# Crop Profile for Raspberries in New England 2007


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**Note**: This profile is a comprehensive list of pests that may be encountered by New England raspberry growers, and the approved pesticides that may be used to control them. Only a few pests actually require treatment on an individual farm in a single year. For each pest all of the available effective options are listed. If treatment is needed, only one of those options would be used per application. Some pests require multiple applications for control, others only require a single application.

# Table of Contents

# Introduction

Information in this crop profile was collected by a survey of New England raspberry growers conducted in 2006. Number of survey respondents, response rate etc.

# I. Basic Commodity Information

## Production Statistics

**Region Rank:**.....5 (6 states considered as a single unit)
**% U.S. Production:**..... 2.6%
**Acres Planted:**..... 521
**Tons Harvested:**..... 469 tons
**Cash Value:**.....$3.9 million
Crop Destination:…….. 96.6% Fresh Market
**Production Regions – Acres** or other production units as appropriate**:** Connecticut (100), Massachusetts (155), New Hampshire (61), Maine (101), Rhode Island (16), Vermont (88).
*Values were determined from New England Raspberry Pest Management Tactic Survey conducted by New England Pest Management Network in 2006, 2002 Census of Agriculture Volume 1, State Level Data (www.nass.usda.gov/census/census02/volume1/), New England Fruits and Vegetables 2006 crop report (http://www.nass.usda.gov/Statistics_by_State/New_England_includes/Publications/05frtveg.pdf) and from New England Agricultural Statistics Service State Rankings from 2002 Census (http://www.nass.usda.gov/nh/2002cenrk.pdf)*

# Cultural Practices:

Most raspberries in New England are Summer (floricane fruiting) red raspberries (50.5% of acres), with Fall (primocane fruiting) red raspberries being ranked second (38.1% of acres). Blackberries (4.4% of acres), Summer black raspberries (2.1% of acres), Fall yellow raspberries (1.6% of acres) and Summer purple raspberries (1.2% of acres) are somewhat less abundant. Generally, summer fruiting types are more common (60.3 of acres) than fall fruiting types (39.7% of acres).
Summer (floricane fruiting) types are most often planted using field dug dormant plants. Some growers are trying tissue-cultured plug plants that have not been out in the field. Spacing varies according to type with:
• red and gold raspberries planted at 24 inches
• black raspberries planted at 30 inches
• purple raspberries planted at 36 inches
• thorny blackberries planted at 36 inches
• thornless blackberries planted at 4 to 6 feet
with the spacing between rows varying according to machinery and trellis type, but being no closer than 8 feet apart.

Rapsberries ripen within 28-30 days after the first bloom and are harvested normally every other day for about 6 to 7 pickings. Fruiting canes are biennial and are removed after harvest each year. New cane growth (primocanes) are overwintered and fruited in their second year. Fall bearing varieties are the exception as they are able to produce

fruit on first year canes (primocanes). These canes are then able to fruit again the second year if overwintered, but the majority of growers remove them and fruit only on the first year canes. This system simplifies pruning dramatically.

The most commonly grown varieties in New England are:
**Summer Red Raspberries**
*Early Season* – 'Boyne', 'Killarney', 'Lauren', 'Prelude';
*Mid Season* – 'Canby', 'Latham', 'Titan'
*Late Season* – 'Encore', 'K81-6', 'Taylor'
**Black Raspberries** – 'Bristol', 'Jewel'
**Purple Raspberries** – 'Brandywine', 'Royalty'
**Fall Bearing** – 'Anne', 'Autumn Bliss', 'Autumn Britten', 'Caroline', 'Heritage', 'Polana'

Plantings are generally fruited for 10-15 years.

Raspberries can grow successfully in a wide variety of New England's soils (e.g., deep river bottom soil of the Connecticut River valley to stony glacial soils of the uplands to the sandy coastal soils). However, to avoid root stress raspberry land should be well drained year-round (no standing water) though not droughty. Where there is a tendency for droughtiness, irrigation is a must. Raspberries prefer a soil pH between 5.5-6.5 with a high organic matter content (≥5%).

Harvested fruit is sold as fresh market retail (31.4%), U-Pick (48.0%), fresh market wholesale (13.2%), processing (3.4%) and CSA (2.3%). Growers describe their production systems as conventional (30.4%), IPM (40.7%), Organic (22.2%), and other (6.7%).

## WORKER ACTIVITIES

### Soil Fumigation

- Fewer than 2% of growers use this practice, but those who do are trying to overcome a serious disease, insect, and/or weed infestations on a particular planting site.
- This practice is performed in the fall prior to the planting year.
- This is a tractor operation so, if performed properly, the only point of potential worker exposure is at the mixing and loading site. PPE should be used for mixing and loading.
- This practice is usually carried out by a contracted applicator, not the farmer, since the application equipment is specialized.

### Land preparation and cultivation

- These activities include clearing, plowing, rock removal, adding required soil amendments, harrowing, and sometimes cover cropping, and are needed to fit the land suitably for planting and production.
- Wild brambles located near production sites are normally destroyed to reduce

possible problems.
- Herbicide applications using glyphosate products may be made 30-days prior to planting with a boom sprayer.
- These activities are performed in the summer and fall prior to the planting year and in the spring of the planting year.
- These are tractor operations to prepare soil for planting and to manage weeds. Little contact by workers with pesticide treated surfaces.

**Planting**
- Dormant bare-root plants are the most common type of planting material. Some growers use tissue cultured plug plants. Plants are set w/ mechanical transplanters on most commercial farms. Very small operations may use hand transplanting.
- This activity is performed in mid-April to mid-May on most New England raspberry farms.
- Transplants are not typically pesticide treated, so worker exposure to pesticides is minimal.

**Fertilization**
- Raspberry fields are fertilized periodically in the establishment and production years. To determine fertilizer needs, some growers collect soil samples (54.4% of New England raspberry growers) and/or leaf tissue samples (17.6% of New England raspberry growers) for analysis. Timing of soil sampling can be any time of the year, while tissue samples are collected for analysis in August.
- Timing of fertilizer applications is early summer up to early July. Fertilizer may be delivered in a single application (53.2% of New England raspberry growers) or in a split application (34.9% of New England raspberry growers) with the first going on at bloom and the second no more than a month later. Compost is used fertilization by 20.6% of New England raspberry growers.
- Fertilizer application is a tractor operation so worker exposure to pesticide treated surfaces is negligible. Worker exposure to pesticide residues during soil sampling depends on when samples are collected. It is possible to collect samples in a manner and at a time of year when pesticide exposure is minimal. Collection of leaf tissue samples is done after renovation when new foliage has grown which is unlikely to be treated with pesticides. Never-the-less, it is recommended that samples are collected by workers wearing gloves.

**Harvest**
- Fruit is harvested for sale.
- Harvest is carried out by hired pickers and pyo customers.
- The harvest period for most varieties grown in New England ranges from the end of June to the end of September. Some growers use high tunnels to extend the season and continue harvest into October.
- Pesticides are used prior to harvest on conventional farms. If all required pre-harvest intervals and restricted entry intervals are observed, worker and customer exposure to pesticide residues should be minimal. However,

harvesting required significant contact with the plants and plant surfaces my have been treated with pesticides.

**Irrigation**

- Irrigation is used in raspberry production to deliver water (and sometimes fertilizer) to plants. This is done primarily through the use of drip irrigation which is permanently installed and does not require workers to go into the field to operate unless repairs are needed.

**Field Scouting for Integrated Pest Management (IPM)**

- Many raspberry growers (40.7% of New England raspberry growers) practice IPM. This involves regular scouting of fields to determine if action thresholds for various pests have been exceeded and control measures are required to avoid economic loss.
- Detailed field sampling procedures are followed to make these determinations and fields are scouted weekly during the time beginning in late April through harvest and less frequently thereafter. IPM scouting is carried out by growers themselves (68.2% of respondents), farm employees (18.2% of respondents), private IPM scouts or crop consultants (8.7% of respondents), University Extension scouts (7.9% of respondents), or chemical salespeople (<1% of respondents).
- Worker contact with potentially pesticide treated surfaces is high as they carry out field scouting. This risk is mitigated by strict adherence to restricted entry intervals. Scouts must consult WPS information prior to entering a field.

**Pest Management Decision Making Overview:**

| Primary Decision Making Method | For taking insect/mite control measures | For taking disease control measures | For taking weed control measures |
|---|---|---|---|
| **Sampling and trapping w/ action thresholds plus the use of pest models** | 6.2% | 0.9% | 1.7% |
| **Sampling and trapping w/ action thresholds** | 17.0% | 14.8% | 10.4% |
| **Informal observations (no protocol or action thresholds)** | 65.2% | 67.8% | 66.4% |
| **Calendar based spraying** | 11.6% | 16.5% | 21.5% |

**Pesticide applications**

The spray schedule for bramble production begins with applications made at the

delayed dormant stage (before ¼" shoot growth) through harvest and in some cases during the post harvest season.

**Herbicides**

- Pre-plant herbicide applications are generally made at least 30-days prior to transplanting.
- Herbicide applications in established plantings may be made at various times of the year, depending on the target weed population.

**Fungicides**

- Fungicide applications for cane diseases are generally made as delayed dormant applications in the spring of post harvest applications in late summer (on summer bearing types)
- Fungicide application for fruit rot and foliar diseases are generally made during the bloom period as preventative measures but sometimes later applications are needed to stop secondary infections or post harvest rots.
- Fungicide applications for root and crown diseases are generally made pre-plant or in the dormant season as soil applications.
- Occasionally when environmental conditions favor disease development producers may to make fungicide applications at times other than the above.

**Insecticides**

- Insecticide/miticide applications are made at various times of the year. The only stated limitation is to avoid making applications during the bloom period so as to preserve and protect pollinating insects.

Pesticide application is a tractor operation so worker exposure to pesticide treated surfaces is negligible as long as all mixing and loading instructions are followed. It is recommended that workers wear Personal Protective Equipment (PPE) while mixing, loading and applying pesticides. Grower practices on this practice are summarized below:

| PPE Used | % Always | % Occasionally | % Never |
|---|---|---|---|
| **Long pants** | **94%** | **4%** | **2%** |
| **Long-sleeved shirt** | **80%** | **17%** | **3%** |
| **Gloves** | **76%** | **19%** | **5%** |
| **Goggles** | **42%** | **34%** | **24%** |
| **Face shield** | **20%** | **38%** | **42%** |
| **Nitrile gloves** | **56%** | **26%** | **18%** |
| **Latex gloves** | **22%** | **30%** | **48%** |
| **Cotton gloves** | **3%** | **10%** | **87%** |
| **Chemical resistant suit** | **27%** | **33%** | **40%** |
| **Respirator** | **41%** | **35%** | **24%** |
| **Boots (chemical resistant)** | **42%** | **30%** | **28%** |

**Pruning, training and sanitation**

- Spent floricanes are removed after harvest, usually during the dormant season (73.8% of New England raspberry growers).

- Overwintering primocanes are thinned to reduce competition and also to promote good air circulation in the canopy during the next growing season (44.4% of New England raspberry growers).
- Pruning activities are done during the dormant season in January (4.8% of respondents), February (7.1% of respondents) and March (48.4 of respondents).
- The exception to this is the primocane fruiting types which can be mowed to the ground at any time after going into dormancy in late Fall but prior to new growth starting in early Spring.
- Workers wear gloves during this practice to reduce abrasions from removal of plant residue and are also protected from contact with unlikely pesticide residues.

**Mowing or cultivation of row middles**

- Workers mow or cultivate row middles periodically during the growing season.
- This is a tractor operation so worker exposure to pesticide treated surfaces is negligible.

## II. INSECTS AND MITES

**Group A – Insect and mite pests identified by New England Growers as most important**
Japanese Beetle, Tarnished Plant Bug, Raspberry Cane Borer

**Group B – Insect and mite pests identified by New England Growers to be significant problems in some years**
Yellow Jackets, Raspberry Crown Borer, Raspberry Fruitworm

**Group C – Insect and mite pests identified by New England Growers as occasional pest problem**
Two-Spotted Spider Mite, Aphids, Sap Beetles, Strawberry Bud Weevil

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**Group A –** Insect and mite pests identified by New England Growers as most important

**Japanese Beetle** (*Popillia japonica*)
**Type of Pest:** Insect
**Biology:** The Japanese beetle is about ½ inch long and copper colored, with metallic green markings and tufts of white hairs on the abdomen. The larvae develop in pastures, lawns and other types of turf, where they live in the soil and feed on the roots of grasses. The adults move to raspberries to feed on flowers, leaves and fruit. Japanese beetles begin to emerge in June and July when they feed on foliage but prefer ripe red raspberries, especially those exposed to full sunlight. Leaves are skeletonized by Japanese beetles and ripe berries destroyed. Additional damage is caused when beetles defecate on unharvested fruit. Japanese beetles are most troublesome during the first 2-3 years after a planting is established.
**Frequency of Occurrence:** 89% of respondents reported this pest occurring at least occasionally.

| Control needed | Percent of growers |
|---|---|
| Annually | 45% |
| Occasionally | 44% |
| Never | 11% |

**Damage Caused:** Most significant damage is adult beetles feeding on foliage, flowers and ripe fruit. Feeding by grubs on roots may also weaken plants.
**% Acres Affected:** 44.7% of raspberry acres affected annually.
**Timing of Control:** Insecticides applied when adults are feeding in late June to mid July. Insecticides used to control grubs in the soil may be applied around bloom and/or in late summer when grubs are feeding near the surface of the soil and are accessible.
**Yield Losses:** Direct feeding on fruit under high infestations can result in up to 50% yield loss. Foliar feeding may also result in yield loss especially when due to defecation on fruit. Weakening of plants from root feeding of grubs is undetermined.

**Regional Differences:** somewhat more significant in southern New England than in colder regions of northern New England.
**Cultural Control Practices:** Good crop rotation practices or fallow and cover crop treatments before planting raspberry in high-risk locations may suppress this pest. Periodic tilling of sod row middles can suppress populations.
**Biological Control Practices**: Parasitic nematode and Milky Spore applications may be effective in some locations but are currently too expensive.
**Postharvest Control Practices:** Soil application of materials that control grubs (chemical or biological) may be made post harvest.
**Other Issues:** None identified.

**Chemical Controls for *Japanese Beetle*:**

| **Pesticide** alphabetically by a.i. | **Survey Data (% growers reporting use, % acreage, efficacy rating)** | **Typical Dose (a.i./A)** | **PHI days** | **REI hours** | **Comments & Application Notes** |
|---|---|---|---|---|---|
| azadirachtin (Aza-Direct) | 3.2% growers<br>4.4 % Acres<br>67% Excellent efficacy<br>33% Good efficacy | .01-.02 lb | 0 | 4 | Repellant and anti-feedant.<br><br>**OMRI listed** |
| carbaryl (Sevin 80S, 80WSB, XLR) | 20.6% Growers<br>21.1% Acres<br>54% Excellent efficacy<br>42% Good efficacy<br>4% Poor efficacy | 1-2 lb | 7 | 12 | |
| malathion (various formulations) | 13% Growers<br>14% Acres<br>6% Excellent efficacy<br>81% Good efficacy<br>13% Poor efficacy | 1-2 lb | 1 | 12 | |
| pyrethrins (Pyganic, Pyrenone Crop Spray) | 10.4% Growers<br>11.1% Acres<br>38% Excellent efficacy<br>46% Good efficacy<br>16% Poor efficacy | 0.56 lb | 0 | 12 | |
| **Other Pesticides** | | | | | |
| esfenvalerate (Asana XL) | 1.6% growers<br><1% acres<br>50% Excellent efficacy<br>50% good efficacy | .03-.05 lb | 7 | 12 | Japanese Beetle do not appear on the label under caneberries. **Restricted Use Material** |
| imidacloprid (Provado 1.6F, Solupak) | 1% growers<br>2.3% acres<br>100% Excellent efficacy | 0.1 lb | 3 | 12 | Japanese Beetle do not appear on the label under |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | caneberries. |
| phosmet (Imidan 70WSB, 70W) | 1% growers<br>1.7% acres<br>100 % poor efficacy | 0.93 lb | 3* | 24* | *Caneberries do not appear on the label. |
| **Other Strategies** | | | | | |
| Hand Picking | 5.6% Growers<br>3.7% Acres<br>40% Excellent efficacy<br>40% Good efficacy<br>20% Poor efficacy | na | na | na | |
| Traps | 4% Growers<br>6.5% Acres<br>20% Excellent efficacy<br>60% Good efficacy<br>20% Poor efficacy | na | na | na | |

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**Tarnished Plant Bug** ***(Lygus lineolaris)***
**Type of Pest:** Insect
**Biology:** Adult tarnished plant bugs are 1/4 inch long, brownish in color and marked with yellow and black dashes. A distinguishing characteristic is a small, yellow-tipped triangle on the back, behind the head. Nymphs are pale green when they first hatch, are very small (less than 1/16 inch long), and resemble aphids. Later, nymphal instars are successively larger, becoming brown in color, and have wing pads. Older nymphs have a characteristic pattern of five spots on their back. Tarnished plant bug overwinters in vegetation and stubble that provide protection from the extreme cold. In the spring the adults are attracted to flower buds and shoot tips of many plants, including raspberries. The females lay eggs in April and early May in the plant tissue. There are several generations of tarnished plant bugs each year, so adults and nymphs can be found from April or May until a heavy frost in the fall. Populations tend to be higher in weedy locations.
**Frequency of Occurrence:** 73% of respondents reported this pest occurring at least occasionally.

| Control needed | Percent of growers |
|---|---|
| Annually | 27% |
| Occasionally | 46% |
| Never | 27% |

**Damage Caused:** Tarnished plant bug (TPB) feeding results in malformed berries or failed druplets when feeding occurs in early development. Whitening of the damaged

druplet results from plant bug feeding on mature fruit. Injured fruit tend to crumble easily and are generally unmarketable. This damage can occur from either adult or nymphal TPB feeding on fruit.

**% Acres Affected:** 45% of raspberries acres affected annually.
**Timing of Control:** Late pre-bloom through petal fall is when the most significant injury can occur. Apply insecticide prior to bloom if scouting results indicate presence of egg laying females, DO NOT SPRAY INSECTICIDES DURING BLOOM to avoid harming pollinators. After bloom scout fields for nymphs and apply insecticide if action threshold is exceeded. Infestations of over 10% of inspected canes indicates the need for control.
**Yield Losses:** 25% without management, 5% with management
**Regional Differences:** None identified.
**Cultural Control Practices:** Since they have a wide host range, reducing weeds in areas surrounding the field may aid in control these migrating pests. Avoid mowing around planting during bloom. Avoid use of broad spectrum insecticides on raspberries and surrounding crops to encourage predators (esp. spiders) and parasites.
**Biological Control Practices:** There are several predators and parasites of tarnished plan bugs including the egg parasite *Anaphis iole* Girault, and the nymphal parasites *Leiophron uniformis* (Gahan), *Peristenus pallipes* (Curtis) and *P. pseudopallipes* (Loan) (all Hymenoptera). The native parasites seem to be more effective at parasitizing Lygus on weeds than on crops. The imported parasitoid *Peristenus digoneutis* Loan (Hymenoptera: Braconidae) is reported to have decreased tarnished plant bug abundance by 75% in New Jersey but there is no current data available for this parasitoid in New England. None are commercially available at this time. *Beauveria bassiana* (BotaniGard ES) is a fungal pathogen of Lygus bugs that is available commercially. But, these products are expensive.
**Postharvest Control Practices:** Reducing weeds in areas surrounding the field may aid in control these migrating pests.
**Other Issues:** None identified.

**Chemical Controls for *Tarnished Plant Bug*:**

| **Pesticide** alphabetically by a.i. | **Survey Data (% growers reporting use, % acreage, efficacy rating)** | **Typical Dose (a.i./A)** | **PHI days** | **REI hours** | **Comments & Application Notes** |
|---|---|---|---|---|---|
| azadirachtin (Aza-Direct) | 3.2% Growers<br>6.1% Acres<br>100% Excellent efficacy | .01-.02 lb | 0 | 4 | Repellant and anti-feedant.<br><br>**OMRI listed** |
| carbaryl (Sevin 80S, 80WSB, XLR) | 21.4% Growers<br>23.2% Acres<br>26% Excellent efficacy<br>67% Good efficacy<br>7% Poor efficacy | 1-2 lb | 7 | 12 | |
| pyrethrins | 7.2% Growers | 0.56 lb | 0 | 12 | |

| | | | | | |
|---|---|---|---|---|---|
| (Pyganic, Pyrenone Crop Spray) | 11.3% Acres<br>44% Excellent efficacy<br>56% Good efficacy | | | | |
| **Other Pesticides** | | | | | |
| esfenvalerate (Asana XL) | 4.0% Growers<br>4.2% Acres<br>20% Excellent efficacy<br>60% Good efficacy<br>20% Poor efficacy | 0.025 – 0.05 lb | 7 | 12 | TPB do not appear on the label under caneberries.<br>**Restricted Use Material** |
| bifenthrin (Brigade 2EC, WSB) | 1.0% Growers<br>2.3% Acres<br>100% Excellent efficacy | 0.05-0.1 lb | 3 | 12 | TPB do not appear on the label under caneberries.<br>Broad spectrum; harmful to beneficials<br>**Restricted Use Material** |
| fenpropathrin (Danitol 2.4EC) | 1.0% Growers<br>1.7% Acres<br>100% Good efficacy | 0.2 lb | 2* | 24* | *Caneberries do not appear on the label.<br>Broad spectrum; harmful to beneficials<br>**Restricted Use Material** |
| malathion (various formulations) | 3.0% Growers<br>2.8% Acres<br>100% Good efficacy | 1-2 lb | 1 | 12 | |
| endosulfan (Thiodan EC) | 1.0% Growers<br><1 % Acres<br>100% Good efficacy | 1 lb | 4* | 48* | *Caneberries do not appear on the label. |

**Raspberry/Red Necked Cane Borer** (*Oberea bimaculata* and *Agrilus ruficollis)*
**Type of Pest:** Insect
**Biology:** Raspberry Cane Borer is a slender beetle, about 1/2 inch long, and black, except for a bright orange thorax that has two or three black spots. The long, black antennae are easily noticed.
These insects require two years to complete their life cycle. The adults appear in raspberry plantings in early June and may be present until late August. They feed on the tender, green epidermis of cane tips and leave brownish patches or scars. Before laying an egg, the female punctures the stem with her mouthparts in a girdling fashion. She creates two puncture rings around the cane, about ½" apart and about 6" from the cane tip or lateral shoot. After puncturing, the female deposits an egg into the cane pitch

in between the rings. Upon hatching, larvae burrow down through the cane, reaching its base by the fall and down to the crown by the next summer. The larvae spend the next season underground, then pupation occurs the second spring, generally in an old stub from which adults emerge.

The Red-necked Cane Borer, has a reddish-colored thorax that contrasts sharply with its black head and wing covers. Adults are about ¼" long with short antennae. The larvae are white, legless, ¾" when fully grown, and fl at-headed
Adult Red-necked Cane Borers are present from late May to early August. They feed along leaf edges and can be most easily found on sunny days. Females deposit whitish, scale-like eggs along the bark of new growth in May and June. After hatching, the larvae construct long, winding tunnels which spiral around the cane several times in the sapwood, turn into the hardwood, and then end in the pith. A swelling usually develops where the tunneling occurs and is apparent by July or August. Once the tunnel reaches the pith, it straightens into a path through the pith. The larva is full-grown by fall, remains in the tunnel during the winter, and pupates in the spring. Adults emerge in the summer.
**Frequency of Occurrence:** 71% of respondents reported this pest occurring at least occasionally.

| Control needed | Percent of growers |
|---|---|
| Annually | 26% |
| Occasionally | 45% |
| Never | 29% |

**Damage Caused:** Raspberry Cane borer damage is most commonly to young primocanes which wilt and flag over when infested. Red-necked Cane Borer damage is less obvious and can be seen when dormant pruning as swellings at or near the base of overwintering canes. Damage is to the yield potential of overwintered canes which are either less productive or completely unproductive in as floricanes.
**% Acres Affected:** 24.6% of raspberry acres affected annually.
**Timing of Control:** Insecticide can provide some control by targeting emerging new adult beetles; however, no insecticides are currently registered for control of this pest. If an insecticide becomes available for this use, it should be applied when cane borer beetles first appear on foliage of primocanes, which is generally at late prebloom for summer-bearing types or when primocanes are 18 inches tall. Adult beetles emerge for two to three weeks. Sprays can be repeated at weekly intervals until no more adults are found, which is usually by petalfall.
**Yield Losses:** Unknown.
**Regional Differences:** None identified.
**Cultural Control Practices:** In the summer, flagging primocanes can be pruned back to below the tunnel made by the larvae of the Raspberry Cane Borer and removed from the field. Red-necked Cane Borer larvae can be pruned out and removed from the field at any time that swelling galls are found, especially during dormant pruning. Eliminating nearby wild brambles also reduces populations.

**Biological Control Practices:** None identified.
**Postharvest Control Practices:** Pruning out infested canes during the dormant period is very effective for the Red-necked Cane Borer.
**Other Issues:** None identified.

**Chemical Controls for Raspberry/Red Necked Cane Borer:**

| **Pesticide** alphabetically by a.i. | **Survey Data (% growers reporting use, % acreage, efficacy rating)** | **Typical Dose (a.i./A)** | **PHI days** | **REI hours** | **Comments & Application Notes** |
|---|---|---|---|---|---|
| pyrethrin/rotenone (Pyrellin EC) | 3.2% Growers<br>4.7% Acres<br>50% Excellent efficacy<br>50% Good efficacy | .01-.02 lb | 0 | 12 | |
| Other Pesticides | | | | | |
| azinphos methyl (Guthion Solupak) | 1.0% Growers<br><1 % Acres<br>100% Good efficacy | n/a* | n/a* | n/a* | *Caneberries do not appear on the label. **Restricted Use Material** |
| bifenthrin (Brigade 2EC, WSB) | 1.0% Growers<br>2.3% Acres<br>100% Excellent efficacy | 0.05-0.1 lb | 3 | 12 | Cane borers do not appear on the label under caneberries. Broad spectrum; harmful to beneficials **Restricted Use Material** |
| carbaryl (Sevin 80S, 80WSB, XLR) | 2.4% Growers<br>2.3% Acres<br>67% Good efficacy<br>33% Poor efficacy | 1-2 lb | 7 | 12 | Cane borers do not appear on the label under caneberries. |
| malathion (various formulations) | 1.0% Growers<br><1 % Acres<br>no efficacy reported | 1-2 lb | 1 | 12 | Cane borers do not appear on the label under caneberries. |
| permethrin (Pounce 1.5G, 25WP,32EC) | 1.0% Growers<br><1 % Acres<br>100% Excellent efficacy | 0.05-0.1 lb | n/a | n/a | *Caneberries do not appear on the label. **Restricted Use Material** |
| **Other Strategies** | | | | | |
| Pruning out | 15.5% Growers | na | na | na | |

| | | | | | |
|---|---|---|---|---|---|
| damage manually | 15.0% Acres<br>28% Excellent efficacy<br>72% Good efficacy | | | | |

**Potato Leafhopper** (*Empoasca fabae*)
**Type of Pest:** Insect
**Biology:** Potato Leafhoppers are approximately 1/8 inch long, green and bullet-shaped insects that take flight quickly if disturbed. Their nymphs are light green, do not fly and crawl sideways when disturbed. They feed mostly on the undersides of young raspberry leaves. This feeding causes the leaves to yellow between the veins and become curled and distorted. Under heavy infestation internodes on primocanes can become significantly shortened resulting in severely stunted canes.

**Damage Caused:** Feeding injury on leaves causes distorted growth. No direct damage to fruit is caused, but overall plant health can be affected, especially in primocane bearing varieties.
**% Acres Affected:** Unknown.
**Timing of Control:** This insect does not overwinter in New England and migrates up on storm fronts. Timing of its arrival varies but is found every year by mid-summer.
**Yield Losses:** Unknown.
**Regional Differences:** None identified.
**Cultural Control Practices:** None identified
**Biological Control Practices:** None identified.
**Postharvest Control Practices:** Postharvest is generally too late for controlling this pest.
**Other Issues:** None identified.

**Chemical Controls for Potato Leafhopper:**

| **Pesticide** alphabetically by a.i. | **Survey Data (% growers reporting use, % acreage, efficacy rating)** | **Typical Dose (a.i./A)** | **PHI days** | **REI hours** | **Comments & Application Notes** |
|---|---|---|---|---|---|
| carbaryl (Sevin 80WSP) | n/a | 1-2 lb | 7 | 12 | |

**Group B – Insect and mite pests identified by New England Growers to be significant problems in some years**

**Yellow Jackets** (*Paravespula* spp*., Vespa* spp.,and *Vespula* spp.)
**Type of Pest:** Insect
**Biology:** Yellowjackets are yellow-and-black wasps that are about 1/2- to one-inch long. While yellowjackets are the most common, other types of wasp such as whiteface hornets may also become a problem in brambles. Most species of yellowjacket build their nests underground or in old. The workers scavenge food such as caterpillars or other insects, pieces of flesh from dead animals, or ripe or injured fruit. Food is taken back to the nest to feed the larvae. Yellowjackets are attracted to ripe and injured fruit to feed on fluids and sugars, especially in late summer and during dry weather. Populations of yellowjackets peak in late summer.
**Frequency of Occurrence:** 57% of respondents reported this pest occurring at least occasionally.

| Control needed | Percent of growers |
|---|---|
| Annually | 14% |
| Occasionally | 43% |
| Never | 43% |

**Damage Caused:** Yellowjackets feed on ripe and injured fruit. They can be especially abundant in droughty years as they are looking for sources of hydration. Their ability to sting and their aggressive behavior make them an annoyance and a danger to pickers.
**Timing of Control:** If nests can be located prior to harvest, destroying them is advised. If nest locations are unknown, trapping prior to fruit ripeness is best. If infestations occur during harvest, spraying with short residual insecticides may be needed.
**Yield Losses:** 25% without management, <5% with management
**Regional Differences:** None identified.
**Cultural Control Practices:** Prompt harvesting of ripe berries and "clean" picking practices will help decrease the fruit's attractiveness to the wasps. Where yellowjackets are attracted to brambles despite good harvest practices, traps may offer a practical method for control. The key to trapping success is to get traps out early, before yellowjackets begin feeding on raspberry fruit. Traps should be put up around the perimeter of the planting before the berries begin to ripen. There are many yellowjacket traps on the market, and not all are effective for the species of concern. Different baits and traps may have to be tried to determine which combination will work in a particular raspberry planting.
**Postharvest Control Practices:** Locating and destroying nests.
**Other Issues:** None identified.

**Chemical Controls for *Yellow Jackets*:**

| **Pesticide** alphabetically by a.i. | **Survey Data (% growers reporting use, % acreage, efficacy rating)** | **Typical Dose (a.i./A)** | **PHI days** | **REI hours** | **Comments & Application Notes** |
|---|---|---|---|---|---|
| azadirachtin (Aza-Direct) | 1.0% Growers<br>1.6% Acres<br>100% Good efficacy | .01-.02 lb | 0 | 4 | Repellant and anti-feedant.<br><br>**OMRI listed** |

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**Raspberry Crown Borer** (*Pennisetia marginata*)
**Type of Pest:** Insect
**Biology:** This pest takes two years to complete its life cycle. The adult is a clear-winged moth resembling a yellow jacket with a wingspan of 1 ¼ “. Larvae are dull white with a brown head and are ½ - ¾ inch long by the end of their first full summer, and reach a length of 1 ¼” when fully grown during their second summer.
The adult moths are active in mid to late summer. Females lay eggs singly on the lower surface of leaves. Eggs take 30 to 60 days to hatch. In early fall newly hatched larvae crawl down the cane and form a hibernation cavity at the base of a cane, below the soil line. The following spring, they tunnel into and girdle new canes and the crown. They pass the second winter in bramble roots. They pupate inside the plant base in mid- to late-summer of the second year, and new adults emerge from late July to September.

**Frequency of Occurrence:** 52% of respondents reported this pest occurring at least occasionally.

| **Control needed** | **Percent of growers** |
|---|---|
| Annually | 20% |
| Occasionally | 32% |
| Never | 48% |

**Damage Caused:** The canes damaged by the crown borer will wilt and become weak and spindly. Foliage may turn prematurely red and then die. Crowns infested with the larvae often swell and eventually die along with all of the canes from the crown. Infested canes will break easily. When injured plants are dug up, roots and crowns may be girdled and marked with swellings, gall, cracks and cavities. Piles of frass may be present.
**% Acres Affected:** % of raspberry acres affected annually is unknown.
**Timing of Control:** Severe infestations may require removal of the bed and rotation out of brambles for several years.
**Yield Losses:** Yield impact is generally minor until infestations build to a high level.
**Regional Differences:** None identified.

**Cultural Control Practices:** Removal of wild brambles in the vicinity of the planting can reduce populations of this pest.
**Biological Control Practices**: None identified
**Postharvest Control Practices:** None identified
**Other Issues:** None identified

**Chemical Controls for Raspberry Crown Borer:**

| **Pesticide** alphabetically by a.i. | **Survey Data (% growers reporting use, % acreage, efficacy rating)** | **Typical Dose (a.i./A)** | **PHI days** | **REI hours** | **Comments & Application Notes** |
|---|---|---|---|---|---|
| bifenthrin (Brigade 2 EC, WSB | No repoted use in New England | | | | Only material labeled for this use |
| Other Pesticides | | | | | |
| bifenthrin (Capture 2EC) | Appears in some state recommendations | n/a* | n/a* | n/a* | *Caneberries do not appear on the label. **Restricted Use Material** |
| **Other Strategies** | | | | | |
| Rouging out infested plants | No reported use of this strategy | na | na | na | |

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**Raspberry Fruit Worm** (*Byturus unicolor*)
**Type of Pest:** Insect
**Biology:** Raspberry fruitworm adults are beetles that are small, yellowish brown, about 1/8-inch long, with clubbed antennae. The larvae are yellowish white with a light brown section on top of each segment and a light brown head and are ¼" long when fully grown.
Raspberry fruitworm overwinter as pupae in the soil around brambles. Adults emerge at about the time raspberry leaves are unfolding, in spring. The adults first feed along the midrib of folded leaves, leaving characteristic elongated holes in the leaves when they unfold. Females usually deposit eggs on unopened flower buds or on developing fruit. Larvae tunnel into the flower receptacle to feed, then into the center of developing fruits. When infested fruit is picked, larvae often remain attached to the inner surface of the druplets. Those that remain on receptacles after harvest will drop to the ground to pupate and overwinter.
**Frequency of Occurrence:** 50% of respondents reported this pest occurring at least occasionally.

| Control needed | Percent of growers |
|---|---|
| Annually | 23% |
| Occasionally | 27% |
| Never | 50% |

**Damage Caused:** Feeding by adults is generally insignificant. Feeding by larvae on ripening fruit may result in unmarketable fruit.
**% Acres Affected:** 28% of raspberry acres affected annually.
**Timing of Control:** Insecticide applications at early prebloom late prebloom stage
**Yield Losses:** 20% without management, <2% with management
**Regional Differences:** None identified.
**Cultural Control Practices:** Summer cultivation of row middles can disrupt the life cycle of this pest, but may not be adequate for complete control. Fall fruiting varieties are not affected by this pest.
**Biological Control Practices**: None identified.
**Postharvest Control Practices:** None identified.
**Other Issues:**

**Chemical Controls for *Raspberry Fruit Worm*:**

| **Pesticide** alphabetically by a.i. | **Survey Data (% growers reporting use, % acreage, efficacy rating)** | **Typical Dose (a.i./A)** | **PHI days** | **REI hours** | **Comments & Application Notes** |
|---|---|---|---|---|---|
| azadirachtin (Aza-Direct) | 2.4% growers<br>4.8 % Acres<br>100% Excellent efficacy | .01-.02 lb | 0 | 4 | Repellant and anti-feedant.<br><br>**OMRI listed** |
| pyrethrin/rotenone (Pyrellin EC) | 1.0% Growers<br>2.3% Acres<br>100% Poor efficacy | .01-.02 lb | 0 | 12 | |
| pyrethrins (Pyganic, Pyrenone Crop Spray) | 4.0% Growers<br>2.1% Acres<br>40% Excellent efficacy<br>60% Good efficacy | 0.56 lb | 0 | 12 | |
| carbaryl (Sevin 80S, 80WSB, XLR) | 17.5% Growers<br>18.3% Acres<br>32% Excellent efficacy<br>68% Good efficacy | 1-2 lb | 7 | 12 | |
| **Other Pesticides** | | | | | |
| esfenvalerate (Asana XL) | 1.0% growers<br><1% acres<br>100% Excellent efficacy | .03-.05 lb | 7 | 12 | Raspberry Fruitworm do not appear on the label under caneberries. |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | **Restricted Use Material** |
| *Bacillus thuringiensis* (various formulations) | 1.0% Growers<br><1% Acres<br>100% Excellent efficacy | 0.25-0.5 lb | 0 | 4 | Raspberry Fruitworm do not appear on the label under caneberries. **Some products OMRI listed** |
| phosmet (Imidan 70WSB, 70W) | 1.0% Growers<br>1.7% Acres<br>100% Good efficacy | 0.93 lb | 3* | 24* | *Caneberries do not appear on the label. |
| malathion (various formulations) | 3.2% Growers<br>4.0% Acres<br>100% Good efficacy | 1-2 lb | 1 | 12 | Raspberry Fruitworm do not appear on the label under caneberries. |
| **Other Strategies** | | | | | |
| Trichogramma wasps | 1.0% Growers<br>2.3% Acres<br>100% Excellent efficacy | na | na | na | |
| Predatory mites | 1.0% Growers<br><1% Acres<br>100% Good efficacy | na | na | na | |

**Group C – Insect and mite pests identified by New England Growers as infrequent pest problem**

**Two spotted spider mite** (*Tetranychus urticae*)
**Type of Pest:** Mite (Arthropod)
**Biology:** This pest can cause significant problems when severe infestations occur. The adult mite is only about 1/50 inch in length and its color varies from pale greenish yellow to dark crimson, usually with dark spots. Adults feed and deposit eggs on the underside of the leaf and in a heavy infestation, a tangle of fine, silken threads can be found there. The mites suck sap from the leaves which can cause them to lose their healthy green color and turn coppery-bronze. The life cycle of the mite varies but usually is completed in two weeks. New broods can be produced continuously from early spring to late fall. Mite population increases are more severe in hot, dry weather. The mites overwinter as mature fertile females in protected areas in the fields.
**Frequency of Occurrence:** 53% of respondents reported this pest occurring

| Control needed | Percent of growers |
|---|---|
| Annually | 9% |
| Occasionally | 44% |
| Never | 47% |

**Damage Caused:** Mites suck sap and chlorophyll from leaves, weakening the plants. The feeding activity causes the plants to become stunted and berries will not attain full size. Webbing and presence of mites on fruit can reduce market value.
**% Acres Affected:** 8.9% of raspberry acres affected annually.
**Timing of Control:** Season long control may be needed, but is generally from early summer through fall.
**Yield Losses:** no direct impact on yield but high populations can sap vigor of plants, thereby reducing yield. Presence of mites on fruit can reduce sales in PYO situations.
**Regional Differences:** None identified.
**Cultural Control Practices:** Reduced nitrogen applications can suppress build-up of mite populations. Some variation among cultivars has been reported.
Biological Control Practices: Various mite predators commercially available including *Phytoseiulus persimilis* and *Neoseiulus fallacis*. Excellent control from releases of *Neoseiulus fallacis*, mite predator, are reported if done early enough to avoid excessive pest mite populations.
**Postharvest Control Practices:** Predator mite releases.
**Other Issues:** None identified.

**Chemical Controls for *Two-spotted spider mite*:**

| **Pesticide** alphabetically by a.i. | **Survey Data (% growers reporting use, % acreage, efficacy rating)** | **Typical Dose (a.i./A)** | **PHI days** | **REI hours** | **Comments & Application Notes** |
|---|---|---|---|---|---|
| azadirachtin (Aza-Direct) | 2.4% Growers<br>2.3% Acres<br>33% Excellent efficacy<br>67% Good efficacy | .01-.02 lb | 0 | 4 | Repellant and anti-feedant.<br><br>**OMRI listed** |
| bifenthrin (Brigade 2EC, WSB) | 1.0% growers<br>2.8% acres<br>50% Good efficacy<br>50% Poor efficacy | 0.05-0.1 lb | 3 | 12 | Broad spectrum; harmful to beneficials<br>**Restricted Use Material** |
| hexythiazox (Savey 50DF) | 1.6% Growers<br>1.6% Acres<br>100% Excellent efficacy | 0.125 – 0.188 lb | 3 | 12 | |
| parafinic oil (JMS Stylet Oil) | 1.0% Growers<br>1.1% Acres<br>No efficacy data provided | 0.73 gal | 0 | 4 | **OMRI listed** |
| **Other Pesticides** | | | | | |
| bifenthrin (Capture 2EC, Fanfare2EC) | 1.0% Growers<br><1% Acres<br>100% Good efficacy | n/a* | n/a* | n/a* | *Caneberries do not appear on the label.<br>**Restricted Use Material** |
| malathion (various formulations) | 1.0% growers<br><1% acres<br>100% Good efficacy | 1-2 lb | 1 | 12 | |
| **Other Strategies** | | | | | |
| predatory mites (several species) | 1.0% growers<br><1% acres<br>100% Good efficacy | 10,000 per acre | n/a | n/a | |

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**Raspberry Aphids** (*Amphorophora agathonica*, *A. sensoriata* and *Aphis rubicola*)
**Type of Pest:** Insect
**Biology:** Aphids are small, pear-shaped, softbodied insects that feed on plant sap. They tend to congregate on the underside of leaves or near the tips of new primocanes. The larger raspberry aphids 1/8" long and either yellow-green *(A. agathonica)* or pale bluish green *(A. sensoriata)*. The smaller raspberry aphid (*A. rubicola)* is 1/16" long and pale yellowish green. Raspberry aphids overwinter as eggs on brambles. Eggs hatch in the spring. Development is rapid during the summer with many generations.

**Frequency of Occurrence:** 47% of respondents reported this pest occurring at least occasionally.

| Control needed | Percent of growers |
|---|---|
| Annually | 10% |
| Occasionally | 37% |
| Never | 53% |

**Damage Caused:** Aphids feed on succulent tissue near the cane tips causing leaf curling. High populations can weaken plants but even low populations can transmit viruses, especially if wild brambles are nearby. This is the greatest risk posed by aphid infestations.
**% Acres Affected:** 26.6% of raspberry acres affected annually.
**Timing of Control:** Late spring to early summer through late summer.
**Yield Losses:** No data available
**Regional Differences:** None identified.
**Cultural Control Practices:** Elimination of wild brambles will reduce migration into cultivated plantings.
**Biological Control Practices**: Aphids are attacked by a variety of natural predatory and parasitic insects. These are usually not introduced but resident populations.
**Postharvest Control Practices:** Summer bearing varieties will benefit from post harvest controls, but fall bearing varieties are too late for this practice.
**Other Issues:** None identified.

**Chemical Controls for Aphids:**

| **Pesticide** alphabetically by a.i. | **Survey Data (% growers reporting use, % acreage, efficacy rating)** | **Typical Dose (a.i./A)** | **PHI days** | **REI hours** | **Comments & Application Notes** |
|---|---|---|---|---|---|
| azadirachtin (Aza-Direct) | 1.6% Growers<br>2.8% Acres<br>50% Excellent efficacy<br>50% Good efficacy | .01-.02 lb | 0 | 4 | Repellant and anti-feedant.<br><br>**OMRI listed** |
| esfenvalerate (Asana XL) | 4.7% Growers<br>7.7% Acres<br>67% Excellent efficacy<br>33% Good efficacy | .03-.05 lb | 7 | 12 | **Restricted Use Material** |
| malathion (various formulations) | 7.1% growers<br>12.8% acres<br>22% Excellent efficacy<br>78% Good efficacy | 1-2 lb | 1 | 12 | |
| **Other Pesticides** | | | | | |
| carbaryl (Sevin 80S, | 7.1% growers<br>12.8% acres | 1-2 lb | 7 | 12 | |

| | | | | | |
|---|---|---|---|---|---|
| 80WSB, XLR) | 22% Excellent efficacy<br>78% Good efficacy | | | | |
| imidacloprid (Provado 1.6F, Solupak) | 1.0% growers<br>2.3% acres<br>100% Excellent efficacy | 0.1 lb | 3 | 12 | |
| endosulfan (Thiodan EC) | 1.0% Growers<br><1 % Acres<br>100% Good efficacy | 1 lb | 4* | 48* | *Caneberries do not appear on the label. |

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**Picnic Beetle and Strawberry Sap Beetle** (*Glischrochilus* spp., *Stelidota geminata*)
**Type of Pest:** Insect
**Biology:** Picnic Beetle: adults are about ¼" long and colored black, with four orange-red spots on their wing covers.
Strawberry Sap Beetle: adults are about $^{1}/_{8}$ " long, oval shaped, flat, and mottled brown in color. Larvae are white with a brown head and up to $^{1}/_{10}$" long.
Overwintered beetles emerge in May from organic matter in sheltered sites, generally after temperatures exceed 60-65˚F for several days. They feed, mate, and lay eggs in the organic matter. After larval and pupal development is completed, new adult beetles appear from July to September when they feed on the ripening fruits.
**Frequency of Occurrence:** 43% of respondents reported this pest occurring at least occasionally.

| Control needed | Percent of growers |
|---|---|
| Annually | 8% |
| Occasionally | 35% |
| Never | 57% |

**Damage Caused:** Adult beetles feed directly on ripe fruit causing it to be unmarketable. They can also introduce and spread fruit rotting fungi.
**% Acres Affected:** 26.6% of raspberry acres affected annually.
**Timing of Control:** Control measures are needed during the fruit ripening period which means a short residual insecticide is the only practical option.
**Yield Losses:** 25% without management, <5% with management
**Regional Differences:** None identified.
**Cultural Control Practices:** Sanitation is the key to preventing sap beetle infestation. Keep berries off the ground and practice frequent, complete picking. Remove overripe and damaged berries, and bury culled berries. Management in alternate hosts (strawberries, blueberries, peaches, corn, etc.) will help keep populations down.
**Biological Control Practices**: None identified.
**Postharvest Control Practices:** Soil application of insecticides targeting larvae may be helpful.

**Other Issues:** Control of this pest with insecticides is difficult because infestations occur during fruit ripening and harvest. Also, this pest tends to find or create protective cavities which makes contact with insecticides difficult. A better understanding of the life cycle and alternate hosts of this insect would aid in developing better control strategies. Also, Bifenthrin is a broad spectrum pyrethroid and will kill pest and beneficial arthropods. Frequent use may disrupt biological control of spider mites resulting in mite outbreaks.

**Chemical Controls for *Picnic Beetle* and *Strawberry Sap Beetle*:**

| **Pesticide** alphabetically by a.i. | **Survey Data (% growers reporting use, % acreage, efficacy rating)** | **Typical Dose (a.i./A)** | **PHI days** | **REI hours** | **Comments & Application Notes** |
|---|---|---|---|---|---|
| azadirachtin (Aza-Direct) | 1.6% Growers<br>4.0% Acres<br>100% Excellent efficacy | .01-.02 lb | 0 | 4 | Repellant and anti-feedant.<br>**OMRI listed** |
| bifenthrin (Brigade 2EC, WSB) | 1.0% growers<br><1% acres<br>50% Good efficacy<br>50% Poor efficacy | 0.05-0.1 lb | 3 | 12 | Broad spectrum; harmful to beneficials<br>**Restricted Use Material** |
| carbaryl (Sevin 80S, 80WSB, XLR) | 1% Growers<br>1.4% Acres<br>100% Excellent efficacy | 1-2 lb | 7 | 12 | |
| malathion (various formulations) | 4.8% Growers<br>6.3% Acres<br>17% Excellent efficacy<br>83% Good efficacy | 1-2 lb | 1 | 12 | |
| pyrethrins (Pyganic, Pyrenone Crop Spray) | 4.0% Growers<br>8.7% Acres<br>60% Excellent efficacy<br>40% Good efficacy | 0.56 lb | 0 | 12 | **Some formulations OMRI listed** |
| **Other Strategies** | | | | | |
| Sanitation | 1.6% growers<br>1.8% acres<br>100% Good efficacy | n/a | n/a | n/a | |

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***Strawberry Bud Weevil aka 'Clipper'*** *(Anthonomus signatus)*
**Type of Pest:** Insect
**Biology:** The beetles overwinter in fence-rows and woodlots. Once temperatures reach 60˚F the clippers move to nearby early budding plants such as early flowering brambles. The adults feed on the immature pollen of the blossom buds and then females deposit

one egg inside the bud. The clipper girdles the bud and clips the stem, causing the bud to hang down or fall to the ground. In about a week, the egg hatches into a white, legless grub. The larva develops inside the bud and reaches maturity in three to four weeks. Adult clippers, which are dark, reddish-brown weevils about 1/10-inch long, with a head prolonged into a thin curved snout about half as long as the body, emerge from the buds in late June through July. After feeding on the pollen from various flowers for a short time, the new adults seek hibernating sites and remain there until the next spring. Only one generation of clippers appears each year.
**Frequency of Occurrence:** 38% of respondents reported this pest occurring at least occasionally.

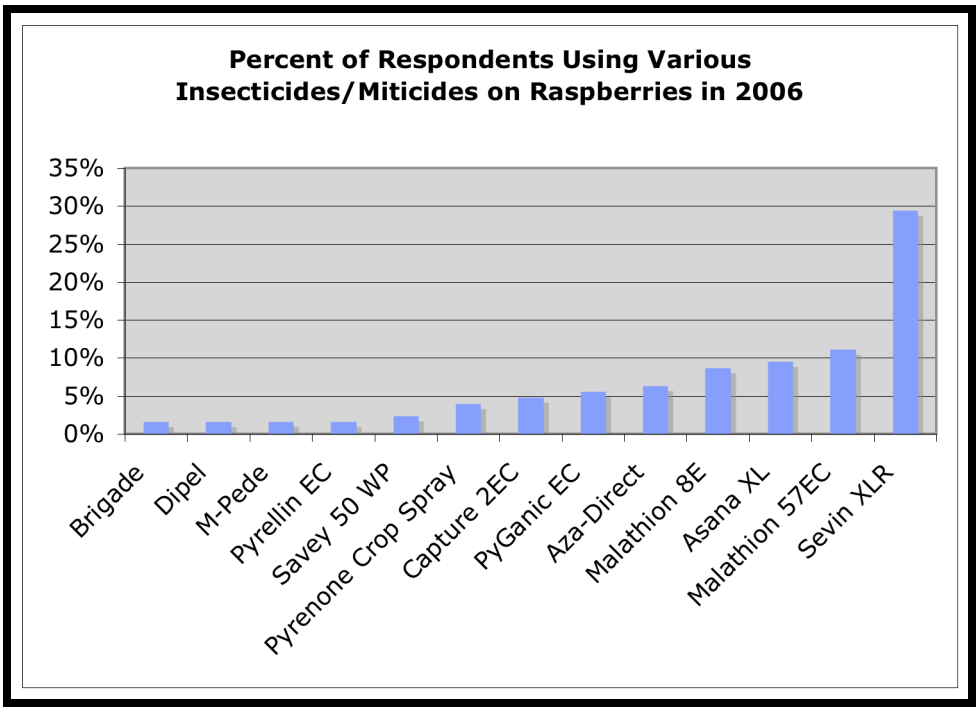
| Control needed | Percent of growers |
|---|---|
| Annually | 12% |
| Occasionally | 26% |
| Never | 62% |

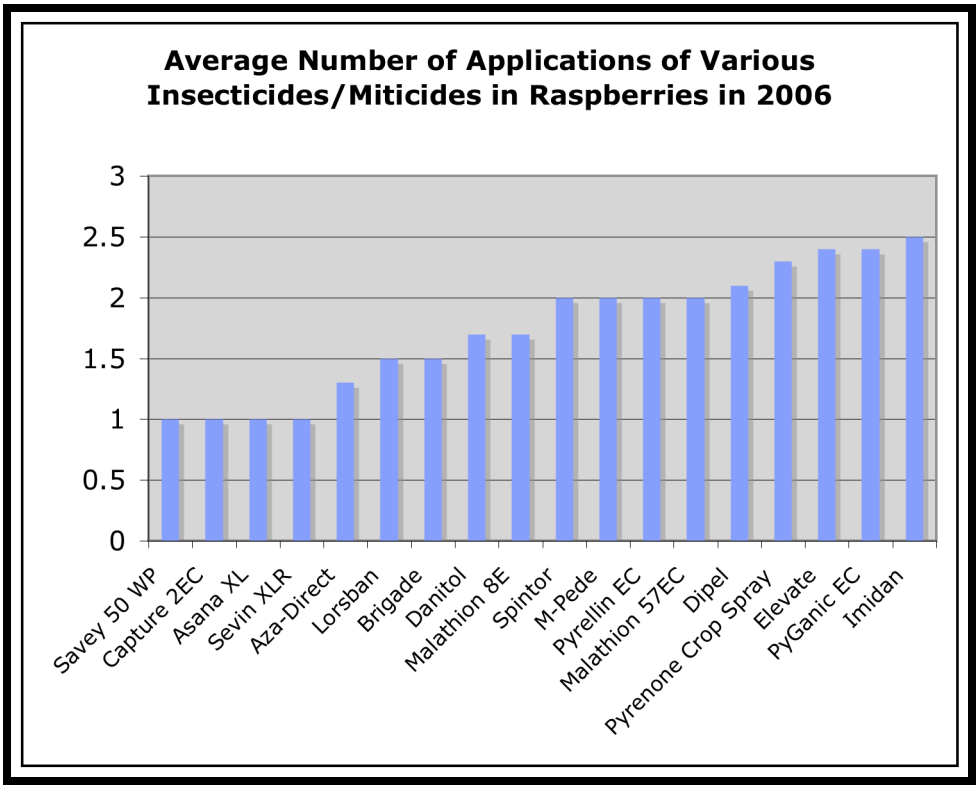
**Damage Caused:** Stems of infested flower buds are girdled and buds fail to develop into fruit.
**% Acres Affected:** 22.1% of raspberry acres affected annually.
**Timing of Control:** Apply insecticide pre-bloom if scouting results indicate presence of this pests or field history of damage is high. In some cases, border row treatments may be sufficient. DO NOT SPRAY INSECTICIDES DURING BLOOM.
**Yield Losses:** 10% without management, <2% with management.
**Regional Differences:** None identified.
**Cultural Control Practices:** Fall bearing varieties are not susceptible to this pest.
**Biological Control Practices:** None identified.
**Postharvest Control Practices:** None identified
**Other Issues:** Bifenthrin is a broad spectrum pyrethroid and will kill pest and beneficial arthropods. Frequent use may disrupt biological control of spider mites resulting in mite outbreaks.

**Chemical Controls for *Strawberry Bud Weevil*:**

| **Pesticide** alphabetically by a.i. | **Survey Data (% growers reporting use, % acreage, efficacy rating)** | **Typical Dose (a.i./A)** | **PHI days** | **REI hours** | **Comments & Application Notes** |
|---|---|---|---|---|---|
| azadirachtin (Aza-Direct) | 1.0% Growers<br>2.3% Acres<br>100% Excellent efficacy | .01-.02 lb | 0 | 4 | Repellant and anti-feedant.<br>**OMRI listed** |
| carbaryl (Sevin 80S, 80WSB, XLR) | 9.5% growers<br>12.4% acres<br>42% Excellent efficacy<br>58% Good efficacy | 1-2 lb | 7 | 12 | |
| **Other Pesticides** | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| azinphos methyl (Guthion Solupak) | 1.0% Growers<br>3.4% Acres<br>100% Excellent efficacy | n/a* | n/a* | n/a* | *Caneberries do not appear on the label. **Restricted Use Material** |
| bifenthrin (Brigade 2EC, WSB) | 1.6% growers<br>4.6% acres<br>50% Good efficacy<br>50% Poor efficacy | 0.05-0.1 lb | 3 | 12 | Strawberry bud weevil does not appear on the label under caneberries. Broad spectrum; harmful to beneficials **Restricted Use Material** |
| esfenvalerate (Asana XL) | 1.0% growers<br><1% acres<br>100% Excellent efficacy | .03-.05 lb | 7 | 12 | Strawberry bud weevil does not appear on the label under caneberries. **Restricted Use Material** |
| malathion (various formulations) | 1.0% Growers<br>1.0% Acres<br>no efficacy data reported | 1-2 lb | 1 | 12 | Strawberry bud weevil does not appear on the label under caneberries. |
| permethrin (Pounce 1.5G, 25WP,32EC) | 1.0% Growers<br><1 % Acres<br>100% Excellent efficacy | 0.05-0.1 lb | n/a* | n/a* | *Caneberries do not appear on the label. **Restricted Use Material** |


Percent of Respondents Using Various Insecticides/Miticides on Raspberries in 2006
35%
30%
25%
20%
15%
10%
5%
0%
Brigade
Dipel
M-Pede
Pyrellin EC
Savey 50 WP
Pyrenone Crop Spray
Capture 2EC
PyGanic EC
Aza-Direct
Malathion 8E
Asana XL
Malathion 57EC
Sevin XLR


Average Number of Applications of Various Insecticides/Miticides in Raspberries in 2006
3
2.5
2
1.5
1
0.5
0
Savey 50 WP
Capture 2EC
Asana XL
Sevin XLR
Aza-Direct
Lorsban
Brigade
Danitol
Malathion 8E
Spintor
M-Pede
Pyrellin EC
Malathion 57EC
Dipel
Pyrenone Crop Spray
Elevate
PyGanic EC
Imidan

**Insecticides used on Raspberries in 2006:**

| Chemical Name | Formulations | Target pests | PHI (days) | REI (hrs) | Label Issues | Comments and Resistance Group |
|---|---|---|---|---|---|---|
| azadirachtin | Aza-Direct | • Strawberry Bud Weevil<br>• Picnic and Sap Beetle<br>• Raspberry Aphids<br>• Raspberry Fruitworm<br>• Yellow Jackets<br>• Two-Spotted Spider Mites<br>• Tarnished Plant Bug<br>• Japanese Beetle | 0 | 4 | | OMRI Listed<br>Group 18B |
| azinphos-methyl | Guthion Solupak | • Cane Borers<br>• Strawberry Bud Weevil | n/a | n/a | not labeled for use in caneberries | Group 1B |
| bifenthrin | Brigade 2EC<br>BrigadeWSB<br>Capture 2EC<br>Fanfare 2EC | • Strawberry Bud Weevil<br>• Picnic and Sap Beetle<br>• Two-Spotted Spider Mite<br>• Cane Borers<br>• Tarnished Plant Bug<br>• Rasberry Crown Borer | | | Capture and Fanfare not labeled for Caneberries | Restricted Use<br>Group 3 |
| carbaryl | Sevin 80S<br>Sevin 80 SWB<br>Sevin XLR | • Strawberry Bud Weevil<br>• Picnic and Sap Beetle<br>• Raspberry Aphids<br>• Potato Leafhopper<br>• Cane Borers<br>• Tarnished Plant Bug<br>• Japanese Beetle | 7 | 12 | | Cost effective<br>Group 1A |
| endosulfan | Thiodan EC | • Raspberry Aphids<br>• Tarnished Plant Bug | 4 | 48 | not labeled for caneberries | Group 2A |
| esfenvalerate | Asana XL | • Raspberry Aphids<br>• Japanese Beetle*<br>• Tarnished Plant Bug*<br>• Raspberry Fruitworm*<br>• Strawberry Bud Weevil* | 7 | 12 | * not labeled under caneberries | Restricted Use<br>Group 3 |
| fenpropathrin | Danitol 2.4EC | • Tarnished Plant Bug | 2 | 24 | not labeled for caneberries | Restricted Use<br>Group 3 |
| hexythiazox | Savey 50DF | • Two-Spotted Spider Mite | 3 | 12 | | Group 10B |
| imidacloprid | Provado 1.6F<br>Provado Solupak | • Raspberry Aphids<br>• Japanese Beetle* | 3 | 12 | * not labeled under caneberries | Group 4A |

| | | | | | | |
|---|---|---|---|---|---|---|
| malathion | various formulations | • Japanese Beetle<br>• Tarnished Plant Bug<br>• Cane Borers<br>• Raspberry Fruitworm<br>• Two-Spotted Spider Mite<br>• Raspberry Aphids<br>• Picnic and Sapbeetles<br>• Stawberry Bud Weevil | 1 | 12 | | Group 1B |
| parafinic oil | JMS Stylet Oil | • Two-Spotted Spider Mite | 0 | 0 | | OMRI Listed Group Unknown |
| permethrin | Pounce 1.5G Pounce 25WP Pounce 32EC | • Cane Borers<br>• Strawberry Bud Weevil | n/a | n/a | not labeled for caneberries | Restricted Use<br>Group 3 |

# III. DISEASES

**Group A – Diseases identified by New England Growers as most important**
Botrytis Fruit Rot, Powdery Mildew, Cane Blight, Phytophthora Root Rot

**Group B – Diseases identified by New England Growers to be significant problems in some years**
Anthracnose, Spur Blight, Orange Rust

**Group C – Diseases identified by New England Growers as infrequent pest problem**
Late Leaf Rust, Viruses, Verticillium Wilt, Crown Gall

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**Group A – Diseases identified by New England Growers as most important**

**Botrytis Fruit Rot** (*Botrytis cinerea*)
**Type of Pest:** fungal pathogen
**Biology:** Gray Fruit Rot is caused by the fungus *Botrytis cinerea*. It can cause great damage during wet, warm seasons. The fungus overwinters in infected plant debris. In the springs spores are spread by wind and deposited on blossoms and fruit. The spores germinate when moisture is present and infection quickly occurs. The fungus usually enters the fruit through flower parts, where it remains inactive within the tissues of green fruit. As the fruit matures, the fungus becomes active and rots the fruit. Infected berries usually become covered with a gray, dusty, or powdery growth of the fungus. Even though infection occurs during bloom, symptoms are usually not observed until harvest. Temperature between 70-80°F and moisture on the foliage are ideal which are carried by wind to cause additional infections on other flowers and ripe fruit.
**Frequency of Occurrence:** 77% of respondents reported this disease occurring at least occasionally.

| Control needed | Percent of growers |
|---|---|
| Annually | 56% |
| Occasionally | 21% |
| Never | 23% |

**Damage Caused:** Fruit rot; other parts infected by the fungus include leaves and canes.
**% Acres Affected:** 64.6% of raspberry acres affected annually.
**Timing of Control:** Early to mid-bloom fungicide applications; later applications needed only if weather is wet.
**Yield Losses:** >50% without management, <10% with management.
**Regional Differences:** None identified.
**Cultural Control Practices:** Prune and set row spacing to maximize air circulation and good drying conditions to reduce infection periods. Avoid build up inoculum on ripe and

over-ripe fruit by frequent harvesting. Avoid over-fertilization with nitrogen which leads to dense canopies and increased infection periods.
**Biological Control Practices:** None commercially available.
**Postharvest Control Practices:** Good pruning practices that maximize air circulation and drying conditions
**Other Issues:** Fungicide resistance is a concern and materials of differing chemistries should be alternated in a spray program to avoid resistance development.

## Chemical Controls for *Gray Mold*

| **Pesticide** alphabetically by a.i. | **Survey Data (% growers reporting use, % acreage, efficacy rating)** | **Typical Dose (a.i./A)** | **PHI days** | **REI hours** | **Comments & Application Notes** |
|---|---|---|---|---|---|
| captan (Captan 50W, 80WDG, Captec 4L) | 21.0% growers<br>37.0% acres<br>30% Excellent efficacy<br>67% Good efficacy<br>3% Poor efficacy | 2-3 lb | 0 | 72 | Group M4 |
| cyprodinil fludioxonil (Switch 62.5WG) | 15.8% growers<br>28.6% acres<br>80% Excellent efficacy<br>20% Good efficacy | .043-0.55 lb | 0 | 12 | Group 9 and 12 |
| fenhexamid (Elevate 50WDG) | 22.2% growers<br>40.9% acres<br>75% Excellent efficacy<br>25% Good efficacy | 0.75 lb | 0 | 12 | Group 17 |
| iprodione (Rovral 4F) | 10.3% growers<br>10.4% acres<br>23% Excellent efficacy<br>77% Good efficacy | 0.5-1.0lb | 0 | 24 | Group 2 |
| pyraclostrobin (Cabrio EG) | 18.3% Growers<br>28.1% Acres<br>39% Excellent efficacy<br>61% Good efficacy | 0.175lb | 0 | 24 | Group 11 |
| pyraclostrobin boscalid (Pristine WG) | 14.3% growers<br>21.1% acres<br>67% Excellent efficacy<br>33% Good efficacy | 3-3.5 lb | 0 | 12 | Group 7 and 11 |
| **Other Pesticides** | | | | | |
| fenbuconazole (Indar 2F, 75WSB) | <1% growers<br>1.7% acres<br>100% Good efficacy | n/a | n/a | n/a | Not labeled for Caneberries<br>Group 3 |
| hydrogen dioxide | 1% growers<br><1% acres | .07-0.27 lb | 0 | 1 | |

| | | | | | |
|---|---|---|---|---|---|
| (Oxidate) | 100% Good efficacy | | | | OMRI listed<br>Group NC |
| lime sulfur (Miller's Lime Sulfur, Sulforix) | <1% growers<br><1% acres<br>100% Good efficacy | | 0 | 48 | Group M2 |
| potassium bicarbonate (Milstop) | 1% growers<br><1% acres<br>100% Good efficacy | 1.7-2.5lb | 0 | 1 | OMRI listed<br>Group NC |
| thiophanate-methyl (Topsin-M) | 1.6% growers<br>5.1% acres<br>50% Excellent efficacy<br>50% Good efficacy | n/a* | n/a* | n/a* | *Caneberries do not appear on the label<br>Group 1 |
| **Other Strategies** | | | | | |
| Remove moldy berries | <1% Growers<br>1.1% Acres<br>no efficacy data reported | n/a | n/a | n/a | |
| Pruning | 1.6% Growers<br>1.1% Acres<br>100% Good efficacy | n/a | n/a | n/a | |

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**Powdery Mildew** (*Sphaerotheca macularis*)
**Type of Pest:** fungal pathogen
**Biology:** The fungus overwinters within infected buds near the tips of heavily infected canes. Shoots that emerge from these buds the following spring are infected, and spores produced upon them are distributed by air currents to spread the disease. Repeat cycles of infection can continue throughout the summer. Unlike most fungal diseases, powdery mildew infections do not require periods of wetness in which to develop. However, they are more likely to become severe during humid weather conditions.
**Frequency of Occurrence:** 58% of respondents reported this disease occurring at least occasionally.

| Control needed | Percent of growers |
|---|---|
| Annually | 16% |
| Occasionally | 42% |
| Never | 42% |

**Damage Caused:** Infected leaves are covered with a white powdery growth, usually on their undersides, and may curl upwards. Some cultivars simply develop light green blotches on the leaf surfaces. Infected shoots may be long and spindly and have

dwarfed leaves. The disease can be severe on highly susceptible cultivars, and these plants may be stunted and less productive. The infection of flower buds reduces fruit quantity. Infected fruit may be lower in quality or unmarketable as a result of the unsightly covering of powdery growth.
**% Acres Affected:** 31.5% of raspberry acres affected annually.
**Timing of Control:** Fungicide applications are made beginning at early bloom.
**Yield Losses:** No documented direct yield impact, but may weaken plants and reduce yield indirectly.
**Regional Differences:** None identified.
**Cultural Control Practices:** Narrow rows and good row spacing to promote air circulation, and avoid highly susceptible cultivars.
**Biological Control Practices:** None identified.
**Postharvest Control Practices:** None identified.
**Other Issues:** Fungicide resistance is a concern and materials of differing chemistries should be alternated in a spray program to avoid resistance development.

## Chemical Controls for *Powdery Mildew*

| **Pesticide** alphabetically by a.i. | **Survey Data** % growers reporting use, % acreage, efficacy rating | **Typical Dose (a.i./A)** | **PHI days** | **REI hours** | **Comments & Application Notes** |
|---|---|---|---|---|---|
| azoxystrobin (Abound) | <1% growers<br><1% acres<br>100% Good efficacy | 0.1-0.25 lb | 0 | 4 | Highly phytotoxic to some apple cultivars<br>Group 11 |
| myclobutanil (Nova 40W) | 7.9% Growers<br>16.3% Acres<br>60% Excellent efficacy<br>40% Good efficacy | 0.5-1.0lb | 0 | 24 | Group 3 |
| pyraclostrobin (Cabrio EG) | 14.3% growers<br>18.5% acres<br>44% Excellent efficacy<br>56% Good efficacy | 0.175lb | 0 | 24 | Group 11 |
| pyraclostrobin boscalid (Pristine WG) | 7.1% growers<br>13.5% acres<br>44% Excellent efficacy<br>56% Good efficacy | 3-3.5 lb | 0 | 12 | Group 7 and 11 |
| **Other Pesticides** | | | | | |
| chlorothalonil (Bravo Ultrex, Weather Stik) | <1% growers<br><1% acres<br>no efficacy date reported | n/a | n/a | n/a | Not labeled for Caneberries<br>Group M5 |
| cyprodinil fludioxonil (Switch | <1% growers<br><% acres<br>100% Good efficacy | .043-0.55 lb | 0 | 12 | *Powdery Mildew is not listed under Caneberries |

| | | | | | |
|---|---|---|---|---|---|
| 62.5WG) | | | | | Group 9 and 12 |
| hydrogen dioxide (Oxidate) | <1% growers<br>5.7% acres<br>100% Good efficacy | .07-0.27 lb | 0 | 1 | OMRI listed<br>Group NC |
| potassium bicarbonate (Milstop) | 1% growers<br><1% acres<br>no efficacy date reported | 1.7-2.5lb | 0 | 1 | OMRI listed<br>Group NC |
| **Other Strategies** | | | | | |
| Pruning for good air circulation | <1% Growers<br>1.1% Acres<br>no efficacy data reported | n/a | n/a | n/a | |

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**Cane Blight** (*Leptosphaeria coniothyrium*)
**Type of Pest:** fungal pathogen
**Biology:** This pathogen overwinters in old infected or dead canes and spores are released during rainy periods in the spring. The spores are dispersed by wind or splashing rain, and they germinate and infect new canes if wound sites are available. New spores are produced from these infection sites for further disease spread. Infections may occur any time during the growing season if wounds are present, and are particularly favored by extended periods of warm, wet weather. The pathogen can continue to release infective spores for up to four years if the cane debris is not destroyed.
**Frequency of Occurrence:** 56% of respondents reported this disease occurring at least occasionally.

| Control needed | Percent of growers |
|---|---|
| Annually | 16% |
| Occasionally | 40% |
| Never | 44% |

**Damage Caused:** Cane Blight causes weak growth of fruiting laterals followed by wilting of the leaves above the blighted area. Dark brown or purple cankers appear on the cane often extending several inches along the cane. Cane tissue in the infected region is weak and bends easily. Infection sites are usually associated with pruning wounds or other injuries. Cane Blight is more common in black and purple raspberries because of tipping practices but red raspberries are equally susceptible.
**% Acres Affected:** 44.6% of raspberry acres affected annually.
**Timing of Control:** Delayed dormant or very early spring before budswell reaches ½ “.
**Yield Losses:** >50% without management, <10% with management.
**Regional Differences:** None identified.

**Cultural Control Practices:** Narrow rows, thin primocanes and good row spacing to promote air circulation. Sanitation by removing prunings from the production area.
**Biological Control Practices:** None identified.
**Postharvest Control Practices:** Narrow rows, thin primocanes and good row spacing to promote air circulation. Sanitation by removing prunings from the production area.
**Other Issues:** Fungicide resistance is a concern and materials of differing chemistries should be alternated in a spray program to avoid resistance development.

## Chemical Controls for *Cane Blight*

| **Pesticide** alphabetically by a.i. | **Survey Data** % growers reporting use, % acreage, efficacy rating | **Typical Dose (a.i./A)** | **PHI days** | **REI hours** | **Comments & Application Notes** |
|---|---|---|---|---|---|
| lime sulfur (Miller's Lime Sulfur, Sulforix) | 13.5% growers<br>24.7% acres<br>23% Excellent efficacy<br>59% Good efficacy<br>18% Poor efficacy | 6-7lb | 0 | 24 | Group M2 |
| **Other Pesticides** | | | | | |
| captan (Captan 50W, 80WDG, Captec 4L) | 2% growers<br>6.5% acres<br>67% Good efficacy<br>33% Poor efficacy | 2-3 lb | 0 | 72 | Group M4 |
| copper hydroxide (Champ) | <1% growers<br><1% acres<br>100% Poor efficacy | .76 lb | prebloom or post harvest only | 24 | Group M1 |
| myclobutanil (Nova 40W) | <1% Growers<br><1% Acres<br>100% Poor efficacy | 0.5-1.0lb | 0 | 24 | Group 3 |
| pyraclostrobin (Cabrio EG) | 1.6% growers<br>1.7% acres<br>50% Good efficacy<br>50% Poor efficacy | 0.175lb | 0 | 24 | Group 11 |
| **Other Strategies** | | | | | |
| Pruning for good air circulation | 19.8% Growers<br>27.5% Acres<br>41% Excellent efficacy<br>55% Good efficacy<br>4% Poor efficacy | n/a | n/a | n/a | |

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**Phytophthora Root Rot** (*Phytophthora* spp.)
**Type of Pest:** fungal pathogen

**Biology:** Phytophthora root rot is caused by several species of soilborne fungi belonging to the genus *Phytophthora* including *P. megasperma, P. cryptogea, P. citriocola, P. cactorum,* and at least two additional unidentified Phytophthora species. The disease occurs on red, black, and purple raspberries, although in the northeastern United States, it has been documented most commonly on red raspberries. The fungi persist in infected roots and in the soil. When the soil is moist, reproductive structures are formed containing motile zoospores. These zoospores are expelled into the soil when the soil is saturated with water. The zoospores have tails, which allow them to swim through free water in the soil to reach new plant parts and cause infections. Water saturated soil is oxygen-depleted and the plant is progressively less capable of resisting infection.
**Frequency of Occurrence:** 46% of respondents reported this disease occurring at least occasionally.

| Control needed | Percent of growers |
|---|---|
| Annually | 20% |
| Occasionally | 26% |
| Never | 54% |

**Damage Caused:** Infected plants produce fewer and weaker canes. Leaves on the canes may be stunted and necrotic along the edges and between the veins. Infected plants may wilt and collapse under heat stress or heavy fruit load. If spring weather is very wet, primocanes may wilt and die, showing dark water-soaked tissue near the soil line. During the early stages of infection roots and crowns may be reddish. By comparison, healthy roots will be white. Plants in low or poorly drained field sites are frequently infected.
**% Acres Affected:** 24.4% of raspberry acres affected annually.
**Timing of Control:** Early Spring or Fall; 60 day pre-harvest interval on labeled fungicides.
**Yield Losses:** >50% without management in high-risk situations, <10% with management.
**Regional Differences:** None identified.
**Cultural Control Practices:** Avoid highly susceptible varieties such as 'Titan', 'Lauren', 'Ruby', 'Canby', 'Dinkum', 'Polana', and 'Encore' on all but very well-drained sites. Avoid wet sites or provide supplemental drainage and/or raised beds for planting if needed.
**Biological Control Practices:** None identified.
**Postharvest Control Practices:** None identified.
**Other Issues:** Fungicide resistance is a concern and materials of differing chemistries should be alternated in a spray program to avoid resistance development.

## Chemical Controls for *Phytophthora Root Rot*

| **Pesticide** alphabetically by a.i. | **Survey Data** % growers reporting use, % acreage, efficacy rating | **Typical Dose (a.i./A)** | **PHI days** | **REI hours** | **Comments & Application Notes** |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| fosetyl al or aluminum tris (Aliette WDG) | 3.2% growers<br>2.1% acres<br>100% Good efficacy | 4lb | 60 | 12 | Group 33 |
| mefanoxam (Ridomil Gold EC, 2.5 GR) | 14.3% growers<br>12.8% acres<br>28% Excellent efficacy<br>44% Good efficacy<br>28% Poor efficacy | 0.5 lb | 45 | 48 | Group 4 |
| phosphorous acid (Phostrol, Nutriphyte) | 2% growers<br>8.8% acres<br>100% Good efficacy | 2.43lb | 0 | 4 | Group 33 |
| **Other Strategies** | | | | | |
| Raised Beds | 7.9% Growers<br>6.3% Acres<br>33% Excellent efficacy<br>67% Good efficacy | n/a | n/a | n/a | |
| Resistant Cultivars | 5.6% Growers<br>6.3% Acres<br>33% Excellent efficacy<br>50% Good efficacy<br>17% Poor efficacy | n/a | n/a | n/a | |

**Group B – Diseases identified by New England Growers to be significant problems in some years**

**Anthracnose** (*Elsinoe veneta*)
**Type of Pest:** fungal pathogen
**Biology:** Anthracnose is one of the most common and widespread diseases of brambles in the US. The fungus overwinters in the bark of within lesion on infected canes. In early spring the spores are rain-splashed, blown or carried by insects to young, susceptible plant tissue. The spores germinate in a film of water and penetrate into the plant tissue. Symptoms appear about a week later. Disease risk is greatest between bud break and the preharvest period since infections occur on young, actively growing plant tissue.
**Frequency of Occurrence:** 49% of respondents reported this disease occurring at least occasionally.

| Control needed | Percent of growers |
|---|---|
| Annually | 20% |
| Occasionally | 29% |
| Never | 51% |

**Damage Caused:** Anthracnose can cause symptoms on canes, leaves, fruit and stems of berry clusters. The most recognized symptoms appear on the canes, which will first show small purplish spots that grow in diameter and become oval in shape. The centers become sunken and are lighter in color. The margins are raised and purple to purplish-brown. If numerous the lesions may merge and cover large portions of the cane and the diseased tissue will extend down into the bark, partially girdling the cane. As the canes dry in late summer and early fall, diseased tissue often crack. In the following year, fruit produced on severely diseased canes may fail to develop to normal size. On leaves anthracnose first appears as small yellowish-white spots on the upper surface. The spots enlarge and develop darker margins. The light centers may drop out producing a "shot hole" effect.
**% Acres Affected:** 43.6% of raspberry acres affected annually.
**Timing of Control:** Budbreak through bloom.
**Yield Losses:** Yield losses are not well documented but can be significant (>25% in bad years)
**Regional Differences:** May be more prevalent in Southern New England.
**Cultural Control Practices:** Prune and burn or remove diseased canes before new canes emerge in the spring. Maintain good air circulation by controlling weeds, thinning primocanes and establishing narrowing fruiting rows.
**Biological Control Practices:** None identified.
**Postharvest Control Practices:** Good pruning practices and sanitation.
**Other Issues:** Fungicide resistance is a concern and materials of differing chemistries should be alternated in a spray program to avoid resistance development.

## Chemical Controls for *Anthracnose*

| **Pesticide** alphabetically by a.i. | **Survey Data** % growers reporting use, % acreage, efficacy rating | **Typical Dose (a.i./A)** | **PHI days** | **REI hours** | **Comments & Application Notes** |
|---|---|---|---|---|---|
| azoxystrobin (Abound) | 1.6% growers<br>2.6% acres<br>100% Good efficacy | 0.1-0.25 lb | 0 | 4 | Highly phytotoxic to some apple cultivars<br>Group 11 |
| copper hydroxide (Kocide) | 4.8% growers<br>4.6% acres<br>40% Excellent efficacy<br>60% Good efficacy | 2.5 lb | post-harvest | 24 | fall and/or delayed dormant only<br>Group M1 |
| pyraclostrobin (Cabrio EG) | 13.5% growers<br>20.9% acres<br>41% Excellent efficacy<br>59% Good efficacy | 0.175lb | 0 | 24 | Group 11 |
| pyraclostrobin boscalid (Pristine WG) | 8.7% growers<br>8.1% acres<br>64% Excellent efficacy<br>36% Good efficacy | 3-3.5 lb | 0 | 12 | Group 7 and 11 |

| | | | | | |
|---|---|---|---|---|---|
| lime sulfur (Miller's Lime Sulfur, Sulforix) | 10.3% growers<br>22.6% acres<br>62% Excellent efficacy<br>38% Good efficacy | 6-7lb | 0 | 24 | Group M2 |
| **Other Pesticides** | | | | | |
| captan (Captan 50W, 80WDG, Captec 4L) | 1% growers<br>5% acres<br>100% Good efficacy | 2-3 lb | 0 | 72 | Group M4 |

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**Spur Blight** (*Didymella applanata*)
**Type of Pest:** fungal pathogen
**Biology:** This fungus overwinters in infected cane tissue and spores produced from these infections are released in the spring and are carried by wind currents to new infections sites on new primocanes during wet, rainy periods. A second type of spore is produced within new infection sites during the summer. This type is spread by splashing rain, and can help cause an epidemic spread of disease during excessively wet years.
**Frequency of Occurrence:** 46% of respondents reported this disease occurring at least occasionally.

| Control needed | Percent of growers |
|---|---|
| Annually | 16% |
| Occasionally | 30% |
| Never | 54% |

**Damage Caused:** Chocolate brown or purple blotches centered on individual buds appear on canes in mid to late summer. Buds within the discolored areas either fail to grow or produce weak shoots the following year. Leaves on infected canes may show yellow or brown areas, which begin at the mid-vein and spread to the leaf tip. The disease is more severe on red raspberries than on blacks.
**% Acres Affected:** 31.5% of raspberry acres affected annually.
**Timing of Control:** Dormant lime-sulfur or budbreak to early bloom w/ other fungicides.
**Yield Losses:** No yield impact data available.
**Regional Differences:** None identified.
**Cultural Control Practices:** Plant less susceptible cultivars such as 'Brandywine', 'Killarny', 'Latham', and 'Newburgh'. Avoid more susceptible cultivars such as 'Royalty', 'Titan', 'Canby', 'Willamette', 'Reveille', and 'Sentry'. Prune and burn or remove diseased canes before new canes emerge in the spring. Maintain good air circulation and drying conditions by controlling weeds, thinning primocanes and establishing narrowing fruiting rows.
**Biological Control Practices:** None identified.
**Postharvest Control Practices:** Good pruning practices and sanitation.

**Other Issues:** Fungicide resistance is a concern and materials of differing chemistries should be alternated in a spray program to avoid resistance development.

## Chemical Controls for *Spur Blight*

| **Pesticide** alphabetically by a.i. | **Survey Data** % growers reporting use, % acreage, efficacy rating | **Typical Dose (a.i./A)** | **PHI days** | **REI hours** | **Comments & Application Notes** |
|---|---|---|---|---|---|
| pyraclostrobin (Cabrio EG) | 7.1% growers<br>19.5% acres<br>44% Excellent efficacy<br>45% Good efficacy<br>11% Poor efficacy | 0.175lb | 0 | 24 | Group 11 |
| pyraclostrobin boscalid (Pristine WG) | 3.1% growers<br>13.3% acres<br>50% Excellent efficacy<br>50% Good efficacy | 3-3.5 lb | 0 | 12 | Group 7 and 11 |
| sulfur (Kumulus DF) | <1% growers<br><1% acres<br>100% Poor efficacy | 4.8-12 lb | 0 | 24 | Avoid application in hot weather<br>Group M2 |
| **Other Pesticides** | | | | | |
| captan (Captan 50W, 80WDG, Captec 4L) | <1% growers<br>4.6% acres<br>100% Good efficacy | 2-3 lb | 0 | 72 | Group M4 |
| lime sulfur (Miller's Lime Sulfur, Sulforix) | <1% growers<br>1.1% acres<br>100% Good efficacy | 6-7lb | 0 | 24 | Group M2 |
| **Other Strategies** | | | | | |
| Pruning for good air circulation | 11.1% growers<br>17.4% acres<br>55% Excellent efficacy<br>45% Good efficacy | n/a | n/a | n/a | |

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**Orange Rust** (*Arthuriomyces peckianus* and *Gymnoconia nitens*)
**Type of Pest:** fungal pathogen
**Biology:** This disease occurs only on black and purple raspberries and blackberries. Red raspberries are not susceptible to infection by orange rust. The orange rust fungus overwinters within plants, which they infect systemically. New shoots growing from plants infected the previous year are already infected. The rust-colored spores produced upon the leaves of these shoots early in the growing season are spread by

wind currents. The spores can infect the leaves of healthy plants under the proper environmental conditions. These conditions are not well-defined, but are presumed to be relatively stringent.
**Frequency of Occurrence:** 42% of respondents reported this disease occurring at least occasionally.

| Control needed | Percent of growers |
|---|---|
| Annually | 10% |
| Occasionally | 32% |
| Never | 58% |

**Damage Caused:** New canes arising from infected plants in the spring are weak, spindly, and thornless and have misshapen, pale leaves. In contrast to new canes arising from a healthy plant, infected canes usually arise in bunches rather than singly. The lower surfaces of new leaves are covered first with large orange pustules that erupt several weeks after the leaves unfold.
**% Acres Affected:** 14.9% of raspberry acres affected annually.
**Timing of Control:** Bloom to post harvest.
**Yield Losses:** No yield impact data available.
**Regional Differences:** None identified.
**Cultural Control Practices:** Do not establish new plantings next to wooded areas or fence rows unless wild brambles are first eradicated. Examine new plants for symptoms about one month after planting. Re-check them for rust each following year when canes are 12-18 inches tall. Rogue out (including roots) and burn any plants suspected of infection before any spores can be produced.
**Biological Control Practices:** None commercially available.
**Postharvest Control Practices:** Rogue out infected plants.
**Other Issues:** Fungicide resistance is a concern and materials of differing chemistries should be alternated in a spray program to avoid resistance development.

## Chemical Controls for *Orange Rust*

| **Pesticide** alphabetically by a.i. | **Survey Data** % growers reporting use, % acreage, efficacy rating | **Typical Dose (a.i./A)** | **PHI days** | **REI hours** | **Comments & Application Notes** |
|---|---|---|---|---|---|
| pyraclostrobin (Cabrio EG) | 2.4% growers<br>5.9% acres<br>100% Excellent efficacy | 0.175lb | 0 | 24 | Group 11 |
| pyraclostrobin boscalid (Pristine WG) | 2.4% growers<br>3.9% acres<br>33% Excellent efficacy<br>67% Good efficacy | 3-3.5 lb | 0 | 12 | Group 7 and 11 |
| myclobutanil | 6.3% Growers | 0.5-1.0lb | 0 | 24 | |

| | | | | | |
|---|---|---|---|---|---|
| (Nova 40W) | 6.5% Acres<br>25% Excellent efficacy<br>75% Good efficacy | | | | Group 3 |
| **Other Pesticides** | | | | | |
| hydrogen dioxide (Oxidate) | <1% growers<br>5.7% acres<br>no efficacy data reported | .07-0.27 lb | 0 | 1 | OMRI listed<br>Group NC |
| cyprodinil fludioxonil (Switch 62.5WG) | <1% growers<br><1% acres<br>100% Good efficacy | .043-0.55 lb | 0* | 12* | *Orange Rust is not listed under Caneberries<br>Group 9 and 12 |
| **Other Strategies** | | | | | |
| Pruning for good air circulation | <1% growers<br>1.1% acres<br>no efficacy data reported | n/a | n/a | n/a | |
| Rogue out infected plants | 2.4% growers<br>1.9% acres<br>no efficacy data reported | n/a | n/a | n/a | |

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**Group C – Diseases identified by New England Growers as infrequent pest problem**

**Late Leaf Rust** (*Pucciniastrum americanum*)
**Type of Pest:** fungal pathogen
**Biology:** Late leaf rust is caused by the fungus *Pucciniastrum americanum*. Unlike the fungus that causes orange rust, the late leaf rust fungus is not systemic. The fungus is heteroecious, which means it requires an alternate host to complete its life cycle. The alternate host for the rust is white spruce (*Picea americanum*).
Spores are released from infected white spruce in mid-June to early July and are capable of infecting raspberry during this period. In early July powdery-yellow to orange spores start to form on the underside of infected raspberry leaves or flower parts. These can continue to cause infections on raspberry leaves and fruit throughout the growing season.
Overwintering spores develop on infected raspberry leaves in the fall and develop into the type of spore which can infect white spruce needles during rainy periods from mid-May to early June the following year, completing the life cycle.
**Frequency of Occurrence:** 36% of respondents reported this disease occurring at least occasionally.

| Control needed | Percent of growers |
|---|---|

| | |
|---|---|
| Annually | 6% |
| Occasionally | 30% |
| Never | 64% |

**Damage Caused:** On mature leaves small yellow areas initially form on the upper surface of infected leaves. These spots may eventually turn brown before leaves die in the fall. Unless the disease is severe, foliar infections may be difficult to see. Small pustules filled with yellow to orange powdery spores (not waxy like the spores of orange rust) are formed on the underside of infected leaves. Badly infected leaves may drop prematurely, and in years when the disease is severe, canes may be bare by September. Flower calyces, petioles, and fruit at all stages of development may be attacked. On fruit, pustules develop on individual drupelets, producing yellow masses of spores, which make the berries unattractive and unacceptable for fresh market sales. Infections may also occur on leaf petioles and canes.
**% Acres Affected:** 8.6% of raspberry acres affected annually.
**Timing of Control:** Early to Mid Summer.
**Yield Losses:** No yield impact data available.
**Regional Differences:** None identified.
**Cultural Control Practices:** Avoid planting raspberries in proximity to the alternate host white spruce (*Picea americanum*) especially if Christmas trees are part of the farm operation. Maintain good air circulation and drying conditions by controlling weeds, thinning primocanes and establishing narrowing fruiting rows.
**Biological Control Practices:** None identified.
**Postharvest Control Practices:** None identified.
**Other Issues:** Fungicide resistance is a concern and materials of differing chemistries should be alternated in a spray program to avoid resistance development.

## Chemical Controls for *Late Leaf Rust*

| **Pesticide** alphabetically by a.i. | **Survey Data** % growers reporting use, % acreage, efficacy rating | **Typical Dose (a.i./A)** | **PHI days** | **REI hours** | **Comments & Application Notes** |
|---|---|---|---|---|---|
| hydrogen dioxide (Oxidate) | <1% growers<br>5.7% acres<br>100% Good efficacy | .07-0.27 lb | 0 | 1 | OMRI listed<br>Group NC |
| myclobutanil (Nova 40W) | 1.6% Growers<br>7.7% Acres<br>50% Excellent efficacy<br>50% Good efficacy | 0.5-1.0lb | 0 | 24 | Group 3 |
| **Other Strategies** | | | | | |
| Pruning for good air circulation | <1% growers<br>1.1% acres<br>100% Good efficacy | n/a | n/a | n/a | |

**Viruses** (Mosaic, Leaf Curl, Raspberry Streak, Tomato Ringspot Virus)
**Type of Pest:** viral pathogens
**Biology:** The life cycles of these pathogens varies but each involves a vector which transmits the virus from infected plants to uninfected ones. Tomato ringspot virus is spread by the dagger nematode*. Xihinema americanum.* Mosaic virus is spread by the large raspberry aphid, *Amphorophora agathonica.* The raspberry leaf curl virus is spread by the small raspberry aphid *(Aphis rubicola).* Once the virus is introduced to the plants, infections are permanent and no pesticide will eliminate the infection. Damage and spread may occur slowly but will eventually infect the whole planting if infected plants are not removed and destroyed.
**Frequency of Occurrence:** 36% of respondents reported this disease occurring at least occasionally.

| Control needed | Percent of growers |
|---|---|
| Annually | 7% |
| Occasionally | 29% |
| Never | 64% |

**Damage Caused:** Symptoms vary among the viruses mentioned, but generally include mottled and/or crinkly appearance of the foliage, distortion of growth on primocanes, streaking appearance of canes and crumbly fruit. Some viruses (Mosaic, Tomato Ringspot) are more abundant, some cause more significant yield impact (Leaf Curl), while others infect only certain types of bramble plants (Raspberry Streak).
**% Acres Affected:** Unknown
**Timing of Control:** Preplant for nematode vectored viruses; early to mid-summer for aphid vectored viruses.
**Yield Losses:** No yield impact data available.
**Regional Differences:** None identified.
**Cultural Control Practices:** Wild brambles must be eliminated in the vicinity of commercial raspberry plantings (500-1,000 ft.). Recheck the areas annually for regrowth and rogue out as needed. Use certified, disease-free, virus-indexed plant material that is produced from tissue culture propagation. This eliminates the risk of importing viruses in nursery plants into new fields.
Avoid planting black or purple raspberries near red raspberries. Even if the red raspberries appear healthy they may have latent infections which can still be transmitted from them to healthy black or purple raspberries. If black and red raspberries are planted together, separate them as far as possible and plant black raspberries upwind from reds to reduce the ability of aphids to migrate from one to the other.
Rogue out all plants showing any virus symptoms twice each growing season, about mid-June and again in late August or September. Before removing infected plants, kill all aphids on them by spraying infected plants with an insecticide a day or two before removal. Dig out the diseased plants, including roots, and dispose of them away from the planting site.

For nematodes-transmitted viruses, the nematodes must be controlled to control the disease. Have soil tested for plant parasitic nematodes before planting. Samples should be taken in July of the year preceding planting. Avoid sites where nematode vectors are abundant.
**Biological Control Practices:** None commercially available.
**Postharvest Control Practices:** None recommended.
**Other Issues:** None identified.

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**Verticillium Wilt** (*Verticillium albo-atrum*)
**Type of Pest:** fungal pathogen
**Biology:** This common fungus has a wide host range and can be carried over in fields that have grown susceptible crops (e.g., tomato, potato, strawberry) prior to planting raspberries. The fungus persists in the soil in an actively growing state or as dormant resting structures and Infection occurs when roots come in contact with one of these structures. Once inside the plant tissue, the fungus grows into the water-conducting cells of the root (xylem), and produces spores that help spread the infection upward into the cane xylem with the normal flow of water. Infected xylem cells develop constrictions and become plugged by the growth of the fungus within them. Eventually, the flow of water is so restricted that the canes wilt and die. Fungal structures are then returned to the soil as the dead roots decompose and spores become available to infect new plants. The disease is favored by cool, wet spring weather.
**Frequency of Occurrence:** 32% of respondents reported this disease occurring at least occasionally.

| Control needed | Percent of growers |
|---|---|
| Annually | 4% |
| Occasionally | 28% |
| Never | 68% |

**Damage Caused:** Leaves wilt, turn yellow, and fall off, starting from the bottom of the cane and progressing toward the top. Symptoms frequently appear on only one side of a cane or on only one or two canes out of several in group growing from the same crown. This disease is much more severe on black raspberries than on reds.
**% Acres Affected:** Unknown.
**Timing of Control:** Pre-plant.
**Yield Losses:** No yield impact data available.
**Regional Differences:** None identified.
**Cultural Control Practices:** Red raspberries are more resistant to wilt than black raspberries. Avoid planting raspberries on sites where other susceptible hosts have been grown, including potato, tomato, eggplant, pepper, strawberry, cherry, squash, and cucumber. If unavoidable, non-host crops such as wheat or corn should be grown for at least 2 years prior to planting raspberries.
Many weeds, particularly nightshade, horse nettle, ground-cherry, redroot pigweed, and lambsquarters, are hosts of the *Verticillium* fungus. These weeds should be strictly

controlled in current and future planting sites to keep the Verticillium population low.
**Biological Control Practices:** None commercially available.
**Postharvest Control Practices:** None identified.
**Other Issues:** None identified.

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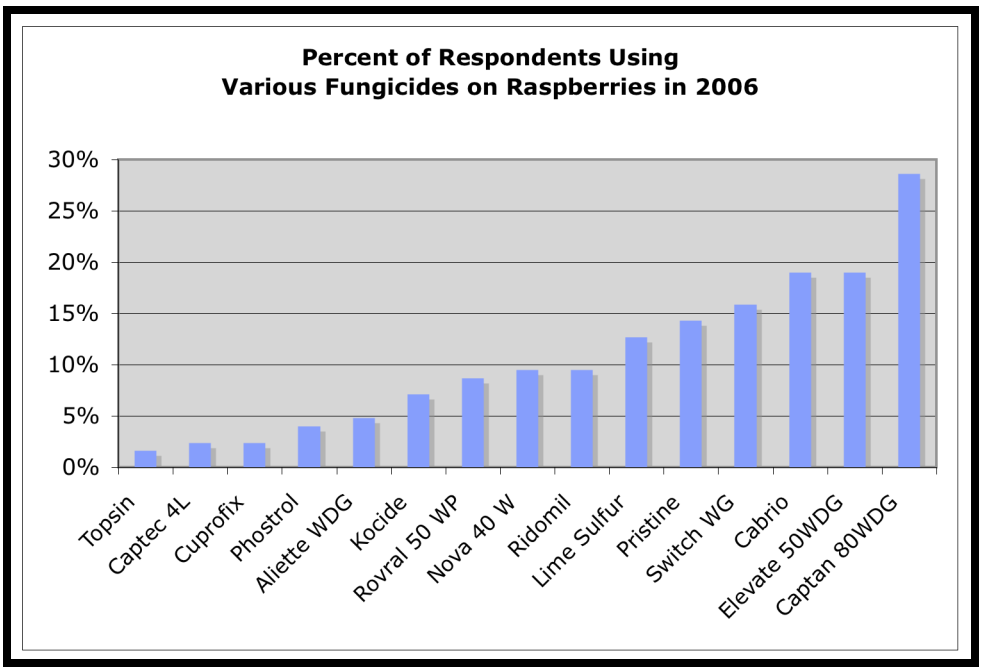
**Crown Gall** (*Agrobacterium tumefaciens*)
**Type of Pest:** bacterial pathogen
**Biology:** Crown gall bacteria enter the plant only through natural openings or wounds in the epidermis or bark of the plant. The bacteria survive in infested soil for years and can invade the roots and crowns of susceptible plants through natural growth cracks, tissue damaged by winter injury, or damage caused by soil insects. Man-made wounds that occur during pruning and cultivation are important points of entry. After the bacteria enter plant tissues, an incubation period of 11 to 28 days, or more if the host is dormant, may be required before the bacteria induce cell proliferation, enlargement, and disorganized growth, resulting in the production of galls. Bacteria, abundant in the outer portions of galls, are continually sloughed off into the soil. The bacteria overwinter in soil and in diseased galls. The following spring, these bacteria are spread by splashing rain, water, cultivation (any practice that moves soil), pruning tools, and insect feeding. When they contact wounded tissue of a susceptible host, they enter and induce gall formation, completing the disease cycle.
**Frequency of Occurrence:** 30% of respondents reported this disease occurring at least occasionally.

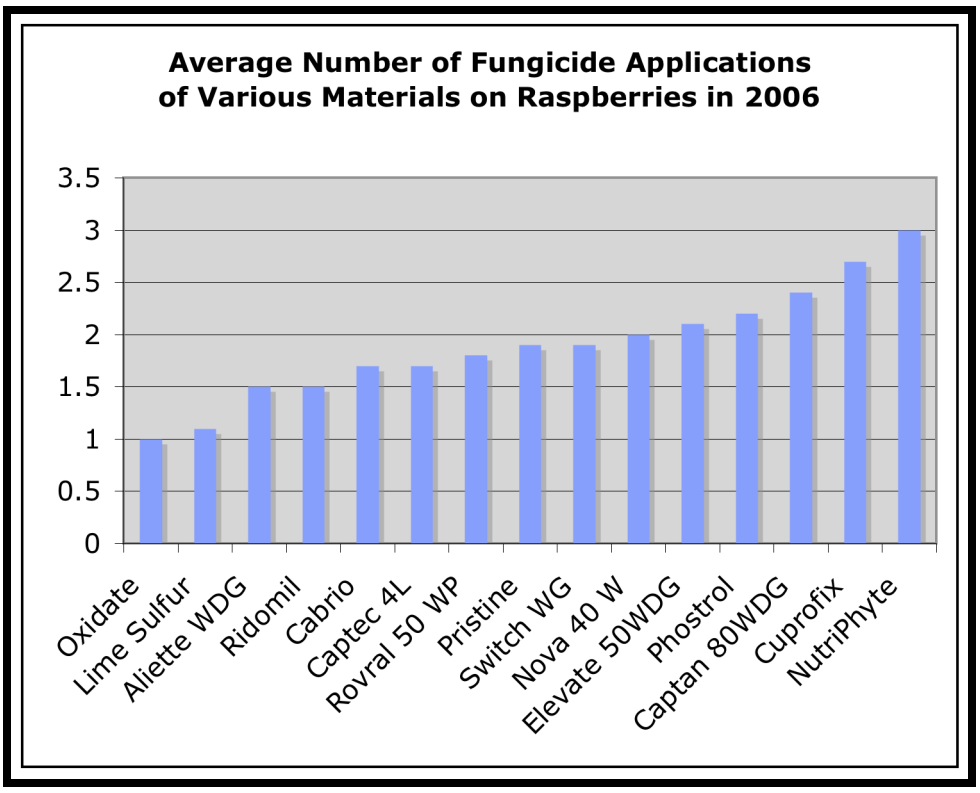
| Control needed | Percent of growers |
|---|---|
| Annually | 4% |
| Occasionally | 26% |
| Never | 70% |

**Damage Caused:** Young galls are rough and spongy and can vary in size from a pinhead to several inches in diameter. They develop near the soil line or underground in the spring and become hard, brown to black, woody knots as they age. The tops of infected plants may show no symptoms, but plants with numerous galls may be stunted; produce dry, poorly-developed berries; break easily and fall over; or show various deficiency symptoms due to impaired uptake and transport of nutrients and water.
**% Acres Affected:** Unknown.
**Timing of Control:** Pre-plant.
**Yield Losses:** No yield impact data available.
**Regional Differences:** None identified.
**Cultural Control Practices:** Purchase certified plant material; sanitation to avoid spread; crop rotation; avoid winter injury.
**Biological Control Practices:** A biocontrol agent (Galltrol) is currently available as a preplant treatment.

**Postharvest Control Practices:** None recommended.

**Other Issues:** None identified.




**Fungicides used on Raspberries in 2006:**

| Chemical Name | Formulations | Target pests | PHI (days) | REI (hrs) | Label Issues | Fungicide Resistance Group |
|---|---|---|---|---|---|---|
| azoxystrobin | Abound | • Powdery Mildew<br>• Anthracnose | 0 | 4 | | Group 11 |
| captan | Captan 50W<br>Captan 80WDG<br>Captec 4L | • Gray Mold<br>• Cane blight<br>• Anthracnose<br>• Spur blight | 0 | 72 | | Group M4 |
| chlorothalonil | Bravo Ultrex<br>Weather Stik | • Powdery Mildew | n/a | n/a | not labeled for caneberries | Group M5 |
| copper hydroxide | Champ<br>Kocide | • Cane blight<br>• Anthracnose | pb<br>ph | 24 | | Group M1 |
| cyprodinil fludioxonil | Switch 62.5WG | • Gray Mold<br>• Powdery Mildew*<br>• Orange Rust* | 0 | 12 | * not labeled under caneberries | Groups 9 and 12 |
| fenbuconazole | Indar 2F<br>Indar 75WSB | • Gray Mold | n/a | n/a | not labeled for caneberries | Group 3 |
| fenhexamid | Elevate 50WDG | • Gray Mold | 0 | 12 | | Group 17 |
| fosetyl al or aluminum tris | Aliette WDG | • Phytophthora | 60 | 12 | | Group 33 |
| hydrogen dioxide | Oxidate | • Gray Mold<br>• Powdery Mildew<br>• Orange Rust<br>• Late Leaf Rust | 0 | 1 | | No Group |
| iprodione | Rovral4F | • Gray Mold | 0 | 24 | | Group 2 |
| lime sulfur | Miller's Lime Sulfur<br>Sulforix | • Gray Mold<br>• Cane Blight<br>• Anthracnose<br>• Spur Blight | 0 | 24 | | Group M2 |
| mefanoxam | Ridomil Gold EC<br>Ridomil Gold 2.5 GR | • Phytophthora | 45 | 48 | | Group 4 |
| myclobutanil | Nova 40W | • Powdery Mildew<br>• Cane Blight<br>• Orange Rust<br>• Late Leaf Rust | 0 | 4 | | Group 3 |
| phosphorous acid | Phostrol<br>Nutriphyte | • Phytophthora | 0 | 4 | | Group 33 |
| potassium bicarbonate | Milstop | • Gray Mold<br>• Powdery Mildew | 0 | 1 | | Group NC |

| | | | | | | |
|---|---|---|---|---|---|---|
| pyraclostrobin | Cabrio EG | • Gray Mold<br>• Powdery Mildew<br>• Cane Blight<br>• Anthracnose<br>• Spur Blight<br>• Orange Rust | 0 | 24 | | Group 11 |
| pyraclostrobin boscalid | Pristine | • Gray Mold<br>• Powdery Mildew<br>• Anthracnose<br>• Spur Blight<br>• Orange Rust | 0 | 12 | | Groups 7 and 11 |
| sulfur | Kumulus DF | • Spur Blight | 0 | 24 | | Group M2 |
| thiophanate-methyl | Topsin-M | • Gray Mold | n/a | n/a | not labeled for caneberries | Group 1 |

## Cultural practices used to control raspberry diseases and their efficacy (write-in responses; 94% survey recipients report using these methods overall).

| %Growers | #Growers | Practices used to manage diseases |
|---|---|---|
| **76.2** | **96** | Prune out diseased plants |
| **63.5** | **80** | Use certified virus-free plants |
| **63.5** | **80** | Narrow fruit rows about 2 feet wide |
| **60.3** | **76** | Thin to 4 to 5 canes per foot of row |
| **46.0** | **58** | Application of fungicides |
| **42.9** | **54** | Disease tolerant varieties |
| **34.1** | **43** | Plant rows in direction of prevailing winds |
| **31.7** | **40** | Remove all wild brambles within 600 feet of planting |
| **24.6** | **31** | Raised beds |
| **19.0** | **24** | Crop rotation |
| **1.6** | **2** | Good trellis system |
| **1** | **1** | Rows far apart |
| **1** | **1** | Increase organic matter |
| **1** | **1** | Plant in high tunnel |
| **1** | **1** | Soil management |
| **1** | **1** | Increase drainage |

# IV. Weeds

**General Description of Damage**: Weeds reduce yields by competing with the crop for water, light, and nutrients. Weeds can also serve as alternate hosts for insects, diseases, and nematodes. They can inhibit spray penetration, air circulation, and drying conditions. They can also promote infestations by small vertebrate pests such as voles and mice.

**General description of herbicide practices:** Weed infestations occur in mixed populations (i.e., annual and perennial grasses and broadleaf weeds). Herbicide applications are made often to control a range of weeds. Success in weed management can start with preplant site preparation practices including herbicide applications. Herbicide use is described below in table summarizing preplant applications and post plant preemergence and postemergence herbicide applications.

**Group A – Weeds identified by New England Growers as most important**
Annual broadleaf weeds
Annual grasses
Perennial grasses
Perennial broadleaf weeds

**Group B – Weeds identified by New England Growers to be significant problems in some years**
None Identified

**Group C – Weeds identified by New England Growers as occasional pest problem**
None Identified

| Weed Type | Growers Needing Some Control | Annual Control Needed | Occasional Control Needed | No Control Needed |
|---|---|---|---|---|
| Annual Broadleaf | 95% | *82%* | *13%* | *5%* |
| Annual Grasses | 93% | *77%* | *16%* | *7%* |
| Perennial Grasses | 91% | *73%* | *18%* | *9%* |
| Perennial Broadleaf | 96% | *70%* | *26%* | *4%* |

## Transplant Year

**Pre-emergence Control**
**Frequency of Use:** 17.5% of survey respondents reported making this application
**Damage Caused:** See General Description of Damage above.
**Percent acres affected:** 25.7% of acres
**Timing of Control:** varies according to material and target weeds.

**Yield Losses:** Variable
**Regional Differences:** none identified.
**Biological control:** none identified
**Other Issues:** none identified

**Herbicides used for Pre-emergence Control in the Transplant Year**

| **Pesticide** alphabetically by a.i. | **Survey Data** % growers reporting use, % acreage, efficacy rating | **Typical Dose (a.i./A)** | **PHI days** | **REI hours** | **Comments & Application Notes** |
|---|---|---|---|---|---|
| napropamide (Devrinol 50DF, 10G) | 6.3% growers<br>9.9% acres<br>25% Excellent efficacy<br>75% Good efficacy | 4 lb | 0 | 12 | Group 15 |
| simazine (Princep 4L, 90WDG, Caliber 90) | 10.3% Growers<br>27.2% Acres<br>33% Excellent efficacy<br>50% Good efficacy<br>17% Poor efficacy | 2-4 lb | | 12 | Group 5 |
| oryzalin (Surlfan 4AS, DF) | 4.8% Growers<br>8.9% Acres<br>17% Excellent efficacy<br>83% Good efficacy | 2-6 lb | | 24 | Group 3 |
| **Other Pesticides** | | | | | |
| metam sodium (Vapam HL) | <1% growers<br>1.1% acres<br>100% Excellent efficacy | n/a | n/a | n/a | Not labeled for use in caneberries |
| **Other Strategies** | | | | | |
| Handweed | <1% growers<br><1% acres<br>no efficacy data reported | n/a | n/a | n/a | |

**Post-Emergence Control**
**Frequency of Use:** 14.3% of survey respondents reported making this application
**Damage Caused:** See General Description of Damage above.
**Percent acres affected:** 27.1% of acres
**Timing of Control:** varies according to material and target weeds.
**Yield Losses:** Variable
**Regional Differences:** none identified.
**Biological control:** none identified
**Other Issues:** none identified

**Herbicides used for Post-emergence Control in the Transplant Year**

| **Pesticide** alphabetically by a.i. | **Survey Data** % growers reporting use, % acreage, efficacy rating | **Typical Dose (a.i./A)** | **PHI days** | **REI hours** | **Comments & Herbicide Group** |
|---|---|---|---|---|---|
| flauzifop (Fusilade DX) | 2.4% growers<br>2.3% acres<br>67% Excellent efficacy<br>33% Poor efficacy | 0.25-0.375 lb | I year | 12 | Group 1 |
| sethoxidim (Poast) | 10.3% Growers<br>27.2% Acres<br>33% Excellent efficacy<br>50% Good efficacy<br>17% Poor efficacy | 0.14 – 0.47 lb | 45 | 12 | Group 1 |
| **Other Pesticides** | | | | | |
| glyphosate (Roundup Weather Max) | 1.6% growers<br>3.0% acres<br>100% Excellent efficacy | 0.25 – 0.75 lb | 14 | 12 | Group 9 |
| **Other Strategies** | | | | | |
| Hand-weeding | <1% growers<br><1% acres<br>100% Poor efficacy | n/a | n/a | n/a | |
| Plastic mulch | <1% growers<br><1% acres<br>no efficacy data reported | n/a | n/a | n/a | |

## Established Plantings

**Pre-emergence Control**
**Frequency of Use:** 38.1% of survey respondents reported making this application
**Damage Caused:** See General Description of Damage above.
**Percent acres affected:** 52.8% of acres
**Timing of Control:** varies according to material and target weeds.
**Yield Losses:** Variable
**Regional Differences:** none identified.
**Biological control:** none identified
**Other Issues:** none identified

**Herbicides used for Pre-emergence Control in Established Plantings**

| **Pesticide** alphabetically by a.i. | **Survey Data** % growers reporting use, % acreage, efficacy rating | **Typical Dose (a.i./A)** | **PHI days** | **REI hours** | **Comments & Herbicide Group** |
|---|---|---|---|---|---|
| dichlobenil | 14.3% growers<br>24.2% acres | 4 lb | 0 | 12 | |

| | | | | | |
|---|---|---|---|---|---|
| (Casoron 50WP, 4G) | 56% Excellent efficacy<br>44% Poor efficacy | | | | Group 20 |
| napropamide (Devrinol 50DF) | 7.1% Growers<br>9.3% Acres<br>33% Excellent efficacy<br>67% Good efficacy | 4 lb | 0 | 12 | Group 15 |
| simazine (Princep 4L) | 20.6% Growers<br>31.9% Acres<br>15% Excellent efficacy<br>73% Good efficacy<br>12% Poor efficacy | 2-4 lb | 0 | 12 | Group 5 |
| terbacil (Sinbar 80WP) | 10.3% Growers<br>16.8% Acres<br>38% Excellent efficacy<br>62% Good efficacy | 0.8-1.6 lb | 70 | 12 | Group 5 |
| norflurazon (Solicam 80DF) | 2.4% Growers<br>4.7% Acres<br>33% Excellent efficacy<br>67% Good efficacy | 2-4 lb | - | 12 | Group 12 |
| oryzalin (Surflan 4AS) | 4.8% Growers<br>14.5% Acres<br>17% Excellent efficacy<br>66% Good efficacy<br>17% Poor efficacy | 2-4 lb | - | 24 | Group 3 |
| **Other Pesticides** | | | | | |
| sethoxidim (Poast) | <1% Growers<br><1% Acres<br>no efficacy data reported | 0.14 – 0.47 lb | 45 | 12 | Group 1 |
| **Other Strategies** | | | | | |
| Plastic mulch | <1% growers<br><1% acres<br>no efficacy data reported | n/a | n/a | n/a | |

**Post-emergence Control**
**Frequency of Use:** 37.3% of survey respondents reported making this application
**Damage Caused:** See General Description of Damage above.
**Percent acres affected:** 39.8% of acres
**Timing of Control:** varies according to material and target weeds.
**Yield Losses:** Variable
**Regional Differences:** none identified.
**Biological control:** none identified
**Other Issues:** none identified

**Herbicides used for Post-emergence Control in Established Plantings**

| **Pesticide** alphabetically by a.i. | **Survey Data** % growers reporting use, % acreage, efficacy rating | **Typical Dose (a.i./A)** | **PHI days** | **REI hours** | **Comments & Herbicide Group** |
|---|---|---|---|---|---|
| paraquat (Gramoxone Max) | 6.3% growers<br>8.2% acres<br>12% Excellent efficacy<br>62% Good efficacy<br>26% Poor efficacy | 0.6 – 0.9 lb | - | 12 | Restricted Use<br>Group 22 |
| sethoxidim (Poast) | 16.7% growers<br>22.6% acres<br>25% Excellent efficacy<br>55% Good efficacy<br>20% Poor efficacy | 0.14 – 0.47 lb | 45 | 12 | Group 1 |
| glyphosate (Roundup Ultra) | 21% growers<br>17% acres<br>30% Excellent efficacy<br>60% Good efficacy<br>10% Poor efficacy | 0.25 – 0.75 lb | 14 | 12 | Group 9 |
| pelargonic acid (Scythe) | 1.6% growers<br>1.9% acres<br>50% Good efficacy<br>50% Poor efficacy | 2.25-20 gal | - | 12 | Group 27 |
| **Other Pesticides** | | | | | |
| 2,4-D (Formula 40) | <1% Growers<br>1.7% Acres<br>50% Good efficacy | 0.95 lb | n/a | n/a | Not labeled for caneberries<br>Group 4 |
| terbacil (Sinbar 80WP) | <1% Growers<br>1.7% Acres<br>100% Excellent efficacy | 0.8-1.6 lb | 70 | 12 | Group 5 |

| ***Chemical Name*** | ***Formulations*** | ***Target pests*** | ***PHI (days)*** | ***REI (hrs)*** | ***Label Issues*** | ***Fungicide Resistance Group*** |
|---|---|---|---|---|---|---|
| 2,4-D | Formula 40 | Emerged annual and perennial broadleaf | n/a | n/a | Not labeled for caneberries | Group 4 |
| dichlobenil | Casoron 50WP | Preemergence | 0 | 12 | | Group 20 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Casoron 4G | annual and perennial broadleaf | | | | |
| flauzifop | Fusilade DX | Emerged annual and perennial grasses | I year | 12 | | Group 1 |
| glyphosate | Roundup Weather Max, Ultra | Emerged annual and perennial grasses and broadleafs | 14 | 12 | | Group 9 |
| metam sodium | Vapam HL | Soil fumigation all weeds | n/a | n/a | Not labeled for caneberries | |
| napropamide | Devrinol 50DF Devrinol 10G | Preemergence annual grasses and certain broadleafs | 0 | 12 | | Group 15 |
| norflurazon | Solicam 80DF | Preemergence annual grasses and certain broadleafs | - | 12 | | Group 12 |
| oryzalin | Surflan 4AS Surflan DF | Preemergence annual grasses and certain broadleafs | | 24 | | Group 3 |
| paraquat | Gramoxone Max | Burndown of emerged annuals and perennials | - | 12 | Restricted Use | Group 22 |
| pelargonic acid | Scythe | Burndown of emerged annuals and perennials | - | 12 | | Group 27 |
| sethoxidim | Poast | Emerged annual and perennial grasses | 45 | 12 | | Group 1 |
| simazine | Princep 4L Princep 90WDG Caliber 90 | Preemergence annual broadleafs | | 12 | | Group 5 |
| terbacil | Sinbar 80WP | Preemergence annual broadleafs | 70 | 12 | | Group 5 |

**Cultural Control Practices:** A variety of cultural control practices are employed for weed control in raspberries. These practices are used for all types of weeds and are summarized below:

| Practices | %Respondents | Excellent | Good | Poor |
|---|---|---|---|---|
| **Hand weeding** | 74% | 33% | 55% | 12% |
| **Mulching** (see below) | 39% | 42% | 48% | 10% |
| **Mechanical cultivation** | 37% | 29% | 62% | 9% |
| **Hoeing** | 32% | 20% | 62% | 18% |

| | | | | |
|---|---|---|---|---|
| **Mowing** | 5% | 33% | 50% | 17% |
| **No-till or zone-till** | 2% | 0% | 67% | 33% |
| **Weed whacker** | 1% | 0% | 100% | 0% |
| **Flaming** | 1% | 0% | 0% | 100% |

| **Mulch Material Used** | **#Growers** | **Excellent** | **Good** | **Poor** |
|---|---|---|---|---|
| **Wood chips** | 24% | 56% | 33% | 11% |
| **Sawdust** | 16% | 16% | 67% | 18% |
| **Compost manure** | 13% | 20% | 80% | 0% |
| **Straw/Barley straw** | 11% | 20% | 50% | 25% |
| **Hay** | 11% | 100% | 0% | 0% |
| **Leaves/chopped leaves** | 5% | 50% | 50% | 0% |
| **Bark** | 5% | 50% | 50% | 0% |
| **Plastic** | 5% | 100% | 0% | 0% |

# V. Vertebrate Pests

**Group A –** Vertebrate Pests identified by New England Growers as most important

## Birds (*various species*)

**Type of pest**: small vertebrate
**Biology:** Various
**Frequency of Occurrence:** 56% of respondents reported this pest occurring at least occasionally.

| Control needed | Percent of growers |
|---|---|
| routine annual control | 13% |
| occasional control | 43% |
| never a problem | 44% |

**Damage Caused:** Birds (especially Cedar Waxwings, *Bombycilla cedrorum*) feed on ripe fruit in the field by pecking at it. This damage renders the fruit unmarketable. Feeding damage varies widely by location and year.
**Percent acres affected:** Undetermined
**Timing of Control:** Early season control so that birds do not begin feeding on fruit. Once feeding has started, bird management is much more difficult.
**Yield Losses:** Undetermined
**Regional Differences:** bird pressure varies a lot with location, but a method for predicting high pressure locations, aside from field history, has not been established to date.

**Cultural Control Practices:**

| Strategy | %Growers | %Excellent | %Good | %Poor |
|---|---|---|---|---|
| **Scare-eyed balloons** | 32% | 7% | 50% | 43% |
| **Recorded distress call devices** | 18% | 0% | 75% | 25% |
| **Cannons** | 18% | 25% | 50% | 25% |
| **Shell crackers** | 9% | 25% | 75% | 0% |
| **Shoot** | 7% | 33% | 67% | 0% |
| **Nylon flash tape** | 7% | 0% | 50% | 50% |
| **Avitrol bait** | 2% | 0% | 100% | 0% |
| **Plant extra raspberry** | 2% | 0% | 100% | 0% |
| **Owls** | 2% | 0% | 0% | 100% |
| **Balloons** | 2% | 0% | 100% | 0% |
| **Cats** | 1% | 100% | 0% | 0% |

**Biological control:** None identified
**Postharvest Control Practices:** None identified.
**Other Issues:** None identified.

## **Mice and Voles** (*Peromyscus sp, Microtus pennsylvanicus, Microtus pinetorum*)

**Type of pest**: small vertebrate

**Biology:** White-footed mice are commonly found in diverse habitats including open, grassy, brushy and wooded areas. They spend the winter as a family group in a nest made of stems, leaves, sticks and roots and lined with fur, feathers or shredded cloth. Nests are found underground or in protected areas such as old burrows, under boards, hollow logs or buildings. Breeding occurs from spring to fall, with two to four litters of one to eight young per year. Mice born in spring or summer may breed that same year. White-footed mice feed in an area from 1/3 to 4 acres.

Voles are active day and night the entire year. They construct a complex tunnel system with surface runways and numerous burrow entrances. A single tunnel system may contain several adults and young.

Voles have short life spans, ranging from two to sixteen months. Breeding occurs primarily in spring and summer, producing from one to five litters of three to six young per year. Females mature in 35 to 40 days.

**Frequency of Occurrence:** 32% of respondents reported this pest occurring at least occasionally.

| Control needed | Percent of growers |
|---|---|
| routine annual control | 13% |
| occasional control | 19% |
| never a problem | 68% |

**Damage Caused:** Mice and voles feed on underground plant parts. When populations are high, crop damage to roots and crowns can be extensive. In addition to direct feeding on the raspberry plants, their extensive tunnel systems cause root destruction and interfere with crop irrigation, as well. In late summer and fall, voles store seeds, tubers, bulbs and rhizomes in their tunnels which can add to weed control problems in the field.

**Percent acres affected:** Undetermined

**Timing of Control:** Early season control is the most important, especially in newly planted fields. But, year-round control must be maintained in high pressure locations.

**Yield Losses:** Undetermined

**Regional Differences:** none identified

| Strategy | %Growers | %Excellent | %Good | %Poor |
|---|---|---|---|---|
| **Mouse baits** | 30% | 38% | 62% | 0% |
| **Mow grass** | 12% | 0% | 100% | 0% |
| **Cats** | 3% | 100% | 0% | 0% |
| **Plastic owls** | 3% | 100% | 0% | 0% |
| **Dogs** | 3% | 0% | 100% | 0% |

| | | | | |
|---|---|---|---|---|
| **No sod** | 3% | 0% | 100% | 0% |
| **Fill in holes** | 3% | 0% | 0% | 0% |
| **Weed management** | 3% | 0% | 100% | 0% |

**Biological control:** None identified
**Postharvest Control Practices:** Mice and voles do not feed on fruit, so control is not related to the harvest period.
**Other Issues:** None identified.

**Group B –** Vertebrate Pests identified by New England Growers to be significant problems in some years
**Whitetail Deer (***Odocoileus virginianus*)
**Type of pest**: large vertebrate
**Biology:** White-tailed deer breed from mid-September through late February, with peak breeding occurring during mid-November. Fawns are born in the spring after 200 days gestation. Does (and occasionally fawns) usually produce a single fawn during their first pregnancy. Twins are typically born in subsequent years in areas with adequate food resources. Triplets may also occur.
Bucks begin antler development in spring and antler size depends on both age and nutrition. The growing bone is covered with hairy skin called velvet which nourishes the antler. The bone hardens and the velvet is rubbed off in the fall. Bucks shed their antlers each winter.
Deer consume a variety of vegetative foods and show considerable preferences for individual plants and plant parts. Commonly-eaten foods include grasses, fruits, nuts, herbs and mushrooms, as well as leaves and stems from trees and shrubs. Deer concentrate their feeding on woody materials when herbaceous plants are unavailable.
**Frequency of Occurrence:** 27% of respondents reported this pest occurring at least occasionally.

| Control needed | Percent of growers |
|---|---|
| routine annual control | 14% |
| occasional control | 13% |
| never a problem | 73% |

**Damage Caused:** Deer may occasionally trample crops, but the primary form of damage consists of feeding on selected plant parts. Without control measures, damage levels may severely reduce crop yields on many sites especially in sites near woods or other refugia.
Deer browsing damage is readily distinguished from that caused by rabbits or rodents. Deer leave a ragged, broken end on browsed crowns or rip crowns out of the ground, compared to the cleanly-nipped terminal left by other wildlife.
**Percent acres affected:** undetermined
**Timing of Control:** Early season control is the most important, especially in newly planted fields. But, year-round control must be maintained in high pressure locations.

**Yield Losses:** undetermined
**Regional Differences:** none identified

| Strategy | %Growers | %Excellent | %Good | %Poor |
|---|---|---|---|---|
| **Hunting/Shoot** | 40% | 48% | 24% | 28% |
| **Dogs** | 18% | 30% | 50% | 20% |
| **Electric fence** | 15% | 44% | 33% | 23% |
| **Hanging soap** | 11% | 14% | 72% | 14% |
| **Fence (non electric)** | 8% | 60% | 40% | 0% |
| **Baited (peanut butter) electric fence** | 2% | 0% | 100% | 0% |
| **Moth balls** | 2% | 100% | 0% | 0% |
| **Garlic** | 2% | 100% | 0% | 0% |
| **Human urine** | 1% | 100% | 0% | 0% |
| **Coyote urine** | 1% | 100% | 0% | 0% |
| **Capsaicin (Spray repellent)** | 0% | | | |
| **Hinder (Spray repellent)** | 0% | | | |
| **Deer Away (spray repellent)** | 0% | | | |

**Biological control:** None identified
**Postharvest Control Practices:** Deer do not feed on fruit, so control is not related to the harvest period.
**Other Issues:** Efficacy and affordability of control measures need to be addressed by research.

**Wild Turkey** (*Meleagris gallapavo*)
**Type of pest**: large vertebrate
**Biology:** Turkeys are active during the day, roosting at night to avoid predators. In residential areas, it is not uncommon for turkeys to roost on railings, roofs, or sometimes on vehicles. Gobbling, during breeding season, usually starts around mid-March, peaking in early May. This is when the males puff out their feathers, fan their tails and "strut their stuff." Hens lay eggs after the first mating. The nest is a shallow, leaf-lined depression on the ground, and contains 12 to 15 eggs. Hatching occurs after an incubation period of 28 days. Broods usually appear in the first week of June. The young poults are active as soon as they hatch. Predators such as foxes and goshawks may take a few young turkeys, and cold spring rains can easily chill the poorly-feathered young birds. Young turkeys remain with their mother for at least 4 to 5 months. Turkeys learn from each other, often by imitation, and, by associating with older more experienced birds, remember the layout of their home ranges and the location of various foods.
**Frequency of Occurrence:** 23% of respondents reported this pest occurring at least occasionally.

| Control needed | Percent of growers |
|---|---|

| | |
|---|---|
| routine annual control | 6% |
| occasional control | 17% |
| never a problem | 77% |

**Damage Caused:** Turkeys feed on fruit especially in dry seasons when they are a source of moisture as well as food. Damage can be particularly severe in fall bearing varieties as the turkeys are feeding heavily to prepare for winter.
**Percent acres affected:** undetermined
**Timing of Control:** As with most wildlife, control before feeding starts is best. It is very difficult to deter feeding once it has started. Mid to late season is when pressure is heaviest.
**Yield Losses:** undetermined
**Regional Differences:** none identified

| **Strategy** | **%Growers** | **%Excellent** | **%Good** | **%Poor** |
|---|---|---|---|---|
| Shoot | 36% | 75% | 25% | 0% |
| Dogs | 18% | 0% | 200% | 0% |
| Electric fence | 10% | 0% | 0% | 100% |
| Cannons | 9% | 0% | 100% | 0% |
| Fence | 9% | 100% | 0% | 0% |
| Scare crackers | 9% | 0% | 100% | 0% |
| Aluminium pie plates | 9% | 0% | 100% | 0% |

**Biological control:** None identified
**Postharvest Control Practices:** Hunting
**Other Issues:** Efficacy and affordability of control measures need to be addressed by research.

**Group C – Vertebrate Pests identified by New England Growers as occasional pest problem**

**Skunks** (*Mephitis mephitis*) 8% of respondents reported this pest occurring.
**Porcupines** (*Erethizon dorsatum*) 4% of respondents reported this pest occurring.
**Raccoons** (*Procyon lotor*) 4% of respondents reported this pest occurring.
**Black Bear** (*Ursus americanus*) 4% of respondents reported this pest occurring.

## VI. Acknowledgements and Contacts

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