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Update on Pest Management and Crop Development

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COMING EVENTS

	43°F	50°F
Current DD* accumulations		
(Geneva 1/1-4/27):	129	60
(Geneva 1/1-4/27/2014):	167	83
(Geneva "Normal"):	246	111
(Geneva 1/1-5/4, predicted):	188	86
(Highland 1/1-4/27/15):	217	102

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

Green apple aphid present	127-297	38-134
Green fruitworm peak catch	51-151	12-70
Obliquebanded leafroller larvae active	158-314	64-160
Pear psylla 1st egg hatch	174-328	60-166
Pear thrips in pear buds	137-221	50-98
Redbanded leafroller 1st catch	112-178	40-82
Rosy apple aphid nymphs present	91-291	56-116
Spotted tentiform leafminer 1st catch	81-274	44-102

Spotted tentiform leafminer

1st oviposition........................	143-273	58-130
McIntosh tight cluster................	176-282	90-126

*[all DDs B.E.]

Phenologies

Geneva:	Current	5/4, Predicted
Apple (McIntosh, Empire):	half-inch green	half-inch green to tight cluster
Apple (R. Delicious):	1/4-inch green	half-inch green
Sweet Cherry (early, late):	bud burst	bud burst to white bud
Peach:	bud burst	half-inch green

Highland:
Apple (McIntosh, Spur Red Delicious, Ginger Gold, Empire): tight cluster
Pear (Bartlett, Bosc): early bud burst
Peach (Early): swollen bud
Apricot: full bloom

TRAP CATCHES (Number/trap/day)

Geneva	4/20	4/23	4/27
Green fruitworm	0.9	2.2	0.1

Redbanded Leafroller	0.0	0.0	0.0
Spotted Tentiform Leafminer	0.0	0.0	0.0

Highland (Peter Jentsch)	4/20	4/27
Green fruitworm	0.4	0.9
Redbanded Leafroller	2.5	1.4
Spotted Tentiform Leafminer	0.0	0.0

ORCHARD RADAR DIGEST

[Box Text: IT'S IN THE AIR]

Beginning with today's issue, we will once again be publishing pest predictions generated by the Univ. of Maine's Orchard Radar model estimation service, provided to us by Glen Koehler. This pest management tool uses commercially available weather data as an input for apple pest occurrence and development models taken from many established university and practitioner sources. It's offered as another perspective on what's happening in the orchard to compare against our own record-generated advisories and, of course, personal observations from the field. We'll be printing only some of the short-term arthropod events; the full Orchard Radar product range covers disease and horticultural events as well. The public New England sites available for anyone to use are located at:

http://extension.umaine.edu/ipm/programs/apple/pestcasts/. Growers interested in exploring this service for their specific site may wish to contact Glen personally (glen.koehler@maine.edu).

Geneva Predictions:

Roundheaded Appletree Borer

RAB egglaying begins: June 14. Peak egglaying period roughly: Jul7 3 to 17.

Dogwood Borer

First DWB egg hatch roughly: July 3.

Codling Moth

1st generation 3% egg hatch expected: June 16.

Lesser Appleworm

1st LAW trap catch: May 22.

Mullein Plant Bug

Expected 50% egg hatch date: May 24, which is 6 days before rough estimate of Red Delicious petal fall date

Obliquebanded Leafroller

1st generation OBLR flight, first trap catch expected: June 16.

Oriental Fruit Moth

1st generation OFM flight starts: May 12.

Redbanded Leafroller

1st generation RBLR 1st trap catch: April 29.

San Jose Scale

First adult SJS caught on trap: May 29.
1st generation SJS crawlers appear: June 26.

Spotted Tentiform Leafminer
1st STLM flight peak trap catch: May 21.

White Apple Leafhopper
1st generation WALH found on apple foliage: May 23.

[Section: INSECTS]

A MATTER OF DEGREE

(Art Agnello, Entomology, Geneva; ama4@cornell.edu)

[Box text: NEWA IDEAS]

Many orchards will soon be progressing to the stage where some insecticidal protection is typically needed, and this week's predictions of gradual warming could very well complete the transformation from a slow start to a healthy trot. Once again, we would like to point out the opportunity for testing out the predictive accuracy of our historical records combined with the best biological projections we can offer, by checking out the NEWA Apple Insect Models website. [NOTE: See today's article by Julie Carroll and Kerik Cox about the improvements that have already been made to the Apple Scab tool.]

During the last several years, we have been working to improve this web-based, "Real-Time" Apple IPM Decision Support System, which can deliver relevant, current information on weather data and pest populations to facilitate grower pest management decisions throughout the growing season. This system tracks seasonal development of fruit bud stage, key insect pests, and diseases using Degree Day and Infection Risk models. The models indicate pest status, pest management advice and sampling options, and are linked to an interactive system that helps growers choose appropriate materials when pesticide use is recommended. (So far, the apple phenology predictions have been pretty accurate.)

Insect pest developmental stages are calculated from Degree Day (DD) accumulations at IPM's NEWA and National Weather Service airport weather stations throughout the state, as well as a large number of sites in 15 other states, including MA, VT, NJ, CT, RI, PA, and DE. The insect pests addressed by this website are: apple maggot, oriental fruit moth, codling moth, plum curculio, obliquebanded leafroller, and spotted tentiform leafminer. Disease predictions are available for apple scab and fire blight, and summer diseases (sooty blotch and flyspeck).

Access to the Apple Insects (and Diseases) models is through the "Pest Forecasts" list or the "Apples" link on the NEWA homepage (http://newa.cornell.edu). From the Apples homepage, clicking on the link that says "Apple Insect Phenology Models and IPM Forecasts" brings up a state map showing the available weather stations, plus pull-down menus on one side. After the user selects a weather station, pest of interest, and the desired end date for weather data accumulation, pest DD models and historical records are used to calculate: Tree Phenological Stage, Pest Stage(s), Pest Status, and Pest Management Information, all of which appears on a "Results" page. The phenological stage can be adjusted according to field observations by selecting from a pull-down menu; this will generally change some of text provided in the advice boxes. Hyperlinks on this page can take the user to various other online resources, such as color photos of the bud development stages, NYS IPM Fact Sheets of the pests in question, and when appropriate, sampling charts for use in conducting field samples of specific pest life stages (e.g., eggs, larvae, mines). When a pesticide spray is recommended, a "Pesticide Information" link in the "Pest Mangement" box takes the user to the Pest Management Education Program's (PMEP) Tree Fruit

IPM home page, where a pesticide decision filter helps users pick an appropriate material to use, based on anticipated pest severity and program type. We are also working with a colleague at Penn State to incorporate a least-cost calculator function, to provide users with an estimate of how much they'll have to pay for a given pesticide choice.

A pesticide search returns a series of profiles of all the NY-registered products fitting the specified pest species and efficacy rating. The profile gives the common and trade names, labeled use rate, re-entry and pre-harvest intervals, and EPA registration number of each product. Also included are some general remarks on the range of product efficacy, and any known effects on beneficial species. A "Details" link in each profile takes the user to a more extensive list of information, including notes on the active ingredient (including its mode of action classification), an overview of recommended use periods, and a link to a scanned copy of the NYS DEC-approved product label, which can be read or printed out.

All of the information presented is already available online at various other Cornell fruit sites, but this website brings these resources together in one place that is more convenient and efficient to access. Predictions provided by the website can be refined and adjusted to reflect current insect activity by user-entered events obtained through field monitoring (such as pest biofix; i.e., the first sustained flight of a pest species). The pesticide selection filter uses Cornell University product efficacy ratings and the type of management program selected by the user (i.e., conventional, reduced-risk, non-organophosphate, organic).

The website uses DD information based on either historical records or user-entered biofix data, and includes: the start, peak, or progress of the oviposition or egg hatch period (for CM, OBLR, OFM, and STLM); the start, peak or end of the pest's 1st, 2nd, etc., flight (for AM, CM, OBLR, OFM, and STLM); the first occurrence of adult or larval feeding, foliar or fruit damage, or mines (for OBLR and STLM). Some improvements to the site we plan to implement this season include adding a San Jose scale phenology model, restoring a degree day calculator to the list of Degree Day tools, and implementing apple insect 5-day forecasts (which has already been done for apple scab – see the following article).

We are continuing our efforts to refine and improve the accuracy of the website's pest predictions, and expand the range of sites from which weather data is able to be collected. During this process, we encourage everyone in the apple industry to check this website for themselves throughout the growing season, to see how well it forecasts pest events in specific areas of the state. We appreciate hearing of any anomalies or irregular predictions generated by using the local data to chart pest or disease development in your growing area, and hope to end up with a pest management tool that is useful and accurate for advising apple growers about what's going on in their orchards in Real-Time.

[Section: DISEASES]

FORECASTING APPLE SCAB INFECTION
(Juliet Carroll & Kerik Cox, NYS IPM Program & Plant Pathology, Geneva; jec3@cornell.edu; kdc33@cornell.edu)
[Box text: SCAB ON NEWA]

We have incorporated National Weather Service forecasts into the apple scab tool on NEWA! Some confusion arose initially because of the way a combined wetting event was being displayed in the apple scab Infection Events Summary, but we have fixed that and added some explanations to the page to help you look into the 5-day future forecast for disease risk. As always, we welcome feedback at newa@cornell.edu. Now these IPM tools show the two past days, the current day, and the 5 day forecast.

The apple scab tool calculates the maturity of ascospores overwintering in leaf litter. The Ascospore Maturity degree day model begins at 50% green tip on McIntosh flower buds and provides an estimate of the potential for ascospore discharge in the next rain. To recalculate ascospore maturity for your specific orchard situation, you can enter your green tip date. Always keep it handy for the next time you use the apple scab tool, because NEWA doesn’t remember this for you. The ascospore maturity graph, accessed from the Ascospore Maturity Graph button, gives a snapshot of the primary scab season for your location.

Apple scab infection events, shown in red in an Infection Events Summary, are calculated beginning with 0.01 inch of rain. The word "Combined" in the table means the wetting event on this day is being combined with another wetting event. To calculate the length of a wetting period, we use the following rule: two successive wetting periods, the first started by rain, should be considered a single, uninterrupted wet period if the intervening dry period is less than 24 hours. When an infection event is in the 5-day forecast, the actual weather data logged may or may not translate into an actual infection event. Therefore, the table output may change once actual weather data is logged.

Always check the download date and time, because the Current date in the Infection Events Summary has data that is made up of actual data and forecast data, so the infection event on this date may change, depending on the accuracy of the forecast.

DISEASE MANAGEMENT IN STONE FRUIT
(Kerik Cox, Plant Pathology, Geneva & Debbie Breth, Lake Ontario Fruit Team, Albion; kdc33@cornell.edu & dib1@cornell.edu)
[Box text: ROT-N-KNOTS]

A critical period for brown rot management starts when flower buds start to show color.

Brown rot and European Brown rot

In NY and even in neighboring states, sterol demethylation inhibiting fungicide (DMI or SIs: Indar, Rally, Tilt, Quash, Inspire Super, etc.) resistance in populations of *Monilina fructicola*, the causal agent of brown rot, is fairly widespread. However, DMI resistance in *M. fructicola* is affected by rate and intrinsic activity of the fungicide in question. Fortunately, some DMI chemistries such as difenoconazole in Inspire Super, and higher rates of older DMI chemistries, will allow us to better control DMI resistance brown rot. Hence, the DMIs may still be a viable option in early covers. Previously, we had observed a slow incremental resistance to the components of Pristine (QoI/Stroby & SDHI) in orchard populations in 2006–2010. Interestingly, we have still not found any populations with resistance to DMI and QoI fungicides in recent years. Although little can be said about the persistence of resistance in orchards in the region, it may be that both of these fungicide chemistries can be used sparingly and in rotation. Additionally, we still have Merivon under an SLN label. Like Pristine, Merivon is a QoI/Stroby & SDHI combination product that is labeled for stone fruit with a 0-day PHI. The SDHI component in Merivon is unlike the previous SDHI fungicide boscalid, which was included in Pristine. We found Mervion to be very effective against brown rot and other fruit rots when used pre- and post harvest. Most excitingly, Merivon can even be used on sweet cherries.

Currently, we are at the time of year when European brown rot is likely to play a larger role in brown rot infections, and the causal agent of European brown rot, *M. Laxa*, is incredibly sensitive to both DMI and QoI chemistries, even in the same orchard. Tart cherries, sweet cherries, apricots and nectarines are susceptible to European brown rot, which must be managed during cool, wet weather at bloom. If there's time and labor, consider removing any mummies from the orchard, as they will contribute to considerable inoculum. If you do remove mummies, take them from the orchard, as the spring winds could carry spores to the susceptible fruit if they remain on the orchard floor.

Begin fungicide sprays at pink or white bud using Bravo/Echo/Equus (chlorothalonil). If you had blossom or shoot blight in cherries, there is a strong possibility that you have European brown rot in your planting. In this case, start with one of the DMI or SI fungicides instead. After this application, continue with a Bravo/Echo/Equus (chlorothalonil), program until shuck-split has passed. During this time, consider bringing in Rovral (iprodione), which is a different fungicide chemistry that can be used during the first few applications, but may not be used after petal fall.

As you approach pre-harvest periods, rotate between fungicide classes to minimize the risk of fungicide resistance in brown rot populations. Also, consider the following:

- Alternate DMI with QoI/SDHI (Pristine or Merivon) fungicides during cover sprays to prevent the development of quantitative fungicide resistance. With a 0-day PHI and excellent activity against post-harvest rot fungi, consider finishing your pre-harvest program with Merivon.
- Another possibility would be to use the SDHI fungicide Fontelis. It is effective against brown rot and other stone fruit diseases, but use caution tank-mixing Fontelis. The SLN label does indicate that Fontelis includes oil and cautions the user regarding tank mixes with sulfur and captan. Such issues could present themselves for peaches, where captan and sulfur use is commonplace. Like Merivon, Fontelis has a 0-day PHI, and can be applied the day of harvest.
- If allowed on the crop and practical for your spray plan, use an AP fungicide (Scala SC, Vangard). Vangard at 5 oz/acre is labeled for a maximum of 2

sprays per season (but not on sweet cherries), or Scala at 9–18 oz/acre (but not on cherries) using the low rate in mixtures with other fungicides. Scala is labeled for use on apricots, peaches, and plums. Vangard is labeled on apricots, tart cherries, peaches, and plums. The AP fungicides cannot be used on sweet cherries.

- Bear in mind that if the weather is favorable for brown rot, product failures are possible, even with a little quantitative (incremental) resistance.
- The key to preventing the development of fungicide resistance is to use appropriate rates. Do not reduce rates or practice alternate row spraying.
- Make sure to provide considerable protection during the period from petal fall to pit hardening. This is a period when stone fruit (except tart cherry) are most susceptible to brown rot infection. However, such infections may not necessarily become active or apparent until the fruit gets closer to ripening.

Black Knot on plums and cherries:

The black knots you see right now in plums and tart cherries will provide ascospores that will release under rainy conditions and infect succulent green twigs of the current season's growth, usually at the leaf axils.

Ascospores can be released from these black, tumor-like infections as early as bud break until terminal shoot growth stops. Within this time frame, most of the ascospores are available and the tissue is most susceptible between white bud and shuck split. However, the risk of primary infection can be extended through June if we have a dry spring. Only a few hours of rain are required at temperatures above 55°F to cause a black knot infection, whereas much longer rainy periods are required to produce infection at temperatures below 55°F.

Knots from the current season's infections may become visible by late summer, but are usually not noticed until the following spring, when they begin to enlarge rapidly. Young knots in the year following infection are capable of producing a few ascospores, but the majority of ascospores are often not formed until the second spring. In some situations, what you are seeing in your trees now is a result of an infection 2 seasons ago!

Control of this disease requires some vigilance in pruning out visible swellings from last season, as well as the black knots that have fully matured. Check your hedgerows for wild black cherry trees that may also harbor black knot. It may take a few seasons to clean up an epidemic. Be sure to burn the black knots you remove from the orchard, since they will continue to release ascospores from the knots until they are destroyed. In severe pressure years, you should consider an application of fungicide as early as budburst. Under lower pressure, fungicide applications can be delayed until white bud. The fungicide that has performed best in trials is Bravo (chlorothalonil sold as other generics), but alternatives include captan or Topsin M. Be sure to stop chlorothalonil applications at shuck split. Chlorothalonil and captan applied for black knot will also double for brown rot blossom blight protection in tart cherries and plums.

CONTROLLING EARLY-SEASON APPLE DISEASES IN ORGANIC ORCHARDS

(Dave Rosenberger, Plant Pathology, Highland;
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[Box text: IT AIN'T EASY BEING GREEN]

Until recently, the mantra for disease control in organic orchards was to plant scab-resistant cultivars, to use sulfur and liquid lime sulfur (LLS) for scab where scab-susceptible cultivars were grown, and to use a delayed-dormant copper spray to suppress fire blight followed by streptomycin sprays during bloom when conditions favored that disease. These options left organic apple growers struggling with several problems. First, the heavy use of sulfur and LLS depressed productivity. Second, sulfur, LLS, and copper have not been very effective for controlling rust diseases. Many of the best scab-resistant cultivars are highly susceptible to cedar apple rust, and almost all apple cultivars are susceptible to quince rust. The recent change outlawing the use of streptomycin in organic orchards adds a third challenge for organic apple growers this year. Fortunately, recent research from various parts of the US and Europe have provided some new options for addressing the challenges.

In this article, I will not take time to review all of the basic components that must be considered when establishing an organic apple orchard. Suffice it to say that while site selection, soil preparation, cultivar selection, and planting design are essential for any new orchard, these preplant components are even more critical for establishing a successful organic orchard because organic protocols disallow many of the measures (fertilizers, synthetic pesticides, plant growth regulators) that conventional growers can use to compensate for less-than-ideal sites or poor soil preparation. Risks of losses to diseases in organic orchards can be significantly reduced if:

- the orchard is planted with scab-resistant cultivars;
- orchards are kept at least several hundred feet away from woodlots, hedgerows, and overgrown meadows that provide inoculum for cedar apple rust, SBFS, and bitter rot;
- and orchards can be located on sites with excellent air drainage so that leaves dry quickly after rains.

Following are updates on disease control strategies for several early-season apple diseases in northeastern United States.

Apple scab

As noted above, apple scab can be avoided or diminished by planting scab-resistant apple cultivars or conventional cultivars that are fairly resistant to scab. Avoid cultivars such as McIntosh, Cortland, and Ginger Gold that are disease magnets and that may require 8–10 sulfur sprays to control scab. Multiple field trials in various locations have shown that repeated applications of sulfur and/or LLS will reduce apple yield by 25 to 35% compared with comparable plots not sprayed with these products. Most of these sulfur and

LLS sprays can be avoided in orchards of scab-resistant cultivars. However, scab-resistant cultivars will still need several sulfur sprays to suppress powdery mildew and to reduce selection pressure scab populations that overcome the Vf scab resistance gene. The Vf gene provides resistance to scab in most of the currently available scab-resistant cultivars. A minimal program that includes sulfur at pink, petal fall, and first cover should help to protect the Vf gene.

In Europe, where the Vf gene no longer provides protection against scab in some localities, organic growers have developed scab control programs that utilize copper, potassium bicarbonate (PB) plus sulfur, and LLS. Converting application rates and timings from the European system can be complicated, not only because of conversions from the metric system, but also because they express product rates as percentage of active ingredient in 300 liters of spray solution. The following program is my interpretation of their approach from a published article (Jamar et al. 2010) and from conversations with Marc Trapman, a private consultant.

To control apple scab, some European programs use copper (at 2.1 oz/A of metallic or elemental copper) applied ahead of infection periods between green tip and pink. The labels for copper products indicate what percentage of elemental copper are in the formulations. For example, Kocide 3000 contains 46% copper hydroxide, but only 30% metallic copper. Therefore, the low rate of 2.1 oz of metallic copper/A would be equivalent to 7 oz of Kocide 3000/A, which is just a bit below the 0.5 lb/A listed on the Kocide 3000 label for in-season control of apple scab and fire blight. Copper should never be applied to wet leaves, and risks of fruit russetting can be reduced if it is applied using low volumes of water per acre and if applications are made under fast-drying conditions. Applications after pink are not recommended for scab control because of the risk of fruit russetting, but copper may be needed during bloom to control fire blight.

If copper protection is not in place before rains during the prebloom period, then a tank mix of potassium bicarbonate (PB) at 4.3 lb a.i./A and sulfur 4.3 lb a.i./A can be used to arrest scab development. This combination is also preferred after pink when copper is no longer considered safe, but rates of both products can be cut in half during bloom to minimize phytotoxicity. PB is very effective against scab spores that are germinating, but it has virtually no residual activity and therefore cannot be applied ahead of rains, because it would be washed away before the germinating spores become susceptible to it. Because PB is not systemic, it will not arrest scab development if it is applied after the infection process has been completed. Therefore, PB applications must be timed rather precisely for the period after criteria for a Mills infection period have been met and during the interval between the accumulation of 200 and 540 degree hours (base 32°F) counting from the time that the Mills criteria were met. Thus, if temperatures held steady at 52°F during an infection period, it would take 11 hr of wetting before the infection criteria were met (using the revised Mills criteria established by McHardy and Gadoury). After that, one would accumulate 20 degree-hours (dh) during every hour and PB applications therefore would need to be made between 21 hr from the start of the rain (11 hr for the Mills period, plus 200 dh divided by 20 dh/hr) and 38 hr from the start of the rain. Using similar calculations, PB applications for a wetting period at 62°F would need to be completed between 12 and 24 hr after the start of the rain, whereas for a wetting period at 41°F the application timing would be 28 to 66 hr after the start of the rain. Sulfur is usually mixed with PB to provide forward protection because, as noted earlier, the potassium bicarbonate acts more like a wash that kills spores and then disappears.

Although the post-infection applications using PB as described above have been proven effective, they have the disadvantages of requiring rather precise timing. Meeting those timing criteria will sometimes require spraying during the rain and/or under windy conditions. Nevertheless, the post-infection activity of PB can be useful in some situations.

LLS also provides some post-infection activity, but it will burn leaves and fruit if applied to wet foliage. It will cause some fruit drop if applied during or shortly after bloom, because it shuts down photosynthesis for several days after application. For that same reason, repeated applications of LLS can significantly reduce yield. In my opinion, one of the best descriptions about how to use sulfur products for scab control was published by Dr. Art Burrell in the 1945 Proceedings of the N.Y. State Horticultural Society. That publication can be accessed on-line via a link at the bottom of the apple scab page on my blog (http://blogs.cornell.edu/plantpathhvl/apple-diseases/apple-scab/). Several cover sprays of sulfur may be needed after bloom to control both scab and powdery mildew. If LLS is used to reduce crop load, then no additional fungicides are required during the week(s) when LLS is applied.

Fire blight

The biocontrol Blossom Protect has provided good control of blossom blight in Europe, the Pacific Northwest, and Virginia (Yoder et al. 2015a), but it has performed with less reliability in trials in Michigan. Blossom Protect must be applied several days ahead of anticipated infection periods because it must have time to colonize the flower stigmas before the fire blight bacteria reach levels that could trigger infections. Blossom Protect must be applied with the buffer provided by the manufacturer. It can be inactivated by copper, LLS, and potassium bicarbonate, but it is compatible with sulfur.

Copper can also be used to protect against fire blight in organic orchards, although copper applications during bloom may cause fruit russetting. The delayed dormant copper spray using high rates of copper can help to suppress inoculum in orchards with a history of fire blight, but the high-rate copper application at green tip is not needed (and probably should not be used) if low rates of copper will be applied repeatedly during the prebloom period to control apple scab. Copper should be applied at very low rates during bloom (about 1.5 to 2.0 oz/A of metallic copper), and applications should be made only to dry leaves under rapid drying conditions. The copper must be in place ahead of infection periods because it has no post-infection activity against fire bight. To protect open flowers while minimizing the number of copper sprays that may be needed, copper applications during bloom should be made only when one of the blossom blight models (MaryBlyt or Cougar Blight) indicates that infections are immanent.

Recent work by Dr. Keith Yoder in Virginia has shown that the biocontrol Double Nickel, when applied with low rates of copper, either during bloom or to control shoot blight during summer, can reduce the amount of russetting that is otherwise attributable to copper sprays (Yoder et al., 2014a, 2015a). It is not yet clear why this occurs or whether other *Bacillus*-containing biocontrols would act similarly to reduce copper-induced russetting.

Cedar rust diseases

Cedar apple rust and quince rust are notoriously difficult to control with sulfur, LLS, or copper.

Eradicating red cedars within several hundred feet of orchards was recommended in older literature and can significantly reduce disease pressure, but in some locations it is almost impossible to eradicate enough cedars to keep apples free of rust diseases, even if trees are regularly protected with sulfur or copper sprays. Most quince rust infections occur between pink and petal fall, but cedar apple rust infections can infect terminal leaves for four to six weeks after petal fall. Quince rust infects apple fruit and therefore usually causes the most losses.

In recent trials, Dr. Keith Yoder in Virginia has shown that the biocontrol Regalia (an extract from giant knotweed) provides good suppression of both cedar apple rust and quince rust (Yoder et al., 2014, 2015). Regalia at the full rate of 4 qt/A applied with JMS Stylet Oil provided post-infection activity against quince rust equal to that of Rally, but it is not clear whether Regalia would have performed as well in post-infection mode if used at lower rates or without oil. Sulfur and oil are not compatible, so Regalia must be used without oil where sulfur is being used for scab control or where LLS is being used to adjust crop load. Lower rates of Regalia (2 qt/A) provided good control of quince rust when applied on a regular 7–10-day interval, but the current label indicates that Regalia should not be applied to apples before petal fall. Ironically, further down on the label is a recommendation for 1 qt/A to be applied throughout the prebloom and bloom periods to control apple scab. However, it is not clear if the 1-qt rate of Regalia that is allowed before petal fall would suppress rust. (Incidentally, Regalia has only marginal activity against apple scab.) Combinations of Regalia and sulfur might provide the best approach for controlling rust, scab, and mildew, but I'm not aware that this combination has been tested and I'm not certain what rate of sulfur might be needed to complement the activity of Regalia.

Warnings

When using any of the products mentioned in this article, be careful to read the product labels and also to verify that the specific product you wish to use has been approved by OMRI for applications in organic production. Mention of specific products in this article is not meant to imply that the mentioned products are better than similar products that are not mentioned, although we lack data from controlled trials for many approved products. Some of the biorational products can burn petals and/or russet fruit of some apple cultivars, so new combinations of products should be tested on just a few trees of various cultivars to determine that they are safe and effective before they are applied to larger acreages.

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