



## Incorporating Maximum Residue Limits (MRLs) into Treatment Decisions for Spotted Wing Drosophila



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**Introduction-** The recent introduction of spotted wing drosophila (SWD) into cherry-producing orchards of the western United States has resulted in the need for insecticide-based management programs close to harvest. These treatments have become problematic due to inconsistencies among export markets regarding maximum residue levels (MRLs) that are allowed on imported fruit. As a result, fruit that was treated and harvested in a safe manner according to the U.S. E.P.A. may or may not qualify for export to countries that have lower MRLs, or where MRLs are not established for a particular pesticide. This means that growers need to be very careful when choosing treatments to ensure that they are using insecticides that are effective, but that will also allow the export of fruit.

**Materials and Methods-** In the spring of 2011 we conducted two field trials in Kern County, CA to evaluate the rates of degradation of six insecticides that are considered effective against SWD. These include the pyrethroids Danitol, Mustang and Warrior II, the spinosyns Delegate and Success, and the organophosphate Malathion (Table 1). Insecticides were applied using a Pul-Blast sprayer at 2.5 mph in 100 gal of water per acre to two locations at either 21 or 7 days to harvest. Residues were evaluated by PrimusLabs™ (Santa Maria, CA) from 300 g cherry samples that were collected at 0, 3, 7, 14 and 21 days after treatment (DAT) for plots treated 21 days to harvest, and at 0, 1, 2, 3 and 7 DAT for plots treated 7 days to harvest.

Table 1. Insecticides tested, rates and timing of application

Insecticide	Form.	Manu- facturer	Active ingredient	Rate form prod. per acre <sup>1</sup>	A.i. per acre (lbs.)	Application date (days to harvest)	
						15 Apr (21)	26 Apr (7)
Danitol®	2.4EC	Valent	Fenpropathrin	21 1/3 fl oz	0.40	Yes	Yes
Warrior II	2CS	Syngenta	λ-cyhalothrin	2.56 fl oz	0.04	Yes	No
Mustang®	1.5EW	FMC	Zeta-cypermethrin	4.3 oz	0.05	Yes	No
Delegate™	25WG	Dow	Spinetoram	7 oz	0.11	Yes	Yes
Success®	2SC	Dow	Spinosad	8 fl oz	0.12	Yes	Yes
Malathion	8 Aq	Loveland	Malathion	1.5 pt	1.50	Yes	Yes

<sup>1</sup>With the exception of Malathion, application rates were defined as the highest rate allowable per the pesticide label. Due to the risk of phytotoxicity the Malathion rate was lowered to a level that is generally considered to be effective on SWD, but that minimizes the risk of damaging the leaves and fruit.

**Results-** Applications of the spinosyns Delegate and Success resulted in relatively low residue levels that degraded quickly (Figures 1, 2). When applied 21 or 7 days to harvest, residue levels for both insecticides ranged from non-detectable to 0.19 ppm during the evaluations from 0 to 3 DAT. By the pre-harvest interval (PHI) of 7 days both products were below the minimum detection level of 0.05 ppm at both sites for both application timings.

Applications of Malathion at 21 and 7 days to harvest at the 1.5 pt/ac rate resulted in residue levels that ranged from non-detectable to 0.12 ppm through 2 DAT and from non-detectable to 0.06 ppm at the pre-harvest interval of 3 DAT (Figure 3). These levels were well below the 2011 MRLs for the U.S., Canada, Japan, Korea, Taiwan and Australia (range from 0.50 to 8.0 ppm), but were in some cases still

above the MRL of 0.02 ppm for the EU (Table 2). By 7 DAT residue levels for Malathion ranged from non-detectable to 0.02 ppm.

Residue levels for pyrethroids (Figures 4-6) were more variable among treatments than for spinosyns and had relatively long residuals. Applications of Danitol produced the highest residue levels and had the slowest degradation. Despite having a PHI of only 3 days, residue levels all the way through 21 DAT would have disqualified fruit from being shipped to Canada, South Korea, Taiwan, the EU, and Australia through 21 DAT (Table 2).

Applications of Mustang at 21 days to harvest resulted in residue levels ranging from 0.09 to 0.11 ppm at the PHI of 14 days. These are comfortably within the U.S., Japan and EU MRLs, but are about equivalent to the Canada MRL of 0.10 ppm and above the Australian MRL of 0.01 ppm. Korea and Taiwan do not have MRLs established for zeta-cypermethrin, such that any residues would disqualify fruit from this market. By 21 DAT fruit still did not qualify for export to Korea, Taiwan or Australia.

Applications of Warrior II at 21 days to harvest resulted in residue levels ranging from 0.08 to 0.11 ppm at the PHI of 14 days. These levels were approximately one-half to one-fifth of the MRLs for all major export markets (0.20 to 0.50 ppm).

Table 2. Pesticide MRLs for six SWD insecticides in major US cherry export markets for the 2011 season<sup>1</sup>.

Trade Name	Common Name	US MRL (ppm)	Canada MRL (ppm)	Japan MRL (ppm)	South Korea MRL (ppm)	Taiwan MRL (ppm)	EU MRL (ppm)	Australia MRL (ppm)
Danitol	Fenpropathrin	5.00	0.10	5.00	0.50	0.50	0.01	-
Delegate	Spinetoram	0.20	0.20	0.01	0.10	-	0.05	0.20
Malathion	Malathion	8.00	6.00	6.00	0.50	0.50	0.02	2.00
Mustang	Zeta-cypermethrin	1.00	0.10	2.00	-	-	2.00	0.01
Success	Spinosad	0.20	0.20	0.20	0.05	0.20	1.00	1.00
Warrior II	Lambda cyhalothrin	0.50	0.20	0.50	0.50	0.40	0.30	0.50

<sup>1</sup>Source: Excerpt from a California Cherry Advisory Board internal memo dated March 18, 2011, based on the CCAB's Online Export Manual: <http://www.calcherry.com/industry>, with updates confirmed by the CCAB and CTFRC as of May 21, 2011. Since MRLs change frequently be sure to check for updated and current MRLs prior to shipping fruit to export markets.

### Conclusions

Current management programs for SWD are based on three general types of treatments. These are long-residual products with PHIs of at least 14 days, middle-range products with a 7 to 10 day PHI, and products for use close to harvest with a PHI not to exceed three days.

Long-residual products are typically applied at the initiation of the straw stage of development when fruit becomes susceptible to attack by SWD. Of the products tested, Danitol, Mustang and Warrior II all had relatively long residuals. Of these Warrior II has the best overall profile as a long-residual product whose application resulted in residue levels in this study that were below the MRLs of all major export markets for cherries. Data suggest that growers who export fruit need to avoid the use of Danitol. Mustang should be avoided for fruit being exported to Canada, Korea and Taiwan.

Of the middle-range products for use 7 to 10 days to harvest, Delegate and Success both produced residue levels below the lower detection limit of 0.05 ppm at the PHI of 7 days after treatment.

However, between these two products Success has a better MRL profile of 0.05 to 1.00 ppm for major export markets while Delegate is more likely to disqualify fruit due to a 0.01 ppm MRL for Canada and no MRL for Taiwan. Another benefit of Success is that an organic version of spinosad (Entrust) is available as a control option in organic cherry orchards.

Malathion and Danitol were the only two insecticides in our study that have PHIs of 3 days or less. At a use rate of 1.5 pt per acre residue levels for Malathion in our studies were low enough to allow for the export of fruit to all major export markets with the exception of the EU. Growers planning on shipping fruit to the EU should probably avoid Malathion because residue levels in our trials, even at 7 days after treatment, were still close to the EU MRL of 0.02 ppm. In weighing their options these growers might also consider the use of permethrin or pyrethrin, which are considered to have very short residuals, but were not tested as part of this project.

When all things are considered, data from this project can be used to outline potential spray programs that should be effective for SWD and still allow for the export of fruit. For example, areas requiring three insecticide applications could consider using Warrior II at the initiation of straw, followed by an application of Success 7 to 14 days to harvest, and followed by an application of Malathion 3 to 7 days to harvest. This should allow fruit to be shipped to all major export markets with the potential exception of the EU (depending on how quickly Malathion residues degrade). It would also allow for an effective management program that utilizes multiple modes of action of pesticides as part of a resistance management program. In areas where only two applications are needed, the second and third applications described above could be combined into one application of either Success or Malathion (with the same concerns as previously listed). In cases where a treatment is needed between harvests, data suggest that Malathion can be used as long as the fruit is not going to the EU. Other options between harvest are permethrin or pyrethrin, though products based on these active ingredients were not tested.

Because of the complexity of treatment programs for SWD and the potential for residue-based export restrictions of fruit, growers should develop plans for SWD management well before harvest. Plans should be made only after consulting with representatives of the packing house and should include multiple options for control programs depending on where the fruit will be shipped. They should also be flexible enough to account for one or more treatments based on in-field monitoring programs.

Growers should also be conservative while estimating how data from this project relate to their individual orchards. This is because residue levels are dependent on many factors such as equipment type, application type, water volume, drive speed, rate used, tree size, canopy density, exposure to sunlight, precipitation, etc. It is important to remember that this project only represents two orchards in Kern County during the 2011 harvest season, and results are expected to vary among locations throughout the western United States.

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*Disclaimer: Discussion of research findings necessitates using trade names. This does not constitute product endorsement, nor does it suggest products not listed would not be suitable for use. Some research results included involve use of chemicals which are currently registered for use, or may involve use which would be considered out of label. These results are reported but are not a recommendation from the University of California for use. Consult the label and use it as the basis of all recommendations.*

Fig. 1 Delegate (spinetoram)

7.0 oz in 100 GPA

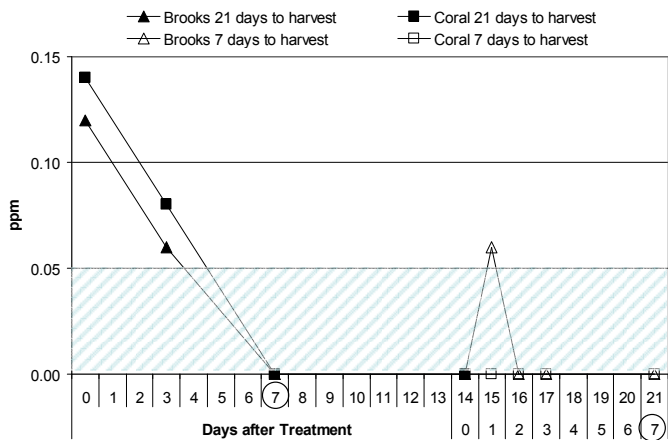


Fig. 2 Success (spinosad)

8.0 fl oz in 100 GPA

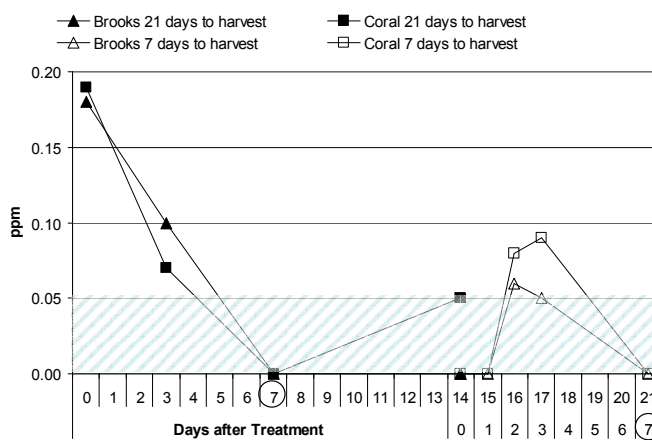


Fig. 3 Malathion 8 Aquamul (malathion)

1.5 pt in 100 GPA

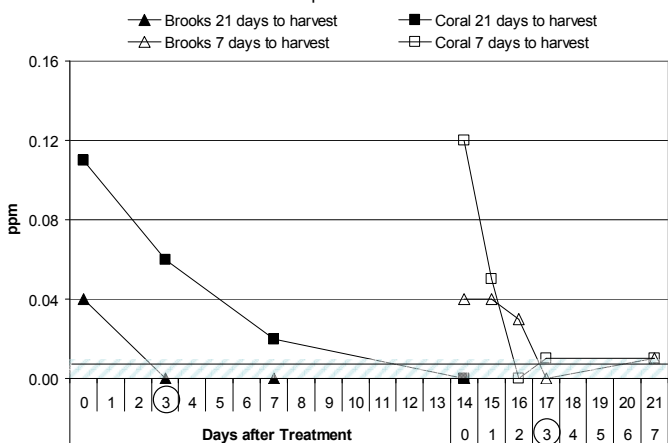


Fig. 4 Danitol 2.4EC (fenpropathrin)

21.3 fl oz in 100 GPA

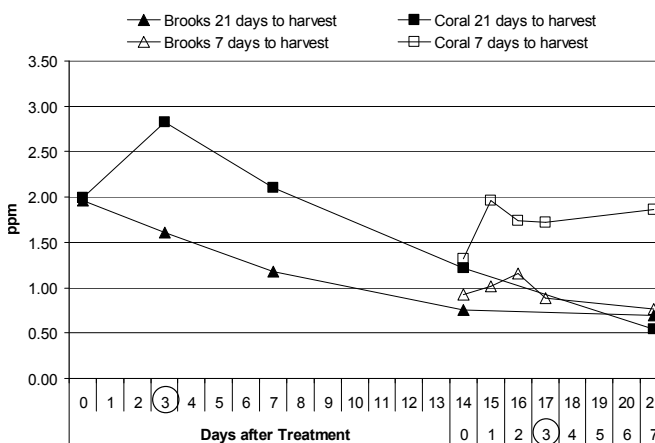


Fig. 5 Mustang (zeta-cypermethrin)

4.3 fl oz in 100 GPA

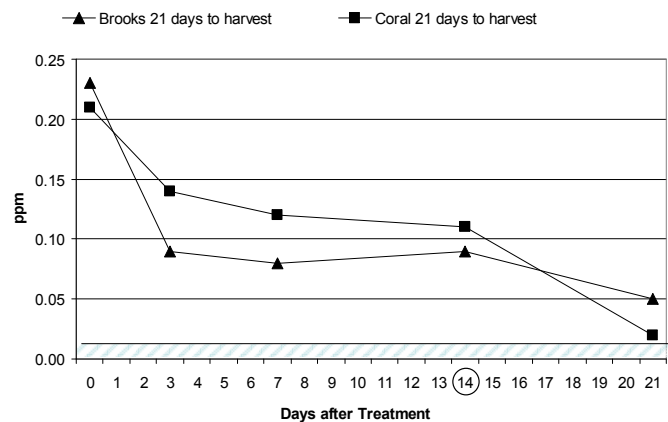
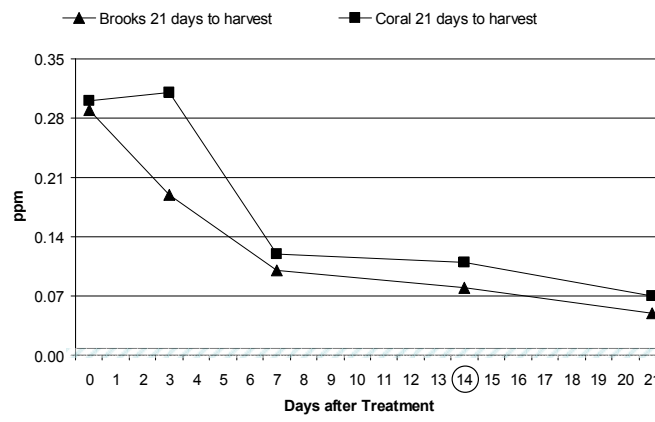


Fig. 6 Warrior II (lambda-cyhalothrin)

2.56 fl oz in 100 GPA



Figures 1-6. Residue levels following applications at 21 and 7 days prior to harvest. Residue levels of non-detectable are reported as zero residues even though actual residue levels may be anywhere between 0.0 ppm and the detection threshold of 0.01 ppm or 0.05 ppm (indicated by the shaded area). Circled dates indicate pre-harvest interval (PHI).

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