Management of Lygus Bugs in Bush Baby Limas, 2015

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ABSTRACT

The western tarnished plant bug Lygus, *Lygus hesperus*, is a major pest of dry beans in California, affecting yield and seed quality. Insecticides are the primary means for managing this pest due limited alternative control methods. The purpose of our study was to evaluate registered and experimental insecticides for lygus control in baby lima beans with the goal of finding 'softer' insecticides that have minimal impacts to non-target species. Our data showed that the currently registered pyrethroid insecticides (alone and in mixtures) provided good lygus control with increases in yields and bean quality compared to untreated plots. Dimethoate and Steward were intermediate for yields and pest control. Rimon is an insect growth regulator and needs to be tank mixed with another insecticide to control adults for good efficacy. For the experimental materials, Belay and Transform gave good lygus control with yields comparable to Dimethoate. Beleaf and cyclaniliprole showed little lygus pest control benefits. The insecticides evaluated in this trial did not significantly negatively impact beneficial insects. Our lygus data are fairly consistent with other UC insecticide trials on baby lima beans at UC Davis, 2010-11 and blackeye (cowpea) trials at the UC Kearney Research and Extension Center in Parlier, 2011-2013. Overall, the pyrethroids are working well for lygus management. Dimethoate and Steward are generally moderate. For the experimental pesticides, Belay and Transform show potential for lygus management in lima bean production.

Key Words: lima, lygus bug, insecticides, natural enemies, yield

INTRODUCTION

Lygus bugs are serious pests of dry beans in California and difficult to control. This insect probes into bean plant tissue and aborts buds, flowers, and small pods causing yield losses. The adults and nymphs also probe developing beans, causing a scar (sting) on the bean and quality losses. This damage is undesirable and affects the marketability of beans. Discounts can result due to lygus bug damage. Both the immature stages (nymphs) and the adult stages of lygus bugs inflict damage.

Lygus has more than 200 hosts including cotton, strawberries, leafy greens, beans, celery, eggplant, fruit, and tomatoes. Many weeds are also hosts for lygus, such as Russian thistle, black mustard, and wild radish. These plants allow lygus to persist during periods when crop hosts are not available. Adjacent crops such as alfalfa and safflower also impact lygus bugs when they are harvested or dry down and the lygus bugs migrate out of fields and into dry bean crops.

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Insecticides are primarily relied on for controlling lygus bugs in dry bean production. Although an integrated approach is preferred where insecticides are one tool used, the severe pest status of lygus and lack of other effective management tools means that insecticides are the primary method of management. The benefits of insecticides are good crop yield and quality.

The disadvantages of pesticides include higher production costs and negative impacts to natural enemies, and water and air quality. Some pyrethroids might also stimulate increased egg production in insect pests (an effect called hormoligosis), leading to more pest outbreaks. With issues of insecticide resistance and the threat of older insecticides being phased out by regulatory agencies, the purpose of our study was to find more effective and environmentally sound insecticides for lygus bug control in dry bean production.

PROCEDURES

The bush baby lima variety "Luna" was planted at the UC Davis Agronomy Farm (1-acre) on May 22, 2015, next to several acres of safflower. A natural infestation of lygus bugs developed in the plots starting in late July, with adults migrating from the adjacent safflower as it dried down. Treatments are shown in Table 1 and were applied to plots measuring 12 rows wide (30-in beds) by 30 feet long. Each treatment was replicated four times in a randomized complete block design. Pesticide applications were made with a CO_2 backpack sprayer at 20 GPA on July 22 and August 10; the beans were in early bloom for the initial treatment and full bloom with some pod set for the second application.

Lygus bug populations were sampled with a sweep net several days and weeks after each application. The lygus bugs were separated into nymphs and adults. Western spotted cucumber beetles and stink bugs were also also evaluated, though not reported in this study, as populations were low in our plots. Beneficial insects were also quantified in each plot from the sweep net samples. Bigeyed bugs (*Geocoris* spp.), minute pirate bugs (*Orius* spp.), lacewings (*Chrysopa spp*), damsel bugs (*Nabis* spp.), and lady beetles (*Hippodamia convergens* and other species), and syrphid flies *(Syrphidae)* were included in the analyses. Finally, bean yields and quality were determined from the middle six rows of each plot. The lima beans were cut on September 3 and threshed on September 21. The beans were subsequently cleaned and weighed and evaluated for yield (lb/ac) and quality (weight per bean in grams, percent stings, and percent off color and size) from 200 beans.

The data were analyzed by UC Davis PhD Student Sacha Heath, using a one-way Analysis of Variance (ANOVA) on all lygus and lima bean response variables using treatment as the fixed effect and block as the random effect. The Fisher's Least Significant Difference (LSD) values were calculated using critical t-values at $\alpha = 0.05$, and within group degrees of freedom and mean squared error values derived from ANOVA results.

RESULTS

Lygus Bugs: Lygus bugs moved into the lima bean plots in high numbers at bud time. The pretreatment numbers on July 21 were mostly adults (2.4 adults/sweep, 0.05 nymphs/ sweep) indicating they had recently migrated into the plots. The threshold for lygus in limas is 1.5/sweep, but we delayed treatment until the plants started blooming. After the first pesticide application on July 22, the adults in the control plots stayed fairly constant, but the nymphs began to increase significantly. 8 DAT (days after treatment), Warrior and Belay kept the lygus below the threshold values, although there were no statistically significant differences in lygus numbers between any treatment across all dates for the first insecticide application. For the second application on August 10, 3 DAT, the pyrethroids showed some control against the adults but not the nymphs. However, Rimon, Steward, Belay, and Transform showed some efficacy against the nymphs. Cyclaniliprole did not control nymphs or adult lygus. Overall, there were few statistically significant differences in lygus counts between the treatments (Tables 2 and 3 and Figures 1 and 2).

Natural Enemy Populations: Predators (Table 4) were generally not negatively affected by the different pesticide treatments compared with the untreated control, though Belay tended to have reduced natural enemy numbers overall, but this was not statistically significant ($P>0.05$). Of all the types of beneficial insects counted, 95% were minute pirate bugs. These insects are predators of pests such as lygus nymphs, aphids, thrips and mites.

Yield and Quality: Lima bean yields ranged from 990 lbs/ac to 1495 lbs/ac (Table 5, Figure 3), much lower than expected (statewide average for 2015 for baby limas was 2,150 lbs/ac). Overall, 2015 was a low bean yielding year in California, with some suggesting that high summertime temperatures during bloom affected production. Salts may also be accumulating in the soil due to the drought and little rainfall to flush them out, further reducing yields. High continuous lygus pressure in our plots may have also reduced yields. With the exception of Rimon, all of the treatments yielded higher than the control, with the pyrethroids (Warrior, Leverage, and Brigadier) having the best yields overall. For Rimon, this material does not control adult lygus bugs, only eggs and nymphs, so it is not surprising that by itself it did not show higher yields. This material must be mixed with another insecticide to control the adults.

In looking at yield versus average number of lygus bugs per sweep for data from blackeyes in 2011-13 and baby limas in 2010, 2011 and 2015, with the exception of Steward, overall the registered materials are controlling the lygus bugs better than the unregistered/experimental materials (Figures 4-9). The pyrethroids (Warrior, Leverage, and Brigadier) overall are working well for yield gains compared to untreated plots. The Warrior+Rimon treatment shows very good lygus nymph and adult control and yield gains. Dimethoate and Steward control lygus, but yields are not as strong as for the pyrethroids. The experimental insecticides sulfoxaflor and Belay show promise for lygus control, but more studies are needed because the yield gains with these pesticides varied in our trials. Cyclaniliprole and Beleaf did not show consistent lygus control or yield increases.

There were no significant differences in bean weight per bean (gms) between the treatments ($P>0.05$), although the lower yielding plots tended to have higher bean weights. Overall stings were highest in the control plot at 10%. Using 5% damage or less for #1 quality beans, this was achieved by Brigadier and very close for the other pyrethroid treatments (Warrior and Leverage) as well as Belay and Transform. The differences in misshapen/off color beans were not significantly different between treatments ($P>0.05$, Table 5).

SUMMARY

There were high levels of lygus bugs in this study with populations exceeding the treatment threshold in untreated control plots from the beginning of bloom to maturity at pod set. The

registered insecticides generally showed acceptable lygus control but it was short-term (control was lost from 8 to 14 days after treatment, depending on the product). In addition, the level of control was in the 60% to 70% range for the pyrethroids for the adults, but almost no control for the nymphs. Steward, Belay and Transform provided around 50% control of both lygus nymphs and adults. For the experimental insecticides, Beleaf and cyclaniliprole showed little lygus control. Rimon is an insect growth regulator with good mortality to lygus eggs and small nymphs and will not control the adults.

In looking at yield versus average number of lygus bugs per sweep for data from blackeyes (cowpeas) in 2011-13 and baby limas in 2010, 2011 and 2015 (Figures 4-9), overall the pyrethroids (such as Warrior, Leverage, and Brigadier) showed good lygus control with higher yields, compared with the untreated control. Rimon is an insect growth regulator and controlled nymphs best in these trials. Mixed with Warrior, it shows good promise for lygus management and enhanced yields. Dimethoate is still providing control of lygus with increased yields, but not as strong as the pyrethroids. For the experimental insecticides, cyclaniliprole and Beleaf did not show good consistent lygus control or yield increases. Belay and sulfoxaflor show good promise for lygus control and yield increases, though more studies are needed to evaluate their efficacy in pest control in dry beans.

Belay decreased the beneficial insects more than the other treatments, though it was not statistically different from the untreated plots. Percentage lygus stings to the beans were highest in the untreated control plots. In general, the pyrethroid treatments held the number of stings close to the 5% limit in our trials for grade one beans, as well as Belay and Transform.

Acknowledgements. The technical assistance of Julia Modell, Kevin Goding, and Ben Leacox was critical and appreciated.

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Table 1. Treatment list for Lygus bug control study, UC Davis, 2015.

Trt	Product[1]	Active Ingredient	Product per Ac	Status
1	Untreated	---	---	---
2	Dimethoate 2.67EC	dimethoate	1.5 pt	Registered
3	Warrior II	lambda-cyhalothrin	1.92 fl. oz.	Registered
4	Leverage 360	imidacloprid+cyfluthrin	2.8 fl. oz.	Registered
5	Brigadier	bifenthrin+imidacloprid	5.6 fl. oz.	Registered
6	Rimon 0.83EC	novaluron	12 fl. oz.	Registered
7	Beleaf 50SG	flonicamid	2.8 oz.	Experimental
8	Steward EC	indoxacarb	11.3 fl. oz.	Registered
9	Belay	clothianidin	5.0 fl. oz.	Experimental
10	Transform	sulfoxaflor	2.25 fl. oz.	Experimental
11	--	cyclaniliprole	22 fl. oz.	Experimental

[1]Dyne-Amic surfactant at 0.5% solution added to all insecticide treatments.

Table 2. Average number of Lygus bugs per sweep (adults, nymphs-Nym), following application of experimental and registered insecticides on July 22. Pretreatment counts on 7/21 were 2.4/sweep for adults and 0.05/sweep for nymphs, UC Davis, 2015.

Product	**7/24, 2 DAT**			**7/27, 5 DAT**			**7/30, 8 DAT**			**8/5, 14 DAT**		
	Adult	Nym	Total	Adult	Nym	Total	Adult	Nym	Total	Adult	Nym	Total
Untreated	**2.7**	**0.1**	**2.8**	**1.6**	**0.1**	**1.7**	**1.9**	**0.6**	**2.5**	**1.9**	**2.7**	**4.6**
Dimethoate	0.8	0.1	0.9	0.9	0.2	1.1	2.2	0.6	2.8	2.4	3.4	5.8
Warrior II	0.4	0	0.5	0.4	0	0.4	0.5	0.6	1.1	0.7	3	3.7
Leverage	0.4	0.1	0.5	0.2	0.1	0.3	1.5	0.7	2.2	1.7	4	5.7
Brigadier	0.6	0.1	0.7	0.3	0.1	0.4	1.7	0.3	2	2.8	3	5.8
Rimon	3.3	0.1	3.4	1.6	0	1.6	2.1	0.4	2.5	1.9	1.5	3.4
Beleaf	1.6	0.2	1.8	1.4	0.1	1.5	2.5	0.2	2.7	1.9	2.5	4.4
Steward	0.9	0.1	1.0	0.7	0.1	0.8	2.1	0.6	2.7	1.9	3.6	5.5
Belay	0.7	0.1	0.8	0.5	0	0.5	1.2	0	1.2	1.7	1.8	3.5
Transform	0.7	0.1	0.8	0.8	0.1	0.9	1.8	0.4	2.2	2.5	2	4.5
cyclaniliprole	2.6	0.1	2.7	1.4	0.3	1.7	2.2	1	3.2	1.8	3.1	4.9
Anova F-statistic and p-value	F=2.04 p=0.08	F=0.46 p=0.90	F=1.73 p=0.13	F=1.27 p=0.30	F=0.84 p=0.59	F=1.15 p=0.37	F=0.81 p=0.63	F=0.32 p=0.97	F=0.35 p=0.96	F=0.64 p=0.77	F=0.76 p=0.67	F=0.47 p=0.89
LSD Value	1.64	0.24	1.79	1.11	0.21	1.24	1.44	0.94	1.88	1.50	2.06	2.58

Table 3. Average number of Lygus bugs per sweep (adults, nymphs-Nym, Total), following application of registered and experimental insecticides on August 10, UC Davis, 2015.

Product	**8/13, 3 DAT**			**8/17, 7 DAT**			**8/24, 14 DAT**			**8/31, 21 DAT**		
	Adult	Nym	Total	Adult	Nym	Total	Adult	Nym	Total	Adult	Nym	Total
Untreated	**1.3**	**3.8**	**5.1**	**2.2**	**3.3**	**5.5**	**0.9**	**2.1**	**3**	**0.2**	**3.8**	**4**
Dimethoate	1.1	3.2	4.3	2.4	2.3	4.7	0.9	3	3.9	0.1	3.2	3.3
Warrior II	0.6	4.4	5	1.8	3.2	5	0.4	1.7	2.1	0.1	4.4	4.5
Leverage	0.7	3	3.7	1.5	2.7	4.2	0.6	1.7	2.3	0.1	3	3.1
Brigadier	0.4	4.2	4.6	2	3.2	5.2	0.8	2.2	3	0.2	4.2	4.4
Rimon	1.2	0.9	2.1	1.6	0.9	2.5	1.3	1.2	2.5	0.5	0.9	1.4
Beleaf	1.2	2.5	3.7	1.3	2	3.3	1.3	1.9	3.2	0.4	2.5	2.9
Steward	0.5	0.9	1.4	0.8	1.5	2.3	0.7	1.5	2.2	0.3	0.9	1.2
Belay	0.7	1.2	1.9	1.3	0.9	2.2	0.5	0.9	1.4	0.1	1.2	1.3
Transform	0.5	1.6	2.1	1.2	1.7	2.9	0.7	1.2	1.9	0.2	1.6	1.8
cyclaniliprole	1.5	3.3	4.8	2.2	3.2	5.4	1.6	3.1	4.7	0.4	3.3	3.7
Anova F-statistic and p-value	F=2.40 *p*=0.039	F=4.58 *p*=0.001	F=3.50 *p*=0.006	F=1.22 *p*=0.33	F=1.15 *p*=0.40	F=1.41 *p*=0.24	F=1.69 *p*=0.14	F=1.56 *p*=0.18	F=1.65 *p*=0.15	F=1.07 *p*=0.43	F=4.58 *p*=0.001	F=3.75 *p*=0.004
LSD Value	0.59	1.58	1.83	1.27	2.13	2.74	0.86	1.45	2.00	0.42	1.58	1.66

Table 4. Average number of natural enemies per sweep following application of registered and experimental insecticides on July 22 and August 10. Pretreatment counts were 1.5 beneficials per sweep. Most beneficial insects found were minute pirate bugs (95% of natural enemies in plots).

Product	**7/24**	**7/27**	**7/30**	**8/5**	**8/13**	**8/17**	**8/24**	**8/31**	**Average**
Untreated	**2**	**0.9**	**3**	**2.3**	**5.3**	**2.6**	**0.8**	**0.6**	**2.2**
Dimethoate	2.8	1.3	2.7	3.8	6.4	1.9	0.9	0.6	2.5
Warrior II	2.3	0.4	2	2.9	5	2.3	1	0.6	2
Leverage	2.7	0.3	2.3	4	6.3	1.9	0.8	0.7	2.3
Brigadier	3	0.1	2.6	3.4	6	2.5	0.8	0.9	2.4
Rimon	3.1	1.6	3.3	2.7	6	2.8	1.6	0.8	2.7
Beleaf	2.6	0.5	1.9	3.3	5.2	2.5	1.3	0.8	2.3
Steward	3.2	0.7	2.5	3.3	5.7	1.3	0.7	0.6	2.2
Belay	2.9	0.2	0.6	2.2	2.8	1.1	0.5	0.7	1.3
Transform	3.4	0.5	1.6	2.9	4.4	1.6	0.7	0.6	1.9
cyclaniliprole	3.6	0.9	3	2.5	5.5	2.1	1.4	0.8	2.5
Anova F-statistic and p-value	F=0.13 *p*=1.00	F=0.67 *p*=0.74	F=1.53 *p*=0.19	F=0.49 *p*=0.88	F=0.52 *p*=0.86	F=0.84 *p*=0.60	F=1.41 *p*=0.24	F=0.24 *p*=0.99	F=0.67 *p*=0.75
LSD Value	2.49	1.25	1.54	2.32	3.41	1.48	0.90	0.52	1.04

Table 5. Average yield (lbs/ac), seed quality (weight per bean in gms, % lygus stings, and % off color and size determined from 200 beans) from the Lygus bug control study in bush baby limas, UC Davis, 2015.

Product	Yield (lbs/ac)	Seed weight (gm) per bean	% damaged (lygus sting)	% off color/size
Untreated	1044.1	0.42	10.1	3.0
Dimethoate	1281.1	0.40	7.6	2.0
Warrior II	1344.6	0.38	5.9	3.9
Leverage	1385.5	0.37	5.7	1.2
Brigadier	1495.3	0.38	4.3	1.6
Rimon	990.6	0.38	8.9	2.5
Beleaf	1085.2	0.40	7.1	6.1
Steward	1262.2	0.36	8.2	0.4
Belay	1304.1	0.36	4.5	1.4
Transform	1282.6	0.37	5.4	4.4
cyclaniliprole	1162.7	0.39	3.8	4.7
Anova F-statistic and p-value	F=2.20 *p*=0.058	F=1.31 *p*=0.28	F=1.78 *p*=0.12	F=2.11 *p*=0.07
LSD Value	253.20	0.031	0.036	0.041

Figure 1. Average total number of Lygus bugs per sweep (nymphs and adults), following application of registered and experimental insecticides on July 22 and August 10. Data are averages from Tables 1 and 2, for 8 sampling dates, UC Davis, 2015.

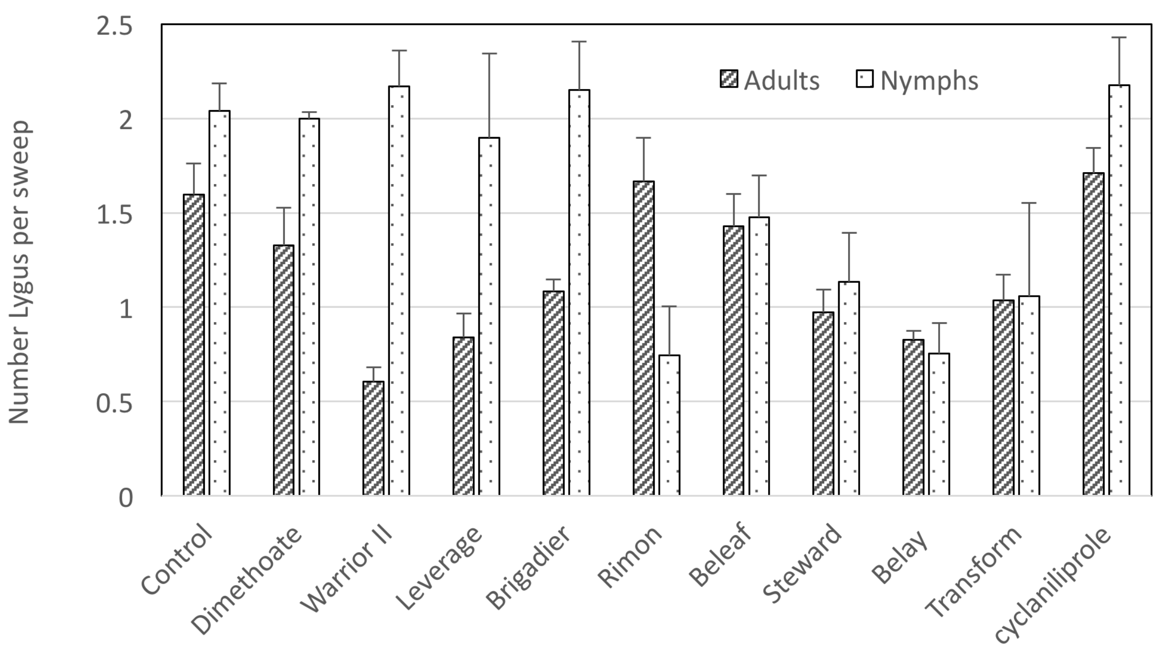

Figure 2. Average number of Lygus nymphs and adults per sweep throughout the season, UC Davis, 2015.

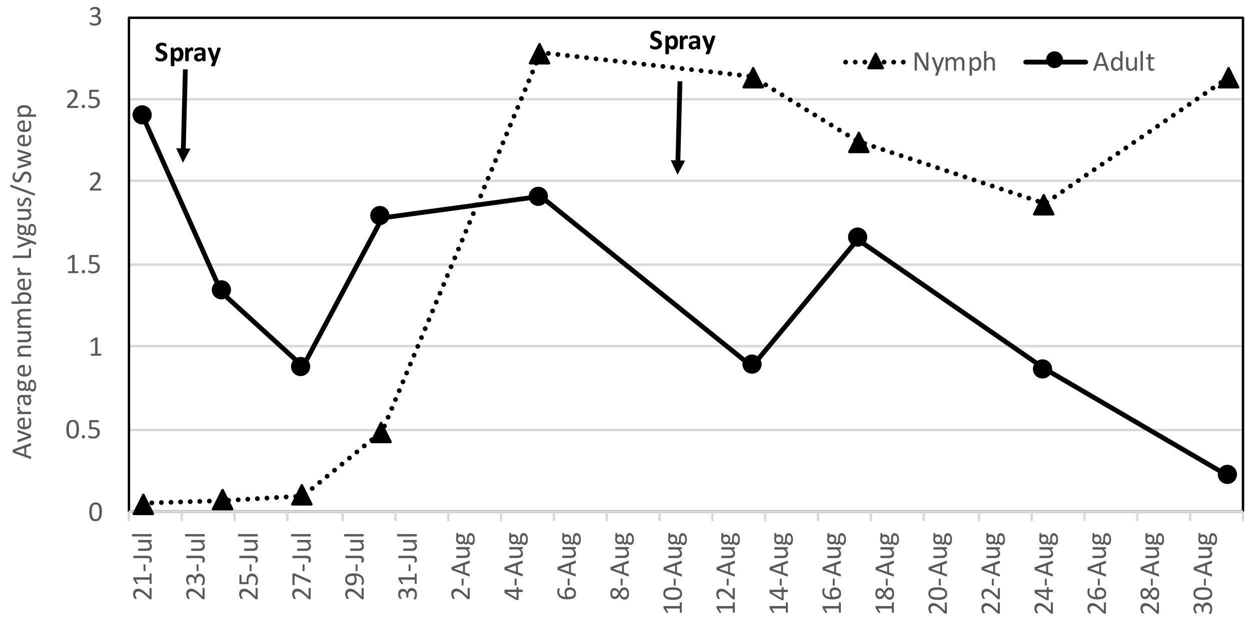

Figure 3. Yield (lbs/ac) versus insecticide treatment, 2 applications, UC Davis, 2015. Line shows yields relative to the untreated control plots.

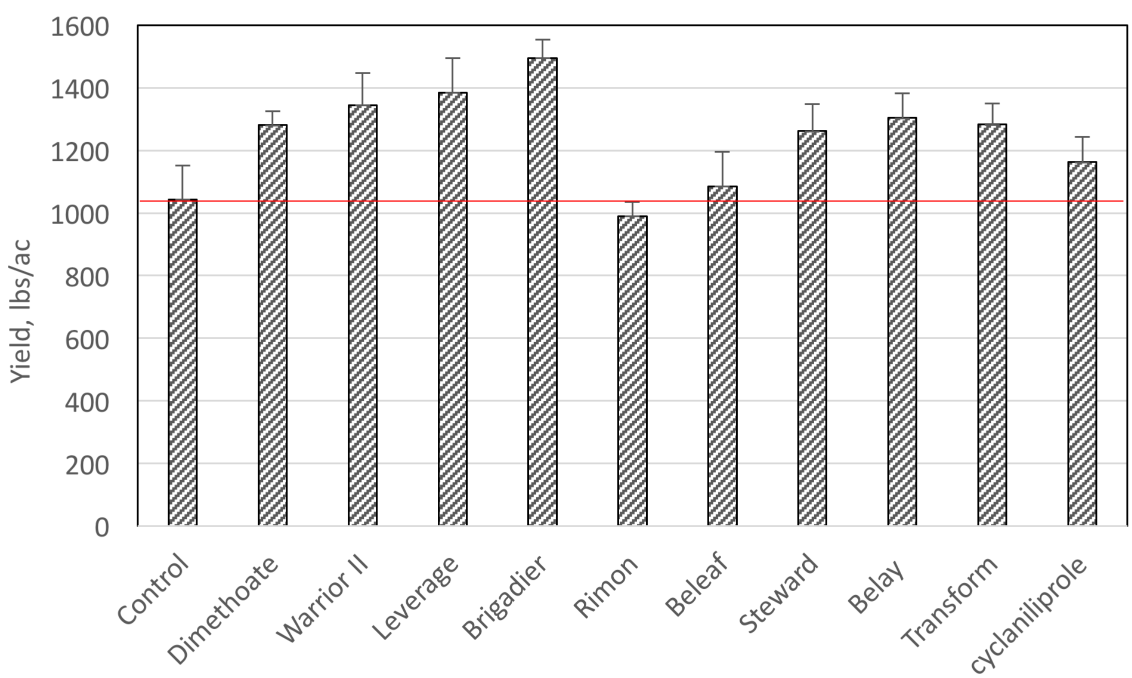

Figure 4. Long and Godfrey 2015. Average number of Lygus per sweep versus yield, bush baby limas, UC Davis, 2 applications per treatment. The asterisk (*) refers to pesticide not registered.

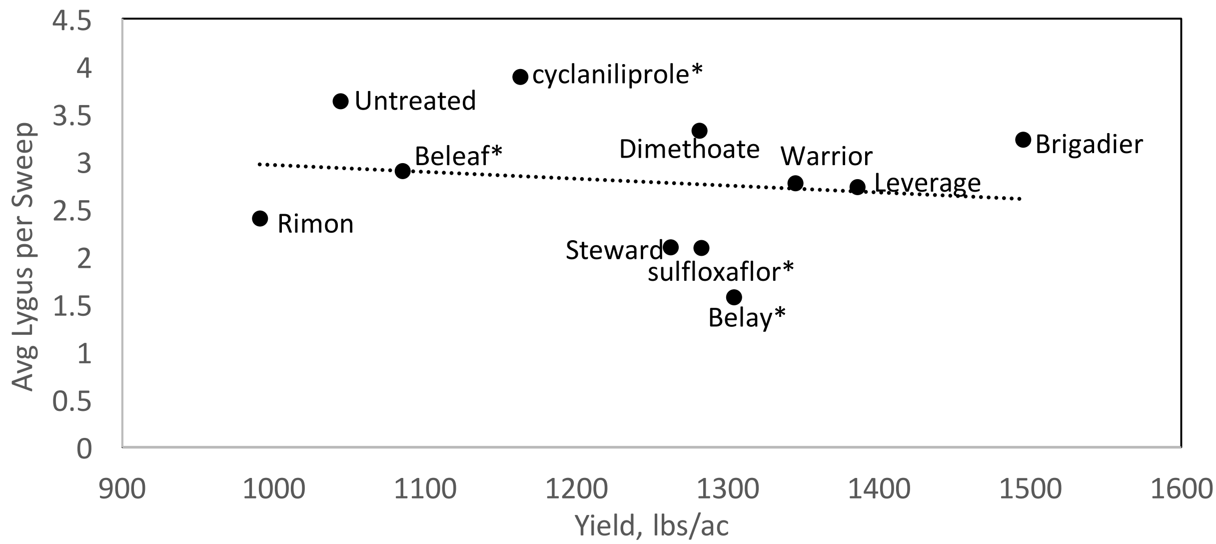

Figure 5. Godfrey et al., 2010. Average number of Lygus per sweep versus yield, bush baby lima, UC Davis, 2 applications per treatment. The asterisk (*) refers to pesticide not registered.

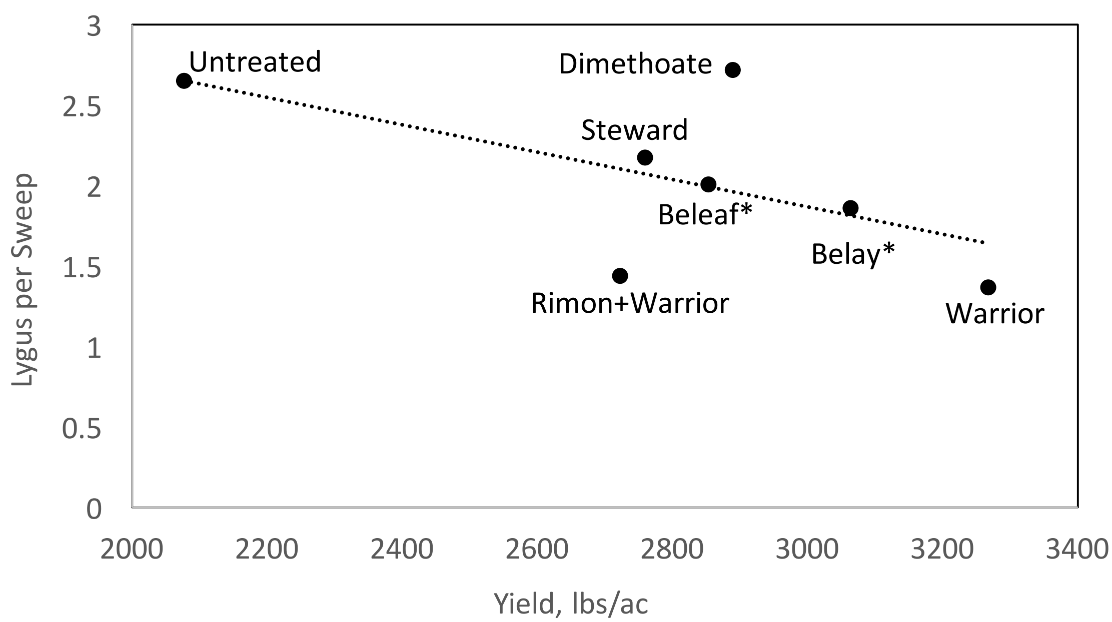

Figure 6. Godfrey et al., 2011. Average number of Lygus per sweep versus yield, bush baby lima, UC Davis, 3 applications per treatment. The asterisk (*) refers to pesticide not registered.

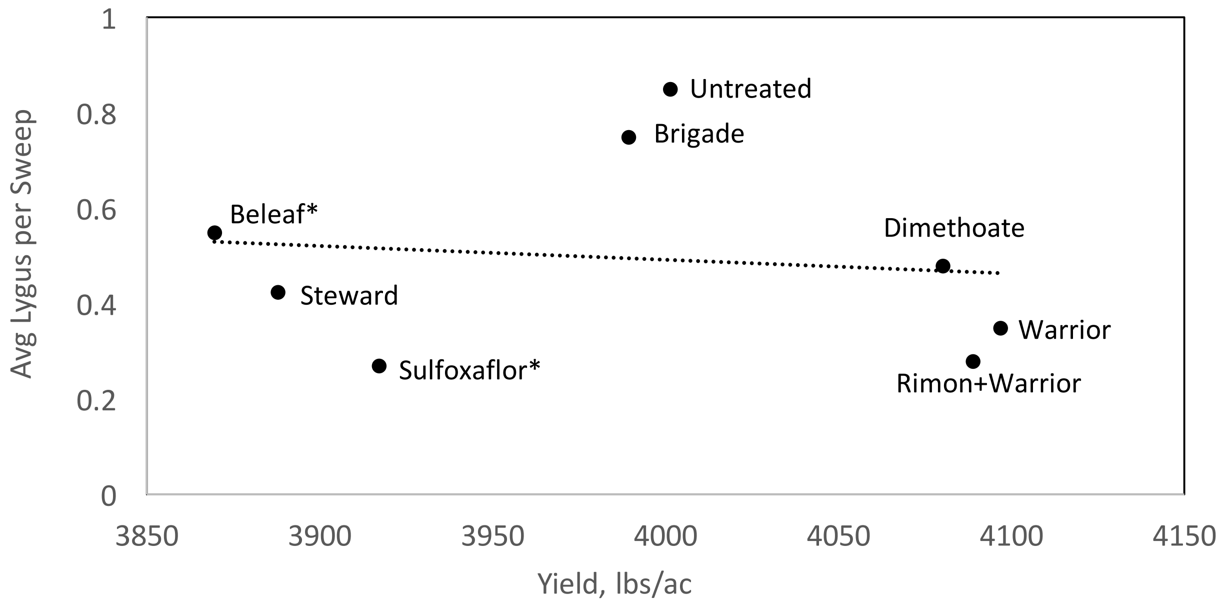

Figure 7. Frate et al., 2011. Average number of Lygus per sweep versus yield, blackeyes, UC Kearney Research and Extension Center, 2 applications per treatment. The asterisk (*) refers to pesticide not registered.

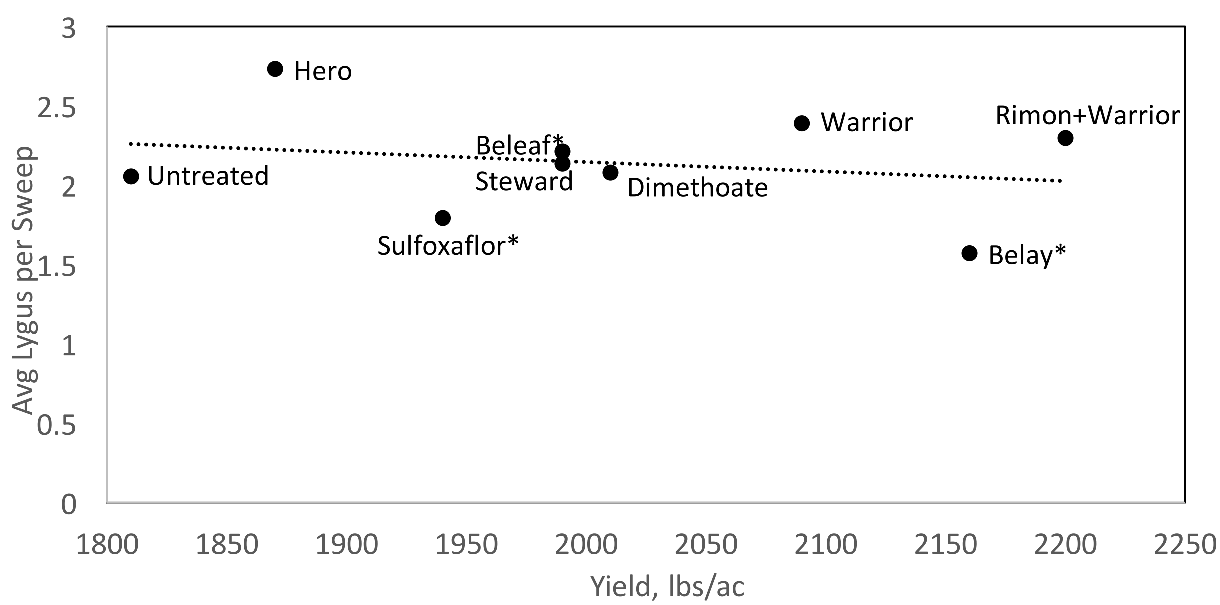

Figure 8. Frate et al., 2012. Average number of Lygus per sweep versus yield, blackeyes, UC Kearney Research and Extension Center, 2 applications per treatment. The asterisk (*) refers to pesticide not registered.

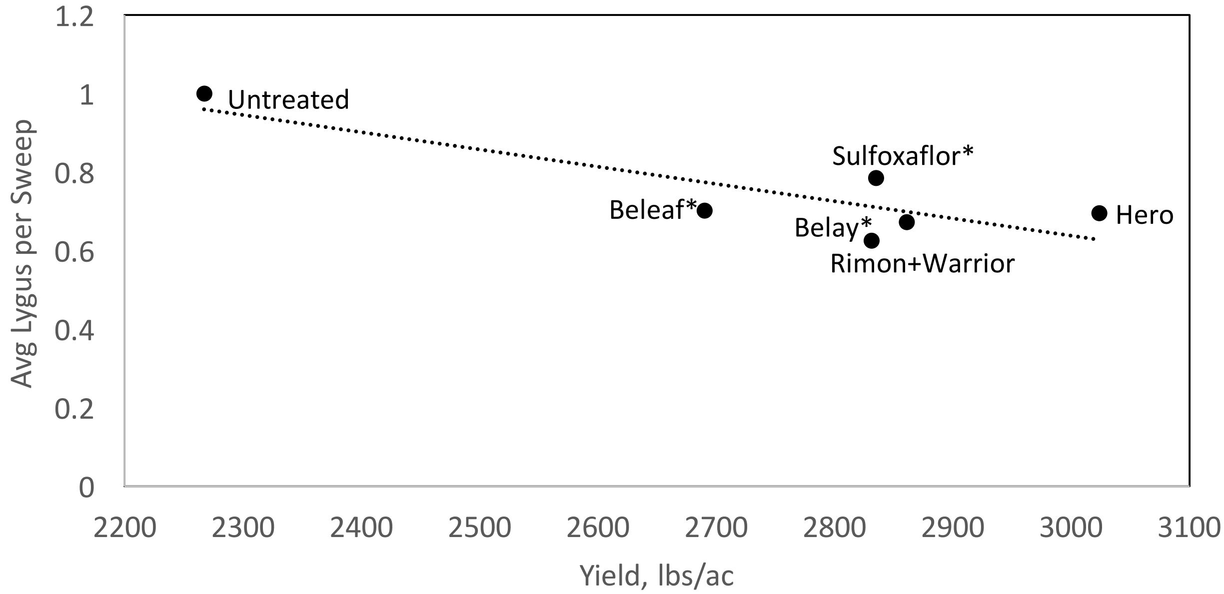

Figure 9. Frate et al., 2013. Average number of Lygus per sweep versus yield, blackeye. UC Kearney Research and Extension Center, 1 application per treatment. The asterisk (*) refers to pesticide not registered.