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Update on Pest Management and Crop Development

May 2, 2016

COMING EVENTS

	43°F	50°F
Current DD* accumulations		
(Geneva 1/1-5/2):	270.3	113.1
(Geneva 1/1-5/2/2015):	173.1	82.6
(Geneva "Normal"):	280.5	138.6
(Geneva 1/1-5/9, predicted):	355.4	157.7
(Highland 1/1-5/2):	516.9	247.0

Upcoming Pest Events – Ranges (Normal +/- Std Dev):

Apple grain aphid		
nymphs present	128-488	63-247
Comstock mealybug		
1st gen crawlers in pear buds ...	215-441	80-254
European red mite egg hatch	231-337	100-168
Green apple aphid present	111-265	38-134
Green fruitworm flight subsides .	264-460	122-248
Lesser appleworm		
1st adult catch..........................	271-565	127-307
Mirid bugs 1st hatch	331-443	163-229
Obliquebanded leafroller		

larvae active	158-314	64-160
Oriental fruit moth		
1st flight peak	331-537	168-286
Rebanded leafroller		
1st flight peak	230-380	104-198
Rose leafhopper nymphs		
on multiflora rose	239-397	96-198
Rosy apple aphid		
nymphs present	134-244	56-116
Spotted tentiform leafminer		
1st oviposition	143-273	58-130
Spotted tentiform leafminer		
1st flight peak	269-409	125-215
McIntosh bloom	346-416	172-218

*[all DDs Baskerville-Emin, B.E.]

Phenologies

Geneva:	Current	5/9, Predicted
Apple (McIntosh):	pink	bloom
Apple (Empire/ Red Delicious):	pink	king bloom
Pear (Bartlett/Bosc):	early white bud	bloom
Sweet Cherry:	bloom	petal fall

Tart Cherry:	white bud-bloom	bloom
Plum:	bloom	petal fall

Highland:
Apple
(McIntosh/Empire): bloom
(Red Delicious): bloom
(Ginger Gold): bloom
Pear
(Bartlett, Bosc): petal fall
Peach (early/late): petal fall

Pest Focus
Geneva: 1st Oriental Fruit Moth trap catch today, 5/2.
Highland: 1st Lesser Appleworm trap catch today, 5/2.

TRAP CATCHES (Number/trap/day)
Geneva

	4/22	4/25	4/29	5/2
Green Fruitworm	19.5	18.0	6.0	1.5
Redbanded Leafroller	114.5	26.5	9.5	14.5
Spotted Tentiform Leafminer	62.5	2.5	0.0	12.0
Oriental Fruit Moth	0.0	0.0	0.0	3.5*

Highland (Peter Jentsch)

	4/11	4/18	4/25	5/2

Green Fruitworm	0.1	<0.1	0.2	<0.1
Redbanded Leafroller	1.8	8.4	21.6	4.0
Spotted Tentiform Leafminer	0.9	19.5	96.9	12.7
Oriental Fruit Moth	-	0.0	16.4*	1.9
Lesser Appleworm	-	-	-	1.1*

* 1st catch

ORCHARD RADAR DIGEST

[Box Text: MAY FLIES]

Geneva Predictions:

Roundheaded Appletree Borer

RAB egglaying begins: June 10. Peak egglaying period roughly: June 29 to July 13. First RAB eggs hatch roughly: June 25.

Dogwood Borer

First DWB egg hatch roughly: June 27.

Codling Moth

1st generation 3% egg hatch expected: June 10.

Lesser Appleworm

1st LAW trap catch: May 15.

Mullein Plant Bug

Expected 50% egg hatch date: May 18, which is 6 days before rough estimate of Red Delicious petal fall date

Obliquebanded Leafroller

1st generation OBLR flight, first trap catch expected: June 11.

Oriental Fruit Moth

1st generation OFM flight starts: May 4.

Redbanded Leafroller

1st generation RBLR peak trap catch and approximate start of egg hatch: May 6.

San Jose Scale

First adult SJS caught on trap: May 23.

1st generation SJS crawlers appear: June 21.

Spotted Tentiform Leafminer
1st STLM flight peak trap catch: May 13.
White Apple Leafhopper
1st generation WALH found on apple foliage: May 16.

[Section: INSECTS]

FIRST FLIGHT: CONSIDERATIONS FOR EARLY "WORM" MANAGEMENT

(Peter Jentsch, Entomology, Highland; pjj5@cornell.edu)

[Box Text: CHEWING MOUTHPARTS]

The early "worm" complex found in commercial apple during the pre-bloom period begins with the emergence of the green fruitworm (GFW). In Highland, we traditionally have our first flight of GFW in early March, with our first capture of this insect on the 11th of March this season (March 25 in Geneva). This insect group is comprised of at least three different lepidopteran species whose larvae feed on the foliage, flowering parts and developing fruits of pear and apple. An in-depth look at this insect complex can be found in a PDF of the 1974 New York Food and Life Sciences Bulletin No. 50 by Chapman, P.J., and Lienk, S.E. 1974. Green Fruitworms (https://ecommons.cornell.edu/bitstream/handle/1813/5043/FLS-050.pdf?sequence=1&isAllowed=y)

In the Hudson Valley, it's a fairly predictable event to catch GFW adults flying during the warmest days of early March, yet the damage to fruit can be sporadic from year to year. This group comprises many species, including the speckled green fruitworm, *Orthosia hibisci* (Guenee), the widestriped green fruitworm (*Lithophane antennata*), and the humped green fruitworm (*Amphipyra pyramidoides*), among others, that are aptly named after predominantly physical features the larvae exhibit. Many other Lepidoptera follow the GFW complex during the pre-bloom period and include the redbanded leafroller, spotted tentiform leafminer, oriental fruit moth, lesser appleworm, codling moth, and emerging larval populations of overwintering obliquebanded leafroller (OBLR). The GFW and OBLR are of greatest concern to commercial fruit growers prior to and shortly after bloom, and many control measures used against these two insects are effective in managing the secondary lepidopteran pests.

The GFW complex are members of the Noctuidae family and fly at night. Flight begins during apple bud development and peaks at tight cluster, with flight completed by the pink stage. GFW adults have a wingspan of about 1.5 inches. The forewings are grayish pink; each is marked near the middle with 2 purplish-gray spots, outlined by a thin pale border with the hind wings lighter in color than the forewings. Females begin ovipositing on twigs and developing leaves when apples are at the half-inch green stage. GFW eggs are about 3/8" in diameter and 3/16" in height. GFW eggs are white with a grayish tinge and ridges radiating from the center. The egg takes on a mottled appearance shortly before hatch. A female will deposit only 1 or 2 at any given site, laying several hundred eggs from late March to mid-May in the Hudson Valley.

In the northern regions of the Champlain Valley and throughout the mid-Hudson Valley, GFW can be a severe pest on early developing apples. The GFW larvae pass through 6 instars, the early stages possessing a grayish green body, brown head and thoracic shield. Mature larvae, about 1.5" in length, have a light green body and head. A number of narrow white stripes run along the top of the body with a wider, more pronounced white line running along each side. The areas between the stripes are speckled white. Early stages of larvae feed on foliage and flower buds, and are found inside rolled leaves or clusters. Mature larvae damage flower clusters during bloom, feeding on developing fruit and foliage 2 weeks after petal fall, with peak populations during bloom. The fruit remaining on the tree will have both shallow and deeply indented corky scars at harvest, which are indistinguishable from obliquebanded leafroller injury. Larvae then drop to the ground, burrow into the soil to pupate, and overwinter 2–4 inches into the soil to emerge the following spring as adults.

Control: In years of heavy infestation pressure from GFW, as much as 10% fruit injury can occur. Employing adult pheromone traps will provide growers with information on GFW presence and the onset of adult flight. Scouting for larvae to determine levels of pest pressure should begin shortly after tight cluster. Although NY has not developed thresholds for this pest, a provisional threshold of 1 larva or feeding scar per tree has been used to begin applications in Massachusetts. A more conservative threshold should be applied in high-value apple varieties on dwarfing rootstocks in high-density planting systems. If GFW populations historically cause economic injury to fruit, management should begin from tight cluster to pink to target the pre-bloom Lepidoptera complex. The GFW complex and OBLR are less susceptible or resistant to most organophosphates, with the exception of chlorpyrifos (Lorsban, IRAC Class 1B). If Lorsban is used as a pre-bloom foliar application, it will also control San Jose scale. Asana, Ambush/Pounce, Baythroid, Danitol, Warrior, all pyrethroids (IRAC Class 3), tend to have highest efficacy against larvae under cooler temperatures ($<72^{o}$F). Generally, as temperature increases, larvae metabolize/detoxify pyrethroid chemistries more effectively, while OPs, carbamates and newer chemistries tend to be more stable and less susceptible to this phenomenon.

The Bt products such as Biobit, Dipel, Javelin, and MVP (IRAC 11 B2) have a low impact on beneficial mites and are very effective against OBLR and the GFW complex. The Bt products can be used through bloom as needed, and their use should be optimized by employing multiple applications at the low-labeled rate at 5–7-day intervals. Intrepid (methoxyfenozide) (IRAC 18A), another reduced-risk insecticide, is very effective against the larvae, and imitates the natural insect molting hormone by initiating the molting process. Intrepid is quite safe to birds, fish, and most beneficial insects. Proclaim (emamectin benzoate) (IRAC 6), a second-generation avermectin insecticide related to Agri-Mek, is also an excellent insecticide against the GFW complex, while having a low impact on beneficial mites. If European red mite (ERM) has emerged, Proclaim, used with a penetrating adjuvant, would reduce early ERM populations. Altacor (chlorantraniliprole), Belt (flubendiamide) (IRAC Class 28), Delegate (spinetoram) and Entrust (spinosad) (both IRAC Class 5), have been used successfully against both the surface-feeding and internal Lep complex. However, the placement of these materials has been predominantly at the onset of hatch of the summer generation OBLR, and has provided excellent results in NY.

As we would be managing the overwintering OBLR larvae at the same time as GFW, we need to consider these applications in light of OBLR management throughout the remainder of the season. Since the development of insecticide resistance is dependent on the volume and frequency of applications of insecticides and the inherent characteristics of the insect species, we should limit an insecticide class to a single generation of a pest for resistance management purposes. The present model for insecticide resistance management (IRM) practices then is to *use a single insecticide class for a single generation of insect pest*. For example, an IRM program against the lepidopteran complex, specifically OBLR, would use effective insecticides listed above (X, Y, Z) in three different IRAC classes (A, B, C) throughout the season.
- Insecticide X (Class A) 1 application @ TC-Pink for GFW, or PF for OBLR, RBLR, LAW, OFM larva
- Insecticide Y (Class B) 2 applications @ 14d; first emergence of 1st brood OBLR larvae
- Insecticide Z (Class C) 1 application @ first emergence of 2nd brood OBLR larvae if needed.

Given the historic failures the apple industry has experienced managing the leafroller and internal worm complex, we should consider designing programs to maintain the effectiveness of these excellent IPM tools beginning early in the season, before the heat of the battle begins.

MEET THE BEETLES
(Art Agnello, Entomology, Geneva; ama4@cornell.edu)
[Box text: ON THE DOWN LOW]

Despite the mostly cool weather, we've begun to see the first of the emerging black stem borer adults in our Wayne Co. traps. The first catch was actually on April 19, but it was just a single beetle. In last week's readings (April 27), we began to see very small numbers across most of our sites, so with a bit of heat, we would expect a more pronounced emergence over the next 5-7 days. Since most trees are at or approaching pink bud, this would be a good time to consider a preventive trunk spray of Lorsban or Warrior, which is not a total solution, but will help to decrease the probability of new infestations. A direct trunk application will give better coverage than an airblast, if you're able to put in the extra effort.

[Section: DISEASES]

RUST DISEASES OF APPLES AND PEARS
(Dave Rosenberger, Plant Pathology, Highland; dar22@cornell.edu)
[Box text: RUST ISSUES]

Rust diseases of apples and pears are usually minor problems, even in regions where these diseases are prevalent, because many fungicides used for apple scab or pear scab also control rust diseases, and the fungicide schedules required for scab control are also appropriate for controlling rust diseases. However, rust diseases pose special problems for organic production where fungicide options are limited and for farms in a few locations where an abundance of cedars on adjoining properties can generate inoculum levels that overcome even conventional fungicide programs. Furthermore, while the old literature on apple rust diseases generally mentions cedar apple rust, quince rust, and hawthorn rust as the three rust diseases of concern, several additional rust species have been identified in the eastern United States in recent years. The rust diseases reported in New York or in nearby states are listed in Table 1.

All of the rust diseases require alternate hosts in the cedar (*Juniperus*) family. The rust fungi infect apple or pear only during spring and early summer. Spores from these pome fruit hosts are blown back to cedars in late summer or fall. All of these rust pathogens overwinter on their cedar hosts and then produce spores in gelatinous masses during spring rains. None of the rust fungi have a secondary infection cycle on pome fruits. The spores that infect apples and pears (basidiospores) must come from cedar trees and the spores that infect cedar trees (aeciospores) must come from apple trees. Therefore, when the supply of basidiospores produced on cedar trees is exhausted each year, no further infections can occur on apples and pears during that season.

Rust lesions on leaves are almost always bright yellow or orange, at least initially. However, quince rust infections on fruit may lack the typical yellow or orange coloration. Quince rust produces fruit distortions than can take many different forms.

The infection window for apples and pears varies among rust species. Fruit infections caused by the cedar apple rust or quince rust fungi usually occur between the tight cluster and petal fall bud stages. Fruit become resistant to infection within about a week after petal fall. Risks of fruit infections may be slightly lower during bloom than during the periods before and after bloom because the open petals decrease the probability that spores released during bloom will land on the base of the flower where fruit infections are initiated.

All of the rust species require a wetting period for spore development, dissemination, and infection. Severe rust infections, especially on fruit, are usually associated with rather long wetting periods (>48 hr) with moderate temperatures (45–75°F) and limited rainfall. During heavy rains, many spores are washed to the ground, whereas light or intermittent rains allow more basidiospores to become airborne. Longer wetting periods allow time for more spore production and for spores from more distant cedar groves to be blown into orchards. Given all of the factors mentioned above, the worst outbreaks of quince rust have occurred in years when we have had long, warm wetting periods with limited rainfall, either at tight cluster to pink bud stages or near petal fall.

Quince rust probably causes the most economic damage in commercial orchards because infections occur on fruit and fruit stems. Although quince rust appears only sporadically, when weather conditions and tree phenology align to create ideal infection conditions, more than 40% of fruit in commercial orchards can become infected with quince rust during a single infection period in trees not protected with fungicides. Virtually all apple cultivars are susceptible to quince rust, but disease incidence may vary among cultivars both because of inherent genetic differences in susceptibility and because the bloom stage (and therefore susceptibility) during infection events will vary depending on the cultivar phenology at the time of the infection event. Severe infections during late bloom can result in so many stem infections that all fruit will be aborted. Quince rust infections on pears are much less common than on apples.

Cedar apple rust infections are far more common on leaves than on fruit because susceptible tissue is available for infection over a longer period of time. Spores can only infect young, newly emerging leaves. In the Hudson Valley, basidiospores of the cedar apple rust fungus are usually produced during every rain from the tight cluster bud stage until about a month after petal fall, or even longer if the bloom and immediate post-bloom periods are exceptionally dry. Thus, in some years, new terminal leaves formed during late June may still develop rust lesions if cover sprays during June do not include fungicides with activity against rust diseases. A few rust lesions on terminal leaves, while unsightly, will not cause economic loss, but leaves with numerous infection will drop from the tree in midsummer.

Hawthorn rust is far less common on apples than quince rust or cedar apple rust. However, hawthorn rust can appear on leaves of some apple cultivars that are resistant to cedar apple rust. Thus, rust lesions on leaves of Liberty, Empire, Cortland, or McIntosh apple trees are usually caused by hawthorn rust because those cultivars are resistant to cedar apple rust. On cultivars that are susceptible to cedar apple rust, it is difficult to tell if leaf lesions are caused by cedar apple rust, hawthorn rust, or Japanese apple rust because the lesions are very similar. These species can be differentiated by observing the aecia that form on the undersides of leaves in mid- to late summer because the aecia have distinctive characteristics.

Cultivars that are resistant to cedar apple rust, such as Liberty, Empire, and McIntosh, can still sustain leaf damage if not protected by fungicides, because the rust spores that land on rust-resistant cultivars will germinate and infect a few cells before the host resistance mechanism prevents further development of the rust fungus. The cells that were initially invaded will nevertheless die and provide an entry point for other leaf-spotting fungi such as *Botrosphaeria obtusa* and *Phomopsis* species that will ultimately cause frog-eye leaf spot. In trees not protected with fungicides, this leaf spotting can cause almost as much damage as cedar apple rust would cause on a rust-susceptible cultivar.

Japanese apple rust, pear trellis rust, and juniper broom rust have all been reported in various locations east of the Mississippi River, but they are less common than the other three rust species listed in Table 1. Pear trellis rust may be a problem for pear growers or nurseries growing ornamental pears if the ornamental cedars that are the alternate hosts are also growing nearby. All of these rust species will be controlled by the same fungicides that control cedar apple rust and quince rust.

Options for Controlling Rust Diseases

The best option for avoiding rust diseases on apples and pears is to locate orchards away from cedars that provide the inoculum or to remove cedars that are within 300 feet of the orchard. However, although separating orchards from cedars will reduce disease pressure, that alone will not eliminate rust infections in some years in regions where cedar trees are abundant. During long wetting periods, spores can be blown considerable distances and large cedar populations can generate so many spores that distance alone will not provide complete protection.

All of the rust diseases can be controlled with preventive sprays of mancozeb, Polyram, QoI fungicides, or DMI fungicides. Although Captan, Syllit, AP fungicides and SDHI fungicides are either ineffective or only slightly effective, they can be mixed with mancozeb or Polyram to provide control of both rust and scab. However, only the DMI fungicides provide meaningful post-infection activity against rust diseases. The post-infection activity against quince rust is especially useful. Thus, the best rust control is generally achieved by applying any of the fungicides with rust activity ahead of predicted wetting periods, but then following up with mancozeb plus a DMI fungicide after any infection periods that might be especially conducive for rust. When long wetting periods occur during bloom or near petal fall, using a DMI at petal fall and first cover can provide extra insurance against rust infections on fruit.

Controlling rust diseases in organic blocks is very difficult because sulfur and liquid lime-sulfur have only limited activity against rust diseases. Other options such as Regalia or potassium bicarbonate may provide some benefits if applications are made just as spores are germinating, but more research is needed to pinpoint the best spray timing for these products. Anyone attempting to grow organic apples should be especially careful to locate orchards away from cedar trees and/or remove cedar trees that are located close to orchards.

More photos and information about rust diseases of pome fruits have been posted on my website at http://blogs.cornell.edu/plantpathhvl/apple-diseases/rust-diseases/.

Table 1. Rust species that may occur on apples and pears in New York and a partial list of hosts that may be infected (from http://nt.ars-grin.gov/fungaldatabases/)

Common name and Latin binomial (genus *Gymnosporangium)*	Crops affected	Tissues affected on apples and pears	Alternate hosts (genus *Juniperus*)	Type of infection on wild host
Cedar apple rust *G. juniperi-virginianae*	apples, crabapples; rarely on hawthorn	leaves and fruit	Red cedar, *J. virgininae* Ornamental: cedars *J. chinensis,* *J. horizontalis,* *J. communis,* *J. scopulorum*	galls that sporulate for only one year
Quince rust *G. clavipes*	apples, crabapples European pears, Asian pear flowering pear	fruit, fruit, pedicels twigs *J. horizontalis,*	Red cedar, *J. virgininae* Ornamental cedars: *J. chinensis,*	perennial cankers in branches that may persist for decades

	P. calleryana hawthorn, aronia, *Amelanchier* sp. *Cotoneaster* sp. *Sorbus* sp. including mountain ash	*J. communis,* *J. scopulorum,* *J. sabina*		
Hawthorn rust *G. globosum*	apples, crabapples European pears, hawthorn, quince *Sorbus* sp. including mountain ash	leaves	Red cedar, *J. virgininae* Ornamental cedars: *J. chinensis,* *J. horizontalis,* *J. communis,* *J. scopulorum*	small galls that sporulate for only one year
Japanese apple rust *G. yamadae*	apples, crabapples flowering pear *P. betulifolia*	leaves	Ornamental cedars: *J. chinensis,* *J. squamata*	very small galls on shoots
Pear trellis rust or European pear rust *G. sabinae*	European pears, flowering pear *P. calleryana* *P. betulifolia*	leaves	Red cedar, *J. virgininae* Ornamental cedars: *J. chinensis,* *J. sabina,* *J. communis*	spindle-shaped galls on cedar branches may persist for several years
Juniper broom rust *G. nidus-avis*	apple, quince, *Amelanchier* sp.	leaves	Red cedar, *J.* *virgininae* Ornamental cedars: *J. chinensis,* *J. horizontalis,* *J. scopulorum*	small cankers on one-year old stems that usually die after one year

Useful references:

Kenaley, S. Daughtrey, M., O'Brien, D., Jensen, S., Snover-Clift, K., and Hudler, G. 2012. First report of the pear trellis rust fungus, *Gymnosporangium sabinae*, on *Pyrus calleryana* ('Bradford' and 'Chanticleer') and *P. communis* in New York State. Plant Dis. 96:1373. Online at http://dx.doi.org/10.1094/PDIS-11-11-0972-PDN.

Koetter, R., and Grabowski, M. 2016. Cedar apple rust and other Gymnosporangium rusts. Univ. Minnesota Extension. On-line at http://www.extension.umn.edu/garden/yard-garden/trees-shrubs/cedar-apple-rust-and-gymnosporangium-rusts/#six

Yun, H.Y., and Rossman, A.Y. 2009. First report of *Gymnosporangium sabinae*, European pear rust, on Bradford pear in Michigan. Plant Dis. 93:841. Online at: http://dx.doi.org/10.1094/PDIS-93-8-0841A.

For photos of *G. sabinae*, see https://en.wikipedia.org/wiki/Gymnosporangium_sabinae

Yun, H.Y., Minnis, A.M., and Rossman, A.Y. 2009. First report of Japanese apple rust caused by *Gymnosporangium yamadae* on *Malus* spp. In North American. Plant Dis. 93:430. Online at http://dx.doi.org/10.1094/PDIS-93-4-0430A.

[Section: GENERAL INFO]

EVENT ANNOUNCEMENTS

The Cornell Fruit Field Day will be held in Geneva on Wednesday, July 20. This even, being organized by Cornell University, the NYS Agricultural Experiment Station, CALS Fruit Program Work Team and Cornell Cooperative Extension, will feature ongoing research in berries, hops, grapes, and tree fruit. All interested persons are invited to learn about the fruit research under way at Cornell University. Attendees will be able to select from tours of different fruit commodities. It will be based at the NYSAES Fruit and Vegetable Research Farm South, 1097 County Road No. 4, 1 mile west of Pre-emption Rd. in Geneva, NY. Admission is $50/person ($40 for additional attendees from the same farm or business). Pre-registration is required; walk-in registration may be available for a $10 surcharge on the day of the event. Please use the registration link below to register via credit card:
http://events.cals.cornell.edu/ffd2016
To participate as a sponsor, see the website page or contact Shelly Cowles (315-787-2274; mw69@cornell.edu).

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