2021
Cornell Pest Management Guidelines for Berry Crops

Cornell Cooperative Extension

These guidelines are not a substitute for pesticide labeling. Always read and understand the product label before using any pesticide.

2021 Cornell Pest Management Guidelines for Berry Crops

Authors

Marvin Pritts (School of Integrative Plant Science, Horticulture Section, Cornell University, Ithaca, NY; *Editor, horticulture, nutrient guidelines*)

Elizabeth Bihn (Department of Food Science, Cornell University, Ithaca, NY; *food safety*)

Juliet Carroll (New York State IPM Program, Geneva, NY; *integrated pest management*)

Kerik Cox (School of Integrative Plant Science, Plant Pathology and Plant-Microbe Biology Section, Cornell University, Geneva, NY; *plant pathology*)

Michael Helms (Pesticide Management Education Program, Cornell University, Ithaca, NY; *pesticide information*)

Andrew Landers (Department of Entomology, Cornell University, Geneva, NY; *sprayer technology*)

Greg Loeb (Department of Entomology, Cornell University, Geneva, NY; *entomology*)

Laura McDermott (Cornell Cooperative Extension Eastern NY Commercial Horticulture Program, Washington County, Hudson Falls, NY; *weed management*).

Special Appreciation

Special appreciation is extended to Mary Kirkwyland (NYS IPM Program), William Parken (Pesticide Management Education Program), the research staff at Geneva and Ithaca, and regional and county specialists and educators in the preparation of these Guidelines.

Abbreviations and Symbols Used in This Publication

A ..... acre
AI ..... active ingredient
D ..... dust
DF ..... dry flowable
DG ..... dispersible granule
E ..... emulsion, emulsifiable
EIQ..... Environmental Impact Quotient
EC ..... emulsifiable concentrate
F ..... flowable
FRAC... Fungicide Resistance Action Committee: Code
G ..... granular
IRAC .... Insecticide Resistance Action Committee: Mode of Action Classification
L ..... liquid
NA..... not available
OMRI ... Organic Materials Review Institute
P ..... pellets
PHI ..... pre-harvest interval
REI ..... restricted-entry interval
S ..... soluble
SP ..... soluble powder
ULV ..... ultra-low volume
W ..... wettable
WDG.... water-dispersible granules
WP ..... wettable powder
WSP..... water soluble packet
WSSA.. Weed Science Society of America: Herbicide: Site of Action Classification List
* ..... Restricted-use pesticide; may be purchased and used only by certified applicators
† ..... Not for use in Nassau and Suffolk Counties
Δ ..... Rate and/or other application restrictions apply. See label for more information.

Every effort has been made to provide correct, complete, and up-to-date pest management information for New York State at the time this publication was released for printing (April 2021). Changes in pesticide registrations, regulations, and guidelines occurring after publication are available in county Cornell Cooperative Extension offices or from the Pesticide Management Education Program web site (pmep.cce.cornell.edu).

Trade names used in this publication are for convenience only. No endorsement of products is intended, nor is criticism of unnamed products implied.

These guidelines are not a substitute for pesticide labeling. Always read and understand the product label before using any pesticide.

The guidelines in this bulletin reflect the current (and past) authors' best effort to interpret a complex body of scientific research, and to translate this into practical management options. Following the guidance provided in this bulletin does not assure compliance with any applicable law, rule, regulation or standard, or the achievement of particular discharge levels from agricultural land.

Cover photo: Juneberry (Amelanchier) is a native plant in the Rose family that produces fruit resembling blueberries. They are grown extensively in Canada and some colder regions of the US. (*Photo by: Marvin Pritts, School of Integrative Plant Sciences, Horticulture Section*)

1 Pesticide Information

1.1 Pesticide Classification and Certification

The Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) created two classifications of pesticides – general-use and restricted-use. **General-use pesticides** may be purchased and used by anyone. **Restricted-use pesticides can** only be purchased by a certified applicator. Restricted-use pesticides must also be used by a certified applicator or someone under their supervision.

The same federal law that classifies pesticides divided applicators into two groups: private and commercial. **Private applicators** use or supervise the use of pesticides to produce agricultural commodities or forest crops on land owned or rented by the private applicator or their employer. A farmer must be certified as a private applicator in order to purchase and use restricted-use pesticides on agricultural commodities. (No certification is needed if a farmer does not use restricted-use pesticides.)

A **commercial applicator** uses or supervises the use of pesticides for any purpose or on any property not covered by the private applicator classification. In New York, a commercial applicator must be certified to purchase or use any pesticide whether it is general- or restricted-use.

Information about pesticide certification and classification is available from your Cornell Cooperative Extension office (cce.cornell.edu/localoffices), regional NYSDEC pesticide specialist (www.dec.ny.gov/about/ 558.html), the Pesticide Applicator Training Manuals (https://www.cornellstore.com/books/cornell-cooperative-ext-pmep-manuals), or the Pesticide Management Education Program (PMEP) at Cornell University (psep.cce.cornell.edu).

1.2 Use Pesticides Safely

Using pesticides imparts a great responsibility on the user to protect their health and that of others and to protect the environment. Keep in mind there is more to "pesticide use" than the application. Pesticide use includes mixing, loading, transporting, storing, or handling pesticides after the manufacturer's seal is broken; cleaning pesticide application equipment; and preparing a container for disposal. These activities require thoughtful planning and preparation. They are also regulated by state and federal laws and regulations intended to protect the user, the community, and the environment from any adverse effects pesticides may cause.

1.2.1 Plan Ahead

Many safety precautions should be taken *before* you actually begin using pesticides. Too many pesticide applicators are dangerously and needlessly exposed to pesticides while they are preparing to apply them. Most pesticide accidents can be prevented with informed and careful practices. **Always read the label on the pesticide container before you begin to use the pesticide.** Make sure you understand and can follow all directions and precautions on the label. Be prepared to handle an emergency exposure or spill. Know the first aid procedures for the pesticides you use.

1.2.2 Move Pesticides Safely

Carelessness in transporting pesticides can result in broken containers, spills, and contamination of people and the environment. Once pesticides are in your possession, you are responsible for safely transporting them. Accidents can occur even when transporting materials a short distance. You are responsible for a pesticide accident so take every effort to transport pesticides safely. Be prepared for an emergency.

1.2.3 Personal Protective Equipment and Engineering Controls

Personal protective equipment needs depend on the pesticide being handled. ***Required personal protective equipment (PPE) are listed on pesticide labels.*** The required PPE are based on the pesticide's toxicity, route(s) of exposure, and formulation. Label required PPE are the minimum that must be worn during the pesticide's use. Pesticide users can always wear more protection than the label requires.

The type of protective equipment used depends on the type and duration of the activity, where pesticides are being used, and exposure of the handler. Mixing/loading procedures often require extra precautions. Studies show you are at a greater risk of accidental poisoning when handling pesticide concentrates. Pouring pesticide concentrates from one container to another is the most hazardous activity.

Engineering controls are devices that help prevent accidents and reduce a pesticide user's exposure. One example is a closed mixing/loading system that reduces the risk of exposure when dispensing concentrated pesticides. Consult the product label for more information on using engineering controls in place of PPE.

1.2.4 Avoid Drift, Runoff, and Spills

Pesticides that move out of the target area can injure people, damage crops, and harm the environment. Choose weather conditions, pesticides, application equipment, pressure, droplet size, formulations, and adjuvants that minimize drift and runoff hazards. See product labels for specific application and equipment requirements.

2 General Information

2.1 Introduction

Cornell's 2021 Pest Management Guidelines for Berry Crops is intended to provide growers with general nutrient guidelines and information to aid with insect, mite, disease, and weed management decisions. Cultural, biological, and chemical management tools are identified whenever available.

In-depth information on commercial berry crop production may be found in the resources listed in Table 2.15.

Guidelines provided in this guide are consistent with label guidelines formulated for large-scale operations. Smaller scale producers may use the same guidelines by converting them to the appropriate unit (Table 2.1.1).

2.2 Site Selection and Preparation

Preparations for a berry planting must begin one to two years in advance. Select a site with good air and water drainage and have a preplant soil and a nematode analysis performed on representative soil samples. *Growers may wish to select a more broad-spectrum approach to preplant soil analysis at this time by opting for a comprehensive Cornell soil health assessment.*

2.2.1 Basic Soil Test

Agro-One provides soil and nutrient testing services previously available through the Cornell Nutrient Analysis Laboratory along with additional analytical services. Key input regarding analytical methods and quality control is provided by Cornell, and Cornell nutrient management guidelines are provided by Cornell through DairyOne.

Table 2.1.1. Conversion factors to convert from one unit to another.

To convert from	To	Multiply by
lb/A	lb/100 sq ft	**0.0023**
tn/A	lb/100 sq ft	**4.6**
lb/A	kg/ha	**1.12**
kg/ha	lb/A	**0.893**
lb	oz	**16**
qt of fruit	lb of fruit	**1.5**
qt	pt	**2.0**
pt	qt	**0.5**
gal of liquid	lb of liquid	**8.3**
Strawberries		
lb/A	lb/100 ft of row	**0.008**
Yield in lb/100 ft of row	lb/A	**125**
Yield in qt/100 ft of row	lb/A	**188**
Raspberries and Blackberries		
lb/A	lb/100 ft of row	**0.0184**
lb/A	oz/plant	**0.009**
Yield in lb/100 ft of row	lb/A	**55**
Yield in pt/100 ft of row	lb/A	**73**
Blueberries		
lb/A	oz/plant	**0.015**
Yield in lb/100 ft of row	lb/A	**44**
Yield in pt/100 ft of row	lb/A	**58**
Currants and Gooseberries		
lb/A	oz/plant	**0.012**
lb/A	lb/100 ft of row	**0.0184**
Yield in lb/100 ft of row	lb/A	**55**
Yield in pt/100 ft of row	lb/A	**73**

5) Frequent tillage to expose root debris and subject nematodes to drying conditions.

Preplant fumigation may further reduce nematode numbers in soil.

2.2.4 Nematode Testing

Samples may be submitted for nematode testing to the Plant Disease Diagnostic Clinic, College of Agriculture and Life Sciences, Ithaca, NY. The best time for collecting samples for nematode testing is during the active growing season. A minimum of 6 soil subsamples, approx. 1" in diameter and 4" in depth should be collected randomly from an area approx. ½ acre in size. Gently mix samples together, transfer about 1 pint of mixed soil to a plastic bag. For best results, ship as soon as possible to the diagnostic lab. Refrigerate sample if it cannot be shipped immediately. For more information and fee schedules visit their website at www.plantclinic.cornell.edu.

Follow the recommendations of the soil and nematode tests to ensure a good planting in future years. A nutritionally healthy planting in a well-drained soil with exposure to air movement is least susceptible to damage from pests.

2.2.5 Garden Symphylans

Garden symphylans (sometimes called garden centipedes) are very small, thin white animals with 8 to 12 pairs of legs and very distinctive bead-like antennae. They inhabit soil, spending all of their life cycle underground in the dark. Symphylans feed on germinating vegetable and weed seeds, roots and root hairs of plants. Sometimes feeder roots are completely cut off by symphylan feeding; leaving brown stubs were the roots should be. Feeding on roots interferes with plant growth and yield, and causes plant stunting.

Damage may also lead to wilting on warm days and in some instances, plant death. Symphylans may chew holes in larger roots and strawberry fruit. Damage may also occur to above ground plant parts in contact with soil. Chewing injuries then become infection courts for soil-borne diseases.

Direct observation is probably the best method for determining the presence of symphylans in soil. Sample the top 6 to 12" of warm, moist soil prior to tillage. Gently place a shovel full of soil on a piece of black plastic. Break apart soil clumps and count numbers of symphylans present. Sample 10 to 20 shovels of soil per acre. A rule of thumb action threshold for symphylans is 5 to 20 per shovelful of soil for moderate to highly susceptible crops.

Cultural management practices for symphylans include:

1. Deep, thorough cultivation between crops to destroy earthworm tunnels, symphylans and eggs present, and crop rotation. Reports indicate 2 to 3 tillings per week for 3 to 4 weeks prior to planting have been recorded as being successful in reducing symphylan numbers.
2. Crop rotation. Populations have been demonstrated to decrease significantly following potato crops; allowing growth of a more susceptible crop afterwards. While no other cover crops reduce population numbers as much as potatoes, spring oats also showed reduced numbers. Conversely, numbers were higher following mustard and spinach crops.

Preplant fumigation may further reduce symphylan numbers in soil.

2.3 Fumigation

Fumigation may be required if nematode and/or symphylans levels are high or if pathogenic fungi or insect pests are present in the soil. Fumigation may also provide some weed control. The grower can apply some types of fumigants; others must be commercially applied. Soil should be friable and moist prior to fumigation, and the soil temperature should be 50° to 90°F. All plant material must be decomposed prior to fumigation. See Table 2.3.1.

Growers who fumigate their crops are requirements to have a detailed "Fumigant Management Plan" (FMP) in place before fumigating, and for at least two people at the fumigation site to have an appropriate respirator and be fit-tested and medically cleared to use one. Even growers who have their fumigation done by custom work will need an FMP specific to their farm.

2.3.1 Soil Fumigant Management Plans

Soil fumigations are complex processes that require specialized equipment and practices to properly apply volatile and toxic pesticides. EPA's risk mitigation allows for site-specific decisions to address the conditions where the fumigant is applied. To address this complexity and flexibility, EPA is requiring that fumigant users prepare a written, site-specific fumigant management plan (FMP) before fumigations begin. Written plans and procedures for safe and effective applications will help prevent accidents and misuse and will capture emergency response plans and steps to take in case an accident occurs.

Once the application begins, the certified applicator must make a copy of the FMP available for viewing by handlers involved in the fumigation. The certified applicator or the owner/operator of the application block must provide a copy of the FMP to any local/state/federal/tribal enforcement personnel who request the FMP. In the case of an emergency, the FMP must be made available when requested by local/state/federal/tribal emergency response and enforcement personnel.

3. Sprayer Technology

3.1 Introduction

The average berry planting in New York State is less than 5 acres. Selecting sprayers for small-size plantings can be challenging because it may not be possible to justify the expense of a full-sized sprayer. Larger growers may also use their sprayer for multiple crops, thereby justifying the expense. Sprayers for the small berry crop planting are discussed in sections 3.2 and 3.3.

Sprayers for larger plantings or multiple crops are discussed in sections 3.8 through 3.11.

Regardless of sprayer size, information presented on nozzles (sections 3.5, 3.6 and 3.9), drift reduction (sections 3.3 and 3.7), and solutions for safer spraying (section 3.13) is relevant for all types of sprayers.

3.2 Selecting a Small Sprayer for the Small Berry Crop Planting

There are many important points to consider before purchasing a sprayer, not the least of which is the area to spray, the proximity of the local supplier, standard of manufacture, etc. There are many growers with small plantings who need spraying equipment ranging from backpack sprayers to small truck- or ATV-mounted machines.

3.2.1 Canopy Sprayers

3.2.1.1 Backpack Sprayers

Small capacity (4-5 gallon) sprayers will produce up to approximately 100 psi pressure. Weight is an important consideration and growers should select a sprayer with good, wide, padded straps to ease the load on your shoulders. Correct nozzle selection according to the target is very important to ensure even coverage. A good-sized filling hole at the top is also important.

There are three factors affecting application rate – forward speed, pressure, and nozzle tip size. Unfortunately, most inexpensive backpack sprayers have no pressure gauge. Pay more money and purchase a backpack sprayer with a pressure gauge or, better still, purchase a spray management valve as standard or as an option. Normally output increases or decreases according to the pressure in the system, (which is dependent upon how vigorous you are in pumping the handle up and down). A spray management valve, such as a CF valve, will ensure a constant output irrespective of hand pump action. The CF valve evens out fluctuations in pressure, e.g. will only allow a maximum and minimum pressure thus ensuring even flow. The Fountainhead Group (www.thefountainheadgroup.com) sells a backpack sprayer with a simple valve which ensures the correct pressure is not exceeded.

An alternative to the hand-operated backpack sprayer is an electrically-operated backpack sprayer, which utilizes a small rechargeable battery. Maximum pressure is relatively low and it is easier than using a traditional hand pump system, particularly if you have many rows of plants to spray. Similarly a small back pack sprayer fitted with a small gas engine is available. The electric version is quieter to use, but you must remember to recharge the batteries otherwise spraying will be delayed.

3.2.1.2 Portable Mist and Air Blower Backpacks

These are ideal for plantings where canopy penetration is required, e.g. denser, vigorous plantings. A small gas engine drives a fan blower which creates an airstream which passes along a hand-held tube (similar to a leaf blower). The tube has a nozzle situated at the end so that liquid spray can be squirted into the airstream. The operator directs the spray cloud towards the canopy by pointing the hand-held tube. It is preferable to point the tube backwards to avoid walking into the spray cloud. Engine speed can be reduced which enables a slower airspeed to match a smaller canopy in early season. They are very good at rustling the canopy and getting good penetration and deposition. They are heavy! Noise is a problem, so ear protection must be worn.

3.2.1.3 Portable Gas Engine-driven Sprayers

If weight is a problem, and ground conditions are relatively smooth, a number of manufacturers offer a sprayer with a small gas engine and a 10 to 12 gallon tank. Larger capacity tanks (14 to 100 gallons) are often trailed and can be pulled by a lawn tractor, ATV, Gator, or small tractor.

3.2.1.4 Small, Mounted Sprayers

Ideal for mounting onto the carrier rack of an ATV, 15 to 25 gallons, they use a small electric pump to provide up to 70 psi. When used with a hand wand and a hose, they can be used to spray short length rows. The same system is ideal for weed control and spot spraying of weeds.

3.2.1.5 Large, Skid Mounted Sprayers

Ideal for fitting into the back of a pick-up truck, these sprayers have a tank capacity of 35 to 200 gallons, and an electric-start gas engine.

3.2.1.6 Small, Trailed Airblast Sprayers

Very small airblast sprayers, with tank capacities up to 110 gallons and a 5.5 to 20 hp gas engine, can be towed by an ATV or a small tractor. Larger tank capacities up to 300 gallons are also available but require larger tractors with weights and brakes for safe operation. Remember, the

Where:
GPM = total sprayer output in gallons per minute
GPA = application rate in gallons per acre
MPH = travel speed in miles per hour
Nozzle spacing = width between rows of vines in inches
495 = a mathematical constant to correct units of measurement

Example:

$$GPM = \frac{20 \times 4 \times 20}{5940} = \frac{1600}{5940} = 0.27$$

Consider forward speed – if too high, the boom may bounce
Consider pressure – if too high, may lead to drift; too low, may lead to droplet bounce

Example
Using the flat fan nozzle chart, as found in the nozzle catalog page as shown in Figure 4.3

1. Read along the colored row at the top of the table.
2. Look at the column headed Capacity one nozzle in GPM
3. Look down the column until you see a figure close to 0.27 gpm
4. Then look to the left to see the colored nozzle to select. There are several options. Note the spray quality column entitled Drop size, 80º and 110º:
    a. Select nozzle purple XR 110025 at 50 psi to give 0.28 gpm (F spray quality)
    b. Select nozzle blue XR8003VS at 30 psi (M spray quality) or blue XR11003VS at 30psi (F spray quality) to give 0.26 gpm
    c. Select nozzle red XR8004VS at 20 psi (C spray quality) or red XR11004VS at 20psi to give 0.28 gpm (M spray quality)

Select the appropriate nozzle for the target.

Spray classification and target
1. Fine sprays when using fungicides and insecticides; beware of drift.
2. Medium sprays when the leaf is the target; ideal for herbicides.
3. Coarse sprays when the soil is the target; low risk of drift.

	PSI	DROP SIZE 80°	DROP SIZE 110°	CAPACITY ONE NOZZLE IN GPM	CAPACITY ONE NOZZLE IN OZ./MIN.	20" GPA 4 MPH	5 MPH	6 MPH	8 MPH	10 MPH	12 MPH	15 MPH	20 MPH
XR8001 XR11001 (100)	15	M	F	0.061	7.8	4.5	3.6	3.0	2.3	1.8	1.5	1.2	0.91
	20	F	F	0.071	9.1	5.3	4.2	3.5	2.6	2.1	1.8	1.4	1.1
	30	F	F	0.087	11	6.5	5.2	4.3	3.2	2.6	2.2	1.7	1.3
	40	F	F	0.10	13	7.4	5.9	5.0	3.7	3.0	2.5	2.0	1.5
	50	F	VF	0.11	14	8.2	6.5	5.4	4.1	3.3	2.7	2.2	1.6
	60	F	VF	0.12	15	8.9	7.1	5.9	4.5	3.6	3.0	2.4	1.8
XR80015 XR110015 (100)	15	M	F	0.092	12	6.8	5.5	4.6	3.4	2.7	2.3	1.8	1.4
	20	M	F	0.11	14	8.2	6.5	5.4	4.1	3.3	2.7	2.2	1.6
	30	F	F	0.13	17	9.7	7.7	6.4	4.8	3.9	3.2	2.6	1.9
	40	F	F	0.15	19	11.1	8.9	7.4	5.6	4.5	3.7	3.0	2.2
	50	F	F	0.17	22	12.6	10.1	8.4	6.3	5.0	4.2	3.4	2.5
	60	F	F	0.18	23	13.4	10.7	8.9	6.7	5.3	4.5	3.6	2.7
XR8002 XR11002 (50)	15	M	M	0.12	15	8.9	7.1	5.9	4.5	3.6	3.0	2.4	1.8
	20	M	F	0.14	18	10.4	8.3	6.9	5.2	4.2	3.5	2.8	2.1
	30	M	F	0.17	22	12.6	10.1	8.4	6.3	5.0	4.2	3.4	2.5
	40	F	F	0.20	26	14.9	11.9	9.9	7.4	5.9	5.0	4.0	3.0
	50	F	F	0.22	28	16.3	13.1	10.9	8.2	6.5	5.4	4.4	3.3
	60	F	F	0.24	31	17.8	14.3	11.9	8.9	7.1	5.9	4.8	3.6
XR110025 (50)	15		M	0.15	19	11.1	8.9	7.4	5.6	4.5	3.7	3.0	2.2
	20		M	0.18	23	13.4	10.7	8.9	6.7	5.3	4.5	3.6	2.7
	30		F	0.22	28	16.3	13.1	10.9	8.2	6.5	5.4	4.4	3.3
	40		F	0.25	32	18.6	14.9	12.4	9.3	7.4	6.2	5.0	3.7
	50		F	0.28	36	21	16.6	13.9	10.4	8.3	6.9	5.5	4.2
	60		F	0.31	40	23	18.4	15.3	11.5	9.2	7.7	6.1	4.6
XR8003 XR11003 (50)	15	M	M	0.18	23	13.4	10.7	8.9	6.7	5.3	4.5	3.6	2.7
	20	M	M	0.21	27	15.6	12.5	10.4	7.8	6.2	5.2	4.2	3.1
	30	M	F	0.26	33	19.3	15.4	12.9	9.7	7.7	6.4	5.1	3.9
	40	M	F	0.30	38	22	17.8	14.9	11.1	8.9	7.4	5.9	4.5
	50	M	F	0.34	44	25	20	16.8	12.6	10.1	8.4	6.7	5.0
	60	F	F	0.37	47	27	22	18.3	13.7	11.0	9.2	7.3	5.5
XR8004 XR11004 (50)	15	C	M	0.24	31	17.8	14.3	11.9	8.9	7.1	5.9	4.8	3.6
	20	C	M	0.28	36	21	16.6	13.9	10.4	8.3	6.9	5.5	4.2
	30	M	M	0.35	45	26	21	17.3	13.0	10.4	8.7	6.9	5.2
	40	M	M	0.40	51	30	24	19.8	14.9	11.9	9.9	7.9	5.9
	50	M	F	0.45	58	33	27	22	16.7	13.4	11.1	8.9	6.7
	60	M	F	0.49	63	36	29	24	18.2	14.6	12.1	9.7	7.3

Figure 3.6.1. Flat fan nozzle chart from Spraying Systems Tee Jet Catalog 50A 2009

3.7 Boom Sprayer Calibration

Note: Use clean water!

Step 1. Check your tractor/sprayer speed

$$\textbf{Formula: } \frac{\text{ft. traveled}}{\text{sec. traveled}} \text{ X } \frac{60}{88} = \text{MPH}$$

Your tractor sprayer speed:

$$MPH = \frac{\text{ft. traveled}}{\text{sec. traveled}} \text{X } \frac{60}{88} = \text{MPH}$$

Step 2. Record the inputs

	Your figures	Example
Nozzle type on your sprayer (all nozzles must be identical)	_____	110 04 flat fan
Recommended application volume (from manufacturer's label)	_____	20 GPA
Measured sprayer speed	_____	4 mph
Nozzle spacing	_____	20 inches

4 Emerging Pests

4.1 Introduction

The disease and pest complement affecting a particular crop or group of crops is dynamic by nature. New pests, (invasive species), are introduced into our country, state, or region from abroad. Native species, perhaps previously considered minor pests of a berry crop, become more prevalent or pervasive in nature. Environmental conditions during a particular season or successive seasons are conducive for buildup and explosion of a known pest or disease problem, causing higher levels of economic impact.

This chapter is designed to provide commercial berry growers with information and resources on how to recognize new and/or emerging pest issues in berry crops through pest alert pages for each pest or disease as they appear. Each pest alert page contains information on identification, monitoring, management strategies and resources for the particular pest or disease.

For assistance with diagnosing berry problems use the Berry Diagnostic Tool at https://blogs.cornell.edu/berrytool/ or contact your Cornell Cooperative Extension Office for assistance.

To submit samples for disease diagnosis, contact Plant Disease Clinic, Cornell University, Plant Pathology section, SIPS, 334 Plant Science Building, Ithaca, NY 14853-4203, (607) 255-7850, plantclinic.cornell.edu.

To submit samples for insect diagnosis or for phone consultations, contact Insect Diagnostic Laboratory, Cornell University, Department of Entomology, 4140 Comstock Hall, Ithaca, NY 14853-2601, (607) 255-3250, idl.entomology.cornell.edu.

The following resources are suggested to help with weed identification. If you are unable to identify your problem weed with the resources listed below please contact your Cornell Cooperative Extension Office for assistance.

1. Uva, R.H., Neal, J.C. and DiTomaso, J.M. 1997. Weeds of the Northeast. Cornell University Press, Ithaca, NY. 397 pgs.
2. Royer, F. and Dickinson, R. 1999. Weeds of Canada and the Northeastern United States. Lone Pine Publishing/University of Alberta Press. 434 pgs.

Table 4.1.1. Emerging berry crop pests

Emerging pest	Berry crops potentially affected:	See section:
Arthropod Pests		
Spotted Wing Drosophila	blueberries, brambles, day neutral strawberries, elderberries	4.2
Brown Marmorated Stinkbug	blueberries, brambles, possibly others	4.3
Diseases		
Blueberry Scorch Virus	blueberries	4.4
Blueberry Shock Virus	blueberries	4.5
Currant Cane Blight	currants	4.6
White Pine Blister Rust	currants	4.7
Weeds		
Wild Parsnip	all	4.8
Giant Hogweed	all	4.9
Herbicide-Resistant Weeds	all	4.10

4.2 Spotted Wing Drosophila

Genus species:	*Drosophila suzukii*
Common name:	Spotted wing drosophila
Distribution:	Becoming established throughout Northeast; first detected in NY in 2011
Background:	Originally from Asia, spotted wing drosophila (SWD) first showed up in California in about 2008 and has spread north into Oregon, Washington, and western Canada, south into Florida and now has been found in much of the USA. SWD was first reported throughout the Northeast in the late summer of 2011. In 2012, adult SWD first appeared in late June/early July and caused wide-spread injury to some berry crops. A similar pattern has been observed in subsequent years, with first detection of the season varying from year to year.

5 Highbush Blueberries

5.1 Introduction

Numerous pests affect highbush blueberries, although the pest complex is much narrower than with many other fruit crops. For photographs of these pests and for detailed information on blueberry culture, obtain a copy of the Highbush Blueberry Production Guide (NRAES-55) from your Cornell Cooperative Extension Office or download a free fair use pdf copy (23.0 MB) of this publication at: http://www.hort.cornell.edu/fruit/berry-guides/blueberry.pdf.

For assistance with diagnosing highbush blueberry problems, use the online Berry Diagnostic Tool at: https://blogs.cornell.edu/berrytool/ or contact your Cornell Cooperative Extension Office for assistance.

To submit samples for disease diagnosis, contact Plant Disease Clinic, Cornell University, Plant Pathology section, SIPS, 334 Plant Science Building, Ithaca, NY 14853-4203, (607) 255-7850, online at: plantclinic.cornell.edu. To submit samples for insect diagnosis or for phone consultations, contact Insect Diagnostic Laboratory, Cornell University, Department of Entomology, 4140 Comstock Hall, Ithaca, NY 14853-2601, (607) 255-3250, online at: idl.entomology.cornell.edu.

The following information is provided for management of highbush blueberry pests. If a pesticide is used, it must be registered with the state and federal governments. Use Tables 5.1.2 (insecticides and miticides), 5.1.3 (fungicides), 5.1.4 (herbicides) and 5.1.5 (other highbush blueberry pest management products) to determine legal pesticides, their brand names, and any restrictions that may apply. Unless otherwise noted, use 100 gal water per acre. Always read the label before applying any pesticide.

Table 5.1.1. Highbush blueberry pests and the associated stage of plant development.

Stage of development	Scout for:	See section:
Dormant	Insect stem gall, Botrytis blossom and twig blight Cankers (Fusicoccum and Phomopsis) Scale insects	5.2.1.1 5.2.1.2 5.2.1.3 and 5.2.1.4 5.2.1.5
Green tip	Mummyberry Botrytis blossom and twig blight Phomopsis canker	5.2.2.1 5.2.2.2 5.2.2.3
Pink bud	Mummyberry Botrytis blossom and twig blight	5.2.3.1 5.2.3.2
Bloom	Mummyberry Botrytis blossom and twig blight Anthracnose fruit rot/blossom blight Blueberry leaf rust Powdery mildew Double spot	5.2.4.1 5.2.4.2 5.2.4.3 5.2.4.4 5.2.4.5 5.2.4.6
Petal fall/Post bloom	Cranberry fruitworm Cherry fruitworm Leafrollers Blueberry tip borer Plum curculio	5.2.5.1 and 5.2.6.1 5.2.5.2 and 5.3.6.2 5.2.5.3 and 5.3.6.3 5.2.5.4 and 5.2.6.4 5.2.5.5
Summer preharvest	Blueberry maggot Japanese beetle Anthracnose fruit rot Blueberry stem borer Spotted wing drosophila	5.2.7.1 5.2.7.2 5.2.7.3 5.2.7.4 5.2.7.5
Harvest	Spotted wing drosophila	5.2.8.1
Special pests	Brown marmorated stink bug Ants Witches' broom	5.2.9.1 and 4.3 5.2.9.2 5.2.9.3

Table 6.1.1. Bramble pests and the associated stage of plant development.

Stage of development:	Scout for:	See section:
Special pests *(continued)*	Blackberry psyllid	6.2.9.9
	Brown marmorated stink bug	6.2.9.10
	Borers/cane girdlers	6.2.9.11
	Raspberry crown borer	6.2.9.12
	Potato leafhopper	6.2.9.13
	Tree cricket	6.2.9.14
	Twospotted spider mite	6.2.9.15
	Raspberry aphid	6.2.9.16
	Yellow jackets and hornets	6.2.9.17

NOTE: For purposes of slowing resistance development in pest populations growers should alternate use of products with different modes of action (indicated by number/letter codes in the last column of the following tables) whenever possible. Product trade names are provided but other products with the same active ingredient may be labeled for the same purposes. Note: With most pesticides, reentry is not allowed until spray material has dried. Read the label.

Table 6.1.2. Selected insecticides and miticides registered for use on brambles (raspberries and blackberries).

Active Ingredient	Trade Name	EPA Reg. Number	PHI (days)	REI (hours)	IRAC Code
acetamiprid	Assail 30SG	8033-36-70506	1	12	4A
acequinocyl	Kanemite 15SC	66330-38	1	12	20B
azadirachtin	*§AzaSol	81899-4-74578	-	4	UN
	§Molt-X	68539-11	0	4	UN
	Azatrol-EC	2217-836	0	4	UN
	§Aza-Direct	71908-1-10163	0	4	UN
	§AzaGuard	70299-17	0	4	UN
	§AzaMax	71908-1-81268	0	4	UN
	§Ecozin Plus 1.2% ME	5481-559	0	4	UN
azadirachtin, pyrethrins	§Azera	1021-1872	0	12	UN
Beauvaria bassiana	§Mycotrol ESO	82074-1	0	4	NC
bifenazate	Acramite 50WS	400-503	1	12	20D
bifenthrin	*Bifenture 10DF	70506-227	3	12	3A
	*Brigade WSB	279-3108	3	12	3A
	*Brigade 2EC	279-3313	3	12	3A
bifenthrin, zeta-cypermethrin	*Hero	279-3315	3	12	3A
chlorantraniliprole	*†Altacor	279-9607	1	4	28
Chromobacterium subtsugae str. PRAA4-1	§Grandevo WDG	84059-27	0	4	
cyantraniliprole	*†Exirel (Dupont)	352-859	1	12	28
cyclaniliprole	*†ΔVerdepryn 100 SL	71512-34-88783	1	4	28
etoxazole	Zeal Miticide1	59639-138	0	12	10B
fenazaquin	Magister SC Miticide	10163-322	7	12	21A
fenpropathrin	*ΔDanitol 2.4EC	59639-35	3	24	3A
flupyradifurone	*†Sivanto Prime	264-1141	0	4	4D
	*†Sivanto HL	264-1198	0	4	4D
hexythiazox	Savey 50DF	10163-250	3	12	10A
imidacloprid	*Admire Pro Systemic Protectant	264-827	7 (soil), 3 (foliar)	12	4A
malathion	Malathion 5EC	19713-217	1	12	1B
	Malathion 57EC	34704-108	1	12	1B
	Malathion 8 Aquamul	34704-474	1	12	1B
mineral oil	§SuffOil-X	48813-1-68539	UDH	4	

7.3.2 PREBLOOM

7.3.2.1 Bud Weevil or Clipper (Anthonomus signatus)

Refer to information given under EARLY SPRING (section 7.3.1).

7.3.2.2 Tarnished Plant Bug (Lygus lineolaris)

Symptoms- This pest causes "cat faced" or "button" berries. It damages the fruit by feeding on the flower buds; the berries in the immediate area stop developing. Little information is available on cultivar differences in susceptibility to tarnished plant bug, but early maturity is correlated with freedom from injury; later cultivars may suffer more damage.

Management Options	*Guideline*
Scouting/thresholds	Anytime from just before the blossoms open until harvest, check for tarnished plant bug nymphs by striking the plant over a flat, low-sided, light-colored dish. Suggested action threshold: 0.5 nymphs per cluster, or 4 out of 15 clusters with 1 or more nymphs.
Resistant cultivars	'Honeoye' is less susceptible to feeding injury than other cultivars. Late season and day-neutral varieties often experience much higher pest pressure due to high TPB populations.
Cultural management	Row covers accelerate development and help avoid injury. Tarnished plant bug pressure is often highest in weedy fields or in fields bordered by woody shrubs.

7.3.2.2 Tarnished Plant Bug (Lygus lineolaris)

Pesticide Options	Active Ingredient	Trade Name	Product Rate	Field Use EIQ	Comments
Conventional	**acetamiprid**	Assail 30SG	4-6.9 oz/acre	2.2 - 3.7	
	bifenthrin	*Brigade WSB	16-32 oz/acre	4.4 - 8.9	
	bifenthrin	*Bifenture 10DF	6.4-32 oz/acre	1.8 - 8.9	
	fenpropathrin	*ΔDanitol 2.4EC	10.6 fl oz/acre	5.4	*See comments below*
	No aerial application allowed in NYS. Do not exceed more than 2 consecutive applications. Maximum 16 fl oz/A (0.3 lb AI/A) per application and maximum of 32 fl oz (0.6 lb AI)/A/year.				
	flonicamid	Beleaf	2.8 oz/acre	0.8	
	flupyradifurone	*†Sivanto HL	7 fl oz/acre foliar; 10.5-14 fl oz/ac soil	NA	
	imidacloprid, bifenthrin	*ΔBrigadier	5.1-6.1 fl oz/acre	3 - 3.6	
	malathion	Malathion 57 EC	1.5-3 pts/acre	21.3 - 42.5	
	naled	*Dibrom 8 EC	1 pt/acre	31.8	
	thiamethoxam	*†Actara	4 oz/acre	2.1	
Organic	**Beauvaria bassiana**	§Mycotrol ESO	0.25-1 qt/acre	NA	
	Chromobacterium subtsugae str. PRAA4-1	§Grandevo WDG	2-3 lb/acre	NA	
	Isaria fumosorosea Apopka str. 97	§PFR-97 20% WDG	1-2 lb/acre	NA	
	pyrethrins	§PyGanic EC 1.4 II	16 fl oz/acre	0.5	*See comments below.*
	Short residual activity may require multiple applications. Caution: do not use when bees are active in the planting.				
	pyrethrins	§PyGanic EC 5.0 II	4.5-15.61 fl oz/acre	0.5 - 1.9	*See comments below.*
	Short residual activity may require multiple applications. Caution: do not use when bees are active in the planting.				

* Restricted-use pesticide.

Δ Rate and/or other application restrictions apply. See label for more information.

† Not for use in Nassau and Suffolk Counties.

§ Potentially acceptable in certified organic production programs.

Table 8.3.1. Application details for herbicides labeled for use on Ribes in New York State.

Herbicide	Formulation	Amount of product per sprayed acre	lb active ingredient
• May be used on bearing, non-bearing and nursery stock. Do not apply until 4 weeks after transplanting. For a soil surface treatment, apply Casoron 4G from November 15 to February 15. • Do not make surface applications to areas which have been cultivated during the fall or summer prior to application. For incorporated treatments, apply and incorporate immediately from late fall or very early spring before May 1. Uniform application is essential – calibration of applicator designed for spreading granules is appropriate.			
flumioxazin	Chateau SW	12 oz/acre	0.38 lbs/acre
• Pre- and some post-emergence control of annual broadleaves and suppression of some annual grasses. • Pre-emergent applications should be made to a weed free soil surface prior to weed emergence. Moisture is necessary to activate Chateau SW on soil for residual weed control. Chateau SW should be tank mixed with a labeled burndown herbicide for post-emergence control. • Do not apply to bushberries established less than 2 years unless they are protected from spray by non-porous wrap, grow tubes or waxed containers. Do not allow spray to contact new or green bark or foliage. Do not apply more than 12 oz/A of Chateau SW during a single application or during a 12-month period. Allow 30 days between applications. Note: A maximum rate of 6 oz/A/application should be used on any soil with sand/gravel content over 80% if the bushes are less than 3 years of age; 2 applications of 6 oz/A in a 12-month period can still be made as long as there have been 60 days between applications. Dust created by mowing in treated areas can injure desirable vegetation; see label for details. Do not apply withing 300 yards of non-dormant pome or stone fruit.			
napropamide	Devrinol 2-XT	2 gal/acre	4 lbs/acre
• Pre-emergence control of annual grasses and some broadleaf weeds. • For use in newly planted or established crops. Apply fall through early spring but not to frozen ground. Devrinol is sensitive to photodegradation, see labels regarding incorporation depth and timing. Leaf litter or weedy vegetation can interfere with soil-herbicide contact, which may adversely affect weed control. • Devrinol is not recommended for use on soils containing more than 10% organic matter. Do not apply more than 2 gal/A per crop cycle. For use on both currants and gooseberries.			
napropamide	Devrinol DF-XT	8 lb/acre	4 lbs/acre
• Pre-emergence control of annual grasses and some broadleaf weeds. • For use in newly planted or established crops. Apply fall through early spring but not to frozen ground. Devrinol is sensitive to photodegradation, see labels regarding incorporation depth and timing. Leaf litter or weedy vegetation can interfere with soil-herbicide contact, which may adversely affect weed control. • Devrinol is not recommended for use on soils containing more than 10% organic matter. Do not apply more than 8 lb/A Devrinol DF-XT per crop cycle. For use on both currants and gooseberries.			
oryzalin	Surflan A.S.	2-6 qt/acre	2-6 lbs/acre
• Pre-emergence control of annual grasses and some broadleaf weeds. • For use in non-bearing and bearing crops. Apply directly to the soil surface, prior to weed emergence, that is free of leaf litter, standing vegetation and large soil clods. A single 0.5 to 1 inch of water is required to activate Surflan A.S.; 1 inch or more of water is needed on fine-textured, high organic matter soils. If weeds begin to emerge, a shallow cultivation to a depth of 1 to 2 inches will destroy existing weeds and place Surflan A.S. in the zone of weed germination. • Do not use on soils containing more than 5% organic matter. Do not apply more than 12 qt/A per year. To broaden spectrum of weed control Surflan A.S. may be applied in tank mix combination with labeled rates of other herbicides products; see label for details.			
POSTEMERGENT			
ammonium nonanoate	§Axxe	6-15% v/v. See label for details.	See rate table on label for details
• Post-emergence, contact, non-selective herbicide that provides control and burndown suppression of annual and perennial broadleaf and grass weeds; spore producing plants, such as mosses and liverworts, are also controlled. • May be used for the following purposes in currants: Directed and shielded sprays - spray nozzle type or configuration for directed spray or a shield placed around the nozzle to prevent spray contact on the foliage or green stems or bark. Directed/shielded spray applications to area between plastic mulch strips and staked crops for weed control. • Do not allow spray to contact any green plant parts of desirable plants. Do not apply to weeds covered with dirt or when wet from dew, rain or irrigation or if rainfall is expected within 2 hours. Do not irrigate within 2 hours after application.			
carfentrazone-ethyl	Aim EC	1-2 fl oz/acre	0.016-0.031 lbs/acre
• Post-emergence control of annual broadleaf weeds. • May be applied as broadcast application during dormant stage of crop; do not apply more than 2 fl oz/A during the dormant season. Can be used as a directed application for post-emergence weed control. Newly planted bush berries should only be treated with shielded sprayers or hooded sprayers.			