

Insect Virus Vector Management on Raspberries



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Topics

- **Background**
 - **Viruses & vectors**
 - **Aphid behavior**
- **Viruses of berries**
 - **Symptoms**
 - **Vectors**
 - **Management**
- **Review of other pests of brambles**

Common Virus Vectors



Aphids

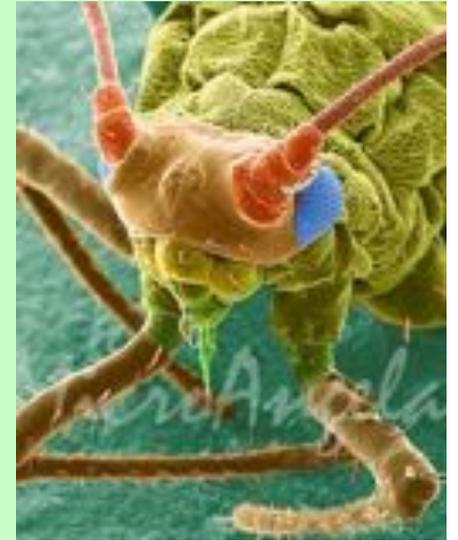


Leafhoppers



Thrips

Classification of Aphid-Vectored Viruses



- Non-persistent, stylet-borne
- Semi-persistent, stylet-borne
- Circulative, non-propagative
- Circulative, propagative

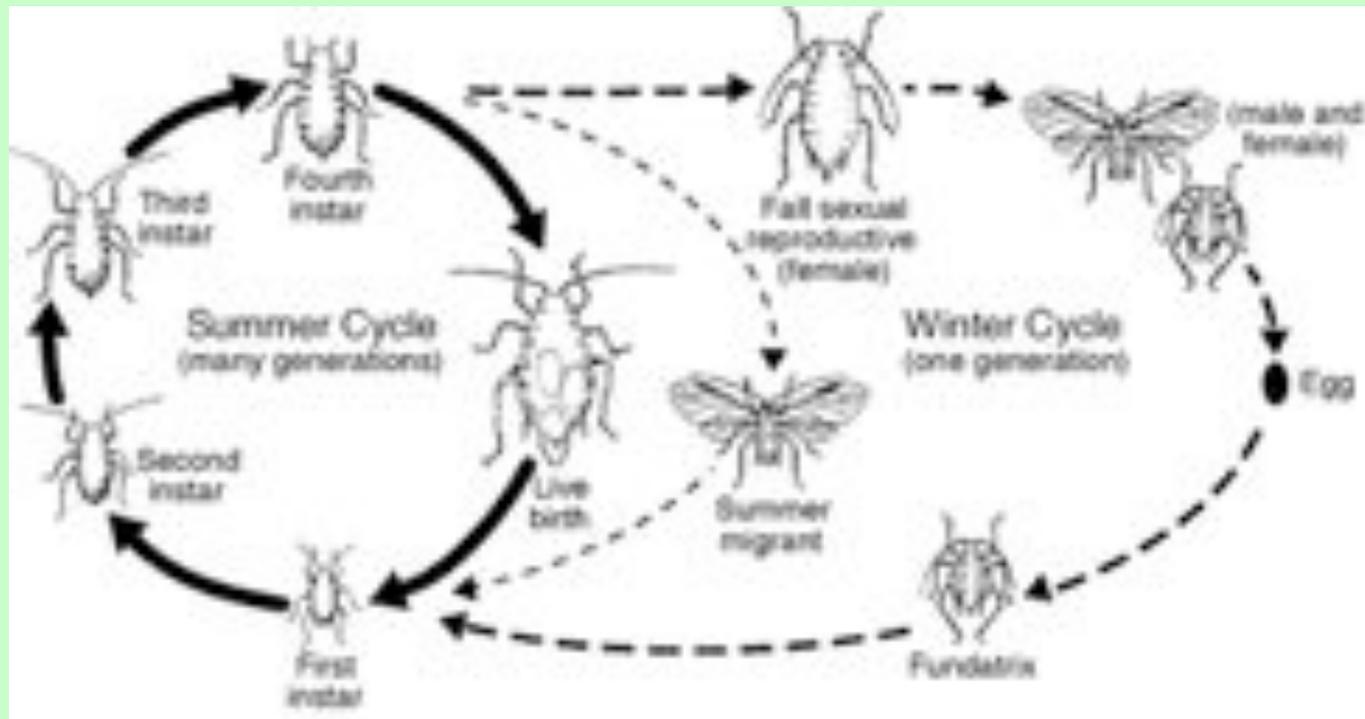
Aphid/Virus Classification

	Non-persistent	Semi-persistent	Circul., non-propag.	Propagative
Acquire	Seconds/minutes	Minutes/hours	Hours/days	Hours/days
Latent period	None	None	Hour/day	Weeks
Retain	Minutes	Hours	Day/week	Week/month

Aphids & Viruses

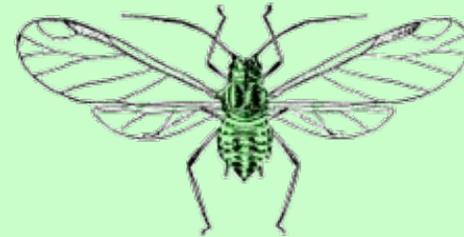
- **Aphids:**
 - 4000 species described
 - 192 species known vectors
- **Viruses:**
 - 208 non-persistent
 - 25 semi-persistent
 - 33 circulative
 - 9 propagative

Aphid Life Cycle



Aphid Behavior

Fly



Land



Taste



Feed



Fly



Aphid Behavior

Fly



Land



Taste



Feed



Fly

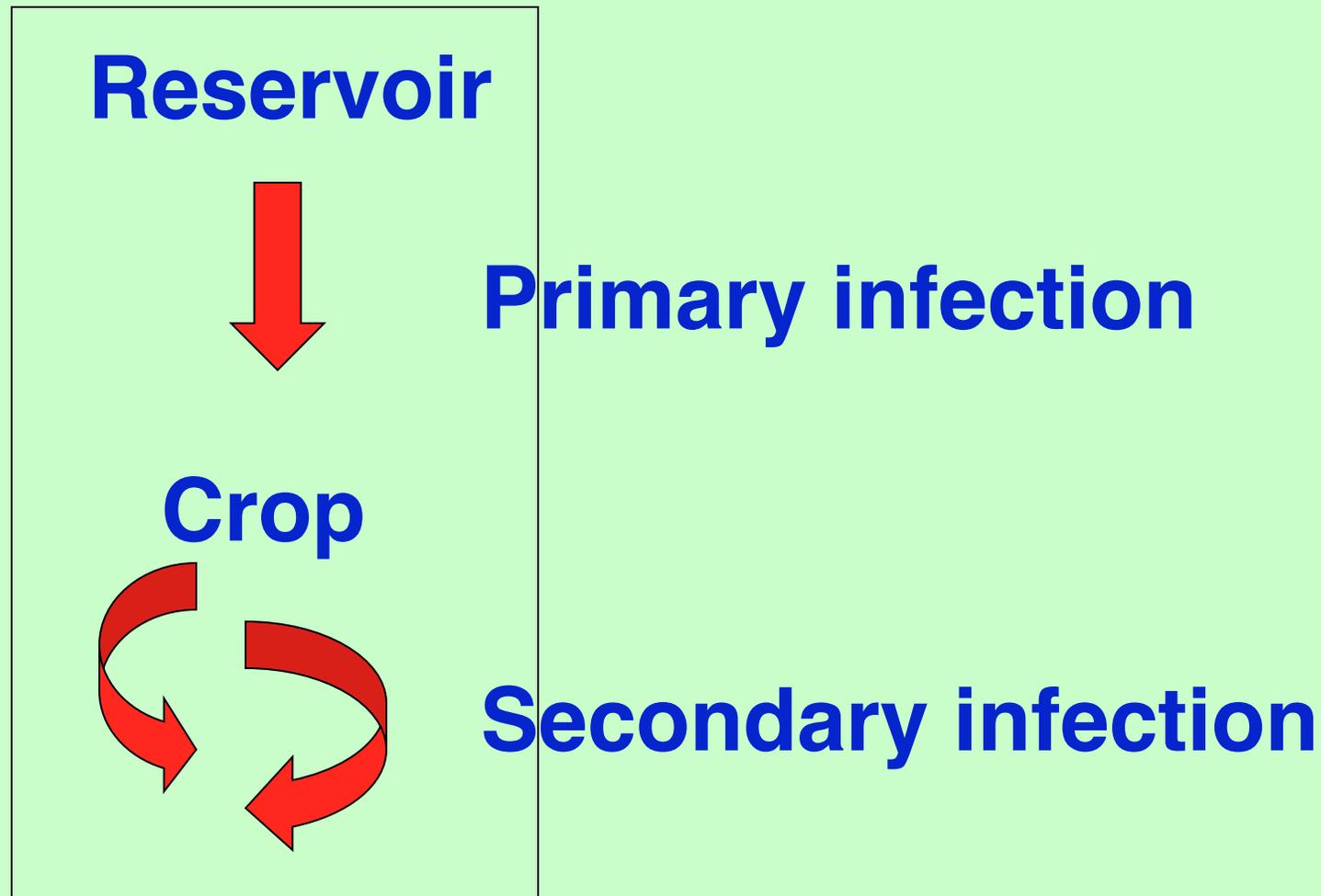


Colonizers



Non-Colonizers

Virus Spread



Management of Aphid- Vectored Viruses

- 1. Reduce infection severity in plant**
- 2. Reduce initial inoculum**
- 3. Reduce rate of spread**

Management of Aphid-Vectored Viruses

- 1. Reduce infection severity
in plant**
 - Resistant varieties**

Management of Aphid-Vectored Viruses

2. Reduce initial inoculum

- Reservoir control
- Crop rotation
- Plant upwind from source
- Roguing

Management of Aphid-Vectored Viruses

3. Reduce rate of spread

- **Insecticides?**
 - For primary infection: no
 - For secondary infection:
 - Yes, if 1° infection limited
 - No, if 1° infection widespread
- **Stylet oil**
- **Reflective mulch**
- **Row covers**



Viruses on Berries

<i>Crop</i>	<i>Disease</i>	<i>Vector</i>
Brambles	Raspberry mosaic virus	Aphid
	Raspberry leaf curl virus	Aphid
	Raspberry/tobacco streak virus	Pollen,seed
	Tomato ringspot virus	Nematode
	Raspberry bushy dwarf virus	Pollen,seed
Blueberry	Blueberry shoestring virus	Aphid
	Blueberry stunt virus	Leafhopper
	Red ringspot virus	Mealybug?
Straw- berry	Strawberry Latent C virus	Aphid
	June yellows virus-like disease	-

Raspberry Viruses & Vectors

- **Raspberry mosaic disease**
 - **Vector: Large raspberry aphid**
 - **Most important virus**
 - **Less damaging than #2**
- **Raspberry leaf curl virus**
 - **Vector: Small raspberry aphid**
 - **Less common virus**
 - **More damaging than #1**

Raspberry Mosaic Disease

- **Caused by a complex of 2+ viruses:**
 - **Black raspberry necrosis virus**
 - **Rubus yellow net virus**
- **Semi-persistent**

Raspberry Mosaic Disease



mottling



blistering

- Evident on new canes in spring & fall
- Tops curl downward, turn black, die
- Infected canes short, less vigorous
- Fruit yield reduced (up to 50%)
- Fruit dry, crumbly

Raspberry Mosaic Disease

- **Most damage on black raspberries & purple raspberries**
- **Less damage on red raspberries**
- **Least damage on blackberries**

Raspberry Mosaic Disease Vectoring by Aphids

- **Semi-persistent**
- **Acquired within minutes**
- **Retained for several hours**
- **Can be acquired & transmitted by young nymphs, older nymphs, and adult aphids**

Large raspberry aphid



- *Amphorophora agathonica*
- Large greenish aphid (1/6"; 3-4 mm)
- Feed on new foliage
 - Near cane tip, early summer
 - On new lower leaves, late summer
- Spreads virus up to 1/4 mile

Large raspberry aphid: Life history



- Overwinter as eggs, primocane bud axils
- Hatch in May
- **Winged** forms
 - Active in June
 - Long-distance field spread of virus
- Many (20) generations per year
- All females, mostly **wingless**, in summer
 - Active; drop to ground when disturbed
 - Local movement of viruses
- Males produced only in fall

Large raspberry aphid: Management



- **Scout for aphids**
 - Cane tips
 - May & June
- **Action threshold:**
 - >2 aphids per cane tip
- **Insecticides:**
 - Malathion
 - Not Asana (although labelled)

Raspberry mosaic: Control by Cultivar Selection

Type	Reds	Black/purple
Vector resistant	CANBY (PA, ON, OR) Titan (PA, ON, NY) Tulameen (ON, OH, NY) Nordic (OH) Milton (OH) September (OH) Indian Summer (OH)	ROYALTY (PA, ON)
Virus resistant or tolerant	Latham (PA) Qualicum (ON, OH) Autumn Bliss (ON) Autumn Britten (ON) Heritage (ON)- toler.	Logan (OH) ?Dundee (OH) ?Black Hawk (OH) ?Bristol (OH)

Raspberry Leaf Curl Virus

- **More damaging than mosaic**
- **Spreads slowly in infected fields**

Raspberry Leaf Curl Virus



- **Initially shoots pale yellow-green**
- **Shoots then turn dark, brittle**
- **Leaves rounded, small, crinkled, dark green, curl down and inward**
- **Growth stunted, excessively branched**
- **Yield reduced (70%)**
- **Fruit small, crumbly, seedy**

Small raspberry aphid

- *Aphis rubicola*
- *Behavior*
 - Sluggish aphid
 - Does not readily drop from foliage if disturbed
- **Peak activity**
 - Late July
 - Early October

Raspberry Leaf Curl Vectoring by Aphids

- **Persistent**
- **Virus acquired after 2 hours feeding**
- **Can transmit for many days**
- **Probably retained for life of aphid**
- **Transmitted by nymphs & adults**

Raspberry leaf curl: Control by Variety Selection

- **Plant vector-resistant purple cultivar
– ‘Royalty’**

Raspberry streak

- **Caused by Tobacco Streak Virus**
- **Black & purple raspberries**
- **In northern Ohio**
- **Symptoms**
 - **Purplish streaks on lower canes**
 - **Terminal leaves hooked, twisted, dark green**
 - **Leaf yellowing on veins**
 - **Fruit small, dull, seedy, crumbly**
 - **Uneven ripening**



Tomato Ringspot Virus



- **General stunting of bush**
- **General yellowing of leaves**
- **Small crumbly berries**
- **Affects red raspberries**
- **Affects blackberries**

Tomato Ringspot Virus



- **Spread via dagger nematodes**
- **Spreads 2 meters per year**
- **Expanding patches in infected fields**

Virus Management in NEW Plantings

- Buy **certified** virus-indexed nursery grown rootstocks
- Plant into soil free of dagger nematodes
 - Or fumigate
- Separate blacks or purples from reds
 - Do not grow near each other
 - Plant blacks upwind of reds
- Destroy wild brambles within **400 yards**
 - Or use windbreak between new & wild

Virus Management in Established Plantings

- **Rogue out** symptomatic plants
 - Including root system
 - Destroy immediately
 - Begin in early June
 - At least twice per year

Bramble Pests

Crown	*Raspberry crown borer
Canes	*Rednecked cane borer *Raspberry cane borer Snowy tree cricket Rose scale
Fruit	Raspberry fruitworm Japanese beetle Picnic beetle
Leaf	Two-spotted spider mite Blackberry psyllid Aphids Raspberry leafminer Raspberry leafroller Raspberry sawfly

Raspberry Crown Borer



- **Symptoms**

- Withering, wilting cane foliage
- Damaged canes break off when pulled
- Girdled roots and crowns
- Cavities in crown

- **Remove all wild brambles**
- **Destroy infested plants**
- **Guthion soil drench**
- **Future: nematode biocontrol**



Rednecked cane borer



- **Galls usually close to ground level**
- **Adults emerge in mid-June**
- **Prune** infested canes in winter
- **No insecticides registered**

Raspberry cane borer



- **Causes wilting tips**
- **Egg laid between 2 rings of punctures**
- **Adults (beetles) appear in June**
- **Eggs hatch in July**
- **Prune** infested canes before egg hatch
- **No insecticides registered**

Insecticides for Brambles

<i>Class</i>	<i>Product</i>	<i>Target</i>
Organo-phosphates	Guthion	Broad spectrum
	Malathion	Aphids, beetles
Carbamates	Sevin	Beetles, bugs
Pyrethroids	bifenthrin (Brigade, Capture)	Broad spectrum
	Asana	Broad spectrum
Insect growth regulators	Confirm	Caterpillars
Microbials	DiPel & other BTs	Caterpillars
Other	Pyrethrins (Pyganic, Pyronyl)	Broad spectrum
	SpinTor	Caterpillars
	Savey	Mites
	Neem	Beetles, caterpillars