What insect & disease management practices work, and which products can you keep on-hand or know to order when interventions are warranted in fruit and vegetable production?

**Organic IPM Strategies and Pesticides That Can Help...**

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NC Cooperative Extension

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Many Little Hammers  
(a phrase coined by Matt Liebman and Eric Gallant, 1997)

- Manage pests via multiple, concurrent strategies:
  - A whole farm ecology is greater than the sum of its parts.
  - Increase odds of success by spreading the burden of control across several methods, beginning with soil health.
  - Decrease pest resistance by reducing exposure to any one management tactic.

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**National Organic Program**

- § 205.206 Crop pest, weed, and disease management practice standard.
  - The producer must use management practices to prevent crop pests, weeds, and diseases including but not limited to:
    - Crop rotation
    - Soil and crop nutrient management
    - Sanitation
    - Cultural practices that enhance crop health

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**IPM Terms**

- Biological Control: Natural enemies (predators, parasites, pathogens).
  - Examples: Beneficial nematodes, Green lacewings

- Cultural Control: Methods that alter the environment, host, or pest.
  - Examples: Sanitation, variety selections, crop rotation, water & nutrient management, plant spacing, mulching

- Mechanical Control: Equipment, physical control.
  - Examples: Cultivation, mowing, row covers, traps

- Biopesticides: Pesticides derived from natural materials.
  - Examples: Bacillus thuringiensis, Bacillus subtilis, Beauveria bassiana, neem

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**Intercropping**

- Visual masking – confuse the pests
- Physical interference – other crops serve as barriers
- Chemical repellent

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**Conservation Biological Control**

Maintain and enhance natural enemy populations

- Conserve fall broods of beneficial insects in winter and spring
- Encourage natural enemies to colonize the area
- Provide food and shelter for beneficial insects
- Maintain healthy plant populations to support beneficial insects

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This slide adapted from Karen McSwain - CFSA
Farmscaping
A whole-farm, ecological approach to increase and manage biodiversity with the goal of increasing the presence of beneficial organisms.

- Insectary plants in crop fields (mostly annuals, especially Asteraceae, Apiaceae, etc.)
- Hedgerows (flowering perennials and woody species along field borders)
- Cover crops in rotations allowed to flower when practical (buckwheat, clovers, etc.)
- Water reservoirs to attract and support populations of beneficial organisms.

Inundative Biocontrol Example – Beneficial Nematodes
While some nematode species feed on roots, causing problems for growers, others feed on soil-dwelling insects. Natural populations of these exist in healthy soils, but pest control is achieved by releasing a huge population of purchased Hb, Sc, Sf, or similar species, depending on the target pest.

- Huge range of target pests.
  - Flies, cutworms, beetles, wireworms, weevils, etc.
  - Success depends upon soil moisture, timing, temperature, etc.

Commercially-Available Beneficial Organisms

<table>
<thead>
<tr>
<th>Beneficial Generals (Insects)</th>
<th>Beneficial Specialties (Insects)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ladybird beetle, (Hippodrome convergens)</td>
<td>Aphid Paráctoc (aphidius paphymus)</td>
</tr>
<tr>
<td>Gram leafworm, (Chrysopa sp.)</td>
<td>Aphid Paráctoc (aphidius marginatus)</td>
</tr>
<tr>
<td>Minute pirate bug, (Orius sp.)</td>
<td>Leafhopper Paráctoc (diglyphus isaea)</td>
</tr>
<tr>
<td>Praying mantis, (Tenodera aridifolia sinensis)</td>
<td>Moth fog Paráctoc (Sethogramma sp.)</td>
</tr>
</tbody>
</table>

Beneficial Nematodes
- Heterohabditis bacteriophora
- Bacillus subtilis
- Steinernema carpocapsae
- Steinernema feltiae

Insecticides: http://www.biocnet.com/index.html

Factors Affecting Biocontrol Success

<table>
<thead>
<tr>
<th>BIOTIC FACTORS</th>
<th>ABOITIC FACTORS</th>
<th>PROCEDURAL FACTORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant Community</td>
<td>Climate temperature, precipitation</td>
<td>Before release site selection, colony source, collection method, shipment, sex ratio, etc.</td>
</tr>
<tr>
<td>host density; succession</td>
<td>Site characteristics soil, slope, aspect, shade, moisture</td>
<td>Release method, wrong agent, wrong host, timing, life stage, documentation, etc.</td>
</tr>
<tr>
<td>Interactions</td>
<td>Elevation temperature, precipitation</td>
<td>After release site management, agent detection, sanitation</td>
</tr>
<tr>
<td>predation, parasitism, competition</td>
<td>Latitude seasons, day length</td>
<td>Personnel training, experience, continuity, prioritization, follow-up</td>
</tr>
<tr>
<td>Biocontrol Organism</td>
<td>Disturbance fire, flood, etc.</td>
<td></td>
</tr>
<tr>
<td>synchronization, physiology, fecundity, behavior, genetic diversity, emigration</td>
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</tbody>
</table>

§ 205.201 Organic Production System Plan – Pest Management

- Write your observed and/or expected pests and planned pest management practices and procedures, including the frequency with which they will be performed.
- Build a list of organic pesticides to be used, including their product names, composition, source, location(s) where it will be used.
- Also include a description of the monitoring practices and procedures, including the frequency they will be performed, to verify that the plan is effectively implemented.

General Rule for Organic Pesticides

- Natural (aka nonsynthetic) inputs are ALLOWED
  - Unless they are on the Nonsynthetic Substances Prohibited for Use in Organic Crop Production list
  - The “Prohibited Naturals” list in the NOP is fairly short.
  - Strychnine, lead salts, tobacco extracts, ash from burnt manure...
- Synthetic substances are PROHIBITED
  - Unless they are on the Synthetic Substances Allowed for Use in Organic Crop Production list
  - The “Allowable Synthetics” list is long and sometimes controversial.

This slide adapted from Mark Dempsey – CFSA
**Organic Insect IPM**

Emphasizes Preventative Practices

1st phase: Cultural practices compatible with natural processes, such as crop rotation, soil management, non-transgenic host plant resistance, and controlled location.

2nd phase: Vegetation management to enhance natural enemy impact and exert direct effects on pest populations.

3rd phase: Indigenous and inoculative releases of biological control agents.

4th phase: Approved insecticides of biological and mineral origin, and use of mating disruption.

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**Allowed Synthetics**

(b) As herbicides, weed barriers, as applicable

(i) Herbicides, soap-based - for use in farmstead maintenance and ornamental crops

(ii) Mulches

(iii) Plastic mulch and covers (petroleum-based other than PVC)

(e) As insecticides

(i) Copper, fixed - copper hydroxide, copper oxide, copper oxychloride, includes products exempted from EPA tolerance

(g) Hydrogen peroxide (Hydrogen dioxide)

(b) Soaps, insecticidal

(i) As plant disease control

Coppers, fixed - copper hydroxide, copper oxide, copper oxychloride, includes products exempted from EPA tolerance

Copper sulfate - Substance must be used in a manner that minimizes accumulation of copper in the soil

Hydrated lime

Hydrogen peroxide (Hydrogen dioxide)

(8) Peracetic acid - permitted in hydrogen peroxide formulations as allowed in 205.601(i) at concentration of no more than 6% as indicated on the product label

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**Grandervo**

- The active ingredients are heat-killed *Chromobacterium subsugae* strain PRAA4-1 cells and spent fermentation media.

- Grandervo functions primarily as a stomach poison, so it must be ingested by insects and mites to be effective.

- It does not have systemic activity.

- Considered a “Dead Microbial Insecticide” – no viable cells, just metabolites. This gives it a shelf life of > 3 years.

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**Trusted Databases & Other Resources**

- Organic Materials Review Institute (OMRI)

- Washington State Department of Ag (WSDA)

- ATTRA's Biorationals Database (link)

- Cornell Law’s NOP rulebook (link to allowed synthetics)

- Search online with “site:edu” “site:gov”

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**50% scouting thresholds for insects?**

- Organic products can work more slowly than conventional products, and they can biodegrade more quickly.

- If using a contact insecticide (soap, spinosad, pyrethrum, etc.) or an insecticide that requires ingestion (Bt, Grandevo, etc.), consider spraying at ½ the population threshold recommended for conventional IPM to allow for potential follow-up spray rotations if necessary.

- If using a biological insecticide that requires incubation time and favorable environmental conditions (predatory nematodes, PFR-97, *Beauvaria bassiana*, etc.), consider spraying at ½ the population threshold recommended for conventional IPM to allow for effects to take hold and be evaluated.

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**Grandervo**

- Penn State Southeast Agriculture Research and Extension Center (SEAREC) “got excellent control of Western Flower Thrips, aphids, spider mites and Broad mites” in high tunnel vegetable research. Other data sparse so far.

- Grandervo is more effective on newly hatched larvae and nymph stages of insects and arthropods, so regular scouting and early applications are necessary for good control.

- Potential efficacy against Spotted Wing Drosophila?
Another of the "Dead Microbial Insecticides" from Marrone Bio-Innovations.

"Treat early in the pest population life cycle. Established treatment thresholds might not be relevant."

For lepidopteran pests apply at egg hatch.

According to MBI recommendations, it's important to use a quality adjuvant such as BioLink, Nu-Film P or Therm X 70 (these three are all OMRI-listed) with both Grandevo DF/WDG and with Venerate XC.

Kills insects by infection when the insects come into contact with fungal spores: by having the spray droplets land on their bodies, or by contacting a treated surface. Infected insects can also spread the fungus through mating.

Once fungal spores attach to the insect's skin (cuticle), they germinate, sending out hyphae that penetrate the insect's body and proliferate.

It may take three to five days for insects to die. Infected cadavers may serve as a source of spores for secondary spread of the fungus.

Beauvaria bassiana needs >80% humidity. To get this full white bloom on insect cadavers & effective further spread of the fungus, humidity >92% is necessary.

Beauvaria can grow as an endophyte in corn plants. “In studies in Iowa, the fungus colonized the plant when applied as a granular formulation of conidia on foliage at whorl stage, moved internally in the plant, and persisted throughout the season to provide significant suppression of corn borers.” (OSU Extension)

Organic formulations include Mycotrol (OMRI?) & Bio Ceres.

However, according to several studies cited by Xerces, Beauvaria can harm Leafcutter Bees (87% mortality in one study), Bumblebees (no mortality statistics cited), and potentially other bees. Obey all label restrictions, and it would certainly be preferable to employ only on non-flowering or pre-flowering crops.
Another living fungus product that attacks insect bodies. OMRI-listed products include PFR-97, NoFly, & Preferal.

- Labeled & increasingly used to control thrips, psyllids, whiteflies, mealybugs and spider mites on fruit and vegetable crops.
- Works best at high humidity (>80%) and moderate temperatures (70-80 degrees F).
- The organic world has lacked options to control spider mites & broad mites, but if feedback from the cannabis community counts as data, then Isaria-based pesticides have serious potential.
- Short shelf life: Only ~1 week at room temperature; perhaps ~1-6 months when tightly-sealed and kept at 34°F.

**Isaria fumosorosea**

**Kaolin Clay**

- Surround WP™ - OMRI Listed
- Used as a repellent; alters feeding, oviposition behavior of insect pests
- Most use in tree fruit, grapes
- Good protection vs flea beetles, etc. via dipping seedlings just prior to field transplanting
- Difficult to spray (clogs nozzles & falls out of suspension without agitation). Do not mix with sulfur or copper.
- Difficult to wash all residue off harvested crops.

This slide adapted from Geoff Zehnder – Clemson University / SARE PDP

**Neem Extracts, Oils, & Soaps**

- Consider these three entirely-different products:
  - Neem extracts are azadirachtin-based insecticides.
  - Neem oils behave much like other horticultural oils, perhaps with some additional activity.
  - Neem soaps behave much like other insecticidal/fungicidal soaps.

**Azadirachitin: Product names & properties**

- Neemix, Aza-Direct, Azatrol, AzaGuard, etc.

Azadirachitin affects insects in many different ways including acting as an insect growth regulator, anti-feedant, repellent, sterilant and oviposition inhibitor.

- It is more effective on the immature/young life stages of insects than eggs or adults. Azadirachitin works as a stomach poison in which insects must ingest the active ingredient during feeding in order to be negatively affected. Foliar applications seem to work better on chewing (vs. sucking) insects. This may be the reason why azadirachitin sprays are most effective against caterpillars. It has minimal contact activity against most insect pests
- Azadirachitin works best at warmer temperatures (>70°F) with reduced efficacy at lower temperatures.

**Neem/Azadirachitin Systemic Activity**

- Azadirachitin can be systemically taken up by plants through roots and is also weakly systemic when sprayed on the leaves, although is contingent on plant type and pH of the growing medium, with less systemic activity at a pH greater than 7.0 (alkaline). Only sucking and piercing insects are affected by the systemic form.

- Once inside the plant, Azadirachitin / neem remains active for a longer period of time (i.e.: reduced photodegradation).

- Neem oils have not been proven to show systemic activity.
Azadirachtin: efficacy

- **Beetles (Coleoptera):** Fair to good control has been obtained against Colorado potato beetle and Mexican bean beetle. The few published studies on flea beetles show poor to fair efficacy. Results have been mostly poor against pepper weevil.
- **Caterpillars (Lepidoptera):** Neem gives fair control of most caterpillars. Good results have been obtained against beet armyworm, cabbage looper, and diamondback moths.
- **Thrips (Thysanoptera):** Efficacy has mostly been poor, with one fair result, against onion thrips.
- **Aphids (Homoptera):** Generally good control has been observed, except for fair control against green peach aphid.
- **True bugs (Hemiptera):** Promising results against squash bug. Fair control of stink bugs was demonstrated in two trials. Useful to try vs. Harlequin bugs?

Neem Oils

- **OMRI-listed products:** Trilogy, Triact 70, Green Light Neem Concentrate

- Most neem oil products are made from crushed neem seed, and have had some or all azadirachtin removed: called "clarified hydrophobic extract of neem oil."

- There is not a lot of data to demonstrate that Neem oil works any better than other horticultural oils, but like other oils, they can help to control mites and powdery mildew disease.

- Like all horticultural oils, neem can cause phytotoxicity when temperatures >90°F &/or when humidity is >90%.

Biocontrol Landmark

**Bacillus thuringiensis**

- 1901: Silkworm “sudden collapse” disease
- 1911: Named by Ernst Berliner (Thuringia)
- Farmer use in 1920s France; Sporine
- EPA registration in 1961
- Thousands of strains active against caterpillars, beetles, flies
- Toxin attacks gut cells

This slide adapted from Geoff Zehnder – Clemson University / SARE PDP

Bacillus thuringiensis - varieties

- There are dozens of Bt proteins, some of which are toxic to particular types of insects. Generally, the following guidelines can be used for commercial products:
  - **Bt kurstaki:** caterpillars
  - **Bt aizawai:** caterpillars
  - **Bt tenebrionis** (also called Bt San Diego): beetles
    - No OMRI-listed products at present.
  - **Bt israelensis**: fly larvae (including fungus gnats, blackflies, and mosquitoes) – Gnathol & Vectobac are OMRI-listed
OMRI-Listed Bt Products

- **Bacillus thuringiensis subsp. kurstaki**
  - Deliver (Certis USA)
  - Biobit 32 (Valent BioSciences Corp)
  - DiPel 2X (Valent BioSciences Corp) - wild type
  - DiPel DF (Valent BioSciences Corp) - wild type
  - Javelin WG (Certis USA) - wild type

- **Bacillus thuringiensis subsp. israelensis**
  - Gnatrol WDG (Valent BioSciences Corp), VectoBac WDG (Valent BioSciences Corp)

- **Bacillus thuringiensis subsp. aizawai**
  - Agree WG (Certis USA)
  - XenTari DF (Valent BioSciences Corp) - wild type
  - XenTari WDG (Valent BioSciences Corp) - wild type

Bt – Application Guidelines

- Bt must be eaten by the insect pest in order to be effective
  - Many insects feed on the undersides of leaves and in concealed parts of the plant, so thorough coverage is required.

- Bt breaks down within two to three days, so reapplication or rotation will likely be warranted.

- Young larvae are generally more susceptible than older larvae, so treatments should be timed accordingly. Early detection and application are crucial for good control.

Bt – Rotation Options

- For ongoing Lepidopteran control, rotate away from Bt at least every third spraying
  - Rotate with PFR-97 (Isaria), especially when mites, whiteflies, and thrips are also a problem & humidity is high.
  - Rotate with azadirachtin-based insecticide (Neem extracts) when leafhopper, true bug, weevil, or aphid pests are also present & temps are >70°F.
  - Rotate with Beauvaria when weevils, beetles, leafhoppers, true bugs, whiteflies, or thrips are also present & humidity is high.
  - Rotate with Grandevor Venerate when aphids, scale, leafhoppers, true bugs, weevils, beetle pests or mites are present.
  - Rotate with Spinosad when beetle, thrips, or aphid pests are also present (but not when plants are in flower or beneficials are present!)

Pesticidal Soaps

- Made from potassium or ammonium salts of fatty acids.
- Moderately effective action via suffocating soft-bodied insects and disrupting their cuticle/skin.
  - Aphids, mealybugs, whiteflies, mites, etc.
- Must contact the pest directly. Dried soap has no residual or systemic activity.
- Some soap products labeled for powdery mildew suppression – probably also via a suffocating effect, but check w/certifier about whether this is allowed.
- Fungicidal activity against other diseases too?
- Can be phytotoxic if sprayed too often (especially cucumbers, plus grapes when sulfur is used withing 3 days)

Pesticidal Soap (M-Pede, Safer, etc.) Efficacy
**Pyrethrum**

- Products include Pyganic (1.4 & 5.0), Pyrol-Ö, Safer® Brand Insecticidal Soap and Pyrethrin Insect Killer, 32oz concentrate etc.
- Most useful against beetles, leafhoppers, spittlebugs
- Toxic to bees & beneficial insects.
- Breaks down quickly (~24 hours), but effects can be extended when sprayed with UV-inhibiting adjuvants (Therm-X 70, etc.) & horticultural oils.
- Pyrethrum is very sensitive to pH; do not mix with lime, sulfur, soaps, fish emulsion, or any other strongly acid or alkaline materials. Pyrethrum can safely be mixed with most oils.

**Spinosad (Entrust, Conserve, Regard, etc.)**

- While spinosad can harm bees and beneficials via contact, it is much less toxic to our good guys once the material dries.
- Reasonably effective against most caterpillar pests, some beetles, most thrips and Diptera (fly) pests. Variable but promising against the Homoptera (aphids, leafhoppers, & whiteflies). Spinosad can penetrate leaves enough to provide some control of leaf miners.
- Not rated highly against most mites or true bugs (Hemiptera), but still one of the better available options vs. Harlequin bugs.

**Organic Insecticide Redux**

- Keep some soap &/or neem (or other) oil around for initial actions against soft-bodied insects, mites, etc., and as a tank-mix / spray adjuvant for certain other insecticides. Also useful against powdery mildews.
- Consider keeping a few of the more powerful and shelf-stable insecticides (pyrethrum, azadirachtin, spinosad) on-hand for timely interventions when required.
- Choose one or more of the shelf-stable “dead microbials” (Bt, Grandevo, Venerate, etc.) based upon crops, pests, and environment.
- Be ready to order some active biologicals (Beauvaria, Isaria, etc.) at the right moment (serious pests at a time of high rainfall & humidity).

**Organic Disease Control Products**

- Most organic fungicides are designed to prevent or slow the spread of disease, not cure it!
- The Southern Appalachians are a temperate rainforest, and the Southeast as a whole is a prime warm & humid region for plant disease development.
- Growers need to study their fields, soils, microclimates, and crops, while staying in touch with their neighbors, Extension Agents, and forecasting websites in order to ‘scout’ and know what plant diseases are present or coming. Write your OSP with a broad range of possible diseases in mind.
**Fungicides within Organic Disease IPM**

- The 205.206 rules do allow the use of approved organic materials for disease prevention when proper cultural, soil-management, and preventive steps have been employed, and a need is documented.

- Therefore, with disease management, “scouting” becomes a multifaceted process of remembering seasonal patterns, observing macro-climate trends, knowing one’s soils and micro-climate, and of course also direct observation of crops.

- You will almost certainly need to spray many crops before observing signs of disease, so anticipate the diseases in your farm plan and note the products that will be part of their management.

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**Bacillus subtilis & Bacillus pumilis, etc.**

- Serenade & Cease products are *B. subtilis*. Double Nickel 55 is a *B. subtilis* var. *amyloliquifaciens*. Sonata is a *B. pumilis*

- In all these products, the culture of the beneficial bacteria produces natural lipopeptide antibiotics such as iturins.

- For foliar applications, the wettable powder formulations (Serenade Opti, Double Nickel) are thought to deliver the iturins, etc. without much promised bacterial colonization activity. For beneficial root colonization, aqueous suspensions such as Serenade ASO (formerly Serenade Soil) and Cease are labeled for control of soilborne diseases.

- Considered a good protectants / rotation spray options.

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**Potassium Bicarbonate**

- Marketed as Kaligreen and MilStop

- Good efficacy against black rot (!), downy mildew, and phomopsis in grapes, many powdery mildews (grapes & apples especially), tomato early blight, and mummy berry on blueberries.

- Increased effectiveness when tank-mixed with a horticultural oil.

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**Coniothyrium minitans**

- “Contans” is the OMRI-listed product. Was hard to find, but should be easier now that it is owned by Bayer.

- Labeled & effective for control of Sclerotinia diseases (lettuce drop, bean white mold, etc.) in soils where the disease has been a problem.

- Best applied several months ahead of planting a vulnerable crop (either just after fall harvest or in early spring). The Coniothyrium fungus attacks the sclerotia of *Sclerotinia sclerotiorum* & *S. minor*.

- Requires tillage in order to reach sclerotia.
**Copper Products**

OMRI-listed products include fixed coppers such as Champ WG & Nordox, along with copper soaps (i.e.- Copper Octanoate) such as Cueva.
- Less active ingredient & duration in copper octanoates, but also less persistent staining of crop.
- Be careful about mixing with oils or acidic substances (like fish emulsion or sulfur) due to increased phytotoxicity risks.

**Hydrogen Peroxides/Dioxides**

- Function as a surface disinfectant.
- Can also clean the waxy cuticle and other protective structures right off of plant surfaces, so be careful about spray frequency, and try to hold in reserve for more mature crops.
- OMRI-listed products include Oxidate 2.0, which also has peroxyacetic acid as an additional active ingredient.
- Low efficacy when used alone, but maybe a late-season place in a disease-control rotation?

**Regalia**

- Produced by MBI & OMRI-listed. Derived from Reynoutria sachalinensis (aka Fallopia sachalinensis, a giant knotweed)
- Induces Systemic Acquired Resistance (SAR) in plants. Therefore, must be applied well in advance of any disease pressure in order to be effective.
- Not a lot of evidence showing it can prevent disease on its own, but maybe worthwhile as an early component of season-long spray programs.

**Sulfur**

- Also labeled as a miticide, but can flare mite problems due to killing off predatory mites first.
- Useful against some rusts and powdery mildews.
- Less expensive than many fungicides.
- Difficult to keep in suspension. Use agitation & micronized products if possible. OMRI-listed products include Golden Micronized Sulfur & Crusade DF.

Elemental sulfur may cause phytotoxicity at high temperatures; it should not be used if temperatures are forecasted to be above 90°F within three days following application. It should not be applied within two weeks of an oil application. It may cause toxicity in sensitive plants, including some varieties of grapes; apples and pears; cranberries; apricots; certain varieties of cucurbits, particularly melons; cereals; and spinach. Test a few plants of each cultivar in sensitive families before applying sulfur to the entire crop.
**Trichoderma**

- OMRI-listed products include Tenet, T-22 HC, RootShield, Bio-Tam 2.0, etc.

- A living beneficial fungus that requires product refrigeration and generally a <6 month shelf life.

- Useful for root inoculation at the seedling stage, transplanting stage, and some labels also include foliar applications (less data supports this use).

**Organic Vegetable Fungicide Redux**

- Use a rotation of plant extracts such as Regalia, biofungicides like *Trichoderma* &/or *B. subtilis*, and less-toxic sprays such as MilStop as protectants early in production as necessary.

- If leaf diseases become a serious threat, add copper to the rotation (in addition to the protectants) for labeled crops / diseases.

- As the season &/or crop matures, maybe add Oxidate 2.0 or another H2O2/PAA to the rotation for “clean-up.” If still using copper at this stage, switch to octanoate-types if possible.

- Even though some of these products have a low efficacy in single-variable trials, anecdotes from the field indicate some benefit from spray rotations including three or more different modes of action.

**Sources**

- Lina Quesada – NCSU
- Karen McSwain & Mark Dempsey - CFSA
- Oregon State University Extension, Penn State Extension
- Greenhouse Grower Magazine
- Margaret Tuttle McGrath – Cornell University
- Charts, white-boxed text, and much else from the Resource Guide for Organic Insect and Disease Management