# PREVENTING AND MANAGING SEEDLING PESTS AND DISEASES

When preventing and managing specific pests, it helps to create a framework for recognizing the pest and determining which steps to take to treat and prevent further damage. Your framework should include the factors that contribute to the presence of your pest, the type of damage it causes, prevention measures, tolerance threshold of your crops, how to treat the damage and/or remove your pest, and which crops are most susceptible.

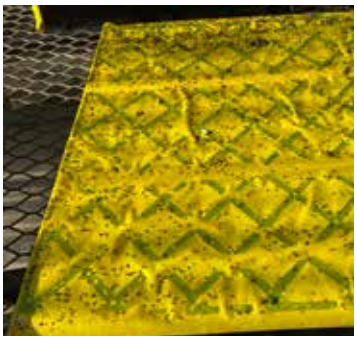
The table below provides best practices for preventing and managing a broad spectrum of pests and diseases. The tables that follow offer information on identifying and managing specific pests and diseases common to growers on the Central Coast.

## Pest and Disease Management Table

A framework for thinking about managing all potential seedling pest and disease issues

**PEST SPECIES:**

Requires proper identification to take informed action. Sticky traps and a hand lens can be particularly useful to aid in identification.



**Yellow sticky traps attached to plastic flats and placed at soil or canopy level amongst vulnerable crops will greatly aid monitoring.** *Photo: Christof Bernau*

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| Causes | Temperature, soil media structure/texture/porosity, moisture, lack of air circulation, improper fertility are some common causes of pests and/or diseases. |
| Damage/ symptoms | Signs of damage or symptoms caused by pests often include stunted growth, weak roots, holes in leaf canopy. |
| Prevention | Sanitation, clean seed, exclusion, altering cultural practices-temperature, moisture, air circulation. |
| Tolerance threshold | What level of pest or disease presence threatens neighboring crops, becomes a significant setback, or is an irreversible problem. |
| Treatment strategies | What organic tools–physical, chemical, biological–will address the problem. |
| Crops most susceptible | So as to know what other crops to monitor and potentially act upon. |

## PEST: Damping off

caused by fungal organisms: *Pythium* (most likely candidate), *Rhizoctonia, Fusarium, Phytophthora*

**Cilantro infected with the damping off fungus Pythium, showing seedlings with characteristic root loss and shrunken stem diameter.**

**Swiss Chard infected with the damping off fungus *Rhizoctonia*, showing characteristic stem collapse at the soil surface, adjacent to healthy seedlings.**
*Photos: Steve Koike, TriCal Diagnostics*

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| Causes | • Constant and excessive soil moisture as a result of irrigating too frequently and heavily and/or poorly drained and aerated soil mixes.<br>• Also caused by poor air circulation and lack of airflow.<br>• Damping off fungi thrive in the mid 60's to 70's°F temperature range—the same range that many common seedlings thrive in. |
| Type of damage/ symptoms | Damping off fungi attack and feed upon the vascular system of plants, interrupt the flow of water and nutrients, and, in the process, kill the afflicted young seedlings. This can manifest in symptoms including:<br>• Seedlings fail to emerge; when excavated, cotyledons and young stems appear water soaked, soft, and discolored.<br>• Seed, when squeezed, may exude milky white substance.<br>• Newly emerging root and/or shoot system is shrunken and collapsed.<br>• Recently-emerged seedlings that are seemingly healthy will collapse at the soil level. Upon closer inspection of stems at and just below the soil level, the stem tissue is shrunken, shriveled, and discolored—sometimes appearing gray or black.<br>• Stems become thin and thread-like at the point of infection. |
| Prevention measures | • Make sure you have a well-drained, well-aerated soil mix and that your water delivery frequency and quantity allows for moderate wet/dry swings, even in the pre-germination phase.<br>• Promote consistent air flow and circulation throughout the greenhouse.<br>• Dropping greenhouse temperatures below the optimal range for your crops, even for short periods, can have an adverse impact on damping off organisms.<br>• Start with pathogen-free soil mixes.<br>• Blend a commercial product containing beneficial fungus *Trichoderma harzianum*, such as RootShield®, into your soil mix.<br>• Maintain good greenhouse sanitation practices for tools, benchtops, and containers.<br>• Keep hose ends and watering implements off of the floor where fungal spores may accumulate. |
| Tolerance threshold | • No tolerance threshold. Damping off is caused by fungi that attack and kill young crops. If conditions allow, fungi can spread rapidly, causing extensive losses. |
| Treatment | • Drop temperatures to below 60°F repeatedly during the day.<br>• Allow things to dry down and then enforce a proper wet/dry swing thereafter.<br>• Ensure there is good airflow.<br>• When symptoms appear, take dry peat moss and sprinkle on the surface of the containers. This pulls away excess moisture, and peat moss contains mild antifungal properties |
| Crops most susceptible | • Squash family<br>• Solanum family<br>• Brassica family |

## PEST: Whitefly

**Whiteflies are sap feeders that rob nutrients from your crop and reduce plant vigor.**

**Like aphids, whiteflies excrete a sticky honeydew that is then colonized by sooty mold, reducing photosynthesis.**
*Photos: Graham Montgomery*

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| Causes | • Introduction of imported infected plants into the greenhouse area/zone.<br>• Also introduced by alternate host weeds growing in close proximity to your greenhouse crops.<br>• Rate of reproduction and extent of damage increased when greenhouse temperatures exceed 75°F. |
| Type of damage/ symptoms | • Like aphids, they are sap feeders that rob nutrients from your crop and reduce plant vigor.<br>• Also like aphids, they excrete a sticky honeydew that is then colonized by sooty mold, further reducing photosynthesis.<br>• Whiteflies can be vectors for virus introduction onto otherwise healthy crops. |
| Prevention measures | • Monitor with yellow sticky cards and regularly inspect the leaf undersides of susceptible crops.<br>• Screening of all vents and having double doorways can help prevent entry of new whiteflies into the greenhouse.<br>• Quarantine and monitor any new plants introduced into the greenhouse that could be alternate hosts for a period of one to two weeks, and inspect after quarantine.<br>• Control in-greenhouse and adjacent weed populations and crop residues that could be alternate hosts.<br>• Because whiteflies depend upon live host food sources, heating an empty greenhouse for as little as one to two weeks can eliminate prior infestations. |
| Tolerance threshold | • A small amount of damage can be acceptable in young seedlings but whiteflies can reproduce rapidly and have only a three week life cycle, so many generations per season are possible. Thus, early intervention is important. |
| Treatment | • Introduce parasitic wasps such as *Encarsia formosa*.<br>• Biological sprays such as Botanigard, which is a *Beauveria* fungus.<br>• Fatty acid sprays such as Safer Insecticidal Soap.<br>• Neem-based sprays such as Azadirect. These sprays are broad-spectrum and would also target beneficial insects. |
| Crops most susceptible | • Lettuce, tomatoes, peppers, salvias and pelargonium. |

# PEST: Aphids

**Aphids are common pests on the Central Coast and throughout the U.S. These tiny insects multiply quickly, but with early intervention, virtually all plants can outgrow some initial damage.** *Photo: Hema Shah*

**There are many species of aphids that can impact greenhouse crops, and you may encounter black, green, yellow, rust and other colored species. Damage is largely the same and control is identical regardless of species.** *Photo: William Keim*

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| Causes | • Monocultures of attractive crops such as pepper or eggplant could provide substantial draw.<br>• Excessively nitrogenous plant tissue can be very attractive to aphids.<br>• Lack of biological controls (predators and parasitoids) in the greenhouse combined with warm temperatures and lack of airflow can invite aphids. |
| Type of damage/ symptoms | • These rasping and sucking insects draw on the vascular systems in plant leaves and stems to get carbohydrates.<br>• The sucking of nutrients weakens the plants and causes mutated growth, a typical plant response to damage. This results in small, distorted leaves, or a small, distorted plant.<br>• Ants are frequently associated with aphids; When they are present, always look for aphids. |
| Prevention measures | • Avoid providing excess nitrogen that creates excessively lush, nitrogenous in plant tissue.<br>• Avoid extreme monocultures.<br>• Ensure good airflow and reduce greenhouse temperatures when outbreaks occur to slow population development. |
| Tolerance threshold | • With early intervention, virtually all plants can outgrow some initial damage |
| Treatment | • Contact insecticides such as neem oil or insect killing soap concentrates can be applied directly onto the seedling to kill aphids. Reading label instructions carefully as proper dilution rate and timing of application is critical.<br>• Once aphids are present in the greenhouse, remove the seedlings from the area as soon as possible. If you have a biodiverse and healthy system, you may be able to rely on biological control once the plants are outside of the protected greenhouse environment. Outdoors, the plants will experience improved air circulation and more significant day/night temperature fluctuation. This outside environment will be less desirable to aphids while simultaneously more favorable to natural predators. |
| Crops most susceptible | • Solanums<br>• Brassicas |

# PEST: Rats

"Safe spaces" where predators are excluded, such as the gap under pallets, can be a nesting site for rats near the greenhouse.

Dense vegetation, especially when near greenhouses and hardening off tables can be another habitat that will attract rats to your propagation zone and may lead to seedling losses.

Rat damage in the greenhouse and hardening off areas can take many forms and impact many crops, appearing as small excavations and hollow seed hulls on the surface of ungerminated trays, to seedlings that look as though they have been clear cut but rough shears. Unlike most insect damage that spreads gradually across crops, rats can impact entire crops and greenhouses very swiftly.
*Photo: Christof Bernau*

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| Causes | • Excessive rat habitat present in or near the propagation facility such as brush piles, woodpiles, material storage.<br>• Readily available food sources such as open garbage cans, nearby compost piles, etc. |
| Type of damage | • Rats consume and damage large quantities of seeds and seedlings. |
| Prevention measures | • Manage and eliminate all attractants and habitat (listed above).<br>• Exclude them from the greenhouse by using hardware cloth to screen vents and keeping doors closed. In hardening off areas, crops may need to be covered with floating row cover. |
| Tolerance threshold | • Zero tolerance—Not only can rats decimate ungerminated seeds and young seedling foliage, they can also be a major food safety hazard and must be excluded from all production areas, especially harvest, processing and pack out areas. |
| Treatment | • Trap them with snap or live traps.<br>• Get lots of farm cats. |
| Crops most susceptible | • Rats are attracted to a wide range of seeds, especially larger-seed crops such as cucurbits and sunflowers. They also go after smaller seeded crops such as chard, kale, broccoli, etc.<br>• Virtually all crops are susceptible, particularly brassicas. |

## PEST: Fungus gnat

**Fungus Gnat.** *Photo: Richard Leung*

**Shore Fly.** *Photo: James Bailey*

**Keeping yellow sticky cards present in the greenhouse throughout the growing season can be helpful in identifying the presence of fungus gnats, as opposed to shore flies which are attracted by similar soil and environmental conditions but do not cause measurable damage.**

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| Causes | • Attracted to soil mix or a media environment with a very large presence of peat moss and/or only partially decomposed organic matter.<br>• Tend to favor consistently wet soil environments and soil media that does not drain well. |
| Type of damage/ symptoms | • Adults lay eggs in soil media and once the eggs hatch, the larvae feed on roots, causing substantial below-ground damage, stunting, clorosis, sudden wilting, and greatly weakened crop development. |
| Prevention measures | • Keeping yellow sticky cards present in the greenhouse throughout the growing season can be helpful in identifying the presence of fungus gnats, as opposed to shore flies which are attracted by similar soil and environmental conditions but do not cause measurable damage. Yellow sticky cards, combined with a hand lens, are valuable tools in identifying fungus gnats, which have similar morphology to mosquitos, versus shore flies, which look like flies. These traps will capture some fungus gnats amongst your crops, but will not provide full control. Rather, they will provide you information you need to begin intervening.<br>• Limit the amount of undecomposed organic matter in soil and time watering to allow for thorough wet/dry swings. |
| Tolerance threshold | • Very low |
| Treatment | • Gnatrol: a strain of Bt that preys on fungus gnat larvae, interrupting root feeding and reproduction.<br>• NemAttack: a beneficial nematode, *Steinernema feltiae,* that parasitizes fungus gnat larvae, interrupting root feeding and reproduction. |
| Crops most susceptible | • Virtually all crops started in the greenhouse are susceptible if your mix and watering practices create a favorable environment for fungus gnats. |

**This is only a partial list of potential pests and you may encounter others. However, using the basic template to understand the causes, damage, tolerance thresholds, preventative measures, and treatment strategies, will build better knowledge to fight pests.**

**Use the following blank template to assess and manage pests or diseases present in your greenhouse.**

## PEST:

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| Causes |
| Type of damage/ symptoms |
| Prevention measures |
| Tolerance threshold |
| Treatment |
| Crops most susceptible |

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