WORM PEST MANAGEMENT IN ALFALFA IN IMPERIAL VALLEY, CALIFORNIA

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ABSTRACT

In the low desert region of southern California and Arizona, beet armyworm, *Spodoptera exigua*, alfalfa caterpillar, *Colias eurytheme*, and Granulate cutworm, *Agrotis subterranea* (Fabricius), must be managed for successful alfalfa hay production. Considerable progress has been made toward the control of the worm pests through integrated pest management, but insecticide applications are commonly needed to maintain population densities of worm pests below damaging levels. Experiments were conducted at the University of California Desert Research and Extension Center in 2003, 2002 and 2001 to compare efficacy of registered and unregistered materials and combinations of materials for worm pest control in alfalfa. The results of these three insecticide efficacy experiments indicate that beet armyworm and alfalfa caterpillar susceptible to control by several different insecticides. Data from the 2002 study shows that indoxacarb is less harmful to damsel bugs than pyrethroid insecticides and chlorpyrifos.

INTRODUCTION

Although integrated pest management (IPM) strategies have been developed that have reduced the reliance on insecticides for control of worm pests in alfalfa, insecticides are still one of the important IPM tools need to control these pests. The beet armyworm alfalfa caterpillars and granulate cutworms are commonly controlled in low desert alfalfa with indoxacarb or one of several pyrethroid insecticides registered for alfalfa hay production. Insecticides are applied to a large portion of the alfalfa acreage in the low desert region of the Southwestern United States each year for worm pest control.

Alfalfa caterpillar, *Colias eurytheme* is a warm weather pest with as many as seven generations in the low desert between May and October. Check fields for alfalfa caterpillars when yellow alfalfa butterflies appear in May. Alfalfa butterflies flying over tall alfalfa likely have emerged from the field. Eggs are laid singly, standing on end, on the upper surface of leaves in fields with re-growth under 6 inches. Larvae hatch in 3 to 10 days, grow to about an inch long and pupate in approximately 2 weeks. Alfalfa caterpillars are green with white stripes down their sides and are distinguished from beet armyworm by their velvety appearance (Anonymous 1985).

All alfalfa caterpillars consume leaves and large larvae are most destructive. In contrast to armyworms, the caterpillars do not skeletonize leaves, consuming the midrib. A small 0.25 inch long black wasp, *Cotesia medicaginis*, is a parasite of alfalfa caterpillar. The wasp stings very small caterpillars laying an egg inside. Wasp eggs hatch and the wasp larvea consume the body

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contents of the caterpillars. *Cotesia medicaginis* parasitized larvae are lighter than normal in color, being somewhat shiny rather than velvety on the surface, and swollen toward the rear. The wasp larva can be exposed by grasping the caterpillar at each end of the swelling and pulling it apart. A parasitized caterpillar dies before it reaches 0.5 inch in length (Anonymous 1985).

Management guidelines. Damage may be avoided by cutting hay early. However, timing of early cutting is critical to obtain satisfactory yield and to avoid serious damage. Monitor fields weekly from June through October, checking 2 to 3 times per week during periods of heavy infestations, by taking 5 sweep counts in 4 to 5 field locations. Check for *Cotesia medicaginis* parasitism. Treatment with an insecticide when field counts average 10 non-parasitized caterpillars per sweep. *Bacillus thuringiensis* may give satisfactory control of alfalfa caterpillars without adversely affecting beneficial species, and leaves no undesirable residue on the hay. When caterpillars ingest *B. thuringiensis*, they cease feeding, but may remain on plants 3-4 days before dying (Anonymous 2003).

Beet armyworm is a common pests in desert alfalfa from June through September, occasionally damages alfalfa in April or May in the low desert valleys of Southern California. Egg masses of both species are deposit on the upper side of leaves. White cottony scales cover beet armyworm egg masses. Eggs hatch in a few days and larvae reach full size in 2 to 3 weeks. Larvae pupate on or under the soil surface. Adults of both species are brown nocturnal moths with a 1¼ wing span. Moths emerge to re-infest alfalfa or to infest other crops. There are at least 5 generations of beet armyworm per year in the low desert; the final generation of each species overwinter as pupae in the soil. Beet armyworm larvae are smooth-skinned and are usually olive green, but color varies from bright green or purplish green. They have very fine dark stripes on their backs and pale yellow stripes on each side. An intense black spot on the lateral margin of the first legless segment is a distinguishing characteristic. First instar larvae of both species web terminal leaves together and skeletonize the leaves, later dispersing through the crop. Spiders and various species of predacious bugs prey on the larvae of both armyworm species. *Hyposoter exigua* wasps prey on both armyworm species by depositing an egg in the larvae. A *Hyposoter exigua* larva hatches from the egg and parasitizes the armyworm larva (Anonymous 1985).

Management guidelines. Sample for parasitism by pulling the heads from ½ inch long armyworms, squeezing the body contents out from the anal end toward the head end. *Hyposoter exigua* larvae will be pushed out of parasitized armyworms. Monitor fields weekly by making 5 sweep counts at each of 4 to 5 locations per field using a standard sweep net. Check fields 2 to 3 times per week when heavy populations begin to develop. Treat with an insecticide when there are 15 non-parasitized ½ inch armyworms of either species per sweep (Anonymous 2003).

Cutworms are occasional pests of desert alfalfa in the Central Valley, but are frequent pests in low desert bed-planted alfalfa. Granulate cutworm, *Agrotis subterranea* (Fabricius), and the variegated cutworm, *Peridroma sausia* (Hòbner), are the two species that most commonly attack desert alfalfa. Cutworm adults are night-flying moths in the Family: Noctuidae. White to greenish eggs of these noctuids are laid in irregular masses, on alfalfa leaves or stems often near the base of the plant. Eggs darken as they approach hatching. Larvae can grow up to 2 inches long. The heavy-bodied larvae appear as smooth-skinned caterpillars of various colors and patterns and frequently roll into a C-shape when disturbed. Larvae hide under loose soil, in soil

cracks or under duff during the day, move to the plants at night to feed (Anonymous 1985). Variegated cutworm populations may develop in weedy areas and migrate into seedling stands or mature stands. Seedling alfalfa stands can be severely damaged by cutworms cutting the seedlings off at or just below the soil surface. Established fields are damaged when cutworms cut off new growth of feed on the alfalfa foliage (Anonymous 1985).

Granulate cutworm is a devastating pest of bed planted alfalfa, but can also be a pest of alfalfa planted between borders. Low desert alfalfa fields are attacked by granulate cutworm from May through October, but the pest is resident in fields throughout the year. Established alfalfa fields can be severely injured when cutworms cut off new shoots at or below ground level following hay harvest. The pest often goes undetected after cutting and hay removal. The problem becomes apparent when the field is watered back and there is little or no re-growth due to cutworms feeding. Cutworms feeding on shoots, thereby holding back re-growth, deplete starch reserves in the crowns, weakening the plants, making them susceptible to disease. Granulate cutworm is nocturnal, but will move from daytime hiding places and climb into the alfalfa canopy to feed in the evening.

Management guidelines. Cutworms are most injurious in fields with high plant residue. Pre-plant tillage and abatement of weedy refuge areas around fields help prevent cutworm infestations (Anonymous 2003). Flood irrigation will drown many cutworm larvae. Flood irrigation during daylight hours will attract Egrets, Ibis, gulls and other birds that prey on the cutworm as the advancing water forces the larvae from hiding. Cutworms can be detected by looking under duff and carefully digging to a depth of one inch deep in loose soil near alfalfa crowns. When cutworm numbers exceed one or two per foot of row or severe damage is apparent, treatment with an insecticide is usually warranted. Pyrethroid insecticides had been the only efficacious insecticides for control granulate cutworm in the low deserts during the 1990's, but are now being replaced by indoxacarb.

INSECTICIDE EFFICACY EXPERIMENTS FOR WORM PEST CONTROL

An insecticide efficacy study was conducted during the summer of 2003 at the UC Desert Research and Extension Center. A first year stand of alfalfa, VAR. CUF 101, was used for the experiment. Plots were arranged in a randomized complete block design with four replications. Eight insecticide treatments were compared to an untreated control for efficacy against beet armyworm and the insecticides were evaluated for their negative impact on predacious insects and spiders in alfalfa. Insecticide treatments and rates as fluid ounces or dry ounces of formulated product per acre are listed in Table 1. Plots measured 35 feet by 50 feet and insecticide treatments were broadcast applied August 5, 2003, using a tractor mounted spray boom with 19 X TJ-60 11003VS nozzles at 20 psi delivering 29 gpa.

Populations of beet armyworm and beneficial arthropods were measured in each plot with a standard 15 inch diameter insect sweep net consisting of ten 180^{o} sweeps on August 4, 6, 8, 12 and 19, 2003, or 1 day pre-treatment (PT) and 1, 3, 7, and 14 days after treatment (DAT).

Steward 1.25 SC (indoxacarb) at 0.045 lb, 0.065 lb and 0.09 lb AI per acre and Lorsban 4E

(chlorpyrifos) provided the best beet armyworm control with post treatment means that were significantly less than means for all other insecticide treatments and for the untreated control mean (LSD, P<0.05) (Table 1). The beet armyworm post treatment means for Gamma-cyhalothrin, Mustang Max (zeta-cypermethrin) and Assail WSP (acetamiprid) were not significantly different from the untreated control. The Warrior (lambda cyhalothrin) was not different from Gamma-cyhalothrin, Mustang Max, or Assail WSP.

The untreated control post treatment means for minute pirate bugs, collops beetles and spiders were not significantly different from the post treatment means for any of the insecticide treatments (LSD, P<0.05) (Table 2). Therefore, by this criteria, none of the insecticide treatments had a negative impact on the minute pirate bugs, collops beetles, nor spiders. All of the insecticide treatments negatively impacted bigeyed bugs. The post treatment means for bigeyed bugs for each insecticide treatment was significantly less than the mean for the untreated control. All insecticide treatments except the three Steward 1.25 SC treatments and the Assail WSP treatment had post treatment means for damsel bugs that were significantly less than the mean for the untreated control.

Table 1. Numbers[v] of Beet Armyworms per Ten Sweeps in Alfalfa, Holtville, CA, 2003.

Treatment	oz/acre	1 DPT[w]	1 DAT[xy]	3 DAT[y]	7 DAT	14 DAT[y]	PTM[yz]
Untreated Control	---------	19.0 a	39.1 a	42.5 a	42.5 a	34.3 a	39.3 a
*Gamma-cyhalothrin	3.84	13.0 a	39.8 a	36.9 ab	40.5 a	24.6 ab	35.0 ab
Warrior 1CS	3.84	14.5a	24.8 a	15.8 ab	24.0 abc	16.7 abc	21.0 b
Steward 1.25SC	4.6	16.3 a	2.2 b	0.9 d	0.0 d	6.9 d	2.9 d
Steward 1.25SC	6.7	21.8 a	3.8 a	0.7 d	1.0 d	12.1 bcd	4.4 cd
Steward 1.25SC	9.22	23.5 a	6.3 b	5.0 c	8.0 cd	8.6 cd	6.3 c
*Mustang Max	2.5	16.3 a	42.8 a	14.8 b	21.3 d	14.0 bcd	23.9 ab
Lorsban 4 E	32.0	14.3 a	2.0 b	0.4 d	0.8 bc	11.3 bcd	3.9 cd
*Assail WSP	1.7	15.3 a	35.0 a	22.4 ab	31.0 ab	21.2 ab	26.9 ab

[v] Mean separations within columns by $LSD_{0.05}$.
[w] Days pre-treatment. [x] Days after treatment.
[y] Log transformed data used for analysis; reverse transformed means reported.
[z] Post treatment mean.
* Not registered for this use at time of publication.

Table 2. Post Treatment Mean Numbers [z] for Predacious Insects and Spiders per Ten Sweeps in Alfalfa, Holtville, CA, 2003.

Treatment	oz/acre	MPB	BEB	DB	CB	Spiders
Untreated Control	---------	9.1 a	7.9 a	2.5 ab	1.6 a	2.3 a
*Gamma-cyhalothrin	3.84	6.4 a	4.6 b	2.0 bcd	1.0 a	2.1 a
Warrior 1CS	3.84	6.8 a	4.6 b	1.7 bcd	0.9 a	2.0 a
Steward 1.25SC	4.6	7.6 a	5.0 b	2.4 abc	1.3 a	2.1 a
Steward 1.25SC	6.7	7.3 a	4.9 b	2.1 abcd	1.4 a	1.9 a
Steward 1.25SC	9.22	6.3 a	5.1 b	2.1 abcd	1.1 a	2.2 a
*Mustang Max	2.5	6.4 a	4.3 b	1.2 d	0.8 a	2.1 a
Lorsban 4 E	32.0	6.1 a	4.0 b	1.4 cd	1.9 a	1.6 a
*Assail WSP	1.7	6.8 a	5.6 b	3.1 a	2.1 a	2.4 a

[z]Mean separations within columns by $LSD_{0.05}$.
* Not registered for this use at time of publication.
MPB = Minute Pirate Bug
BEB = Bigeyed Bug
DB = Damsel Bug
CB = Collops Beetle

An insecticide efficacy study was conducted during the summer of 2002 at Holtville, CA. A third year stand of the alfalfa variety CUF 101 was used for the experiment. Plots were arranged in a randomized complete block design with four replications. Eleven insecticide treatments were included along with an untreated control. Insecticide treatments and rates fluid ounces or pounds of formulated product per acre are listed in Table 3. Plots measured 35 feet by 50 feet and insecticide treatments were broadcast applied September 3, 2002, using a tractor mounted spray boom with 19 X TJ-60 11003VS nozzles at 20 psi delivering 27.5 gpa.

Populations of beet armyworm and alfalfa caterpillar were measured in each plot with a standard 15 inch diameter insect net consisting of ten 180^{o} sweeps on September 4, 6, 10, 13, and 17, 2002 or 1, 3, 7, 10, and 14 days after treatment (DAT).

The Lorsban 4 E treatment, Intrepid (methoxyfenozide), Steward (indoxacarb), and Success (spinosad) provided excellent beet armyworm and alfalfa caterpillar control at all application rates through the 14 DAT sample, Table 3 and Table 4. Dipel (*Bacillus thuringiensis* - Berliner), Dipel DF + XenTari (*B. thuringiensis, subspecies aizawai*), and Warrior (lambda cyhalothrin) did not adequately control beet armyworm. The beet armyworm populations in the Warrior treated plots exceeded the levels in the untreated control for all sampling dates except 1 DAT. Dipel DF + XenTari and Dipel alone provided good control of alfalfa caterpillar on all sampling

dates except 1 DAT, Tables 4. Alfalfa caterpillar populations in the Warrior plots exceeded the levels in the untreated control on all sampling dates after 3 DAT.

Population levels of bigeyed bug were adversely affected by treatments with Lorsban, Warrior and the two highest rates of Steward. Damsel bug populations were adversely affected by treatments with Lorsban, Warrior, and the 6.7 fluid ounces per acre rate of Steward. Population levels of minute pirate bug, green lacewing, collops beetle, and spiders were not adversely affected by any of the insecticide treatments.

Steward is an insecticides recently development by E. I. Dupont de Nemours & Co. (Inc.) and is registered for use on alfalfa grown for hay in California. Success is an insecticide developed by Dow AgroSciences that is not currently registered for use on alfalfa. Intrepid is an insecticide under development by Dow AgroSciences and is not registered for use on alfalfa.

Table 3. Mean Numbers[w] of Beet Armyworms per Ten Sweeps in Alfalfa, Holtville, CA, 2002.

Treatment	Oz/acre	1 DAT[xz]	3 DAT[z]	7 DAT[z]	10 DAT[z]	14 DAT	PTM[yz]
Untreated	---------	18.0 a	20.4 a	36.3 ab	10.2 a	9.5 bc	19.4 a
Success 2SC	3.0	3.1 de	2.0 e	0.7 ef	0.7 cd	5.3 c	2.5 fg
Success 2SC	6.0	3.6 cde	4.5 bcd	0.5 f	2.4 bc	3.5 c	3.2 ef
Intrepid 2 SC	4.0	8.6 abc	4.5 bcd	6.4 cd	0.07 cd	3.0 c	5.7 cd
Intrepid 2 SC	6.0	6.5 bcd	3.6 cde	0.9 ef	0.03 d	5.0 c	3.4 def
Steward 1.25 SC	4.6	3.5 cde	6.9 bc	3.3 de	1.4 cd	6.5 c	5.1 de
Steward 1.25 SC	6.7	2.8 de	2.8 de	1.3 ef	1.1 cd	3.8 c	2.8 fg
Steward 1.25 SC	11.3	3.4 cde	1.7 e	0.4 f	0.03 d	1.8 c	1.7 g
Lorsban 4 E	32.0	2.2 e	2.1 de	1.3 ef	2.7 bc	5.8 c	3.1 ef
Dipel DF + XenTari 10.3%	12.0 + 4.0	5.7 bcde	7.7 b	16.8 bc	1.0 cd	15.3 ab	10.0 b
Dipel DF	12.0	7.6 abcd	6.3 bc	10.1 cd	6.1 ab	8.3 bc	8.5 b
Warrior	3.8	10.0 ab	22.0 a	58.4 a	11.4 a	20.5 a	25.5 a

[w] Mean separations within columns by $LSD_{0.05}$.
[x] Days after treatment. [y] PTM = Post treatment mean.
[z] Log transformed data used for analysis; reverse transformed means **reported.**

Table 4. Mean Numbers[w] of Alfalfa Caterpillars per Ten Sweeps in Alfalfa, Holtville, CA, 2002.

Treatment	Oz/acre	1 DAT[x]	3 DAT[z]	7 DAT	10 DAT	14 DAT[z]	PTM[y]
Untreated	---------	5.3 a	3.4 a	4.0 b	1.3 ab	1.1 ab	3.0 a
Success 2SC	3.0	4.0 abc	0.6 cd	0.0 d	0.0 c	0.0 c	1.0 bcd
Success 2SC	6.0	0.8 d	1.1 cd	0.0 d	0.5 bc	0.4 bc	0.5 d
Intrepid 2 SC	4.0	5.0 a	1.1 cd	2.0 c	0.3 c	0.2 c	1.7 b
Intrepid 2 SC	6.0	5.0 a	0.9 cd	0.3 d	0.0 c	0.0 c	1.3 bcd
Steward 1.25 SC	4.6	3.0 abcd	1.9 abc	0.8 cd	0.0 c	0.0 c	1.3 bcd
Steward 1.25 SC	6.7	1.3 cd	0.6 cd	0.5 cd	0.0 c	0.0 c	0.5 d
Steward 1.25 SC	11.3	3.0 abcd	1.2 bcd	0.3 d	0.3 c	0.2 c	1.0 bcd
Lorsban 4 E	32.0	2.0 bcd	0.4 d	0.0 d	0.0 c	0.0 c	0.7 cd
Dipel DF + XenTari 10.3%	12.0 + 4.0	3.0 abcd	1.1 cd	2.0 c	0.3 c	0.2 c	1.5 bc
Dipel DF	12.0	4.8 ab	0.9 cd	1.0 cd	0.3 c	0.2 c	1.5 bc
Warrior	3.8	3.8 abc	2.9 ab	5.8 a	1.5 a	1.2 a	3.1 a

[w] Mean separations within columns by $LSD_{0.05}$.
[x] Days after treatment. [y] PTM = Post treatment mean.
[z] Log transformed data used for analysis; reverse transformed means reported.

An insecticide efficacy study was conducted during the summer of 2001 at Holtville, CA on a second year stand of alfalfa, VAR. CUF 101. Plots were arranged in a randomized complete block design with four replications. Twelve insecticide treatments were included along with an untreated control. Insecticide treatments and rates as pounds active ingredient (AI) per acre are listed in Table 5. Plots measured 25 feet by 50 feet and insecticide treatments were broadcast applied September 27, 2001, using a tractor mounted spray boom with 19 X TJ-60 11003VS nozzles at 40 psi delivering 33 gpa.

Populations of beet armyworm were measured in each plot with a standard 15 inch diameter insect net consisting of ten 180^{o} sweeps on September 26, one day prior to treatment and on September 27, October 1, 4, 8, and 11, 2001 or 1, 4, 7, 11, and 14 days after treatment.

The Lorsban 4 E treatment, the two highest rates of Steward, and the two rates of Success provided the highest levels of alfalfa caterpillar control and beet armyworm control on all post treatment sampling dates and for the post treatment means, Tables 5 and 6. S-1812 is an experimental insecticide under development by Valent and is not registered for use on alfalfa.

F0570 is an insecticide under development by FMC Corporation and is not registered for use on alfalfa.

Table 5. Beet Armyworm per Sweep In Alfalfa, Holtville, CA 2001.[x]

Treatment	lb AI/acre	26 Sep	28 Sep	1 Oct	4 Oct	8 Oct[y]	11 Oct[y]	PTM [z]
Untreated	--------	4.6 a	5.1 a	3.9 a	3.4 a	2.8 a	2.4 a	3.6 a
*XDE-225 0.5CS	0.0125	4.4 a	3.6 b	2.4 abcd	2.1 bc	3.1 a	2.7 a	2.9 ab
Warrior T	0.025	5.5 a	3.7 b	3.3 ab	2.2 b	3.0 a	1.5 abc	2.9 ab
*F0570 0.8 EW	0.014	3.7 a	2.1 cde	2.2 abcde	1.0 cde	3.2 a	2.6 a	2.3 bc
*F0570 0.8 EW	0.017	7.5 a	2.9 bcd	2.8 abc	1.5 bcd	2.3 ab	1.8 ab	2.3 bc
*S-1812 35WP	0.1	5.8 a	3.4 bc	1.6 bcde	1.0 cde	1.0 bc	1.3 abc	1.7 cd
Dipel DF	0.206	3.9 a	3.3 bc	0.6 de	0.6 de	0.9 cd	0.8 cd	1.3 de
*Steward 1.25 SC	0.065	5.8 a	1.7 de	1.5 bcde	0.7 de	1.1 bc	0.7 c	1.3 de
*Steward 1.25 SC	0.089	5.7 a	1.7 de	0.4 de	0.4 e	0.8 cd	0.2 e	0.7 e
*Steward 1.25 SC	0.110	3.9 a	1.5 e	0.5 de	0.1 e	0.4 d	0.3 e	0.6 e
*Success 2SC	0.0625	4.3 a	1.4 e	1.1 cde	0.3 e	0.4 d	0.4 de	0.7 e
*Success 2SC	0.0938	5.9 a	1.9 de	0.3 e	0.2 e	0.5 cd	0.3 e	0.7 e
Lorsban 4 E	1.00	7.3 a	0.9 e	0.4 de	0.2 e	0.9 cd	1.0 bc	0.7 e

[x] Mean separation within columns by $LSD_{0.05}$.

[x] Log transformed data used in analysis, reverse transformed means reported. [z] Post-treatment mean.

* Not registered for this use at the time of publication.

Table 6. Alfalfa Caterpillar per Sweep In Alfalfa, Holtville, CA 2001.[x]

Treatment	lb AI/acre	26 Sep	28 Sep	1 Oct	4 Oct	8 Oct[y]	11 Oct[y]	PTM [z]
Untreated	--------	0.90 a	0.45 a	0.30 a	0.03 cd	0.36 abc	0.11 abc	0.26 a
*XDE-225 0.5CS	0.0125	1.28 a	0.28 a	0.18 a	0.23 ab	0.40 a	0.11 abc	0.26 a
*F0570 0.8 EW	0.014	0.58 a	0.38 a	0.15 a	0.10 bcd	0.37 ab	0.24 a	0.26 a
*F0570 0.8 EW	0.017	1.18 a	0.45 a	0.03 a	0.18 abc	0.24 abcd	0.04 bcd	0.25 a
Warrior T	0.025	0.43 a	0.18 a	0.30 a	0.30 a	0.14 def	0.20 a	0.24 ab
*S-1812 35WP	0.1	0.60 a	0.38 a	0.10 a	0.15 a	0.15 cde	0.16 ab	0.20 abc
Dipel DF	0.206	0.50 a	0.28 a	0.08 a	0.18 abc	0.16 bcde	0.02 cd	0.15 bcd
*Success 2SC	0.0625	0.68 a	0.25 a	0.18 a	0.08 bcd	0.06 efg	0.03 cd	0.13 cd
*Success 2SC	0.0938	0.63 a	0.35 a	0.00 a	0.05 cd	0.02 g	0.00 d	0.09 d
*Steward 1.25 SC	0.065	0.60 a	0.43 a	0.15 a	0.05 cd	0.10 defg	0.06 bcd	0.17 abcd
*Steward 1.25 SC	0.089	0.75 a	0.35 a	0.03 a	0.05 cd	0.10 defg	0.00 d	0.11 cd
*Steward 1.25 SC	0.110	0.83 a	0.23 a	0.08 a	0.00 d	0.03 fg	0.00 d	0.07 d
Lorsban 4 E	1.00	0.65 a	0.10 a	0.05 a	0.05 cd	0.11defg	0.04 bcd	0.08 d

[x] Mean separation within columns by $LSD_{0.05}$.
[x] Log transformed data used in analysis, reverse transformed means reported. [z] Post-treatment mean.
* Not registered for this use at the time of publication.

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