

Chapter 19. Biopesticides and Alternative Disease and Pest Management Products¹

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The following tables list registered pesticides that should be integrated with other pest management methods. Additional information on integrated management methods can be requested from UF/IFAS Extension horticulture or agriculture agents. A list of local UF/IFAS Extension offices is available at <https://sfyl.ifas.ufl.edu/find-your-local-office/>.

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The use of trade names in this publication is solely for the purpose of providing specific information. UF/IFAS does not guarantee or warranty the products named, and references to them in this publication do not signify our approval to the exclusion of other products of suitable composition.

Use pesticides safely. Read and follow directions on the manufacturer's label.

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Table 1. Biopesticides labeled for management of arthropod pests of many crops. Contact: Sriyanka Lahiri, UF/IFAS Gulf Coast Research and Education Center.

Trade Name (Active Ingredient)	MOA Code ¹	Insect or Mite Pest	Days to Harvest	REI (Hours)	OMRI- Listed ²	Remarks
Agree WG, Xentari (<i>Bacillus thuringiensis</i> subspecies <i>aizawai</i>)	11A	Caterpillars	0	4	Yes	Apply when larvae are small for best control. Can be used in greenhouse.
Biobit HP, Deliver, DiPel DF, Javelin WG (<i>Bacillus thuringiensis</i> subspecies <i>kurstaki</i>)						
Aza-Direct (azadirachtin)	U	Aphids, beetles, caterpillars, leafhoppers, leafminers, thrips, whiteflies	0	4	Yes	Antifeedant, repellent, IGR (insect growth regulator).
Azaguard (azadirachtin)	U	Aphids, beetles, caterpillars, leafhoppers, leafminers, thrips, whiteflies	0	4	Yes	Use in combination with 0.25%–1.0% nonphytotoxic crop oil.
Azatin O (azadirachtin)		Aphids, beetles, caterpillars, leafhoppers, leafminers, thrips, whiteflies	0	4	Yes	Rate depends on targeted pest.
BoteGHA Optima ES (<i>Beauveria bassiana</i> strain GHA)	U	Thrips (chilli thrips), twospotted spider mite, whitefly, leaf feeding and stem boring lepidoptera, mealybug, aphids, weevils, leaf feeding beetles, scarab beetles, leafhoppers, planthoppers, orthoptera, plant bugs, psyllids,	0	4	Yes	Apply at 5- to 10-day interval. Acts by contact.
BotaniGard ES (<i>Beauveria bassiana</i> strain GHA)	U	Aphids, leafhoppers, mealybugs, mites, plant bugs, planthoppers, crickets, thrips, whiteflies, cockroaches	0	4	No	Works by contact. Spores attach to insects, germinate, and penetrate insect cuticle. May be used in greenhouses.
BotaniGard Maxx (<i>Beauveria bassiana</i> strain GHA + pyrethrins)	3A + U	Aphids, leafhoppers, leafminers, plant bugs, thrips, whiteflies	0	12	No	–
Captiva (<i>Capsicum oleoresin</i> extract, garlic oil, soybean oil)	U	Leafhoppers, mites, thrips, whiteflies	0	4	No	–
Captiva Prime (<i>Capsicum oleoresin</i> extract, garlic oil, canola oil)	U	Leafhoppers, mites, thrips, whiteflies, psyllids, plant bugs, borers, mealybugs, lepidopteran larvae, whiteflies	0	4	Yes	–
Debug Turbo EC (fats and glyceridic oils margosa + azadirachtin)	U	Several pests	–	–	Yes	Repeat applications every 10–15 days.
Des-X (soap, insecticidal)	U	Aphids, mites, plant bugs, whiteflies	0			–
Entrust SC (spinosad)	5	Beetles, caterpillars, thrips, seed bugs	1	4	Yes	Highly toxic to bees and other pollinators. No more than 2 applications per crop season.

Trade Name (Active Ingredient)	MOA Code ¹	Insect or Mite Pest	Days to Harvest	REI (Hours)	OMRI- Listed ²	Remarks
Entrust SC Naturalyte Insect Control (spinosad)	5	Thrips, armyworms	1	4	Yes	–
Evergreen EC 60-6 (pyrethrins + piperonyl butoxide)	3A	Ants, aphids, armyworms, weevils, flea beetles, fruit flies, leafhoppers, lygus, mealybug, stink bugs, thrips	0	12	No	Reapplications at least 7 days apart.
Grandevio WDG (<i>Chromobacterium subtsugae</i> strain PRAA4-1)	U	Aphids, mites, plant bugs, whiteflies, armyworms	0	4	Yes	Can be tank-mixed with a contact insecticide for improved control of targeted pests.
JMS Stylet Oil (paraffinic oil)	U	Aphids, thrips, leafhoppers, leafminers, mites, whiteflies	0	4	No	–
Lalgard M52 OD (<i>Metarhizium brunneum</i> strain F52)		Mites, thrips, aphids, psyllids, weevils, whiteflies	0	12	Yes	–
Molt-X (Azadirachtin)	U	Aphids, beetles, caterpillars, leafminers, leafhoppers, mealybugs, thrips, whiteflies	0	4	Yes	Rates depend on the pest. Check label.
M-Pede 49% EC (potassium salts of fatty acids)	U	Aphids, leafhoppers, mites, thrips, whiteflies	0	12	Yes	Do not apply to stressed plants (high heat or drought conditions).
Mycotrol ESO (<i>Beauveria bassiana</i> strain GHA)	U	Aphids, thrips, leafhoppers, whiteflies, crickets, cockroaches	0	4	Yes	–
Mycotrol WPO (<i>Beauveria bassiana</i> strain GHA)	U	Aphids, leafhoppers, whiteflies	0	4	Yes	–
Neemix 4.5 (azadirachtin)	U	Aphids, leafminers, leafrollers, scales, whiteflies, worms	0	12	Yes	IGR and feeding repellent. Greenhouse and field.
Organic JMS Stylet Oil (paraffinic oil)	U	Aphids, leafhoppers, leafminers, mites, whiteflies	0	4	Yes	Use ceramic spray nozzles and apply at a pressure of no less than 400 psi.
PFR-97 20% WDG (<i>Cordyceps javanica</i> Apopka strain 97)	U	Aphids, leafminers, mites, plant bugs, psyllids, weevils, whiteflies	0	4	Yes	Can be used on vegetables grown for transplant. Do not mix with fungicides or apply within 5 days of fungicide applications other than copper. Dust/mist respirator must be used for mixing and applying.
Pyganic EC 5.0 (pyrethrins)	3A	Aphids, armyworms, beetles, leafhoppers, leafminers, mealybugs, mites, plant bugs, seed bug, planthopper, psyllids, stink bugs, thrips, weevils, whiteflies	0	12	Yes	Harmful to bees. Can be used in greenhouses.
Requiem EC (<i>Chenopodium ambrosioides</i> terpenes synthetically manufactured)	U	Leafminers, leafhoppers, mites, thrips, whiteflies,	0	4	No	Rate varies depending on crop.

Trade Name (Active Ingredient)	MOA Code ¹	Insect or Mite Pest	Days to Harvest	REI (Hours)	OMRI- Listed ²	Remarks
Seduce Insect Bait (spinosad)	5	Caterpillars	See specific crops on label	4	Yes	–
Seican (Cinnamaldehyde)	U	Mites, aphids, thrips, psyllids, whiteflies	0	4	Yes	–
Suffoil-X (mineral oil)	U	Aphids, leafhoppers, thrips, whiteflies	0	4	Yes	Thorough coverage is essential.
SunSpray 98.8% Ultra-Fine	U	Aphids, mites, beetle larvae, leafminers, leafhopper, whitefly thrips	0	Until sprays have dried	No	Apply 2.5 Tbsp/gal. No more than 4 applications per season. Reapplications at least 2 weeks apart. Do not spray plants under stress and do not apply during periods of temperature > 90°F.
Surround (kaolin clay)	U	Whiteflies, thrips, psyllids	0	0	Yes	It is better to not use it too close from harvest to avoid white spots on the fruits.
Trilogy (extract of neem oil)	U	Aphids, mites, thrips, whiteflies	0	4	Yes	Apply morning or evening to reduce potential for leaf burn. Toxic to bees exposed to direct treatment.
Venerate XC (heat-killed <i>Burkholderia</i> spp. strain A396 cells and spent fermentation media)	U	Corn earworm, mealybugs, mites, stink bugs, weevils, whiteflies, aphids	0	4	Yes	–

¹ Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 11.1 January 2024. Number codes are used to distinguish the main insecticide mode of action groups, with additional letters for certain subgroups within each main group. All insecticides within the same group (with same number) indicate the same active ingredient or similar mode of action. This information must be considered for the insecticide resistance management decisions. U = unknown, or a mode of action that has not been classified yet.

² OMRI Listed means that a product is approved for use in certified organic production under the USDA National Organic Program (NOP).

Table 2. Biopesticides and other alternative products labeled for plant disease management. **Labels change frequently. Be sure to read a current product label before applying any pesticide. Refer to crop-specific tables for conventional pesticides labeled for disease and pest management.** Contact: Gary E. Vallad, UF/IFAS Gulf Coast Research and Education Center.

Product (Active Ingredient), Fungicide Group ¹	Crops	Pertinent Diseases or Pathogens	Minimum Hours to		OMRI- Listed ²	Remarks ³
			Harvest	Reentry		
2-3-2 Companion (<i>Bacillus subtilis</i> strain GB03)	Vegetables & Strawberries	Broad-spectrum fungicide and bactericide	0	4	No	Do NOT mix with copper-based fungicides, concentrated acids such as sulfuric acid, solvents, oxidizing agents, or bactericides. Do not mix with products with a pH below 4 or above 9. Consult specific product labels for additional information or restrictions concerning tank-mixing.
Actinovate AG Actinovate SP (<i>Streptomyces lydicus</i> WYEC 108), NC	Vegetables & Strawberries	Broad-spectrum fungicide and bactericide	0	1	Yes	See label for specific rates and application recommendations.
Afla-guard GR (<i>Aspergillus flavus</i> NRRL 21882), NC	Sweet Corn	Aspergillus	–	4	No	No more than 20 lb/A per growing season. See label for specific application instructions.
AgriPhage (bacteriophage), NC	Tomato, Pepper	Bacterial spot, Bacterial speck	0	0	No	Bacterial strains must be characterized periodically by manufacturer to correctly formulate the bacteriophage mixture.
Agro Pro X Agro XP (soybean and sesame oils)	Vegetables & Strawberries	Powdery mildew	0	0	Yes	See label for specific rates and application recommendations.
Aura 360 (Flg22-Bt peptide)	Vegetables & Strawberries	Broad-spectrum fungicide and bactericide	0	12	No	Broad spectrum activator of disease resistance. See label for specific rates and application recommendations.
Aviv Bacix Milagrum Plus (<i>Bacillus subtilis</i> strain IAB/BS03)	Vegetables & Strawberries	Broad-spectrum fungicide	0	4	Yes	See label for specific rates and application recommendations.
(<i>Bacillus subtilis</i> strain QST 713), 44 Many brands available: Cease, Minuet, Rhapsody, Serenade ASO, Serenade Opti,	Vegetables & Strawberries	Broad-spectrum fungicide and bactericide	0	4	Yes	For foliar applications, mix with copper compounds or other effective fungicides for improved disease control. See label for details regarding specific foliar and soil applications and target diseases.
BioCover (oil, petroleum), NC	Vegetables & Strawberries	Powdery mildew, Rust	0	4	No	See label for specific rates, application recommendations, and precautions regarding use with other pesticides.

Product (Active Ingredient), Fungicide Group ¹	Crops	Pertinent Diseases or Pathogens	Minimum Hours to		OMRI- Listed ²	Remarks ³
			Harvest	Reentry		
Bionatrol-M (soybean oil)	Vegetables & Strawberries	Powdery mildew, Botrytis, Rust, Sour rot	0	0	Yes	Do not apply any copper, sulfur, or others within 12 days of Bionatrol-M application. Do not spray when freezing temperatures are anticipated within 48 hours and do not apply above 95°F. Do not mix with foliar fertilizers.
BIO-TAM 2.0 Tenet WP (<i>Trichoderma asperellum</i> strain ICC 012 + <i>Trichoderma gamsii</i> strain ICC 080), NC	Vegetables & Strawberries	<i>Fusarium</i> spp., <i>Phytophthora</i> spp., <i>Pythium</i> spp., <i>Rhizoctonia</i> spp., <i>Sclerotinia</i> spp., <i>Sclerotium rolfsii</i> , <i>Thielaviopsis basicola</i> , and <i>Verticillium</i> spp.	—	1	Yes	See label for additional rates and recommendations for transplant production and details for specific diseases. Check label for product incompatibility with certain chemical fungicides.
Botector (<i>Aureobasidium pullulans</i> strain DSM 14940, 14941)	Tomatoes & Strawberries	Anthracnose, Botrytis, Phomopsis, Rhizopus	0	4	Yes	See label for specific rates and application recommendations. Check label for precautions regarding incompatibility with fungicides.
BotryStop WP (<i>Ulocladium oudemansii</i> U3 strain), NC	Vegetables & Strawberries	Botrytis, Sclerotinia	0	4	No	See label for specific rates, application recommendations, and precautions regarding fungicide compatibility.
CHR-1WP (<i>Bacillus subtilis</i> strain CH3000 and <i>Bacillus paralicheniformis</i> strain CH2970), NC	Vegetables & Strawberries	<i>Rhizocotnia</i> , <i>Fusarium</i> , <i>Pythium</i> , <i>Verticillium</i> , Botrytis, and Sclerotinia	0	4	No	See label for specific rates and application recommendations. Also labelled for several parasitic nematode species.
Cinnaction Cinnerate EMP Barrier (cinnamon oil), NC	Vegetables & Strawberries	Powdery mildew, Botrytis, Rusts	0	0	Yes	See label for specific rates and application recommendations.
Contans WG (<i>Coniothyrium minitans</i> strain CON/M/91-08)	Vegetables & Strawberries	<i>Sclerotinia sclerotiorum</i> and <i>Sclerotinia minor</i>	0	4	Yes	See label for specific rates and application recommendations.
Cyclops (olive and cinnamon oils), NC	Vegetables & Strawberries	Broad-spectrum fungicide	0	0	Yes	See label for specific rates and application recommendations. Ingredients are exempt from FIFRA.
DART Funigicide EC (capric acid, caprylic acid)	Vegetables & Strawberries	Broad-spectrum fungicide	0	24	Yes	See label for specific rates and application recommendations.
Debug ON Debug Optimo Debug Tres Debug Turbo (fats and glyceridic oils Mongosa, Azadirachtin), NC	Vegetables & Strawberries	Powdery mildew, Rust, <i>Rhizoctonia</i> , <i>Sclerotinia</i> , <i>Sclerotium rolfsii</i>	0	4	Yes	See labels for specific rates, application recommendations, and precautions regarding use with other pesticides.

Product (Active Ingredient), Fungicide Group ¹	Crops	Pertinent Diseases or Pathogens	Minimum Hours to		OMRI- Listed ²	Remarks ³
			Harvest	Reentry		
Double Nickel 55 Double Nickel LC Triathlon BA (<i>Bacillus amyloliquefaciens</i> strain D747), 44	Vegetables & Strawberries	<i>Alternaria</i> spp., Anthracnose, Bacterial diseases, Botrytis, Early blight, <i>Fusarium</i> spp., Late blight, <i>Phytophthora</i> spp., Powdery mildew, <i>Pythium</i> spp., <i>Rhizoctonia</i>	0	4	Yes	See label for additional rates and recommendations for foliar and soil application rates and details for specific diseases. Use as a soil drench at transplant and periodically throughout the season. Can also be used as a seed treatment. See label for details.
EcoSwing (extract of <i>Swinglea glutinosa</i>), NC	Vegetables & Strawberries	<i>Alternaria alternata</i> , <i>Monilinia fructicola</i> , <i>Monilinia laxa</i> , <i>Botrytis cinerea</i> , <i>Erysiphaceae</i> spp., <i>Erwinia carotovora</i> subsp., <i>Aspergillus niger</i> , <i>Alternaria tenuis</i> , <i>Cladosporium herbarum</i> , <i>Rhizopus arrhizus</i> , <i>Penicillium</i> spp.	0	4	Yes	See label for specific rates, application recommendations, and greenhouse use.
EcoWorks EC Rango Socoro (cold pressed neem oil)	Vegetables & Strawberries	Broad-spectrum fungicide, insecticide, miticide, and nematicide	0	4	Yes	See label for specific rates, application recommendations, and greenhouse use.
Ethos (bifenthrin, <i>Bacillus velezensis</i> strain RTI301, and <i>Bacillus subtilis</i> strain RTI477)	Vegetables	Damping off, seedling blights, & root or crown rot caused by <i>Phythium</i> , <i>Rhizoctonia</i> , <i>Fusarium</i> and <i>Phytophthora</i>	–	12	No	For at-plant disease suppression, must be applied in-furrow with the seed or with transplant water at transplant.
Flower Pharm (potassium chloride, sodium bicarbonate, soy oil, and rosemary oil)	Vegetables & Strawberries	Broad-spectrum fungicide, insecticide, and miticide	0	0	Yes	See label for specific rates, application recommendations.
FungOUT (citric acid)	Vegetables, Stone Fruits, Blueberries, Greenhouse Vegetables	Downy mildew, Target spot, Bacterial canker, Powdery mildew, Bitter rot, Fire Blight, and Anthracnose	0	4	Yes	For disease suppression, obtain excellent coverage on both sides of leaf, do not apply within 24 hr of rainfall.
Fungus Pharm (soybean oil, cinnamon oil, and rosemary oil)	Vegetables & Strawberries	Broad-spectrum fungicide, insecticide, and miticide	0	0	Yes	See label for specific rates, application recommendations.
Gargoil (cinnamon oil and garlic)	Vegetables and small fruit	Broad-spectrum contact fungicide/insecticide/miticide	0	0	Yes	See label for specific rates, application recommendations, and precautions regarding use with other pesticides.
Glacial Spray Fluid (oil, petroleum), NC	Vegetables & Strawberries	Powdery mildew, Rust	0	4	Yes	See label for specific rates, application recommendations, and precautions regarding use with other pesticides.

Product (Active Ingredient), Fungicide Group ¹	Crops	Pertinent Diseases or Pathogens	Minimum Hours to		OMRI- Listed ²	Remarks ³
			Harvest	Reentry		
GreenClean PRO PerCarb (sodium carbonate peroxyhydrate), NC	Vegetables & Strawberries	Broad-spectrum fungicide/bactericide	0	–	No	See label for specific rates and application recommendations.
Howler (<i>Pseudomonas chlororaphis</i> strain AFS009), NC	Vegetables & Strawberries	Rhizoctonia, Pythium, Fusarium, Phytophthora, Sclerotinia, Colletotrichum, and Botrytis.	0	4	Yes	See label for specific rates and application recommendations.
(Hydrogen peroxide + peroxyacetic acid), NC Many brands available: GreenClean Liquid, Jet-Ag, OxiDate, Purpose Plus, Rendition, SaniDate, SporeQuell, StorOx, TerraClean, TerraStart, ZeroTol	Vegetables & Strawberries	Broad-spectrum fungicide	0	1 for enclosed areas; until spray dries in open-field areas.	No	See labels for specific rates, application recommendations, and precautions regarding use with other pesticides. Some formulations can be used as a soil drench at transplant and periodically throughout the season. Can also be used as a seed treatment or for postharvest treatments.
JMS Stylet-Oil Organic JMS Stylet-Oil (paraffinic oil), NC	Vegetables & Strawberries	Potato Virus Y, Tobacco Etch Virus, Cucumber Mosaic Virus	0	4	Yes, but only for 1 label	See label for specific rates, application recommendations, and precautions regarding use with other pesticides.
LEAPES (<i>Bacillus thuringiensis</i> subsp. <i>kurstaki</i> , strain ABTS-351 and methyl salicylate)	Tomato & Pepper	<i>Xanthomonas</i> spp.	0	12	No	Apply before disease is observed in the field; should be used as part of a plant pathogen control program. See label for details regarding insecticidal activity.
LifeGard (<i>Bacillus mycoides</i> isolate J)	Vegetables	Broad-spectrum fungicide	–	4	Yes	See label for specific rates and application recommendations.
Mildew Cure (cotton, corn, and garlic oils), NC	Vegetables & Strawberries	Powdery mildew	0	0	Yes	See label for specific rates and application recommendations. Ingredients are exempt from FIFRA.
(mineral oil), NC Many brands: 440 Superior Spray Oil, BioCover, Glacial Spray Oil, Omni Supreme Oil, PureSpray Green, SuffOil-X, TriTek, Ultra-Pure Oil	Vegetables & Strawberries	Powdery mildew	0	4	Yes	See label for specific rates, application recommendations, precautions, and fungicide compatibility.
Mycostop LALSTOP K61 SP (<i>Streptomyces</i> sp. strain K61)	Vegetables & Strawberries	Broad-spectrum fungicide	0	4	No	See label for specific rates and application recommendations.

Product (Active Ingredient), Fungicide Group ¹	Crops	Pertinent Diseases or Pathogens	Minimum Hours to		OMRI- Listed ²	Remarks ³
			Harvest	Reentry		
Nutrol (potassium phosphate), NC	Cucurbits, Peppers, & Tomatoes	Powdery mildew	0	0	No	Do not mix with copper fungicides or other products affected by low pH (<5.5). See label for specific rates and application recommendations.
Obrona (PDHP 25279)	Vegetables and small fruit	Broad-spectrum fungicide	0	4	No	See label for specific rates and application recommendations.
OxiPhos (mono- and dipotassium salts of phosphorus acid + hydrogen peroxide), 33 & NC	Vegetables & Strawberries	<i>Alternaria</i> spp., Anthracnose, Bacterial diseases, Botrytis, Early blight, <i>Fusarium</i> spp., Late blight, <i>Phytophthora</i> spp., Powdery mildew, <i>Pythium</i> spp., Rhizoctonia	0	1 for enclosed areas; until spray dries in open-field areas.	No	See label for additional rates and recommendations for transplant production and details for specific diseases. Use as a soil drench at transplant and periodically throughout the season. Can also be used as a seed treatment.
PlantShield HC RootShield WP Trianum-G (<i>Trichoderma harzianum</i> Rifai strain KRL-AG2), NC	Vegetables & Strawberries	<i>Cylindrocladium</i> spp., <i>Fusarium</i> spp., <i>Pythium</i> spp., <i>Rhizoctonia</i> spp., <i>Thielaviopsis</i> spp.	0	PlantShield: 4 RootShield: 0 if soil-applied; until spray dries	Yes	See label for specific rates, application recommendations, and precautions regarding use and fungicide compatibility.
(potassium bicarbonate), NC Many brands available: Armicarb 100, Armicarb "O", Carb-O-Nator, Eco-mate, Kaligreen, Milstop	Vegetables & Strawberries	Broad-spectrum fungicide	0	4	Yes	See label for specific rates and application recommendations.
(potassium phosphite; mono- and dipotassium salts of phosphorous acid), 33 Many brands available: Alude, Appear, Confine Extra T&O, Fosphite, Fungi-Phite, Helena Prophyt, K-Phite 7LP AG, Phiticide, Phorcephite, Phostrol, Rampart, Reveille	Vegetables & Strawberries	<i>Alternaria</i> spp., Anthracnose, Bacterial diseases, Downy mildew, <i>Fusarium</i> spp., Late blight, Leaf blights caused by <i>Cercospora</i> and <i>Septoria</i> spp., <i>Phytophthora</i> spp., Powdery mildew, <i>Pythium</i> spp., <i>Rhizoctonia</i> spp., Root rots	0	4	No	See label for details, specific recommendations, and precautions for tank mixing with copper-based fungicides.
Prev-Am (sodium tetraborohydrate decahydrate), NC	Vegetables & Strawberries	Downy mildew, Botrytis, Powdery mildew, Late blight, White rust, White mold	0	12	No	See label for details, crop-specific recommendations, and precautions.
ProBlad Verde Fracture (Banda de Lupinus albus doce (BLAD))	Vegetables & Strawberries	Anthracnose, Botrytis, Powdery mildew, Southern blight, White mold	24 24	4 4	Yes No	See label for details, crop specific recommendations, and precautions.
Procidic BerryCare FungOUT (citric acid), NC	Vegetables & Strawberries (labels vary)	Broad-spectrum fungicide & bactericide	0 0 0	0 4 4	No Yes Yes	See label for specific rates, application recommendations, and precautions regarding use with other pesticides.

Product (Active Ingredient), Fungicide Group ¹	Crops	Pertinent Diseases or Pathogens	Minimum Hours to		OMRI- Listed ²	Remarks ³
			Harvest	Reentry		
PureCrop1	Vegetables & Strawberries	Botrytis, Fusarium wilt, downy mildew, and powdery mildew.	0	0	Yes	See label for specific rates, application recommendations, and precautions.
Purespray Green (oil, petroleum), NC	Vegetables & Strawberries	Powdery mildew, Rust	0	4	Yes	See label for specific rates, application recommendations, and precautions regarding use.
Pvent LALSTOP G46 WG (<i>Clonostachys rosea</i> strain J1446), NC	Vegetables & Strawberries	Broad-spectrum fungicide	0	4	Yes	See label for details, crop specific recommendations, and precautions.
Regalia Regalia Rx Pacesetter (extract of <i>Reynoutria sachalinensis</i>), P	Vegetables & Strawberries	Bacterial canker, Bacterial speck, Bacterial spot, Botrytis, Early blight, Late blight, <i>Phytophthora</i> spp., Powdery mildew, Target spot	0	4	Yes	Tank-mix with other effective fungicides for improved disease control under heavy pressure. See label for details.
Romeo (Cerevisane; cell walls of <i>Saccharomyces cerevisiae</i> strain LAS117)	Vegetables & Strawberries	Alternaria leaf spot, Anthracnose, Botrytis, Downy mildew, Fusarium, Late blight, <i>Phytophthora</i> , Powdery mildew, Rhizoctonia, Scab, Sour rot	0	4	Yes	See label for details, crop specific recommendations, and precautions.
RootShield Granular RootShield WP Trianum WG (<i>Trichoderma harzianum</i> Rifai strain T-22), NC	Vegetables & Strawberries	<i>Cylindrocladium</i> spp., <i>Fusarium</i> spp., <i>Pythium</i> spp., <i>Rhizoctonia</i> spp., <i>Thielaviopsis</i> spp.	0	0	Yes	See label for specific rates, application recommendations, and precautions regarding use and fungicide compatibility.
RootShield Plus Granular RootShield Plus WP (<i>Trichoderma harzianum</i> Rifai strain T-22 and <i>Trichoderma virens</i> strain G-41), NC	Vegetables & Strawberries	<i>Cylindrocladium</i> spp., <i>Fusarium</i> spp., <i>Pythium</i> spp., <i>Rhizoctonia</i> spp., <i>Thielaviopsis</i> spp.	0	4	Yes	See label for specific rates, application recommendations, and precautions.
Seican (cinnamaldehyde)	Vegetables & Strawberries	Botrytis, Powdery mildew, Rusts	0	4	No	See label for details, crop specific recommendations, and precautions.
Serifel Biofungicide Serifel NG Biological Fungicide Subtilex NG (<i>Bacillus amyloliquefaciens</i> strain MBI 600), NC	Vegetables & Strawberries	Broad-spectrum fungicide	0	4	Yes	See label for details, crop specific recommendations, and precautions.
Sil-Matrix (potassium silicate), NC	Vegetables & Strawberries	Broad-spectrum fungicide	0	4	No	Must be used in a rotational program with other fungicides when conditions are conducive for disease development. See label for details.

Product (Active Ingredient), Fungicide Group ¹	Crops	Pertinent Diseases or Pathogens	Minimum Hours to		OMRI- Listed ²	Remarks ³
			Harvest	Reentry		
Soilgard (<i>Gliocladium virens</i> GI-21), NC	Vegetables & Strawberries	Fusarium root and crown rot, <i>Phytophthora capsici</i> , <i>Pythium</i> spp., <i>Rhizoctonia</i> , <i>Sclerotinia</i> spp., <i>Sclerotium</i> spp.	0	0	Yes	For best results, apply to transplants or as a drench during transplanting. Subsequent applications can be made as drench, directed spray, or by chemigation. See label for precautions regarding use and fungicide compatibility.
Sonata (<i>Bacillus pumilus</i> QST 2808), NC	Vegetables & Strawberries	Early blight, Downy mildew, Late blight, Powdery mildew, Rust	0	4	Yes	Mix or alternate with other effective fungicides for improved disease control. See label for details.
Soyote (soybean oil and sodium lauryl sulfate)	Vegetables & Strawberries	Broad-spectrum fungicide and bactericide	0	0	Yes	See label for specific rates and application recommendations.
Sporan (oils of clove, peppermint, rosemary, and thyme)	Vegetables & Strawberries	Broad-spectrum fungicide and bactericide	0	0	Yes	See label for specific rates and application recommendations.
Sporatec (oils of clove, rosemary, and thyme), NC	Vegetables & Strawberries	Bacterial spot, Botrytis, Early blight, Gray mold, Late blight, Powdery mildew	0	0	Yes	Exercise care when applying. Begin applications once disease is observed. Use of a spreader and/or penetrant adjuvant recommended for improved performance. Do not apply when temps are above 90°F. See label for details. Ingredients are exempt from FIFRA.
Stargus (<i>Bacillus amyloliquefaciens</i> strain F727 cells and spent fermentation media)	Vegetables & Strawberries	Broad-spectrum fungicide and bactericide	0	4	Yes	See label for specific rates and application recommendations.
Taegro 2 (<i>Bacillus subtilis</i> var. <i>amyloliquefaciens</i> strain FZB24), NC	Vegetables	Foliar diseases: Downy mildew, Powdery mildew, <i>Pseudomonas</i> spp., <i>Xanthomonas</i> spp. Soilborne diseases: <i>Fusarium</i> spp., <i>Phytophthora</i> spp., <i>Pythium</i> spp., <i>Rhizoctonia</i> spp., <i>Sclerotinia</i> spp.	–	24	No	See label for specific instructions regarding soil injected, spray, or incorporated applications. No more than 12 applications per season. For best efficacy, product should be applied prior to disease or disease establishment. May be applied to greenhouse-produced crops.
Thyme Guard (thyme oil extract), NC	Vegetables & Strawberries	Broad-spectrum bactericide and fungicide	0	0	–	See label for specific rates, application recommendations, and precautions regarding use with other pesticides. Ingredients are exempt from FIFRA.

Product (Active Ingredient), Fungicide Group ¹	Crops	Pertinent Diseases or Pathogens	Minimum Hours to		OMRI- Listed ²	Remarks ³
			Harvest	Reentry		
Guarda Huma Gro Promax Huma Gro Proud 3 JUDGEMENT PathoCURB RECKONING SPORICIDE Slam Org THYME GUARD Thymic Thymox Control (thyme oil)	Vegetables & Strawberries	Broad-spectrum fungicide	0	0	Check label	See label for specific rates and application recommendations. Ingredients are exempt from FIFRA. Not all labels are OMRI listed.
Timorex ACT (tea tree oil), BM 01	Vegetables & Strawberries	Broad-spectrum fungicide	48	4	Yes	See label for specific rates and application recommendations.
Timorex Gold (tea tree oil), BM 01	Vegetables & Strawberries	Broad-spectrum fungicide	48	12	No	See label for specific rates and application recommendations.
Trilogy (clarified hydrophobic extract of neem oil), NC	Vegetables & Strawberries	<i>Alternaria</i> spp., Anthracnose, Botrytis, Early blight, Powdery mildew	0	4	Yes	See label for specific rates, application recommendations, and precautions regarding use with other pesticides.
Ultra-Pure Oil (mineral oil), NC	Vegetables & Strawberries	Powdery mildew	0	4	Yes	See label for specific rates, application recommendations, precautions, and fungicide compatibility.
Vacciplant (laminarin), P	Vegetables & Strawberries	Anthracnose, Bacterial speck, Bacterial spot, Early blight, Phytophthora blight, Powdery mildew	0	4	No	Start applications preventatively when weather conditions are favorable for disease development. Repeat applications until disease conditions end. Add a labeled copper product to Vacciplant if the disease symptoms appear.
Vectorite with CR-7 (<i>Clonostachys rosea</i> strain CR-7)	Vegetables & Strawberries	Broad-spectrum fungicide	0	0	Yes	Biofungicide is dispensed using commercially reared bumble or honey bees using Bee Vectoring Technology-approved hive dispensers.
Veggie Pharm (oils of soybean, garlic, rosemary, and peppermint)	Vegetables & Strawberries	Broad-spectrum bactericide and fungicide	0	0	Yes	See label for specific rates and application recommendations and precautions.
Veg'Lys, Brandt (garlic oil), NC	Vegetables & Strawberries	Broad-spectrum bactericide and fungicide	0	0	Yes	See label for specific rates and application recommendations and precautions. Do not apply when temps are above 90°F. Ingredients are exempt from FIFRA.
Gleam Kitogard WarHammer (chitosan)	Vegetables & Strawberries	Broad-spectrum bactericide and fungicide	0	0	No	See label for specific rates and application recommendations and precautions. Ingredients are exempt from FIFRA.

Product (Active Ingredient), Fungicide Group ¹	Crops	Pertinent Diseases or Pathogens	Minimum Hours to		OMRI- Listed ²	Remarks ³
			Harvest	Reentry		
Vegalab Mildew Control Zayin Zealous (geraniol)	Vegetables & Strawberries (labels vary)	Broad-spectrum fungicide	0 0	0 0	Yes No	See label for specific rates and application recommendations.
Zivion S (natamycin)	Strawberries	Anthracnose, Verticillium, Charcoal rot	0	4	No	Apply prior to plant as a preplant transplant root or whole-plant dip treatment. Do not apply after or to harvestable commodities.
ZONIX (rhamnolipid biosurfactant)	Vegetables & Strawberries	Broad-spectrum fungicide (see label)	0	4	Yes	See label for specific rates and application recommendations.

¹ FRAC code (fungicide group): Letters (BM, NC, and P) are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with same letter and number) indicate the same active ingredient or similar mode of action. This information must be considered for the fungicide resistance management decisions. However, products with BM, NC, or P are considered low risk and don't require any rotation unless specifically directed on the label. BM = Biologicals with multiple modes of action; NC = not classified, includes mineral oils, organic oils, potassium bicarbonate, and other materials of biological origin; P = host plant defense inducers. Source: FRAC Code List 2024 <http://www.frac.info/> (FRAC = Fungicide Resistance Action Committee).

² OMRI Listed means that a product is approved for use in certified organic production under the USDA National Organic Program (NOP).

³ Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by UF/IFAS Extension nor discrimination against similar products or services not mentioned.

Table 3. Biopesticides labeled for management of nematode pests of many crops. Contact: Johan Desaeger, UF/IFAS Gulf Coast Research and Education Center.

Pest	Active Ingredient	Product(s)	Rate Product/ Acre	Days to Harvest	REI (Hours)	Remarks ¹
Nematodes	Azadirachtin	Aza-Guard, Ecozine Plus, Molt-X, Neemix	See label	0	4	OMRI-listed. ¹
	<i>Burkholderia rinojensis</i> heat-killed	Majestene	4–8 qt	0	4	OMRI-listed. ¹
	Mustard oil + capsaicin	Dazitol	6.25 gal	0	4	OMRI-listed. ¹ Apply 3–5 days preplant or 1/4 rate postplant.
	<i>Purpureocillium lillicanum</i> PL-251	LALNIX ACT DC	10.25 fl oz	0	4	OMRI-listed. ¹
	<i>Purpureocillium lillicanum</i> PL-11	NemaClean 10% WP	1-2 lb	0	12	OMRI-listed. ¹
	Saponins of <i>Quillaja saponaria</i>	Nema-Q	See label	0	4	OMRI-listed. ¹
	Thyme oil	Nemakill, Promax, Thyme Guard	See label	0	4	OMRI-listed. ¹

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