# Insecticidal Control of Thrips on Onions in South Texas: Insecticide Selection and Application Methodology

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## ABSTRACT

**A series of small plot efficacy trials were conducted in the Lower Rio Grande Valley of Texas to evaluate the efficacy of a carbamate (methomyl) and pyrethroid (cypermethrin and lambda-cyhalothrin) insecticides against the onion thrips (OT), *Thrips tabaci* Lindeman, and the western flower thrips (WFT), *Frankliniella occidentalis* (Pergande). Additional small plot studies were conducted to evaluate the effects of spray additives, nozzle type, spray pressure, and total spray volume on the efficacy of insecticides against thrips on onions. The pyrethroid insecticides were found to provide better control than the carbamate for OT, whereas the carbamate provided better control than the pyrethroids for WFT. Spray methodology and spray additives did not effect efficacy (minimum volume tested was 93.5 l/ha [10 GPA]).**

## RESUMEN

**Se condujeron una serie de pruebas en parcelas pequeñas en el Bajo Valle del Río Grande en Texas para evaluar la eficacia de un carbamato (metomil) y de los piretroides (cipermetrina y lambda-cialotrina) en contra de los trips de la cebolla (OT), *Thrips tabaci* Lindeman, y los trips de las flores del oeste (WFT), *Frankliniella occidentalis* (Pergande). Se condujeron estudios adicionales en parcelas pequeñas para evaluar los efectos del uso de aditivos, el tipo de boquilla, la presión del rociado y el volumen total asperjado sobre la eficacia de los insecticidas en contra de los trips en las cebollas. Se encontró que los piretroides controlaron mejor que el carbamato en el caso de *Thrips tabaci*, mientras que el carbamato ofreció mejor control que los piretroides en el caso de *Frankliniella occidentalis*. Ni el método de aspersión ni los aditivos utilizados afectaron la eficacia de los insecticidas (el volumen mínimo probado fue 93.5 l/ha [10GPA]).**

*Additional index words: onion thrips, western flower thrips, spray volume, spray additives*

Thrips are the primary arthropod pest of onions in south Texas. The thrips complex on onions consists of the onion thrips (OT), *Thrips tabaci* Lindeman, and the western flower thrips (WFT), *Frankliniella occidentalis* (Pergande). The onion thrips was reported as the predominant thrips on onions in the Lower Rio Grande Valley (LRGV) of Texas (Edelson 1985, Edelson et al. 1986, Wene and White 1952) and the WFT was reported as the predominant thrips during a two year study in Crystal City (Harding 1961). Surveys conducted in 1993 and 1994 demonstrated that the thrips complex on onions in the LRGV consists of both species, with populations from individual fields varing from 100 % of either species to equal densities of both (Sparks, unpublished data). Densities of both species are generally very low until early spring but can exceed hundreds per plant by harvest. Thrips damage onions by puncturing leaf tissue and feeding on plant juices. Significant yield reductions have been demonstrated with populations averaging as low as 1 thrips per plant throughout the production season (Royer et al. 1986). Yield reductions result from a reduction in bulb size which can effect both total yield and value per pound (Edelson et al. 1989). In addition to direct damage to the plant, thrips injury provides entry sites for disease organisms which compounds impacts on yield and quality (McKenzie et al. 1993). Thus, management of thrips is paramount to production of onions in south Texas.

Insecticides, used as necessary, are the primary management tool for thrips on onions. Commercial producers may apply insecticides 3 to 10 times per season for control of thrips (Edelson et al. 1986, Royer et al. 1986). Species composition within a field can vary greatly within a short time (Sparks and Anciso, unpublished data) and may effect the efficacy of pesticide applications. Furthermore, although thrips feed throughout the leaf surface on onions, they tend to aggregate at the base of onion leaves between axils (Edelson et al. 1986, Royer et al. 1986). This location likely provides some protection from contact insecticides. High volume sprays and use of spray additives to attempt to penetrate this protective environment are frequently suggested for maximizing treatment efficacy. However, data to support these suggestions in onions are lacking.

These studies were conducted to evaluate the efficacy of selected insecticides against each of the species of the south Texas thrips complex on onions and to evaluate the effects of application methodology on efficacy. Application methodology evaluated in these studies included spray nozzle selection, spray volume, spray pressure, and spray additives.

## MATERIALS AND METHODS

Eight small plot efficacy studies were conducted in commercial fields or at the Texas Agricultural Research and Extension Center in the LRGV from 1990 through 1997. Four studies were conducted in locations with thrips populations consisting primarily of OT (88.5-99.5 %) and four studies were conducted with populations consisting primarily of WFT (90.7-99.7 %). Thrips complex composition was determined for each test by collecting adults from across the test area prior to application and examining these adults in the laboratory.

The number of treatments varied between tests; however, for this publication only data for a standard carbamate insecticide, methomyl (Lannate, E.I. Du Pont de Nemours and Company, Wilmington, DE 19898), and a standard pyrethroid insecticide, cypermethrin (Ammo, FMC Corporation, Philadelphia, PA 19103 [except 1996 when lambda-cyhalothrin (Karate, Zeneca Ag Products, Wilmington, DE 19850) was used]) are presented. The experimental design in all studies was a randomized complete block with four replications. Plot size varied from 1 to 3 beds wide (each 1 m [40 in] bed with two rows of onions on a 25 cm [10 in] spacing) and 4.57 to 12.2 m (15 to 40 feet) long (Table 1). Treatment methodology and dates are presented in Table 1. Thrips densities were sampled in each test by random selection of 5 plants per plot (except the WFT 1993 and 1994 tests in which 3 plants were selected per plot on one sample date and 5 on all others) and counting all thrips on each plant.

Three small plot studies were conducted to evaluate the effects of application methodology and spray additives on the performance of insecticides against thrips on onions. In 1990, two studies were conducted in commercial onion fields. Both tests were established as randomized complete block designs with four replications. Experimental plots measured two 1 m (40 in) beds by 6.1 m (20 ft) in both tests. The first test was conducted to evaluate the effects of selected spray additives on insecticide efficacy. All additives (Table 2) were applied as a broadcast application with methomyl at a rate of 1 kg ai/ha (0.9 lb ai/ac) with a $CO_2$ pressurized backpack sprayer (467.7 l/ha [50 GPA], 3.52 kg/cm$^2$ [50 PSI], 2 TX10 hollow cone nozzles per bed). A single application was made on 23 Jan. The second study in 1990 was conducted to evaluate the effects of nozzle selection, spray volume, and spray pressure on insecticide efficacy. The combinations of nozzle selection, spray pressure, and total volume tested are presented in Table 3. Spray volume within hollow cone nozzle treatments was manipulated by varying boom speed. This test was treated twice; once with methomyl at 1 kg ai/ha (0.9 lb ai/ac) on 2 March, and once with cypermethrin at 0.112 kg ai/ha (0.1 lb ai/ac) on 12 March. Thrips in both tests were sampled by counting all thrips on 5 randomly selected plants per plot. Pretreatment samples indicated that the thrips populations in both studies consisted primarily of OT.

The 1994 OT test also included an evaluation of a spray additive (Silwet L-77, Loveland Industries LTD., Greeley, CO 80632) and spray volume. Applications were made as indicated in Table 1 with the addition of treatments of reduced total volume and treatments with Silwet L-77 mixed with each insecticide at a rate of 0.625 ml/l (8 oz/100 gal) of total spray (Table 4). Thrips were sampled as previously described.

Data in all of the studies were analyzed with the GLMprocedure of PC-SAS (SAS Institute Inc., 1988). Where significant differences were determined to exist ($P<0.05$), means were separated with Duncan's multiple range test ($P=0.05$). Although all of the treatments in each test were included in the analysis, only data for the treatments of specific concern are presented in this manuscript.

**Table 1.** Plot size and treatment application information for small plot insecticide efficacy studies targeted at onion thrips (OT) and western flower thrips (WFT) on onions in the Lower Rio Grande Valley of Texas

| Test | Plot size[a] | Spray volume[b] | Nozzles[c] per bed | Application dates |
|---|---|---|---|---|
| | | (l/ha) | | |
| WFT 1993 | 1 by 7.62 | 467.7 | 3 | Feb. 27; Mar. 8, 16, 19 |
| OT 1993 | 1 by 7.62 | 233.8 | 2 | Feb. 9, 12, 20 |
| WFT 1994 | 1 by 7.62 | 280.6 | 3 | Mar. 11, 18 |
| OT 1994 | 3 by 7.62 | 280.6 | 3 | Mar. 4, 11, 18 |
| WFT 1995 | 1 by 6.10 | 280.6 | 2 | Mar. 17, 24 |
| WFT 1996 | 1 by 7.62 | 280.6 | 3 | Mar. 19 |
| OT 1996 | 2 by 12.19 | 280.6 | 3 | Feb. 12, 19; Mar. 6, 19 |
| OT 1997 | 2 by 4.57 | 280.6 | 3 | Jan 29; Feb. 4, 21; Mar. 3, 21 |

[a]Plot size presented as width (number of 1 m [40 in] beds) by length in m (4.57 m = 15 ft; 6.1 m = 20 ft; 7.62 m = 25 ft; 12.19 m = 40 ft).

[b]233.8 l/ha = 25 GPA; 280.6 l/ha = 30 GPA; 467.7 l/ha = 50 GPA.

[c]Nozzle arrangement was 2 nozzles per bed over-the-top on 0.5 m (20 in.) spacing, or three nozzles per bed (1 over-the-top, 2 on drops). TX10 hollow cone nozzles were used in all tests. All treatments were applied with a $CO_2$ pressurized backpack sprayer at 2.81 kg/cm$^2$ (40 PSI).

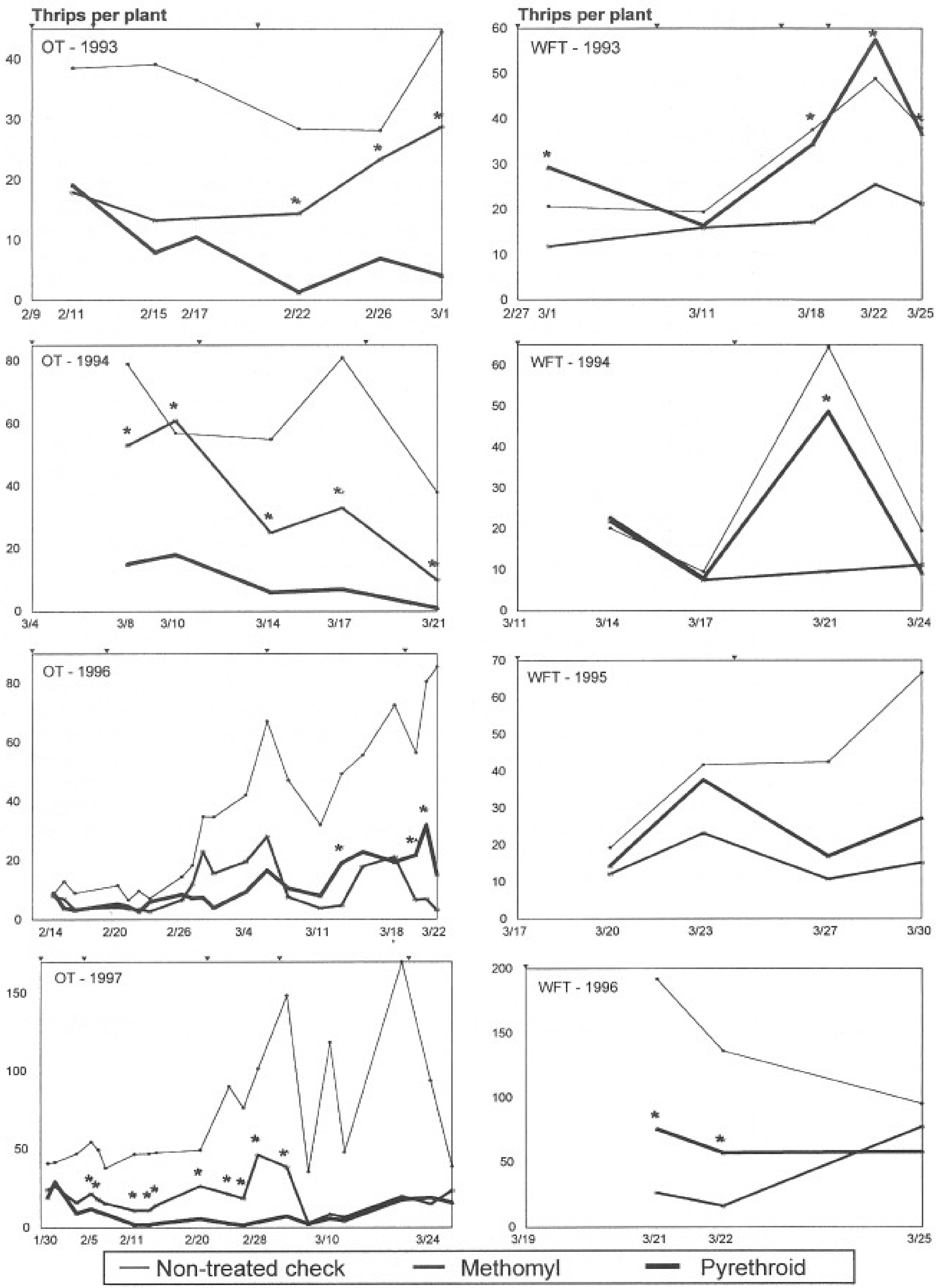


**Fig. 1.** Mean number of thrips per plant in selected treatments from small plot efficacy studies conducted in the Lower Rio Grande Valley of Texas. Tests were conducted in locations with the thrips complex consisting primarily of onion thrips (OT) or western flower thrips (WFT). Application dates are indicated at the top of each graph. An asterisk (*) above sample points indicates a significant difference (DMRT, P=0.05) between the carbamate and pyrethroid treatments.

## RESULTS AND DISCUSSION

Results for the eight efficacy studies are presented in Fig. 1. For the two full season tests (OT-1996 and OT-1997), only sample dates immediately prior to or within 10 days after an application are included. The results for the onion thrips efficacy studies generally indicate improved efficacy with cypermethrin as compared to methomyl. In the one OT test in which lambda-cyhalothrin was used as a standard (OT - 1996), only minor differences occurred between lambda-cyhalothrin and methomyl. However, in the OT-1994 test, both pyrethroids were included and performed equally better than methomyl (Table 4). This information supports previous findings by Royer et al. (1987, 1988) which indicated that the pyrethroid insecticides provided excellent control of OT. The apparent occasional reduction in efficacy of the pyrethroids in experimental plots and reports of similar problems in commercial fields may be indicative of potential pyrethroid resistance in OT and should be monitored.

Results of the WFT tests, as compared to the OT tests, demonstrate the need to identify the species present prior to selecting an insecticide for control. Whereas the pyrethroids generally provided good control of OT, they generally showed little or no impact on WFT. Where differences existed among treatments for the WFT in the 1993, 1994 and 1996 tests, the carbamate insecticide consistently provided better control than the pyrethroid. In the 1995 WFT test, no differences occurred within a sample date, but differences were consistent enough that analysis across sample dates indicated a significant difference with methomyl providing improved control as compared to the pyrethroid. Additional data for WFT (Sparks and Anciso 1994 and unpublished data) indicated that the organophosphate insecticides performed similar to the carbamates against WFT, with improved control as compared to the pyrethroids.

Results of the spray additive and application methodology tests are presented in Tables 2-4. The spray additives appeared to have little effect on efficacy. In the 1990 spray additive test, only three of the additive treatments showed a significant reduction in populations as compared to the untreated check at 3 days after treatment, and none of these were significantly different from the insecticide without additive treatment (Table 2). By 6 days after treatment, no differences were detected among treatments. Similar results were seen with Silwet L-77 (Table 4, comparisons of the 280.6 l/ha treatments with an

**Table 2.** Thrips densities following application of methomyl (Lannate) applied with selected spray additives.

| Spray additive | Rate[a] | Number of thrips per 5 plants [b] 3 DAT | 6 DAT |
|---|---|---|---|
| | % by volume | | |
| Non-treated check | | 163 a | 142 a |
| Triton B-1956 | 0.625 ml/l (0.0625 %) | 134 ab | 120 a |
| NuFilm 17 | 0.58 l/ha (0.125 %) | 132 abc | 113 a |
| Leaf Act 80 | 0.625 ml/l (0.0625 %) | 130 abc | 96 a |
| LI 700 | 2.5 ml/l (0.25 %) | 104 bc | 108 a |
| Methomyl alone | | 122 abc | 85 a |
| X 77 | 0.625 ml/l (0.0625 %) | 89 c | 106 a |
| Plex | 0.58 l/ha (0.125 %) | 94 bc | 92 a |

[a]0.625 ml/l = 8 oz/100 gal; 2.5 ml/l = 32 oz/100 gal; 0.58 l/ha = 8 oz/ac.

[b]Means within columns followed by the same letter are not significantly different (DMRT; P=0.05).

**Table 3.** Thrips densities following applications of methomyl (Lannate applied March 2) and cypermethrin (Ammo applied March 12) using specified application methodology.

| Nozzle | Pressure[a] | Spray[b] Volume | Number of thrips per 5 plants[c] Mar. 5 | Mar. 16 | Mar. 19 |
|---|---|---|---|---|---|
| | $kg/cm^2$ | l/ha | | | |
| Non-treated check | | | 235 a | 163 a | 228 a |
| Hollow cone | 3.52 | 93.5 | 149 a | 34 b | 117 b |
| Hollow come | 3.52 | 374.1 | 168 a | 37 b | 103 b |
| Hollow cone | 3.52 | 748.3 | 93 a | 45 b | 145 b |
| Hollow cone | 7.03 | 93.5 | 149 a | 39 b | 146 b |
| Hollow cone | 7.03 | 374.1 | 139 a | 37 b | 104 b |
| Hollow cone | 7.03 | 748.3 | 102 a | 34 b | 114 b |
| Flat fan | 3.52 | 374.1 | 73 a | 31 b | 102 b |
| Flat fan | 7.03 | 374.1 | 126 a | 21 b | 130 b |
| Twin jet | 7.03 | 374.1 | 157 a | 48 b | 101 b |

[a]3.52 $kg/cm^2$ = 50 PSI; 7.03 $kg/cm^2$ = 100 PSI.

[b]93.5 l/ha = 10 GPA; 374.1 l/ha = 40 GPA; 748.3 l/ha = 80 GPA.

[c]Means within columns followed by the same letter are not significantly different (DMRT; P=0.05).

**Table 4.** Mean densities of onion thrips following applications of selected insecticides with and without Silwet L-77 and at varying spray volumes.

| Treatment | Spray[a] volume | Mean thrips per plant[b] | | | | |
|---|---|---|---|---|---|---|
| | | Mar. 8 | Mar. 10 | Mar. 14 | Mar. 17 | Mar. 21 |
| Non-treated check | l/ha | | | | | |
| Methomyl+Silwet | 280.6 | 79 a | 57 a | 55 a | 81 a | 38 a |
| Methomyl | 93.5 | 75 a | 47 b | 21 b | 27 b | 7 bc |
| Methomyl | 280.6 | 54 b | 33 c | 20 b | 31 b | 7 bc |
| Cypermethrin+Silwet | 280.6 | 53 b | 61 a | 25 b | 33 b | 10 b |
| Cyperthrin | 93.5 | 22 c | 26 cd | 9 c | 6 c | 2 c |
| Cyperthrin | 280.6 | 17 cd | 12 e | 4 c | 4 c | 2 c |
| Lambda-cyhalothrin | 280.6 | 15 cd | 18 de | 6 c | 7 c | 1 c |
| | | 12 cd | 9 e | 4 c | 4 c | 1 c |

[a]93.5 l/ha = 10 GPA; 280.6 l/ha = 30 GPA.

[b]Means within columns followed by the same letter are not significantly different (DMRT; P=0.05).

d without Silwet L-77). With the less efficacious product, methomyl, the addition of Silwet L-77 showed decreased efficacy on the first sample, increased efficacy on the second sample and no difference in the last three samples. With the more efficacious product, cypermethrin, no differences occurred between the 280.6 l/ha with and without Silwet L-77 treatments.

As with the spray additives, application methodology also showed little impact on insecticide efficacy. Results from the test evaluating nozzle selection, spray pressure, and spray volume showed no effect on insecticidal efficacy (Table 3). The initial application with methomyl did not significantly effect thrips density. Following the application with cypermethrin, all insecticide treatments significantly reduced thrips density, but no differences occurred among application methodology treatments. Results were similar for comparisons of the spray volume treatments in the 1994 OT test (Table 4). In comparison of the 93.5 and 280.6 l/ha treatments, no differences were detected on 4 of the 5 sample dates. The only significant difference occurred with methomyl on March 10, with the lower volume treatment providing better control.

In general, the results of the spray methodology studies indicated that within the methods tested, spray additives, nozzle selection, spray pressure and total spray volume had no significant effect on efficacy. This suggests that spray coverage is not limiting efficacy of thrips control in onions within the range tested (minimum of 93.5 l/ha [10 GPA]). Furthermore, the addition of various spray additives and high volume sprays did not appear to improve penetration of the protective environment of the neck of the onion.

These studies indicate that identification of the species of thrips present prior to selection of an insecticide for control is an integral part of thrips management in onions. Proper insecticide selection is much more crucial than application methodology.

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