LYGUS BUG MANAGEMENT IN SEED ALFALFA

Eric T. Natwick and M. Lopez[1]

ABSTRACT

Lygus bugs, *Lygus spp.*, are a common pest of alfalfa grown for seed in California. Alfalfa seed producers and their pest control advisors have stated that lygus bug control has been less than satisfactory on alfalfa grown for seed in recent years. Many older products are currently registered for lygus bug control on alfalfa grown for seed, mostly organophosphate insecticides and pyrethroid insecticides. New insecticides with different modes of action are needed to combat the serious threat that lygus bugs pose to alfalfa seed production and to reduce the risk of insecticide resistance development. Field data for new insecticides that have reduced risk to leafcutter bees and honey bees were evaluated and compared to older registered insecticides for lygus bug control at the University of California Desert Research and Extension Center during the summer of 2008. All insecticide treatments evaluated except the experimental compound NNI-0101 and treatments that included a pyrethroid insecticide had good efficacy for control of lygus bug. Treatments that include a pyrethroid have consistently shown poor efficacy against lygus bug over the past three years in studies conducted in the Imperial Valley.

INTRODUCTION

Lygus bugs are the most important insect pests affecting production of alfalfa seed. It is vitally important to properly time insecticide treatment applications. Timing of insecticides applications should base on realistic treatment levels. Proper timing of insecticide applications helps to minimizes pest control costs while successfully controlling lygus bugs. To control lygus bug we must understand the biology of this pest.

During the summer, it takes about 28 days for lygus bugs to complete their lifecycle. Insecticides applications must be timed to coincide with egg hatch and stage of development to achieve maximum lygus bug control. Lygus bugs are most easily controlled as nymphs up to the third instar. Older nymphs are more difficult to control, especially fifth instar nymphs. It is not uncommon to find fourth and fifth instar nymphs and adults in alfalfa seed production fields after an insecticide treatment. Adults are strong fliers and will often be repelled from seed production fields following an insecticide application, but adult can quickly return when the repellency has subsided.

Withhold insecticide application when newly hatched first instar nymphs are observed in the field to allow all eggs to hatch unless an insect growth regulator such as Novaluron (Rimon®) is to be applied. Percentages of control are improved when all lygus bug eggs have hatched and some nymphs have developed to the third instar. Lygus bug nymphs hatching a few days after an

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[1] E. Natwick and M. Lopez, UCCE, Imperial County, 1050 E. Holton Rd., Holtville, CA 92250; Email: etnatwick@ucdavis.edu.
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insecticide application often survive and an additional insecticide treatment may be necessary.

The first lygus bug insecticide treatment should be applied when a population of 4 to 6 bugs per sweep is reached during the period of early bloom when many buds are vulnerable to attack. During full bloom and seed set, treatment is suggested at 8 to 10 bugs per sweep. Later in the season, when the crop begins to mature, the suggested treatment level is 10 to 12 bugs per sweep. These guidelines are suggested action levels and are not necessarily fixed, but can vary with field condition.

Lygus bugs levels of 8 to 10 bugs per sweep during bloom and seed set usually do not adversely affect seed yield or quality and can be tolerated without economic loss. Fewer insecticide applications and less frequent disturbance to pollinator activity can be achieved by extending treatment intervals following the suggested action thresholds.

Several insecticides were evaluated for lygus bug control in alfalfa grown for seed at conducted at the University of California Desert Research and Extension Center in Imperial Valley, CA over the past three seasons and some of these new materials show promise for lygus bug control. Results from the 2006 research helped California alfalfa seed growers obtain a Section 24c for Novaluron (Rimon) and the 2007 results were used to support a Section 24c for flonicamid (Beleaf). The results of the 2008 alfalfa seed production season research in the Imperial Valley are summarized in this report.

The objectives for this study were to: 1) Evaluate the efficacy of new insecticides for lygus bug control in order to develop a data base for industry to seek label registrations for new chemistries for seed alfalfa and 2) Evaluate the efficacy and document the reduced efficacy of insecticides that are currently registered for control of lygus bug in seed alfalfa.

MATERIALS AND METHODS

The study was conducted at the UC Desert Research and Extansion center in Imperial Valley, CA on a three year old stand of Alfalfa, var. CUF-101. The alfalfa was on beds of 40 inch centers, furrow irrigated, normal commercial cultural practices were used on the seed production. The experimental design was Randomized Complete Block with 4 replicates and plots measured 50 feet by 13.3 feet or 4 beds per plot. The insecticide application equipment was a Lee Spider Spray Trac tractor with a rear mounted spray boom that had 3 nozzles (TJ-60 1103VS) per bed delivering 53.4 gallons per acre at 40 psi.

Prior to trial initiation, the alfalfa was cut and irrigated for seed production. Test materials were applied as needed at the specified rate equivalencies (Table 1). Pretreatment (PT) evaluations of insect populations in each plot were conducted on 19 May 2008. Post treatment evaluations were conducted on 29 May, 2, 9, 13, 16, 24, 30 June, 7 and 14 July 2008. 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 (LB) nymphs and adults (Tables 2 - 5). On 14 July 2008, mature seed pods were stripped from a few plants at random in each plot, hand-threshed and 100 seeds from each plot were examined under a binocular microscope for damage from lygus bug, stink bug, alfalfa seed chalcid, water damage, green seed and good seed (Table 6). Raw data were analyzed using ANOVA and means separated using Least Significant Difference Test (LSD; P=0.05) using MSTAT-C. Log (X+1) transformations were used, as needed, with transformed means presented in tables. NAI-2302 is Tolfenpyrad and NNI-0101 is Pyrifluqinazon both are products under development by Nichino America Inc.

Table 1. Seed Alfalfa Insecticide Treatment Rates and Dates, Holtville, California, 2008.

Treatment	oz/acre	Application Dates
1. Untreated	--------	-----------
2. Carzol 92 SP*	17.4	26 May, 10 June
3. Rimon	12.0	26 May, 10 June, 1 July
4. Rimon 0.83EC f/b Lorsban 4E	12.0 f/b 32.0	26 May & 10 June
5. NAI-2302 15EC	27.0	26 May, 10 June
6. NNI-0101 20SC	6.37	26 May, 10, 20 June
7. Beleaf 50 SG	2.8	26 May, 10 June
8. Beleaf 50 SG	5.6	26 May, 10 June
9. Beleaf 50 SG + Hero 1.25 EC	2.8 + 10.3	26 May, 10, 20 June, 1 July
10. Cobalt	32.0	26 May, 10, 20 June, 1 July
11. Lorsban 4E	32.0	26 May, 10 June, 1 July
12. Warrior 1 CS	3.84	26 May, 10, 20 June, 1 July

NIS @ 37.9 ml/4 gal added to foliar spray mixtures. *Buffered to pH 5.0.

RESULTS AND DISCUSSION

Pre-treatment numbers of lygus bug adults, small nymphs and all lygus bug stages were similar (*P*=0.05) among treatments and the untreated control (UTC) (Table 1-4). All insecticide plots received treatments on 26 May and 10 June; thereafter, treatments were applied when the means for all lygus bug stages was near or over a treatment threshold of six lygus bugs per sweep. All insecticide treatments had means for small and large lygus bug nymphs and for all stages of lygus bug that were significantly lower than the means for the UTC on 29 May and 2 June 3- and 7- days after treatment one (DAT1), but for lygus adults, Beleaf at 2.8 oz/acre and the mean for Lorsban 4E were not different from the UTC on 29 May and the mean for Warrior was not different from the UTC on 2 June. All insecticide treatments except NAI-2302 15EC, Beleaf at 2.8 oz/acre, and Cobalt had significantly fewer small lygus bug nymphs, all but Beleaf 50 SG + Hero 1.25 EC significantly fewer large nymphs, and all but Warrior had significantly fewer adults compared to the means for the UTC on 9 June, 14-DAT1. Small lygus bug nymph means for NNI-0101, Beleaf at 5.6 oz/acre, Cobalt and Warrior were not different from the UTC on 13 June (3-DAT2), but all other insecticide treatments had means that were significantly lower. All insecticide treatments except Cobalt and Warrior had means for large nymphs and all treatments except Warrior had adult means that were lower than the means for the UTC on June 13. Small and large lygus bug nymph means for all but NNI-0101, Cobalt and Warrior were significantly lower than the means for the UTC on 16 June (6-DAT2), but only Warrior for adults and Cobalt and Warrior for all nymphs did not have a means significantly lower than the UTC means.

Insecticide treatments NNI-0101, Cobalt, and Warrior were applied on 20 June because the lygus bug threshold was exceeded on 16 June. All insecticide treatment except NNI-1010, Lorsban 4E and Warrior had small nymph means that were lower (P=0.05) than the UTC on 24 June, and only Lorsban 4E and Warrior, Rimon at 12 oz/acre and Rimon followed by Lorsban 4E did not have large nymph means different from the mean for the UTC (Tables 2 and 3). All insecticide treatment except Lorsban 4E and Warrior had adult and all lygus bug means that were lower than the UTC means on 24 June (Tables 4 and 5). On 30 June, all insecticide treatments had small nymph means that were significantly lower than the UTC, but Rinom at 12 oz/acre, Cobalt, Lorsban, and Warrior did not have means for large nymphs that were different from the mean for the UTC. Only Carzol, Rimon followed by Lorsban, NAI-2302, NNI-0101, and both rates of Beleaf had adult lygus bug means that were lower than the mean for the UTC on 30 June. All insecticide treatment except Beleaf 50 SG + Hero 1.25 EC, Cobalt, Lorsban 4E, and Warrior had means for all lygus bugs that were significantly lower than the UTN on 30 June.

Insecticide treatments Rimon at 12 oz/acre (6.00), Beleaf 50 SG + Hero 1.25 EC (7.55), Cobalt (9.75), Lorsban 4E (8.38), and Warrior (9.13) were applied on 1 July because they had “all lygus bug” means that exceeded the treatment threshold of six per sweep. All insecticide treatment except Cobalt and Warrior for small lygus bug nymphs had means that were lower (P=0.05) than the UTC on 7 July; there were no differences among the treatment means for large nymphs and adult lygus bugs (Table 2-5). Only Rimon followed by Lorsban, Cobalt and Warrior did not have means for all lygus bugs compared to the UTC on 7 July. All insecticide treatment except Beleaf + Hero, Cobalt and Warrior for small lygus bug nymphs and all but Cobalt and Warrior for large nymphs had means that were lower than the UTC means on 14 July. All insecticide treatment except Warrior for adults and all but Cobalt and Warrior for all lygus bugs had means that were lower than the UTC means on 14 July.

All insecticide treatments had significantly (P = 0.05) lower percentages of lygus bug damaged seed than the UTC with the exception of NNI-0101 (Table 6). All insecticide treatments except Carzol, Rimon, Rimon followed by Lorsban, and NNI-0101 had significantly lower percentages of stink bug damaged seed than the UTC. There were no differences among the means for alfalfa seed chalcid damaged seed, water damage and green seed. Data were not shown for chewing damage to seed other insects, such as worm pests, because none was detected. All of the insecticide treatments had significantly higher percentages of good seed compared to the untreated control except NNI-0101.

In conclusion, all insecticide treatments except NNI-0101 and those treatments that included a pyrethroid insecticide had good efficacy for control of lygus bug. Treatments that include a pyrethroid have consistently shown poor efficacy against lygus bug over the past three years in studies conducted in the Imperial Valley. None of the insecticide treatments had exceptional efficacy against stink bugs. Carzol 92 SP, Rimon 0.83 EC followed by Lorsban 4E, NAI-2302 15 EC, and Beleaf 50 SG all had exceptional residual activity against lygus bug in this study.

Table 2. Lygus Bug Small Nymphs per Sweeps in Seed Alfalfa. Holtville, CA. 2008.

Treatment	oz/acre	19 May	29 May	2 Jun	9 Jun	13 Jun	16 Jun	24 Jun[z]	30 Jun	7 Jul[z]	14 Jul[z]
Untreated	--------	5.48	2.83 a	3.73 a	3.65 a	3.05 a	5.15 a	0.45 a	0.93 a	0.35 bc	0.52 b
Carzol 92 SP	17.4	4.60	0.95 b	0.65 b	0.98 de	1.15 bcd	0.75 d	0.07 c	0.08 bc	0.20 bcd	0.45 b
Rimon	12.0	3.20	1.10 b	0.63 b	0.80 e	1.2 bcd	1.50 cd	0.20 bc	0.45 b	0.26 bcd	0.48 b
Rimon 0.83EC f/b Lorsban 4E	12.0 f/b 32.0	4.10	1.40 b	0.85 b	0.88 e	0.43 d	0.78 d	0.13 bc	0.05 bc	0.32 bcd	0.44 b
NAI-2302 15EC	27.0	3.58	0.63 b	0.73 b	3.23 ab	0.70 cd	2.03 bcd	0.08 c	0.23 bc	0.09 d	0.44 b
NNI-0101 20SC	6.37	3.55	1.05 b	1.48 b	1.75 cde	2.10 abc	3.28 abc	0.22 abc	0.15 bc	0.10 d	0.44 b
Beleaf 50 SG	2.8	5.13	1.30 b	1.30 b	2.30 abcd	0.78 cd	0.73 d	0.18 bc	0.00 c	0.19 bcd	0.42 b
Beleaf 50 SG	5.6	3.45	0.55 b	1.10 b	1.48 cde	1.98 abc	1.38 cd	0.74 c	0.28 bc	0.15 cd	0.33 b
Beleaf 50 SG + Hero 1.25 EC	2.8 + 10.3	5.53	0.75 b	1.18 b	2.03 bcde	1.30 bcd	2.53 bcd	0.12 c	0.13 bc	0.40 b	1.03 a
Cobalt	32.0	3.60	1.05 b	0.78 b	2.38 abc	1.75 abcd	4.85 a	0.18 bc	0.23 bc	0.72 a	1.05 a
Lorsban 4E	32.0	5.00	1.23 b	1.58 b	1.93 bcde	1.48 bcd	1.58 cd	0.36 ab	0.28 bc	0.34 bc	0.56 b
Warrior 1 CS	3.84	6.00	1.25 b	3.43 a	1.78 cde	2.43 ab	4.00 ab	0.36 ab	0.18 bc	0.68 a	1.15 a
LSD; *P*=0.05		NS[y]	0.85	0.98	1.39	1.50	2.30	0.24	0.43	0.24	0.33

Means within columns followed by the same letter are not significantly different; $LSD_{0.05}$.
[y] Not significant by ANOVA; *P*=0.05.
[z] Log 10^x transformed data used for analysis.

Table 3. Lygus Bug Large Nymphs per Sweeps in Seed Alfalfa. Holtville, CA. 2008.

Treatment	oz/acre	19 May	29 May	2 Jun	9 Jun [z]	13 Jun [z]	16 Jun [z]	24 Jun [z]	30 Jun [z]	7 Jul	14 Jul
Untreated	--------	10.33	6.50 a	7.53 a	0.76 a	0.72 a	0.76 a	0.66 a	0.24 a	0.88	1.88 cd
Carzol 92 SP	17.4	9.85	1.63 de	1.13 def	0.24 d	0.50 bcd	0.17 cd	0.21 cd	0.00 c	0.25	1.83 d
Rimon	12.0	12.05	2.40 bcde	1.08 ef	0.35 cd	0.33 def	0.19 cd	0.38 abc	0.12 abc	0.28	2.83 cd
Rimon 0.83EC f/b Lorsban 4E	12.0 f/b 32.0	4.93	3.68 bc	1.48 cdef	0.27 d	0.23 f	0.14 d	0.41 abc	0.08 bc	0.60	2.20 cd
NAI-2302 15EC	27.0	12.93	1.58 de	0.53 f	0.41 bcd	0.25 f	0.20 cd	0.21 cd	0.04 bc	0.10	1.23 d
NNI-0101 20SC	6.37	12.60	3.33 bcd	2.85 c	0.54 bc	0.46 bcd	0.56 ab	0.33 bcd	0.07 bc	0.55	1.58 d
Beleaf 50 SG	2.8	7.33	4.18 b	2.70 cd	0.53 bc	0.24 f	0.19 cd	0.26 cd	0.00 c	0.13	1.30 d
Beleaf 50 SG	5.6	10.65	2.18 cde	1.33 cdef	0.41 bcd	0.26 ef	0.17 cd	0.07 d	0.06 bc	0.10	1.25 d
Beleaf 50 SG + Hero 1.25 EC	2.8 + 10.3	8.65	1.45 e	2.35 cde	0.57 ab	0.44 bcde	0.38 bc	0.34 bcd	0.05 bc	0.50	9.30 b
Cobalt	32.0	15.48	2.73 bcde	1.88 cdef	0.50 bc	0.55 abc	0.73 a	0.24 cd	0.14 ab	0.83	11.18 ab
Lorsban 4E	32.0	10.13	3.88 bc	2.23 cde	0.37 bcd	0.40 cdef	0.29 cd	0.46 abc	0.16 ab	0.43	4.08 c
Warrior 1 CS	3.84	9.23	4.05 b	4.98 b	0.52 bc	0.60 ab	0.71 a	0.57 ab	0.13 abc	1.35	11.73 a
	LSD; *P*=0.05	NS [y]	1.86	1.59	0.21	0.19	0.22	0.28	0.13	NS [y]	2.23

Means within columns followed by the same letter are not significantly different; $LSD_{0.05}$.
[y] Not significant by ANOVA; *P*=0.05.
[z] Log 10^x transformed data used for analysis.

Table 4. Lygus Bug Adults per Sweeps in Seed Alfalfa. Holtville, CA. 2008.

Treatment	oz/acre	19 May	29 May	2 Jun	9 Jun	13 Jun [z]	16 Jun	24 Jun [z]	30 Jun [z]	7 Jul	14 Jul
Untreated	--------	3.70	5.63 a	9.13 a	7.38 a	0.82 a	5.40 a	0.52 a	0.94 ab	4.15	2.28 bcd
Carzol 92 SP	17.4	3.73	1.78 d	2.75 de	1.98 d	0.52 bcd	0.93 cd	0.15 cde	0.59 d	1.95	1.75 cd
Rimon	12.0	2.70	2.35 d	3.40 cde	3.35 cd	0.34 de	0.80 cd	0.18 cde	0.70 abcd	1.95	2.00 bcd
Rimon 0.83EC f/b Lorsban 4E	12.0 f/b 32.0	2.15	2.88 cd	5.10 bcd	1.55 d	0.36 cde	1.13 cd	0.21 cde	0.69 bcd	3.88	2.05 bcd
NAI-2302 15EC	27.0	2.45	2.40 d	2.35 e	1.48 d	0.30 e	0.93 cd	0.10 de	0.56 d	1.50	1.53 bcd
NNI-0101 20SC	6.37	3.68	2.83 cd	5.68 bc	3.58 cd	0.48 bcde	2.75 bc	0.28 bcd	0.69 bcd	1.35	1.63 cd
Beleaf 50 SG	2.8	2.60	4.70 ab	3.88 cde	3.73 bcd	0.42 cde	1.98 bcd	0.18 cde	0.62 cd	2.05	3.15 ab
Beleaf 50 SG	5.6	5.85	2.98 bcd	3.40 cde	2.23 cd	0.35 de	0.63 d	0.01 e	0.57 d	1.08	2.53 bcd
Beleaf 50 SG + Hero 1.25 EC	2.8 + 10.3	2.35	1.33 d	4.50 cde	4.40 bc	0.56 bc	1.58 bcd	0.20 cde	0.85 abc	3.90	2.25 bcd
Cobalt	32.0	6.00	3.03 bcd	3.43 cde	3.00 cd	0.41 cde	2.68 bcd	0.19 cde	0.95 a	3.30	2.73 bcd
Lorsban 4E	32.0	2.95	4.65 ab	4.63 bcde	1.83 d	0.44 cde	1.60 bcd	0.35 abc	0.80 abcd	2.03	2.93 bc
Warrior 1 CS	3.84	3.28	4.28	6.98 ab	6.00 ab	0.66 ab	3.30 ab	0.46 ab	0.90 ab	2.70	4.53 a
LSD; *P*=0.05		NS [y]	1.74	2.40	2.35	0.21	2.11	0.24	0.25	NS [y]	1.38

Means within columns followed by the same letter are not significantly different; $LSD_{0.05}$.
[y] Not significant by ANOVA; *P*=0.05.
[z] Log 10^x transformed data used for analysis.

Table 5. Lygus Bug All Stages per Sweeps in Seed Alfalfa. Holtville, CA. 2008.

Treatment	oz/acre	19 May	29 May	2 Jun	9 Jun	13 Jun [z]	16 Jun	24 Jun [z]	30 Jun [z]	7 Jul [z]	14 Jul
Untreated	--------	19.50	14.95 a	20.38 a	16.28 a	1.13 a	15.70 a	0.93 a	1.01 a	0.84 abc	7.15 c
Carzol 92 SP*	17.4	18.18	4.35 de	4.53 de	3.83 de	0.83 bc	2.20 d	0.33 de	0.60 e	0.54 de	6.70 c
Rimon	12.0	17.95	5.85 cde	5.10 de	5.40 cde	0.63 cde	2.88 d	0.52 bcd	0.74 bcde	0.60 cde	7.33 c
Rimon 0.83EC f/b Lorsban 4E	12.0 f/b 32.0	11.18	7.95 bc	7.43 cde	3.28 e	0.52 e	2.33 d	0.55 bcd	0.71 cde	0.77 abcd	6.50 c
NAI-2302 15EC	27.0	18.95	4.60 cde	3.60 e	6.38 bcde	0.53 e	3.65 d	0.32 de	0.60 e	0.45 e	4.93 c
NNI-0101 20SC	6.37	19.83	7.20 bcd	10.00 c	8.20 bcd	0.81 bcd	9.13 bc	0.55 bcd	0.72 cde	0.45 e	4.95 c
Beleaf 50 SG	2.8	15.05	10.18 b	7.88 cde	8.48 bc	0.60 de	3.28 d	0.48 cd	0.62 de	0.51 de	6.13 c
Beleaf 50 SG	5.6	19.95	5.70 cde	5.83 cde	5.33 cde	0.67 cde	2.55 d	0.14 e	0.60 e	0.41 e	5.10 c
Beleaf 50 SG + Hero 1.25 EC	2.8 + 10.3	16.53	3.53 e	8.03 cd	9.43 bc	0.82 bc	5.98 cd	0.45 cde	0.87 abcd	0.85 abc	21.95 b
Cobalt	32.0	25.08	6.80 bcde	5.98 cde	7.63 bcde	0.84 bc	12.53 ab	0.38 de	0.98 ab	0.99 a	24.50 ab
Lorsban 4E	32.0	18.08	9.75 b	8.43 cd	5.13 cde	0.76 cd	4.35 cd	0.71 abc	0.82 abcde	0.69 bcde	9.80 c
Warrior 1 CS	3.84	18.50	9.58 b	15.38 b	10.18 b	0.99 ab	11.83 ab	0.82 ab	0.93 abc	0.94 ab	30.73 a
LSD; *P*=0.05		NS [y]	3.46	4.31	4.63	0.22	5.28	0.32	0.25	0.29	6.51

Means within columns followed by the same letter are not significantly different; $LSD_{0.05}$.
[y] Not significant by ANOVA; *P*=0.05.
[z] Log 10^x transformed data used for analysis.

Table 6. Percentage Seed Damage from Lygus Bug, Stink Bug, Alfalfa Seed Chalcid and Water and Percentage of Green Seed and Good Seed. Holtville, CA 2008.

Treatment	oz/acre	Lygus	Stink Bug	Seed Chalcid	Water	Green Seed	Good Seed
Untreated	--------	19.75 a	5.25 a	3.00	0.00	8.50	63.50 c
Carzol 92 SP	17.4	7.75 c	4.25 abc	0.75	0.00	3.00	84.25 a
Rimon	12.0	8.25 c	3.75 abcd	0.75	0.00	6.75	80.50 ab
Rimon 0.83EC f/b Lorsban 4E	12.0 f/b 32.0	9.25 c	3.25 abcde	1.00	1.00	6.50	79.00 ab
NAI-2302 15EC	27.0	12.00 bc	1.50 e	1.25	0.00	4.25	80.75 ab
NNI-0101 20SC	6.37	16.50 ab	4.50 ab	2.00	0.00	7.00	70.00 bc
Beleaf 50 SG	2.8	9.50 c	2.50 bcde	0.75	0.25	6.25	80.75 ab
Beleaf 50 SG	5.6	9.50 c	1.75 de	1.50	0.00	1.00	86.25 a
Beleaf 50 SG + Hero 1.25 EC	2.8 + 10.3	9.25 c	2.25 cde	0.25	0.50	5.50	82.25 a
Cobalt	32.0	10.75 bc	2.75 bcde	0.75	0.00	2.00	83.75 a
Lorsban 4E	32.0	12.75 bc	2.00 de	0.75	0.25	4.75	79.50 ab
Warrior 1 CS	3.84	11.00 bc	2.75 bcde	2.00	0.25	1.50	82.50 a
LSD; *P*=0.10		6.20	2.07	NS [y]	NS [y]	NS [y]	11.65

Means within columns followed by the same letter are not significantly different; $LSD_{0.10}$.
[y] Not significant by ANOVA; *P*=0.10.
[z] Log 10^x transformed data used for analysis.