

Table 1: Some key pests of potted herbs grown in the greenhouse

Plant	Pest (s)
Basil	Primarily thrips, also aphids, whiteflies Botrytis blight, Fusarium wilt, Pythium and Rhizoctonia root rots, Rhizoctonia web blight, Impatiens necrotic spot virus, Pseudomonas Leaf Spot
Lavender	Aphids, whiteflies, also mites, mealybugs Primarily crown and root rots, also Botrytis blight, Septoria leaf spot
Lemon Balm	Primarily mites, also aphids, whiteflies, thrips Botrytis blight, powdery mildew
Lemon Grass	Mites, thrips, rust
Lemon Verbena	Aphids, mites and whiteflies
Marjoram	Whiteflies, Botrytis blight
Mint	Primarily whiteflies, mites, also aphids, thrips Crown and root rots, Rhizoctonia web blight, powdery mildew, rust (peppermint and spearmint)
Parsley	Primarily root rots, also Botrytis blight, Rhizoctonia web blight
Rosemary	Whiteflies, aphids, and thrips Primarily powdery mildew, also Pythium and Rhizoctonia root rots, Rhizoctonia web blight
Rue	Aphids, whiteflies Crown and root rots
Sage	Primarily whiteflies, also mites and aphids Primarily powdery mildew, also Phytophthora root rot
Scented Geranium	Primarily whiteflies Bacterial blight (<i>Xanthomonas</i>), Bacterial fasciation
St. Johnswort	Anthracnose, powdery mildew
Thyme	Aphids, thrips Crown and root rots, Rhizoctonia web blight, Botrytis blight

Table 2 Scouting guidelines and biological control options for herb bedding plants

Pest	How To Monitor	Signs and Symptoms	Biological Control Options
Aphids	Monitor weekly. Look on the underside of leaves and along stems on tips of new growth for small (1/16 inch long) aphids with 2 cornicles or tailpipes at the rear of their bodies.	Distorted young growth (will vary depending upon type of aphid). Shed white skins of aphids that have molted. Honeydew and sooty mold.	<i>Aphidoletes aphidimyza</i> (aphid midge, predator) <i>Aphidius matricariae</i> (aphid parasite) <i>Aphidius colemani</i> (aphid parasite) <i>Aphidius ervi</i> (aphid parasite) <i>Aphelinus abdominalis</i> <i>Chrysoperla carnea</i> (green lacewing, predator) <i>Hippodamia convergens</i> (lady bird beetles) <i>Beauveria bassiana</i> (insecticidal fungus)
Bacterial Diseases Bacterial Fasciation Pseudomonas Leaf Spot Bacterial Blight	Look for abnormal branching near the base of scented geraniums. Inspect basil and other small plugs during routine monitoring. Test plants prior to use as stock plants.	Plants are stunted with short, swollen, fleshy and misshapen leaves. Look for water-soaked, dark-brown to black leaf spots especially on young plugs. Symptoms easily confused with fungal diseases. Confirm diagnosis through a plant diagnostic laboratory. Scented geraniums may be carriers of disease without exhibiting symptoms. Infected plants may not show any of the typical symptoms: wilting, small leaf spots and v-shaped angular lesions.	None. <i>Bacillus subtilis</i> (Rhapsody)

Beetles	During routine inspection, look for chewed holes or pinholes in leaves especially on herbs grown outdoors.	Chewed holes or pinholes in leaves.	<i>Beauveria bassiana</i> (Mycotrol O)
Botrytis Blight	Concentrate scouting in areas where crop is closely spaced with poor air circulation, and on tender crops. Look for dieback, stem cankers (especially near a wound), and powdery gray spores during humid conditions. May see gray mold on the leaves.	Leaf blights, stem cankers, damping off and occasionally root rots.	<i>Trichoderma harzianum</i> (PlantShield) (suppression)
Caterpillars	If adult moths or butterflies are seen in the greenhouse, look for eggs and young caterpillars. During weekly foliage inspection, look for fecal droppings and bites taken out of leaves.	If damage is observed, look under pots or in planting medium just around the base of the plants. Many caterpillars hide during the day and feed at night.	<i>Bacillus thuringiensis</i> subsp. <i>kurstaki</i> (DiPel DF, Dipel Pro DF)
Crown and Root Rots	Inspect plants weekly for signs of disease: wilted, off-colored plants with discolored root systems. Pay particular attention to media that stays wet. Monitor fungus gnats and shore flies, especially in propagation houses. Monitor soluble salt levels.	Leaves turn yellow and wilt. Plants are stunted and off-color. Roots are discolored and may turn brown or black.	<i>Trichoderma harzianum</i> (PlantShield & RootShield) (suppression)
Damping Off	Monitor weekly. Scan flats for signs of seedlings that do not emerge or collapse at the soil line. Disease often spreads from a central point. Discard heavily infected flats to avoid future problems.	Seeds do not germinate or collapse with dark, necrotic stem canker at soil line. Infected plants may later develop crown and root rots.	<i>Trichoderma harzianum</i> (PlantShield & RootShield) (suppression)

Fungus Gnats	Use sticky cards to monitor for adults. Place cards at base of plants at soil line. Place potato chunks on soil surface to monitor for larvae. (Check every two days.) Scout favorable habitats including areas with standing pools of water, dirt floors or spilled media and weeds.	On cuttings, fungus gnat larvae may feed on callus, slowing down rooting. Larvae feed upon roots and may tunnel into stems causing plants to wilt and die.	<i>Steinernema feltiae</i> (Nemasys, Nemashield, Scanmask) <i>Hypoaspis miles</i> (mite predator) <i>Hypoaspis aculifer</i> (mite predator)
Fungal Leaf Spots	Scan the crop for leaf spots. With a hand lens, look for small, fungal fruiting bodies. To confirm, send sample to diagnostic laboratory.	Alternaria leaf spots are generally dark brown to black with a yellow border. Septoria leaf spots are small, grayish-brown with a dark brown edge.	<i>Bacillus subtilis</i> (Rhapsody)
Fusarium Wilt on Basil	Scan the crop for symptoms. The first symptom is a downward bending or cupping of the leaves. May be confused with water stress, root rot diseases or <i>Botrytis</i> stem canker. To confirm, send sample to diagnostic laboratory.	Leaves may cup downward or the top of the stem will bend like a shepherd's crook. On large-leaved cultivars, defoliation may occur. In later stages, brown streaks can be seen on the stem.	None. Use resistant varieties such as the Genovese Basil 'Nufar' and 'Aroma' or Basil 'Green Gate', or Lemon Basil 'Lemon Dani'
Mealybugs	Inspect herbs propagated by cuttings. Look for small, oval, soft-bodied insects covered with a white, wax-like layer especially along stems, and on underside of leaves.	White, cottony residue may be seen.	<i>Cryptolaemus montrouzieri</i> (predatory beetle) is used against citrus mealybug but is ineffective against those species that give birth to live young such as long-tailed mealybugs. <i>Beauveria bassiana</i> (insecticidal fungus)
Plant Bugs	Monitor herbs outdoors and those in greenhouses especially if weeds are nearby.		Naturally occurring predators include big-eyed bugs and damsel bugs. The big-eyed bug (<i>Geocoris punctipes</i>) is available commercially.

Four-lined plant bugs	Look for signs of feeding activity - small, yellow spots on upper leaf surface. Four-lined plant bugs tend to be secretive and drop off the leaf or run around the leaf.	Round, brown, dead leaf spots that may be confused with fungal leaf spot disease.	<i>Beauveria bassiana</i> (insecticidal fungus)
Tarnished plant bugs	Look for signs of feeding injury on youngest growth and buds.	Look for death of tender young, growth, dead spots and badly distorted buds.	
Powdery Mildew	Scout weekly. Inspect susceptible crops. Scout areas near vents, hanging baskets or any location with a sharp change between day and night temperatures. Use a hand lens to see white fungal threads and spores.	White powdery fungal growth can occur on upper or lower leaf surfaces. If severe, white coating can be seen on the foliage.	<i>Bacillus subtilis</i> (Rhapsody)
Rhizoctonia Web Blight	Scout susceptible crops, especially when they are closely spaced. Look for cobweb-like growth that mats leaves together (web blight) especially during humid conditions.	Stems and leaves collapse rapidly and turn mushy with fine, web-like fungal strands present.	<i>Trichoderma harzianum</i> (PlantShield & RootShield) (suppression only)
Rusts	Look for yellow spots on the upper leaf surface and rusty brown spots on the lower leaf surface during routine foliage inspections.	Rusty brown spots or stripes especially on the lower leaf surface.	<i>Bacillus subtilis</i> (Serenade) labeled for rust on mints grown outdoors
Scale -: Brown Soft Scale	Look for yellow-brown, to dark brown scale insects along veins and stems of susceptible herbs such as bay.	Honeydew and sooty mold are additional signs of infestation.	<i>Metaphycus helvolus</i> (parasitic wasp)

Slugs	Look for chewed holes in leaves and shiny patches of slime. Slugs hide under dense foliage, beneath pots and benches and in other protected spots.	Chewed, irregular holes with smooth edges in leaves and slime that dries into silvery trails on foliage.	Several species of lightning bug larvae. Entomopathogenic nematodes including <i>Steinernema carpocapsae</i> are reported to reduce slug populations.
Two-Spotted Spider mites	Look on leaf undersides, especially along the veins, for all stages of mites, empty eggshells and webbing. Look near hot, dry areas of greenhouse near furnace and near vents. Tap foliage over sheet of white paper to look for mites and faster-moving predatory mites. Scout mite-infested areas last.	Light flecking, and discolored foliage. Leaf drop and webbing may occur during outbreaks.	<i>Amblyseius fallacis</i> (predatory mite) <i>Feltiella acarisuga</i> (predatory midge) <i>Neoseiulus californicus</i> (predatory mite) <i>Phytoseiulus persimilis</i> (predatory mite)
Thrips	Rely on sticky cards (placed just above crop canopy) and foliage inspection to track population trends and to evaluate treatments.	Distortion of flowers, buds and tender young growth. White scarring on expanded leaves and flowers. Transmission of tospoviruses.	<i>Chrysoperla carnea</i> (green lacewing) <i>Hypoaspis miles</i> (predatory mites) <i>Neoseiulus cucumeris</i> (predatory mites) <i>Amblyseius swirskii</i> (predatory mite) <i>Orius insidiosus</i> (minute pirate bug, predator) <i>Beauveria bassiana</i> (insecticidal fungus)
Viruses	Scan crops weekly. Inspect incoming plants. Look for mosaic patterns, leaf crinkle or distortion, chlorotic streaking, ringspots, line patterns and stunted plants	For confirmation, send sample to diagnostic laboratory.	None.
Whiteflies	Rely on plant inspection to detect scale-like immature stages. Egg laying adults found on uppermost tender leaves. Immature stages found on underside of leaves. Use sticky cards to detect adults.	When high populations develop, honeydew and sooty mold may be seen.	<i>Chrysoperla rufilabris</i> (green lacewing) <i>Eretmocerus eremicus</i> (whitefly parasite) <i>Eretmocerus mundus</i> (whitefly parasite) <i>Beauveria bassiana</i> (insecticidal fungus) <i>Delphastus catalinae</i> (formerly <i>D. pusillus</i>)

Table 3: Selected insecticides and miticides for use for herb bedding plants

Insecticide	Use Site	Target Pests	Labeled Crops	Comments
<p>Azadirachtin (Aza-Direct) 4 hr. REI</p> <p>(Azatin XL) 4 hr. REI</p> <p>(Ornazin 3% EC) 12 hr. REI</p> <p>(Neemix 4.5) 12 hr. REI</p>	<p>G, O</p> <p>G, O</p> <p>G, O</p> <p>G, O</p>	<p>Aphids, beetles, caterpillars, weevils, thrips, true bugs, leafhoppers, whiteflies, scales, mealybugs, leafminers, leafhoppers, cutworms, loopers, armyworms, fungus gnat larvae</p> <p>Aphids, armyworms, beetles, caterpillars and loopers, cutworms, fungus gnat larvae, shore fly larvae, leafhoppers, leafminers, mealybugs, leafrollers, thrips and whiteflies</p> <p>Aphids, armyworms, beetles, cutworms, fungus gnat larvae and shore flies, leafminers, leafrollers, leafhoppers, loopers, mealybugs, soft scales, thrips, weevils and whiteflies</p> <p>Whiteflies, thrips, mealybugs, leafminers, loopers, caterpillars, armyworms and aphids</p>	<p>Herbs and Spices</p>	<p>Insect growth regulator for immature stages of insects. Repeat applications needed. Repels some insects and can be used as antifeedant.</p>

<i>Bacillus thuringiensis</i> subsp. <i>aizawai</i> (Xen Tari) 4 hr. REI	G, O	Armyworms, <i>Heliothis</i> (corn earworm), loopers, salt marsh caterpillars	Herbs, spices and leafy herbs	Treat when larvae are young. Larvae must be actively feeding on treated, exposed plant surfaces. Insect stops feeding and dies from 1 to 5 days later.
<i>Bacillus thuringiensis</i> subsp. <i>kurstaki</i> (Dipel DF, (DiPel Pro DF) 4 hr. REI	G, O	Caterpillars	Herbs, spices and mints	Stomach poison that must be eaten by target insect to be effective. Treat when larvae are young. Insect stops feeding and dies 1 to 5 days later.
<i>Beauveria bassiana</i> Strain GHA (Botanigard ES) 4 hr. REI (Botanigard 22 WP) 4 hr. REI (Mycotrol O) 4 hr. REI	G, O	Aphids, thrips, whitefly, psyllids, mealybugs, plant bugs	Herbs and spices	Contains a fungus that must contact the target pest. Thorough spray coverage is essential. Do not tank mix with fungicides. Most effectively used when insect populations are low. Repeat applications may be needed. Contact company representative for information on tank mixing with fungicides.
Bifenthrin (Talstar Nursery Granular) 12 hr. REI	O	Fungus gnat larvae, mealybugs	Balm, basil, borage, burnet, chamomile, catnip, chervil, chive, coriander, costmary, curry (leaf), dillweed, horehound, hyssop, lavender, lemongrass, lovage, marjoram, parsley, pennyroyal, rosemary, rue, sage, savory, sweet bay, tansy, tarragon, thyme, wintergreen, woodruff, & wormwood.	For soil incorporation into potting media used in containerized plantings of herbs listed. Minimum preshipment interval is 70 days. Rate varies depending upon the bulk density of the potting mix. (See label for additional information).

Horticultural Oil Paraffinic Oil (Ultra-Fine Oil) 4 hr. REI	G, O	Aphids, mites, beetle larvae, leafminers, mealybugs, thrips, leafhoppers, scale and whiteflies	Herbs and Spices	Acts by contact. Thorough spray coverage is needed. Do not exceed 4 applications in a growing season. Due to varietal differences, conduct a small-scale test spray before application. See label for application intervals.
Insecticidal Soap Potassium Salts of Fatty Acids (M-Pede) 12 hr. REI	G, O	Aphids, caterpillars, leafhoppers, lace bugs, thrips, mealybugs, scales, whiteflies, spider mites, broad mites, leafminers, mealybugs	Herbs and spices	Acts by contact. Good coverage is needed. Avoid treatment when plants are stressed. Certain species or cultivars may be sensitive. Spot treat first. May also help suppress powdery mildew.
Parasitic nematodes (NemaShield, Nemasys, Scanmask) Exempt from REI	G	Fungus gnat larvae, thrips pupae.	All greenhouse crops	Nematodes move through media on a film of water and release a bacterium that reproduces within and kills larvae. Water into soil surface. See label for specific information on application including temperature and moisture requirements.
Pyrethrins (PyGanic EC) 12 hr. REI	G, O	Many including aphids, caterpillars, fungus gnats (adults), greenhouse thrips, leafhoppers, leafrollers, mealybugs, and whiteflies	Herbs and Spices	Provides rapid knockdown of pests.

Pyrethrins plus PBO (Pyrethrum TR) 12 hr. REI	G, O	Aphids, beetles, cabbage worms, Fungus gnats (adults), mealybugs, spider mites, thrips, scale, and whiteflies	Herbs such as basil, chives, fennel, marjoram, oregano, parsley and thyme	Follow specific directions for placement and use for successful application.
Pyrethrins plus PBO (Pyrenone Crop Spray) 12 hr. REI	G	Aphids, caterpillars, fungus gnat adults, leafhoppers, thrips, leafminers, mealybugs, whiteflies and others	Herbs and spices	May be combined with other insecticides used to flush insects out of hiding. Phytotoxicity to certain herbs has been reported in certain studies. (1)
Pyrethrins and Rotenone (Pyrellin E.C.) 12 hr. REI	G, O	Aphids, loopers, mites, plant bugs, thrips and whiteflies	Herbs and spices	May be combined with other insecticides to flush insects out of hiding. Repeat applications may be needed.

- G =Greenhouse, ** O = Outdoor

- Updated 12/06

This information is supplied here with the understanding that no discrimination is intended and no endorsement supplied. Due to constantly changing regulations, we assume no liability for suggestions. Additional products may be available for certain herbs grown in the field. Growers should always read and follow label instructions. Always follow label instructions regarding registered uses and note cautions. To avoid any phytotoxicity problems, spot test first before widespread use.

1) For more information on potential phytotoxicity see: Cloyd, R. and N. Cycholl. 2002. Phytotoxicity of Selected Insecticides on Greenhouse – grown herbs. HortScience 37(4): 671 or *Pest Control on Herbs* by Raymond Cloyd and Nina Cycholl in Greenhouse Product News. April 2003. Vol. 13(4).

Table 4: Selected Fungicides labeled for Herb Bedding Plants

Fungicide	Use Site	Targeted Pest	Labeled Crops	Comments
<i>Bacillus subtilis</i> (Rhapsody) 4 hr. REI	G	Suppression of <i>Rhizoctonia</i> , <i>Pythium</i> , <i>Fusarium</i> and <i>Phytophthora</i> . <i>Pseudomonas</i> , <i>Colletotricum</i> and <i>Alternaria</i>	Fruits, vegetables and other crops grown in greenhouses and nurseries Herbs and Spices	Preventative biofungicide. For maximum effectiveness, apply prior to or in the early stages of disease development. Applied as foliar spray or drench. For spray applications, it is recommended to add a non-phytoxic adjuvant to the spray tank to help improve plant surface coverage.
Copper sulphate pentahydrate (Phyton 27) 24 hr. REI	G, O	Botrytis	Lavender Stock Plants and Cuttings	For use on stock plants and cuttings. See label for specific use directions.
Harpin protein (Messenger STS) 4 hr. REI	G, O	Increase vigor of herbs and aid in the management of disease.	Herbs	Preventative. A biochemical pesticide used for plant disease management, insect suppression and plant growth enhancement. Activates natural defense mechanism in plants. Do not use with strong oxidizing agents.
Harpin αβ Protein (ProAct) 4 hr. REI	G, O	Reduces transplant shock, increases plant stamina and vigor	Herbs	Stimulates plants natural growth and defense systems. It has no direct killing effect on pests.

Horticultural Oil Paraffinic Oil (Ultra-Fine Oil) 4 hr. REI	G, O	Powdery mildew	Herbs and spices: basil, lemon balm, Mexican oregano, and spearmint.	Application should be made when the disease is first noticed. Acts by contact. Due to varietal differences, conduct a small-scale test spray first. Greenhouse applications should be at lower rates stated on the label.
Hydrogen dioxide (OxiDate) 0 hr. REI 1 hr. REI (spray)	G, O	Powdery mildew damping off and root and stem disease	Herbs and spices	Contact, oxidizing sanitizer. Strong oxidizing agent
Potassium bicarbonate (MilStop) 1 hr. REI	G, O	Powdery mildew, alternaria leaf spot, anthracnose, Botrytis, Downy mildew, Fusarium, Phoma, Phytophthora ----- Powdery mildew, downy mildew, botrytis	Lemon Balm, basil, oregano, rosemary, sage, thyme ----- Herbs: basil, oregano, rosemary, sage, thyme	Contact, eradicant fungicide. Thorough coverage essential. Use sufficient volume of spray solution to obtain complete coverage of stems and foliage. Begin application at first sign of disease. Repeat at one to two week intervals until conditions are no longer favorable for disease development.
(Armicarb 100) (Ecomate Armicarb "O") 4 hr. REI				
<i>Streptomyces</i> <i>griseoviridis</i> strain K61 (Mycostop Mycostop Mix) 4 hr. REI	G, O	<i>Fusarium</i> , <i>Alternaria</i> <i>Phomopsis</i> , <i>Botrytis</i> , <i>Pythium</i> and <i>Phytophthora</i> that can cause seed, root and stem rot	Herbs	Preventative biofungicide. Contains a beneficial bacterium. Repeat applications may be needed. Use as a soil spray or drench.

<i>Streptomyces lydicus</i> (Actinovate SP) 1 hr. REI	G	Suppression of soil borne fungi such as <i>Fusarium</i> , <i>Rhizoctonia</i> , <i>Pythium</i> , <i>Phytophthora</i> , Suppression of foliar diseases such as powdery mildew, Botrytis, Alternaria and others	Greenhouse herbs	Preventive biological fungicide that contains a beneficial bacterium that can be applied as a drench or spray. It may also increase plant size, vigor and root mass. Note storage conditions needed and expiration date on the package.
<i>Trichoderma harzianum</i> Rifai strain KRL-AG2 (PlantShield HC) (RootShield Granules)	G, O G,O	<i>Pythium</i> , <i>Rhizoctonia</i> <i>Fusarium</i> and <i>Thielaviopsis</i> When applied as a foliar spray, suppresses <i>Botrytis</i> and powdery mildew <i>Pythium</i> , <i>Rhizoctonia</i> , <i>Fusarium</i> , <i>Thielaviopsis</i>	Herbs, spices and mints	Preventative biofungicide. Contains a beneficial fungus. Acts as a preventative and will not cure diseased plants. Becomes active when soil temperatures are above 50 °F.

*G= Greenhouse, ** O= Outdoors

This information is supplied here with the understanding that no discrimination is intended and no endorsement supplied. Due to constantly changing regulations, we assume no liability for suggestions. Additional products may be available for certain herbs grown in the field. See the New England Vegetable Management Guide for information on growing basil in the field. Go to the web site <http://www.kellysolutions.com/CT/> and search for herbs under the site use list to determine products available for use in the field.

Growers should always read and follow label instructions. Always follow label instructions regarding registered uses and note cautions. To avoid any phytotoxicity problems, spot test first before widespread use.

Organic Materials Review Institute (www.omri.org) is a non-profit organization whose mission is to publish information on lists of materials allowed for organic food production. Final decisions regarding organic use production reside with the USDA.

Updated 12/06