



WSU Whatcom County Extension

Integrated Pest Management for Blueberries

Introduction

This manual is intended to be used as a tool to aid in sampling and decision-making for managing key insect, mite, and disease pests in Northwest Washington blueberry fields. It compiles information from numerous written sources and practical pest scouting experience of growers in Whatcom County.

This manual is based on crop stage and pest development because this is the way the grower or scout encounters blueberry pests and decides how to manage them. The crop stages are divided into five periods:

Pre-Bloom ([link](#))

Bloom ([link](#))

Pre-Harvest ([link](#))

Harvest ([link](#))

Post-Harvest ([link](#))

Key pest biology, sampling methods, and treatment thresholds are presented in a narrative form for each of the five crop stages. Scouting sheets for each of these crop stages are available in pdf form which can be printed out and used for each scouting trip. A matrix is provided for each crop stage which shows identification, monitoring, decision points, and management options in a convenient layout ([link to these pages at left](#)). Pest profiles are provided for each insect, disease, and weed pest – these sheets provide information on the identification, life history, and management of the pest as well as pictures and links to other relevant web pages. The weed management section is a new addition to this manual and incorporates a weed inventory scouting method. As in the apple and raspberry IPM manuals, this manual provides a section on “Pesticide Selection” and “Pesticides and Water”. Additional resources, such as books and websites, are provided in the section relevant to that resource.

It is our hope that growers, chemical company field representatives, private consultants, extension agents and others who are interested in blueberry IPM will use this manual. This manual is directly developed from previous manuals produced from the Nooksack IPM Project. This manual has been designed in a compact disc and online format, which will allow the user to easily navigate through the manual and print pages where required. New information will be added to the web version as it is developed. The development of IPM in blueberries, as in other crops, will continue to change and improve; it is a dynamic process affected by many factors. The design of this manual reflects the evolving field of Integrated Pest Management.

Rationale

Regular field scouting is an important component of any IPM program. Blueberry growers have an active role to play in gaining a better understanding of pests and beneficial insects and mites in their fields. By performing some of the basic scouting and record-keeping procedures outlined in this manual, growers can be more informed and more involved in pest management decision-making.

General Guidelines for Scouting in Blueberry Fields

Regular systematic scouting and record keeping are fundamental components of Integrated Pest Management. The scouting season typically begins in early March prior to the onset of bloom with four to five trips during pre-bloom and bloom, two to three trips pre-harvest, and two to three trips during harvest and post-harvest. Eight to ten well-timed trips through the field for the entire season are usually enough to provide valuable information on which to help make decisions. Experience with the Nooksack IPM program shows that scouting and record keeping takes about an hour for each field visit. This represents a total season-long investment of about eight to ten hours per block. It is important to be systematic and use your time efficiently, concentrating on the key pests and tasks at hand which vary with the crop stage and target pest.

Scouting involves performing two or three tasks at each of three to five sites in a block (field or portion). A minimum of three sites should be checked in small blocks (< 5 acres) and five sites are usually adequate in larger blocks (10 acres or more). Sampling in several sites rather than just in a spot or two will illustrate the range or variation in pest abundance found across a block. Recording information on a site by site basis allows the sampler to return later to determine trends in pest population which are helpful in making decisions and in evaluating treatments that have been applied. In general, sites should be distributed throughout the block and effort should be made to return to those approximate areas for each visit.

At each site, visit 10 to 20 bushes. These bushes should be spaced 3-5 plants apart and on both sides of the row, in order to cover a larger area at each site.



At each plant, follow the monitoring guidelines as described in each crop stage section. This will include inspecting leaves for aphids, leafrollers, and gall midge; inspecting the soil for mummy berries and weevil larvae; and inspecting the stems for evidence of disease. Some diseases, such as scorch virus, should be identified in a field even during non-scouting events. When performing other duties in the field, the grower or other trained field worker should keep a notepad handy to record locations of plants showing suspicious symptoms. Scouting for pests and disease should occur during regularly planned scouting trips, but can, and should, also occur during general trips to the field.

Scouting Equipment

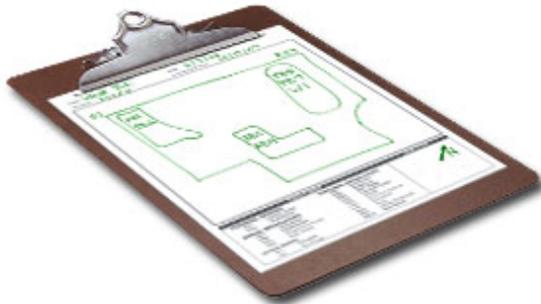
The tools used in scouting are quite simple. For most of the field visits, you should have the following equipment with you when you enter the orchard:

Magnifying Hand Lens (10 to 14X power) or an OptiVisor® (3.5X power)



For convenience, a hand lens should be tied to a small nylon line (loop) and hung from the neck so it frees up the hands and is accessible when needed. It is used most often for identifying and counting spider mites and their predators in the field. The extra power of a 14X is useful mite scouting but is not essential. Some growers prefer using an OptiVisor®, which has lower but adequate magnification. These fit around the head with an adjustable head band and have a flip-down lens, so both hands are free to hold and examine an object.

Clipboard with Scouting Sheet Attached or a Small Notebook (3 X 5")



Scouting sheets are provided for printing for each crop stage. For each key pest, a box is provided to record pest numbers or level of damage. These sheets contain a location for a field map to be drawn to indicate site locations as well as space for notes on other pests seen in the field. These sheets can be used with a clipboard to take into the field for recording data. Some may find it more convenient to use a small notebook that can be used to record data and observations from each site and then transcribe the data into the scouting sheet or onto the computer for future reference.

Carpenter's Apron or Nail Pouch



A carpenter's apron provides additional pockets for holding a small notebook, penknife or pruning shears, pencil, and small containers such as empty film canisters or plastic bags for collecting insect specimens or foliage.

Traps for Key Pests



Sticky traps and pheromone traps for specific pest species are important tools for monitoring the flight activity of these pests. Pheromone traps and lures can be purchased from various suppliers. Check with your extension office for information on these traps.

Digital Camera



Small digital cameras can be used to document symptoms or pests seen in the field and to further identify the problem when returning to the office. These pictures can easily be sent to an extension professional or field representatives via email to aid in identification. Furthermore, these photos can be used as a way to train field workers in identification of pest issues. Digital cameras with a macro setting will be able to produce the best pictures of small objects, such as insects.

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Pre-Bloom Biology and Monitoring

	Insects	Diseases
Key Pests	<ul style="list-style-type: none"> • Aphids • Wintermoth & Spanworm 	<ul style="list-style-type: none"> • Mummyberry • <i>Godronia</i> Canker • <i>Botrytis</i> • Bacterial Blight • Shock Virus
Occasional Pests	<ul style="list-style-type: none"> • Leafrollers • Root Weevils • Yellowjackets 	<ul style="list-style-type: none"> • <i>Phytophthora</i> • Anthracnose • Tomato Ringspot

Biology

Aphids

Aphids begin to emerge from overwintered eggs in the spring and females give live birth. Populations will increase in an unchecked environment; beneficial insects are often present in sufficient numbers to discourage high infestation levels, especially later in the season.

Aphids feed with their piercing-sucking mouthparts on succulent new growth. This can cause deformation of plant tissue and defoliation. High infestations can reduce fruiting bud formation for the following year. Aphids may be found in colonies on the undersides of leaves and in new, curled leaves.

Aphids are also the vectors of viruses, such as Blueberry Scorch Virus (BISV). In areas with BISV, monitoring and management of aphids is essential to control this virus.

Wintermoth and Bruce Spanworm

Eggs hatch in March and April, which often coincides with bud break of flowers and leaves. Larvae can disperse by ballooning in the wind on silken threads. Blueberry fields bordered by trees and shrubs are often infested by ballooning larvae from other hosts. Larvae are green inchworms (up to 1" in length) with 2 yellow or white stripes running the length of the body.

Mummyberry

Mummyberry affects shoots, flower clusters, and fruit. Fruit infection results in unmarketable fruit and can reduce yield by over 50% in susceptible varieties if not controlled. In late February or early March, the small mushroom-like spore cup emerges from infected berries on the soil surface. Spores are released and spread by wind currents to infect leaves and flowers, causing flowers to brown and stems to blacken.

Godronia Canker / *Fusicoccum* Canker

Godronia (asexual form is *Fusicoccum*) canker infects and causes dieback of new stem tissue. This fungal disease overwinters in infected stems. Conidia produced in the spring are released during wet periods and spread through splashing rain. New infections occur at leaf scars and other openings on the bark of new growing tissue. Infections form a bull's eye pattern. Large cankers can girdle stems and cause flagging. Most cankers are near ground level, but some occur as high as 3 feet above the ground.

Botrytis

Botrytis overwinters in infected stems of bushes and plant debris. Branch tips killed by winter injury are easily infected. Spores are produced during wet spring months and are dispersed through wind movement and water splashes. Damaged leaves and blossoms are vulnerable to *Botrytis* infection. Infected tissue may appear blighted or be covered in a gray fuzzy mold.

Bacterial Blight / Canker

Pseudomonas bacterial blight is a bacteria naturally present in the environment that becomes a problem if it manages to enter plant tissue. Infection occurs only on previous season's growth. Symptomatic tissue turns a reddish brown color; buds in this region will die. It is a problem during early to late spring, especially if late frosts are prevalent.

Blueberry Shock Virus (BIShV)

Shock virus is transmitted by pollinating insects between plants and can spread quickly in a field. Symptoms begin to appear just prior to bloom; affected new tissue appears black and older foliage will turn orange. Foliage and developing flowers will wither. Once a plant is infected, severe yield loss will occur that year. Plants will flush with new growth later in the season and yields will recover in the following year.

Voles

Voles resemble house mice; they are 4-5 inches long, and gray or gray-brown in color. They create tunnels in the soil and can feed on fine roots or girdle stems. This tunneling also creates air pockets in the root zone. Vole populations are regulated by food availability and climatic conditions.

Monitoring

General Guidelines

Follow general guidelines in the "[Introduction](#)" section. For each pest below, record pest numbers or symptoms on record sheet.

Aphids

- At each site, visit 20 bushes and inspect 5 leaves for aphid populations.
- Examine the undersides of leaves and inside the curled leaves of terminal shoot growth. Record the number of leaves with over 6 aphids.
- Low numbers of aphids will not cause economic damage. Beneficial insects should keep this pest in check.

Note: If Blueberry Scorch Virus is present, intensive aphid control is required. One critical period of monitoring and treatment is early in the season when winged aphids are present. Winged aphids will spread the disease through a field and between fields.

Wintermoth and Bruce Spanworm

- Inspect 5 shoot tips per plant for wintermoth and Bruce spanworm. Record number of buds infested or showing feeding damage.
- Evidence of feeding activity includes silk, frass, discolored buds, chewed entrance holes in the sides of buds.
- Consider treatment if 5-10% of bushes have infested buds. Insecticide treatments should be scheduled to target the hatching larvae; insecticides are less effective once larvae have entered the bud or flower.

Mummyberry

- Scrutinize the soil at the base of 20 plants per site.

- In February: rake the soil and look for fallen mummified berries. Open berries and look for the developing spore cup which appears like a germinating seed. Record the level of mummyberry found (none, low, medium, high)
- In March: monitor for mushroom-like spore cups on the soil surface. Peak spore production usually occurs shortly after bud break. Record the level of spore cups found (none, low, medium, high)
- Once green foliage develops, scout for primary infection on the leaves, which shows as a blackening in the center of the leaf. The leaves will wilt quickly and the twig tips will bend. Look for grayish green tufts of fungus associated with the wilted foliage and blackened stems.

Management:

- Prior to budbreak, shallow cultivation, less than one inch deep, will prevent spore cup development, but will not be effective if sawdust mulch is used.
- Mummies can be covered with soil or mulch at least 2 inches deep.
- Avoid wet sites and overhead irrigation at least until petal fall and try to improve drainage.
- Select resistant cultivars, if available. Late flowering cultivars are often able to avoid infection.
- Consider treatment if spore cups are found at 10-20% of bushes and weather conditions are wet and above 50°F.

Godronia Canker

- Inspect several stems per plant for evidence of cankers. Record the number of plants showing symptoms.
- Cankers are seen as small reddish-brown blemishes in early spring.
- This disease is spread through wet weather in the spring; early treatment is important to reduce infection.

Management:

Infected stems should be pruned from the plant and destroyed.

Botrytis

- Examine 5 branch tips per plant for evidence of *Botrytis*.
- Look for branch tips that are grayish and brittle or dried-up. Record number of plants showing symptoms.
- Branch tips killed by winter injury are easily infected.

Management:

- Remove infected plant material.
- Avoid excessive use of nitrogen fertilizer in the spring; the *Botrytis* fungus will readily infect succulent green growth.
- In areas with high levels of infection, a treatment may be made during bloom and fruit ripening.

Bacterial Blight / Canker

- At each plant, look for blighted tips or cankered twigs, especially when frost has occurred. Record number of plants showing symptoms.
- Symptoms are similar to Blueberry Scorch Virus and Botrytis mold. Send samples to be tested if unsure.

Management:

Prune out diseased wood as soon as possible.

Blueberry Shock Virus

- Regularly monitor for shock just prior to bloom.
- Visit 20 bushes at each site. Record the number of plants that exhibit symptoms and tag these plants.
- Also, monitor throughout the field for symptoms. Tag suspected plants and have them tested.

- Blueberry shock virus symptoms are very similar to blueberry scorch virus, so have suspected plants tested immediately. Testing is done at USDA-ARS in Corvallis Oregon for a small fee. Contact your extension office for more information on testing. Sampling information is included in the profile pages for scorch virus.

- At this stage, symptoms are flowers and new leaves unexpectedly dying. Often just a branch will show symptoms, but sometimes the whole plant will show symptoms.

Management:

- Certified new stock should be used.
- Do not plant a new field next to an infected field.
- If in larger fields with an isolated area of the disease, rogue out the diseased plants. Otherwise, let the disease run it's course.

Voles

- Spring monitoring is done to assess winter mortality and new populations.

- Monitoring stations can be constructed using a protected shelter to cover a runway or tunnel entrance. Shelters can be constructed using roofing shingles or PVC piping. Place an apple wedge as bait underneath the shelter. Check the apple bait every 24 hours for 2-3 days. Inspect the apple wedge for feeding damage. Four to eight bait stations per acre can provide an accurate assessment of vole populations.

- Monitor again 2-3 weeks following treatment to determine efficacy.

Management:

- Treatment threshold ranges from 20-40% positive from monitoring station.
- Habitats can be changed to reduce vole problems
- Remove debris piles
- Regularly mow field margins and keep large weeds under control
- Pelletized baits can be broadcast, but they degrade quickly.
- Bait stations can be made by making a T out of 2-3 inch PVC pipe filled with bait. ([see profile page for more information](#))

Bloom

Biology and Monitoring

	Insects	Diseases
Key Pests	<ul style="list-style-type: none"> • Aphids • Wintermoth & Spanworm • Gall Midge • Leafrollers • Root Weevils 	<ul style="list-style-type: none"> • Mummyberry • <i>Godronia</i> Canker • <i>Botrytis</i> • Shock Virus • Scorch Virus • Anthracnose
Occasional Pests	<ul style="list-style-type: none"> • Scale • Cherry Fruitworm • Tent Caterpillars • Sawflies 	<ul style="list-style-type: none"> • Bacterial Blight • Premature Fruit-drop • <i>Phomopsis</i> Canker

Biology

Aphids

Wingless and winged aphids may be present at this time. Winged aphids are a concern if in an area of blueberry scorch virus. Populations will continue to build throughout the growing season if beneficial populations are not sufficient.

Wintermoth and Bruce Spanworm

Larvae prefer to feed on flower buds by tunneling into the bud and feeding on the developing flower parts. During bloom, small larvae can be found inside the flower and in clusters.

Leafrollers

All life stages of this pest are present at this time. As leaves expand, larvae roll up leaves to feed and pupate. Second generation adult moths begin to emerge in late May or June.

Gall Midge

Adults emerge in May and June to oviposit in the terminal growth of new shoots. Adults are very small gnats, less than 1/16 of an inch long. Eggs hatch within a few days and the tiny larvae feed in the terminal buds causing the foliage to curl and deform. This feeding may also cause branching or witches' broom symptoms resulting in decreased plant growth and reduced bud set for the next season.

Early larval stages are clear to ivory; as they mature, they become pink or orange in color and are only 1/16 inch long at maturity.

Gall midge has several generations per year with two main population peaks; one pre-harvest and one post-harvest, or during active foliar growth periods.

Root Weevils

Root weevil larvae feed on roots and can cause damage to roots. Adult weevils feed on foliage and new stems to cause notching of new growth.

Adult black vine weevils, clay colored weevils, and strawberry weevils will be emerging during this period. When weevils first emerge, their bodies have not fully hardened and are quite soft to the touch.

Black vine weevils are up to 1/3" long and are black with a few small yellow or orange spots.

Clay colored weevils are slightly smaller than black vine weevils and are mottled with darker and lighter shades of brown or gray.

Strawberry weevils are 1/5" long and range from black to brown in color.

Other weevil species are present as larvae during this period and may be found in the soil below the plant.

Mummyberry

At bloom stage, leaves and blossoms begin to become infected by spores from the mummies on the ground. Infected leaves will flag and turn brown. Infected blossoms turn brown and wither. Environmental factors such as air moisture and prevailing winds contribute to the degree of infection.

Godronia Canker

New infections may be forming at this stage at leaf scars and other wounds on stems. Infections are reddish brown and form a bull's eye pattern.

Botrytis

Spores are transmitted under favorable conditions at this time of year, such as high humidity and cool to mild temperatures. Blossoms are susceptible to infection and the pathogen can move from the blighted blossom to the stem and may cause girdling. All growth above the girdling is then killed.

Bacterial Blight

Reddish-brown to black cankers may have developed from infections in January and February. Infection only occurs on previous season's growth and enters through wounds in stem tissue.

Blueberry Shock Virus

Shock virus is transmitted by pollinating insects between plants and can spread quickly in a field. Symptoms begin to appear just prior to bloom; affected new tissue appears black and older foliage will turn orange. Foliage and developing flowers will wither. Once a plant is infected, severe yield loss will occur that year. Plants will flush with new growth later in the season. Yield will recover in the following year.

Blueberry Scorch Virus

This serious disease can be quickly spread through a field and between fields by aphid transmission. Symptoms are similar to that of blueberry shock virus, but plants will not recover in the following year. Symptoms include twig die-back, complete browning of blossoms and some leaves and eventual stem and plant death. The plant usually retains the scorched blossoms into the fall and sometimes through the following season. Early detection is very important; management depends on minimizing spread of the disease.

Anthracnose

Spores are released from infected twigs throughout the growing season and are transmitted to flowers and developing fruit during a rain event. Fruit are susceptible to infection at all stages of development but do not show symptoms until ripening.

Voles

Voles resemble house mice; they are 4-5 inches long, and gray or gray-brown in color. They create tunnels in the soil and can feed on fine roots or girdle stems. This tunneling also creates air pockets in the root zone. Vole populations are regulated by food availability and climatic conditions.

Birds

Several types of birds may be present and have the potential to cause damage in a field. Starlings, robins, house finches, and red-winged blackbirds are common. Damage to fruit can be caused in several ways; fruit may be knocked off of bushes during foraging, eaten wholly by the bird, or punctured or pecked at by a bird.

Monitoring

General Guidelines

See general guidelines in the "[Introduction](#)" section of the manual.

Aphids

- Check 5 leaves at each plant for aphid nymphs and adults.
- Inspect the undersides of leaves and inside the curled leaves of terminal shoot growth.
- Record the number of leaves with more than 5 aphids per leaf.

Consider treatment:

- When not in a scorch virus area: if 50% of leaves sampled have over 5 aphids per leaf.
- When in a scorch virus area: if 10% of leaves sampled have over 5 aphids per leaf.

Wintermoth

- Inspect five flower clusters per plant. Record number of infested or damaged clusters.
- Look for feeding activity such as silk, frass, discolored buds and chewed entrance holes in the sides of buds.
- Consider treatment if 5-10% of bushes have infested buds.
- Be cautious of applying pesticides that may disrupt pollinators.

Leafrollers (OBLR)

- Place pheromone traps in fields beginning in late April or May and check weekly. Starting one week after peak flight, examine leaves for worm infestation
- Inspect 5 flower clusters per bush at each site.
- Gently pull apart flower clusters and look for larvae and feeding damage.
- Record the number of caterpillars found.

Gall Midge

- Begin looking for damage in May.
- Inspect 5 shoots per plant.
- Look for blackened tips of unfolding leaves of the terminal growth and deformed shoots.
- Using a hand lens, inspect the tip for the small maggot, usually located at the stem and leaf junction.
- Record the percent of shoot tip infection to track population trends. No thresholds are currently known. By keeping records of trends you may be able to determine a farm specific threshold.

Management:

If branching like witches broom occurs to a large degree, prune out damaged branches to promote normal bush growth.

Root Weevils

- Look for plants with reduced vigor. These may have larval feeding damage on the roots.
- At several places at each site, dig around the soil at the crown of the plant to look for grubs feeding on roots. Record number of grubs found in soil around 10 plants.
- After May, look for notching on lower leaves and new shoots. Record adult feeding damage on a scale of 1-5
- At night, look for adult weevils feeding on foliage by shaking the plant onto a light colored cloth.
- In the day, look for adults in debris and mulch around the base of the plant.
- Consider treatment if plants show signs of low vigor and weevils have been found.

Management:

- Manage weeds in the infested area to eliminate alternate food sources for adults and larvae.

Mummyberry

- At each bush, inspect 5 shoots for infected leaves.
- Infection will appear as drooping shoots and the upper surface of the leaves will turn brown from the petiole outwards. The brown section of the leaf may be covered in tan-gray fuzz.
- Record percent of shoots that are infected.
- Consider treatment when conidia are present to avoid secondary infection of flowers and fruit clusters.

Godronia Canker

- Inspect 20 plants per site.
- Look for infections on current year stems or wounded areas that show up as reddish brown cankers, often with gray centers.
- New cankers may appear as small, reddish discolorations, often around leaf scars.
- Record number of infected plants.

Botrytis

- On each plant, examine 5 branch tips for evidence of *Botrytis*.
- Inspect 5 flower clusters per plant, especially during wet weather. Look for a brown, water-soaked appearance. Blossoms may also be covered with gray fuzzy mold. Record number of infected plants.
- Branch tips killed by winter injury are easily infected.

Management:

- Keep an open canopy to increase air circulation.
- Remove infected plant material.
- Avoid excessive use of nitrogen fertilizer in the spring; the *Botrytis* fungus will readily infect succulent green growth.
- In areas with high levels of infection, a treatment may be made during bloom and fruit ripening

Bacterial Blight

- Monitor plants at site for reddish-brown to black cankers
- Send samples to lab for diagnosis.

Management:

- Prune out infected wood immediately.
- Educate farm workers on identification and pruning techniques.

Blueberry Shock Virus

- Monitor plants at site for blackening new foliage and flower clusters.
- Tag plants with symptoms and record the location of these plants on your scouting sheet.
- Plants that do not recover from symptoms should be suspect for blueberry scorch virus.

Blueberry Scorch Virus

- Monitoring of the plants at each scouting site will be helpful, but plants throughout the field should be noticed and location recorded if symptomatic.
- Symptoms are similar to shock virus symptoms. Blossoms and leaves blight and dry up. Symptoms may be seen on the whole plant or on just one or a few stems of the plant.
- Plants next to infected plants may not show symptoms.
- If scorch virus is suspected, samples should be sent to Oregon State University. See the profile page for Blueberry

Scorch Virus for sampling protocol.

Management:

- Plants found with scorch virus should be removed from the field immediately. Bordering plants should be carefully monitored for symptoms.
- There are currently no control measures for this virus.

Anthracnose

- Inspect 20 plants per site.
- Look for orange spore masses on last year's fruit stems. Symptoms are more evident on ripened fruit
- Record number of symptomatic plants.

Voies

- Monitor for voles using monitoring stations with apple baits, as described in the [profile page](#).
- Continue monitoring 2-3 weeks following treatment.

Birds

- Scout for birds in the early morning or just before dusk. Identify type of bird present, number present, and change in population size.
- Continue monitoring through harvest.

Management

- Several types of management options are available. A management plan should be developed that is appropriate to farm site and surrounding properties.
- Adapt management plan according to scouting levels

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Pre-Harvest Biology and Monitoring

	Insects	Diseases
Key Pests	<ul style="list-style-type: none"> • Aphids • Wintermoth & Spanworm • Gall Midge • Leafrollers • Root Weevils 	<ul style="list-style-type: none"> • Mummyberry • <i>Godronia</i> Canker • <i>Botrytis</i> • Shock Virus • Scorch Virus • Anthracnose • <i>Alternaria</i> Fruit-Rot
Occasional Pests	<ul style="list-style-type: none"> • Symphylans • Cherry Fruitworm 	<ul style="list-style-type: none"> • Bacterial Blight • <i>Phomopsis</i> Canker • Nematodes

Biology

Aphids

Unchecked aphid populations continue to increase. Both winged and wingless forms are produced. The spread of scorch virus is still a concern in affected areas; monitor closely for aphids in areas where scorch virus is present.

Wintermoth and Bruce Spanworm

Maturing larvae feed on emerging foliage and developing fruit through June or July. Upon maturing (up to 1 inch long), larvae cease feeding and drop to the soil to pupate.

Leafrollers (OBLR)

Leaves may be rolled, chewed and tied together with silk at this time and may be attached to fruit clusters with silk. Leafrollers cause little damage to established plants, but may be a harvest contaminant.

Gall Midge

In May and June, adults emerge from their overwintering pupal casing in the soil to oviposit eggs in the terminal growth of new shoots. Hatching larvae then feed in the terminals causing the foliage to curl and deform, sometimes resulting in excessive branching.

Root Weevils

Rough strawberry root weevil adults usually emerge in June and July. Other species of root weevils may be present as adults, eggs, or larvae in the soil.

Mummyberry

Fruit will start to show symptoms of infection at this stage. Infected fruit will show white growth in the interior of the fruit. Infected fruit may fall to the ground before healthy berries are harvested. This will become the inoculum for the next year.

Godronia Canker

Cankers are evident as reddish brown lesions on the stem.

Botrytis

The gray fuzzy mold may be seen on developing berries at this time. Infected twigs and leaves may also be seen.

Bacterial Blight

This pathogen enters through wounds in stem tissue. Infection levels increase during wet springs and on stems with winter injury. Only previous season's canes are affected.

Blueberry Shock Virus

Infected plants may start to show new growth at this time. Blighted blossoms may still be on the plant or they may have fallen to the ground.

Blueberry Scorch Virus

Plants infected with scorch virus will not be recovering at this point like shock infected plants. Scorch virus can be devastating to a field, destroying all plants in an area in a short period of time. Testing for this virus and plant removal are critical in controlling its spread.

Anthraxnose

Berries will show symptoms when they are nearing maturity which shows as shriveled sections and orange spore masses. Infected ripe fruit can cause great damage to the entire harvest.

Alternaria Fruit-Rot

Infected ripening fruit will show symptoms of caving in on one side with dark gray-green spore growth. Dry fruit may become watery when stored following harvest.

Birds

Several types of birds may be present and have the potential to cause damage in a field. Starlings, robins, house finches, and red-winged blackbirds are common. Damage to fruit can be caused in several ways; fruit may be knocked off of bushes during foraging, eaten wholly by the bird, or punctured or pecked at by a bird.

Monitoring

General Guidelines

Follow general guidelines in the "[Introduction](#)" section. For each pest below, record pest numbers or symptoms on record sheet.

Aphids

- Inspect 5 leaves per plant at each site.
- Examine the undersides of leaves and record the number of leaves with 5 or more aphids.
- Look for aphid predators such as ladybug beetles and lacewings that may be contributing to control of the aphid population.

- Consider treatment if:
 - When not in a scorch virus area: if 50% of leaves sampled have more than 5 aphids.
 - When in a scorch virus area: if 10% of leaves sampled have more than 5 aphids.

Wintermoth and Bruce Spanworm

- Inspect 5 fruit clusters per plant at each location
- Look for webbing and frass in the fruit cluster.
- Record number of clusters infested.
- Consider treatment if 5-10% of fruit clusters are infected.

Leafrollers (OBLR)

- Inspect 5 leaves per plant at each site.
- Pull apart rolled leaves to confirm the presence of caterpillars inside.
- Record the number of larvae or damaged leaves found.

Gall Midge

- Inspect 5 shoot tips per plant at each site.
- Look for blackened tips of unfolding leaves of the terminal growth and deformed shoots.
- Uncurl leaves and inspect the tip for the small maggot. Use a hand lens to identify.
- Record the number of damaged shoot tips or the presence of larvae.

Root Weevils

- Inspect 20 plants per site for evidence of adult leaf feeding, which appears as notching on leaves and stems sometimes followed by flagging of stem sections.
- Record adult feeding damage on a scale of 1-5
- Consider treatment if plants show signs of low vigor and weevils have been found or if plants show excessive feeding damage.
- Treatments should be made when the majority of adults of the predominant species have emerged.

Mummyberry

- Inspect five fruit clusters per plant at each site.
- Look for early “ripening” of fruit, where healthy fruit are green and infected fruit are turning a reddish color.
- Record number of clusters with early “ripening” symptoms.
- Cut open 10 fruit per plant to look for whitish growth inside the berry.
- Record number of infected fruit.
- Treatment is not effective at this stage, but you will be able to determine the disease pressure for the next season.

Godronia Canker

- Inspect bushes for infections on stems at wounded areas and leaf scars.
- Cankers appear reddish brown with gray centers, giving a bull’s eye appearance.

- Record number of plants with symptoms.
- Remove and destroy infected stems.

Botrytis

- Inspect 20 plants per site for infected shoot tips, seen as brown to black sometimes with black sclerotia near the tip. Record the number of infected plants.
- Inspect five fruit clusters per plant for fuzzy gray mold. Record number of infected fruit clusters.

Bacterial Blight

- Inspect plants for blighted tips and cankered twigs.
- Symptoms can resemble those of Scorch Virus and *Botrytis* blight. Send samples to a diagnostic lab for verification.

Management:

Prune out diseased wood

Blueberry Shock Virus

- Plants with shock virus should be recovering at this stage with new growth filling in on the plant. Very little fruit will be produced.
- Record number of symptomatic plants.
- Plants still showing symptoms should be suspected for scorch and tested immediately.

Blueberry Scorch Virus

- Monitor for scorch during all crop activities, however, scorch symptoms are less visible after bloom.
- Continue to flag suspected bushes and send samples to Oregon State University to be tested.

Anthracoze

- Later in fruit maturity, inspect five fruit clusters per plant at each site.
- Infected mature fruit will show symptoms of sunken, shriveled berries, sometimes with orange regions of sporulation.
- Rate whether the level of infection is low, medium, or high.
- Consider treatment if levels of infection are medium to high, especially if weather is warm and wet.

Alternaria Fruit-Rot

- Inspect five fruit clusters per plant at each site.
- Look for a caving-in on one side of a berry as well as a dullish gray spore mass at that area.
- Rate whether the level of infection is low, medium, or high.
- Consider treatment if levels of infection are medium to high.

Birds

- Scout for birds in the early morning or just before dusk. Identify type of bird present, number present, and change in population size.
- Continue monitoring through harvest

Management

- Several types of management options are available. A management plan should be developed that is appropriate to farm site and surrounding properties.
- Adapt management plan according to scouting levels

WSU Whatcom County Extension • 1000 N. Forest St., Bellingham, WA 98225 • 360-676-6736 • whatcom@wsu.edu

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Harvest

Biology and Monitoring

	Insects	Diseases
Key Pests	<ul style="list-style-type: none"> • Aphids • Fruit Contaminants 	<ul style="list-style-type: none"> • Mummyberry • <i>Godronia</i> Canker • <i>Botrytis</i> • Shock Virus • Scorch Virus • Anthracnose
Occasional Pests	<ul style="list-style-type: none"> • Gall Midge • Scale • Symphylans • Cherry Fruitworm • Root Weevils 	<ul style="list-style-type: none"> • <i>Phomopsis</i> Canker

Biology

Aphids

Aphids continue to produce offspring until late fall, but the rate of population increase is lower at this time.

Fruit Contaminants

These are primarily egg sacs of spiders or pupae of lacewing and syrphid flies that are contained in the blossom end of the berry. They usually appear as a white furry mat in the calyx end of the fruit. Spiders, lacewings, and syrphid flies are considered beneficial, so controlling them is often not recommended; this may result in outbreaks of pests such as thrips, mites, aphids, and caterpillars. The best way to manage this problem is to remove contaminated fruit on the grading lines after harvest.

Mummyberry

Infected berries will show up in the clusters and drop to the ground to overwinter. Mummyberries first appear pink and puckered looking. The inside tissue is brown and corky. As it ages, it turns white and withered and dried.

Godronia Canker

Cankers are still growing in size through the season. The cankers will start to appear more like a bull's eye, with gray centers and a reddish-brown outside.

Blueberry Shock Virus

Infected plants appear normal in late summer except for the lack of fruit. Plants may fully recover after the first year or may show symptoms for up to three years. Symptomless plants still carry the virus.

Blueberry Scorch Virus

Plants with scorch virus will not show recovery at this time. Fruit and shoot production are drastically reduced on infected plants. Testing and removal of plants is necessary to control the spread of this virus.

Botrytis

This fungus becomes more active on fruit as they ripen. Wet and warm weather conditions can increase the spread of the disease.

Anthracnose Ripe-Rot

Ripening infected berries will start showing symptoms of the blossom end softening and salmon colored spore masses may be seen. Warm and rainy conditions will increase the spread of this disease.

Alternaria Fruit-Rot

Alternaria infections occur from late bloom to fruit maturity but symptoms will not show until fruit is ripening or even until fruit is in storage. Infected berries will cave in at the sides and may have greenish-gray spores. If infection spreads through harvested fruit in storage, yield losses can be great.

Birds

Several types of birds may be present and have the potential to cause damage in a field. Starlings, robins, house finches, and red-winged blackbirds are common. Damage to fruit can be caused in several ways; fruit may be knocked off of bushes during foraging, eaten wholly by the bird, or punctured or pecked at by a bird.

Monitoring

General Guidelines

See general guidelines in the "[introduction](#)" section.

Aphids

- At each site, inspect 5 leaves per plant.
- Look for winged and wingless aphids as well as aphid mummies that have been parasitized by aphid parasitic wasps. Also, look for beneficial insects such as ladybug larvae, lacewing larvae, and syrphid larvae.
- The presence of honeydew and sooty mold on fruit and leaves indicates a high aphid population. Make a note if you find this condition.

Fruit Contaminants

- Inspect 5 fruit clusters per plant for contaminants at the blossom end.
- Record this number and train harvesting and processing crew to be aware of these contaminants.

Mummyberry

- At each plant, check 5 berry clusters for mummyberry symptoms.
- Examine the ground beneath the plants to see if any infected fruit has fallen to the ground.

Management:

- If on a small farm, clean up dropped fruit following harvest. The use of geese may also be used to clean up the dropped fruit as well as weeds.

Godronia Canker

- Inspect 20 plants per site
- Look for leaves turning color earlier than normal. These leaves will turn bright red/brown and remain attached – looking like red flags in the field.

Blueberry Shock Virus

- Visit marked plants at each site and throughout field to observe recovery from shock virus.
- Symptomatic plants should be sent to a diagnostic lab immediately to determine if scorch is present.

Blueberry Scorch Virus

- Plants with scorch symptoms should be sent for testing immediately.
- Symptoms include leaf dieback and blighted blossoms remaining on the plant.

Botrytis

- Inspect 5 fruit clusters per plant. Observe fruit for fuzzy gray mold during harvest.
- Fruit should be harvested frequently where gray mold is commonly seen, especially in conditions of wet and warm weather.

Anthracnose Ripe-Rot

- Inspect 5 fruit clusters per plant for signs of infection.
- Symptoms include softening at the blossom end and masses of salmon colored spores.

Management:

- To reduce the spread among harvested fruit, reduce the temperature of the fruit to 32°F as soon as possible.

Alternaria Fruit-Rot

- Inspect 5 fruit clusters per plant.
- Look for fruit with sides caving in and greenish-gray spores.
- Rate the level of infection (low, medium, high)

Management:

- Avoid over ripening by harvesting in a timely fashion.
- Cool fruit immediately after harvest.

Birds

- Scout for birds in the early morning or just before dusk. Identify type of bird present, number present, and change in population size.
- Continue monitoring through harvest

Management

- Several types of management options are available. A management plan should be developed that is appropriate to farm site and surrounding properties.
- Adapt management plan according to scouting levels

Post Harvest Biology and Monitoring

	Insects	Diseases
Key Pests	<ul style="list-style-type: none"> • Aphids • Root Weevils • Tent Caterpillars 	<ul style="list-style-type: none"> • Mummyberry • <i>Bacterial Blight</i> • <i>Botrytis</i> • Shock Virus • Scorch Virus

Biology

Aphids

Natural predators should have aphids under control at this stage. Winged aphids may be present at this time. If the scorch virus is a problem in your area, you may wish to control aphids during the dormant period.

Root Weevils

Root weevils overwinter either as larvae or adults. The obscure root weevil adults are more numerous between September and October. They are ¼ inch long with a wavy brown line across the back towards the rear. This species tends to spend the day hiding in the foliage instead of dropping to the soil.

Tent Caterpillars and Fall Webworms

Tents of the Fall webworm may be present until the middle of September. After maturing, the larvae will drop to the leaf litter to pupate and overwinter in the soil. Tent caterpillars will overwinter as egg masses on stems.

Mummyberry

Mummyberries produced during the current season will have dropped to the ground by this time. These will become the inoculant for the next season; cultural treatment at this time may reduce incidence of the disease in following years.

Godronia Canker

Red flags of dying leaves may be seen in infected plants. These leaves die earlier than those of healthy tissue. It is important to get rid of this tissue to reduce the amount of inoculant for the next year.

Bacterial Blight

Reddish black to brown cankers may still be seen. It is important to practice good pruning techniques to remove this tissue and to open the canopy for good air circulation.

Botrytis

Infected stem tips may appear gray or tan and dried out. Good pruning can help reduce infection in the next year.

Voles

Voles resemble house mice; they are 4-5 inches long, and gray or gray-brown in color. They create tunnels in the soil and can feed on fine roots or girdle stems. This tunneling also creates air pockets in the root zone. Vole populations are regulated by food availability and climatic conditions.

Monitoring

General Guidelines

Follow general guidelines in the "[introduction](#)" section.

Aphids

- Inspect 5 leaves per plant for incidence of aphids, especially winged aphids.
- Record the number of leaves with over 6 aphids found at each site.
- Consider treatment if the scorch virus is in your area and the population of winged adult aphids is not decreasing.

Root Weevils

- Check for adult Obscure Root Weevil leaf feeding by inspecting leaves for notching damage. Adults can also be found by placing a white cloth on the ground under the plant and shaking the plant onto the cloth. Obscure weevils should fall out of the foliage.
- Inspect the soil for larval root weevils. Dig around the root zone of several plants to look for c-shaped grubs.
- If root weevil damage has been detrimental or levels of root weevils are high, consider applying a nematode application in early Autumn when soil temperatures are still warm enough and larvae are young and susceptible. Preferably, time the treatment just before or during a rain event.

Tent Caterpillars and Fall Webworms

- Inspect branches for overwintering egg cases that appear as brown or gray hardened foam-like substance. They can be half inch long bands on twigs, or flattened shapes on tree trunks.

Management:

- Hand-pick or prune out the branches and twigs with egg masses during the post harvest and dormant season.
- Dormant oils may be applied in January and February to kill the eggs.

Mummyberry

- Scout for mummyberries fallen to the ground. If there has been a problem with this disease, consider cultural treatment.

Management:

After harvest and before leaf drop, cultivate shallowly to bury mummies. Berries that are buried 1 inch have been found to not cause infection in the following year.

Godronia Canker

- Look for the 'red flags' of dying leaves.

Management:

- Prune out infected wood
- Educate pruning crew on how to identify infection and prune out infected wood.

Bacterial Blight

- Look for reddish-brown to black cankers while pruning

Management:

- Prune out infected wood
- Educate pruning crew on how to identify infection and prune out infected wood.

Botrytis

- Look for tan or gray stem tips; black sclerotia may also be seen.

Management:

- Prune out infected wood
- Keep canopy open to encourage good air circulation
- Educate pruning crew on how to identify infection and prune out infected wood.

Voles

- Fall monitoring is done to determine populations before winter when crop damage can occur.
- Monitoring stations can be constructed using a protected shelter to cover a runway or tunnel entrance. Shelters can be constructed using roofing shingles or PVC piping. Place an apple wedge as bait underneath the shelter. Check the apple bait every 24 hours for 2-3 days. Inspect the apple wedge for feeding damage. Four to eight bait stations per acre can provide an accurate assessment of vole populations.
- Monitor again 2-3 weeks following treatment to determine efficacy.

Management:

- Treatment threshold ranges from 20-40% positive from monitoring station.
- Habitats can be changed to reduce vole problems
- Remove debris piles
- Regularly mow field margins and keep large weeds under control
- Pelletized baits can be broadcast, but they degrade quickly.
- Bait stations can be made by making a T out of 2-3 inch PVC pipe filled with bait. (see [profile page](#) for more information)

Pre-Bloom

Decision Making Matrices

Pest	Brief Description	Damage / Reason for Concern	Monitoring Approaches	Decision Points / Tolerances	Management Options	Follow Up
INSECTS						
Aphids	Several species ranging from less than 1/16 inch to ¼ inch in length. Color can range from light green or yellow to dark green or black.	Can cause deformation of developing leaves. Can produce honeydew, which may cause sooty molds on foliage and fruit. Acts as a vector for viruses, such as the Blueberry Scorch Virus.	Inspect 5 leaves at each plant. Examine the undersides of leaves and inside the curled leaves of terminal shoot growth.	Aphid counts in low numbers will not cause economic damage; beneficial insects will keep population in check. Pre-Bloom treatment recommended in areas with scorch present.	Aphid populations respond to high nitrogen content in plant tissues. Avoid over fertilization and excessive nitrogen levels. Chemical	Revisit areas with aphid populations to determine whether the numbers are increasing or are being held in check by beneficial insects.
Wintermoth and Bruce Spanworm	Larvae are pale green with three white stripes developing on each side. Head capsules of wintermoth are pale green. Bruce spanworm have dark head capsules which can lighten to pale green.	Larvae feed on flower buds, flowers, and foliage. Can contaminate harvested fruit.	Inspect 5 shoot tips per plant. Look for silk, frass, discolored buds, and chewed entrance holes in buds.	Consider treatment if 5-10% of bushes have infested buds. Insecticide treatment should be scheduled to target the hatching larvae.	<i>Bacillus thuringiensis</i> Chemical	Continue scouting for larvae

DISEASES						
Mummyberry	Mummified berries and mushroom-like spore cups may be seen on the soil surface under the plants. Floral and vegetative shoots are wilted and necrotic with a blackening in the center of the leaf.	Spores from ground will infect leaves and flowers. This will cause infection on developing fruit resulting in non-saleable product.	Look for fallen berries, open, and inspect for developing spore cup. Search soil for mushroom-like spore cups. Record level of incidence (low, medium, high). Inspect 5 developing shoot tips per plant for infection. Record % of tips with infection.	Detection is threshold for treatment.	Disrupt soil surface by raking or cultivating around plants to destroy spore cups. Cover mummies with soil or mulch at least 2 inches deep.	Scout for leaf and flower infection during the next stage.
Godronia Canker	Cankers are seen as small reddish brown blemishes in early spring	If cankers get too large, they can girdle the stem.	Inspect several stems per plant for incidence of lesions.	No tolerance established	Prune out infected wood. Choose resistant varieties.	Educate farm workers on identification of cankers.
Botrytis	Infected tissue may appear blighted or be covered in a gray fuzzy mold.	Can cause leaf and stem death. Can cause fruit rot after harvest.	Examine 5 branch tips at each plant. Look for branch tips that are gray and brittle or dried up. Record # of plants with symptoms.	Consider treatment when infected twigs are found.	Remove infected plant material. Avoid excessive use of nitrogen fertilizer in the spring. Chemical treatment during bloom and fruit ripening.	Continue scouting for infection as new leaves and blossoms emerge.
Bacterial Blight	Previous season's canes are affected. New tissue will appear black and older foliage will turn orange.	Reduction in plant growth. Infection on blossoms to reduce yield.	Look for blighted tips on 20 bushes per site. Symptoms are similar to Scorch Virus and <i>Botrytis</i> mold. Test	Threshold depends on market, weather, and variety grown. In mature planting, consider treatment when more	Prune out diseased wood as soon as possible.	Continue monitoring for symptoms. Tag plants showing symptoms to make sure <i>Scorch</i> or <i>Botrytis</i> are

	Foliage and flowers wilt.		samples if unsure.	than 10% of plants are infected.		not present.
Shock Virus	Flowers and new leaves are unexpectedly dying. Could be on one branch or whole plant.	Will cause a decrease in yield, often for only one year. Symptoms are similar to that of Scorch virus which is much more problematic.	Visit 20 bushes at each site. Record the number of plants exhibiting symptoms at each site. Tag these plants and send samples to OSU to be tested.	Tolerances have not been established. Testing plants is crucial to determine Scorch Virus is not present.	Plants will recover after one year of reduced yield. No management options are available.	Continue monitoring plants throughout field and testing to eliminate the possibility of Scorch Virus.
VERTEBRATE PESTS						
Voies	Small rodents tunnel through soil causing air pockets in the root zone. They will also feed on roots	Can eat roots and girdle crowns.	Set up a monitoring station using PVC pipe and apple wedge. Check for feeding damage on the apple wedge.	20-40% of monitoring stations are positive for feeding damage	Habitat reduction. Rodenticide baits at bait stations.	Monitor again 2-3 weeks following treatment to evaluate efficacy.



WSU Whatcom County Extension

Integrated Pest Management for Blueberries

Bloom Decision Making Matrices

Pest	Brief Description	Damage / Reason for Concern	Monitoring Approaches	Decision Points / Tolerances	Management Options	Follow Up
INSECTS						
Aphids	Winged and non-winged aphids may be present at this time.	Deformation of leaves. May cause honeydew formation and sooty mold on fruit. May transmit viruses.	Check 5 leaves at each plant for adults and nymphs. Record # of leaves with more than 5 aphids.	Consider treatment if: <i>When not in a scorch area:</i> if 50% of leaves sampled have more than 5 aphids. <i>When in a scorch area:</i> if 10% of leaves sampled have more than 5 aphids.	Reduce excessive nitrogen use. Aphids (and other piercing/sucking insects) are attracted to high nitrogen tissues. Chemical control.	Continue scouting for winged and wingless populations.
Wintermoth and Spanworm	Larvae may be feeding on flower buds. Larvae are pale green with three white stripes developing on each side. Head capsules of wintermoth are pale green. Bruce spanworm larvae have dark head capsules which can lighten to pale green.	Larvae can defoliate new growth and flower buds causing a reduction in yield.	Inspect 5 flower clusters per plant. Look for feeding activity such as silk, frass, discolored buds and chewed entrance holes in the sides of buds. Record # of infested or damaged fruit clusters.	Consider treatment if 5-10% of plants have infested buds.	Chemical. Be cautious of applying pesticides that may disrupt pollinators.	Treated fields should be scouted soon after treatment to determine efficacy.

<p>Leafrollers (OBLR)</p>	<p>Larvae are about 1" long and are green with a dark head. Larvae create webbing on leaves and flowers and feed inside of this shelter.</p>	<p>Larvae can feed directly on fruit to reduce yield. They can also act as a contaminant pest.</p>	<p>Place pheromone traps to determine timing of larval presence. Inspect 5 flower clusters per plant at each site. Gently pull apart clusters to look for larvae and feeding damage. Record # of infested clusters.</p>	<p>Detection of leafroller larvae at most sites indicates pre-bloom insecticide application may be necessary.</p>	<p>Microbial insecticide B.t. with spreader sticker on cloudy day. Chemical control.</p>	<p>Continue scouting for larvae at each site.</p>
<p>Gall Midge</p>	<p>Insects are very small; they can be seen with hand lens and appear as a small maggot at this stage. Damage appears as blackened tips of unfolding leaves.</p>	<p>Can cause damage to shoot tips and cause a witches' broom growth. This may result in decreased growth and poor bud set for the following year.</p>	<p>Inspect 5 shoot tips per plant at each site. Look for blackened tips of developing shoots. If seen, open up tips and use hand lens to identify maggots.</p>	<p>New Planting: When more than 4 tips per plant with distortion. Pest is not an economic issue on established plantings.</p>	<p>Chemical control. No pesticides are labeled for Gall midge, but other insecticides may have activity against gall midge.</p>	<p>Main peaks of infestation are before and after harvest, when shoot tips are actively growing. Scout during this stage and again post-harvest.</p>
<p>Root Weevils</p>	<p>Adult black vine weevils, clay colored weevils, and strawberry weevils will be emerging at this time. Black vine weevils are the largest (up to 1/3" long) and are predominantly black. Clay colored weevils are mottled light and darker brown or gray. Strawberry</p>	<p>Adult weevils can cause notching damage to leaves and new stems. Larvae feed on and damage roots.</p>	<p>Look for plants with reduced vigor. Dig around base of plant to look for grubs feeding on roots. After May, look for notching on lower leaves and new shoots. At night, look for adult weevils feeding on foliage by shaking</p>	<p>Consider treatment if plants show signs of low vigor and weevils (adults or larvae) have been found. Young plants have a threshold of 1-3 weevil larvae per plant.</p>	<p>Manage weeds in the infested area to eliminate alternate food sources for adults and larvae. Chemical: Time insecticides to target emerging adults; will depend on species present.</p>	<p>Continue scouting for adult and larval stages of weevils.</p>

	weevils are black to brown in color and 1/5" long. C-shaped larvae are grubs found in the soil approximately 1/2" long.		plant onto light colored cloth or using beating tray.			
DISEASES						
Mummyberry	Leaves and blossoms will begin to become infected. Infected leaves will flag and turn brown. Infected blossoms turn brown and wither.	Infection of blossom resulting in loss of yield. Fruit is non-saleable.	Inspect 5 shoots at each plant. Infection will appear as drooping shoots and the upper surface of the leaves will turn brown from the petiole outwards.	Consider treatment when primary infection is occurring to reduce secondary infection.	Chemical	Continue scouting for infected leaves and shoots and look for infection on developing fruit.
Godronia Canker	Infections form a bull's eye pattern and are formed at leaf scars and other wounds on stems.	Stem girdling when cankers get large.	Inspect 20 plants per site. Look for infections on current year stems or wounded areas.	No tolerance established.	Prune out infected wood. Choose resistant varieties.	Educate farm workers on identification of cankers and pruning out methods.
Botrytis	Blossoms are susceptible to infection. The pathogen can move from the blighted blossom to the peduncle to girdle the stem.	Stem girdling. Blossom infection causing poor fruit set. Fruit may become infected with gray fuzzy mold.	Inspect 5 flower clusters per plant, especially during wet weather. Look for a brown, water-soaked appearance. Blossoms may also be covered with gray fuzzy mold.	No established tolerance. Consider treatment when twigs are found infected.	Keep an open canopy to allow for good air circulation. Time overhead irrigation so that foliage is not wet for prolonged periods. Chemical	Continue scouting for botrytis infection of flowers and fruit.
	Reddish-brown to black cankers may have developed	Large cankers can cause stem girdling and bud death.	Inspect 20 plants per site. Look for reddish-brown to	No established tolerance. Threshold depends on	Prune out infected wood. Chemical	Educate farm workers on identification and pruning techniques

<p>Bacterial Blight</p>	<p>from infections in January and February. Infection only occurs on previous season's growth and enters through wounds in stem tissue.</p>		<p>black cankers on previous season's growth. Send samples to lab for diagnosis.</p>	<p>market, weather, and variety grown. In mature planting, consider treatment if more than 10% plants are infected.</p>		<p>for removal of infected wood.</p>
<p>Anthracnose</p>	<p>Spores are transmitted to flowers and developing fruit during a rain event. Symptoms are seen on last year's fruit stems as orange spore masses.</p>	<p>Fruit infection does not usually show up until fruit ripens, sometimes following harvest.</p>	<p>Inspect 20 plants per site. Look for orange spore masses on last year's fruit stems. Look for infected leaves (circular spots) and blossoms turning black or brown.</p>	<p>No established tolerance. Threshold varies according to end product usage and processor.</p>	<p>Apply overhead irrigation so that plants do not stay wet for prolonged periods. Prune plants to ensure good air circulation. Chemical</p>	<p>Continue scouting for infection on leaves and blossoms. Infection on fruit will often not show up until fruit is fully ripened or after harvest.</p>
<p>Shock Virus</p>	<p>Symptoms will be appearing at this stage. New tissue appears black and older foliage turns orange. Very little fruit will set.</p>	<p>Decrease in yield for at least one season. Plants usually recover after one season with symptoms. Symptoms for Shock Virus are very similar to that of Scorch Virus. Plants with Scorch Virus will not recover. Proper identification is crucial.</p>	<p>At each site, look for plants with blackening new foliage and flower clusters. Tag plants with symptoms and record location. Send samples off for testing to ensure Scorch Virus is not present.</p>	<p>No established tolerance. Plants with Shock Virus will fully recover.</p>	<p>For small plantings, let disease run its course. For larger plantings, rogue plants if contained to a small area, otherwise let disease run its course.</p>	<p>Educate farm workers on identification of symptoms and how to mark plants for identification. Identification should be done throughout the field.</p>
	<p>Symptoms are similar to those of Shock Virus:</p>	<p>Plant death. This virus can be spread</p>	<p>Monitoring of plants should be done</p>	<p>Zero tolerance.</p>	<p>No treatment available for this disease. Plants must</p>	<p>Continue monitoring and testing for virus in</p>

Scorch Virus	shoot tips dying back and blight on blossoms. Plants will not recover from Scorch as they do from Shock.	quickly through a field and between fields. Vectors include aphids and people and tools moving between plants and fields.	through the entire field. Plants suspected for Scorch (or Shock) Virus should be sent to Oregon State University for testing immediately.		be removed from the field as soon as identified.	field.
VERTEBRATE PESTS						
Voies	Small rodents tunnel through soil causing air pockets in the root zone. They will also feed on roots	Can eat roots and girdle crowns.	Set up a monitoring station using PVC pipe and apple wedge. Check for feeding damage on the apple wedge.	20-40% of monitoring stations are positive for feeding damage	Habitat reduction. Rodenticide baits at bait stations.	Monitor again 2-3 weeks following treatment to evaluate efficacy.
Birds	Several types of birds may be present and have the potential to cause damage in a field. Starlings, robins, house finches, and red-winged blackbirds are common.	Damage to fruit can be caused in several ways; fruit may be knocked off of bushes during foraging, eaten wholly by the bird, or punctured or pecked at by a bird.	Scout for birds in the early morning or just before dusk. Identify type of birds present, number present, and change in population size.	Consider treatment if problematic birds are present. Cater management plan to type and number of birds present.	Several types of management options are available. A management plan should be developed that is appropriate to farm site and surrounding properties.	Continue to scout for birds in the field and adapt management plan accordingly.

Pre-Harvest Decision Making Matrices

Pest	Brief Description	Damage / Reason for Concern	Monitoring Approaches	Decision Points / Tolerances	Management Options	Follow Up
INSECTS						
Aphids	Winged and wingless aphids will be seen at this time. Populations may be increasing quickly at this time of year.	Deformation of leaves; reduction of photosynthetic area. May cause honeydew formation and sooty mold on fruit. May transmit viruses; Scorch virus is especially problematic.	Check 5 leaves at each plant for adults and nymphs. Record # of leaves with over 5 aphids per leaf.	Consider treatment if: <i>When not in a scorch area:</i> if 50% of leaves sampled have more than 5 aphids per leaf <i>When in a scorch area:</i> if 10% of leaves sampled have more than 5 aphids per leaf.	Reduce excessive nitrogen use. Aphids (and other piercing/sucking insects) are attracted to high nitrogen tissues. Chemical control.	Continue scouting for winged and wingless populations. If chemical control was applied, scout 5 days following treatment to determine treatment efficacy.
Wintermoth and Spanworm	Maturing larvae feed on emerging foliage and developing fruit.	Larvae can defoliate new growth and flower buds causing a reduction in yield.	Inspect 5 fruit clusters per plant. Look for webbing and frass in the fruit cluster	Consider treatment if 5-10% of plants have infested buds.	Chemical. Be cautious of applying pesticides that may disrupt pollinators.	Treated fields should be scouted soon after treatment to determine efficacy.
Gall Midge	Eggs are laid in May and June in the new terminal growth. Hatching larvae then feed in the terminals.	Can cause shoot tips to deform and curl and may result in excessive branching.	Inspect 5 shoot tips per plant at each site. Look for blackened tips of developing shoots. If seen, open up tips and use hand lens to identify	New Plantings: When more than 4 tips per plant with distortion. Pest is not an economic issue on established plantings.	No pesticides are labeled for Gall midge.	Main peaks of infestation are before and after harvest, when shoot tips are actively growing. Scout during this stage and again post-harvest.

			maggots.			
Leafrollers (OBLR)	Leaves may be rolled, chewed and tied together with silk and may be attached to fruit clusters.	Larvae can feed directly on fruit to reduce yield. They can also act as a contaminant pest. In general, they cause little damage on established plantings.	Inspect 5 leaves per plant. Pull apart rolled leaves to confirm the presence of caterpillars. Record number of larvae or damaged leaves found.	None established	Microbial insecticide B.t. with spreader sticker on cloudy day. Chemical.	Continue scouting for larvae at each site.
Root Weevils	Rough strawberry weevil adults emerge in June and July to lay eggs in summer. Other species of root weevils may be present as adults, eggs, or larvae in the soil.	Adult weevils can cause notching damage to leaves and new stems. Larvae feed on and damage roots.	Examine 20 plants per site for adult feeding damage seen as notching on leaves and stems sometimes followed by flagging of stem sections.	Consider treatment if plants show signs of low vigor and weevils (adults or larvae) have been found. Thresholds depend on age of plant and variety grown. Young plants have a threshold of 1-3 larvae per plant.	Chemical. Manage weeds in the infested area to eliminate alternate food sources for adults and larvae.	Continue scouting for adult and larval stages of weevils.
DISEASES						
Mummyberry	Fruit will start to show symptoms; infected fruit will show white growth in the interior of the fruit and may fall to the ground prematurely.	Loss of yield due to infected fruit.	Inspect 5 fruit clusters at each plant. Look for "early ripening of fruit" where infected fruit are turning a reddish color. Cut open several fruit per cluster to look for whitish growth.	Treatment is not effective at this stage. Monitoring is done to determine the disease pressure for the following year.	None at this stage	Watch for fallen berries during harvest.
	Cankers are evident as reddish brown	Stem girdling when cankers get large.	Inspect 20 plants per site for infections on	No tolerance established	Prune out infected wood. Choose	Educate farm workers on identification of cankers

Godronia Canker	Brown lesions on the stem.		Infections on stems at wounded areas and leaf scars.		Choose resistant varieties.	of cankers and pruning out methods.
Bacterial Blight	Only previous season's growth is affected. Disease enters through wounds in stem.	Stem girdling when cankers get large. Buds in infected area will die.	Inspect plants for blighted tips and cankered twigs.	No tolerance established	Prune out infected wood immediately to avoid spread.	Continue monitoring. Educate farm workers on identification.
Botrytis	Gray fuzzy mold may be seen on developing berries at this time.	Fruit may become infected with gray fuzzy mold resulting in a reduced yield.	Inspect 5 fruit clusters per plant, especially during wet weather. Look for gray fuzzy mold.	No established tolerance	Keep an open canopy to allow for good air circulation. Time overhead irrigation so that foliage is not wet for prolonged periods. Chemical	Continue scouting for botrytis infection of flowers and fruit. Scout for infected fruit during harvest.
Shock Virus	Infected plants may start to show new growth at this time.	Decrease in yield for at least one season. Plants usually recover after one season with symptoms. Symptoms for Shock Virus are very similar to that of Scorch Virus. Plants with Scorch Virus will not recover. Proper identification is crucial.	Monitor plants tagged earlier as identified with symptoms. These plants should be recovering at this time. If they are not, make sure to have the tissue tested for other virus or disease problems.	No established tolerance; plants usually fully recover.	Plants should be recovering at this stage	Educate farm workers on identification of symptoms and how to mark plants for identification. Identification should be done throughout the field.
	Plants infected with Scorch Virus will not be recovering at this time	Plant and field death. This virus can be spread quickly through a field and between	Scouting for infected plants should be done through the entire field.	Zero tolerance.	No treatment available for this disease. Plants must be removed from the field as soon as	Continue monitoring and testing for virus in field.

Scorch Virus	as are those with Shock Virus.	fields. Vectors include aphids and people and tools moving between plants and fields.	Plants suspected for Scorch (or Shock) Virus should be tested immediately.		identified.	
Anthracnose	Fruit will begin to show symptoms of caving in on one side as they mature. Orange spore masses may also be seen.	Infected ripe fruit can cause a great reduction in yield.	Later in maturity, inspect 5 fruit clusters per plant. Look for sunken shriveled berries sometimes with orange spores. Rate the infection level (low, medium, high)	Consider treatment if levels of infection are medium to high, especially if weather is warm and wet. Threshold varies according to end product usage and processor.	Apply overhead irrigation so that plants do not stay wet for prolonged periods. Prune plants to ensure good air circulation. Chemical	Continue scouting up to and into harvest period.
Alternaria Fruit-Rot	Ripening fruit may show symptoms of caving in on one side with dark gray-green spore growth.	Infected ripe fruit is often not saleable. Infection can greatly reduce yield.	Inspect 5 fruit clusters per plant. Look for caving-in on one side as well as a dullish gray spore mass. Rate the infection level (low, medium, high).	Consider treatment if levels of infection are medium to high. Threshold depends on end product usage and processor.	Avoid overripening by harvesting in a timely fashion. Cool fruit immediately after harvest, and avoid wounding fruit during harvest.	Continue scouting up to and into harvest period.
VERTEBRATE PESTS						
Birds	Several types of birds may be present and have the potential to cause damage in a field. Starlings, robins, house finches, and red-winged blackbirds are	Damage to fruit can be caused in several ways; fruit may be knocked off of bushes during foraging, eaten wholly by the bird, or punctured or pecked at by a bird.	Scout for birds in the early morning or just before dusk. Identify type of birds present, number present, and change in population size.	Consider treatment if problematic birds are present. Cater management plan to type and number of birds present.	Several types of management options are available. A management plan should be developed that is appropriate to farm site and surrounding properties.	Continue to scout for birds in the field and adapt management plan accordingly.

	common.					
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WSU Whatcom County Extension

Integrated Pest Management for Blueberries

Harvest Decision Making Matrices

Pest	Brief Description	Damage / Reason for Concern	Monitoring Approaches	Decision Points / Tolerances	Management Options	Follow Up
INSECTS						
Aphids	Offspring are still being produced, but rate of population increase is lower.	Deformation of leaves. May cause honeydew formation and sooty mold on fruit. May transmit viruses; Scorch virus is especially problematic.	Check 5 leaves at each plant. Look for winged and wingless aphids as well as for aphid mummies. Make a note if you find honeydew and sooty mold on fruit, indicating a high level of aphids.	Beneficial insects should be starting to keep this pest in check at this time. If populations are still increasing, consider treatment after harvest.	Reduce excessive nitrogen use. Aphids (and other piercing/sucking insects) are attracted to high nitrogen tissues. Foster habitat for beneficial insects. Chemical control.	Continue scouting for aphid and beneficial insect populations.
Fruit Contaminants	Egg sacs of spiders or pupae of lacewing or syrphid flies contained in the blossom end of the fruit.	Fruit with these contaminants will appear as a white furry mat in the blossom end, rendering the fruit unsaleable. These are beneficial insects so control is not recommended.	Inspect 5 fruit per plant for contaminants at the blossom end. Train harvesting and processing crew on recognizing these contaminants.	Contaminated fruit will need to be removed on the grading line.	Remove fruit from the line when showing contamination.	Train grading staff on what to look for in the way of fruit contaminants.
DISEASES						
Mummyberry	Infected fruit will show up in the clusters and drop to the ground to overwinter. Mummyberries appear pink and puckered with brown	Loss of yield due to infected fruit.	At each plant, check 5 fruit clusters for symptoms. Examine the ground beneath the plant to see if any infected fruit has fallen	No tolerance established.	If on a small farm, clean up dropped fruit following harvest. Chemical	Watch for fallen berries following harvest.

	and corky inside tissue.		to the ground.			
Godronia Canker	Cankers are growing in size through the season; they will appear to be more like a bull's eye with a gray center.	Stem girdling when cankers get large.	Inspect 20 plants per site. Look for leaves turning color earlier than usual acting as red flags in the field.	No tolerance established	Prune out infected wood. Choose resistant varieties.	Educate farm workers on identification of cankers and pruning out methods.
Shock Virus	Infected plants may appear normal except for the lack of fruit.	Loss of yield for at least one year.	Keep monitoring plants with symptoms. Those that have not recovered should be tested by Oregon State University for Scorch Virus.	No tolerance established; plants usually recover.	Plants will probably have recovered by this stage.	Continue monitoring plants with shock symptoms.
Botrytis	Gray fuzzy mold becomes more active on ripening fruit.	Reduces fruit quality and yield.	Inspect 5 fruit clusters per plant. Look for gray fuzzy mold.	No established tolerance	Harvest frequently where gray mold is commonly seen, especially in conditions of warm and wet weather.	Continue scouting for infected fruit.
Anthraxnose	Softening salmon colored spore masses may be seen on infected fruit.	Infected ripe fruit can cause a great reduction in yield.	Inspect 5 fruit clusters per plant for signs of infection. Rate the infection (low, medium, high)	Consider treatment if levels of infection are medium to high, especially if weather is warm and wet.	To reduce the spread among harvested fruit, reduce the temperature of the fruit to 32°F as soon as possible. Chemical	Train harvesting and processing crew on how to identify infected fruit.
Alternaria Fruit-Rot	Ripe fruit may show caving in and greenish-gray spores near the flower end.	Reduction in yield and fruit quality.	Inspect 5 fruit clusters per plant. Look for infection symptoms. Rate the infection level (low, medium, high).	Consider treatment if levels of infection are medium to high.	Avoid over ripening by harvesting in a timely fashion. Cool fruit immediately after harvest, and avoid wounding fruit during harvest.	Train harvesting and processing crew on how to identify infected fruit.
	Plants infected with scorch virus will not be recovering at this time as	Plant and field death. This virus can be spread quickly	Scouting for infected plants should be done through the	Zero tolerance.	No treatment available for this disease. Plants must be removed from	Continue monitoring and testing for virus in field.

Scorch Virus	are those with shock virus.	through a field and between fields.	entire field. Plants suspected for Scorch (or shock) virus should be tested immediately.		the field as soon as identified.	
VERTEBRATE PESTS						
Birds	Several types of birds may be present and have the potential to cause damage in a field. Starlings, robins, house finches, and red-winged blackbirds are common.	Damage to fruit can be caused in several ways; fruit may be knocked off of bushes during foraging, eaten wholly by the bird, or punctured or pecked at by a bird.	Scout for birds in the early morning or just before dusk. Identify type of birds present, number present, and change in population size.	Consider treatment if problematic birds are present. Cater management plan to type and number of birds present.	Several types of management options are available. A management plan should be developed that is appropriate to farm site and surrounding properties.	Continue to scout for birds in the field and adapt management plan accordingly.

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Post-Harvest Decision Making Matrices

Pest	Brief Description	Damage / Reason for Concern	Monitoring Approaches	Decision Points / Tolerances	Management Options	Follow Up
INSECTS						
Aphids	Winged aphids are being produced again at this time. Most aphid populations are being kept in check by natural predators.	Deformation of leaves. May cause honeydew formation and sooty mold on fruit. May transmit viruses; Scorch virus is especially problematic.	Check 5 leaves at each plant. Look for winged and wingless aphids as well as for aphid mummies. Record number of leaves with over 5 aphids per leaf.	Consider treatment if in a scorch virus area and more than 10% of leaves checked have more than 5 aphids per leaf. In scorch areas, post-harvest treatment is recommended, before eggs are layed for overwintering.	Reduce excessive nitrogen use. Aphids (and other piercing/sucking insects) are attracted to high nitrogen tissues. Foster habitat for beneficial insects. Chemical control.	Continue scouting for aphid and beneficial insect populations.
Root Weevils	Obscure root weevil adults are more numerous in September and October. They are ¼ inch long with a wavy brown line across the back towards the rear.	Feeding damage on foliage and new stem growth. Feeding damage on roots.	Inspect leaves for notching damage. Shake plant onto cloth or use beating tray to find adults in foliage. Inspect soil under plants for larval root weevils.	Consider treatment for next spring. If damage has been seen in the current season.	Beneficial nematodes can be used. Apply in early Autumn when soil temperatures are warm and rainfall is common.	
	Fall webworm tents may be present until the middle of September. Tent	Defoliation of plant. Yield reduction.	Inspect branches for overwintering egg cases. Monitor entire field for tents of caterpillars	Rarely of economic concern.	Hand pick or prune out branches with egg masses. Dormant oils may be applied in	Begin scouting in spring for emerging caterpillars.

<p>Tent Caterpillars and Fall Webworms</p>	<p>caterpillars will overwinter as egg masses on stems. Egg cases appear as brown or gray foam like substance.</p>				<p>January and February.</p>	
<p>DISEASES</p>						
<p>Mummyberry</p>	<p>Inoculum for next season is as dropped fruit from this season.</p>	<p>Loss of yield due to infected fruit.</p>	<p>Scout for mummyberries fallen to the ground.</p>	<p>If there has been a problem with this disease, consider treatment.</p>	<p>Following harvest, cultivate shallowly to bury mummies. Chemical</p>	
<p>Godronia Canker</p>	<p>The red flag of dying leaves may be noticed if infection is present. Bull's eye cankers are still a good indicator.</p>	<p>Stem girdling when cankers get large.</p>	<p>During pruning, monitor for cankers and red flag leaves.</p>	<p>No tolerance established</p>	<p>Prune out infected wood. Choose resistant varieties.</p>	<p>Educate pruning crew on how to identify infection and how to prune out infected wood.</p>
<p>Bacterial Blight</p>	<p>Reddish black to brown cankers may be seen.</p>	<p>Stem girdling, death of buds.</p>	<p>During pruning, monitor for cankers.</p>	<p>No tolerance established</p>	<p>Prune out infected wood. Chemical</p>	<p>Educate pruning crew on how to identify infection and how to prune out infected wood.</p>
<p>Botrytis</p>	<p>Infected stems appear tan or gray; black sclerotia may be seen</p>	<p>Reduces fruit quality and yield.</p>	<p>Inspect plants for symptoms on shoot tips.</p>	<p>No established tolerance</p>	<p>Prune out infected wood and keep canopy open to encourage good air circulation.</p>	<p>Look for infected stems during pruning.</p>
<p>Vertebrate Pests</p>						
	<p>Small rodents tunnel through soil</p>	<p>Can eat roots and girdle crowns.</p>	<p>Set up a monitoring station using PVC pipe and</p>	<p>20-40% of monitoring stations are positive for</p>	<p>Habitat reduction. Rodenticide baits at bait</p>	<p>Monitor again 2-3 weeks following</p>

Voles	causing air pockets in the root zone. They will also feed on roots		apple wedge. Check for feeding damage on the apple wedge.	feeding damage	stations.	treatment to evaluate efficacy.
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Cherry Fruitworm (*Grapholitha packardi*) Cranberry Fruitworm (*Acrobasis vaccinii*) Insects & Invertebrates



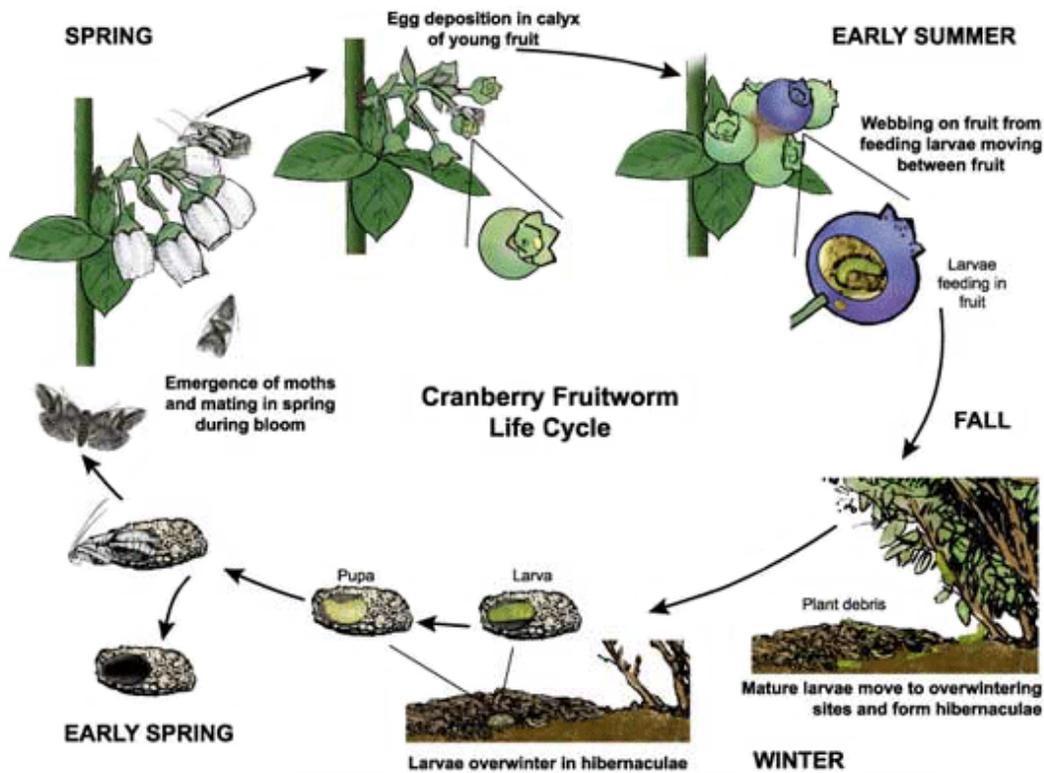
Symptoms

Larvae of both species feed on the inside of fruit by creating a pinhole entrance. One larva is able to destroy several berries by moving between and feeding on berries in a cluster. Symptoms are seen as prematurely blue, shrunken berries since the penetration holes are often not seen. Small entrance holes may appear as brown trails caused by tunneling. Cranberry fruitworm feeding can be identified as frass inside the fruit and the berry cluster clinging together with silk webbing. Larvae may eat only part of the berry or completely consume the inner flesh of a berry.

Identification

Adults of both species are small, dark gray moths with a wingspan of about 1/3 inch (9 to 10 mm). Cranberry fruitworm moths have white patches on their wings. Larvae are smooth caterpillars that will grow to 3/8-inch (9 mm) in length. Cherry fruitworm larvae have pink-red bodies with brown or black heads. Cranberry fruitworm have green bodies with dark heads.

Cranberry Fruitworm Life Cycle



Life History

Fruitworms overwinter as large larvae in cavities usually made in the dead wood on the bush. The adult moths emerge in the late spring. Green-white flattened eggs are laid on the underside of leaves as well as on developing small green fruit. After hatching, larvae enter the berries. They usually feed on one berry and then penetrate and feed on another. Cherry fruitworms seal entrance holes with silk so that frass is not visible outside the berries. Both species have one generation per year.

This Lepidopterous pest is found on a number of host trees including cherry, apple, rose and hawthorne, all of which are commonly found near blueberry fields.

Monitoring

Fruitworm may be monitored in three ways: pheromone traps, scouting for eggs, and scouting for larvae.

Pheromone traps are available for Cranberry fruitworm, but this will not attract the Cherry fruitworm. Number of males caught provides an estimate of population levels and distribution within a field. Trap counts can also act as an indicator for timing of egg laying; eggs are laid shortly after initial adult emergence.

Eggs should be scouted for after early blueberry fruit set and adult flight has started. Eggs are opaque and flattened and are seen on the underside of leaves.

Larval infestations may be difficult to detect early in the season because there is little external evidence of the insect's presence. Look for a pin-sized entry hole near the stem of any small, shrunken berries that have turned blue, and then open adjacent berries to find the larva. Evidence of Cranberry fruitworm can be seen as frass in the fruit and clusters clinging together with webbing.



Thresholds and Management

Remove overwintering environments for larvae, such as weeds and trash around plants; also manage alternate hosts on borders. In small plantings or with low infestation levels, fruitworm can be controlled by hand removing infected fruit. When damage is severe, treat with insecticide. These should be used when larvae are small, usually starting at petal fall.

Resources

Michigan State University; Fruitworm Identification in Blueberries

<http://web1.msue.msu.edu/fruit/bbfrtwm.pdf>

Michigan State University; Blueberry Facts; Cherry Fruitworm

<http://www.blueberries.msu.edu/chryfrtwrm.htm>

Michigan State University Extension; Fruit IPM Factsheet; Cherry Fruitworm

http://web1.msue.msu.edu/vanburen/cherry_fruitworm.htm

Michigan State University; Blueberry Facts; Cranberry Fruitworm

<http://www.blueberries.msu.edu/crbryfrtwrm.htm>

Michigan State University Extension; Fruit IPM Factsheet; Cranberry Fruitworm

<http://web1.msue.msu.edu/vanburen/fcranfrw.htm>

Ontario Ministry of Food, Agriculture, and Rural Affairs; Control of Cranberry and Cherry Fruitworm in Highbush Blueberries

<http://www.omafra.gov.on.ca/english/crops/hort/news/hortmatt/2005/08hrt05a5.htm>

North Carolina State University; Cherry Fruitworm

http://ipm.ncsu.edu/small_fruit/cherworm.html

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Leafroller

Obliquebanded Leafroller (*Choristoneura rosaceana*) and others Insects & Invertebrates



Symptoms

Leafroller larvae feed on leaf and flower buds, opened leaves and blossoms, and ripening fruit. Two generations occur; the overwintering larvae feed on the earlier plant stages and the second generation feeds on leaves and fruit. During feeding, the larvae will roll and tie together leaves, blossoms, and fruit with silk as a protective covering.

On large, established bushes, leafrollers will cause little damage, but may be a contaminant pest in mechanically harvested fields. In fields with younger, smaller plants leafrollers can quickly defoliate entire bushes, causing stunting and undesirable branching of growing points if not located promptly and destroyed.

Identification

Several species of leafrollers of the family Tortricidae will attack blueberries, but the Obliquebanded Leafroller (OBLR) is most common in Whatcom County. Adult OBLR moths are small (1/2" long), bell-shaped, and light brown with a darker band across its wings. Mature larvae are about 1" long and are yellowish-green with dark brown or black heads. Young larvae are tan in color. Eggs are laid on leaves in a greenish patch of up to 200 eggs.



Life History

The obliquebanded leafroller has two generations per year while other related species have one to three generations. Leafrollers overwinter as larvae under loose bark, in twig crotches or in cracks or rough areas. Some moths can start to fly as early as February.

Obliquebanded leafroller larvae resume activity from overwintering in the spring. They spin themselves into tubes in the leaves. When disturbed, they will leave the leaf tube and lower themselves on strands of silk; they may be transported quite a long distance by wind on this silk. Pupation occurs within the leaf tube. Moths emerge from pupation in mid-June to mid-July. Eggs are laid after mating and they will hatch after 10-12 days. New larvae will move to new leaves by crawling or lowering themselves by silk. These larvae will pupate by August, and the next generation of adults is present in August and September. Second generation larvae will overwinter on the host plant or on other nearby plants.



Monitoring

Pheromone traps are available for OBLR and Orange Tortix. These can help to determine the timing of adult emergence and timing of larvae presence. Place pheromone traps in fields beginning in late April or May and check weekly. Starting one week after peak flight, leaves should be examined for worm infestation.

Inspect plants thoroughly especially on the field's outer edges, where the first sign of influx will appear. Look out for rolled leaves and chewed leaves on new growth and blossoms in the early spring.

Degree-days have been determined for OBLR life stages in Michigan. These can be used to predict when to monitor for specific life stages and when effective treatments should be made. Using a base of 43°F, life stage activity is:

Number of Degree Days (base 43)	Life stage
600	First adult emergence
800	First eggs laid
1,150	Peak adult emergence
1,250	Peak egg laying
2,050	First emergence of second generation adults
2,300	First eggs laid by second generation adults

Thresholds and Management

Threshold varies according to end product usage and processor. Processors of IQF fruit have zero tolerance for leafroller larvae. Talk to your buyer for their threshold. Consider control if more than 5% of the terminal growth and floral parts have larvae or larval damage.

Unless leafroller numbers are very high, spraying is not necessary. Repeated or unnecessary sprays will harm natural enemies that are present, such as native parasitic and predatory insects and spiders that will reduce their populations.

Applications of target specific bacterium, *Bacillus thuringiensis, kurstaki* may be used and will not harm bees or other beneficial insects.

Cultural controls such as pruning effectively will help reduce leafroller numbers by removing over wintering sites; effectively weeding fields will remove alternate hosts for this pest.

Resources

Michigan State University, Blueberry Facts, Obliquebanded Leafroller

<http://www.blueberries.msu.edu/oblique.htm>

Michigan State University, Blueberry Facts, Other Leafrollers

<http://www.blueberries.msu.edu/leafrollers.htm>

Michigan State University Extension, Fruit IPM Factsheet, Obliquebanded Leafroller

<http://web1.msue.msu.edu/vanburen/oblr.htm>

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Blueberry IPM: Scouting Sheet - Bloom period (Late April-May)

Inspect 20 plants per site

Field:

Date:

Weather:

Last Sample Date:

Aphid Search: Inspect 5 leaves per plant. Record number of leaves with over 5 aphids per leaf

	Site 1	Site 2	Site 3	Site 4	Site 5
Leaves with >5 aphids per leaf					

Leafroller Search: Inspect 5 flower clusters per plant for leafrollers. Record percent of infested clusters.

	Site 1	Site 2	Site 3	Site 4	Site 5
Wintermoth					
Bruce Spanworm					
OBLR					

Gall Midge Search: Inspect 5 shoot tips per plant. Record the percent of shoot tip infection.

	Site 1	Site 2	Site 3	Site 4	Site 5
Gall Midge infestation					

Root Weevils Search: Record number of grubs found in soil around 10 plants. Record adult feeding damage on a scale of 1-5.

	Site 1	Site 2	Site 3	Site 4	Site 5
Larvae					
Adult feeding					

Mummyberry: Inspect 5 shoots per plant for infested leaves. Record % of infested shoots.

	Site 1	Site 2	Site 3	Site 4	Site 5
% infested shoots					

Stem Diseases: Inspect 20 plants for evidence of diseased stems. Record # of symptomatic plants

	Site 1	Site 2	Site 3	Site 4	Site 5
<i>Godronia</i> Canker					
<i>Botrytis</i>					
Bacterial Blight					
Shock Virus					

Scorch Virus: Tag symptomatic plants and record locations below in "other comments" section.

Evidence of Vole Damage: Check vole monitoring stations and record % with positive feeding damage.

	Site 1	Site 2	Site 3	Site 4	Site 5
Vole feeding					

Record notes on evidence of deer, bird, and other vertebrate damage:



Blueberry IPM: Scouting Sheet – Pre-Harvest period (June-July)

Inspect 20 plants per site

Field:

Date:

Weather:

Last Sample Date:

Aphid Search: Inspect 5 leaves per plant. Record number of leaves 5 or more aphids per leaf

	Site 1	Site 2	Site 3	Site 4	Site 5
# leaves					

Leafroller Search: Inspect 5 flower clusters and 5 leaves per plant for leafrollers. Record number infested

	Site 1	Site 2	Site 3	Site 4	Site 5
Wintermoth					
Bruce Spanworm					
OBLR					

Gall Midge Search: Inspect 5 shoot tips per plant. Record the number of shoot tips infested.

	Site 1	Site 2	Site 3	Site 4	Site 5
Gall Midge infestation					

Root Weevils Search: Record adult feeding damage on a scale of 1-5.

	Site 1	Site 2	Site 3	Site 4	Site 5
Adult feeding					

Mummyberry: Inspect 5 fruit clusters per plant. Record number of clusters with infected, early ripening fruit. Cut open 10 fruit and record number with internal whitish growth.

	Site 1	Site 2	Site 3	Site 4	Site 5
Fruit ripening					
Internal growth					

Stem Diseases: Inspect 20 plants for evidence of diseased stems. Record # of symptomatic plants

	Site 1	Site 2	Site 3	Site 4	Site 5
<i>Godronia</i> Canker					
<i>Botrytis</i>					
Bacterial Blight					
Shock Virus					
Scorch Virus (test)					

Fruit Diseases: Inspect 5 fruit clusters per plant for fruit diseases. Record level of infection (low, medium, high)

	Site 1	Site 2	Site 3	Site 4	Site 5
<i>Botrytis</i>					
Anthracnose					
<i>Alternaria</i>					

Record notes on evidence of deer, bird, and other occasional pest damage:

Draw Map of Field

Blueberry IPM: Scouting Sheet - Harvest period (July-September)

Inspect 20 plants per site

Field:

Date:

Weather:

Last Sample Date:

Aphid Search: Inspect 5 leaves per plant. Record number of leaves with over 5 aphids per leaf. Also record incidence of beneficial insects and mummified aphids seen at this time.

	Site 1	Site 2	Site 3	Site 4	Site 5
# leaves over 6 aphids					
# mummified aphids					
Beneficial insects found					

Fruit Contaminants: Inspect 5 fruit clusters per plant. Look for a furry white mat in the blossom end of the fruit. Record number of plants with contaminants.

	Site 1	Site 2	Site 3	Site 4	Site 5
Fruit contaminants found					

Mummyberry: Inspect 5 fruit clusters per plant. Look for infected, early ripening fruit. Cut open 10 fruit to look for internal whitish growth. Rate the number of mummyberries dropped to ground (low, medium, high)

	Site 1	Site 2	Site 3	Site 4	Site 5
Fruit ripening					
Internal growth					
Mummies on ground					

Stem Diseases: Inspect 20 plants for evidence of diseased stems. Record # of symptomatic plants. Record whether or not plants with suspected shock virus have recovered.

	Site 1	Site 2	Site 3	Site 4	Site 5
<i>Godronia</i> Canker					
Shock Virus					

Scorch Virus: Tag suspected plants and send samples in to Oregon State University for testing. Note locations of plants in comments section below.

Fruit diseases: Inspect 5 fruit clusters per plant for fruit diseases. Record number of clusters infected

	Site 1	Site 2	Site 3	Site 4	Site 5
Botrytis					
Anthraco nose					
<i>Alternaria</i>					

Record notes on evidence of vertebrate and other occasional pest damage:

Draw Map of Field

