DO TANK MIXES OF INSECTICIDES AND FUNGICIDES AFFECT THRIPS CONTROL?

Brian A. Nault[1], Cynthia L. Hsu and Christy A. Hoepting
Associate Professor[1]
Department of Entomology
Cornell University, New York State Agricultural Experiment Station
Geneva, NY 14456

Onion thrips, *Thrips tabaci*, is a key pest of onion and their control is vital to the production and profitability of this crop. If onion thrips are not controlled, damage can routinely reduce bulb yields by 30-50%. Such losses might be compounded if thrips infect the crop with *Iris yellow spot virus* or create damage to permit other pathogens to infect the crop. Insecticides continue to be the most important tools for thrips control. Most onion fields need protection against thrips for one to two months and multiple applications are required to control infestations, but there are few labeled insecticides that provide effective and consistent control.

In fall 2008, spinetoram (Radiant SC) became labeled in the US. Radiant is arguably one of the best products registered for controlling onion thrips on onion. Radiant belongs to a novel class of chemistry called the Spinosyns and it has both contact and ingestion activity. The mode of action targets the insect's nervous system and causes involuntary muscle contractions, paralysis and ultimately death. Radiant has local systemic action and becomes translaminar in the plant tissue. To ensure that spinetoram penetrates the waxy leaf surface of the onion leaves, a methylated crop oil or non-ionic surfactant is recommended.

In 2009 and 2010, spirotetramat (Movento) and abamectin (Agri-Mek 0.15EC) were awarded Section 18s for onion thrips control in New York. Movento is a systemic insecticide that belongs to a novel class of chemistry called tetramic acid. The product is active through ingestion and inhibits lipid biosynthesis, which causes acute poisoning and finally death. Because Movento must penetrate the plant to become systemic, it must be mixed with a spray adjuvant that has both spreading and penetrating properties. Agri-Mek belongs to a novel class of chemistry called the Avermectins and is active primarily through ingestion, but there is some contact activity. Agri-Mek attacks the nervous system and causes irreversible paralysis. Like Radiant, Agri-Mek has limited systemic activity, but will move into plant tissue to provide residual control. For both Movento and Agri-Mek, methylated crop oil or non-ionic surfactants are generally recommended to improve efficacy. To our knowledge, no studies have compared efficacy of these new products when used in combination with different types of penetrating surfactants (e.g., methylated seed oil derivatives, non-ionic surfactants and organosilicones). Information about which adjuvants improve efficacy of products to control thrips and those that do not would be highly valuable to growers.

Insecticides and fungicides are routinely tank mixed and applied as foliar sprays to protect the onion crop from thrips and foliar diseases. This strategy is efficient because it saves time and fuel by pulling the sprayer through the field one time instead of twice. However, there is increasing concern that this tank mixing strategy may reduce the performance of these newer insecticides because most fungicides are formulated to contain a spreader sticker, which may inhibit penetration of the insecticide into plant tissues and reduce efficacy. This is a serious concern because growers can not afford to use an expensive insecticide that is not performing as

well as it should. Moreover, if these insecticides have shorter residual activity when tank mixed with a fungicide, applications may be needed more frequently and this could exacerbate resistance development. The purpose of this study was to evaluate the efficacy of insecticides with or without the commonly used fungicide, chlorothalonil, for managing onion thrips. Additionally, several types of penetrating surfactants were evaluated in combination with these treatments to determine if they impacted the performance of the insecticides.

Materials & Methods

This study was conducted in a commercial onion field near Elba, NY. The field was established by transplanting the cultivar 'Red Bull' on April 12, 2010. Control of onion thrips was evaluated using the insecticides mentioned previously combined with several penetrating surfactants and a fungicide. The insecticides were Agri-Mek SC (@ 3.2 fl oz/ acre), Movento (@ 5 fl oz/ acre) and Radiant SC (@ 6 fl oz/ acre). The penetrating surfactants were a non-ionic surfactant (Induce @ 0.5% v:v), a methylated spray oil concentrate (MSO @ 2 pts/ acre) and an organosilicone surfactant (Silwet L-77). The broad-spectrum fungicide chlorothalonil (Chloronil 720 @ a rate of 3 pts/ acre), which contains a synthetic spreader sticker, and Bond Max (0.25% v:v), which is a synthetic latex spreader sticker, were used. Controls were also included such that the insecticide was applied without a penetrating surfactant and/or without a fungicide or sticker. The experiment was a 3 (insecticide) x 4 (penetrating surfactant) x 3 (fungicide/ sticker) factorial with each treatment replicated 4 times and all treatments arranged in a randomized complete block design. Plots were a single 20-ft long row flanked by untreated rows. No insecticides or fungicides, other than the ones in this experiment, were applied to the test site prior to or during this trial.

Treatments were applied at 42 gallons per acre and 40 psi using a CO_2-pressurized backpack sprayer equipped with a single, twin flat-fan nozzle (TJ60-8004VS). Plots were initially sprayed on 22 June when plants had an average of 21.1 larvae per plant (2.3 per leaf). An additional application was made on 30 June. Efficacy of treatments was evaluated by recording the number of onion thrips larvae per plant from 15 randomly selected plants per plot 7, 14 and 19 days after the first application. Adults were not recorded because they move between plots and their presence does not always reflect the efficacy of the treatment.

Mean cumulative densities of thrips larvae per leaf over the three sampling dates were considered the dependent variable and were analyzed using ANOVA (PROC MIXED), with insecticide, penetrating surfactant and fungicide/ sticker as fixed in the model and replication as a random factor. All mean treatment comparisons were made using Tukey-Kramer at $P<0.05$. To determine residual efficacy of insecticides, a repeated measures ANOVA (PROC MIXED) was conducted with the main treatment effects considered fixed in the model, and unstructured, first-order autoregressive covariance structures used to model covariance between the treatments and sampling dates. Before all analyses were performed, numbers of thrips were transformed using a $\log_{10}(x + 1)$ function. All non-transformed data are presented in this report.

Results. The onion thrips infestation was high and increased during the study. The mean cumulative number of thrips larvae in the untreated control on Day 19 was 298.5 ± 66.8 per plant. The mean cumulative number of thrips larvae per plant was significantly affected by all main effect terms in the model (insecticide, penetrating surfactant and fungicide/ sticker). Additionally, significant interactions existed between most of the main effects. Thus, the results section will focus on these interactions.

Insecticide x penetrating surfactant. Overall, the best thrips control was provided by Radiant followed by Movento and then Agri-mek **(Fig. 1).** Thrips control improved significantly when Movento was combined with a penetrating surfactant. This was true numerically for Agri-Mek, though the difference was not significant **(Fig. 1).** In contrast, Radiant did not show much improvement when combined with a penetrating surfactant **(Fig. 1)**. Agri-Mek provided a similar level of thrips control regardless of the type of penetrating surfactant, whereas Movento and Radiant seemed to work better when combined with Silwet L-77 than with either Induce or MSO, but this difference was not statistically significant **(Fig. 1).**

Insecticide x fungicide/ sticker. Thrips control was reduced for each insecticide when the fungicide Chloronil was included **(Fig. 2)**. Surprisingly, thrips control was not negatively impacted by the inclusion of the spreader sticker Bond Max **(Fig. 2)**. These results suggest that either chlorothalonil is responsible for reducing efficacy of these insecticides, or that the type or quantity of the spreader sticker in the Chloronil formulation is considerably different than the formulation in Bond Max.

Penetrating surfactant x fungicide/ sticker. Despite the fact that Chloronil reduced insecticide efficacy, inclusion of a penetrating surfactant overcame this problem **(Fig. 3)**. Induce and Silwet were more effective than MSO, but this difference was not statistically significant **(Fig. 3).**

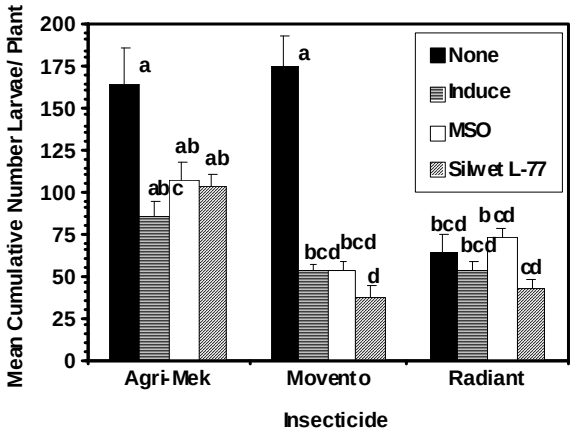

Figure 1. Impact of insecticide and penetrating surfactant mixtures (pooled across fungicide/sticker treatments) on Thrips control (n=4). Means (± SEM) with similar letters are not significantly different at *P*>0.05 (Tukey-Kramer).

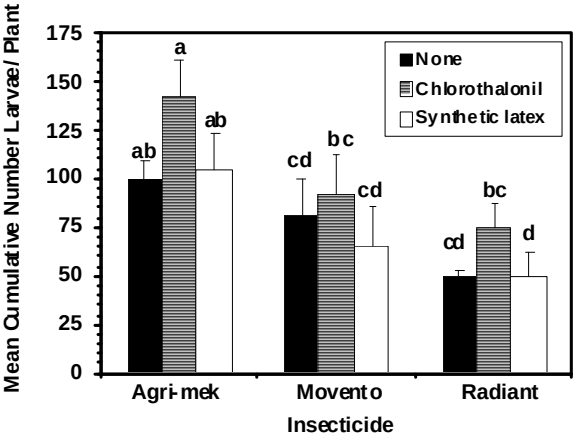

Figure 2. Impact of insecticide and fungicide/ sticker mixtures (pooled across penetrating surfactants) on thrips control (n= 4). Means (±SEM) with similar letters are not significantly different at *P*>0.05 (Tukey-Kramer).

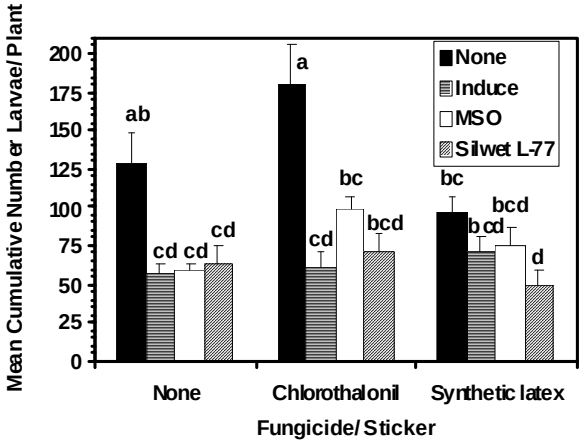

Figure 3. Impact of penetrating surfactant and fungicide/ Sticker mixtures (pooled across insecticides) on thrips control (n= 4). Means (±SEM) with similar letters are not significantly different at *P*>0.05 (Tukey-Kramer).

Thrips control through time. The first application for all treatments was made when the thrips population averaged 21.1 thrips per plant (Day 0), but despite this application thrips densities increased in all treatments by Day 7 **(Fig. 4)**. With the exception of the treatments of Agri-Mek and Movento that did not include a penetrating surfactant, thrips densities declined after the second application (see drop in densities from Day 7 to Day 14) (**Fig. 4**). Thrips densities began to increase in all Agri-Mek and Radiant treatments from Day 14 to 19. The efficacy of these products may have broken down sometime between 7 and 12 days after the second application **(Fig. 4).** In contrast, thrips densities in all Movento treatments continued to decline between Day 14 and 19, indicating that it continued to be efficacious 12 days after the second application **(Fig. 4)**.

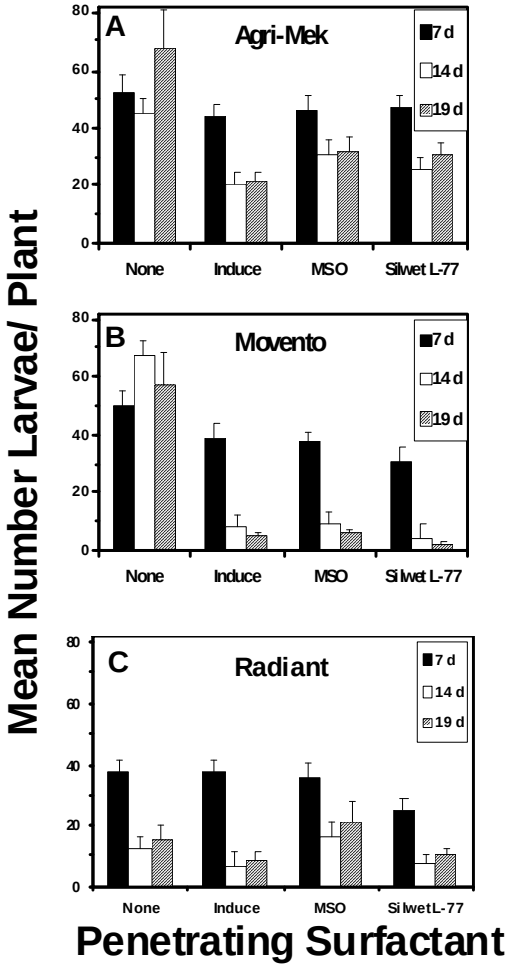

Figure 4. Impact of insecticide and penetrating surfactant mixtures (pooled across fungicide/sticker treatments) on thrips control through time (n=4). Bars indicate standard errors for each mean.

Discussion

Insecticides continue to be an invaluable tool for managing onion thrips on onion. Newer products have novel modes of action and biological properties compared with classical pyrethroid, carbamate and organophosphate products, and research is needed to determine how to use these new products most effectively. In this study, inclusion of Chloronil with either Agri-Mek, Movento or Radiant as a tank mix reduced the efficacy of thrips control compared with using the insecticides without Chloronil. The reason for this phenomenon is not known. Results from this study also revealed that the reduction in thrips control that occurred when Chloronil was included in the tank mix can be mitigated if a penetrating surfactant is included. Therefore, a tank mix that includes the insecticide, Chloronil and a penetrating surfactant should provide an acceptable level of thrips control. More research is needed to determine if rate of the penetrating surfactant used in the insecticide and fungicide tank mix is important for controlling thrips.