# APHID AND WHITEFLY MANAGEMENT IN ALFALFA IN IMPERIAL VALLEY, CALIFORNIA

**Eric T. Natwick and M. Lopez[1]**


## ABSTRACT

In the low desert region of southern California and Arizona,-spotted alfalfa aphid, *Therioaphis maculata*, pea aphid, *Acyrthosiphon pisum*, blue alfalfa aphid, *Acyrthosiphon kondoi*, and cowpea aphid, *Aphis craccivora* must be managed for successful alfalfa hay production. Considerable progress has been made toward the control of the aphid pests via host plant resistance, but insecticide applications are commonly needed to maintain population densities of aphids below damaging levels. Experiments were conducted at the University of California Desert Research and Extension Center in 1999, 2000 and 2004 to compare efficacy of registered and unregistered materials and combinations of materials for aphid control in alfalfa. The results of these three insecticide efficacy experiments indicate that cowpea aphid is susceptible to control by several different aphicides. Currently there are no cowpea aphid resistant alfalfa varieties. Therefore, cowpea aphid should be controlled using an insecticide registered for use on alfalfa when a damaging population builds up in an alfalfa stand.


## INTRODUCTION

Although several resistant varieties have been developed and released, resistance levels have been low and variable (Lehman 1978). Insecticides still have a major role in the alfalfa insect pest management (Natwick 1987). The blue alfalfa aphid, cowpea aphid, pea aphid and spotted alfalfa aphid are commonly controlled in low desert alfalfa with chlorpyrifos or dimethoate when aphid populations reach damaging levels (Anonymous 2003, Anonymous 1985). Other insecticides used in alfalfa that provide aphid control include: carbofuran, several pyrethroid insecticides or malathion. Insecticides are applied to a large portion of the alfalfa acreage in the low desert region of the Southwestern United States each year for aphid control.

Resistance to spotted alfalfa aphid and aphid predators has limited this pest to levels that rarely require treatment. Pea aphid and blue alfalfa aphid are more abundant because the mechanism of resistance is tolerance preventing sever yield and quality losses, rather than antibiosis. Pea aphid and blue alfalfa aphid have sucking mouth parts and consume plant sap from alfalfa stems. Pea aphid and blue alfalfa aphid do not directly reduce the leaf content of the hay by consuming leaf tissue. In resistant alfalfa variety stands, pea aphid and blue alfalfa aphids may reduce yield and may have an affect on the leaf to stem ratio by consuming large quantities of carbohydrates, nutrients and by removing water from the alfalfa plants. Blue alfalfa aphid and spotted alfalfa aphid are capable of stunting susceptible varieties. High aphid population densities will result in honeydew deposits. Honeydew can foul harvesting equipment and supports the growth of sooty molds reducing marketability of hay.

---

[1] E. Natwick and M. Lopez, UCCE, Imperial County, 1050 E. Holton Rd., Holtville, CA 92250; Email: etnatwick@ucdavis.edu. **In** Proceedings, National Alfalfa Symposium, 13-15 December, 2004, San Diego, CA. UC Coop. Ext. Univ. Calif. Davis, 95616. (See http://alfalfa.ucdavis.edu for this and other proceedings).

Infestations of silverleaf whitefly, *Bemisia argentifolii*, Bellows and Perring, reduce alfalfa hay quality via honeydew contamination. Sooty molds often grow on honeydew. Although sooty molds are not known to harm cattle or horses, they superficially resemble molds associated with water damaged hay that produce toxins. Hay buyers are not likely to buy moldy hay or will discount the price of the hay. No insecticides are registered whitefly control in alfalfa, but if they were, they would not likely be cost effective. An alfalfa resistant to silverleaf whitefly, UC-Impalo-WF, was developed by University of California researchers and further whitefly host plant resistance research is ongoing to increase the level of resistance.

## APHIDS

**Pea aphid** is a serious pest during the spring months in the low desert. Pea aphid is distinguished from blue alfalfa aphid by lighter antennae with dark bands at each joint. A blue alfalfa aphid has uniformly dark antennae. Pea aphids first appear in December or January but are usually less abundant than blue alfalfa aphid until later in the spring. However, pea aphid may persist into early summer as they are more heat tolerant. They are found over most of the plant. When high population densities are present, pea aphid can deposit large quantities of honeydew. Regrowth may be stunted following cuttings made while pea aphid populations are moderate to heavy. Several species of predacious bugs and parasitic wasps attack these aphids. Sample alfalfa fields by taking 5 to 6 stems in at least 5 locations per field weekly after aphids are detected. Sample every 2 to 3 days as numbers approach the treatment threshold of 40 to 50 aphids per stem for plants under 10 inches, 70 to 80 per stem for plants 10 to 20 inches tall and more than 100 aphids per stem for plants over 20 inches tall.

**Blue alfalfa aphid** is a serious pest during the winter and spring months in the low desert. Blue alfalfa aphid is distinguished from pea aphid by uniformly dark antennae. Pea aphids have lighter antennae with dark bands at each joint. Typically, the blue alfalfa aphid first appears in December or January when it may be more abundant than pea aphid. Both species are common throughout the spring, but pea aphid is more heat tolerant and may persist into early summer. In susceptible alfalfa varieties, blue alfalfa aphid may stunt growth and infested plants have smaller leaves, shorter internodes, leaf curling, yellowing, and leaf drop. Several species of predacious bugs and parasitic wasps attack these aphids. Sample alfalfa fields weekly when aphids appear, then every 2 to 3 days as numbers approach the treatment threshold of 40 to 50 blue alfalfa aphids per stem.

**Spotted alfalfa aphid** (*Therioaphis maculata*) was introduced into Arizona and California in the 1950's, causing severe damage (Stern and Reynolds 1958). A combination of introduced parasites and resistant varieties brought the pest under control (Lehman 1978, Nielson et al 1970). Presently, spotted alfalfa aphid occasionally causes losses in susceptible varieties (Natwick 1987). Spotted alfalfa aphid is capable of stunting susceptible varieties. High aphid densities deposit honeydew. Since 1996, a few growers reported spotted alfalfa aphid in highly resistant alfalfa varieties in Palo Verde Valley, CA, Imperial Valley, CA and Parker, AZ. Spotted alfalfa aphids appear on highly resistant alfalfa varieties in Saudi Arabia and fields are being treated with insecticides. Reasons for the appearance of spotted alfalfa aphid in highly resistant varieties are being investigated. It is reasonable to believe that cultivars highly resistant spotted alfalfa aphid will continue to keep the pest in check along with the indigenous and introduced natural enemies.

**Cowpea aphid.** The past several years, there has been concern among growers in the western states about a black aphid on alfalfa, the cowpea aphid, (Blackman and Eastop 1984). Cowpea aphid has been in California since the 1900's (Essig 1911). Historically, cowpea aphid has been an occasional invader of new stands of alfalfa during the winter and occasionally infesting older alfalfa stands, but not causing economic injury (Natwick 1999a). In December, 1998, cowpea aphid built to economically damaging levels on alfalfa in Imperial County, California (Natwick 1999b). During the spring of 1999, cowpea aphids spread to alfalfa in high and low desert regions of California and is now reported as an alfalfa pest in Arizona, Iowa, Kansas, Nevada and Texas (Summers 2000b).

Cowpea aphid colonies start on the growing points of the host plant, but unabated can quickly infest the entire plant. This aphid has a broad host range with a marked preference for Leguminosae, but is found on plants in several plant families including weed and crop species. Nearly 30 virus diseases are transmitted by cowpea aphid (Blackman and Eastop 1984) including alfalfa enation, a serious virus disease of alfalfa in Europe, North Africa and Saudi Arabia (Hampton 1990).

Historically, cowpea aphid has been a warm weather pest found on several crops and weeds including cotton (Anonymous 1996). In addition to the western United States, cowpea aphid (possibly a new biotype) has emerged as a pest of alfalfa in South America and in Saudi Arabia (Summers 2000b). When an alfalfa field is threatened by a rapidly growing population of cowpea aphid, treatment with an insecticide may be warranted, just as we would treat fields to prevent heavy infestations of blue alfalfa aphid, pea aphid or spotted alfalfa aphid. Although, treatment thresholds have not been established for cowpea aphid on alfalfa, in some areas of California growers have had to treat alfalfa 3 times before the second cutting (Summers 2000a). Proper insecticide treatments will prevent yield loss, due to stunting, leaf drop, and quality loss, due to contamination with honeydew and sooty molds (Natwick 1999b). Cowpea aphid has been observed attacking both forage and seed alfalfa and can be found in low desert alfalfa during both winter and summer months. Aphid parasites, *Lysiphibus* sp. and *Diaraetiella* sp., have been reared from cowpea aphid mummies collected from both the high and low desert and numerous aphid predators have been observed feeding on cowpea aphid including bigeyed bugs, damsel bugs, lacewings, lady beetles, and syrphid fly larvae (Summers 2000b).

## INSECTICIDE EFFICACY EXPERIMENTS FOR APHID CONTROL

An insecticide efficacy experiment was established on a stand of alfalfa, var. CUF101, for cowpea aphid control at the University of California Desert Research and Extension Center on February 10, 1999. Nine insecticide treatment and an untreated control were arranged in a randomized complete block design experiment with 4 replicates. The insecticide treatments and rates are listed in Table 1. Pre-treatment sample of 10 stems per plot were cut and the aphids counted. Foliar sprays were applied with a tractor mounted spray rig on February 12 and evaluated for control of cowpea aphid control 4, 6 and 12 days after treatment. Aphids were counted on 10 stems from each plot on each sampling date.

All of the insecticide treatment provided excellent control of cowpea aphid 4, 6 and 12 days after treatment with means lower ($P \leq 0.05$) than the control, Table 1. Lorsban 4E and Warrior T provided the best residual control 12 days after treatment. All of the aphicide treatments had means for cowpea aphids per stem that were lower than the untreated control, ($P \leq 0.05$).

**Table 1. Cowpea Aphids per Stem in Alfalfa, Holtville, CA, 1999.**

| Treatment | lb ai/acre | 10 Feb | 16 Feb[z] | 18 Feb[z] | 24 Feb[z] |
|---|---|---|---|---|---|
| **Malathion 8 EC** | **1.0** | **74.00 a** | **0.46 cde** | **1.02 cd** | **5.16 cd** |
| **Pounce 3.2 EC + Malathion 8 EC** | **0.1 + 1.0** | **78.05 a** | **0.00 g** | **0.83 de** | **3.38 de** |
| **Mustang 1.5 EW** | **0.04** | **74.98 a** | **1.67 b** | **2.62 b** | **14.72 b** |
| **Lorsban 4E** | **0.75** | **65.28 a** | **0.08 fg** | **0.40 e** | **0.42 f** |
| **Dimethoate E267** | **0.375** | **69.13 a** | **0.29 def** | **1.08 cd** | **4.69 cde** |
| **Aphistar 1.4 EW** | **0.06** | **54.65 a** | **0.29 def** | **0.52 de** | **6.73 c** |
| **Warrior T** | **0.025** | **58.55 a** | **0.13 efg** | **0.71 de** | **0.51 f** |
| **Asana XL** | **0.025** | **65.98 a** | **0.90 bcd** | **0.84 de** | **9.25 bc** |
| **Asana XL** | **0.05** | **52.05 a** | **1.09 bc** | **1.80 bc** | **2.42 e** |
| **Untreated Control** | **--------** | **73.80 a** | **46.65 a** | **52.59 a** | **39.56 a** |

**[z] Log transformed data used in analysis, reverse transformed means reported.**
**Mean separation within columns by $LSD_{0.05}$.**

In 2000, efficacy of insecticides and insecticide combinations for control of cowpea aphid were compared on alfalfa, var. CUF101, at the University of California Desert Research and Extension Center. Five insecticide treatment and an untreated treated control were arranged in a randomized complete block design experiment with 4 replicates. The insecticide treatments and rates are listed in Table 2. Pre-treatment samples of 10 stems per plot were cut and the aphids counted on January 21. Foliar sprays were applied with a tractor mounted spray rig on January 24 and evaluated for control of cowpea aphid control 1, 4, 7, 14, 21, and 28 days after treatment (DAT) by counting cowpea aphids on 10 stems from each plot on each sampling date.

All of the insecticide treatments, except Furadan 4F at both rates tested, had cowpea aphid means that were lower than the untreated control ($P \leq 0.05$) on January 25, 1 DAT, Table 2.All of the insecticide treatment provided excellent control of cowpea aphid 4, 7, 14, 21 and 28 DAT with means lower than the control ($P \leq 0.05$). Dimethoate E267 and Pounce 3.2 EC plus Dimethoate E267 had the lowest post treatment means, but Furadan 4F provided the best residual control 28 days after treatment.

**Table 2. Cowpea Aphids per Stem In Alfalfa, Holtville, CA, 2000.**

| Treatment | lb ai/ac | 1DPT | 1DAT | 4DAT | 7DAT | 14DAT | 21DAT$^z$ | 28DAT$^z$ | PTM |
|---|---|---|---|---|---|---|---|---|---|
| **Mustang 1.5 EW** | **0.05** | **61.06 a** | **15.68 bc** | **13.18 b** | **3.82 b** | **5.78 b** | **1.62 b** | **1.63 b** | **7.063 bc** |
| **Dimethoate E267** | **0.33** | **21.82 a** | **6.30 c** | **2.76 d** | **4.24 b** | **2.62 c** | **1.62 b** | **1.28 bc** | **3.157 d** |
| **Pounce 3.2 EC + Dimethoate E267** | **0.01 + 0.33** | **47.80 a** | **12.16 bc** | **5.08 cd** | **7.68 b** | **1.66 c** | **0.68 c** | **1.76 b** | **4.853 cd** |
| **Furadan 4 F** | **0.5** | **45.10 a** | **22.52 ab** | **9.78 bc** | **5.72 b** | **2.30 c** | **0.69 c** | **0.69 d** | **6.977 bc** |
| **Furadan 4 F** | **1.0** | **52.06 a** | **23.60 ab** | **13.36 b** | **6.18 b** | **1.18 c** | **0.61 c** | **0.82 cd** | **7.647 b** |
| **Untreated Control** | **--------** | **44.66 a** | **32.54 a** | **23.28 a** | **14.68 a** | **19.30 a** | **15.30 a** | **8.70 a** | **19.133 a** |

**DPT = days pre-treatment; DAT= days after treatment; PTM = post treatment mean.**
**$^z$ Log transformed data used in analysis, reverse transformed means reported.**
**Mean separation within columns by $LSD_{0.05}$.**

In 2004, efficacy of insecticides and insecticide combinations for control of cowpea aphid, pea aphid, blue alfalfa aphid, and spotted alfalfa aphid were compared on alfalfa, var. CUF101, at the University of California Desert Research and Extension Center. Nine insecticide treatment and an untreated control were arranged in a randomized complete block design experiment with 4 replicates. The insecticide treatments and rates are listed in Table 3. A pre-treatment samples consisting of 10 sweeps per plot with a standard 15 inch diameter insect beating net were taken prior to insecticide applications on March 4, 2004. Sweep samples were bagged, labeled and frozen for later counting and data recording. Foliar sprays were applied with a tractor mounted spray rig on March 4 and evaluated for control of cowpea aphid control 4, 7, 14, and 21 DAT. Post-treatment samples were taken in the manner described for the pre-treatment sample.

All of the insecticide treatments, except Renounce 20W, had cowpea aphid means that were lower than the untreated control ($P \leq 0.05$) on March 8, or 4 DAT, Table 3.All of the insecticide treatment provided control of cowpea aphid 7 DAT with means lower than the control. Between the 7 DAT sample and the 14 DAT sample the cowpea aphid population in the untreated control crashed, possibly due to the sudden onset of hot weather. As a result, there were no differences among the treatments for numbers of cowpea aphid 14 DAT. 2.All of the insecticide treatment had means lower that for the untreated control cowpea aphid 21 DAT ($P \leq 0.05$). Imidan 70W plus Dimethoate E267, Furadan 4F and Furadan 4F plus Dimethoate E267 had the lowest post treatment means, Table 3.

The results of these three insecticide efficacy experiments indicate that cowpea aphid is susceptible to control by several different aphicides. Currently there are no cowpea aphid resistant alfalfa varieties. Therefore, cowpea aphid should be controlled using an insecticide registered for use on alfalfa when a damaging population builds up in an alfalfa stand.

**Table 3. Mean Numbers[v] of Cowpea Aphid per Sweep, Holtville, CA, 2004.**

| Treatment | lb ai/a | PT[w] | 4 DAT[xy] | 7 DAT[y] | 14 DAT | 21 DAT | PTM[yz] |
|---|---|---|---|---|---|---|---|
| Untreated Control | ------ | 253.03 a | 91.63 a | 63.51 a | 0.95 a | 0.40 a | 39.17 a |
| Steward 1.25 SC + Lorsban 4E | 0.025 + 0.125 | 255.93 a | 6.67 cde | 5.66 def | 0.23 a | 0.08 b | 3.16 de |
| Steward 1.25 SC + Lorsban 4E | 0.045 + 0.125 | 303.28 a | 12.64 b | 8.97 cde | 0.13 a | 0.15 b | 5.51 c |
| DPX-KN128 1.25 EC + Lorsban | 0.045 + 0.125 | 274.48 a | 11.70 bc | 9.41 cd | 0.25 a | 0.03 b | 5.47 c |
| Renounce 20W | 0.0413 | 255.80 a | 61.76 a | 30.69 b | 0.50 a | 0.10 b | 24.65 b |
| Steward 1.25 SC + Dimethoate 267E | 0.045 + 0.375 | 219.48 a | 8.62 bcd | 6.70 def | 0.15 a | 0.08 b | 4.25 cd |
| Steward 1.25 SC + Malathion 8 | 0.045 + 1.000 | 302.35 a | 10.11 bcd | 11.32 c | 0.33 a | 0.13 b | 5.88 c |
| Imidan 70-W + Dimethoate 267E | 1.429 + 0.375 | 290.23 a | 4.34 e | 3.06 g | 0.33 a | 0.10 b | 1.96 f |
| Furadan 4F | 1.000 | 230.93 a | 5.86 de | 5.34 ef | 0.43 a | 0.05 b | 2.92 e |
| Furadan 4F + Dimethoate 267E | 0.500 + 0.375 | 248.40 a | 6.25 cde | 4.57 fg | 0.15 a | 0.13 b | 2.82 e |

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

All of the insecticide treatments, except Renounce 20W, had pea aphid means that were lower than the untreated control ($P \leq 0.05$) on March 8, or 4 DAT, Table 4. All of the insecticide treatment provided control of pea aphid 7 DAT with means lower than the control. Between the 7 DAT sample and the 14 DAT sample the pea aphid population in the untreated control crashed, possibly due to the sudden onset of hot weather. As a result, there were no differences among the treatments for numbers of pea aphid 14 DAT and 21 DAT. Furadan 4F at 1.0 lb active ingredient per acre had the lowest post treatment means that were significantly lower, Table 4.

All insecticide treatments, except Renounce 20W, had lower blue alfalfa aphid means than the untreated control ($P \leq 0.05$) on March 8, or 4 DAT, Table 5. All of the insecticide treatment had means for blue alfalfa aphid that were lower than the untreated control 7 DAT. Between the 7 DAT sample and the 14 DAT sample the blue alfalfa aphid population in the untreated control crashed, possibly due to the sudden onset of hot weather. There were no differences among the treatments for numbers of blue alfalfa aphid 14 DAT and 21 DAT. Furadan 4F at 1.0 lb active ingredient per acre had the lowest post treatment means that were significantly lower, Table 5.

**Table 4. Mean Numbers[v] of Pea Aphid per Sweep, Holtville, CA, 2004.**

| Treatment | lb ai/a | PT[w] | 4 DAT[xy] | 7 DAT[y] | 14 DAT | 21 DAT | PTM[yz] |
|---|---|---|---|---|---|---|---|
| Untreated | ------ | 19.60 a | 3.67 a | 4.19 a | 0.20 a | 0.05 a | 2.30 a |
| Steward 1.25 SC + Lorsban 4E | 0.025 + 0.125 | 17.58 a | 0.29 bcd | 0.06 f | 0.00 a | 0.10 a | 0.11 ef |
| Steward 1.25 SC + Lorsban 4E | 0.045 + 0.125 | 23.43 a | 0.35 bcd | 0.74 bcd | 0.00 a | 0.35 a | 0.39 bc |
| DPX-KN128 1.25 EC + Lorsban | 0.045 + 0.125 | 20.25 a | 0.41 bcd | 0.43 bcde | 0.00 a | 0.25 a | 0.26 cd |
| Renounce 20W | 0.0413 | 21.10 a | 3.85 a | 1.19 b | 0.03 a | 0.03 a | 1.48 a |
| Steward 1.25 SC + Dimethoate 267E | 0.045 + 0.375 | 16.30 a | 0.55 bc | 0.15 ef | 0.03 a | 0.08 a | 0.22 cde |
| Steward 1.25 SC + Malathion 8 | 0.045 + 1.000 | 30.83 a | 1.01 b | 1.07 bc | 0.00 a | 0.30 a | 0.67 b |
| Imidan 70-W + Dimethoate 267E | 1.429 + 0.375 | 19.88 a | 0.25 cd | 0.26 def | 0.00 a | 0.08 a | 0.17 de |
| Furadan 4F | 1.000 | 19.45 a | 0.12 d | 0.06 f | 0.00 a | 0.00 a | 0.05 f |
| Furadan 4F + Dimethoate 267E | 0.500 + 0.375 | 17.60 a | 0.33 bcd | 0.31 cdef | 0.00 a | 0.08 a | 0.18 de |

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

All insecticide treatments, except Renounce 20W, had lower spotted alfalfa aphid means than the untreated control (P≤0.05) on March 8, or 4 DAT, Table 6. All of the insecticide treatment provided control of spotted alfalfa aphid 7 DAT with means lower than the control. Between the 7 DAT sample and the 14 DAT sample the spotted alfalfa aphid population in the untreated control crashed, possibly due to the sudden onset of hot weather. As a result, there were no differences among the treatments for numbers of blue alfalfa aphid 14 DAT and 21 DAT. Furadan 4F at 1.0 lb active ingredient per acre had the lowest post treatment means that were significantly lower, Table 6.

There are resistant varieties for pea aphid, blue alfalfa aphid and spotted alfalfa aphid that should replanted as a first line of defense against these pests. Occasionally, populations of one or more of these species of aphids will buildup in an alfalfa stand and may require an insecticide treatment to prevent damage. Treatment thresholds have been established and published for each of these pests (Anonymous 2003, Anonymous 1985). Treat with an insecticide registered for aphid control in alfalfa when the treatment threshold is reached.

**Table 5. Mean Numbers[v] of Blue Alfalfa Aphid per Sweep, Holtville, CA, 2004.**

| Treatment | lb ai/a | PT[w] | 4 DAT[xy] | 7 DAT | 14 DAT | 21 DAT | PTM[yz] |
|---|---|---|---|---|---|---|---|
| Untreated | ------ | 72.83 a | 21.45 a | 10.50 a | 0.28 a | 0.28 a | 8.28 a |
| Steward 1.25 SC + Lorsban 4E | 0.025 + 0.125 | 56.68 a | 1.07 cde | 1.20 c | 0.08 a | 0.10 a | 0.62 ef |
| Steward 1.25 SC + Lorsban 4E | 0.045 + 0.125 | 89.23 a | 2.48 bc | 2.10 c | 0.00 a | 0.25 a | 1.21 d |
| DPX-KN128 1.25 EC + Lorsban | 0.045 + 0.125 | 68.20 a | 2.04 bcd | 1.83 c | 0.08 a | 0.18 a | 1.06 d |
| Renounce 20W | 0.0413 | 57.50 a | 10.15 a | 6.93 b | 0.05 a | 0.33 a | 4.33 b |
| Steward 1.25 SC + Dimethoate 267E | 0.045 + 0.375 | 60.33 a | 1.89 bcd | 1.13 c | 0.08 a | 0.13 a | 0.86 de |
| Steward 1.25 SC + Malathion 8 | 0.045 + 1.000 | 77.43 a | 4.21 b | 5.10 b | 0.05 a | 0.70 a | 2.60 c |
| Imidan 70-W + Dimethoate 267E | 1.429 + 0.375 | 63.40 a | 0.58 e | 0.80 c | 0.05 a | 0.18 a | 0.47 f |
| Furadan 4F | 1.000 | 60.93 a | 0.14 f | 0.18 c | 0.08 a | 0.03 a | 0.10 g |
| Furadan 4F + Dimethoate 267E | 0.500 + 0.375 | 73.00 a | 0.94 de | 0.73 c | 0.03 a | 0.23 a | 0.49 f |

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

## SILVERLEAF WHITEFLY

The silverleaf whitefly, *B. argentifolii* Bellows & Perring, (Bellows et al. 1994) first became an economically important pest of alfalfa in California and Arizona during the summer of 1991 (Natwick et al. 1993). Silverleaf whitefly can cause economic damage to alfalfa in the low desert regions of Southern California and Arizona from July through September (Yee et al. 1997).

Infestations of silverleaf whitefly reduce alfalfa hay quality via honeydew contamination. Sooty molds, fungi that produce black spores, often grow on honeydew. Sooty molds are not known to harm cattle or horses, but resemble mold from water damaged hay that produce toxins. Hay buyers are not likely to buy moldy looking hay or will discount the price of the hay. If insecticides were registered whitefly control in alfalfa, they would not be cost effective (Palumbo et al. 2000). Varieties were screened for resistance to silverleaf whitefly in 1992 and differences in levels of susceptibility were noted (Natwick and Robinson 1993). Alfalfa resistant to silverleaf whitefly was developed at the University of California Desert Research and Extension Center (Teuber et al. 1997, Teuber et al. 1999). A silverleaf whitefly-resistant alfalfa cultivar (UC-Impalo-WF) was released in 2000. Research has continued at the University of California to develop cultivars with higher levels of resistance to silverleaf whitefly (Jiang et al. 2003).

**Table 6. Mean Numbers[w] of Spotted Alfalfa Aphid per Sweep, Holtville, CA, 2004.**

| Treatment | lb ai/a | PT[x] | 4 DAT[y] | 7 DAT | 14 DAT | 21 DAT | PTM[z] |
|---|---|---|---|---|---|---|---|
| Untreated | ------ | 3.93 a | 4.16 a | 2.86 a | 0.40 a | 0.23 a | 1.98 a |
| Steward 1.25 SC + Lorsban 4E | 0.025 + 0.125 | 3.20 a | 1.06 bc | 0.90 b | 0.58 a | 0.18 a | 0.66 bc |
| Steward 1.25 SC + Lorsban 4E | 0.045 + 0.125 | 3.75 a | 0.41 cd | 0.86 b | 0.50 a | 0.28 a | 0.58 c |
| DPX-KN128 1.25 EC + Lorsban | 0.045 + 0.125 | 3.55 a | 0.62 c | 1.02 b | 0.35 a | 0.05 a | 0.57 c |
| Renounce 20W | 0.0413 | 3.55 a | 2.06 ab | 0.72 b | 0.40 a | 0.05 a | 0.97 b |
| Steward 1.25 SC + Dimethoate 267E | 0.045 + 0.375 | 3.00 a | 0.11 de | 0.12 c | 0.10 a | 0.18 a | 0.15 d |
| Steward 1.25 SC + Malathion 8 | 0.045 + 1.000 | 4.30 a | 0.56 c | 0.71 b | 0.48 a | 0.28 a | 0.62 bc |
| Imidan 70-W + Dimethoate 267E | 1.429 + 0.375 | 4.03 a | 0.06 e | 0.04 c | 0.05 a | 0.08 a | 0.07 de |
| Furadan 4F | 1.000 | 7.00 a | 0.02 e | 0.00 c | 0.05 a | 0.00 a | 0.02 e |
| Furadan 4F + Dimethoate 267E | 0.500 + 0.375 | 2.60 a | 0.04 e | 0.02 c | 0.08 a | 0.10 a | 0.06 e |

[w] **Mean separations within columns by $LSD_{0.05}$.**
[x] **Pre-treatment.**
[y] **Days after treatment.**
[z] **Post treatment means.**

## LITERATURE CITED


Anonymous 1996. Integrated pest management for cotton. Univ. Calif. Statewide IPM Proj., Publication 3305. 164 pp.

Anonymous 1985. Integrated pest management for alfalfa hay. Univ. Calif. Statewide IPM Proj., Publication 3312. 96 pp.

Anonymous 2003. UC IPM Pest Management Guidelines, Alfalfa. http://www.ipm.ucdavis.edu/PMG/selectnewpest.alfalfa-hay.html.

Bellows, T. S., Jr., T. M. Perring, R. J. Gill, and D. H. Headrick. 1994. Description of a species of *Bemisia* (Homoptera: Aleyrodidae). Ann. Entomol. Soc. Am. 87:195-206.

Blackman, R. L. and V. F. Eastop. 1984. Aphids on the World Crops: An Identification and Information Guide, Wiley - Interscience Publication. 466 pp.

Essig, O. E. 1911. Injurious and Beneficial Insects of California, Supplement The Monthly Bulletin California State Commission of Horticulture. 541 pp.

Hompton, R. O. 1900. Alfalfa enation. Pg. 53 *In* D. L. Stutevill and D. C. Erwin Ed. Compendium of Alfalfa Disease 2nd Edition.

Jiang, Y. X., N. Zareh, G. P. Walker, and L. R. Teuber. 2003. Characterization of alfalfa germplasm expressing resistance to silverleaf whitefly, *Bemisia argentifolii*. J. Appl. Entomol. 8: 447-457.

Lehman, W.F. 1978. Breeding alfalfa for tomorrow. Proceedings Eighth California Alfalfa Symposium, pp. 1-9.

Natwick, E. T. 1999a. New Aphid Invades California Alfalfa Fields. California Alfalfa & Forage Review, Vol. 2, No. 2: 1 & 6.

Natwick, E. T. 1999b. Insecticide efficacy evaluation for cowpea aphid control in alfalfa, 1999. Imperial Agric. Briefs Newsletter, April: 6.

Natwick, E. T. and F. Robinson. 1993. Alfalfa host plant resistance to silverleaf whitefly (formerly sweetpotato whitefly strain B). *In,* S. Mueller (ed.) p. 60-63, Proc. Alfalfa Seed Prod. Symp.

Natwick, E. T., F. Robinson and C. Bell. 1993. Managing sweetpotato whitefly in alfalfa through irrigation practices. (Abstr.) Sweetpotato whitefly: 1993 Supplement to the Five-Year National Research and Action Plan, ARS-112:126.

Natwick, E.T. 1987. Weevil and worm management for low desert alfalfa production. Proceedings Seventeenth California Alfalfa Symposium, pp. 94-100.

Nielson, M. W., H. Don, M. H. Schonhorst, W. F. Lehman, and V. L. Marble. 1970. Biotypes of the spotted alfalfa aphid in the western United States. J. Econ. Entomol. 63:1822-5.

Palumbo, J. C., N. C. Toscano, M. J. Blua, and H. A. Yoshida. 2000. Impact of *Bemisia* whiteflies (Homoptera: Aleyrodidae) on alfalfa growth, forage yield and quality. J. Econ. Entomol., 93: 1688-1694.

Stern, V.M., and H.T. Reynolds.1958.Resistance of spotted alfalfa aphid to certain organophosphate insecticides in southern California. J. Econ. Entomol. 51: 312-6.

Summers, C. G. 2000a. Cowpea aphid spreads. California Alfalfa & Forage Review, 2:1 & 8.

Summers, C. G. 2000b. Tiny pest threatens California’s alfalfa crop. California Alfalfa & Forage Review. 1: 1 & 7-8.

Teuber, L. R., M. E. Rupert, Larry K. Gibbs, K. L. Taggard. 1997. Breeding resistant alfalfa holds promise for silverleaf whitefly management. California Agriculture. 51(3):25-29.

Teuber, L. R., L. K. Gibbs, and K. L. Taggard. 1999. Progress in breeding alfalfa for resistance to the silverleaf whitefly. USDA-ARS 1999-01: 3. [Note: Abstract]

Yee, W. L., N. C. Toscano, J. C. Palumbo, M. J. Blua, and H. A. Yoshida. 1997. Seasonal population trends of *Bemisia argentifolii* (Homoptera: Aleyrodidae) on alfalfa in Southern California and Arizona. Environ. Entomol. 26: 241-249.j