

Evaluation of Insecticides for Control of Lygus Bug in Seed Alfalfa

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Lygus bugs, *Lygus spp.*, are common pests of alfalfa grown for seed in California. Lygus bug control has been less than satisfactory for alfalfa seed growers in recent years using currently registered insecticides, mostly organophosphates and pyrethroids. New insecticides with different modes of action, that are safe for pollinators, are needed to combat the serious threat that lygus bugs pose to alfalfa seed production.

An insecticide efficacy trial for evaluation of lygus bug control was conducted at the UC Desert Research and Extension Center on a stand of CUF-101 alfalfa. The experimental design was Randomized Complete Block using 4 replicates with 12 treatments and plots measured 50 ft x 13.3 ft. Test materials were applied on May 31, June 7, 19 & 27, and 13 July, 2007 at the specified rate equivalencies listed in Table 1. Pretreatment evaluations of insect populations in each plot were conducted on May 25, 2007. Post treatment evaluations were conducted on June 4, 11, 18, and 25, July 2, 11, 16, and 23, and August 1, 2007. During each evaluation, ten sweeps per plot were collected with a standard 15-inch diameter sweep net. Sweep samples were bagged, labeled, and frozen for later counting of lygus bug nymphs and adults (Tables 1 - 4). On August 6, 2007, six 1 m² samples of alfalfa seed pods were harvested at random from each plot and cleaned to estimate yield. Additionally, mature seed pods were stripped from a few plants at random in each plot, hand-threshed to prevent loss of damaged seed and 100 seeds from each plot were examined under a binocular microscope for lygus damage, stink bug damage, chalcid damage, water damage, damage from other insects (such as Lepidoptera), green seed and good seed (Table 5). Raw data were analyzed using ANOVA and means separated using Least Significant Difference Test ($P=0.05$). Log ($X+1$) transformations were used, as needed, with transformed means presented in tables.

Pre-treatment numbers of lygus bug adults and nymphs were similar ($P=0.05$) among treatments (Table 1-4). All insecticide treatments had means for lygus bug nymphs that were significantly ($P=0.05$) lower than the means for the untreated control (Table 1 and 2) but there were no differences among the means for lygus bug adults and the untreated control on June 4 (Table 3) Lygus bug adults and nymphs post-treatment means for pyrethroid insecticides (Hero, Warrior and Rimon + Warrior) were often equal and occasionally significantly greater than the means for untreated control plots. Carzol 92 SP and Beleaf 50 SG provided the best lygus bug control through the study period often with means for nymphs and adults that were significantly lower than the untreated control means. Other insecticide treatments, such as Rimon 0.83 EC, Furadan 4F Lorsban 4 E, and Endosulfan followed by Monitor 4, occasionally had means for lygus bug nymphs or adults that were significantly lower than the means for the untreated control.

All insecticide treatments had significantly ($P = 0.05$) lower percentages of lygus bug damaged seed than the untreated control with the exceptions of Lorsban 4 E, Hero, and Rimon 0.83 EC @ 8 fl oz/acre + Warrior @ 3.84 fl oz/acre, (Table 8). All insecticide treatments except Hero and Warrior had significantly lower percentages of stink bug damaged seed than the untreated control. There were no differences among the means for alfalfa seed chalcid damaged seed. Only Lorsban 4 E, Warrior and BAS 320 05I had significantly lower means for seed damage from other insects (Lepidoptera) compared to the untreated control. There were no differences among

the means for water damaged seed or green seed. All of the insecticide treatments had significantly higher percentages of good seed compared to the untreated control except Hero. There were no significant differences among the insecticide treatments and the untreated control for seed yield means.

In conclusion, all insecticide treatments except those that included a pyrethroid insecticide had some efficacy for control of lygus bug in seed alfalfa and reduced damage to alfalfa seed. However, only Beleaf 50 SG and Carzol 92 SP were consistently efficacious against lygus bugs.

Table 1. Lygus Bug Nymphs (1st to 3rd instar) per Ten Sweep in Seed Alfalfa. Holtville, CA. 2007.

Treatment	oz/acre	25 May	4 Jun	11 Jun	18 Jun	25 Jun ^z	2 Jul ^z	11 Jul	16 Jul ^z	23 Jul ^z	1 Aug
Untreated	-----	2.25	7.25 a	4.75	8.50	0.51 cd	0.08 de	1.25 bc	0.68 bcd	1.10 a	4.75 b
Furadan 4F	32.0	1.00	1.25 b	2.50	4.25	0.19 ef	0.00 e	1.75 bc	0.42 def	0.74 bcd	4.00 b
Carzol 92 SP	17.4	0.00	0.50 b	2.00	3.00	0.23 ef	0.08 de	1.75 bc	0.08 f	0.25 f	2.75 b
Lorsban 4 E	32.0	0.25	2.25 b	1.00	7.25	0.40 de	0.37 cd	1.25 bc	0.51 cde	0.95 abc	3.50 b
Hero	10.0	0.00	2.00 b	2.75	14.75	0.88 ab	0.79 ab	8.00 a	1.09 a	1.10 a	6.75 ab
Beleaf 50 SG	2.8	0.00	1.50 b	2.25	3.75	0.00 f	0.08 de	0.25 c	0.27 ef	0.87 abc	3.00 b
Rimon 0.83EC	12.0	0.75	2.00 b	2.25	7.00	0.71 bc	0.00 e	0.75 c	0.19 ef	0.38 ef	3.25 b
Rimon 0.83EC + Warrior 1 CS	12.0 + 3.84	2.00	1.00 b	2.50	7.25	0.91 bc	0.50 bc	1.25 bc	0.75 abcd	1.22 a	4.00 b
Rimon 0.83EC + Warrior 1 CS	8.0 + 3.84	0.00	3.00 b	4.25	9.75	0.74 bc	0.78 ab	5.25 ab	0.88 abc	1.07 ab	11.50 a
Warrior 1 CS	3.84	0.00	1.00 b	6.75	10.75	1.03 a	0.80 a	3.00 bc	0.98 ab	1.16 a	4.25 b
BAS 320 05I	19.0	0.00	2.50 b	5.00	6.00	0.42 de	0.33 cd	0.25 c	0.40 def	0.49 def	2.25 b
Endosulfan 3EC f/b Monitor 4	42.7 32.0	0.00	0.75 b	0.50	2.50	0.08 f	0.19 de	0.75 c	0.23 ef	0.68 cde	4.25 b
		NS ^y	LSD=2.99 P=0.05	NS	NS	LSD=0.26 P=0.05	LSD=0.30 P=0.05	LSD=4.50 P=0.05	LSD=0.41 P=0.05	LSD=0.35 P=0.05	LSD=4.90 P=0.05

^y Not significant by ANOVA; $P=0.05$. ^z Log 10^x transformed data used for analysis. Mean separations within columns by LSD ($P = 0.05$).

Table 2. Lygus Bug Large Nymphs (4th and 5th instar) per Ten Sweeps in Seed Alfalfa. Holtville, CA, 2007.

Treatment	oz/acre	25 May	4 Jun	11 Jun	18 Jun	25 Jun ^z	2 Jul ^z	11 Jul	16 Jul	23 Jul	1 Aug
Untreated	-----	2.50 a	6.75 a	8.50 abc	15.00	0.69 bc	0.35 cd	6.75 bcd	0.75 b	12.25 abc	8.50
Furadan 4F	32.0	0.25 bc	1.50 b	5.50 bcd	8.25	0.43 cd	0.33 cd	6.25 bcd	3.00 b	6.75 bcd	10.75
Carzol 92 SP	17.4	0.00 c	1.25 b	2.75 cd	2.00	0.37 cd	0.08 d	2.75 d	0.75 b	7.00 bcd	3.00
Lorsban 4 E	32.0	0.00 c	3.25 b	5.00 bcd	6.25	0.58 bcd	0.62 bc	5.75 cd	3.25 b	11.00 abcd	10.25
Hero	10.0	1.00 bc	1.25 b	3.75 cd	13.75	0.92 ab	1.16 a	20.50 a	15.25 a	15.25 ab	14.25
Beleaf 50 SG	2.8	0.50 bc	0.50 b	0.75 d	3.25	0.30 d	0.08 d	2.75 cd	1.50 b	8.50 bcd	6.00
Rimon 0.83EC	12.0	0.50 bc	1.75 b	3.50 cd	6.75	0.42 cd	0.46 bcd	2.75 d	1.25 b	5.75 cd	4.00
Rimon 0.83EC + Warrior 1 CS	12.0 + 3.84	1.50 ab	1.75 b	7.50 abcd	8.50	0.96 ab	0.84 ab	5.50 cd	4.00 b	12.25 abc	9.00
Rimon 0.83EC + Warrior 1 CS	8.0 + 3.84	0.25 bc	1.75 b	3.00 cd	12.25	1.07 a	1.04 a	11.00 bc	6.50 b	8.00 bcd	11.75
Warrior 1 CS	3.84	0.50 bc	2.75 b	11.50 ab	14.50	1.11 a	1.21 a	12.25 b	3.00 b	19.00 a	13.50
BAS 320 05I	19.0	0.25 bc	1.50 b	13.50 a	9.00	0.42 cd	0.42 cd	2.50 d	0.50 b	2.25 d	4.50
Endosulfan 3EC f/b Monitor 4	42.7 32.0	0.25 bc	0.25 b	1.25 d	3.50	0.39 cd	0.47 bcd	5.50 cd	2.50 b	8.75 bcd	12.50
		LSD=1.38 P=0.05	LSD=3.24 P=0.05	LSD=7.06 P=0.05	NS ^y	LSD=0.37 P=0.05	LSD=0.40 P=0.05	LSD=6.30 P=0.05	LSD=6.53 P=0.05	LSD=9.06 P=0.05	NS

^y Not significant by ANOVA; $P=0.05$. ^z Log 10^x transformed data used for analysis. Mean separations within columns by LSD ($P = 0.05$).

Table 3. Lygus Bug Adults per Ten Sweeps in Seed Alfalfa. Holtville, CA. 2007.

Treatment	oz/acre	25 May	4 Jun	11 Jun	18 Jun	25 Jun	2 Jul ^z	11 Jul	16 Jul	23 Jul	1 Aug
Untreated	-----	7.25	8.00	10.25	23.50 a	14.50 bc	1.08 ab	8.75 b	38.50 bc	20.50	20.00
Furadan 4F	32.0	4.25	2.75	13.25	13.50 ab	6.75 de	0.66 cdef	8.75 b	33.00 bcd	13.75	6.75
Carzol 92 SP	17.4	7.00	3.00	9.50	10.00 b	5.00 e	0.44 ef	4.25 b	27.50 cd	19.00	10.50
Lorsban 4 E	32.0	6.00	3.75	6.50	9.75 b	11.25 bcde	0.54 ef	9.00 b	23.00 d	28.75	27.50
Hero	10.0	6.75	6.50	5.25	23.25 a	27.50 a	1.17 a	25.75 a	56.25 a	29.00	25.25
Beleaf 50 SG	2.8	5.00	5.75	6.00	8.25 b	4.75 e	0.54 ef	8.50 b	21.00 d	18.00	15.75
Rimon 0.83EC	12.0	4.25	3.50	5.25	9.00 b	8.50 cde	0.30 f	7.75 b	31.25 bcd	11.00	21.00
Rimon 0.83EC + Warrior 1 CS	12.0 + 3.84	7.25	4.00	5.75	14.50 ab	13.50 bcd	0.77 abcde	8.50 b	30.25 cd	17.75	12.50
Rimon 0.83EC + Warrior 1 CS	8.0 + 3.84	4.75	2.50	6.00	14.50 ab	16.00 bc	0.97 abcd	20.50 a	45.00 ab	22.75	21.00
Warrior 1 CS	3.84	4.50	2.25	10.25	21.75 a	18.00 b	1.03 abc	19.25 a	39.25 bc	18.00	20.25
BAS 320 05I	19.0	6.00	4.00	8.25	21.75 a	6.50 de	0.58 def	7.50 b	24.25 d	11.00	17.75
Endosulfan 3EC f/b Monitor 4	42.7 32.0	5.75	2.50	8.25	11.00 b	5.25 e	0.67 bcdef	10.00 b	33.25 bcd	10.50	13.00
		NS ^y	NS	NS	LSD=10.29 P=0.05	LSD=7.65 P=0.05	LSD=0.42 P=0.05	LSD=6.99 P=0.05	LSD=13.79 P=0.05	NS	NS

^y Not significant by ANOVA; $P=0.05$. ^z Log 10^x transformed data used for analysis. Mean separations within columns by LSD ($P = 0.05$).

Table 4. Lygus Bug All Stages per Ten Sweeps in Seed Alfalfa, Holtville, CA. 2007.

Treatment	oz/acre	25 May	4 Jun	11 Jun	18 Jun	25 Jun	2 Jul ^z	11 Jul	16 Jul ^z	23 Jul	1 Aug
Untreated	-----	12.00	22.00 a	23.50	47.00 ab	22.25 bc	1.14 ab	16.75 c	1.65 bcd	44.50 abcd	33.25
Furadan 4F	32.0	5.50	5.50 b	21.25	26.00 cd	9.25 cd	0.79 bc	16.75 c	1.58 bcde	25.25 de	21.50
Carzol 92 SP	17.4	7.00	4.75 b	14.25	15.00 d	7.50 d	0.51 c	8.75 c	1.43 ef	28.25 cde	16.25
Lorsban 4 E	32.0	6.25	9.25 b	12.50	23.25 cd	16.00 cd	0.89 bc	16.00 c	1.48 def	48.50 abc	41.25
Hero	10.0	7.75	9.75 b	11.75	51.75 a	42.75 a	1.54 a	54.25 a	1.92 a	56.50 a	46.25
Beleaf 50 SG	2.8	5.50	7.75 b	9.00	15.25 d	5.75 d	0.61 c	14.50 c	1.3648 f	33.50 bcde	24.75
Rimon 0.83EC	12.0	5.50	7.25 b	11.00	22.75 cd	14.75 cd	0.60 c	11.25 c	1.53 cdef	18.50 e	28.25
Rimon 0.83EC + Warrior 1 CS	12.0 + 3.84	10.75	6.75 b	15.75	30.25 bcd	33.00 ab	1.15 ab	15.25 c	1.58 bcde	46.75 abc	25.50
Rimon 0.83EC + Warrior 1 CS	8.0 + 3.84	5.00	7.25 b	13.25	36.50 abc	32.00 ab	1.40 a	36.75 b	1.76 ab	42.50 abcd	44.25
Warrior 1 CS	3.84	5.00	6.00 b	28.50	47.00 ab	41.00 a	1.52 a	34.50 b	1.71 bc	53.25 ab	38.00
BAS 320 05I	19.0	6.25	8.00 b	26.75	36.75 abc	11.00 cd	0.81 bc	10.25 c	1.42 ef	15.50 e	24.50
Endosulfan 3EC f/b Monitor 4	42.7 32.0	6.00	3.50 b	10.00	17.00 cd	7.50 d	0.86 bc	16.25 c	1.57 bcdef	24.25 de	29.75
		NS ^y	LSD=8.21 P=0.05	NS	LSD=20.96 P=0.05	LSD=13.07 P=0.05	LSD=0.42 P=0.05	LSD=15.10 P=0.05	LSD=0.20 P=0.05	LSD=20.57 P=0.05	NS

^y Not significant by ANOVA; $P=0.05$. ^z Log 10^x transformed data used for analysis. Mean separations within columns by LSD ($P = 0.05$).

Table 5. Percentages of Damaged Seed from Lygus Bug, Stink Bug, and Alfalfa Seed Chalcid, Percentages of Green Seed and Healthy Seed, and Pounds of Cleaned Seed per Acre. Holtville, CA, 2007.

Treatment	oz/acre	Lygus Bug	Stink Bug	Seed Chalcid	Other Insect Damage	Water Damage	Green Seed	Good Seed	Pounds Seed/Acre
Untreated	-----	17.50 a	11.50 a	1.00	1.50 a	0.50	3.25	64.75 c	365.04
Furadan 4F	32.0	4.75 c	6.75 bcd	1.25	0.75 ab	0.25	0.50	85.75 a	450.17
Carzol 92 SP	17.4	3.50 c	5.00 cd	0.25	1.50 a	0.50	1.75	87.50 a	304.08
Lorsban 4 E	32.0	9.50 abc	6.50 bcd	0.50	0.00 b	0.00	1.75	82.00 ab	313.00
Hero	10.0	15.50 ab	9.75 ab	0.50	0.75 ab	0.25	1.25	72.00 bc	283.26
Beleaf 50 SG	2.8	6.00 c	5.25 cd	1.75	1.50 a	0.00	2.00	83.50 ab	384.37
Rimon 0.83EC	12.0	4.50 c	7.50 bc	2.50	0.50 ab	0.00	1.00	84.00 ab	346.83
Rimon 0.83EC + Warrior 1 CS	12.0 + 3.84	8.00 bc	5.00 cd	1.75	1.00 ab	0.50	1.50	82.25 ab	326.01
Rimon 0.83EC + Warrior 1 CS	8.0 + 3.84	9.50 abc	6.75 bcd	2.75	0.75 ab	0.00	1.75	78.50 ab	295.90
Warrior 1 CS	3.84	7.00 c	8.25 abc	1.25	0.00 b	0.00	2.00	81.50 ab	253.15
BAS 320 05I	19.0	5.00 c	6.00 bcd	1.25	0.00 b	0.25	1.50	86.00 a	386.98
Endosulfan 3EC f/b Monitor 4	42.7 32.0	3.25 c	3.25 d	0.75	0.50 ab	0.50	1.00	90.75 a	355.75
		LSD=8.20 P=0.05	LSD=3.81 P=0.05	NS ^y	LSD=1.14 P=0.05	NS	NS	LSD=12.46 P=0.05	NS

Mean separations within columns by LSD ($P < 0.05$). ^y Not significant by ANOVA.