Spotted-wing Drosophila, Relative Rankings and Seasonal Strategies for Insecticide Use

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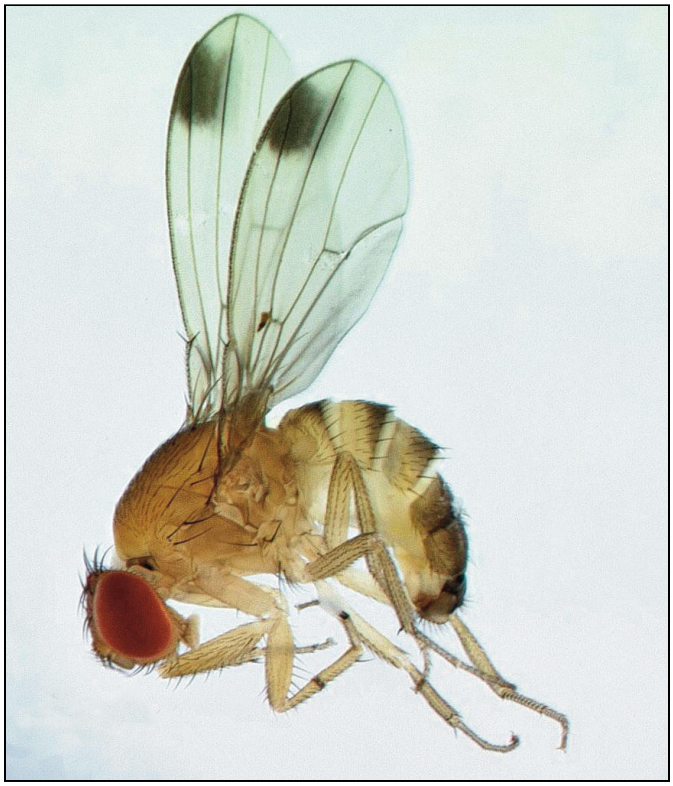
Spotted-wing drosophila (*Drosophila suzukii*) is a pest in soft-skinned fruit production, including blueberry, cherry, blackberry and raspberry. It is a major concern in fruit production worldwide. Insecticide applications remain the most common control strategy against SWD.

Researchers and stakeholders from California, Oregon, Washington, Michigan, Maine, New York, New Jersey, North Carolina, Georgia and Florida have ranked the efficacy of the most-used insecticides to control SWD populations in the field. Insecticides vary in their modes of action, and their efficiency against SWD can vary greatly. To date, insecticide research has focused primarily on adult mortality. Here we consider insecticidal action against immature and adult life stages of SWD, resistance management and sequential order of insecticide sprays. These factors are important when considering efficacy and sustainability in a whole-system approach.

Products are ranked by relative insecticidal efficacy based on laboratory and field experiments in multiple locations across the United States. Products are color-coded based on their modes of action. This relative ranking provides insights into priority chemical control strategies and provides optimal resistance management of SWD. (Figure 1).



A spotted-wing drosophila.

Credit: Oregon State University

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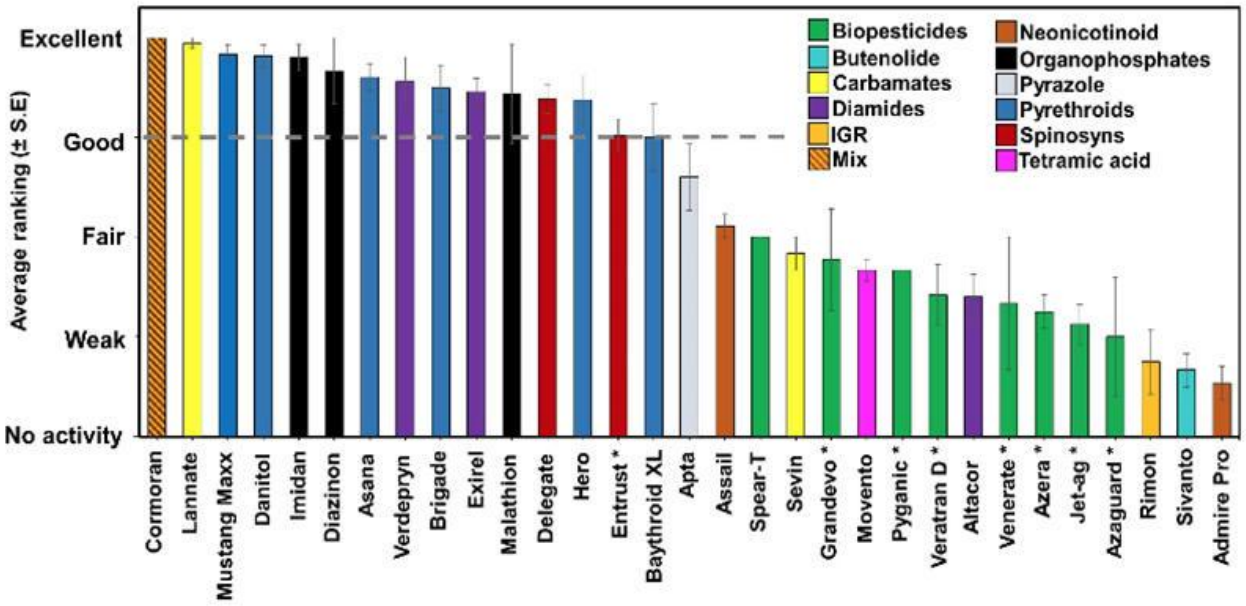

Figure 1. Relative ranking of insecticide efficacy and insecticidal class (indicated by color code) of insecticides commonly used to control spotted-wing drosophila. Insecticides are color-coded by insecticidal class. The relative rankings are 0 = ineffective, 1 = weak, 2 = fair, 3 = good, and 4 = excellent. The data were collected from multiple susceptible crops by producers and scientists nationwide. Insecticides with a ranking above the dashed line are considered Good or Excellent.

Insecticides approved by the Organic Materials Review Institute for organic production.** ***Consult the label for state and federal registration of target crops, application limits, restricted-entry intervals (REI) and preharvest interval (PHI) before applying any pesticide.

Credit: Philip Fanning, University of Maine

Whole-population control

While we tend to think about controlling adult flies, most of the population in the field is in the immature stages, including eggs, larvae and pupae. There are few reports of insecticide effects on these immature life stages. For effective control, we must consider all life stages when planning a spray program. Table 1 shows the percent mortality of all life stages from various pesticides. While unripe fruit may be at reduced risk of infestation, early season control is important to reduce the population seasonlong (Figure 2). Reducing all life stages early in the season can significantly inhibit population growth and reduce the number of SWD adults to be controlled some weeks later. Phosmet efficacy ranked highest in this study (Table 1) and provides excellent management of immature life stages. If applied early in the season, phosmet can reduce immature life stages and the adult SWD population. Growers who detect SWD eggs and larvae in their crop should consider using products ranked “high” in Table 1 as their first spray. Growers should pay extra attention to label restrictions and the maximum number of applications permitted during the season. As the crop nears harvest, growers should apply products with lower relative mortality and a shorter preharvest interval (PHI) to ensure that their crop can be delivered to market.

Table 1. Mortality ranking of commonly used insecticides against all spotted-wing drosophila life stages (adapted from Mermer et al. 2021)

Insecticide (Active ingredient)	Percent mortality				Relative mortality ranking	Average mortality of all stages	PHI* (day)
	Egg	Larvae	Pupa	Adult			
Imidan 70 WP (phosmet)	91	92	>99	99	High	95	3
Lannate (methomyl)	84	77	100	99	High	90	3
Delegate (spinetoram)	84	81	99	95	High	89	3
Entrust (spinosad)	83	76	>99	95	High	88	3
Malathion 8F (malathion)	85	72	98	90	Medium	86	1
Assail (acetamiprid)	80	78	90	90	Medium	84	1
Exirel (cyantraniliprole)	73	69	95	95	Medium	83	3
Danitol 2.4 (fenpropathrin)	63	67	95	95	Medium	80	3
Mustang Maxx (zeta-cypermethrin)	52	60	99	>99	Medium	77	1
Harvanta 50 SL (cyclaniliprole)	67	71	70	70	Low	69	1

*Preharvest interval

Slow the development of resistance

Insecticidal resistance starts to develop with the first product application. Managing insecticidal resistance is essential to maintain effective SWD control and to protect the efficacy of the chemical tools currently available. Researchers have documented SWD resistance in the U.S. to key insecticides, including spinosad (spinosyn).

Rotating chemical classes with different modes of action during the season delays development of insecticide resistance. The Insecticide Resistance Action Committee (IRAC) classification of chemical classes allows producers to design a seasonal control program according to insecticide mode of action. Products approved for SWD are presented in Figure 1, color-coded by insecticidal class. Growers are advised to use spinosad sparingly in the early season, allowing for its use closer to harvest, due to its short preharvest interval. Use of a product such as Harvanta 50 SL (cyclaniliprole) may be of value as it falls in a different chemical class.

Keep resistance in mind as you plan your seasonlong chemical control of SWD.

Plan seasonal applications

SWD populations grow rapidly under ideal summer temperatures. Modeling and field trials indicate that an initial application of an insecticide most effective at killing all life stages (for example, phosmet) will significantly reduce the number of individuals compared to a less-effective insecticide (for example, malathion and cyclaniliprole) (Figure 2).

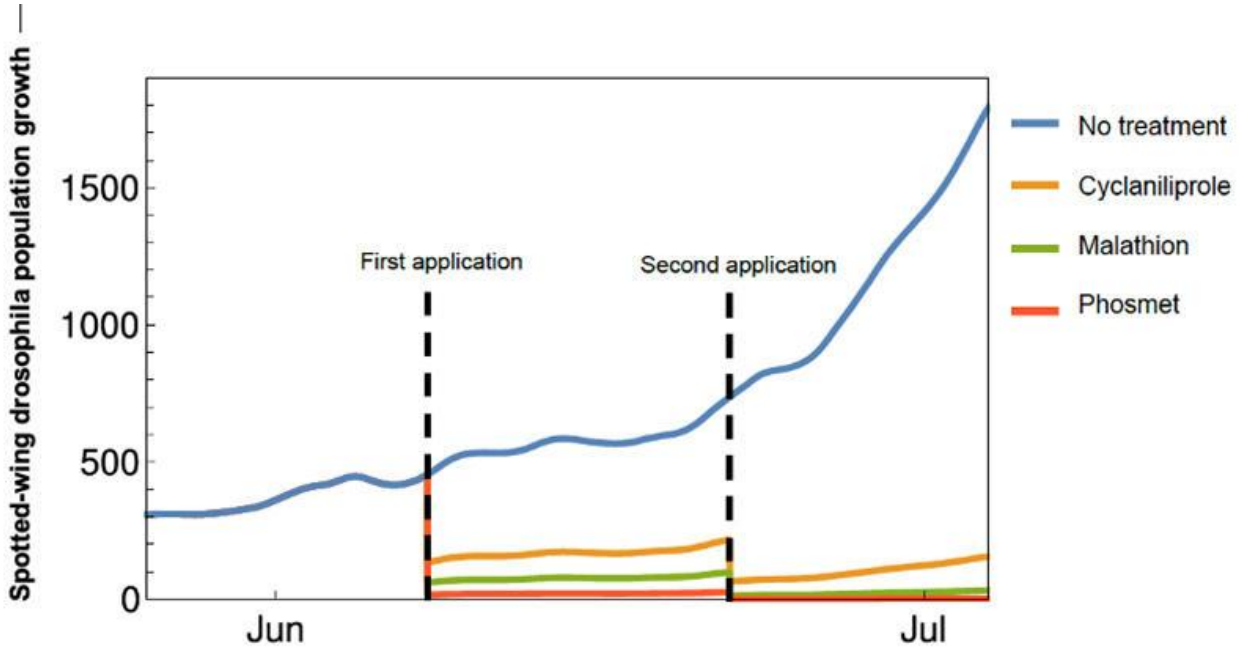

Figure 2.Drosophila suzukii seasonal population growth (blue line) and relative efficacy of two seasonal insecticidal application regimes (dotted lines). The highest level of control is likely obtained by first applying the insecticide with the highest efficacy rate.

Credit: Serhan Mermer et al. 2021, © Oregon State University

Different formulations of the same active ingredient may also perform differently. For example, researchers indicated that cyclaniliprole as Verdepryn provided good control in the field. By contrast, cyclaniliprole as Harvanta 50 SL provided low efficacy on SWD in a laboratory experiment. Controlled laboratory conditions typically generate stronger results than field conditions. Mixed formulations — products that combine more than one active ingredient in a single formulation — could improve control. For example, Cormoran combines acetamiprid and novaluron, and provided excellent control of SWD (Figure 1).

An integrated approach to SWD management offers the greatest chance of success. Integrating cultivar selection, cultural practices and an awareness of site-specific conditions and relative SWD pressure is essential for sustainable management of SWD. Cultural practices, such as weed fabric, pruning and drip irrigation, can also reduce SWD infestation. Use behavioral and biological control and other emerging management tools when available and applicable. Finally, begin the season with an insecticide plan to minimize the development of insecticidal resistance.

Useful links

The Insecticide Resistance Action Committee. The IRAC mode of action classification online (https://irac-online.org/modes-of-action/).

References

Mermer, S., F. Pfab, G. Tait, R. Isaacs, P. D. Fanning, S. Van Timmeren, G. M. Loeb, S. P. Hesler, A. A. Sial, J. H. Hunter, H. K. Bal, F. Drummond, E. Ballman, J. Collins, L. Xue, D. Jiang, and V. M. Walton. 2021. Timing and order of different insecticide classes drive control of *Drosophila suzukii;* a modeling approach. J Pest Sci 94: 743-755.

Use pesticides safely!

- *Wear protective clothing and safety devices as recommended on the label. Bathe or shower after each use.*
- *Read the pesticide label—even if you've used the pesticide before. Follow closely the instructions on the label (and any other directions you have).*
- *Be cautious when you apply pesticides. Know your legal responsibility as a pesticide applicator. You may be liable for injury or damage resulting from pesticide use.*

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