

Product	Rate (formulation/A)	Lbs. AI/A	Chemical Class
Avaunt	6 oz.	0.11	Oxadiazine
Warrior	3.84 fl. oz.	0.03	Pyrethroid
Orthene 75SP	1.0 lb.	0.75	Carbamate
Dimethoate 2.67	1.5 pts.	0.5	Organophosphate
Actara 25WP	3 oz.	0.046	Neonicotinoid
Untreated	---	---	---

These insecticides were chosen because they are registered or are being developed on dry beans but also because they represent five different classes of chemistry. When an insect develops resistance to a material in a given chemical class, it is generally also resistant to other materials in that class. Therefore, these products were chosen as representatives of the class.

Lygus bug adults were collected from a nearby field of beans and confined on treated foliage in the plots within small "mesh bags". The bags were made from floating row cover material which allowed ~85% light transmittance and only slight elevation of temperature. The bags were about 6" wide and 14" long with one end being open to allow them to be placed over the plant terminal; after the bugs were placed inside the open end was closed with twist-ties. Five lygus adults were placed in each bag and two bags were placed per plot. After a 48 hour exposure period, mortality was assessed. Evaluations were done at 2 to 4 days after treatment (DAT), 5 to 7 DAT, 9 to 11 DAT, and 12 to 14 DAT. A second application was made on 20 Aug. for selected treatments and mortality was assessed in the same manner at 5 to 7 and 8 to 10 DAT. Sweep net samples for lygus were collected in each plot at 5, 7, 12, 15 days after the first application and 7 and 10 days after the second application. Bean yield data were collected by cutting plots on 7 Oct. and mechanically harvesting beans on 3 Nov. Lygus damaged seeds were recorded by examining 150 seeds/plot and expressing the results as percentage damaged.

The incidence of insecticide resistance was evaluated for insecticides from four chemical classes. An organophosphate (Metasystox-R®), carbamate (Lannate®), pyrethroid (Capture®), and neonicotinoid (Provado®) were used. These chemicals were chosen because discriminating doses have been developed for lygus bugs in other crops/states to these materials. The test involves coating the inside of a small Zip-Loc plastic bag (~2 x 4") with the appropriate concentration of the insecticide (the discriminating dose), allowing it to dry, and placing five lygus bug adults in the bag for 8 hrs. A small cork was also placed in the bag so the lygus adults could freely crawl; the bags were held at 70^{0}F and mortality was compared with that in untreated bags. The discriminating dose should kill 80-90% of susceptible lygus bugs, thereby classifying the lygus populations as susceptible or resistant.

Results

Results for the field bioassays are shown in Fig. 1. Lygus mortality with Warrior was 100% at the 2 to 4 day evaluation and declined to 62% at 12 to 14 DAT. Control with the second application of Warrior was somewhat less than that seen with the first application (30 to 50% less); however, an unexpected thunderstorm occurred on 22 Aug. and could have washed off some of the active ingredient. Lygus mortality with the other four products ranged from 42 to 68% at 2 to 4 DAT. Control increased slightly with Avaunt and Actara at 5 to 7 days and declined with dimethoate and Orthene. At 9 to 11 DAT, control with all four products was less than 30% and evaluations were stopped. Orthene was evaluated with a second application and the results showed poor control at 5 to 7 DAT. Throughout the study mortality in the untreated ranged from 15-35%.

Lygus incidence in sweep net samples is shown in Table 2.

Table 2. Lygus density and bean yield/quality data from lygus bug insecticide study.

	Lygus Bugs per 10 Sweeps at Days after Treatment						
Product	**5**	**7**	**12**	**15**	**7 ***	**Yield (Lbs./A)**	**% Lygus Damaged Seeds**
Avaunt	5.5 a	4.3 a	8.3 a			2213 a	7.0 ab
Warrior	0.0 b	1.8 a	2.5 b	3.5 b	4.3 b	2596 a	4.1 b
Orthene 75SP	3.3 ab	7.0 a	8.8 a		8.0 a	2300 a	8.1 a
Dimethoate 2.67	3.3 ab	4.5 a	6.8 a			2252 a	7.6 a
Actara 25WP	2.8 ab	3.3 a	7.5 a			2387 a	6.6 ab
Untreated	5.8 a	3.8 a	7.8 a	7.3 a	8.3 a	1725 b	6.0 ab

* Days after second application

Means within columns followed by the same letter are not significantly different P=0.05, SNK Test.

At 5 DAT, significantly fewer lygus were found in the Warrior treated plots than in the untreated and Avaunt plots. Populations were intermediate in the other three treatments. At 7 and 12 DAT, the same trends were seen but there were no statistically significant differences at 7 DAT. Warrior activity continued at 15 DAT (over 50% control). Following the second application of Warrior and Orthene, Warrior significantly reduced the lygus population at 7 DAT, whereas Orthene was ineffective. Overall, the sweep data and field bioassay data on lygus control were in close agreement. Bean yield and quality data are shown in Table 2. Yields were significantly higher in all the treated plots compared with the untreated. The highest yielding treatment, Warrior, resulted in a ~50% increase in yields over that in the untreated. Lygus sting data showed a significantly lower percentage damaged seeds in the Warrior-treated plots (4.1%) than in the Orthene-treated (8.1%) or dimethoate-treated (7.6%) plots. Untreated plots had 6% damaged seeds.

In the discriminating dose test, 20% mortality was seen in the untreated bags, which is slightly higher than optimal. The organophosphate and pyrethroid both provided good mortality at 95% and 90%, respectively, indicating susceptibility. Mortality with the carbamate (27%) and neonicotinoid (20%) was poor.

Clearly the field and lab bioassay tests provided useful information but one must remember that they are bioassays, which are an attempt to reduce real-world conditions down to very controlled conditions. For instance, with the field bioassays, insecticides which kill primarily with contact, over-the-top activity would be hindered because our testing utilized primarily residual activity. For the laboratory bioassay, systemic materials would clearly be biased against in this plastic bag testing. In summary, this type of testing provides useful information and may give some indications on future research questions to address but these results may not directly relate to grower field situations.

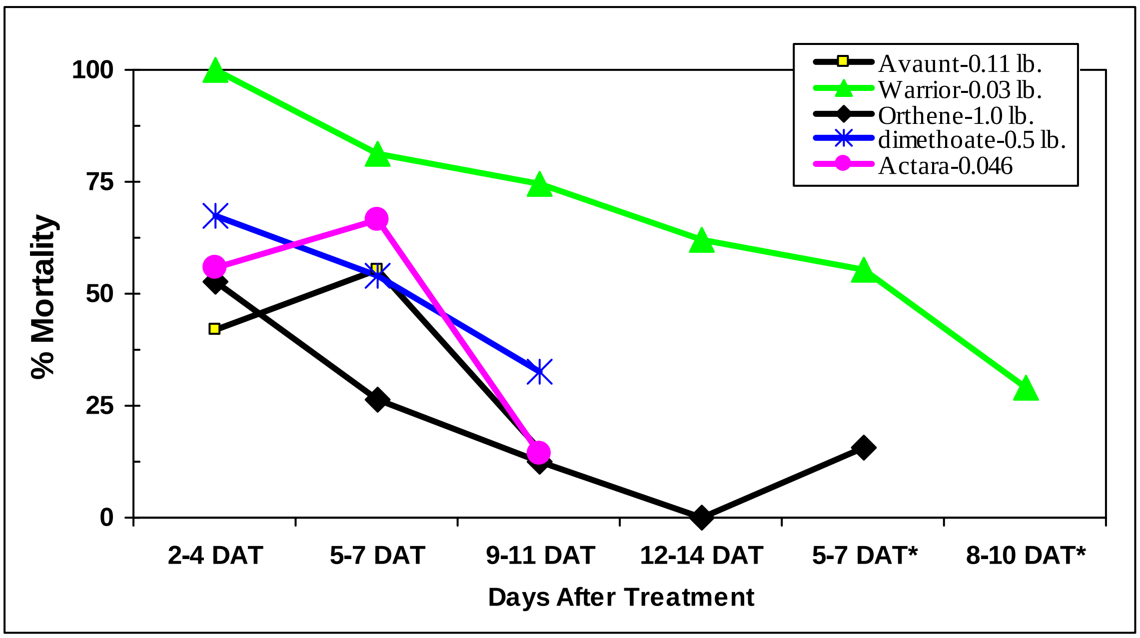

Figure 1. Lygus bug mortality from field bioassay in dry beans, 2003.
* days after second application.