Identifying Causes of Mite Flaring in Apples

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European red mite (ERM), *Panonychus ulmi* (Koch) (Acari: Tetranychidae) is a species of importance among the plant feeding mites of apples, and without biological control acaricides are often needed to prevent economic injury (Cranham & Helle 1985). ERM causes injury to the plant by piercing the top layer of the apple leaf and extracting the content out of the epidermal cells, resulting in bronzing effect and necrosis (Pfeiffer and Schultz 1986). This can lead to leaf abscission and poor quality fruit (Garman and Townsand 1938). The predator mite, *Neoseiulus fallacis* (Garman) (Acari: Phytoseiidae) is a principal mite predator on apple trees in mid-western and eastern commercial apple orchards (Welty 1995). Adult *N. fallacis* overwinter in orchard ground cover and migrates to trees in May and June. High populations of *N. fallacis* and other predacious mites, in relative to ERM numbers, indicate a high likelihood of biological control, reducing the necessity of acaricide sprays.

"The predatory mite, Neoseiulus fallacis plays an important role in biological control of European red mite in apple orchards. The toxicity of insecticides from the pyrethroid, carbamate, spinosyn, neonicotinoid, diamide and insect growth regulator (CSI) classes on N. fallacis can result in a mite-flaring response of European Red Mite egg and motile populations. This study showed that two insecticides (Sevin and Delegate) had the greatest mite flaring effect."

The 1996 Food Quality Protection Act (FQPA) (USEPA 1996) resulted in the US Environmental Protection Agency (EPA) eliminating or restricting the use of many of organophosphate (OP) and carbamate insecticides that apple growers had relied upon for pest management in the 20th century. FQPA required that all registrations for pesticides used in food production be reconsidered for continued registration. Since that time, the EPA also allowed for expedited registration of OP-replacement and reduced-risk insecticides (USEPA 1997) have been introduced, to help fill the void of tools in the apple IPM tool-box (Wise and Whalon 2009, Agnello et al 2009). Since then there have been reports from farmers of mite flaring events (ie; outbreaks) in association with the use of some of the new OP-replacement and reduced-risk compounds (Irish-Brown & Gut 2009). It is not clear, however, which specific insecticides or combinations of materials may be responsible for the observed mite flaring.

Materials and Methods

Researchers in MSU's Department of Entomology conducted a three year study to document mite flaring events in association with six classes of insecticides and tank-mix combinations, and to determine the toxicity of these compounds to the predator, *N. fallacis*, following exposure to direct spray or dry field-aged residues on foliage (Jamil RZ, 2014). Test materials, novaluron (Rimon), spinetoram (Delegate), rynaxypyr (Altacor), acetamiprid (Assail), esfenvalerate (Asana) and Carbaryl (Sevin) were applied twice with labeled rates and dates associated with first generation codling moth control, to 'Red Delicious' apple trees at the Trevor Nichols Research Center in Fennville, MI with an FMC 1029 airblast sprayer calibrated to deliver 100 gpa at 2.5 mph. Mite population evaluations were conducted by picking 50 leaves from each replicate tree, and ERM and predator mites were removed with a mite-brushing machine and counted under a stereo microscope. The predator mite direct spray toxicity study included the same insecticides as described above, and used a Potter spray tower to topically dose *N. fallacis* adults, which were then monitored for mortality over 96 hours. The predator mite residual toxicity study included the same insecticides applied to apple trees with an airblast sprayer, with *N. fallacis* adults exposed to field-aged residues on apple foliage at 1, 7, 14 and 21 days post-application, then monitored for survival over 96 hours.

Results

Evidence of Mite-flaring: The synthetic pyrethroid, esfenvalerate, showed the highest incidence of mite flaring in the two-year study, followed by the neonicotinoid acetamiprid (Figure 1). Tank-mix combinations of the fruit thinner carbaryl with nearly

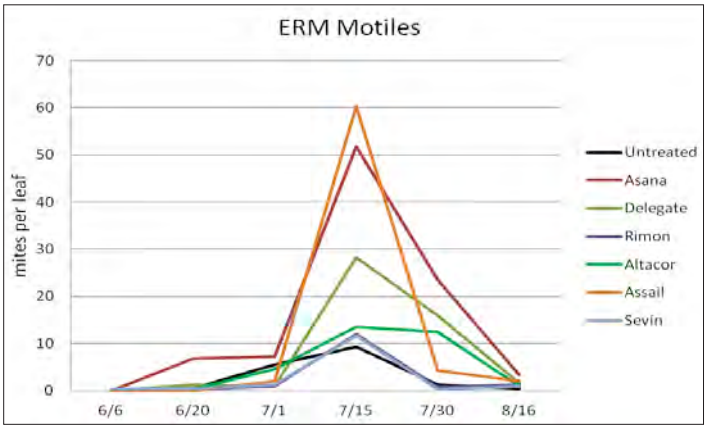

Figure 1. 2011 Mite flaring seasonal trends for ERM motiles in apples after two treatment sprays.

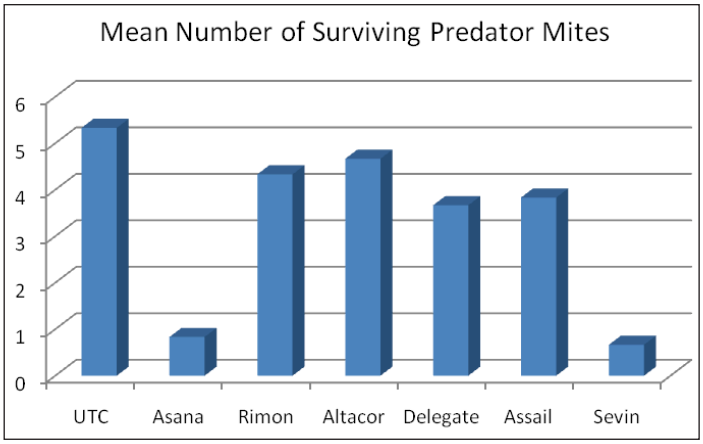

Figure 2. 2011 Toxicity bioassay of insecticides on predator mites (*N. fallacis*) resulting from direct spray.

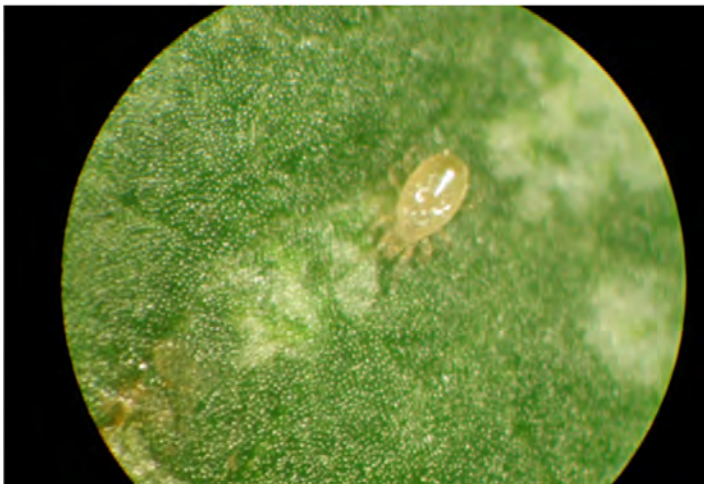

Figure 3. Adult predator mite *N. fallacis* on an apple leaf. Image by Z. Jamil.

any other material also resulted in consistent mite-flaring (data not shown). The insecticides spinetoram, novaluron, and rynaxypyr also showed incidences of heightened ERM motiles numbers, but often not resulting in ERM populations over action thresholds.

Toxicity to Mite Predators: Asana and Sevin were highly toxic to *N. fallacis* as direct sprays, whereas minimal effects were seen from the other compounds, compared to the untreated check (Figure 2). In residual field-aged bioassays Sevin and Delegate caused significant mortality to *N. fallacis*, whereas the other compounds showed minimal effects. The toxicity resulting from exposure to foliar residues diminished for Delegate after 7 days of field aging, whereas Sevin remained toxic for 21 days after the spray.

Discussion

The mite-flaring from synthetic pyrethroids, like esfenvalerate, are primarily associated with direct spray toxicity and stimulative effects of these compounds on ERM. Mite-flaring seen with neonicotinoids, like acetamiprid, are believed to be associated primarily with stimulative (ie; hormolygosis) effects on ERM, since little to no toxicity to mite predators were observed. In our studies the apple thinner carbaryl was shown to have the broadest overall lethality

to mite predators from wet and dry residue exposure, and evoked the longest duration of negative effects on *N. fallacis* (Figure 3).

New insecticides in the spinosyn, diamide, neonicotinoid and IGR classes will continue to be important tools for apple IPM, but judicious use can help minimize mite flaring events in the future.

Summary

The toxicity of insecticides from the pyrethroid, carbamate, spinosyn, neonicotinoid, diamide and insect growth regulator (CSI) classes on *N. fallacis* was measured based on topical and foliar residual exposure (1, 7, 14 , 21 days) bioassays. The mite-flaring response of European Red Mite egg and motile populations was greatest for Sevin and Asana insecticides.

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