

# Whatcom Ag Monthly

July 15, 2014  
Volume 3, Issue 7

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# MANAGING ROUGH STRAWBERRY ROOT WEEVIL IN STRAWBERRY

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Four root weevil species in the genus *Otiorhynchus*: strawberry root weevil (SRW), rough strawberry root weevil (RSRW), black vine weevil (BVW) and more recently the clay colored root weevil (CCRW) remain perennial pests for strawberry growers in the Pacific Northwest. However, RSRW has emerged as the key root weevil pest in Oregon and Washington strawberry over the past decade or more. This population shift began after the label cancellation of Furadan™ for strawberry and major shift to the registered contact and stomach insecticide/acaricide Brigade™/Capture™ in 1996. RSRW larvae damage strawberry rootlets and cambium tissue around the crown during their approximate

nine month life stage. If not controlled this foraging behavior causes stunting, die-back and poor yielding plants of Pacific Northwest summer varieties such as 'Totem' and 'Hood' by the third season.

Current area wide programs in PNW strawberries are aimed at timing drench and canopy applications (e.g., Brigade® WSB, Actara®, Assail®, Admire Pro®, Malathion®) to optimize control of over wintered and newly emerged summer generation of adults before they begin laying eggs in the soil during strawberry harvest. Eggs are laid on the soil at the base of plants and hatch in about three weeks. The main egg laying cycle of new

adults occurs about a month after peak egg laying of the BVW and SRW. Our root weevil research with RSRW indicates this cool weather-adapted species does little feeding on strawberry foliage at night. The characteristic notching of the leaves is an important diagnostic tool to assess a field infestation and subsequent treatment efficacy for a grower (Figs. 1, 2) for other root weevil species. Instead, the RSRW congregate at the



Fig. 1. Feeding notches by BVW adults on strawberry foliage.



Fig. 2. Absence of feeding notches on canopy foliage of plants infested with RSRW.

base/crown area under leaves, debris and soil during the day from May and post harvest (Fig. 3). Given these adults do not notch canopy foliage, are rarely found at night with the traditional flashlight search method after 10 PM, RSRW adults must be sampled in the soil and around the strawberry crown by the hand and knee



Fig. 3. Multiple quiescent adult RSRW in the soil and debris.

method (Fig. 4). By mid-summer this root weevil is often found congregating tightly in the strawberry crown, clumped together in the soil adjacent to the crown or in moist zones within the soil after field renovation in July (Fig. 5). Presumably this behavior is associated with water conservation and a state of quiescence during this period of high soil temperatures. Because of these behaviors and the difficulty penetrating the dense foliage canopy with insecticide, we concluded that postharvest foliar or renovation drench treatments would not effectively control

these quiescent RSRW populations.

Growers are now targeting fall and/or winter neonicotinoid drench application that possess good larval and adult weevil activity. Applications are timed to coincide with periods of rainfall to enhance movement of

the chemical into the root zone. The soil formulations of the neonicotinoids exhibit rapid root uptake and are highly systemic within the plant. These biological parameters provide for



Fig. 4. Daytime hand and knee searches for adult RSRW resting in the soil during the day.



Fig. 5. Quiescent RSRW congregating under a soil clod after field renovation.

100% mortality at one day after treatment. This Group 28 chemistry is in the IR-4 pipeline and will be a new MOA chemistry for root weevils in caneberries and strawberries. Recent reports of fall and early spring failure for larval RSRW suppression with neonicotinoids, along with earlier harvest/post harvest Brigade

excellent residual control. This chemistry may be applied with traditional high-pressure, high-volume boom sprayers and recommended drop nozzles passing through the strawberry's canopy during harvest, fall and winter. This sprayer set-up will also give better soil coverage of other MOA insecticides recommended for the control of both overwintered and summer generations resting during the day under dense strawberry foliage.

Recent bioassays with Actara, Admire Pro, Platinum® and Brigade WSB applied at field rates as air-dried dip treatments to strawberry foliage resulted in near 100% mortality of June emerged RSRW adults. Unregistered foliar Exirel® (registered on blueberry) showed near

applications to control adult populations showed the grower no evidence of economic suppression in spite of five treatments with three insecticides (Fig. 6). Bioassays in the lab indicate good toxicity to adult RSRW that rules out the onset of RSRW resistance to the pyrethroid and neonicotinoid classes of insecticides. The chemistries recommended for root weevil control remain efficacious while poor commercial outcomes suggest further research is needed with regard to timing and delivery methods for the different IRAC classes to control the soil dwelling larvae of the RSRW. Thus, our research for RSRW in strawberry is aimed at timing canopy applications to optimize control of overwintering and summer generation adults before they begin laying eggs in the soil during strawberry har-



Fig. 6. Patchy distribution of RSRW populations showing 3 different levels of root feeding injury (i.e., vigorous, slight and severely stunted).

vest. Uncontrolled summer emerging RSRW will lay eggs well into fall, unlike the BVW and SRW. We feel their less specialized foraging strategy does not expose them to contact/stomach insecticides as we have successfully exploited for the other root weevil species common on strawberry. RSRW's long egg laying period is another major factor that has elevated this species from incidental to the major root weevil pest in strawberry. In summary, the RSRW goes largely undetected by scouts/growers applying traditional root weevil monitoring methods of detecting notched leaves and examining foliage for adults at night with the

help of a flashlight. We hope this article will continue to shed new light to growers and fieldmen about the difficult challenges to economically manage this unique root weevil.

# PHOMOPSIS DIE-BACK ON BLUEBERRIES IN BRITISH COLUMBIA

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BC Ministry of Agriculture, Abbotsford, BC

In recent years, symptoms of twig blight and die-back have been observed in many young blueberry fields, particularly in cultivars Draper and Liberty. These fields establish well a few years after planting. When cropping begins the older stems express a slow decline, leaves get smaller, new growth ceases and fruit fails to size. Affected stems eventually die and, in some cases, the young twigs/shoots begin to show blighting symptoms. Over the years, fruiting stems continue to collapse sometimes resulting in the death of the entire plant. Root system of the affected plant remains healthy. No obvious external symptoms can be seen on stems, but on close inspection, an internal discoloration of the wood is seen which often extends down the stem and, probably, into the crown. In some cases, the young stems produced by the infected plants tend to have silvery, shiny leaves that may or may not be associated with *Phomopsis*. In the lab, *Phomopsis* can be readily isolated from the symptomatic tissues. While *Phomopsis* has certainly been recorded previously in BC blueberry fields, mostly causing distinct cankers on stems, it has not been seen to affect young plantings so aggressively. Further research is underway to characterize this pathogen and to better understand its infection process and disease cycle. It is sus-



*Phomopsis* - internal cane discoloration



*Phomopsis* - internal tissue discoloration

pected that the disease begins as twig infections which occur after plants are set in the field. These infections are believed to grow internally over the years and eventually affect



*Phomopsis* die-back on Draper



*Phomopsis* - cane die-back in Draper

and kill the entire stem or crown. Pending more information, the

following are preliminary recommendations which should help to minimize *Phomopsis* infection and damage in young blueberry fields, particularly cultivars Draper and Liberty.

1. *Monitoring.* Inspect young fields for blighting and dieback on twigs and shoot tips in late winter and early spring. Several other organisms including *Botrytis* and *Pseudomonas* can cause similar symptoms. A lab test can confirm if *Phomopsis* is present.

2. *Pruning.* Prune out and destroy diseased wood.

3. *Frost Protection.* *Phomopsis* damage can be more severe in fields which are prone to fall and spring frosts. Avoid planting Draper and Liberty

in frost-prone fields or provide frost protection.

4. *Nitrogen Management.* Both Draper and Liberty have a tendency to grow vigorously through the fall and can be slow to become dormant. Avoid excessive nitrogen fertilization which can encourage soft and late growth in the fall which, in turn, may contribute to more infection by *Phomopsis* and other pathogens.

5. *Fungicides.* Aside from the use of copper to manage *Pseudomonas*, most growers do not use fungicides during the non-bearing years because there is no fruit to protect. For Draper, Liberty and other cultivars that are susceptible to *Phomopsis*, protective fungicide sprays should be applied during the spring and fall prior to the onset of rains. Bravo, Cab-

## DISEASE ALERT:

# WHITE LEAF SPOT IN CRUCIFER SEED FIELDS IN THE WILLAMETTE VALLEY

Cynthia M. Ocamb  
Oregon State University

Beginning late March 2014, I found several leaf spot diseases in fall-sown crucifer crops and weedy species in the Willamette Valley. A survey in OSU research fields of fall-sown canola during late October 2013 showed no leaf spots or seed/seedling diseases. However, white leaf spot and gray stem caused by the fungus *Pseudocercospora capsellae* (sexual stage: *Mycosphaerella capsellae*) were observed during 2014 in canola research fields as well as in commercial seed fields of forage Brassicas and "field" turnip. White leaf spot was also detected in volunteer black mustard and forage fields. Susceptible hosts reportedly include species of *Brassica* (broccoli, cabbage, canola, cauliflower, Chinese cabbage, mustard, turnip, etc.) as well as radish and horseradish. Weedy types such as

wild radish, wild mustard, and shepherd's purse are susceptible to white leaf spot and gray stem (1).

How the pathogen overwinters and reproduces in the Pacific Northwest is unknown at this time. In the UK, ascospores develop on infected *Brassica* or *Raphanus* residues during the autumn and can be winddispersed relatively long distances following rain or dew events. Beginning in late fall, the asexual spores (conidia) can develop and are spread relatively short distances by rain or splashing water, potentially causing pod infections the following spring; however, seed transmission is not thought to play a major role in disease spread. Temperatures of 50 to 60°F under moist conditions promote disease development.

This fungus can attack leaves, stems and

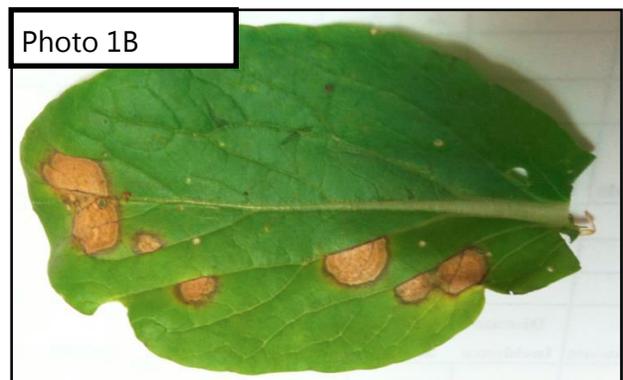
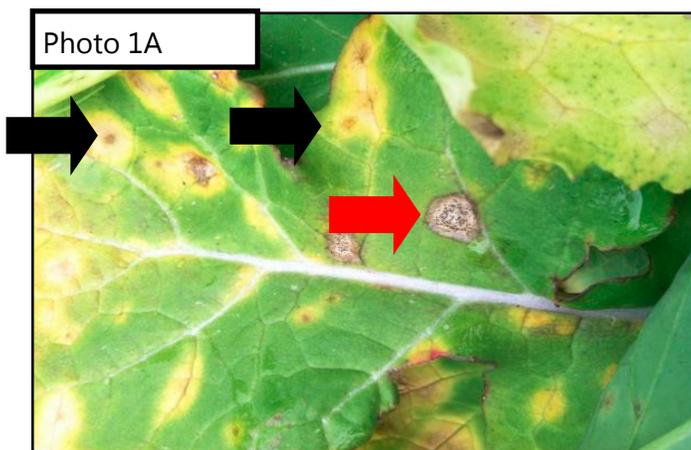


Photo 1A (above left) shows late stage white leaf spot (black arrows) and Phoma leaf spot (red arrow) on turnip; upper right (Photo 1B) is an earlier stage of white leaf spot.

pods. Tan, irregular or roundish spots develop on leaves, especially leaf tips and edges, later becoming ashy gray to white with a brownish margin and yellowish halo (Fig 1A). White conidia can be observed on the leaf spots. The leaf spots become dark brown as leaves senesce due to the initiation of the sexual stage. The center of older lesions may fall out, resulting in a shothole appearance. Foliar lesions may coalesce when disease is severe, resulting in defoliation. Stem lesions are elongated and brown at first, turning ashy gray to white with a brownish margin (Fig 2A); the numerous tiny dark specks due to the formation of the pathogen's sexual stage. There is a distinct boundary between diseased and healthy tissue on the stem. Gray stem lesions are superficial; the pith is not severely infected. Pod infections start as small brown spots that expand and turn grayish-white with age and develop the numerous tiny dark specks indicative of the sexual stage.

#### Cultural controls:

- Eradicate susceptible weeds and volunteer *Brassica* and *Raphanus* plants.

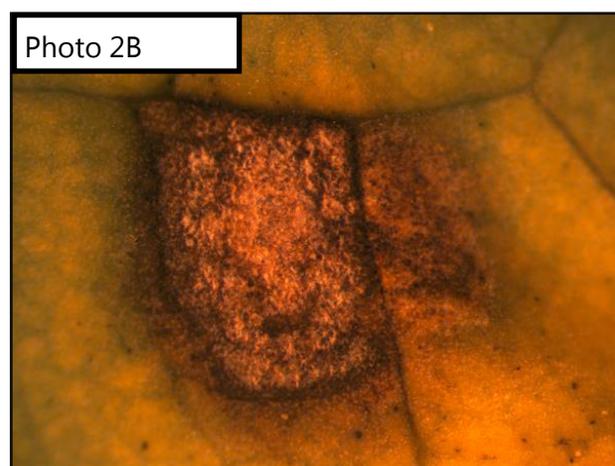


Photo 2A (above left) shows gray stem of turnip; upper right (Photo 2B) is a close-up of white leaf spot showing white conidia.

- Remove plant debris or bury by deep-plowing. Flailing followed by a more shallow plowing may be sufficient depending on amount and size of plant debris and environmental conditions.
- Rotate out of crucifers for three years.
- Avoid planting in or adjacent to a field infected the previous season.
- Plant resistant cultivars; many genotypes of *Brassica napus* and *B. juncea* from China are resistant to this disease (2).

#### References

- (1) Inman, A.J., and Fitt, B.D.L. 2007. White Leaf Spot. Pages 50-54 in: Compendium of Brassica Diseases, Rimmer, S.R., Shattuck, V.I., and Buchwaldt, L. (eds.), APS Press, St. Paul, MN. 117 pp.
- (2) Gunasinghe, N., You, M.P., Banga, S.S., and Barbeti, M.J. 2014. High level resistance to *Pseudocercospora capsellae* offers new opportunities to deploy host resistance to effectively manage white leaf spot disease across major cruciferous crops. *European J. Plant Pathology* 138:873-890.



# DISEASE ALERT: LIGHT LEAF SPOT IN CRUCIFER SEED FIELDS IN THE WILLAMETTE VALLEY

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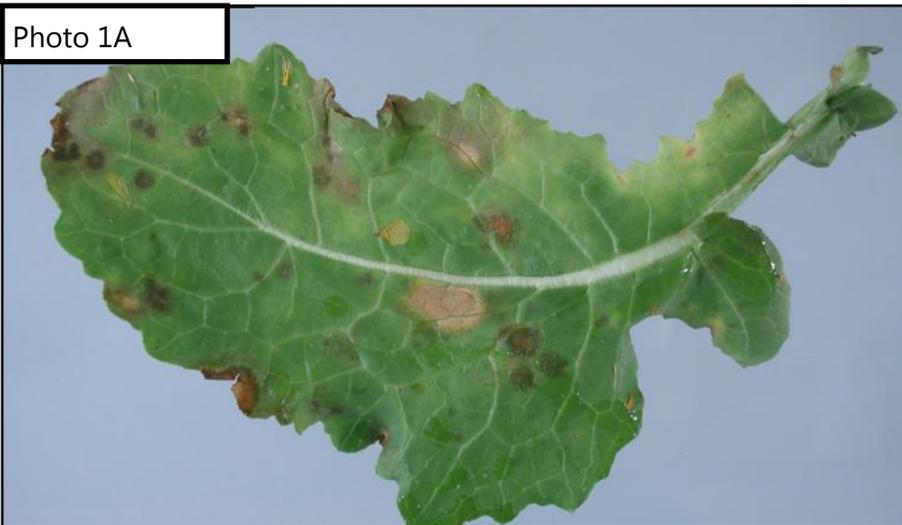
Beginning late March 2014, I found several leaf spot diseases in fall-sown crucifer crops and weedy species in the Willamette Valley. A survey in OSU research fields of fall-sown canola during late October in 2013 showed no leaf spots or seed/seedling diseases. However, light leaf

spot caused by the fungus *Cylindrosporium concentricum* (sexual stage: *Pyrenopeziza brassicae*) was observed causing disease this spring in canola research fields as well as in commercial seed fields of forage *Brassica* species and "field" turnip. Light leaf spot was sub-

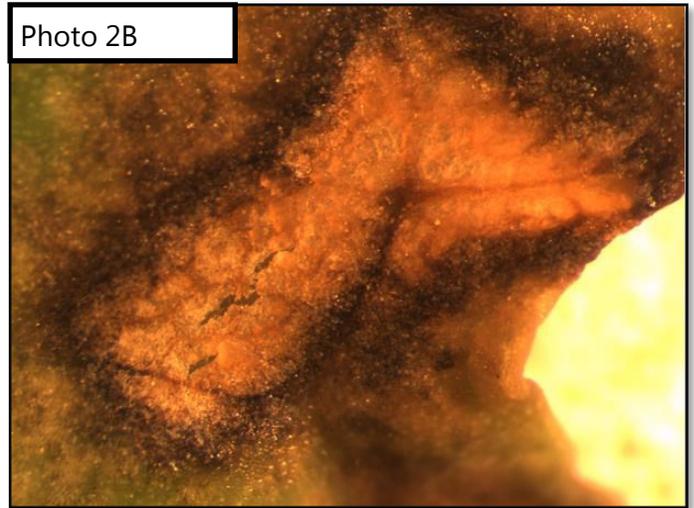
sequently detected in other *Brassica* members including wild mustard, volunteer black mustard, vegetable *Brassica* seed fields, and *Brassica* species used as cover crops during 2014. While the specific host range for *C. concentricum* within the tribe Brassiceae is unknown at this time, it is likely that all brassicas crops grown in the Pacific Northwest are susceptible

(1) with a range of susceptibility within each crop species. This disease hasn't been previously reported in North America, although an infected mustard field was found in western Oregon during 1998. Oilseed rape can be very susceptible with losses resulting from stand die-out, reduced pod numbers, and

premature pod ripening; with less



Photos 1A and 1B above by the OSU Plant Clinic show light leaf spot on mustard and *Brassica*, respectively.



Photos 2A and 2B above by the CM Ocamb show light leaf spot on *Brassica*.

severe infections there is an overall growth reduction. *Brassica* species grown as vegetables in other areas of the globe, where this disease has been reported, suffer blemish defects that result in a decrease in quality but not quantity of yield.

Ascospores (sexual stage) develop from apothecia on infected plant residues; after a wetting period, ascospores can be wind-dispersed relatively long distances to susceptible plants. Asexual spores (conidia) that develop can be spread only relatively short distances by rain or splashing water. Conidia enable increase of disease within a field, and potentially, pod infections during the following spring. Seed can be infected or casually infested with the asexual stage, yet seed transmission occurs at very low rates due to rapid die-out of the pathogen on seed. Even at low rates, infected seeds can move the pathogen into new regions. Epidemics can be initiated by seedborne inoculum or via ascospores arising from neighboring fields with in-

fectured plants or residues, or from infected volunteers. Wet conditions and cool temperatures (around 60°F) promote disease development. Plants infected during autumn may remain symptomless throughout the winter season until the following spring.

*Cylindrosporium concentricum* can attack leaves, stems, and pods; subsequently growing in a systemic manner throughout the plant except in the roots. Flecking may be observed on cotyledons while leaf infections start as discolored patches that develop into irregular brown lesions with cracked centers, sometimes turning black. Leaf lesions can coalesce, causing death of leaves. When young leaves are infected, distortion may also develop. Stem lesions are superficial, elongated brownish streaks with grayishblack margins. Flower infections may cause abortion. Pods infected while immature appear distorted while pods infected later appear relatively healthy looking, but

may have white spore masses present. Seedlings can be killed or plants may be stunted. Cauliflower will have a brown discoloration of curds while Brussels sprouts exhibit black lesions.

### **Cultural controls:**

- Eradicate susceptible weeds and volunteer Brassica plants.
- Remove plant debris or bury by deep-plowing; this is important for preventing sexual recombinants from developing with new virulence or fungicide resistance. Flailing followed by a shallow incorporation may be sufficient depending on the amount and size of plant debris as well as environmental conditions.
- Rotate out of crucifers for three years.
- Avoid planting adjacent to a field infected the previous season.

**Chemical control:** Apply sprays when leaf spots are first observed in the fall. Additional applications during late winter or early spring may be needed.

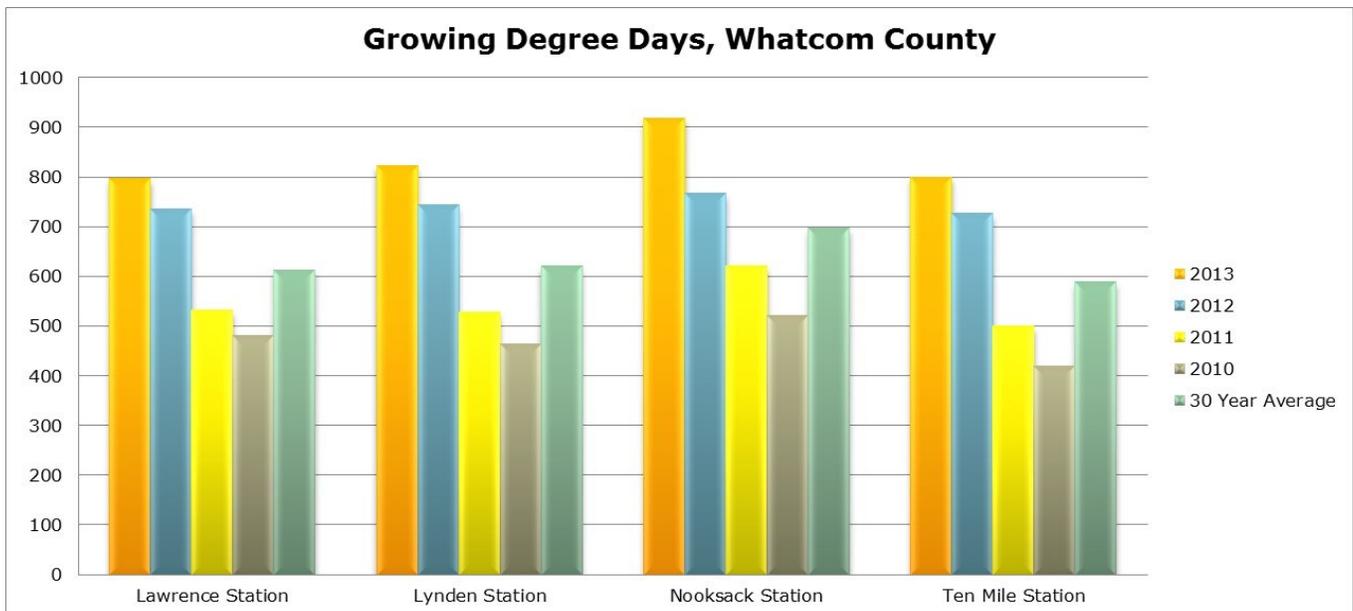
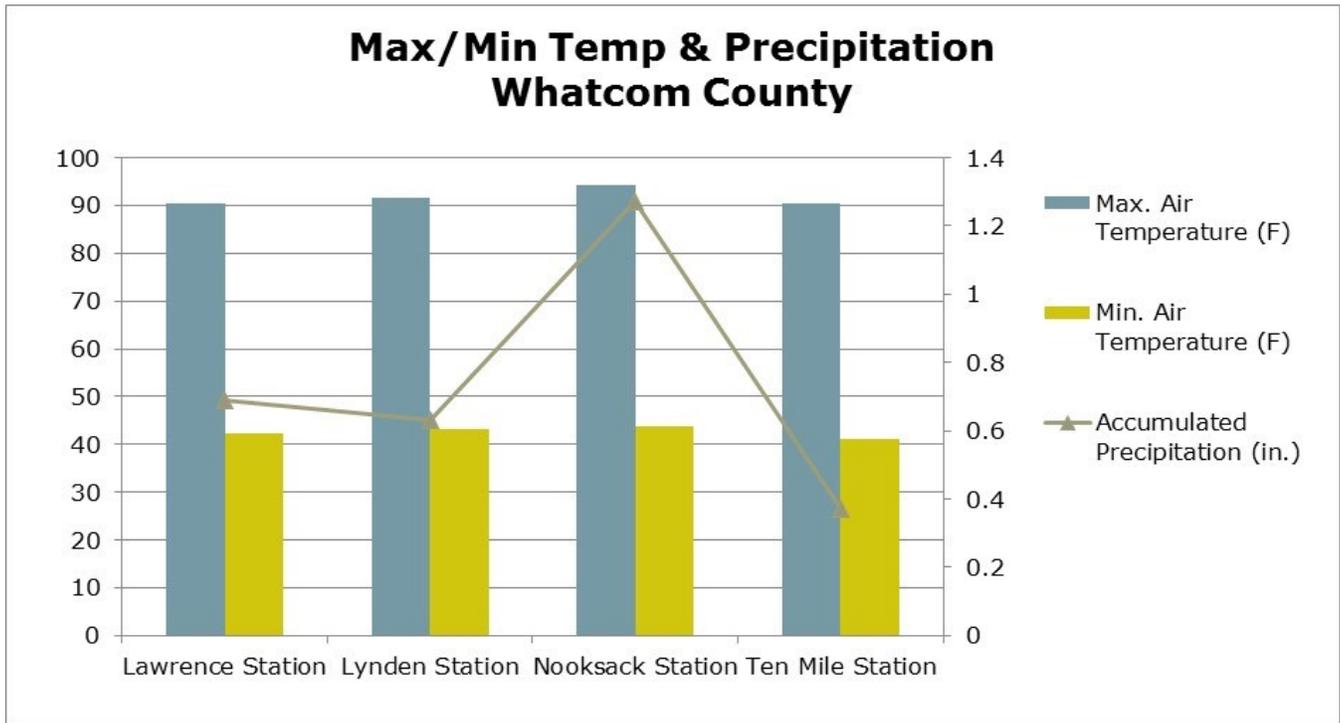
- Proline 480 SC (Fungicide Resistance Action Committee (FRAC) Group 3) at 4.3 to 5.7 fl oz/A is labeled for other fungal diseases on canola and can be used in Oregon on canola to help control light leaf spot.
- Quash (Group 3) at 2 to 4 oz/A at 20% to 50% flowering is labeled for other fungal diseases on canola and can be used in Oregon on canola to help control light leaf spot.

### **Reference**

(1) McCartney, H.A., and Doughty, K.J. 2007. Light Leaf Spot. Pages 31-35 in: Compendium of Brassica Diseases, Rimmer, S.R., Shattuck, V.I., and Buchwaldt, L. (eds.), APS Press, St. Paul, MN. 117 pp.

# WEATHER UPDATE

All information here is derived from the four weather WSU AgWeatherNet stations (<http://weather.wsu.edu/awn.php>) in Whatcom County. Current weather conditions can be found at: <http://whatcom.wsu.edu/ag/currentdata.html>. Station information can be found [here](#).



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# Upcoming Events

## **July**

### **OSU Blueberry Field Day**

July 16th

1:00 pm - 5:00 pm

Aurora, OR

A focus on research for commercial growers; A focus on the breeding program & research on conventional and organic production systems for commercial growers.

### **WSU Raspberry Machine Harvesting Field Day**

July 17th

1:00 pm - 3:00 pm

Lynden, WA

Harvested fruit from the plots will be on display. Three WSU selections (WSU 1980, WSU 2166 and WSU 2188) that are being planted in Grower Trials this year will be fruiting in these plantings. There are also over 80 WSU selections in the 2012 machine harvesting planting that will be machine harvested for the first time this year and 80 selections that were harvested last year in the 2011 planting.

## **August**

### **WSU Organic Agriculture Research Field Day**

August 4th

10:00 am - 12:00 pm

Puyallup, WA

WSU researchers and cooperating farmers are evaluating cover crops

and equipment for use in organic reduced tillage production. Come tour research plots and discuss the evolution of this production system. We will also discuss comparisons of drip irrigation and water chlorination for reducing microbial contamination of produce from irrigation water.

### **North Cascades Meat Producers Cooperative BBQ**

August 6th

5:00 pm - 7:30 pm

Stanwood, WA

The North Cascades Meat Producers Cooperative and Del Fox Meats invite you to a BBQ dinner and presentation of their plans to bring expanded USDA-inspected meat processing to Snohomish, Island, Skagit, and Whatcom Counties!