Special Research Report #215: Effects of Pesticide Mixtures in Controlling Arthropod Pests of Greenhouses

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BACKGROUND

Western flower thrips (*Frankliniella occidentalis*) is the most destructive insect pest of greenhouse-grown horticulture crops. They cause direct and indirect damage to plants. Direct damage is associated with western flower thrips feeding on plant cells, which results in the deformation of leaves and flowers, making the flowers unmarketable. Indirect damage is caused when adults transmit tospoviruses e.g., the impatiens necrotic spot virus (INSV). Therefore, to mitigate populations of western flower thrips, greenhouse producers rely on insecticide applications. Often, however, multiple insect and/or mite pest species including thrips, mealy bugs, mites, aphids, whiteflies and fungus gnats are present simultaneously during a single cropping cycle. Consequently, greenhouse producers apply pesticides (insecticides and miticides) as mixtures, which may broaden the spectrum of pest activity. This results in the mitigation of populations of multiple insect and/or mite pests that greenhouse producers may encounter simultaneously. There is, however, little quantitative research on the impact of pesticide mixtures in regulating populations of western flower thrips. Therefore, the objectives of our study were three-fold: (1) to examine compatibility and phytotoxicity of the most commonly used two-way pesticide mixtures against the western flower thrips, (2) to determine synergistic (enhanced) or antagonistic (negative) effects of the two-way mixtures under laboratory conditions, and (3) to assess the efficacy of currently used two-way and three-way pesticide mixtures against the western flower thrips under greenhouse conditions.

MATERIALS AND METHODS

1. Pesticide Compatibility and Plant Phytotoxicity

Jar tests were performed to determine the visual compatibility of the designated pesticide mixtures. The mixtures were applied to determine any phytotoxicity (plant injury) to a variety of horticultural plants including: chrysanthemum, petunia, marigold, impatiens, begonia and coleus.

2. Formulated Pesticide Bioassays

Bean-dip laboratory bioassays were conducted to determine the lethal dose (LC_{50}) values for the formulated pesticides containing abamectin (Avid), acephate (Orthene), azadirachtin (Ornazin), bifenazate (Floramite), bifenthrin (Talstar), fenpropathrin (Tame), imidacloprid (Marathon), novaluron (Pedestal), pymetrozine (Endeavor) and spinosad (Conserve). The mortality of western flower thrips adults was assessed after 24-hours.

3. Formulated Pesticide Mixture Bioassays

Bean-dip laboratory bioassays (similar to those described above in #2) were used to determine LC_{50} values for each formulated two-way pesticide mixture. The rate of each pesticide used in the mixture was based on the highest recommended labeled rates for western flower thrips, and for products not registered for western flower thrips; the highest recommended labeled rate was used. Concentrations of both pesticides were either increased or decreased proportionally to calculate an LC_{50} value for each mixture. The mortality of western flower thrips adults was assessed after 24-hours.

4. Greenhouse Experiments

Three experiments were conducted in greenhouses at Kansas State University to evaluate the efficacy of the formulated pesticides as well as two- and three-way pesticide mixtures. Yellow cut transvaal daisy (*Gerbera jamesonii*) flowers were used in the three experiments. Individual flowers were processed and placed into 22-mm glass vials containing tap water (Figure 1). After 2 days, approximately 20 western flower thrips adults obtained from our laboratory-reared colonies were aspirated into vials, added to each flower, and allowed to establish for 2 days before application (spray) of the pesticide treatments. Efficacy of each pesticide and pesticide mixture was based on percent mortality of western flower thrips adults.

Figure 1. Experimental design for the greenhouse experiments showing the transvaal daisy (*Gerbera jamesonii*) flowers that were inoculated with western flower thrips (*Frankliniella occidentalis*) adults.

RESULTS

1. Pesticide Compatibility and Plant Phytotoxicity

Each of the two-way pesticide mixtures displayed no visible signs of incompatibility and none of the two-way pesticide mixtures was phytotoxic to any of the floricultural plants tested.

2. Formulated Pesticide Bioassays

Spinosad (Conserve) had the lowest LC_{50} value. This indicated that it was the most toxic to the population of western flower thrips followed by abamectin (Avid), acephate (Orthene), and bifenthrin (Talstar).

3. Formulated Pesticide Mixture Bioassays

Those pesticide mixtures containing spinosad (Conserve) had the lowest LC_{50} values indicating the highest toxicity to adult western flower thrips followed by most of the pesticide mixtures containing abamectin (Avid).

4. Greenhouse Experiments

The results associated with the greenhouse experiments are presented in Figures 2 to 4. For experiment one, most of the pesticide mixtures provided approximately 80 percent mortality of western flower thrips (Figure 1). In experiment two, most of individual treatments and pesticide mixtures resulted in nearly 100 percent mortality of western flower thrips; whereas, the other pesticides resulted in minimal mortality of western flower thrips (Figure 2). For experiment three, most of the individual pesticide treatments and pesticide mixtures resulted in ≥80 percent western flower thrips mortality; however, a number of pesticide treatments resulted in ≤15 percent western flower thrips mortality (Figure 3).

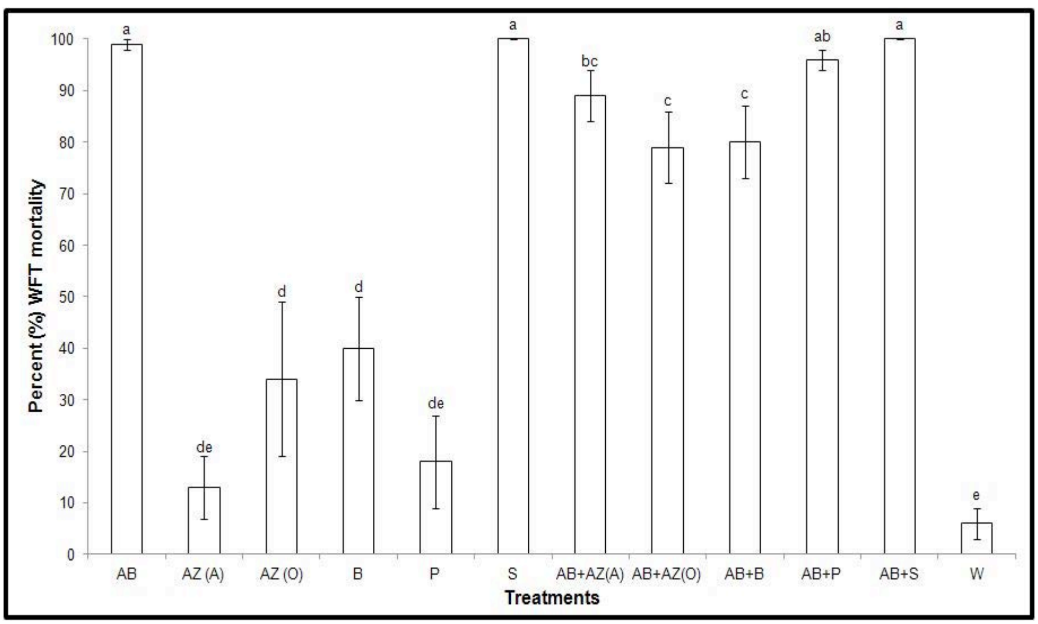

Figure 2. Percent mortality of western flower thrips (WFT) associated with six formulated pesticides and four pesticide mixtures under greenhouse conditions. Treatment designations: AB=abamectin (Avid); AZ(A)=azadirachtin(Azatin); AZ(O)=azadirachtin(Ornazin); B=bifenthrin (Talstar); P=pymetrozine (Endeavor); S=spinosad (Spinosad); and W=water. Bars with the same letter are not significantly different from each other. Vertical bars indicated the standard error of the mean.

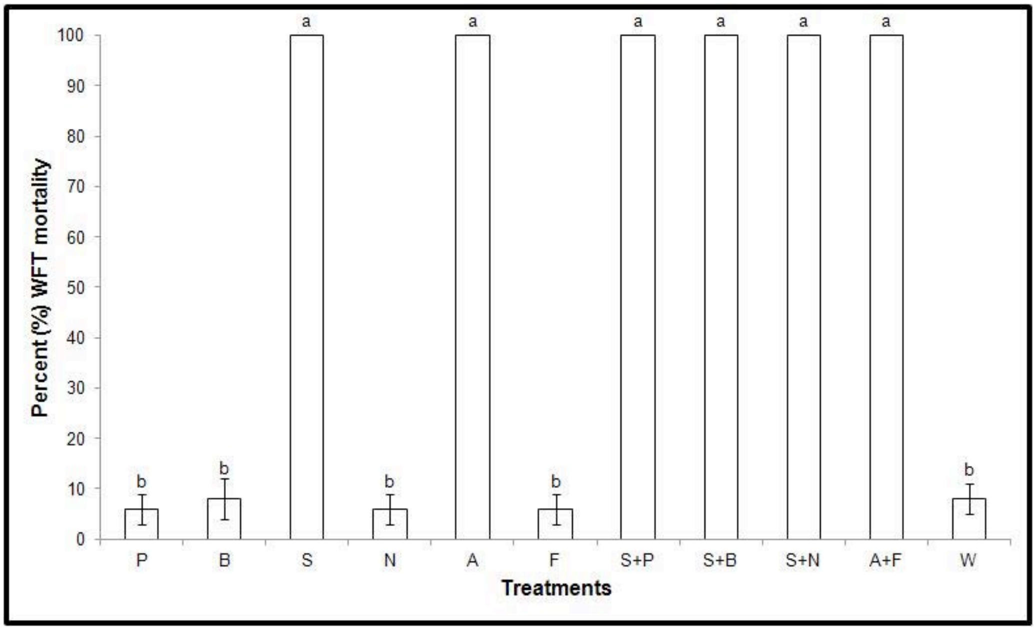

Figure 3. Percent mortality of western flower thrips (WFT) associated with six formulated pesticides and five pesticide mixtures under greenhouse conditions. Treatment designations: P=pymetrozine (Endeavor); B=bifenazate (Floramite); S=spinosad (Conserve); N=novaluron (Pedestal); A=acephate (Acephate); F=fenpropathrin (Tame); and W=water. Bars with the same letter are not significantly different from each other. Vertical bars indicated the standard error of the mean.

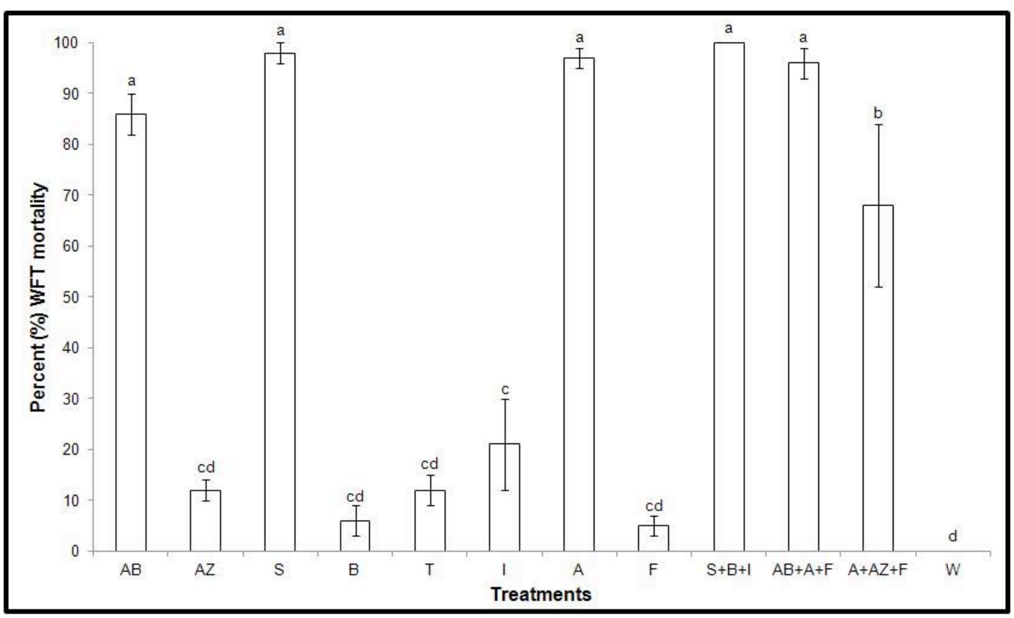

Figure 4. Percent mortality of western flower thrips (WFT) associated with six formulated pesticides and five pesticide mixtures under greenhouse conditions. Treatment designations: AB=abamectin (Avid); AZ=azadirachtin(Azatin); S=spinosad (Conserve); B=bifenazate (Floramite); T=tolfenpyrad (Hachi-Hachi); I=imidacloprid (Marathon); A=acephate (Orthene); F=fenpropathrin (Tame); and W=water. Bars with the same letter are not significantly different from each other. Vertical bars indicated the standard error of the mean.

CONCLUSIONS

None of the two-way pesticide mixtures currently being used in greenhouses were phytotoxic to the floricultural plants. In addition, most of the two-way pesticide mixtures provided 80 percent mortality of western flower thrips under greenhouse conditions. Greenhouse producers may use many of the pesticide mixtures evaluated in our study when attempting to mitigate insect and/or mite pest populations simultaneously with no detrimental effects against western flower thrips.

INDUSTRY IMPACT

This research will assist greenhouse producers who plan to use pesticide mixtures against western flower thrips populations. The studies provide greenhouse producers information to understand which pesticide mixtures will or will not be effective against populations of western flower thrips.

The research aims to prevent the use of ineffective mixtures, which result in financial losses and crop damage. Using only effective mixtures saves time, money and may enable greenhouse producers to use fewer mixture applications.

For Detailed Information Associated With This Study Refer To The Following Publication:

Willmott, A. L., R. A. Cloyd, and K. Y. Zhu. 2013. Efficacy of pesticide mixtures against the western flower thrips (Thysanoptera: Thripidae) under laboratory and greenhouse conditions. Journal of Economic Entomology 106(1): 247-256.

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