COMPARISON OF AERIAL AND GROUND APPLIED THIAMETHOXAM (ACTARA™ & CENTRIC™) FOR CONTROL OF COTTON PESTS

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Abstract

Thiamethoxam, is a second-generation neonicotinoid insecticide being developed for the control of many sucking and chewing pests on a wide array of crops. In cotton, thiamethoxam provides excellent control of aphids, tarnished plant bugs, whiteflies, thrips, and fleahoppers with very low application rates. Thiamethoxam has unique chemical properties which allow it to rapidly penetrate plant tissue to provide a reservoir of active ingredient which is active against leaf feeding pests. The chemodynamic properties of thiamethoxam result in a high degree of pest selectivity. Therefore, it is well suited for use in integrated pest management programs. In addition, these unique properties allow thiamethoxam to be applied by a variety of application methods and provide consistent pest control. Field studies conducted during 1998 and 1999 indicate that pest control with thiamethoxam applied by air or ground is equivalent.

Introduction

Thiamethoxam, a thianicotinyl insecticide in the class neonicotinoid, is currently under development by Novartis Crop Protection for the control of many sucking and chewing pests on a variety of crops. Thiamethoxam exhibits rapid plant uptake and is xylem-transported to untreated portions of the plant. Due to its systemic nature, a variety of application methods may be used to apply thiamethoxam.

Research conducted with foliarly applied thiamethoxam has indicated excellent control of tarnished plant bug, *Lygus lineolaris*, cotton aphids, *Aphis gossypii*, whiteflies, *Trialeurodes abutiloneus*, *Bemisia tabaci*, *B. argentifolii*, cotton fleahoppers, *Pseudatomoscelis seriatus*, and thrips, *Frankliniella fusca* at use rates of 0.047 – 0.062 lbs ai/A. (Ferguson et al. 1999, Lawson et al., 1999, Parker, 1999). However, most of the efficacy trials conducted to present have been applied with ground application equipment. Therefore, studies were initiated during 1998 and 1999 to determine how efficacious thiamethoxam is when applied with aerial application equipment.

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 2:1330-1333 (2000)
National Cotton Council, Memphis TN

Chemodynamic Properties of Thiamethoxam

Thiamethoxam has a low molecular weight (291.7), low octanol-water partition coefficient (-0.13) and relatively high water solubility (4,100 mg/l) all of which favor rapid and efficient plant uptake. Thiamethoxam is only transported in the xylem of the plant. This systemic movement results in the protection of plant parts situated acropetally from the application site. Metabolism of thiamethoxam in the plant is slow, resulting in insect control for an extended period of time.

Studies indicate that thiamethoxam applied to foliage is rapidly translocated into the plant. By the time the spray has dried, 15% of the amount of active ingredient applied has already translocated into the leaf. After 28 hours, 24% of the amount of active ingredient applied has been translocated into the foliage. Once thiamethoxam moves into a leaf, it is locally systemic and quickly moves throughout the leaf to provide uniform insect protection (Fig. 1). This results in thiamethoxam being rainfast as soon as spray droplets have dried. In addition, leaf surface residues are rapidly degraded by light and moisture. Therefore, thiamethoxam has minimal impact on beneficial species while providing excellent pest control.

Objectives

The objective of this research was to determine if thiamethoxam applied using aerial and ground spray equipment resulted in similar pest control.

Materials and Methods

During 1998 and 1999 trials were conduced in California, Louisiana, and Mississippi to determine how aerial and ground applied thiamethoxam performed.

Mississippi, 1998

During 1998 two aerial trials were conduced at Novartis's Delta research station in Greenville, Mississippi. In each study a comparison was made between thiamethoxam applied using a fixed wing airplane delivering 2 gallons per acre and a ground sprayer delivering 10 gallons per acre. In one study, thiamethoxam was applied at a rate of 0.062 lbs ai/A to 1.8 acre unreplicated plots. Tarnished plant bugs were evaluated before the application and at 4 and 8 days after the application. Evaluations were made at four locations per plot using a drop cloth and counting all of the nymphs per 2 meters of row. In the second trial, thiamethoxam was applied at a rate of 0.047 lbs ai/A to one acre unreplicated plots using a fixed wing airplane and a ground sprayer. Whiteflies were evaluated before the application and at 4 and 8 days after the application by counting the total number of adult whiteflies on 10 leaves from three locations within each plot.

Mississippi, 1999

During 1999 one aerial trial was conduced at Novartis's Delta research station in Greenville, Mississippi. In this study cotton aphid control was evaluated when thiamethoxam and Provado® (imidacloprid) were applied using a fixed wing airplane delivering 2 gallons per acre. Thiamethoxam and Provado® where applied at a rate of 0.047 lbs ai/A to 2 acre unreplicated plots. Cotton aphids were evaluated before the application and at 3, 9 and 14 days after the application at four locations per plot by counting the number of aphids on ten leaves per location.

Louisiana, 1999

During 1999 one aerial trial was conducted at Louisiana State Universities' Macon Ridge Research Station. In this trial, cotton aphids, tarnished plant bugs, and beneficial insects were evaluated when thiamethoxam was applied using a fixed wing airplane delivering 3 gallons per acre and a ground sprayer delivering 10 gallons per acre. Thiamethoxam was applied at a rate of 0.047 lbs ai/A and Furadan® (carbofuran) was applied using ground equipment at a rate of 0.25 lbs ai/A. Aphids were evaluated by counting the total number of aphids per 10 terminals per replicate at 4 and 8 days after the application. Tarnished plant bugs and various beneficial insects where evaluated 6 days after the application by using a drop cloth and counting all of insects per cloth. In addition to individual beneficial insect species evaluations, an evaluation of the total number of all beneficial insect species in the plot was made.

California, 1999

During 1999 one aerial trial was conduced in Lemoore, California. Cotton aphid control was compared when thiamethoxam and Provado® were applied using a fixed wing airplane delivering 5 gallon per acre. Thiamethoxam (0.047 lbs ai/A) and Provado® (imidacloprid) (0.047 lbs ai/A) + Silwet (0.25% vol./vol.) were applYed to replicated plots (45 X 200 feet). Cotton aphids were evaluated by counting the total number of aphids per ten leaves in the upper and lower one-third of the plant canopy from each replicate. Evaluations were made before and at 3, 8, and 14 days after the application.

Results

In the 1998 Mississippi trials, thiamethoxam provided excellent control of whiteflies and tarnished plant bugs whether applied by air or ground (Fig. 2 & 3). Control of tarnished plant bug was slightly better when thiamethoxam was applied by air compared to the ground application. However, this may have resulted because the tall rank cotton interfered with good coverage when the ground sprayer was used compared to the aerial application. Results from the second study indicate that whitefly control with thiamethoxam was similar whether the application was made with air or ground spray equipment. Both treatments resulted in a substantial reduction in adult whiteflies and this control was evident for at least 8 days after the application.

In the 1999 Mississippi trial, thiamethoxam and Provado® provided excellent control of cotton aphids when applied by air (Fig. 4). Aphid populations increased dramatically to over 400 aphids per leaf in the control plot 3 days after the application. However, in the thiamethoxam and Provado® treatments, aphid populations were reduced to 10 and 27 aphids per leaf, respectively. By 9 days after the treatment the aphid population in the control plots had decreased and meaningful comparisons could no longer be made.

In the 1999 Louisiana trial, tarnished plant bug control with thiamethoxam applied by ground or air was statistically the same when evaluated 6 days after the application (Fig. 5). Four days after the application, cotton aphid control with thiamethoxam applied by air was statistically equivalent, but numerically higher than the ground applications of thiamethoxam and Furadan® (Fig. 6). However, by 8 days after the application, the level of control in the aerial and ground applied thiamethoxam and Furadan® treatments were equal. At both evaluation dates, the ground application of thiamethoxam provided the same level of aphid control as Furadan applied at 0.25 lbs ai/A.

Evaluations made 6 days after the application indicate that beneficial insect populations in the thiamethoxam treatments were equal to or greater than the untreated check (Fig. 7). However, there appeared to be a slight trend of fewer beneficial insects in the ground applied thiamethoxam plots compared to the aerial applied treatments. In all of the beneficial counts, except the *Geocoris spp*. evaluations, Furadan® treated plots had significantly fewer beneficial insects than thiamethoxam or check plots.

Evaluation of cotton aphid control in the California trial indicated that both thiamethoxam and Provado® + Silwet provided excellent control of aphids in the top one-third of the plant canopy at all evaluations (Fig. 8). Even though the aphid population continued to increase to more than 100 aphids per leaf in the top one-third of the plant canopy in the control plots, applications of both thiamethoxam and Provado® + Silwet provided almost 100% control from 3 to 14 days after the application. However, evaluations made in the bottom one-third of the plant canopy indicate that thiamethoxam provided better aphid control than Provado® + Silwet (Fig. 9). Evaluation made 3 and 8 days after the application indicate that Provado® + Silwet had significantly lower aphid populations than in the control plots. However, aphid counts in the thiamethoxam plots were statistically lower than in the Provado® + Silwet treatment. These results indicate that thiamethoxam is more effective at penetrating

the plant canopy or moving within the plant to control insects located lower in the plant canopy than Provado® + Silwet.

Conclusion

Thiamethoxam, a neonicotinoid insecticide in the subclass thianicotinyl, is being developed by Novartis Crop Protection for control of a wide array of chewing and sucking pests. In cotton, thiamethoxam provides excellent control of tarnished plant bug, *Lygus lineolaris*, cotton aphids, *Aphis gossypii*, whiteflies, *Trialeurodes abutiloneus*, *Bemisia tabaci*, *B. argentifolii*, cotton fleahoppers, *Pseudatomoscelis seriatus*, and thrips, *Frankliniella fusca*. Chemodynamic properties of thiamethoxam suggest that pest control should not be adversely effected when applied with aerial spray equipment. Therefore, thiamethoxam was examined for it ability to control key cotton pests when applied with air and ground equipment. Results indicated that the performance of thiamethoxam against aphids, whiteflies, and tarnished plant bugs was excellent and that application with air or ground equipment resulted in equivalent pest control. Results also indicate that thiamethoxam provided better control of aphids in the lower portions of the cotton plant canopy than did Provado® + Silwet. Thiamethoxam is being developed as a foliar applied product for cotton under two trade names, Centric™ for mid south cotton and Actara™ for western cotton. Registration of these formulations is expected in 2000 and 2001.

References

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Parker, R. D. 1999. New insecticides for control of cotton fleahopper and impact of drought on production. Proceedings of the 1999 Beltwide Cotton Conference, pp. 1055-1056.

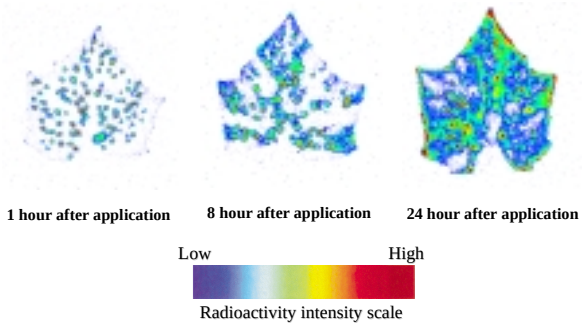


Figure 1. Distribution of C^{14} Labeled Thiamethoxam after a Foliar Application of Cucumber Leaves

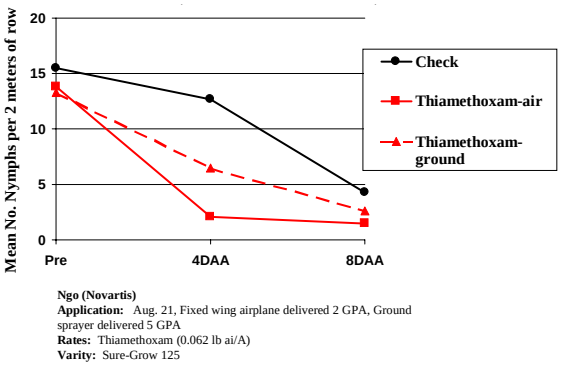


Figure 2. Tarnished Plant Bug Control with Thiamethoxam Applied by Air and Ground (Greenville, MS, 1998).

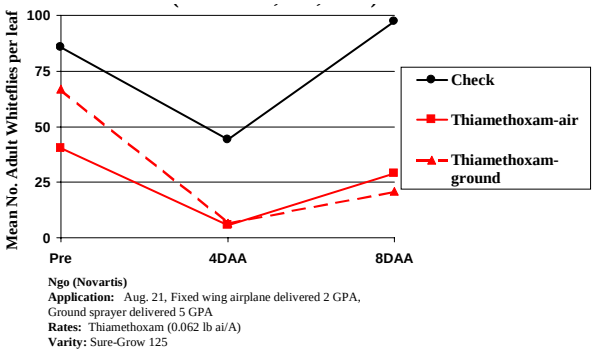
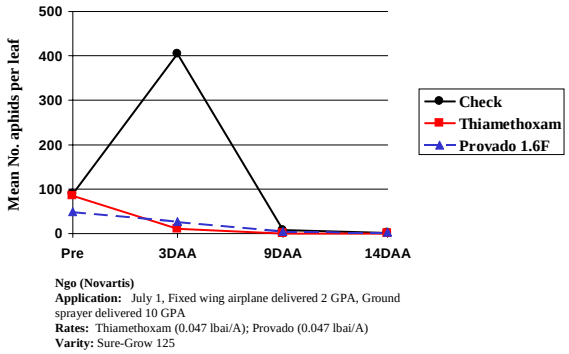
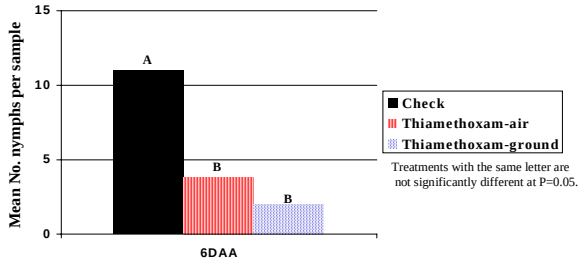


Figure 3. Whitefly Control with Thiamethoxam Applied by Air and Ground (Greenville, MS, 1998)



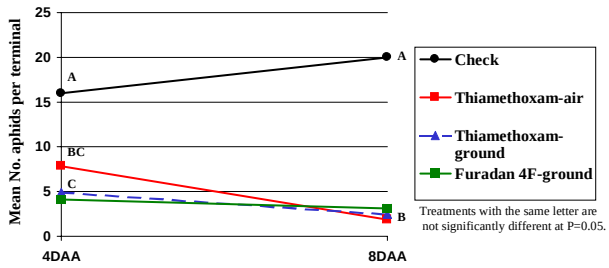
Ngo (Novartis)
Application: July 1, Fixed wing airplane delivered 2 GPA, Ground sprayer delivered 10 GPA
Rates: Thiamethoxam (0.047 lbai/A); Provado (0.047 lbai/A)
Varity: Sure-Grow 125

Figure 4. Cotton Aphid Control with Thiamethoxam Appied by Air (Greenville, MS, 1999).



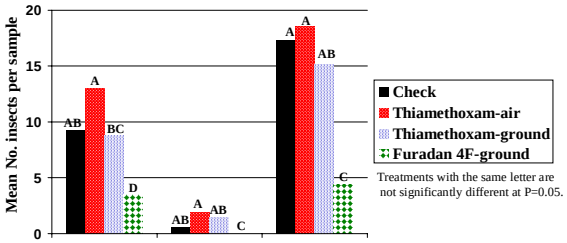
Leonard (LSU)
Application: July 29, Fixed wing airplane delivered 3 GPA, Ground sprayer delivered 10 GPA
Rates: Thiamethoxam (0.047 lb ai/A)
Varity: Sure-Grow 821

Figure 5. Tarnished Plant bug Control with Thiamethoxam Applied by Air and Ground (LSU, Macon Ridge, 1999)



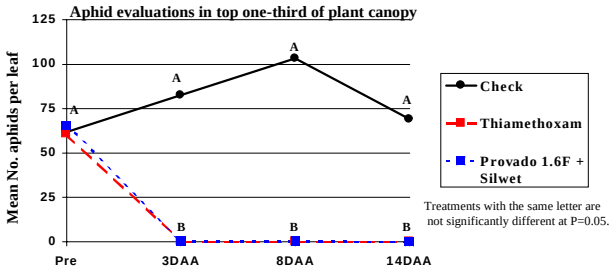
Leonard (LSU)
Application: July 29, Fixed wing airplane delivered 3 GPA, Ground sprayer delivered 10 GPA
Rates: Thiamethoxam (0.047 lb ai/A), Furadan ® (0.25lbai/A).
Varity: Sure-Grow 821

Figure 6. Cotton Aphid Control with Insecticides Applied by Air and Ground (LSU, Macon Ridge, 1999)



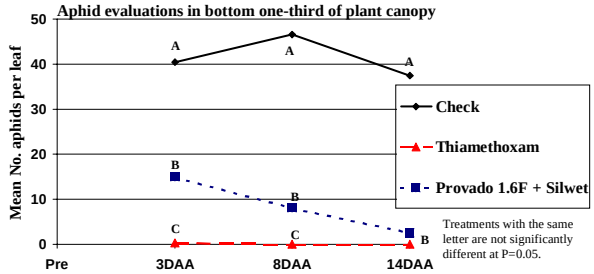
Leonard (LSU)
Application: July 29, Fixed wing airplane delivered 3 GPA, Ground sprayer delivered 10 GPA
Rates: Thiamethoxam (0.047 lb ai/A), Furadan ® (0.025 lb ai/A)
Varity: Sure-Grow 821
Evaluations: Beneficial insects were evaluated August 4.

Figure 7, Impact of Insecticides on Beneficial Insects in Cotton (LSU, Macon Ridge, 1999).



Application: Aug. 17, Fixed wing airplane, 5 GPA.
Rates: Thiamethoxam (0.047 lb ai/A), Provado® (0.047lbai/A) + Silwet (0.25%).
Varity: BXN-47

Figure 8. Cotton Aphid Control in California with Aerial Applied Insecticides (Lemoore, CA, 1999).



Application: Aug. 17, Fixed wing airplane, 5 GPA.
Rates: Thiamethoxam (0.047 lb ai/A), Provado® (0.047lbai/A) + Silwet (0.25%).
Varity: BXN-47.

Figure 9. Cotton Aphid Control in California with Aerial Applied Insecticides (Lemoore, CA, 1999).