

Leaf Bioassays, Foliar Residues and Tolerances on Marketable Blueberries

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Spotted wing drosophila (SWD) has established itself as the most economically damaging pest to blueberry production in the Pacific Northwest. Growers have responded to the challenge of controlling SWD through calendar spray programs and attempted resistance management (IRM). To maximize market flexibility, growers should initially adopt the most restrictive spray program followed by a cautious re-introduction of insecticides to meet changing field conditions and market demands. Access to regionally specific degradation curves, will allow growers the ability to utilize a wider range of insecticides including those with more marginally acceptable tolerance levels, through careful seasonal application timing and PHI adjustment to safely reach target MRL levels. Despite its predictable late season population build-up, SWD damage in early and mid-season blueberry varieties still remains challenging due to a lack of predictable trends. Concurrent berry crops such as red raspberry, wild Himalayan blackberry and late season caneberries may provide a reservoir for re-infestation throughout the blueberry season.

Unlike other insecticide degradation studies, we looked at the three challenges blueberry growers face: harvesting a clean, uninfested crop; staying under target export MRLs and maintaining a protective level of residues on the leaves (where SWD spend the majority of their time) to achieve SWD control. This required that we accurately measure field-aged residues on the berries, leaves and simultaneously perform bioassays using a subset of the leaves. The residue analyses were performed the WSU/Tri-Cities FEQL, Richland, WA and Synergistic Pesticide Laboratory, Portland, OR using GLP standards. These research toxicology laboratories can design protocols best suited to the specific insecticide groups by increasing recoverable residues and information. Other degradation studies simply look at berry MRLs without providing growers with the knowledge of how these levels equate to SWD control. While MRLs refer to levels of daily dietary intake, these same levels must also provide effective SWD control to warrant their use. Our study investigates this parallel relationship.

Blueberry rotation trial

Our leaf bioassays conducted in 2013-14 with a Rears™ orchard airblast sprayer were coupled with foliar degradation declines of two, 7-day rotations of Malathion 8 Aquamul and Mustang Maxx with a final application of Danitol in ‘Elliott’ highbush blueberries. These data provided a quantitative understanding of how calendar spray rotations with different MOA insecticides, can provide season-long fruit protection by creating a toxic field habitat for the flies. This protective habitat resulted from cumulative carryover exposure, while protecting ripening berries at or below MRL tolerances for target export markets. Leaf bioassays, coupled with foliar residue degradation curves, indicate recommended treatment intervals are adequate for protecting the fruit. The residue studies highlighted the cumulative effect from weekly applications, providing both lethal and sublethal protection resulting from layer upon layer of chemicals (See *Whatcom*

AgMonthly, April 2014). Furthermore, insecticides with longer persistency such as Danitol could be applied as the first *knockout* application of the season as well as the *clean-up* treatment at the end of harvest (Fig. 1). Danitol applied at 16 fl oz/acre provided over 90% adult bioassay mortality at 15 DAT while leaf residues (ppm) showed a 2.2-fold decline from 34 to 15 with no significant differences between their adult mortality levels. MRLs at 3 PHI for Danitol were under tolerance for Canada, Japan and Taiwan.

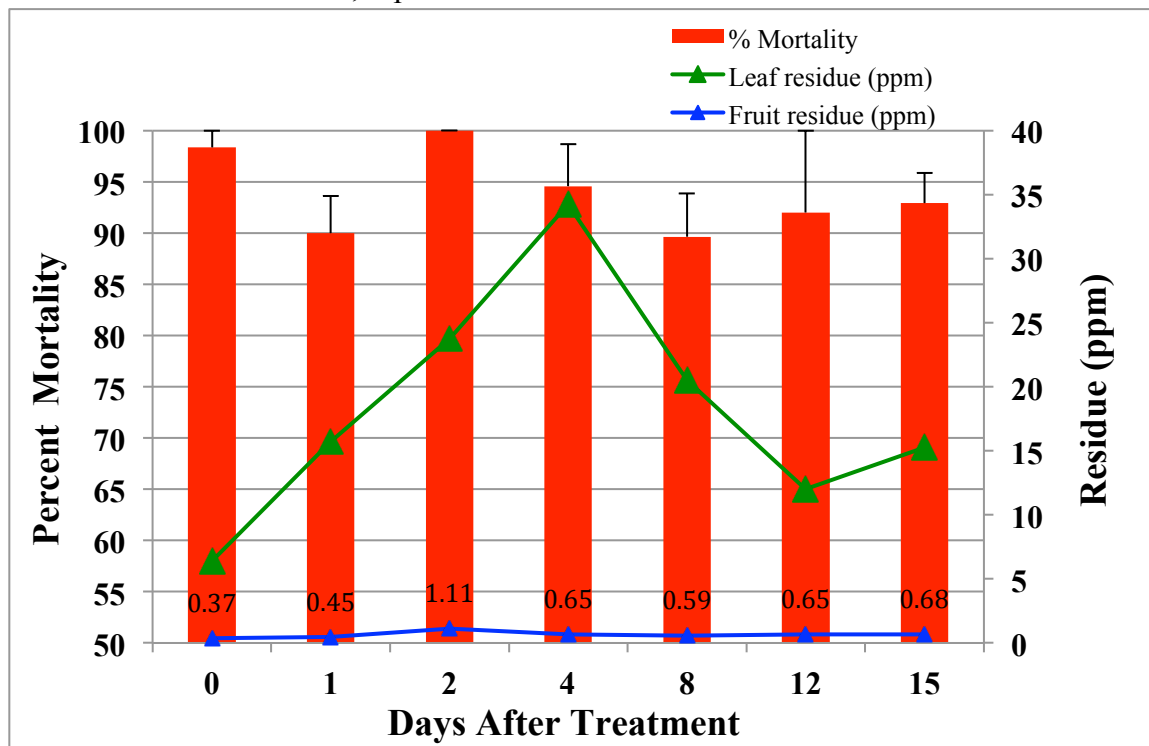


Fig. 1. Danitol residue decline in blueberry leaves, fruit and SWD mortality.

Field decline, MRLs and efficacy of spinosyns in controlling SWD in blueberry

We conducted 3 field trials in 2014 to measure the efficacy, foliar leaf degradation and MRL tolerances for Success and Delegate. Both Success and Delegate are in the same IRAC mode of action class but Delegate (spinetoram) is a second-generation spinosad derivative. It is faster acting, more potent molecule with longer residual activity than spinosad. This study allowed us the opportunity to measure three major parameters needed to confirm our earlier field characterization of the novel MOA insecticides known for their efficacy to control many chewing insects through ingestion.

Berry and leaf samples were collected at -1, 0, 1, 3, 5 and 7 days following an airblast application for each of the 3 field trials. In early August, 4 oz/A of Delegate was applied to ripening ‘Elliott’ highbush blueberries. In late August, 6 fl oz/A of Success was applied to ripening ‘Aurora’ blueberries. In September, 6 oz/A of Delegate was applied to a second ‘Aurora’ blueberry field.

Average SWD percent mortality when exposed to Success leaf residues at 0 DAT was about 50%, rose slightly at 1 DAT then dropped off significantly (Fig. 2).

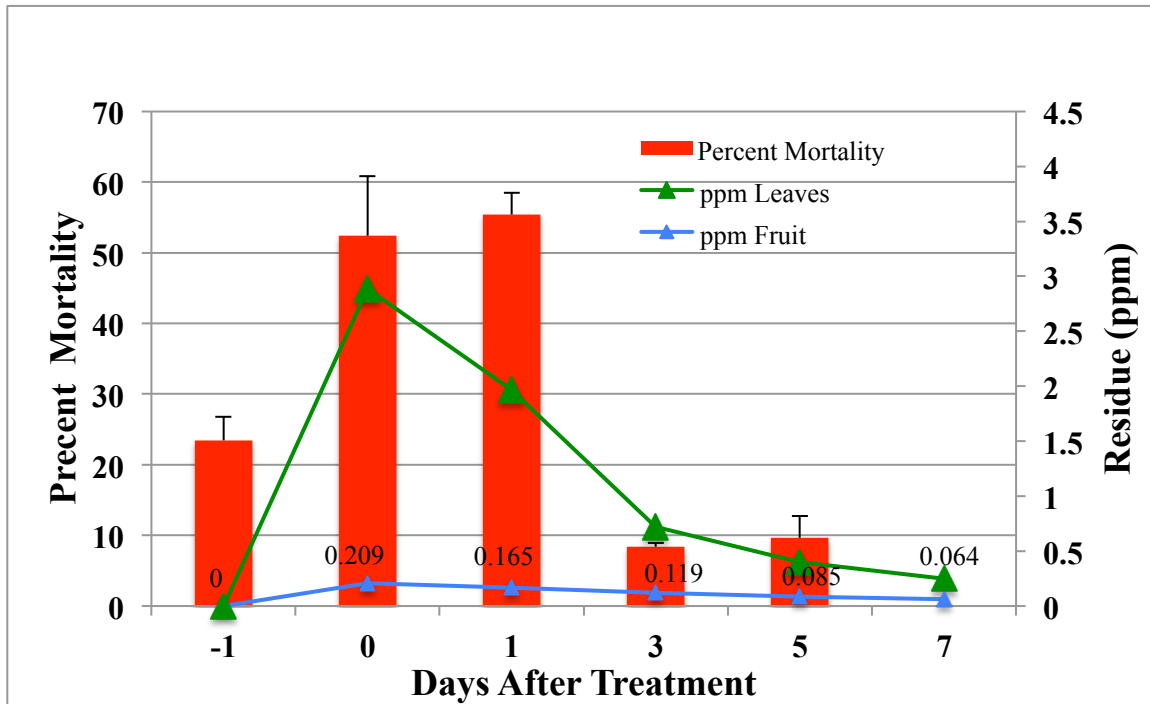


Fig. 2. Success residue decline in 'Aurora' blueberry leaves, fruit and SWD

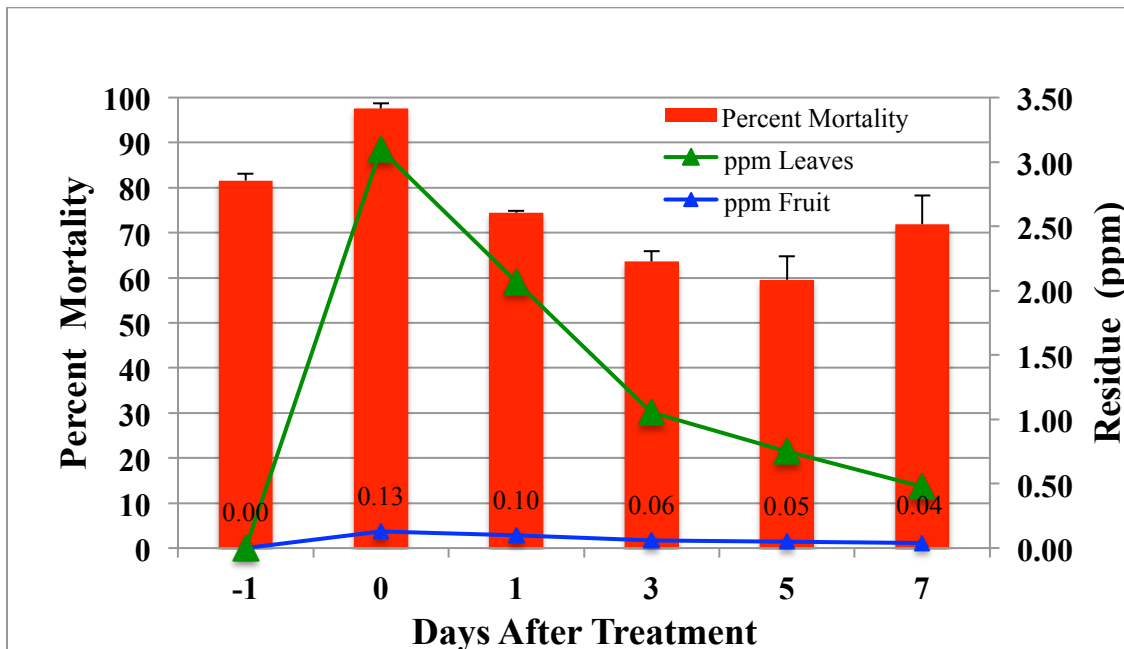


Fig. 3. Delegate residue decline in 'Elliott' blueberry leaves, fruit and SWD

Average mortality of SWD exposed to 'Elliott' leaves treated with Delegate at 4 oz/A was close to 100% at 0 DAT and did not fall below 60% through 7 DAT (Fig. 3). However, the

pretreatment bioassay yielded a high average mortality of 82%. Percent mortality in the August Delegate trial was almost twice that observed in the September Delegate trial (98% and 48% respectively) (Fig. 4), and declined below 40% by 6 DAT.

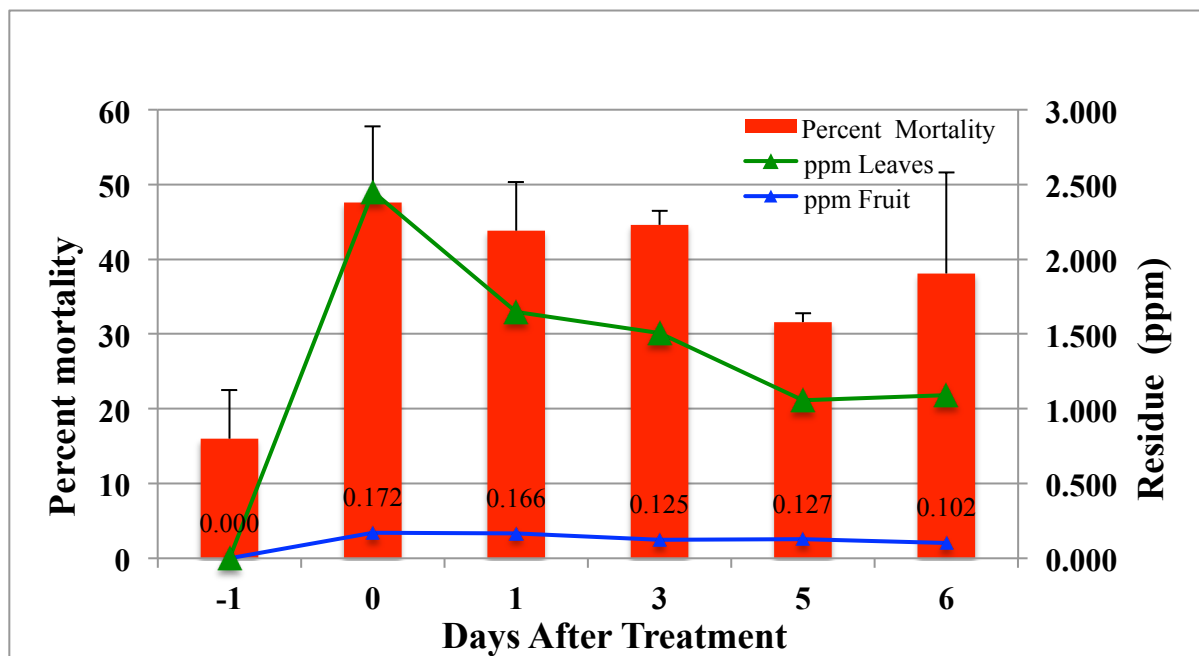


Fig. 4. Delegate residue decline in 'Aurora' blueberry leaves, fruit and SWD mortality.

This improvement for the August Delegate application was caused by carryover from a tank mix of Mustang Maxx and Malathion applied 8 days earlier. Carryover resulting from layering of insecticides accumulating as the season progresses provides a method for including less SWD efficacious products such as the spinosyns, into a rotational program by boosting their insecticidal activity. Incorporating more insecticides representing different mode of action classes, protects against resistance development in the SWD population.

Average spinosyn residues on berries were low immediately following applications of both Delegate and Success and had fallen to nearly zero seven days after treatment (Figs. 2-4). MRLs at 3 PHI for Delegate were under tolerance for EU, UK, Canada, Japan, Korea and Taiwan and similarly for Success, except for Taiwan with NT.

Leaf bioassays, coupled with foliar residue degradation curves, indicate recommended treatment intervals are adequate for protecting fruit. The residue studies highlighted the cumulative effect from weekly applications that provided both lethal and sublethal protection from layer upon layer of chemicals. Furthermore, insecticides with longer persistency such as the pyrethroid Danitol, could be applied as the first *knockout* application of the season as well as the *clean-up* treatment at the end of harvest. Scheduling more persistent chemistries preceding shorter residual materials such as spinosad or OPs could fortify contact residuals of these insecticides. It is conceivable that we will soon have the knowledge to develop rotation schemes that would even delete a rotation because of its long persistency or because SWD populations were below the economic threshold by the 3rd or 4th rotation in a long and late maturing cultivar such as 'Aurora'.

Acknowledgments

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