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# MANAGEMENT OF MELON THRIPS, *THRIPS PALMI* KARNY (THYSANOPTERA: THRIPIDAE) USING VARIOUS CHEMICALS

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*Abstract.* **The melon thrips, *Thrips palmi* Karny, is a significant pest of vegetable crops in south Florida. Four studies were conducted to determine the effectiveness of insecticides in controlling the melon thrips on vegetable crops in south Florida. Fenpropathrin (Danitol®) alone at 21 oz/acre, or fenpropathrin in combination with acephate (Orthene®) and pyriproxyfen (Knack®) strongly suppressed *T. palmi* populations. Emamectin benzoate (Proclaim®) at various rates significantly reduced *T. palmi* adults and larvae. Azadirachtin (Azadirect™ 1.2) at rates between 17.3-21.5 oz/acre provided significant control of *T. palmi* adults.**

The melon thrips, *Thrips palmi* Karny, has continued to be an important pest of various vegetable crops in south Florida since the appearance of this invasive species in Miami Dade County in 1990. It was reported as a pest of vegetable crops in various countries of Asia (Yoshihara, 1982), Puerto Rico, Dominican Republic, and West Indies (Sakimura et al., 1986; Ciomperlik and Seal 2004). Severe infestations of melon thrips were recorded in Hawaii on cucurbits, eggplants, peppers and pigweeds in 1982 and 1983 (Nakahara, 1984). *T. palmi* has become a major pest of cucurbits, legumes, and fruiting and leafy vegetables in many countries in tropical and subtropical regions (Bhatti, 1980; Johnson, 1986; Nagai et al., 1981), and its feeding damage causes discoloration and deformation of foliage and fruits. *T. palmi* may cause total defoliation of host crops resulting into 70-90% economic loss (Seal et al., 1993). *T. palmi* causes damage to host crops worldwide by feeding and by vectoring viruses, most notably the tomato spotted wilt virus (TSWV) (Honda et al., 1989; Kameya-Iwaki et al., 1988; Sakimura 1961).

During the past two decades *T. palmi* has achieved a wide geographical distribution (Lewis, 1997a; Mound, 1997). *T. palmi* was first reported from Sumatra in 1925 (Karny, 1925), but this species has spread to several continents and it is a significant pest in Asia, Africa, Central and South America (Yoshihara, 1982; Nakahara, 1984; Wang and Chu, 1986; Jones, 1990; Kawai, 1990; Hall et al., 1993; Walker, 1992; Cermeli and Montagne, 1990; Mound, 1997), and the Caribbean (Guyot, 1988; Ciomperlik and Seal, 2004). *T. palmi* has also been reported from The Netherlands (Seal and Klassen, 1995).

Typically *T. palmi* infestation of eggplant begins on the older lower leaves but then moves upward to the middle and upper parts of the plant (Seal 2001). Populations of this thrips in the field tend to be significantly more abundant on the bottom or abaxial surfaces of the leaves than on the upper or adaxial surfaces, but the reverse has been observed in the greenhouse (Seal, 2001).

Growers rely on various insecticides to protect vegetable crops from *T. palmi*, but most labeled insecticides provide unsatisfactory control of this pest in the field (Seal et al., 1993). Spintor™ (spinosad, a fermentation by-product based compound derived from a naturally occurring soil actinomyces bacterium, *Saccharopolyspora spinosa*) currently is the most effective insecticide in providing effective control of *T. palmi* (Seal, 2004). Growers make as many as 2-3 foliar applications of various insecticides per week to control severe infestations of this pest. Since multiple applications of broad spectrum insecticides eliminate natural enemies, an unavoidable consequence is the rapid induction of secondary pest problems. Moreover target insects tend to develop resistance against a frequently used insecticide.

Effective insecticides are needed for use in rotation with Spintor to retard the development of resistance and to provide improved management of *T. palmi*. Thus the main objective of this study was to test the effectiveness of additional insecticides against *T. palmi*.

## Materials and Methods

Four studies were conducted to determine the effectiveness of various chemicals in controlling melon thrips.

*First study.* The first study was conducted in 2003 on 'Pod Squad' bush beans in a commercial farm located at Homestead, Fla. Beans were seeded on 4 Mar. 2003 on Krome gravely loam using a tractor-mounted two-row seeder planting 8 seeds per linear foot. Treatments evaluated were: 1) pyriproxyfen (Knack® 0.86EC, 0.05 lb. a.i./acre, Valent USA Corporation, Walnut Creek, Calif.); 2) pyriproxyfen (0.05 lb. a.i./acre) in combination with acephate (Orthene® 97, 0.75 lb. a.i./acre, Valent Corp.); 3) pyriproxyfen (0.05 lb. a.i./acre) in combination with fenpropathrin (Danitol® 2.4 EC, 0.30 lb. a.i./acre,Valent Corp.); 4) fenpropathrin (Danitol® 2.4 EC, 0.30 lb. a.i./acre,Valent Corp.) in combination with acephate (Orthene® 97, 0.75 lb. a.i./acre, Valent Corp.); 5) imidacloprid (Admire 2F, 0.25 lb. a.i./acre, Bayer Cropscience, Research Triangle Park, N.C.); and 6) a nontreated control. Each treatment plot consisted of three rows each 30 ft. long. The plots were arranged in a randomized complete block design with four replications. A 5 ft.-wide buffer of bare soil separated each replication. Imidacloprid was applied once at planting as a soil drench. Other treatments were applied foliarly by using a backpack sprayer with two nozzles per row. Foliar applications of all insecticides were made on four dates: 24 Mar., 1, 8 and 15 April. Treatments were evaluated 24 h after each application by using a binocular microscope (10×) to carefully identify and record the melon thrips adults, larvae and broad mites on each of five randomly selected leaves, one leaf/plant, per treatment plot.

*Second study.* In the second study 'Greensleeves' cucumbers were seeded 12 May 2004, 6 inch apart on raised beds each 8-in. high and 36-in. wide with 72 in. between bed-cen-

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ters. The soil was Krome gravely loam at the Tropical Research and Education Center, Homestead, Fla. Two weeks prior to setting transplants the beds were fumigated with MC-33 (67% methyl bromide and 33% chloropicrin) at 220 lb/acre. Each bed was supplied with one drip irrigation line and covered with 1.5-mil thick black polyethylene mulch. Cucumber plants were drip-irrigated twice daily. Fertilizer (N-P-K mix) was applied at 200-50-240 lb/acre. Weeds were controlled by soil-incorporating trifluralin (Treflan EC, 24 lb/acre) at 10 d before planting, supplemented during the middle of the season with mechanical cultivation. The treatment plots consisted of three rows each 30 ft. long. The plots were arranged in a randomized complete block design with four replications. A 5 ft.-wide buffer of bare soil separated each replication. Treatments evaluated in this study were: 1) two rates of emamectin benzoate (Proclaim® 5%, 0.1 and 0.15 lb. a.i./acre, Syngenta Crop Protection, Greensboro, N.C.), 2) spinosad (Spintor™ 2SC, 0.11 lb. a.i./acre, Dow AgroSciences LLC, Indianapolis, Ind.), and 3) a nontreated control. All insecticides were applied to the foliage on three dates- 17, 27 June and 6 July, 2004 using a backpack sprayer with two nozzles per row at 30 psi delivering 70 gal/acre. There was no phytotoxicity with any of the treatments. Evaluation of treatments was conducted 24 h after each application by collecting five randomly selected leaves, one leaf per plant per treatment plot. Leaves were placed in ziplock bags, transported to the laboratory and washed with 70% ethanol to separate melon thrips adults and larvae.

*Third study.* The third study was conducted in 2005 in a research plot at the Tropical Research and Education Center using 'Greensleeves' cucumber as a host crop. All materials and methods involved in this study were as described in the second study in cucumber in 2004. The seven treatments evaluated in this study were: 1) two rates of azadirachtin (Aza-Direct™ 1.2(%), 0.012 and 0.016 lb. a.i./acre, Gowan Company, Yuma, Ariz.); 2) imidacloprid (Admire 2F, 0.25 lb. a.i./acre, Bayer CropScience, Research Triangle Park, N.C.) at planting as a soil drench followed by foliar application of two rates of azadirachtin (Aza-Direct™ 1.2(%) at 0.012 and 0.016 lb. a.i./acre. 3) imidacloprid alone at 0.25 lb. a.i./acre as a soil drench at planting; 4) spinosad (Spintor™ 2SC, 0.13 lb. a.i./acre, Indianapolis, Ind.); and 5) a nontreated control.

*Fourth study.* In the fourth study, eight treatments with various formulations of azadirachtin (Aza-Direct™ 1.2(%). Ecozin® 3.0 and Neemix® 4.5) were evaluated to control *T. palmi* on cucumber. 'Greensleeves' cucumber was seeded in a Krome gravely loam soil on 28 Mar. 2005. Crop management and insecticide application and efficacy evaluation methods were as described in above studies using cucumber. Treatments evaluated in this study were: 1) three rates of azadirachtin (Aza-Direct™ 1.2 [%] 0.004, 0.006 and 0.012 lb. a.i./acre), 2) four rates of azadirachtin (Ecozin® 3% EC, 0.009, 0.012, 0.015 and 0.018 lb. a.i./acre) in combination with vegetable oil-surfactant (Amigo™, 1% v/v, Loveland Industries, Colo.), 3) azadirachtin (Neemix® 4.5, 0.009 lb. a.i.; Certis USA, Columbia, Md.), and 4) a nontreated control. Treatments were applied on five dates between 25 April and 24 May. Treatments were evaluated for degree of controlling of *T. palmi* 24 h after each application, i.e., on 26 April, 2, 12, 19 and 23 May.

*Data Analysis.* Data were analyzed using software provided by Statistical Analysis System release 6.03 (SAS Institute, Inc., Cary, NC; SAS Institute, 1988). General linear model procedures were used to perform analysis of variance. Means were separated by Duncan Multiple Range Test (DMRT) at the 0.05 level.

## Results and Discussion

The population abundance of the melon thrips was low during the first study. None of the insecticide treatments provided any reduction of melon thrips adults when compared with the nontreated control (Table 1). Knack® alone, Knack® plus Orthene®, and Knack® plus Danitol® provided control of melon thrips larvae when compared with the nontreated control (Table 2). Also Danitol® + Orthene® significantly reduced melon thrips larvae when compared with the nontreated control.

In the second study on cucumber, Proclaim® and Spintor® treatments significantly reduced melon thrips adults and larvae (Table 3) when compared with the nontreated control (Table 4). Mean numbers of melon thrips adults and larvae did not differ between two rates of Proclaim®. Spintor® at 7 oz/acre provided superior reduction of melon thrips.

In the third study, Aza-Direct™ treatments significantly reduced melon thrips adults on cucumber on all sampling dates when compared with the nontreated control (Table 5). Aza-Direct™ alone did not reduce melon thrips larvae when compared with the control (Table 6). Aza-Direct™ at 21.5 oz./acre preceded by Admire® at planting provided significant reduction of melon thrips larvae when compared with the nontreated control. Spintor® significantly reduced mel-

Table 1. Mean numbers of *Thrips palmi* adults per 20-leaf sample of bush bean treated with various insecticides in 2003.

| Treatment | Rate per acre | Mean number of *T. palmi* adults | | | | Overall mean |
|---|---|---|---|---|---|---|
| | | 25 Mar 03 | 2 Apr 03 | 9 Apr 03 | 16 Apr 03 | |
| Knack® | 8 oz | 2.40 a | 0.80 a | 0.55 a | 0.45 a | 1.05 a |
| Knack®<br>Orthene® | 8 oz<br>0.75 lb a.i. | 1.40 a | 0.95 a | 0.60 a | 0.95 a | 0.98 a |
| Knack®<br>Danitol® | 8 oz<br>0.30 lb a.i. | 2.10 a | 1.15 a | 0.65 a | 0.80 a | 1.18 a |
| Danitol®<br>Orthene® | 0.30 lb a.i.<br>0.75 lb a.i. | 2.35 a | 1.30 a | 0.55 a | 0.45 a | 1.16 a |
| Admire® | 16 oz | 1.60 a | 1.20 a | 0.80 a | 0.55 a | 1.05 a |
| Control | | 2.00 a | 1.45 a | 0.80 a | 0.45 a | 1.18 a |

Means within a column followed by the same letter or no letter do not differ significantly (P > 0.05; DMRT).

Table 2. Mean numbers of *Thrips palmi* larvae per 20-leaf sample of beans treated with various insecticides in 2003.

| Treatment | Rate per acre | Mean number of *T. palmi* larvae | | | | Overall mean |
|---|---|---|---|---|---|---|
| | | 25 Mar 03 | 2 Apr 03 | 9 Apr 03 | 16 Apr 03 | |
| Knack® | 8 oz | 4.00 b | 2.90 b | 1.05 b | 1.20 a | 2.29 bc |
| Knack®<br>Orthene® | 8 oz<br>0.75 lb a.i. | 3.50 b | 1.50 c | 0.85 b | 0.95 ab | 1.70 c |
| Knack®<br>Danitol® | 8 oz<br>0.30 lb a.i. | 9.05 a | 2.30 bc | 1.15 b | 1.05 ab | 3.39 ab |
| Danitol®<br>Orthene® | 0.30 lb a.i.<br>0.75 lb a.i. | 3.90 b | 1.50 c | 0.65 b | 0.65 ab | 1.68 c |
| Admire® | 16 oz | 7.40 a | 1.70 c | 0.95 b | 0.40 b | 2.61 bc |
| Control | | 4.30 b | 4.60 a | 2.90 a | 1.10 a | 3.23 a |

Means within a column followed by the same letter do not differ significantly (P > 0.05; DMRT).

Table 3. Mean numbers of *Thrips palmi* adults per 5-leaf sample of cucumber treated with various treatments, Spring 2004.

| Treatment | Rate per acre | Mean number of *T. palmi* adults/sample | | | Overall mean |
|---|---|---|---|---|---|
| | | 18 June 04 | 28 June 04 | 7 July 04 | |
| Proclaim® | 1.56 gm | 9.50 a | 8.75 b | 10.25 b | 4.33 b |
| Proclaim® | 2.35 gm | 3.25 a | 5.50 b | 7.50 b | 3.64 b |
| Spintor® | 7.0 oz | 0.25 b | 0.50 a | 0.25 c | 1.00 c |
| Control | | 9.75 a | 14.25 a | 17.00 a | 6.39 a |

Means within a column followed by the same letter do not differ significantly (P > 0.05; DMRT).

on thrips adults (Table 5) and larvae (Table 6). When adults and larvae are considered together, all treatments significantly reduced melon thrips adults and larvae when compared with the control (Table 7). However Admire® was ineffective in reducing melon thrips populations in the present study.

In the fourth study, population abundance of melon thrips on cucumber was medium at the initiation of this study. The various insecticide treatments did not reduce melon thrips adults when compared with the nontreated control (Table 8). The mean numbers of melon thrips larvae were sig-

Table 4. Mean numbers of *Thrips palmi* larvae per 5 leaf sample of cucumber treated with various treatments, Spring 2004.

| Treatment | Rate per acre | Mean number of *T. palmi* larvae/sample | | | Overall mean |
|---|---|---|---|---|---|
| | | 18 June 04 | 28 June 04 | 7 July 04 | |
| Proclaim® | 3.2 oz | 16.50 b | 17.00 b | 23.00 c | 18.83 b |
| Proclaim® | 4.8 oz | 11.25 b | 11.50 b | 17.00 c | 13.25 b |
| Spintor® | 7.0 oz | 1.50 c | 0.50 c | 0.75 d | 0.92 c |
| Control | | 44.50 a | 39.25 a | 39.00 a | 40.92 a |

Means within a column followed by the same letter do not differ significantly (P > 0.05; DMRT).

Table 5. Mean numbers of melon thrips adults per 3-leaf sample of cucumber treated with various insecticides.

| Treatments | Rate [oz]/acre | Mean number of melon thrips adults | | | | Overall mean |
|---|---|---|---|---|---|---|
| | | 11 June 04 | 18 June 04 | 25 June 04 | 2 July 04 | |
| | | Mean number of *T. palmi* adults/sample | | | | |
| Aza-Direct™ | 17.3 | 25.25 a-c | 12.75 b | 12.50 c | 13.00 b | 15.87 b |
| Aza-Direct™ | 21.5 | 19.75 b-d | 11.25 b | 12.50 c | 11.75 b | 13.81 bc |
| Admire®<br>Aza-Direct™ | 16.0<br>17.3 | 18.00 cd | 11.00 b | 10.00 cd | 10.75 b | 12.44 bc |
| Admire<br>Aza-Direct™ | 16.0<br>21.5 | 13.75 d | 12.50 b | 7.50 d | 11.25 b | 11.25 c |
| Admire® | 16.0 | 28.25 ab | 19.75 a | 17.25 b | 15.75 ab | 20.25 a |
| Spintor® | 8.0 | 4.75 e | 2.75 c | 3.25 e | 3.25 c | 3.50 d |
| Control | | 31.00 a | 21.50 a | 23.25 a | 20.75 a | 24.15 a |

Mean within a column followed by a same letter do not differ significantly (P > 0.05; DMRT).

Table 6. Mean numbers of melon thrips larvae per 3-leaf sample of cucumber treated with various insecticides.

| Treatments | Rate [oz]/acre | Mean number of *T. palmi* larvae/sample | | | | Overall mean |
|---|---|---|---|---|---|---|
| | | 11 June 04 | 18 June 04 | 25 June 04 | 2 July 04 | |
| Aza-Direct™ | 17.3 | 127.25 ab | 67.75 ab | 78.00 a | 39.50 a | 78.13 a |
| Aza-Direct™ | 21.5 | 103.25 ab | 60.75 bc | 63.75 ab | 36.50 a | 66.00 ab |
| Admire® | 16.0 | 89.75 ab | 57.25 bc | 61.25 ab | 36.75 a | 61.25 ab |
| Aza-Direct™ | 17.3 | | | | | |
| Admire® | 16.0 | 75.25 b | 48.25 c | 49.50 b | 27.75 a | 50.19 b |
| Aza-Direct™ | 21.5 | | | | | |
| Admire® | 16.0 | 120.25 ab | 66.50 ab | 81.25 a | 39.25 a | 76.81 a |
| Spintor® | 8.0 | 11.50 c | 10.50 d | 11.00 c | 7.25 b | 10.06 c |
| Control | | 133.50 a | 77.00 a | 76.75 a | 43.75 a | 82.75 a |

Mean within a column followed by a same letter do not differ significantly (P > 0.05; DMRT).

nificantly fewer in all treated plants on the first sampling date when compared with the nontreated control (Table 9). The mean numbers of larvae per sample had increased in all treatments by the second sampling date and did not differ from the control. By the third sampling date, Ecozin® at 10 oz/acre had significantly reduced mean numbers of melon thrips larvae per sample when compared with the control; but did not in relation to the other insecticidal treatments. By the fourth and fifth sampling dates, the mean numbers of larvae per sample had become significantly fewer in all treatments compared with the control. Based on the seasonal mean, Ecozin® at 10 oz/acre and Aza Direct™ at 16 oz/acre significantly reduced *T. palmi* larvae when compared with the control (Table 9). When adults and larvae are considered together

Table 7. Mean number of melon thrips (adult + larvae) per 3-leaf sample of cucumber treated with various insecticides.

| Treatments | Rate [oz]/acre | Mean number of adults plus larvae per sample | | | | Overall mean |
|---|---|---|---|---|---|---|
| | | 11 June 04 | 18 June 04 | 25 June 04 | 2 July 04 | |
| Aza-Direct™ | 17.3 | 152.50 ab | 80.50 bc | 90.50 ab | 52.50 ab | 94.00 ab |
| Aza-Direct™ | 21.5 | 123.00 ac | 72.00 cd | 76.25 ac | 48.25 ab | 79.88 bc |
| Admire | 16.0 | 107.75 bc | 68.25 cd | 71.25 bc | 47.50 ab | 73.69 bc |
| Aza-Direct™ | 17.3 | | | | | |
| Admire® | 16.0 | 89.00 c | 60.75 d | 57.00 c | 39.00 b | 61.44 c |
| Aza-Direct™ | 21.5 | | | | | |
| Admire® | 16.0 | 148.50 ab | 86.25 ab | 98.50 a | 55.00 ab | 97.06 ab |
| Spintor® | 8.0 | 16.25 d | 13.25 e | 14.25 d | 10.50 c | 10.50 c |
| Control | | 164.50 a | 98.50 a | 100.00 a | 64.50 a | 106.88 a |

Mean within a column followed by a same letter do not differ significantly (P > 0.05; DMRT).

Table 8. Mean numbers of melon thrips adults/5-leaf sample of cucumber treated with various formulations of azadirachtin, Spring 2005.

| Treatments | Rate [oz]/acre | Mean number of *T. palmi* adults/sample | | | | | Overall mean |
|---|---|---|---|---|---|---|---|
| | | 26 Apr. 05 | 2 May 05 | 12 May 05 | 19 May 05 | 23 May 05 | |
| Aza Direct™ | 5.00 | 16.75 a | 71.50 a | 29.00 a | 3.50 a | 4.25 b | 25.00 a |
| Aza Direct™ | 8.00 | 11.25 a-c | 39.75 a | 20.50 a | 3.50 a | 13.00 ab | 17.60 a |
| Aza Direct™ | 16.00 | 7.25 bc | 37.00 a | 20.00 a | 5.50 a | 10.75 ab | 16.10 a |
| Ecozin® +<br>Oil | 5.00<br>1.00% | 14.00 ab | 18.75 a | 24.50 a | 7.25 a | 9.50 ab | 14.80 a |
| Ecozin® +<br>Oil | 6.40<br>1.00% | 10.00 a-c | 45.00 a | 31.00 a | 4.50 a | 10.00 ab | 20.10 a |
| Ecozin® +<br>Oil | 8.00<br>1.00% | 11.25 a-c | 27.25 a | 30.00 a | 4.00 a | 6.50 ab | 15.80 a |
| Ecozin® +<br>Oil | 10.00<br>1.00% | 6.75 bc | 23.00 a | 23.50 a | 4.25 a | 7.50 ab | 13.00 a |
| Neemix® | 3.50 | 6.00 c | 39.75 a | 19.50 a | 4.75 a | 11.00 ab | 16.20 a |
| Control | | 13.00 | 48.00 a | 42.75 a | 6.75 a | 15.50 a | 25.20 a |

Means within a column followed by a same letter do not differ significantly (P > 0.05; DMRT).

Table 9. Mean numbers of melon thrips larvae/5-leaf sample of cucumber treated with various formulations of azadirachtin, Spring 2005.

| | | Mean number of *T. palmi* larvae/sample | | | | | |
|---|---|---|---|---|---|---|---|
| Treatments | Rate [oz]/acre | 26 Apr. 05 | 2 May 05 | 12 May 05 | 19 May 05 | 23 May 05 | Overall mean |
| Aza Direct™ | 5.00 | 1.50 c | 188.50 a | 125.25 ab | 5.00 b | 22.00 b | 68.45 ab |
| Aza Direct | 8.00 | 1.75 c | 121.75 a | 67.25 ab | 4.00 b | 21.50 b | 43.25 b |
| Aza Direct™ | 16.00 | 9.50 b | 75.75 a | 57.25 ab | 4.00 b | 19.00 b | 33.10 b |
| Ecozin® + Oil | 5.00 1.00% | 2.00 c | 134.25 a | 120.75 ab | 9.00 b | 20.00 b | 57.20 ab |
| Ecozin® + Oil | 6.40 1.00% | 4.25 bc | 121.75 a | 133.75 ab | 4.50 b | 18.00 b | 56.45 ab |
| Ecozin® + Oil | 8.00 1.00% | 8.25 b | 151.75 a | 63.75 ab | 3.00 b | 15.75 b | 48.50 ab |
| Ecozin® + Oil | 10.00 1.00% | 7.75 b | 70.00 a | 32.25 b | 2.50 b | 14.50 b | 25.40 b |
| Neemix® | 3.50 | 5.25 bc | 106.00 a | 147.00 ab | 5.00 b | 16.75 b | 56.00 ab |
| Control | | 19.00 a | 184.00 a | 179.00 a | 25.00 a | 53.00 a | 92.00 a |

Means within a column followed by a same letter or no letter do not differ significantly (P > 0.05; DMRT).

Table 10. Mean numbers of melon thrips (adult + larvae)/5-leaf sample of cucumber treated with various formulations of azadirachtin.

| | | Mean number of adults plus larvae per sample | | | | | |
|---|---|---|---|---|---|---|---|
| Treatments | Rate [oz]/acre | 26 Apr. 05 | 2 May 05 | 12 May 05 | 19 May 05 | 23 May 05 | Overall mean |
| Aza Direct™ | 5.00 | 18.25 b | 260.00 a | 154.25 ab | 8.50 b | 26.25 b | 93.45 ab |
| Aza Direct™ | 8.00 | 13.00 b | 161.50 ab | 87.75 ab | 7.50 b | 34.50 b | 60.85 ab |
| Aza Direct™ | 16.00 | 16.75 b | 112.75 b | 77.25 b | 9.50 b | 29.75 b | 49.20 b |
| Ecozin® + Oil | 5.00 1.00% | 16.00 b | 153.00 ab | 145.25 ab | 16.25 b | 29.50 b | 72.00 ab |
| Ecozin® + Oil | 6.40 1.00% | 14.25 b | 166.75 ab | 164.75 ab | 9.00 b | 28.00 b | 76.55 ab |
| Ecozin® + Oil | 8.00 1.00% | 19.50 b | 179.00 ab | 93.75 ab | 7.00 b | 22.25 b | 64.30 ab |
| Ecozin® + Oil | 10.00 1.00% | 14.50 b | 93.00 b | 55.75 b | 6.75 b | 22.00 b | 38.40 b |
| Neemix® | 3.50 | 11.25 b | 145.75 ab | 166.50 ab | 9.75 b | 27.75 b | 72.20 ab |
| Control | | 32.00 a | 232.00 a | 221.75 a | 31.75 a | 68.50 a | 117.20 a |

Means within a column followed by a same letter or no letter do not differ significantly (P > 0.05; DMRT).

(Table 10), population reduction of melon thrips on cucumber treated with azadiractin products followed a pattern similar to the reduction of the larvae (Table 9).

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