

Table 21. Selected insecticides labeled for insects and mites on vegetable bedding plants

Insecticide	Target Pests	Labeled Crops	Comments
Acetamiprid (Tristar30SG) 12 hr. REI Group 4A	Aphids, psyllids, mealybugs, leafhoppers, caterpillars, hard and soft scales, plant bugs, whiteflies, fungus gnat larvae, thrips, leaf eating beetles, leaf miners	Vegetable transplants (See supplemental label)	Contact insecticide with translaminar activity. The addition of a surfactant may improve efficacy for certain pests (see supplemental label).
Azadirachtin- Group 18B (Aza-Direct) 4 hr. REI Organic product ----- (Azatrol) 4 hr. REI Organic product ----- (AzaGuard) 4 hr. REI Organic Product ----- (Azahar) 4 hr. REI Organic product ----- (Azatin XL) 4 hr. REI ----- (Molt X)	Aphids, beetles, weevils, thrips, true bugs, caterpillars, leafhoppers, leafminers, whiteflies, and fungus gnat larvae ----- Beetles, weevils, thrips, true bugs, leafhoppers, cutworms, loopers, fungus gnat larvae ----- Leafminers, soft scales, mealybugs, thrips, aphids, fungus gnat larvae, whiteflies, caterpillars, beetles, weevils ----- Beetles, weevils, thrips, true bugs, leafhoppers, whiteflies, aphids, leafrollers, cutworms, loopers, fungus gnat larvae ----- Aphids, caterpillars & loopers, fungus gnat larvae, leafhoppers, leafminers, thrips, whiteflies ----- Whiteflies, leafminers, soft scales,	Many vegetables including bulb, cole, curcubit, leafy and fruiting types (eggplant, tomato, peppers) (see specific labels)	Insect growth regulator for immature stages of insects. Repeat applications needed. Repels some insects and can be used as an antifeedant.

<p>4 hr. REI (Organic Product)</p> <p>-----</p> <p>(Ornazin 3% EC) 12 hr. REI</p> <p>-----</p> <p>(Neemix 4.5) 12 hr. REI Organic product</p>	<p>mealybugs, thrips, aphids, fungus gnat larvae, caterpillars, beetles, weevils</p> <p>-----</p> <p>Aphids, caterpillars & loopers, cutworms, leafminers, leafhoppers, thrips, whiteflies, fungus gnat larvae, beetles, weevils</p> <p>-----</p> <p>Aphids, beetles, caterpillars, fungus gnat larvae, leafhoppers, leafminers, thrips, whiteflies</p>		

<p><i>Bacillus thuringiensis</i> subsp. <i>aizawai</i> (XenTari) 4 hr. REI Group 11B Organic product</p>	<p>Certain caterpillars (see label)</p>	<p>Brassica and fruiting vegetables in the greenhouse (see label)</p>	<p>Stomach poison that must be ingested to be active. Most effective against small, newly hatched larvae. Insects stop feeding and dies 1 to 5 days later.</p>
<p><i>Bacillus thuringiensis</i> subsp. <i>kurstaki</i> (DiPel Pro DF) 4 hr. REI Group 11B Organic product</p>	<p>Certain caterpillars (see label)</p>	<p>Many vegetables including leafy, cole, and fruiting types (see label)</p>	<p>Stomach poison that must be ingested to be active. Thorough coverage of all plant parts is important. Most effective against young, newly hatched larvae. Insects stop feeding and dies 1 to 5 days later.</p>
<p><i>Bacillus thuringiensis</i> subsp. <i>israelensis</i> (Gnatrol WDG) 4 hr. REI Group 11A1 Organic product</p>	<p>Fungus gnat larvae</p>	<p>Vegetable plants such as leafy and cole crops, cucumbers, peppers, tomatoes and eggplants</p>	<p>Stomach poison that must be ingested to be active. Most effective against first instar larvae. Apply as soil drench to control fungus gnat larvae. Larvae must ingest material to be killed. May be applied through drip or sprinkler irrigation system. Do not combine with fungicides or fertilizers containing copper or chlorine.</p>
<p><i>Beauveria bassiana</i> (Botanigard ES) 4 hr. REI(Botanigard 22WP) 4 hr. REI (Mycotrol O) 4 hr. REI Organic product (Naturalis L) 4 hr. REI Organic product</p>	<p>Aphids, thrips, whitefly, psyllids, mealybugs, leafhoppers, plant bugs (See labels for more information)</p>	<p>Many vegetables including cole crops, greens, eggplant, peppers, and squash. Do not use ES formulations on tomatoes.</p>	<p>Contact insecticide. Active ingredient is an insect killing fungus. To be effective needs relative humidity greater than 70% and 65-75°F for 8 to 10 hours. Treat when insect populations are low. Repeated applications may be needed.</p>

Bifenazate (Floramite SC) 12 hr. REI Group 25	Spider mites	Greenhouse tomatoes. Varieties greater than one inch in diameter when mature.	Contact miticide. Active against all stages of the two-spotted spider mites. Not effective against rust mites or broad mites. Relatively inactive against beneficial predatory mites.
Buprofezin (Talus 40SC Insect Growth Regulator) 12 hr. REI Group 16	Whiteflies, mealybugs, leafhoppers	Greenhouse tomatoes	Insect growth regulator active against nymph stages. Thorough coverage of all plant parts is important. Chitin synthesis inhibitor, suppresses oviposition of adults and reduces viability of eggs. Treated pests may remain alive for 3 to 7 days, but feeding damage is low.
Chlorfenapyr (Pylon) 12 hr. REI Group 13	Caterpillars (including hornworms), spider mites, broad mites, western flower thrips	Tomato, tomatillo, ground cherry, peppers, eggplant, pepinos. Do not use on tomato varieties with a diameter of less than one inch when mature.	Insecticide/miticide with contact and translaminar activity. Active on larvae and nymphs of spider mites and thrips. See label for resistant management guidelines.
Dinotefuran (Safari 20 SG) 12 hr. REI Group 4A	Aphids, leafminers, mealybugs, thrips (suppression), whiteflies (including sweet potato whiteflies – B and Q biotypes)	Many vegetable transplants grown in enclosed structures (see label). Do not apply to greenhouse grown vegetables.	Systemic insecticide. Do not make more than one application per crop.
Etoxazole (TetraSan 5 WDG) 12 hr. REI Group unknown	Spider Mites	Indoor grown tomatoes (See supplemental label)	Miticide with contact and translaminar activity. Available in 2 oz. water soluble packets. Active on mite eggs and nymphs. Does not kill adults.
Horticultural oil Petroleum Oil (Ultra-Pure Oil) (Pure Spray Green)	Aphids, leafminers, mites, thrips, whiteflies, leafhoppers	Many vegetables (see labels for specific crops)	Works by contact. Thorough coverage of all plant parts is important. Foliar injury may occur if applied during humid conditions. See

4 hr. REI NC Organic product			labels for information on plant safety. All applications should be preceded by a phytotoxicity check to ensure that the material is safe for that particular plant variety.
Petroleum Oil (Saf-T-Side) 4 hr. REI NC Organic product	Aphids, leafhoppers, leafminers, thrips, mites, whiteflies	Vegetable crops (see label)	
Petroleum Oil (SuffOil-X) 4 hr. REI NC Organic product	Aphids, leafhoppers, leafminers, mites, thrips, whiteflies	Vegetable crops (see label)	Works by contact. Thorough coverage of all plant parts is important. Foliar injury may occur if applied during humid conditions. See label for information on plant safety.
Paraffinic Oil-(White Mineral Oil) (JMS Stylet Oil) 4 hr. REI (Organic JMS Stylet Oil) Organic product	Leafhoppers, leafminers, mites, whiteflies	Many vegetables (see label)	Works by contact. See label for information on plant safety.
Imidacloprid (Marathon II) 12 hr. REI Group 4A ----- (Marathon 60WP) 12 hr. REI Group 4A	Aphids, leafhoppers, leafminers, leafhoppers, thrips (suppression), mealybugs, and whiteflies, fungus gnat larvae ----- Aphids, fungus gnat larvae, leafhoppers, leafminers, mealybugs, thrips (suppression), whiteflies	Vegetable bedding plants intended for resale only. ----- Vegetable bedding plants intended for resale only.	Systemic insecticide. Many other generic products are available including (but not limited to) Imida E Pro 60 WSP QualiPro Imidacloprid 2F)
Insecticidal soap Potassium salts of fatty acids (M-Pede)	Aphids, mites, thrips, whiteflies, broad mites, leafminers, leafhoppers	Many vegetables including bulb, cole, leafy, fruiting and cucurbit types	

12 hr. REI NC Organic product			for information on plant safety. Can be tank mixed with other products to increase efficacy.
Iron phosphate (Sluggo Snail and Slug Bait) 0 hr. REI NC Organic product	Slugs and snails	Many vegetables (see label)	Ingestion causes the slugs and snails to cease feeding, become less mobile and begin to die in 3 to 6 days. Best applied in the evening. Non-toxic to cats and dogs.
Neem Oil (Triact 70) 4 hr. REI Organic Product (Trilogy) 4 hr. REI Organic product	Mites and insects (whiteflies, aphids, leafhoppers) <hr/> Aphids, mites, mealybugs Whiteflies and thrips (suppression)	Many vegetable transplants (see labels)	Works by contact. Thorough coverage of all plant parts is important. Refer to label for information on plant safety and precautions for use in the greenhouse.
Parasitic nematodes (NemaShield, Nemasys, Scanmask)	Fungus gnat larvae Nemasys: western flower thrips	Greenhouse vegetables	Available in packages. Remove screens and filters from fertilizer injector or sprayer. Nematodes are very sensitive to ultra violet light and desiccation. For soil dwelling pests such as fungus gnat larvae: Drench on soil surface and then water in. Apply to moist growing media at temperatures between 50-85 °F. For western flower thrips (Nemasys). Foliar application. Do not apply in direct sunlight. Lightly mist plants before application. Efficacy will be

			variable depending upon relative humidity, temperature, concentration, frequency of application and insect growth stage.
Pyrethrins (PyGanic EC) 12 hr. REI Group 3A Organic product	Aphids, caterpillars, fungus gnat adults, thrips, leafhoppers, whiteflies and others	Many vegetables including bulb, leafy, cole, fruiting and curcurbit types	Contact insecticide. Provides rapid knockdown of pests.
Pyrethrins plus PBO (Pyrethrum TR aerosol) 12 hr. REI Group 3A	Aphids, cabbage worms, adult fungus gnats, mealybugs, thrips, whiteflies and others	Many vegetables including bulb, leafy, cole, fruiting and cucurbit types	Contact insecticide. See label for specific directions for placement and use for successful application.
----- (Pyreth-It Formula 2) 12 hr. REI Group 3A	----- Aphids, caterpillars, fungus gnat adults, leafhoppers, beetles, thrips, whiteflies and others.	----- Many different vegetable crops (see label)	----- Contact insecticide. May be combined with other insecticides.
Pyronyl Crop Spray (Pyrethrins & PBO) 12 hr. REI Group 3 and 27A	Aphids, caterpillars, fungus gnats, leafhoppers, leafminers, mealybugs, plant bugs, thrips, whiteflies and others	Many different vegetables (see label)	Contact insecticide.
Pyriproxyfen (Distance Insect Growth Regulator) 12 hr. REI Group 7C	Foliar spray for whiteflies (greenhouse & sweetpotato) and aphids (suppression) Apply as a sprench (growing media surface spray or drench) for fungus gnat and shore fly larvae	See supplemental label for use on indoor-grown fruiting vegetables. Do not apply to tomato varieties less than one inch in diameter or to non-bell peppers.	Insect growth regulator. See label for specific use instructions on rates and plant safety for use as a drench or sprench (soil surface spray) against fungus gnats or shore flies. Do not make more than 2 applications per

			season.
Soybean Oil (Golden Pest Spray Oil) 4 hr. REI NC Organic product	Aphids, mites, leafminers, certain caterpillars, whiteflies, thrips and others	Vegetables such as cabbage, cauliflower, curcubits, lettuce, melon, peppers, squash and tomatoes	Works by contact. See label for information on plant safety.
Spirotetramat (Kontos) 24 hr. REI Group 23	Aphids, leafhoppers, mealybugs, spider mites (suppression), whiteflies	Vegetable transplants (see label for specific types)	Systemic insecticide.
Sucrose Octanoate Esters (SucraShield) 48 hr. REI NC Organic product	Aphids, caterpillars, leafhoppers, mites, thrips and whiteflies	Many vegetables (see label for specific types)	Contact insecticide with limited residual activity. Thorough coverage of all plant parts is needed. Sucrose octanoate esters are produced in the hairs of tobacco leaves.
Thiamethoxam (Flagship 25 WG) 12 hr. REI Group 4A	Fruiting vegetables: aphids, , flea beetles, leafhoppers, whiteflies, , stink bugs Curcubit vegetables: aphids, flea beetles, cucumber beetles (suppression), leafminers (suppression), whiteflies	Foliar application to vegetable plants grown for resale to consumers See label for specific types of fruiting and curcubit vegetables	Systemic insecticide.

Resistance Groups (number and letter) indicate products with a common mode of action based on the Insecticide Resistance Action Committee (IRAC) guidelines at <http://www.irac-online.org/>. For multiple applications to one crop, select products from different resistant groups.
NC = Not Classified

Table 22. Selected fungicides and bactericides labeled for vegetable bedding plants and transplants.

Fungicide	Targeted Pest	Labeled Crops	Comments
Basic Copper Sulfate (Cuprofix Ultra 40 D Disperss) 12 hr. REI Group M1	Angular leaf spot, downy mildew, Alternaria blight, <i>anthracnose</i> , bacterial blight, bacterial spot (depending upon the crop)	Many including cucumbers, eggplant, peppers, tomatoes, and others	Preventative, contact fungicide. Crops grown in the greenhouse may be more sensitive to copper injury so the user should determine plant sensitivity. Observe for 7 to 10 days for symptoms of injury.
<i>Bacillus pumilus</i> (Sonata) 4 hr. REI Group 44 Organic product	Downy mildew, powdery mildew on many different crops (see label) Early blight, late blight on certain fruiting vegetables	Many including cole crops, cucurbits, fruiting, leafy vegetables	Broad spectrum preventative biological fungicide. Begin applications when conditions in the greenhouse favor disease development.
<i>Bacillus subtilis</i> (Cease) 4 hr. REI Group 44 Organic product	Fungal and bacterial leaf spots, powdery mildew, botrytis blight, downy mildew (see label)	Many including cole crops, cucurbits, fruiting vegetables, leafy vegetables, bulb vegetables	Broad spectrum, preventative biological fungicide. Begin applications when conditions in the greenhouse favor disease development. Thorough coverage is essential.
<i>Bacillus subtilis</i> (Companion Liquid Biological Fungicide) 4 hr. REI NC Organic product	Damping off fungi, root rots (<i>Fusarium</i> , <i>Pythium</i> , <i>Phytophthora</i> , <i>Rhizoctonia</i>) <i>Botrytis</i> , leaf spots, (fungal and bacterial), powdery mildew	Many including cole crops, cucurbits, fruiting vegetables, leafy vegetables, bulb vegetables	Preventative biological fungicide for control and suppression of soil and foliar diseases. Activates ISR (induced systemic resistance).
Copper Hydroxide (Champ Dry Prill, Champ Formula 2 Flowable) (Champ WG) Organic product (Kocide Products) Group M1	Leaf spots, <i>Anthracnose</i> , Bacterial spots and other diseases (see label)	See labels for specific crops.	Protectant, contact fungicide. See labels for specific usage instructions. Several Kocide products available.

Copper salts of fatty and rosin acids (Camelot) 12 hr. REI Group M1	Bacterial leaf spots, fungal leaf spots and blights, downy mildew, powdery mildew and others (see label for specifics)	Greenhouse vegetables (see label for specific crops)	Works by contact. See label for specific usage instructions and plant safety precautions.
Dichloran (Botran 75-W) 12 hr. REI Group 14	<i>Botrytis</i> , White Mold (<i>Sclerotinia</i>)	Cucumbers, leaf lettuce, and tomatoes	Preventative, contact fungicide. Seedlings or newly set transplants of tomatoes may be injured by drenching.
Fenhexamid (Decree 50WDG) 12 hr. REI Group 17	<i>Botrytis</i>	Fruiting vegetables, tomatoes, cucumber and leafy greens (except spinach)	Preventative and curative fungicide. Thorough coverage needed. Do not make more than two consecutive applications. Do not apply in the field.
Hydrogen dioxide (Oximate) 0 hr. REI 1 hr. REI (spray) Organic product N/A	downy mildew, powdery mildew, leaf spots and blights, and root rots (see label)	Tomatoes, peppers, leafy and cole crops, cucurbits, bulb crops and others	Works by contact. Strong oxidizing agent.
Insecticidal soap Potassium salts of fatty acids (M-Pede) 12 hr. REI Organic product	Powdery mildew	Greenhouse cucumber	Works by contact. See label for usage instructions.
Kaolin (Surround WP) 4 hr. REI Group NC Organic product	Powdery mildew	Curcurbit vegetables	Forms a mineral-based particle film resulting in a dry, white film. May be unsightly for retail sales. Uniform coverage important for effectiveness.

Mancozeb (Dithane F45 Rainshield, DF Rainshield) 24 hr. REI Group M3	Leafspot diseases, seed treatment for damping off, seed rots and seedling blights, downy mildew	Tomatoes, cucumbers, melons, summer squash and others	Broad-spectrum, protectant fungicide.
Maneb (Maneb 75 DF, Maneb 80WP) 24 hr. REI Group M3	Anthrachnose, leaf spots, early blight, late blight	Tomatoes (greenhouse)	Protectant, contact fungicide.
Neem Oil (Trilogy) 4 hr. REI Organic product	<i>Alternaria</i> , <i>Anthrachnose</i> , Early blight, <i>Botrytis</i> , Leaf spots, Downy Mildews, powdery mildew	Many different vegetables (see label).	Broad spectrum, contact fungicide. See label for plant safety precautions. Plant injury may occur during humid conditions in the greenhouse.
Pentachloronitrobenzene PCNB (Terraclor 75 WP, Terraclor 15G, Terraclor 400) 12 hr. REI Group 14	Root and stem rot, damping off (<i>Rhizoctonia solani</i>)	Vegetable bedding plants: limited to container-grown broccoli, Brussels sprouts, cabbage, cauliflower, peppers and tomatoes	Protectant, contact fungicide. 400 and 75WP: Apply as a soil drench. 15G: Used as growing media mix. See label for additional information.
Phosphorus Acid (Alude) 4 hr. REI Group 33	Downy mildew, <i>Phytophthora</i> spp., <i>Pythium</i> spp., Gummy stem blight	Vegetable transplants such as cole crops, curcurbits, fruiting vegetables, leafy vegetables, onions, okra	Systemic fungicide. See label for plant safety precautions.
Phosphorus Acid (Fosphite) 4 hr. REI	Downy mildew, powdery mildew, <i>Phytophthora</i> , <i>Pythium</i> , <i>Fusarium</i> , <i>Rhizoctonia</i>	Many vegetables (see label)	Systemic fungicide. Make applications prior to disease development in conjunction with good cultural practices.
Polyoxin D zinc salt (Veranda O) 4 hr. REI Group 19	Curcurbit vegetables: powdery mildew, gummy stem blight, botrytis, <i>Corynespora</i> leaf spot, scab, early blight Fruiting vegetables: powdery	Curcurbit vegetables, fruiting vegetables	Locally systemic fungicide. Active ingredient (Polyxin) is a natural antibiotic and fermentation product of a soil bacterium. Preventive and curative activity.

	mildew, botrytis sp. early blight, suppression of anthracnose		
Potassium bicarbonate (Milstop) 1 hr. REI (Armicarb "O") (Kaligreen) 4 hr. REI Group NC Organic product	Powdery mildew (see labels for more information) Kaligreen is only labeled for powdery mildew	Many vegetables including cabbage, cucumber, eggplant, broccoli, cauliflower, lettuce, peppers, tomatoes and squash	Contact fungicide. Through coverage essential. Potassium bicarbonate disrupts the potassium ion balance in the fungus cell, causing the cell walls to collapse.
Propamocarb HCl (Previcur Flex) 12 hr. REI Group F	Root rot and damping off caused by <i>Pythium</i> , <i>Phytophthora</i>	Tomatoes, cucurbits, peppers, leaf lettuce	Systemic fungicide. Phytotoxicity may occur if applied directly to dry growing media, especially in intense sunlight.
Pyrimethanil (Scala SC) 12 hr. REI Group 9	Gray mold (<i>Botrytis</i>), Early Blight (<i>Alternaria</i>)	Tomatoes	Preventative fungicide. Apply only in well ventilated greenhouses and ventilate for at least 2 hours after application. Phytotoxicity may occur in unventilated greenhouses with relative humidity above 80%.
<i>Reynoutria sachalinsis</i> (Regalia) 24 hr. REI Organic product	Powdery mildew, downy mildew, gummy stem blight, bacterial blight, bacterial leaf spot, early and late blight (depends upon crop)	Edible crops such as cucurbits, peppers, leafy vegetable crops, and tomato	Formulation of an extract from the Giant Knotweed. Use preventatively to increase natural defense system of plants.
<i>Streptomyces griseoviridis</i> strain K 61 (Mycostop) 4 hr. REI Group NC Organic product	For control of seed rot, root and stem rot (<i>Fusarium</i> , <i>Alternaria</i> , and <i>Phomopsis</i>). Suppression of <i>Botrytis</i> , and root rots of <i>Pythium</i> , <i>Phytophthora</i> and <i>Rhizoctonia</i> in the greenhouse	Many including lettuce, cole crops, cucumbers, melons, peppers, tomatoes and others	Preventative biological fungicide. Contains a beneficial bacterium. Repeat applications may be needed. Use as a soil spray or drench.

<p><i>Streptomyces lydicus</i> (Actinovate SP) 1 hr. REI Group NC Organic product</p>	<p>Suppression of soil borne fungi such as <i>Fusarium</i>, <i>Rhizoctonia</i>, <i>Pythium</i>, <i>Phytophthora</i>, and foliar diseases such as downy mildew, powdery mildew, <i>Botrytis</i>, <i>Alternaria</i> and others</p>	<p>All greenhouse vegetables</p>	<p>Preventative biological fungicide for suppression of root rot diseases and some foliar pathogens</p>
<p><i>Streptomyces lydicus</i> (Actino-Iron) 4 hr. REI Group NC Organic product</p>	<p>Suppression of <i>Fusarium</i>, <i>Pythium</i>, <i>Rhizoctonia</i>, <i>Phytophthora</i>, and others</p>	<p>Greenhouse vegetables.</p>	<p>Preventive biological fungicide that suppresses certain diseases. Also, contains iron and humic acid.</p>
<p><i>Streptomyces sulfate</i> (Agri-mycin 17) 12 hr. REI Group 25</p>	<p>Bacterial Spot</p>	<p>Tomatoes and peppers</p>	<p>Xylem mobile fungicide. Repeated applications can result in resistant bacteria. Do not apply through any irrigation system.</p>
<p>Sulfur (Microthiol Disperss) (Micro Sulf) 24 hr. REI Group M2</p>	<p>Powdery mildew</p>	<p>Microthiol Disperss: Crucifers, cucurbits, peppers and tomatoes Micro Sulf: cole crops, cucumbers, eggplants, greens, peppers, tomatoes</p>	<p>Contact fungicide. Crops grown in greenhouses may be more sensitive to sulfur injury, so the lowest label rate should be tried initially. Do not use within two weeks of oil spray treatment.</p>
<p>Thiophanate methyl (3336 WP) 12 hr. REI Group 1</p>	<p><i>Anthraco</i>se, Gummy Stem Blight, Powdery Mildew, Target Spot, <i>Botrytis</i> Blight</p>	<p>Vegetable transplants such as beans and cucurbits</p>	<p>Xylem mobile systemic fungicide (). Resistant populations of <i>Botrytis</i> are common in the greenhouse. High risk of resistance.</p>

<i>Trichoderma harzianum</i> (PlantShield HC) (RootShield Granules) (RootsShield WP) 0 hr. REI Group NC Organic product	<i>Pythium, Rhizoctonia, Fusarium,</i> <i>Cylindrocladium and Thielaviopsis</i>	Fruiting vegetables, leafy vegetables and cole crops; Soil applications only	Preventative biological fungicide. It will not cure diseased plants. Avoid applications of fungicides at least one week before or after application. (Foliar applications only for non-food crops.)
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This information is supplied with the understanding that no discrimination is intended and no endorsement implied. Due to constantly changing regulations, we assume no liability for suggestions. If any information in these tables is inconsistent with the label, follow the label. Always follow label instructions regarding registered uses and note cautions. To avoid any phytotoxicity problems, spot test first before widespread use.

* Fungicides are grouped by their mode of action (MoA) and each MoA group is assigned a Fungicide Resistance Action Committee (FRAC) code. Most systemic fungicides (that are absorbed into plant tissues) are specific in their mode of action. Protectant fungicides are less likely to develop resistance problems as they have multi-site modes of action (M). To prevent the development of resistance, alternative applications among different FRAC codes and incorporate biological fungicides into your disease management plan. See www.frac.info/frac/index.htm

NC = Not classified

Updated 1/11 L. Pundt and T. Smith

Table 23: Plant Growth Regulators for Use on Vegetable Transplants

Plant Growth Regulator	Labeled Crops	Comments
Uniconazole-P (Sumagic) 12 hr. REI	See supplemental label: Fruiting vegetable transplants: eggplant, groundcherry, pepino, tomatillo, tomato only	As with any plant growth regulator, it is recommended to test growth regulator treatments on small crop samples and starting with a low rate before full-scale implementation. The maximum cumulative amount of Sumagic applied must not exceed 10 ppm with coverage of 2 quarts per 100 sq. feet. This means that total amount used in sequential applications can only add up to 10 ppm spray (example, 1 application at 10 ppm or two applications at 5 ppm or 4 applications at 2.5ppm).

		<p>The last spray must be no later than two weeks after the two to four leaf stage of development. Experiments have shown that sequential applications produce the best results and that the earlier that the plants receive the Sumagic spray, the greater effect it will have on the final height of the transplants.</p>
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Table 24. Scouting guidelines and biological control options for bedding plants and transplants.

Pest	How to Monitor	Where to Look	Biological Control Options
Aphids	Monitor weekly. Rely on plant inspection, not sticky cards. Look for small, 1/16 inch long aphids with two cornicles or “tailpipes” at the rear of their body. Identification to species is needed to determine which host specific aphid parasite to release when using biological controls. If uncertain, mixes of different species are available.	Underside of leaves and along stems on tips of new growth on eggplant, pepper, tomatoes and many different leafy vegetables. Signs of aphid activity: shed white skins, shiny honeydew, presence of ants, curled new leaves, and distorted growth.	<i>Aphidoletes aphidimyza</i> (aphid midge, predator) <i>Aphelinus abdominalis</i> (aphid parasite) <i>Aphidius matricariae</i> (aphid parasite) <i>Aphidius colemani</i> (aphid parasite) <i>Aphidius ervi</i> (aphid parasite) <i>Chrysoperla spp.</i> (green lacewing, predator)
Bacterial Leaf Spot	At first, chocolate-brown spots are less than 1/4 inch in diameter, & water-soaked in appearance on pepper. Severely spotted leaves appear scorched and defoliation may occur. Some strains cause leaf spot on tomatoes.	Seed-borne disease. More prevalent during moderately high temperatures and long periods of high humidity and leaf wetness.	<i>Bacillus subtilis</i> (Cease) (biofungicide)
Botrytis blight	Look for leaf blight and tan stem cankers. Botrytis blight produces characteristic gray fuzzy appearing	In areas where plants are spaced close together and where condensation may occur.	<i>Bacillus subtilis</i> (biofungicide) (suppression) <i>Streptomyces griseoviridis</i> (suppression) <i>Streptomyces lydicus</i> (suppression)

	spores on the surface of infected tissues during humid conditions.		
Broad Mites	Look for symptoms of damage – leaf edges curling downward, twisted and distorted growth. Under a microscope, look on underside of leaves for mites and their eggs.	Near ornamental crops affected with broad mites.	<i>Neoseiulus californicus</i> (predatory mites) <i>Neoseiulus cucumeris</i> (predatory mites)
Cyclamen Mites	Look for symptoms of damage – inward curling of leaves, puckering and crinkling. Under a microscope, look within buds for mites and their eggs.	Near ornamental crops affected with cyclamen mites.	<i>Neoseiulus cucumeris</i> (predatory mite) <i>Neoseiulus californicus</i> (predatory mite)
Damping Off (Pythium Root and Stem Rot)	Monitor seed flats of susceptible plants. Inspect weekly. Visually examine roots for cortex that sloughs off leaving central core.	Inspect plants weekly for signs of disease: Wilted, stunted off-color plants with discolored root systems. Focus on areas where plants stay wet. or where there may be high populations of shore flies that may carry disease spores. High soluble salts/fertility increases susceptibility.	<i>Bacillus subtilis</i> (biofungicide) <i>Trichoderma harzianum</i> (biofungicide) <i>Streptomyces griseoviridis</i> (biofungicide) <i>Streptomyces lydicus</i> (biofungicide)
Damping Off (Rhizoctonia Root and Crown rot)	Monitor seed flats of susceptible plants including cole crops, peppers, and tomatoes. Look for small, water-soaked spots on stems or leaves before seedlings collapse.	Seed flats near walkways or near dust and debris. Overcrowded seedling flats are more susceptible to damping off.	<i>Bacillus subtilis</i> (biofungicide) <i>Streptomyces griseoviridis</i> (biofungicide) <i>Streptomyces lydicus</i> (biofungicide) <i>Trichoderma harzianum</i> (biofungicide)
Fungus gnats	Use sticky cards to monitor for adults. Place cards horizontally above soil surface. Potato chunks can be used to monitor for larvae. Check every two days.	Favorable habitats include areas with standing pools of water, mud floors, spilled media and weeds.	<i>Bacillus thuringiensis</i> subsp. <i>israelensis</i> (pathogen) <i>Atheta coriaria</i> (predatory beetles) <i>Hypoaspis miles</i> (predatory mites) <i>Steinernema feltiae</i> (nematodes)
Powdery mildew	Scout weekly. Look for faint, white fungal threads and spores on leaves.	Scout near vents, or any location with a sharp change between day and night	<i>Bacillus subtilis</i> (biofungicide) <i>Streptomyces griseoviridis</i> (biofungicide)

		temperatures.	<i>Streptomyces lydicus</i> (biofungicide)
Spider Mites (Two-spotted Spider mites)	Rely on plant inspection. Look for light flecking, speckling or discolored foliage, and webbing if high populations have developed.	Look in hot, dry locations in greenhouse (i.e. near furnace) or near entranceways.	<i>Feltiella acarisuga</i> (predatory midge) <i>Neoseiulus californicus</i> (predatory mites) <i>Phytoseiulus persimilis</i> (predatory mites)
Thrips (Western flower thrips)	Rely on sticky cards (placed just above crop canopy) and foliage inspection of key plants for early detection and to evaluate treatments. Use petunia and fava bean plants to indicate early thrips feeding.	Inspect plants by tapping tender new growth over a white sheet of paper. Watch for curled, emerging leaves, distorted new growth on pepper. Look for white scarring and black fecal spots (size of pin point) on foliage of cucumber and eggplant.	<i>Amblyseius swirskii</i> (predatory mite) <i>Chrysoperla spp.</i> (green lacewing, predator) <i>Hypoaspis miles</i> (predatory mites) <i>Neoseiulus cucumeris</i> (predatory mites) <i>Orius insidiosus</i> (pirate bug, predator)
Tospovirus Impatiens Necrotic Spot Virus (INSV) & Tomato Spotted Wilt Virus (TSWV)	Symptoms will vary depending upon the host. On pepper, look for necrotic spots on the leaf. Ringspots may also develop. On tomato, young leaves may develop small, dark brown spots.	Thrips populations may be highest at front and rear of the greenhouse. Use fava bean or petunia indicator plants to determine if thrips are carrying the virus. Symptomless weeds may also be a source of virus.	None See thrips.
Whiteflies	Rely on plant inspection to detect immature stages. Use sticky cards to monitor adults.	Egg laying adults are found on the uppermost tender leaves of tomatoes, eggplant and assorted greens. Immature stages are stationary and are found on the undersides of leaves.	<i>Chrysoperla spp.</i> (green lacewing, predator) <i>Amblyseius swirski</i> (predatory mite) <i>Eretmocerus sp.</i> (sweet potato whitefly parasite) <i>Encarsia formosa</i> (greenhouse whitefly parasite)