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Fact Sheet FS-1023
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Spotted Wing Drosophila Monitoring and Management

Spotted wing drosophila (SWD), *Drosophila suzukii,* is an insect pest that continues to be a problem for growers of soft-skinned fruit such as blackberry, blueberry, cherry (sweet and tart), and raspberry (black and red). Unlike other vinegar fly species (*Drosophila* spp.) that lay their eggs in over-ripe, damaged, rotting, and fermenting fruit, SWD will attack undamaged fruit as it ripens.

Figure 1. SWD adult female (left) and male (right)

Adults are small flies about 1/16 to 1/8 inch long with red eyes and an amber colored body with black stripes on the abdomen (Figure 1). The male flies have a black spot towards the tip of each wing. The females do not have spots on the wings but they have a very prominent, saw-like ovipositor (egg laying structure), larger than other vinegar flies. The female penetrates the skin of soft-skinned fruit laying the eggs just under the skin, leaving a small puncture on the fruit surface. Eggs hatch and larvae develop and feed and this damage can provide an entry site for other vinegar flies and secondary pathogens.

SWD Has Wide Range of Host Plants

SWD hosts include many wild and cultivated fruit crops. In the mid-Atlantic region, wild relatives of common cultivated fruit [e.g. Allegheny (aka common) blackberry (*Rubus allegheniensis*), wild black raspberry (*Rubus occidentalis*), American red raspberry (*Rubus strigosus*), wild blueberry (*Vaccinium* spp.), wild cherry (*Prunus* spp.)] are present in the landscape surrounding fruit farms and may harbor SWD.

In addition to these close relatives of commercial hosts, SWD successfully develops on other wild, ornamental and non-crop fruiting plants in the landscape. Recent work in other regions has suggested that species of honeysuckle (*Lonicera* spp.) (abundant in many mid-Atlantic habitats)

and sweet box (*Sarcococca confusa*) (sometimes planted as an ornamental) may serve as early season hosts, allowing SWD populations to build in the landscape prior to the fruiting of commercial hosts.

Other non-crop hosts present in the mid-Atlantic region (either in wild woody areas or as cultivated ornamentals) include species of dogwood (e.g., red osier dogwood, *Cornus sericea*), species of mulberry (e.g., white mulberry, *Morus alba*), and other *Prunus* species (e.g., cherry laurel, *Prunus laurocerasus*). Because SWD may also develop on damaged and overripe fruit of commercial crops that are not hosts when intact, unharvested or dropped fruit may also contribute to SWD populations in commercial settings. Examples include split melons, as well as pome and thicker-skinned stone fruits that SWD cannot directly damage but can persist on when damaged.

The broad range of SWD hosts provides many alternate hosts in and outside of commercial fields. These alternate hosts likely play a role in commercial infestation, though the impact of alternate hosts on SWD populations is unclear at this time.

Monitoring SWD Adults is Difficult

Generating an optimized trapping system that has an attractive and selective lure, and that is effective and easy to use continues to be an important SWD research priority. Currently there are many commercial and at-home baits and traps that can be used to monitor SWD adults. However, none of them consistently capture SWD adults before fruit infestation occurs, and all of them capture many non-target insects, including other vinegar flies. Thus, users have to identify SWD under magnification, which is challenging for non-experts and time consuming. Additionally, the weak relationship between adult trap captures and larval fruit infestation makes it difficult to use adult trapping for making management decisions.

Sampling Fruit for SWD is Best Way to Determine Levels of Damage and Gauge Effectiveness of Management Practices

Once SWD lays its eggs in a ripe fruit, which begins to degrade, and other vinegar flies may also infest it. It is important to sample ripe rather than degraded or overripe fruit to determine whether SWD is present. Sampling a greater number of fruit increases confidence in the results.

It is currently unknown how many fruit to sample to determine whether SWD is present at market-detectable levels. **We typically sample at least 30-40 fruit** at market ripeness from various locations (including border rows) within the planting. Selecting fruit from the interior portions of the plant may increase your chances of detecting SWD. Recent research in Dr. Hannah Burrack's lab at North Carolina State University suggests that SWD density is higher in fruit in the central part of a plant. Most of the time, these berries also do not receive proper spray coverage, and therefore are not well protected from SWD.

There are a variety of methods to sample for larvae in fruit. While there is no scientific evidence regarding the best sampling

method, **directly looking for larvae** in the fruit is the easiest.
One of the earliest signs of larvae in raspberries is juice on the receptacle when the fruit is harvested. Individual fruit can be crushed or cut open and you can look for larvae, though you may miss the smaller larval stages using this method. A hand lens might help find some smaller larvae.

Larger larvae are visible to even the naked eye. SWD larvae are pointed at both ends and only a little longer than 1/8" when fully grown (Figure 2). SWD larvae cannot be visually distinguished from other vinegar flies, so selecting ripe rather than overripe fruit is important.

Figure 2. SWD larva in blueberry

Other larvae that may be found in fruit, such as blueberry maggot, are larger at around 3/16" and are only pointed at one end. Other internal fruit-feeding pests such as plum curculio, raspberry fruitworm, cranberry fruitworm, and cherry fruitworm also may be found during visual inspection or larval flotation (next section). Examples of SWD damage on various fruit can be seen in Figures 3-7.

Use Larval Flotation Methods to See Extracted Larvae Floating in a Water Solution

In this method, fruit should be gently crushed and/or cut into pieces (especially larger fruit like strawberries) in a container. You can put a thin layer in a plastic food storage container or a gallon sized re-sealable bag.

Add a sugar (white sugar or light brown sugar works) water or a salt (non-iodized seems to be better) water solution to the container. Use 1 cup of white sugar or salt, or 2.5 cups of light brown sugar per gallon of water. Dissolving the salt or sugar in warmer water a day or so beforehand can ensure that it is fully dissolved and will increase the flotation.

Figure 3. SWD adults and damage on a ripe raspberry

Sugar solutions tend to keep the larvae alive a bit longer than a salt solution, and live larvae are easier to see because they continue to move and they float. Agitate the fruit while it is in the solution, and allow 10-15 minutes for the larvae to emerge. SWD larvae (if present in the fruit) should float to the surface and be visible. If the larvae die they will sink. Other internal feeders such as

cranberry fruitworm are larger and tend to sink rather than float.

Figure 4. SWD adult and damage on a ripe blackberry

If you are using a tray or plastic food storage container, add a layer of wire mesh or window screen to hold down the fruit particles so that only the water and larvae are at the surface. Pouring the water through a fine mesh (a U.S. Standard Mesh Size 12 or 1/16" opening is a good size) sieve can also help locate larvae by filtering out the fruit particles. The water should be collected and larvae counted after sieving.

Putting water (or water and fruit) in a clear container over a dark background can make it easier to spot the larvae (which are white to cream-colored). A hand lens can also help for viewing smaller larvae.

For a detailed guide with pictures visit: http://ir.library.oregonstate.edu/xmlui/bitstream/handle/1957/52502/em9096.pdf.

Other Techniques, Some Very Simple, will Help You Find SWD Infestations

Heating/freezing/refrigerating fruit in sealed plastic bags often causes the larvae to leave fruit and move to the surface of the fruit or bag. If you leave the bags sealed in your car or truck on a warm day, you may come back to find larvae abandoning the fruit.

The only way to be 100% sure that you have SWD rather than other vinegar flies, is to **rear the flies out** of the fruit. This can be hard to do with fruit like raspberries that degrade very quickly, but is a very successful tactic for cherries and blueberries. Hold the fruit in a tightly sealed container (to prevent escaping and secondary infestation by other vinegar flies) that is still able to exchange air. Making a hole in a plastic food storage container and then sealing it with fine mesh (like organdy) using caulk works well. Because the fruit will start to degrade, you will need to have a lining like cotton, paper towels, or sand on the bottom to soak up the liquid and prevent the larvae from drowning.

Figure 5. SWD damage on a ripe strawberry

Figure 6. SWD damage on ripe tart cherries

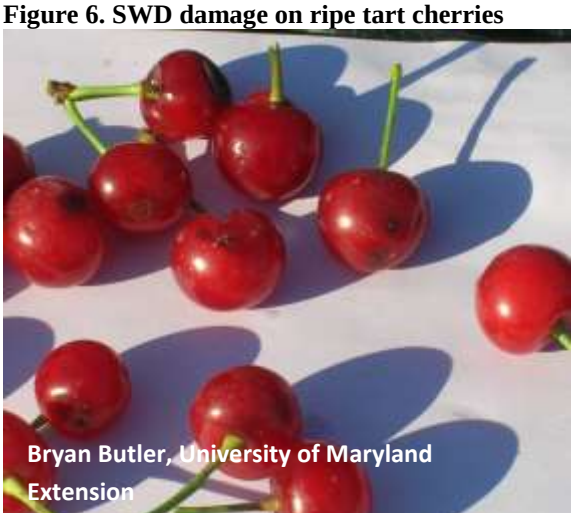
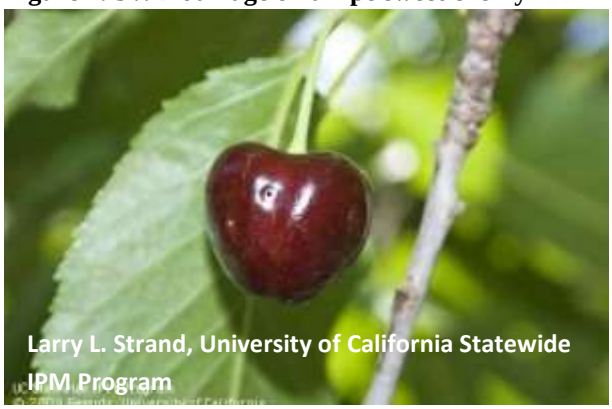


Figure 7. SWD damage on a ripe sweet cherry



Keep the containers at room temperature and use a sticky card to catch the flies as they emerge, or wait until fly emergence and freeze the container to collect the flies. You can then identify the emerging vinegar flies to see if they were SWD. However, this method may overestimate market-detectable infestation because eggs have time to hatch and develop.

Identification guides for SWD can be found at many Integrated Pest Management websites. A list is available at: http://www.fruit.cornell.edu/spottedwing/ID.html.

Comprehensive Management of All Crops is Critical to Controlling SWD

SWD has many alternate hosts and populations can build in many types of overripe fruit even after the main crop season. It is important, therefore, to not only manage crops currently in production but also other crops before and after they are harvested.

Field sanitation within the current host crop may reduce on-farm SWD populations.

- **Remove all ripe and cull fruit** from the planting as frequently as possible. Remember that fruit in the center of the plant are harder to see and spray and SWD may prefer them. Avoid allowing overripe fruit to build up in plantings.
- **Dispose of cull fruit.** Composting is not sufficient for disposal because SWD may still emerge and reproduce. Better options are to remove and destroy cull fruit off-site, bury it at least two feet deep, heat it (bag it in plastic and expose it to full sun for at least a week) or freeze it to kill the eggs and larvae. Any of these methods will prevent cull fruit from contributing to SWD populations on-site.
- **Remove cultivated alternate host fruit** that is not under management, such as the first early fruit that is not harvested or the fruit that remains after harvest as quickly and often as

possible. Renovate/prune plantings promptly after harvest, destroy produce left in fields, and remove culls. This is important to help manage SWD on later ripening susceptible crops because these fruit can be reservoirs for SWD.

- **Remove non-cultivated alternate hosts** that may be reservoirs of SWD and may help reduce SWD populations. However, we do not know how far SWD may migrate to enter a host crop or the relative importance of different hosts. Additionally, alternate host plants provide habitat for several species of pollinators and natural enemies and may provide reservoirs of susceptible SWD to help prevent insecticide resistance.
- **Isolate plantings** away from alternate hosts. Surround them instead with crops that cannot serve as hosts, such as agronomic crops and some vegetables.

When establishing new plantings, we recommend selecting **earlier ripening** fruit crops and varieties to avoid the later season high SWD pressure.

Exclusion with extremely fine mesh with openings less than 0.98 mm (0.039") may protect crops, though ventilation and pollination can be problematic and may adversely affect yield. Using mesh is more feasible for fruit grown in tunnels or where entire fields are covered with bird netting because the infrastructure to hang the mesh is already in place.

Biocontrol Uses Natural Enemies that Feed on SWD Adults and Pupae

Several **natural enemies** are likely present in the Mid-Atlantic, including predatory insects, a species of parasitoid wasp (lays its eggs in SWD pupae), and other arthropods. These natural enemies feed on a variety of insects and do not reproduce as quickly as SWD.

In other U.S. regions, scientists are researching the impact of natural enemies on SWD populations. The results indicate that biological control has not been effective; therefore, using natural enemies alone is unlikely to reduce SWD populations enough to prevent fruit damage.

Pesticide Sprays Primarily Target Adult Flies, which are Smallest Part of Population

Because most chemical active ingredients are unlikely to significantly impact eggs and larvae, applications will not remove existing infestations. **Good spray coverage** is critical as most materials work primarily by contact. Be sure that the sprayer is calibrated and use adequate volumes of spray solution (as close to 100 gallons/acre as possible or greater spray volume is recommended for all susceptible fruit crops) and spray pressure. Evaluate coverage throughout the entire canopy with water-sensitive paper (spray cards).

Increasing the volume of water, using a spreader/sticker surfactant, and driving at

optimal speed through every row with an airblast sprayer can help improve coverage.

Pruning the canopy or using a trellis system can improve spray access and coverage. Residual activity for most products under ideal conditions is around 7-10 days. However, most pesticides that are effective against SWD are not rainfast and reapplications may be necessary after rainy conditions. Evaluate the efficacy of your spray program by monitoring larvae in fruit (see section, *Sampling Fruit for SWD is Best Way to Determine Levels of Damage and Gauge Effectiveness of Management Practices*).

Don't Apply Insecticides during Bloom Period or when Pollinators are Active

Most commercial fruit becomes susceptible at first color. Early crops and varieties may escape periods of high SWD pressure in this region. Checking fruit regularly early in the season to time chemical applications and evaluate their efficacy is critical because SWD reproduces quickly. Populations can increase several-fold within a short period.

However, applying sprays before SWD is present in fruit plantings may negatively affect natural enemies and pollinators and may cause outbreaks of secondary pests. In fact, secondary pest outbreaks (e.g. spider mites and scale insects) are becoming more common in crops that are managed for SWD, particularly with pyrethroid-intensive programs. Do not apply insecticides during bloom period and when pollinators are active. This will be problematic for growers of some fruit crops.

ALWAYS read and follow all instructions on the pesticide label; the information presented here does not substitute for label instructions.

Rotate Modes of Action by Selecting Materials from Different IRAC Activity Groups for each Application to Delay Development of Insecticide Resistance

Ideally no pesticide group should be applied back-to-back to the same planting even if targeting different pests. Tables 1-5 provide some insecticides that have been effective (survey of WERA-1021 SWD Coordinating Committee members) against SWD for some host fruit [blueberry, brambles (blackberry and raspberry), strawberry, sweet cherry, and tart cherry]. This is not an exhaustive list, and other formulations of these active ingredients or other active ingredients in these chemical classes may be equally effective in managing SWD populations in these fruit crops.

These insecticides also may be important components of management programs for other pests so consider the maximum number of applications and active ingredients allowed per season or year when designing spray programs. In some crops, post-harvest application of insecticides may be applied to control remaining SWD adults if later susceptible crops are nearby. Materials with long preharvest intervals may be useful after harvest in this situation.

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This publication, Spotted Wing Drosophila Monitoring and Management (FS-1023), is a series of publications of the University of Maryland Extension and the Department of Entomology. The information presented has met UME peer review standards, including internal and external technical review. For more information on related publications and programs, visit: http://entomology.umd.edu. Please visit http://extension.umd.edu/ to find out more about Extension programs in Maryland.

Blueberry

Table 1. Examples of SWD-active insecticides for blueberry production. This is not an exhaustive list, and other formulations of these active ingredients or other active ingredients in these chemical classes may be similarly effective. **ALWAYS read and follow all instructions on the pesticide label; the information presented here does not substitute for label instructions.**

Trade Name	Active Ingredient	Re-entry Interval	Preharvest Interval	Effectiveness[A]	Application Restrictions	Maximum Usage
Pyrethroids and pyrethrins (IRAC activity group 3A)						
Asana XL	Esfenvalerate	12 hrs	14 days	Excellent	Not specified	0.2 lb ai/acre per season
Brigade WSB	Bifenthrin	12 hrs	1 day	Excellent	Not specified	0.5 lb ai/acre per season
Danitol 2.4 EC	Fenpropathrin	24 hrs	3 days	Excellent	2 per season	0.6 lb ai/acre per season
Mustang Maxx	Zeta-cypermethrin	12 hrs	1 day	Excellent	Not specified	0.15 lb ai/acre per season
Bifenture 10DF	Bifenthrin	12 hrs	1 day	Good-Excellent	Not specified	0.5 lb ai/acre per season
Pyganic EC 5.0 II[B]	Pyrethrins	12 hrs	0 days	Weak-Fair	10 per season	Not specified
Spinosyns (IRAC activity group 5)						
Delegate WG	Spinetoram	4 hrs	3 days	Good-Excellent	6 per year	0.305 lb ai/acre per year
Entrust SC[B]	Spinosad	4 hrs	3 days	Good	3 per crop or 6 per year	0.45 lb ai/acre per crop
Spintor 2SC	Spinosad	4 hrs	3 days	Good-Fair	3 per crop or 6 per year	0.45 lb ai/acre per crop
Diamides (IRAC activity group 28)						
Exirel	Cyantraniliprole	12 hrs	3 days	Good	Not specified	0.4 lb ai /acre per year
Organophosphates (IRAC activity group 1B)						
Imidan 70W	Phosmet	24 hrs[C] 3 days[D]	3 days	Excellent	5 per year	3.63 lbs ai/acre per year
Diazinon 50W	Diazinon	5 days	7 days	Good	1 in season foliar	Not specified
Malathion 8 Flowable	Malathion	12 hrs	1 day	Good	3 per year	Not specified
Carbamates (IRAC activity group 1A)						
Sevin XLR Plus	Carbaryl	12 hrs	7 days	Fair-Good	5 per year	10 quarts product/acre per year
Lannate SP	Methomyl	48 hrs	3 days	Good-Excellent	4 per crop	4 lbs product/acre per crop

[A]Efficacy rankings summarized by Rufus Isaacs at Michigan State University and determined by surveys of WERA-1021 SWD Coordinating Committee members.
[B]OMRI approved for use in organic production
[C]REI for employees in high bush blueberries.
[D]REI for low bush blueberries and non-employees in high bush blueberries, i.e. general public at pick-your-own farms.

Brambles (Blackberry and Raspberry)

Table 2. Examples of SWD-active insecticides for bramble (blackberry and raspberry) production. This is not an exhaustive list, and other formulations of these active ingredients or other active ingredients in these chemical classes may be similarly effective. **ALWAYS read and follow all instructions on the pesticide label; the information presented here does not substitute for label instructions.**

Trade Name	Active Ingredient	Re-entry Interval	Preharvest Interval	Effectiveness[A]	Application Restrictions	Maximum Usage
Pyrethroids and pyrethrins (IRAC activity group 3A)						
Asana XL	Esfenvalerate	12 hrs	7 days	Excellent	Not specified	0.15 lb ai/acre per season
Brigade WSB	Bifenthrin	12 hrs	3 days	Excellent	1 post bloom	0.2 lb ai/acre per season
Danitol 2.4 EC	Fenpropathrin	24 hrs	3 days	Excellent	2 per season	0.6 lb ai/acre per season
Mustang Maxx	Zeta-cypermethrin	12 hrs	1 day	Excellent	Not specified	0.15 lb ai/acre per season
Bifenture 10DF	Bifenthrin	12 hrs	3 days	Good-Excellent	1 post bloom	0.2 lb ai/acre per season
Pyganic EC 5.0 II[B]	Pyrethrins	12 hrs	0 days	Weak-Fair	10 per season	Not specified
Spinosyns (IRAC activity group 5)						
Delegate WG	Spinetoram	4 hrs	1 day	Good-Excellent	6 per year	0.305 lb ai/acre per year
Entrust SC[B]	Spinosad	4 hrs	1 day	Good	6 per year	0.45 lb ai/acre per crop
Spintor 2SC	Spinosad	4 hrs	1 day	Good-Fair	6 per year	0.45 lb ai/acre per crop
Organophosphates (IRAC activity group 1B)						
Malathion 8 Flowable	Malathion	12 hrs	1 day	Good	3 per year	Not specified
Carbamates (IRAC activity group 1A)						
Sevin XLR Plus	Carbaryl	12 hrs	7 days	Fair-Good	5 per year	10 quarts product/acre per year

[A]Efficacy rankings summarized by Rufus Isaacs at Michigan State University and determined by surveys of WERA-1021 SWD Coordinating Committee members.

[B]OMRI approved for use in organic production.

Strawberry

Table 3. Examples of SWD-active insecticides for strawberry production. This is not an exhaustive list, and other formulations of these active ingredients or other active ingredients in these chemical classes may be similarly effective. **ALWAYS read and follow all instructions on the pesticide label; the information presented here does not substitute for label instructions.**

Trade Name	Active Ingredient	Reentry Interval	Preharvest Interval	Effectiveness[A]	Application Restrictions	Maximum Usage
Pyrethroids and pyrethrins (IRAC activity group 3A)						
Brigade WSB	Bifenthrin	12 hrs	0 days	Excellent	Not specified	0.5 lb ai/acre per season
Danitol 2.4 EC	Fenpropathrin	24 hrs	2 days	Excellent	2 per year	0.8 lb ai/acre per year
Bifenture 10DF	Bifenthrin	12 hrs	0 days	Good-Excellent	Not specified	0.5 lb ai/acre per season
Pyganic EC 5.0 II[B]	Pyrethrins	12 hrs	0 days	Weak-Fair	10 per season	Not specified
Spinosyns (IRAC activity group 5)						
Entrust SC[B]	Spinosad	4 hrs	1 day	Good	5 per year	0.45 lb ai/acre per crop
Radiant SC	Spinetoram	4 hrs	1 day	Good	5 per year	0.305 lb ai/acre per year
Spintor 2SC	Spinosad	4 hrs	1 day	Good-Fair	5 per year	0.45 lb ai/acre per crop
Organophosphates (IRAC activity group 1B)						
Diazinon 50W	Diazinon	3 days	5 days	Good	1 foliar per crop	Not specified
Malathion 8 Flowable	Malathion	12 hrs	3 days	Good	4 per year	Not specified
Carbamates (IRAC activity group 1A)						
Sevin XLR Plus[C]	Carbaryl	12 hrs	7 days	Fair-Good	5 per year	10 quarts product/acre per year

[A]Efficacy rankings summarized by Rufus Isaacs at Michigan State University and determined by surveys of WERA-1021 SWD Coordinating Committee members.
[B]OMRI approved for use in organic production.
[C]May injure Early Dawn and Sunrise strawberries (older varieties that are not frequently planted in Mid-Atlantic; however, injury may not have been assessed on newer varieties).

Sweet Cherry

Table 4. Examples of SWD-active insecticides for sweet cherry production. This is not an exhaustive list, and other formulations of these active ingredients or other active ingredients in these chemical classes may be similarly effective. **ALWAYS read and follow all instructions on the pesticide label; the information presented here does not substitute for label instructions.**

Trade Name	Active Ingredient	Re-entry Interval	Preharvest Interval	Effectiveness[A]	Application Restrictions	Maximum Usage
Pyrethroids and pyrethrins (IRAC activity group 3A)						
Asana XL	Esfenvalerate	12 hrs	14 days	Excellent	Not specified	0.3 lb ai/acre between bloom and harvest
Danitol 2.4 EC	Fenpropathrin	24 hrs	3 days	Excellent	2 per season	0.8 lb ai/acre per season
Mustang Maxx	Zeta-cypermethrin	12 hrs	14 days	Excellent	Not specified	0.15 lb ai/acre per season
Warrior II	Lambda-cyhalothrin	24 hrs	14 days	Good	Not specified	0.16 lb ai/acre post bloom
Pyganic EC 5.0 II[B]	Pyrethrins	12 hrs	0 days	Weak-Fair	10 per season	Not specified
Spinosyns (IRAC activity group 5)						
Delegate WG	Spinetoram	4 hrs	7 days	Good-Excellent	4 per year	0.438 lb ai/acre per year
Entrust SC[B]	Spinosad	4 hrs	7 days	Good	Not specified	0.45 lb ai/acre per year
Spintor 2SC	Spinosad	4 hrs	7 days	Good-Fair	Not specified	0.45 lb ai/acre per year
Diamides (IRAC activity group 28)						
Exirel	Cyantraniliprole	12 hrs	3 days	Good	Not specified	0.4 lb ai/acre per year
Organophosphates (IRAC activity group 1B)						
Diazinon 50W	Diazinon	4 days	21 days	Good	1 in season foliar	Not specified
Malathion 57%[C]	Malathion	12 hrs	3 days	Good	4 per year	Not specified
Carbamates (IRAC activity group 1A)						
Sevin XLR Plus	Carbaryl	12 hrs	3 days	Fair-Good	3 per year	9 quarts product/acre per season

[A]Efficacy rankings summarized by Rufus Isaacs at Michigan State University and determined by surveys of WERA-1021 SWD Coordinating Committee members.
[B]OMRI approved for use in organic production.
[C]May injure certain varieties of sweet cherries.

Tart Cherry

Table 5. Examples of SWD-active insecticides for tart cherry production. This is not an exhaustive list, and other formulations of these active ingredients or other active ingredients in these chemical classes may be similarly effective. **ALWAYS read and follow all instructions on the pesticide label; the information presented here does not substitute for label instructions.**

Trade Name	Active Ingredient	Re-entry Interval	Preharvest Interval	Effectiveness[A]	Application Restrictions	Maximum Usage
Pyrethroids and pyrethrins (IRAC activity group 3A)						
Asana XL	Esfenvalerate	12 hrs	14 days	Excellent	Not specified	0.3 lb ai/acre between bloom and harvest
Danitol 2.4 EC	Fenpropathrin	24 hrs	3 days	Excellent	2 per season	0.8 lb ai/acre per season
Mustang Maxx	Zeta-cypermethrin	12hrs	14 days	Excellent	Not specified	0.15 lb ai/acre per season
Warrior II	Lambda-cyhalothrin	24 hrs	14 days	Good	Not specified	0.16 lb ai/acre post bloom
Pyganic EC 5.0 II[B]	Pyrethrins	12 hrs	0 days	Weak-Fair	10 per season	Not specified
Spinosyns (IRAC activity group 5)						
Delegate WG	Spinetoram	4 hrs	7 days	Good-Excellent	4 per year	0.438 lb ai/acre per year
Entrust SC[B]	Spinosad	4 hrs	7 days	Good	Not specified	0.45 lb ai/acre per year
Spintor 2SC	Spinosad	4 hrs	7 days	Good-Fair	Not specified	0.45 lb ai/acre per year
Diamides (IRAC activity group 28)						
Exirel	Cyantraniliprole	12 hrs	3 days	Good	Not specified	0.4 lb ai/acre per year
Organophosphates (IRAC activity group 1B)						
Imidan 70W	Phosmet	3 days[C] 14 days[D]	7 days	Excellent	Not specified	5.25 lbs ai/acre per year
Diazinon 50W	Diazinon	4 days	21 days	Good	1 in season, foliar	Not specified
Malathion 57%	Malathion	12 hrs	3 days	Good	4 per year	Not specified
Carbamates (IRAC activity group 1A)						
Sevin XLR Plus	Carbaryl	12 hrs	3 days	Fair-Good	3 per year	9 quarts product/acre per season

[A]Efficacy rankings summarized by Rufus Isaacs at Michigan State

University and determined by surveys of WERA-1021 SWD Coordinating Committee members.
[B]OMRI approved for use in organic production.
[C]REI for employees.
[D]REI for non-employees, i.e. general public at pick-your-own farms.