

# FARMER FACTSHEET – IPM

## Sweet Pepper

### Crop group: Solanaceae (sweet pepper, tomato, eggplant)

#### Summary

The best insect pest and disease management is prevention and knowledge. Each farm will usually have a few insect pests and diseases that regularly infest or infect their crops and usually one or two regularly cause major crop loss unless actively managed. Knowing which are the major insect pests or diseases, early signs of infestation or infection, understanding what conditions favour their growth and what their natural enemies are, lead to specific management practices that will give the best outcomes [Refer to the pest and disease specific factsheets for more information]. However there are some general crop management or 'cultural' practices that can be used to reduce chances of bringing pests and diseases into crops and once there, in minimising their spread. Crops that have optimal (not too much or too little) nutrition and water, and growing in environmental conditions that they are suited to, will grow more quickly, produce higher yields and in general be more resistant to disease infection and outgrow damage (refer to the Best Practice Guides for Sweet Pepper).

#### Site selection

Practice crop rotation and choose a site that has not recently grown sweet peppers or other solanaceous crops, such as tomatoes, chillies or eggplants, to reduce soil borne diseases. Do not plant next to, down-wind or down-slope of an older sweet pepper crop to reduce movement of insect pests or diseases from the older to younger crop.

#### Land preparation

Waterlogging favours many soilborne diseases, stops plants growing and reduces their chance of resisting infection or infestation so good drainage is important. Raised beds, soil amendments and protected cropping can reduce chances of waterlogging. Make soil more suppressive by adding microbial inoculants such as EM, Vermi-compost, chicken dung and other organic matter as soil amendments. Cabbage residues, wild sunflower (*Tithonia diversifolia*) and hagonoy (*Chromolaena odorata*) were proven effective in reducing soil-borne diseases, especially bacterial wilt caused by *Ralstonia solanacearum*. (Note: these plants should only be used if locally abundant. Do not plant in new areas as they are common weeds). If soil pH is acidic, lime should be applied to the soil at a rate of 250 g/m.



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### Timing

Avoid planting in dry months if whitefly, aphids, thrips and mites are common pests.

### Seedling production

Use certified disease-free seed and clean planting materials. Clean media for planting seeds (sterilized best), monitor seedlings, grow seedlings away from main production area and net well to prevent pest infestation. Check seedlings are pest and disease free before transplanting (see Best Practice Guide to Seedling Production).

### Transplanting

Handle seedlings with care when pricking and transplanting. Extra care should be done to minimise root wounding. Fungicide drenching may be applied to newly transplanted seedlings to protect them from soil-borne fungi. Alternatively, 200 ppm chitosan solution can be applied to the seedlings by root drenching during transplanting.

Use sticky traps around seedling production area and in newly transplanted crop for sucking insects.

### Vegetative

Monitor establishing plants, check leaf terminals for distortion from broad mite infestation, check undersides of leaves as most insect pests will be found there, especially next to leaf veins. Where possible squash eggs, aphids and newly hatched cutworm or fruitworm larva. Not all insects or mites that are seen in crops are causing economic losses. Many are 'natural enemies' or "beneficials" and need to be maintained to assist in managing pest insect populations. Learn to recognise the common natural enemies. Monitor pest and natural enemy populations 1–2 times per week and record numbers per plant to track whether populations are increasing or decreasing. If pest populations are increasing and natural enemies absent or in very low numbers an insecticide spray may be needed. Where possible choose insecticides that are specific to the pest group and least toxic to natural enemies and humans. Always read the label and use appropriate personal protection when spraying.

Monitor the plants for disease symptoms such as wilting, stunting, leaf spots, leaf and shoot blights. Rogue infected plants showing systemic symptoms and carefully prune away infected parts for localized diseases. If pruning needs to be done, sanitary pruning should be done, i.e. disinfect pruning tools after use on every plant.

Bacterial wilt and blight can be transmitted via pruning tools. Preferably carry a container for pruned plant materials (eg. a plastic bag) during pruning and immediately place the pruned diseased plant parts inside the bag to minimise dispersal of inoculum to healthy plants. Control weeds to minimize alternate reservoir of plant pathogens or vectors of plant diseases.

Regulate moisture, do not over-irrigate the plots since a film of moisture in the soil is favorable to bacterial wilt dissemination to other plants. Drain the field quickly after rain by providing drainage canals especially in an open field cultivation. Isolate diseased spots. Prevent water flow in or out of the section and limit the traffic of people and machinery in the infested area. Disease spots can be biofumigated with cabbage residues, *C. odorata* or wild sunflower. More frequent irrigation for a shorter time is less favorable for disease.

Avoid excessive nitrogen fertilization especially with ammonium form of fertilizer since they will make plants susceptible to most pests and diseases. Fungicides can be applied to control fungal diseases. Copper-based fungicides can also be applied to protect plants against bacterial leaf spots and blights. Resistance boosters such as chitosan, benzothiadiazole and phosphonates, if available may also be sprayed to plants.

### Flowering/Fruit set

Set up fruitfly traps (sticky or baited pheromone) early flowering. Monitor closely for fruitworm or cutworm eggs and small larvae as they will burrow into fruit soon after hatching. If pest populations are increasing and few natural enemies are present an insecticide spray may need to be applied.

Monitor the plants for the presence of leaf spots and blights because they may also affect the incoming fruit. Monitor also for early fruit drop. If this happens, try to check soil nutrients and inspect the early fruit for possible infections. To minimize bacterial fruit spots and canker, avoid overhead irrigation and water splashes. Protected cultivation is recommended if feasible. Protectant fungicides may be applied to the fruit and the whole plant at fruit setting to prevent infection by fungal and bacterial diseases that may affect the fruit. Water splashes are major source of fruit infections. This can be minimized by applying mulches.



**Fruit development**

Collect any infested (fruitworm, cutworm or fruit fly) or disease infected fruit and properly dispose to ensure no pests can continue to develop or diseases spread.

Monitor the leaves and fruit for the presence of leaf spots and blights. Monitor also for fruit spots, blotch, deformed fruit, fruit rot and blossom end rot. If blossom end rot is present in some fruit, this is a symptom of calcium deficiency. Ensure irrigation is adequate, too much or too little will inhibit calcium uptake. Adding some calcium can help. To minimize bacterial fruit spots and canker, avoid overhead irrigation and water splashes. Protected cultivation is recommended if feasible. Protectant fungicides may be applied to the fruit and the whole plant at fruit setting to prevent infection by fungal and bacterial diseases that may affect the fruit. Do not apply fungicides when the fruit are about to be harvested. Trellis the plants so that fruit will not get in contact with the soil.

**Harvesting**

Collect any infested fruit and properly dispose to ensure no pests can continue to develop. Do not harvest during rainy days and when conditions are wet. It is important for the fruit to be dry during harvest. Do not let the fruit get in contact with the soil. When it cannot be avoided that the fruit get wet during harvest, dry them before packing into containers, transport or storage.

**Postharvest**

As soon as possible after harvest has finished the crop should be removed and ground ploughed to prevent pest populations continuing.

In the tables below are a list of diseases or pests that can be found in sweet peppers and a summary of useful information. See the individual disease or pest factsheets for more detailed information.

Proper identification of the problem is a prerequisite for effective pest and disease management.

Table 1. Major diseases of sweet pepper



Image	Disease name	Damage symptoms	Management strategies
	Bacterial wilt ( <i>Ralstonia solanacearum</i> )	Sudden wilting of the foliage and the whole plant, internal vascular darkening of root and stem that leads to stem damage and death of the affected plant.	Grafting onto resistant chilli pepper rootstock. Crop rotation, remove infected plants, avoid planting in areas with bacterial wilt history. Grow on raised beds in areas prone to water logging. Biofumigation of soil with cruciferous residues. Biological control agents (BCAs) such as avirulent <i>R. solanacearum</i> strain, <i>Pseudomonas</i> spp. and <i>Bacillus</i> spp.
	Bacterial spot ( <i>Xanthomonas euvesicatoria</i> ; <i>Xanthomonas axonopodis</i> pv <i>vesicatoria</i> )	Symptoms begin as small, angular or round lesions on young leaves and become dark, water-soaked and sometimes with a yellow halo. Infected green fruit also have small water-soaked spots. Severe infections cause premature yellowing and early senescence of plants.	The bacterium is seed-borne so use certified disease-free seed and clean planting materials. In seedling production, use new or bleach-sanitized trays. Practice sanitation to minimize the risk of pathogen introduction. Avoid overhead irrigation. Rotate pepper crops with non-host. Anti-bacterial treatment.



Image	Disease name	Damage symptoms	Management strategies
	<p>Damping off (various, <i>Fusarium</i>, <i>Pythium</i>, <i>Phytophthora</i>, <i>Rhizoctonia</i> spp.)</p>	<p>Seedling stage, stem at ground level brown, thin, plants fall over. Root system brown, rotting.</p>	<p>Use clean or treated soil/media for seedlings. Hot water treatment of seeds and sow into pasteurized soil or another growth medium that is free of damping-off fungi. Remove infected seedlings and destroy. Place seedlings in clean elevated stands, away from splashing water. Avoid excessive watering. Water early in the morning to allow soil to dry. Pots or transplant containers should be new, bleach-sanitised or washed with very hot soapy water. For seedbeds, choose well-drained nursery locations. Keep the seedbed well ventilated and dry. Fungicide seed protectants such as copper and mancozeb; fungicidal drench if the disease appears in seedling trays or seedbeds.</p>
<p><b>Need Image</b></p>	<p>Basal stem rot <i>Phytophthora capsici</i></p>	<p>Darkening and girdling of the basal part of the stem and roots, leading to wilting of the above ground parts of the plant.</p>	<p>Avoid excessive watering. Mound plants and construct drainage canals, especially during rainy season. Increase suppressiveness of the soil. Apply organic materials; compost with animal manures or microbial inoculants. Fungicides</p>
	<p>Fusarium wilt (<i>Fusarium oxysporum</i> f. sp. <i>lycopersici</i>)</p>	<p>Initial yellowing of the foliage, starting at the lower leaves. Loss of turgidity and wilting of the whole plant. Internal browning of the stem. Spread by contaminated seeds and seedlings, contaminated potting mix, soil water, farm equipment and human shoes. Soil dusts containing fungal structures can be spread by wind.</p>	<p>Biofumigate soil with wild sunflower <i>Tithonia diversifolia</i> Fungicides</p>





Image	Disease name	Damage symptoms	Management strategies
	<p>Sclerotium wilt (<i>Sclerotium rolfsii</i>)</p>	<p>Rotting of the base and wilting of the plant. Tiny round brown sclerotial bodies are found at the base near the soil line.</p>	<p>Deep ploughing of soil, solarisation of soil during hot sunny days to reduce inoculum. Rogue infected plants. Eliminate weeds. Keep plant base free of dead leaves and weeds. A number of antagonistic fungi such as <i>Trichoderma harzianum</i>, <i>T. viride</i>, <i>Bacillus subtilis</i> and <i>Gliocladium virens</i> have been shown to provide control. Use of herbicides for weed control. Formalin may be used as fumigant for treatment of seed beds or fields for valuable crops. Pentachloronitrobenzene (PCNB) may provide control when applied to the soil early, before infection.</p>
	<p>Sooty mould (<i>Capnodium</i> spp.)</p>	<p>Velvety grey-black, fungal coating on the leaf which is not pathogenic to plants, but obtains its nourishment from honeydews secreted by small sucking insect pests like aphids, soft scales and mealy bugs. The mould cover reduces the plant's photosynthetic ability and leaves can fall prematurely.</p>	<p>Increase plant distance to avoid overcrowding, control of honeydew-producing insects. Allow good air-flow between plants.</p>
	<p>Frog-eye spot/ Cercospora leaf spot (<i>Cercospora capsici</i>)</p>	<p>Lesions begin as water-soaked spots, which then dry with a dark margin and light brown or light grey centre. The centre can drop out leaving a hole in the leaf. Severe infection may result to defoliation.</p>	<p>Do not plant replant sweet pepper in same field. Use clean seeds. Remove crop debris. Practice sanitation to minimize the risk of pathogen introduction.) Avoid overhead irrigation. Rotate pepper crops with non-host. Fungicides</p>
	<p>Powdery mildew (<i>Leveillula taurica</i>)</p>	<p>Powdery white appearance on older leaves first, especially during warm humid nights. Severely affected leaves yellow and fall.</p>	<p>Avoid excessive rates of nitrogen, since they make plants susceptible to most pests and diseases. Avoid overcrowding and shading of plants. Do not plant near infected crops. Fungicides</p>








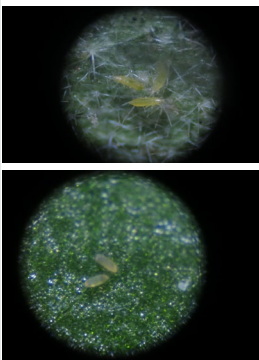









Image	Disease name	Damage symptoms	Management strategies
	<p>Leaf blight <i>Choanephora cucurbitarum</i> (an opportunistic fungus)</p>	<p>This fungus is a weak parasite; it colonizes dead or dying tissue before it actively invades living pepper tissue.</p> <p>Water soaked lesions appear on the leaves, with the margins and leaf tips becoming blighted.</p> <p>In severe conditions, the entire plant may wilt.</p> <p>Stiff, silvery mass of hairy strands growing out of the affected leaf tissue, topped with a black ball is evident.</p>	<p>Plant in well- drained soil.</p> <p>Avoid dense plantings.</p> <p>Use drip irrigation.</p> <p>Avoid overhead irrigation.</p> <p>Fungicides</p>
	<p>Anthracnose (<i>Colletotrichum capsici</i>)</p>	<p>Sunken soft lesions on fruit, with fungal spores in the centre.</p> <p>Fruit rots in wet, favourable conditions.</p>	<p>Latent disease, so use protectant sprays when conditions that favour the disease occur, especially when there is a previous history of its presence.</p> <p>Remove and destroy damaged fruit.</p> <p>Fungicides</p>
	<p>Mosaic virus CMV TSWV Pepper yellows</p>	<p>Leaves mottle or become mis-shapen.</p> <p>Fruit can also become mottled or misshapen.</p>	<p>Manage the virus vectors, aphids (CMV and TSWV) and thrips.</p> <p>Remove and destroy diseased plants and plant parts showing symptoms.</p> <p>Remove alternate host plants in the vicinity.</p> <p>Remove crop debris at end of harvest.</p> <p>See aphid and thrips management.</p>

Table 2. Major pests of sweet pepper

Image	Pest name	Damage symptoms	Management strategies
	Broad mite ( <i>Polyphagotarsonemus latus</i> )	Nymphs and adults suck sap from shoots and leaves resulting in cupping, curling, malformation and plastic appearance; feeding on fruit results in silver scarring. Broad mite may carry plant pathogens like viruses.	Pruning of infested shoots, bagging immediately, sealing bag and leaving in sun to kill mites. Do not work or walk from a mite infested area of crop into an uninfested area. Sulfur Pesticides
	Red spider mite ( <i>Tetranychus kanzawai</i> )	Leaf speckling, webbing, leaf death. Spider mites are more serious in protected cropping and hot dry weather.	Monitor, and remove newly infected leaves. Wet leaves and high humidity reduce mite activity. Pesticides including sulfur
	Thrips, (especially <i>Frankliniella occidentalis</i> )	Vectors of some virus diseases. Feed on underside of the leaves and in flowers. Cause burning/drying of leaves at high populations. Cause scarring on the fruit. High populations during dry months.	Yellow sticky traps for monitoring. Prune infested plants heavily. Remove weeds and alternate hosts. Light coloured bed mulch. Orius predatory bugs Biologicals Botanicals Pesticides Spray oils
	Aphids, (especially <i>Aphis gossypii</i> )	Aphids especially present on growing tips and underside of leaves. Leaves yellow and curl, plants are stunted. Ants and sometimes sooty mould present. Aphids transmit virus diseases.	Prune heavily infested plants. Yellow sticky traps will attack winged aphids. Aphids have many natural enemies, so these should be encouraged. Pymetrozine Soap sprays Spray oils Synthetic pyrethroids Organo phosphates Pesticides
	White fly ( <i>Bemisia tabaci</i> )	Adults suck sap, causing misshapen leaves. Important vector of viral diseases. Nymphs and adults usually on undersides of leaves.	Yellow sticky traps (for monitoring and control) Intercrop using non-hosts crops. Remove weeds. Plant tolerant varieties. Removal and destruction of infested crops. Biologicals Botanicals Pesticides

Refer to the Pesticide table for further information.

Image	Pest name	Damage symptoms	Management strategies
   	<p>Common cutworm (<i>Spodoptera litura</i>)</p>	<p>Early instar larvae feed close together, causing windowing.</p> <p>Larger larvae separate and chew larger ragged holes in leaves. Chew holes in fruit, depositing frass and causing fruit rots.</p>	<p>Hand pick egg mass and larvae.</p> <p>Remove and properly dispose of infested plant/parts.</p> <p>Plant trap crops such as castor plant.</p> <p>Plough soil to minimise pupae survival between crops.</p> <p>Biologicals</p> <p>Botanicals</p> <p>Pesticides</p>
 	<p>Fruit worm (<i>Helicoverpa</i> spp.)</p>	<p>Chew leaves, stem, flowers.</p> <p>Bore and feed inside fruit, deposits frass and causes fruit rots.</p>	<p>Handpick larvae and infested fruit.</p> <p>Remove and properly dispose infested plant/parts.</p> <p>Plough soil to minimise pupae survival between crops.</p> <p>Biologicals</p> <p>Botanicals</p> <p>Pesticides</p>
	<p>Fruit fly (<i>Bactrocera dorsalis</i> <i>Bactrocera cucurbitae</i>)</p>	<p>Flies lay eggs in developing fruit, causing tissue death around puncture marks.</p> <p>Larvae (maggots) feed inside fruit causing fruit rots.</p>	<p>Remove and destroy infested fruit.</p> <p>Use pheromone fruit fly traps for monitoring. If used area-wide will lead to some control.</p> <p>Spinosad in baits.</p> <p>Fermented solution (ex. vinegar + molasses/sugar) in sticky trap bottles.</p>

Refer to the Pesticide table for further information.

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For more information, see individual factsheets and crop best practice guides also produced from this project.

Other information available from [www.plantwise.org](http://www.plantwise.org).

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