DROSOPHILA SUZUKII

SPOTTED WING DROSOPHILA / suzuki-asynvlieg (SWD)

BEST PRACTICE MANAGEMENT GUIDELINE

MONITORING AND IDENTIFICATION

Monitoring of SWD is required to determine the population numbers (absence/presence) and dynamics (trends) of SWD in a particular area to initiate management practices and evaluate whether controls implemented are effective. Monitoring primarily takes place using traps baited with various lures (see **TRAPS** section), but fruit sampling for damage assessment is also critical since trap catches rarely accurately reflect potential levels of infestation and may lag fruit infestation and damage.

SWD Identification: SWD adults resemble *Drosophila melanogaster* (Figure 1 A) but can be distinguished from other flies abundantly collected in traps (e.g., *Zaprionus* sp. – Figure 1B) based on several characteristics.

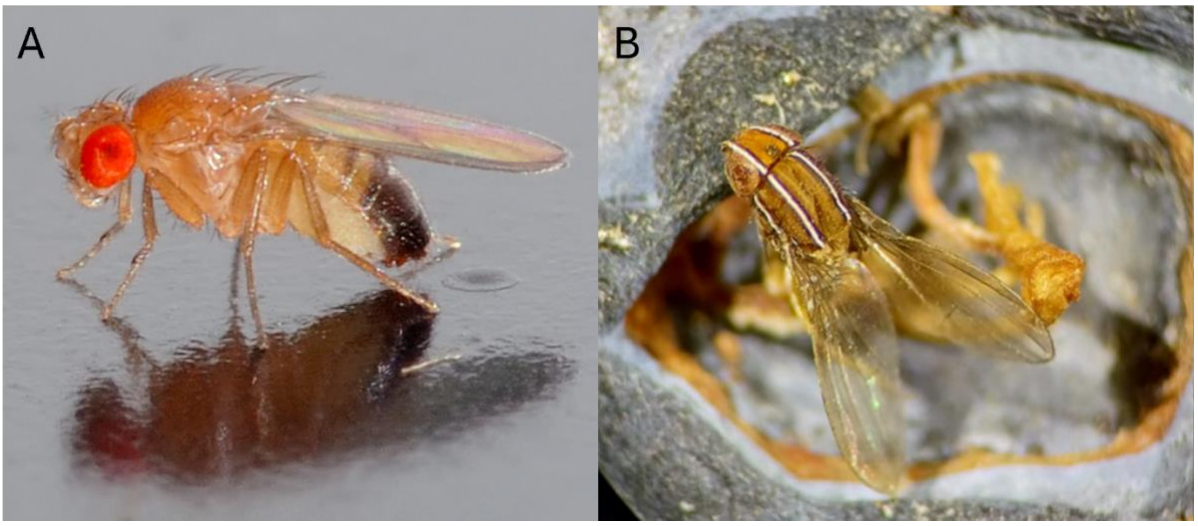

Figure 1. *Drosophila melanogaster* (A) and *Zaprionus sp.* (B) with their characteristic white stripes are examples of vinegar flies often collected in SWD traps (Image credit: André Karwath, via Wikimedia Commons(A), Gulu Bekker(B)).

Adult SWD is about 3mm in length and the males have a black/brown spot on the top edge of each wing as well as setae (black hairs) present on the front leg in two rows (Figure 2). It should be noted that the spots on the wings of the males are not visible when they first emerge; it takes several hours for them to be fully formed. Females have a large, serrated ovipositor and no spot on the wings (Figure 3).

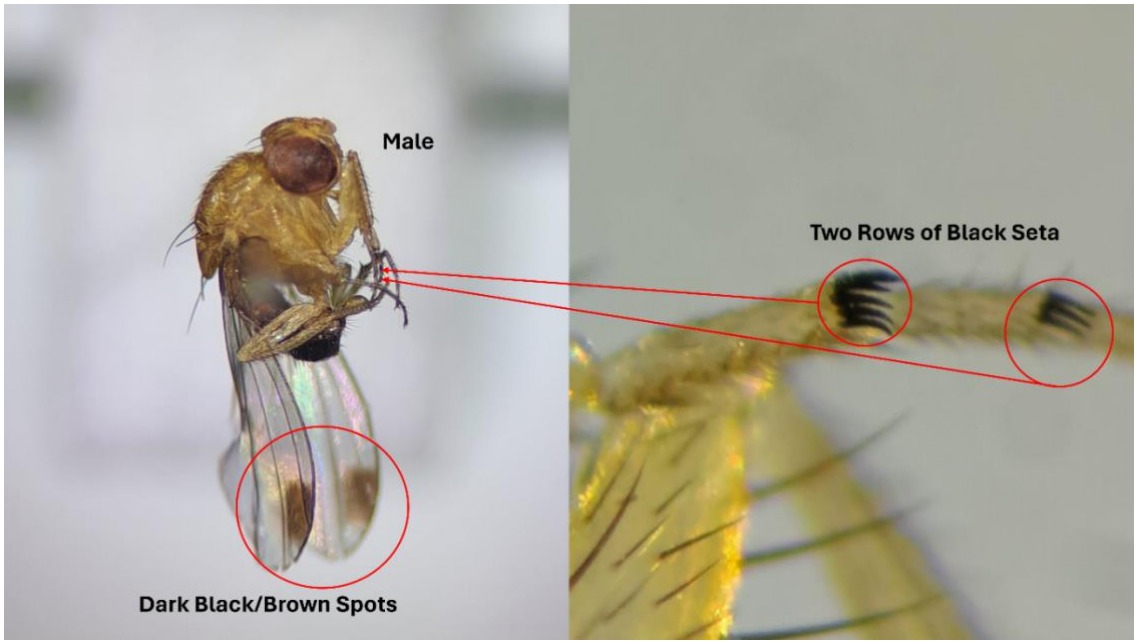

Figure 2. The identification of *Drosophila suzukii* males (Image credit: Zion Jodamus).

Figure 3. The identification of *Drosophila suzukii* females (Image credit: Zion Jodamus).

Although the immature stages (eggs, larvae and pupae) of SWD are easily distinguishable from members of the Tephritidae family (e.g., Mediterranean fruit fly) (Figure 4,5, 6), they are not easy to distinguish from other members of the Drosophilidae and will have to be reared to adults or identified using molecular tools (i.e., DNA sequencing). The use of a magnifying glass, hand lens (X10 or stronger) or microscope will be required to view the female ovipositor.

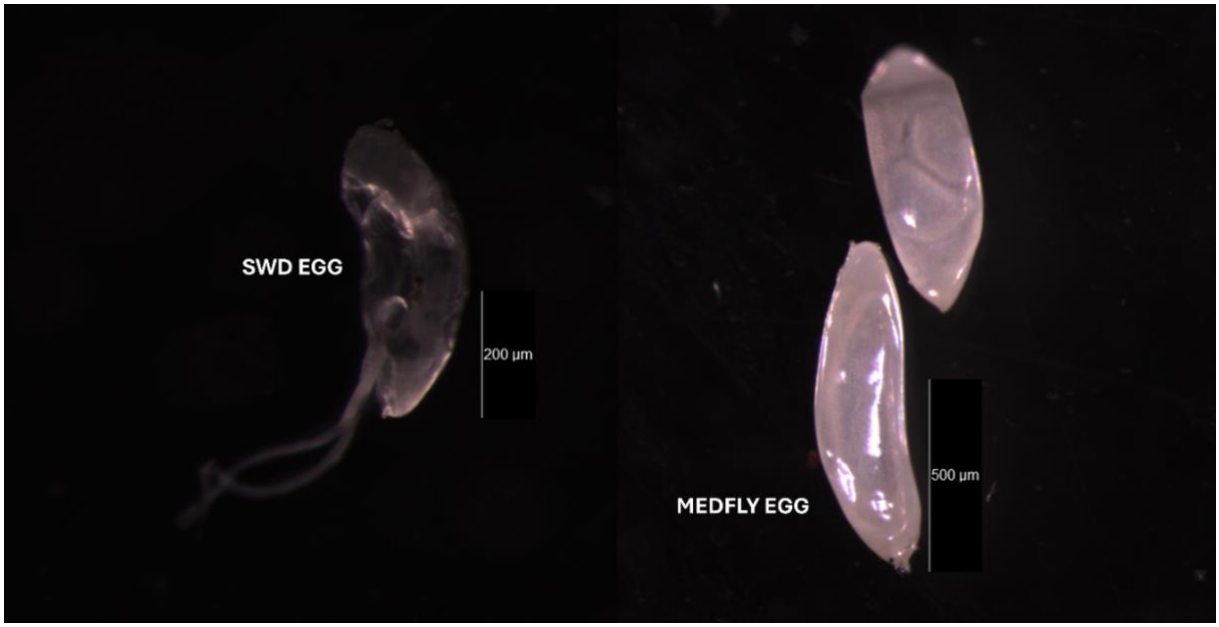

Figure 4 The identification of *Drosophila suzukii* (SWD) larvae (left) vs. *Ceratitis capitata* (Medfly) larvae (right) (Image credit: Zion Jodamus).

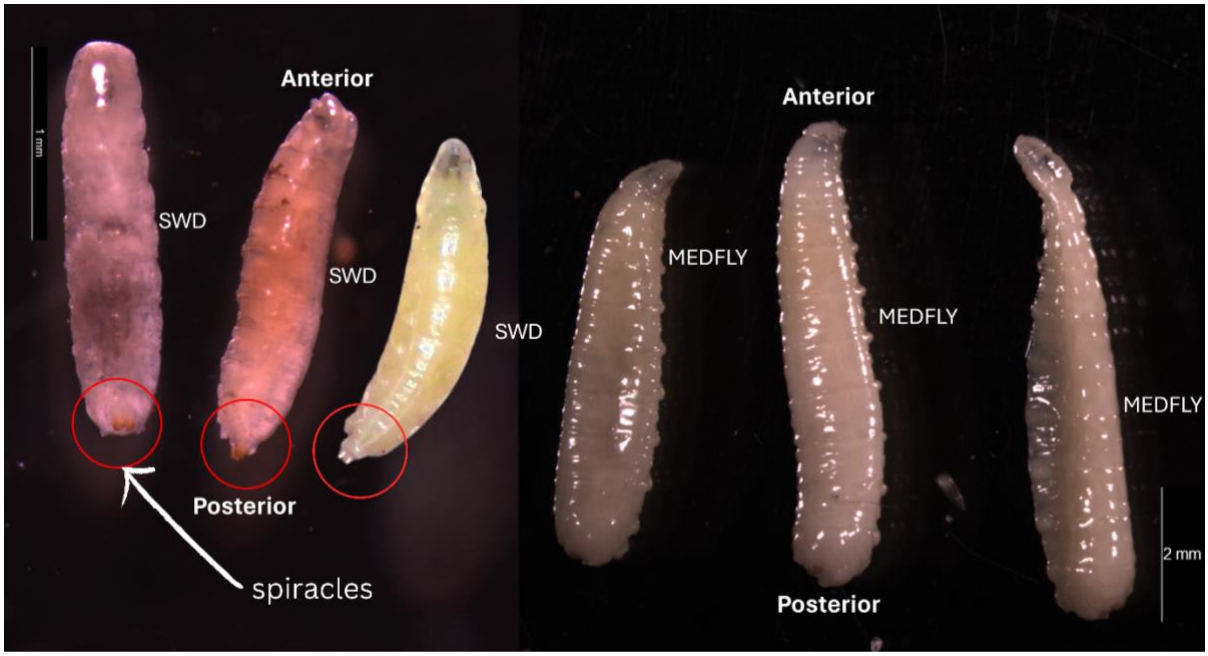

Figure 5 The identification *of Drosophila suzukii* (SWD) larvae (left) vs. *Ceratitis capitata* (medfly) larvae (right) (Image credit: Zion Jodamus).

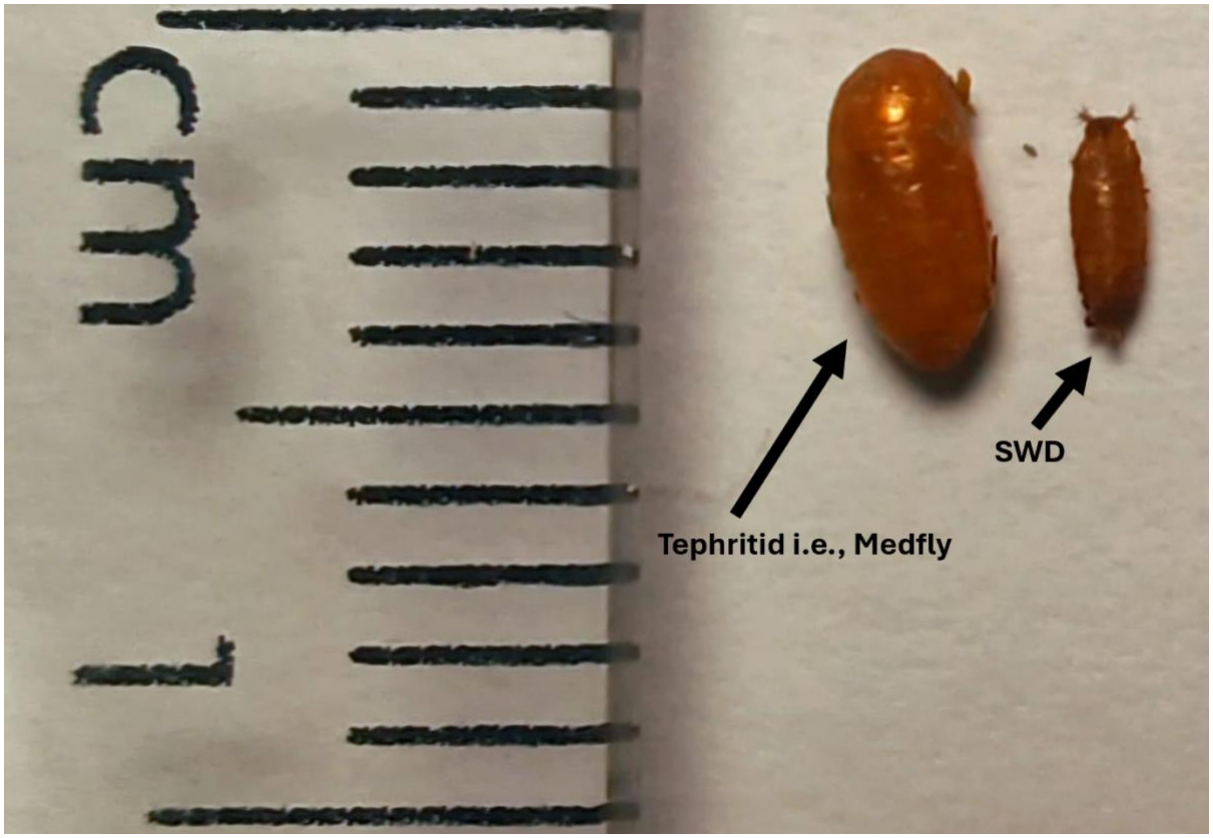

Figure 6 The identification *of Drosophila suzukii* (SWD) pupae (right) vs. *Ceratitis capitata* (medfly) pupae (left) (Image credit: Gulu Bekker).

TRAPS

Adult SWD can be monitored using various homemade and commercially available traps and attractants (https://youtu.be/aMHpI-h_SYI?si=jEflAvrB-hfvqEnq).

What: Commercial McPhail bucket traps (https://youtu.be/p_j4jJMTTY0?si=sqLwfjhs-g1_IrIW), any supplier, or the SWD Scentry trap (https://youtu.be/Jt0lrlAs2O8?si=ls0bSC_ExWNLVzP_) can be used as dry traps baited with a synthetic SWD lure and an insecticide.

Alternatively, homemade wet traps made from clear plastic containers (i.e., honey jars or other plastic containers with a lid) with small holes (±3mm diameter) drilled around the perimeter (see Figure 7) can also be utilised (https://youtu.be/8w16QI8t8MM?si=8QNVOqnpNFI0oBqf and https://youtu.be/NLYFFUeiGTA?si=cCG6FByK1SzQXncm).

Homemade and commercial traps can be baited with synthetic SWD lures, apple cider vinegar, or a mixture of water, yeast and sugar: In 2L of water, add 150g of sugar and 10g of yeast. The mixture has proven an effective attractant for SWD (Iglesias et al. 2014). Adding a small drop of dish soap (e.g., Sunlight liquid) to wet traps can aid in breaking the surface tension to retain specimens.

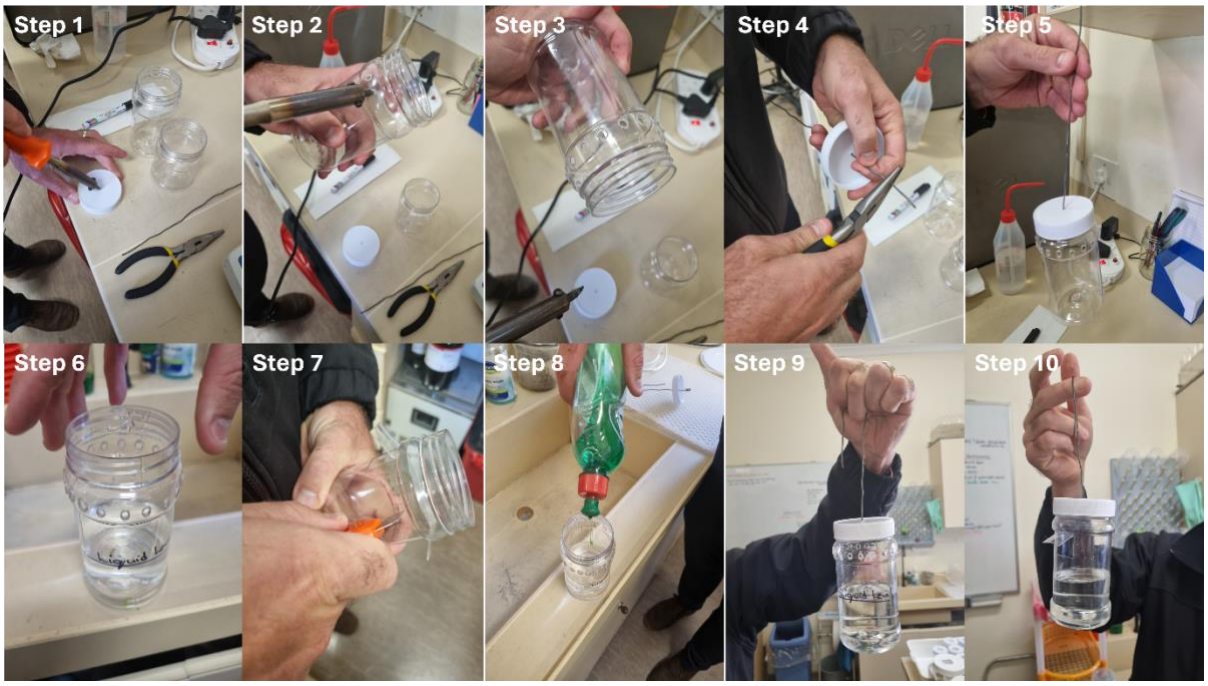

Figure 7. Ten steps to assemble a homemade SWD trap.

How: Traps should be placed in the shade within the canopy since SWD will search out shaded areas with high humidity. Traps should be serviced once a week or bi-weekly (if weekly is not possible) and synthetic lures replaced as suggested by the manufacturer (6-8 weeks). Homemade wet traps need to be rebaited every week, due to the liquid evaporating. If liquid levels are sufficient after a week, no rebaiting is necessary. The attractive range of various traps is limited (approximately 30m) and therefore multiple traps should be placed on the periphery of the orchard/block to detect the arrival of SWD and within the orchard/block to monitor SWD levels.

To determine when SWD starts entering the crop, place 1 trap every 30 meters on the perimeter, e.g., in the hedgerows or other vegetation on the periphery of your orchards/blocks. As soon as SWD is detected in the perimeter traps, start monitoring the crop by placing traps 30 meters apart, and 10 meters into the orchard/block from the edge. Prioritise frequent fruit damage assessments throughout the fruit production season (see **FRUIT ASSESSMENT** section for details).

When: Traps should be placed on the periphery of orchards/blocks before fruit start to ripen (before increased sugar levels) and start to change colour, which will depend on the fruit kind and cultivar. Trapping should continue throughout the entire season and trapping success will be influenced by temperature.

FRUIT ASSESSMENT

The “fruit dunk” or flotation method (information from Van Timmeren et al. 2017, 2021) can be implemented to monitor the presence of SWD larvae in fruit (https://youtu.be/JCOE0Sj3FTw?si=eMYv978E_rwM8sG5).

When: Fruit damage assessments should commence as soon as fruit colour starts to change (with increased sugar levels) and continue weekly until harvest (if possible). This method provides data on fruit infestation levels (potentially eggs, larvae and pupae in fruit) several days before adult emergence and serves as an early warning for when flies will be captured in traps. At optimal temperatures, SWD can complete its life cycle within 10 – 15 days (see the **SWD fact sheet** for more information).

Where: Fruit on the edge of the orchard/block adjacent to natural vegetation is at higher risk of infestation. Fruit should be collected from 10 random plants located 10 meters into the orchard/block from the edge. This should be repeated for all sides of the orchard/block that borders natural vegetation or alternate hosts.

How: Prepare a saturated salt (normal table salt can be used) or sugar solution according to Table 1 below (Shaw et al. 2019).

Table 1 The preferred solution to use for detecting SWD larvae in different fruit kinds. Adapted from Shaw et al. 2019.

Crop	**To detect 1st – 2nd Instar larvae**	**To detect 3rd Instar larvae**
Blueberry	Sugar (18%) or Salt (7.5%)	Sugar (18%) or Salt (7.5%)
Cherry	Sugar (18%) or Salt (7.5%)	Sugar (18%)
Raspberry	Sugar (18%)	Sugar (18%) or Salt (7.5%)

Harvest a representative fruit sample per orchard/block straight from the plants – do not collect damaged or fallen fruit from the orchard floor. Place the fruit in a plastic bag or container, lightly crush the fruit and add sufficient salt or sugar solution (approximately 250mL) to cover the crushed fruit (see Table 1). Let the fruit sit in the solution for approximately 1 hour and then pour the contents through 2 sieves simultaneously: a course sieve above to collect the fruit particles and another filter (fine mesh or a coffee filter) below to collect the potential larvae. Wash the fruit particles with additional water and inspect the fine filter surface for the presence of SWD larvae under a microscope or using a 10x magnification hand lens (https://youtu.be/JCOE0Sj3FTw?si=OcDMS6l4O6z5mOaw).

ALTERNATE HOST MANAGEMENT

The management of alternate hosts within the vicinity of susceptible crops is crucial to managing SWD populations that will later invade your crop. Some of the main alternate hosts commonly found on farms and farm gardens are listed in Table 2. To determine host status, the fruit flotation method can be used as described above (remember to collect fruit directly from the plant and not to collect fallen fruit). However, contact your industry entomologist to confirm the identification of the larvae.

Table 2: Non-crop plants used as hosts by Spotted Wing Drosophila in Europe, but also commonly found on farms and in farm gardens in South Africa. Note that this is not a complete list of hosts of SWD but only serves as a guideline (Kenis et al. 2016).

Scientific Name	Common Names
Actinidia chinensis	Kiwi
Amelanchier lamarckii	Juneberry
Amelanchier ovalis	Snowy Mespilus
Arbutus unedo	Strawberry Tree
Arum italicum	Italian Arum
Cornus alba	Red barked Dogwood
Cornus kousa	Kousa Dogwood
Cornus mas	Cornelian Cherry
Cornus sanguinea	Dogwood
Cotoneaster franchetii	Orange Cotoneaster
Cotoneaster lacteus	Late Cotoneaster
Cotoneaster rehderi	Rehder's Cotoneaster
Crataegus chrysocarpa	Fireberry Hawthorn
Crataegus monogyna	Common Hawthorn
Daphne mezereum	Mezereum
Duchesnea indica	Indian Strawberry
Eriobotrya japonica	Loquat
Ficus carica	Fig
Fragaria vesca	Wild Strawberry
Frangula alnus	Alder Buckthorn
Gaultheria x wisleyensis	Wisley Heath
Hippophae rhamnoides	Sea Buckthorn
Lonicera caerulea	Blue Honeysuckle
Lycium barbarum	Goji Berry
Mahonia aquifolium	Oregon Grape
Mahonia sp.	Mahonia
Malus baccata	Siberian Crab Apple
Paris quadrifolia	Herb Paris
Parthenocissus quinquefolia	Virginia Creeper
Photinia beauverdiana	Beauverd's Photinia
Photinia villosa	Himalayan Photinia
Photinia prunifolia	Taiwan Firethorn
Phytolacca americana	American Pokeweed
Phytolacca esculenta	Chinese Pokeweed
Polygonatum multiflorum	Solomon's Seal
Prunus armeniaca	Apricot
Prunus avium	Sweet Cherry
Prunus cerasifera	Cherry Plum
Prunus cerasus	Sour Cherry

Scientific Name	Common Name
Prunus domestica	Plum
Prunus laurocerasus	Cherry Laurel
Prunus lusitanica	Portugal Laurel
Prunus mahaleb	Mahaleb Cherry
Prunus padus	Bird Cherry
Prunus serotina	Black Cherry
Prunus spinosa	Blackthorn
Pyracantha sp.	Firethorn
Rhamnus cathartica	Common Buckthorn
Ribes rubrum	Red Currant
Rosa acicularis	Prickly Wild Rose
Rosa canina	Dog Rose
Rosa glauca	Red leaved Rose
Rosa pimpinellifolia	Burnet Rose
Rosa rugosa	Rugosa Rose
Rubus caesius	Dewberry
Rubus fruticosus	Blackberry
Rubus idaeus	Raspberry
Rubus phoenicolasius	Wineberry
Rubus saxatilis	Stone Bramble
Sambucus ebulus	Danewort
Sambucus nigra	Elderberry
Sambucus racemosa	Red Elderberry
Solanum dulcamara	Bittersweet Nightshade
Solanum nigrum	Black Nightshade
Sorbus aria	Whitebeam
Sorbus aucuparia	Rowan
Symphoricarpos albus	Snowberry
Tamus communis	Black Bryony
Taxus baccata	English Yew
Vaccinium myrtilloides	Velvetleaf Blueberry
Vaccinium myrtillus	Bilberry
Vaccinium oldhamii	Oldham's Blueberry
Vaccinium praestans	Dwarf Blueberry
Vaccinium vitis	Lingonberry
Viburnum lantana	Wayfaring Tree
Viburnum rhytidophyllum	Leatherleaf Viburnum
Vitis vinifera	Grapevine

When: Depending on what hosts are present in your area, you will have to manage these hosts on a continuous basis, as some of them flower and bear fruit throughout the year.

Where: Manage alternate hosts in close vicinity of your crops, as these hosts will support SWD populations that will invade your crop when it becomes susceptible.

How: SWD populations can be managed either by physically removing alternate hosts or by fruit stripping. Correctly dispose of this fruit, as described under the **ORCHARD/BLOCK SANITATION** section.

ORCHARD/BLOCK SANITATION

Orchard/block sanitation is good farming practice not only for the management of SWD but for other pests and diseases as well. Orchard/block sanitation plays an important role in managing SWD populations over time and preventing rapid increases in populations, which can cause crop losses.

When: Preharvest orchard/block sanitation should be implemented whenever there is fallen fruit on the floor, due to wind or thinning for instance. Orchard/block sanitation should also be done at harvest/picking and post-harvest.

Where: Implement sanitation practices in your crop and alternate hosts.

How: Fruit should be harvested as soon as possible/viable as overripe fruit in an orchard are more vulnerable to attack by SWD. All unmarketable fruit should be removed from your orchard/block. All the fruit that has fallen to the ground during picking must be removed as soon as possible, preferably at picking. No fruit should be left on your tree/bush or be left sitting in punnets/trays or bins anywhere on the farm. Fruit that was removed from the orchard/block during sanitation should be disposed of immediately, by burying the fruit at least 30 cm deep and immediately covering the fruit with soil and compressing the soil. Fruits can also be placed in black bags, tightly closed, and placed in direct sunlight for two weeks to kill any larvae, after which the fruit can be buried.

MASS TRAPPING AND ATTRACT-AND-KILL

Trapping can be used as a control measure, through mass trapping. The same lures and traps mentioned above for monitoring can also be used for mass trapping. There are commercial attract-and-kill devices available which can also be used. Contact your industry representative crop protection advisor for more information on this.

When: As soon as your monitoring traps have detected SWD populations initiate mass trapping or attract-and-kill.

Where Mass trapping or attract-and-kill should be implemented within and on the perimeter of your orchard/block.

How: Within the orchard/block, traps should be evenly spaced, not more than 2-3 meters apart. This equates to roughly ±200 – 300 traps per hectare. On the perimeter, place 1 trap every 2-3 meters around your orchard/block. If you are using liquid traps, check traps weekly and fill them to the original liquid level. When using dry traps, empty traps weekly and replace lures according to the manufacturer's guidelines. In the case of using commercial attract-and-kill products, always follow the manufacturer's label instructions.

CHEMICAL APPLICATION

Chemical applications should be based on the information obtained by your fruit assessments and monitoring traps. Currently, there are no trap catch thresholds that can be used to determine risk. Aspects to consider when using chemical applications are registrations, specific label rates, withholding periods, preharvest intervals (PHI), maximum residue limits (MRL), rotation of chemical classes (resistance management) and the effects on bees, pollinators, and other natural biocontrol agents.

When: Due to the SWD population's ability to rapidly increase, chemical applications should be initiated as soon as larvae are found within fruit during your fruit assessments or as soon as flies are caught in traps (whichever comes first).

Where: Only within the crop.

How: The efficacy of insecticides can be influenced by the type of product, dose/concentration, tractor speed, nozzle type, pressure and spray volume, which you will have to determine based on the size and structure of your crop. Consult with your crop protection technical advisor. The biggest proportion of SWD individuals are found in the centre of the fruit tree/bush where it is shady, cool and humid. Therefore, it is important to get good penetration within your crop when you spray. It is important to know that chemical applications for SWD should be cover sprays and not applied as baits, as would be the case with Mediterranean fruit flies and other Tephritids.

What: Currently there are several insecticides registered under Act 36 of 1947 for the control of SWD in South Africa (see Table 3).

The most used active ingredients for SWD control by conventional growers in other parts of the world are: spinetoram, cypermethrin (variations), cyantraniliprole and malathion/mercaptothion. Please consult your industry entomologist together with your crop protection technical advisor for support on seasonal programmes to manage SWD populations.

Table 3: Currently registered agricultural remedies for use against *Drosophila suzukii* (SWD) – Updated 2025/01/14. Always follow the manufacturer's label instructions.

Trade Name (active ingredient)	**Formulation**	**Dosage (g or ml) per 100L water or kg/ha**	**IRAC Code**	**PHI**	**Notes**	**Crops**
BioMagnet Ruby (Deltamethrin)	Attract & Kill	75 - 150 devices	3A	0	Deploy early in the season, with two applications per year, with application interval of 120 days**. Note:** Emergency registration not yet available.	Blueberries, Cherries, Nectarines, Peaches, Plums, Prunes, Apricots, Table Grapes, Wine Grapes.
Tamprid (Acetamiprid)	200 SP	40 g	4A	35	Apply as a light cover spray at the first signs of infestation based on scouting. Ensure thorough, even coverage. Repeat as required for a maximum of 2 applications at 14-day intervals. If further applications are required, make use of registered insecticides with a different mode of action to TAMPRID 200 SP. **Emergency Registration**	Blueberries, blackberries, cranberries, dewberries, gooseberries, raspberries, blackcurrants, currants
Tracer (Spinosad)	480 SC	20 ml	5A	3	Apply TRACERTM 480 SC during flowering at beginning of infestation or first visible damage on the crop. Application against larvae or immature adults of *D. suzukii*. Application can be repeated every 7 days. Resistance management: For resistance management, TRACERTM 480 SC should not be applied in total more than three times per season on blueberries. **Emergency Registration**	Strawberries, raspberries, plums, peaches and nectarines, cherries, blueberries & blackberries

MULTI-INDUSTY COLLABORATION ON MANAGING SPOTTED WING DROSOPHILA IN SOUTH AFRICA

Since the first report of SWD in South Africa, several fruit industries as well as their researchers have been part of a coordinated effort to address the threat that SWD holds for all these industries. Due to the risk that SWD holds for multiple crops, these industries have been supportive of a collaborative effort to conduct critical research to manage this pest in a heterogenous landscape. See below the proposed research that has been submitted for funding to garner much needed information across the different industries.

Some of the main objectives include:

- Determine the fruit type/cultivar and ripeness stage susceptibility to SWD attack.
- Conduct a survey of potential alternate hosts in the different fruit producing regions.
- Determine SWD population dynamics in different crops and fruit producing regions.
- Develop attractants and evaluate currently available commercial attractants for use in attract and kill applications for SWD in South Africa.
- Determine the diversity of Drosophilidae parasitoids in South Africa for the control of SWD.
- Determine the efficacy of candidate parasitoids (collected during the survey and commercially available) against SWD.

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PHOTO CREDIT

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