PLANT DISEASE

RESEARCH

INVESTIGATORS: S. Annis, G. Kornelis, J. Collins
4. TITLE: Epidemiology of Leaf Spot Diseases and their Control

OBJECTIVES

Improve control of various leaf spots, Septoria leaf spot (*Septoria* sp.), powdery mildew *(Erysiphe vaccinii*), and leaf rust (*Thekopsora minima*) using field and lab research.

- Survey leaf spot disease levels in wild blueberry fields in Maine and evaluate effects of weather conditions on disease.
- Develop a molecular method to detect Thekopsora minima, the causal agent of leaf rust and use it to determine spore dispersal timing of this fungus.
- Determine timing of spore dispersal of key leaf spot producing fungi, particularly *Thekopsora minima,* and compare to weather conditions and disease levels.
- Conduct efficacy trials for testing timing and new fungicides to control leaf spot diseases.

LOCATION(S): Wild blueberry fields in Waldo, Knox, Lincoln, Hancock, Washington counties, ME
PROJECT TIMEFRAME: January to December, 2019 of multiple year projects

INTRODUCTION

Leaf spot diseases, Septoria, leaf rust and powdery mildew, were present in the majority of lowbush blueberry fields surveyed from 2010 to 2015 during a study of management systems (Annis and Slemmons, 2013 and unpublished data), but the effects of these diseases on yield is unclear. There is typically a complex of diseases affecting leaves that vary in their severity depending upon the year, so it is difficult to determine which disease or combination of diseases is causing the most damage to the plants. Having more information on when initial inoculum is produced, what conditions are necessary for infection, and which disease are having a greater impact on the plants will allow for development of improved control measures for the most damaging of these diseases. Most growers use a calendar-based method of applying fungicides for leaf spot control and get mixed results. A more precise timing of fungicide applications coordinating with initial spore release of key fungi will improve control of these diseases.

METHODS

Survey of weather and levels of disease in wild blueberry fields

Fifteen fields with weather stations were rated for leaf loss and leaf spot diseases between October 2 and October 9, 2019. Five sampling plots of 0.25m^2 were rated by one surveyor visually estimating percentages of blueberry coverage, blueberry leaf loss, and blueberry leaf area with the following leaf spot diseases: Septoria leaf spot, powdery mildew, and leaf rust. Fall disease ratings were averaged across the 5 sampling plots within a field.

Spore dispersal and leaf spot diseases

On April 26, 2019, a spore trap was placed in a prune field at Blueberry Hill Research Farm (BBHF) in Jonesboro, ME. Another spore trap was placed in a crop field near Long

Pond on May 8th, and a third was placed at the junction of a crop and prune field near Deblois on May 15th. We collected spore trap tapes containing the trapped airborne spores every week until October 30, 2019. Spore trap tapes were cut in half; half was frozen for future DNA work, and the other half was mounted on glass slides.

Disease assessments occurred weekly, except during rain on July 17th, September 11th and October 2nd, in the spore trap fields when the spore trap tapes were collected. Five sampling plots of 0.25m^2 were rated by visually estimating percentages of blueberry coverage, blueberry leaf loss, blueberry stems with Phomopsis, and blueberry leaf area with the following leaf spot diseases: Septoria leaf spot, powdery mildew, and leaf rust.

Fungicide efficacy trial

A field experiment was established in a prune wild blueberry field at the Blueberry Hill Research Farm in Jonesboro, Maine. Fungicides (Table 1) were randomly assigned to plots and replicated in six blocks. Plots were divided in half, and treatments were randomly assigned to one of two application timings (June 19 or June 25). Control plots received no spray applications.

Disease symptoms and leaf loss were rated three times: July 15, August 14, and September 18. A rope with 10 evenly spaced markings was stretched twice along a transect through each plot (once each to the left and right of the center), and the stem closest to each marking was cut and bagged. The next day, leaves were rated for disease symptoms. Per stem, the total number of leaves, nodes lacking leaves (leaves fallen), and the estimated percent coverage of each disease on remaining leaves was noted. Data were analyzed using SAS (Statistical Analysis Software - SAS Cary, NC).

RESULTS

Survey of Weather and Levels of Disease in Wild Blueberry Fields

There was very little rust sporulation visible in many fields making it difficult to distinguish between Septoria leaf spots and leaf rust. Spots were reported as Septoria/leaf rust if there is no sporulation and as leaf rust if sporulation was found. There was a median of 3.5% Septoria/rust, 6.25% powdery mildew and less than 0.5% leaf rust in all the weather stations fields with some fields showing much higher levels of disease, particularly powdery mildew (Figure 1). There was a median of 32% leaf loss by the week starting Oct. 2nd (Figure 2) but levels varied widely. Leaf loss was not correlated to any of the disease levels recorded in October.

Table 1. Fungicides tested in 2019 for their efficacy to control leafspot.

Treatment Number & Trade Name		Material	Application Rate (per acre)	Manufacturer	FRAC group	EPA Regist-ration Number	Registered on Wild Blueberry
1	OSO SC	Polyoxin D zinc salt	13 fl oz	Certis USA	19	68173-4	Yes
2	Propulse	Fluopyram/ Prothioconazole	13.6 fl oz	Bayer	7/3	264-1084	Yes
3	Kenja 400SC	Isofetamid	15.5 fl oz	ISK Biosciences	7	71512-22	Yes

	and DYNE-AMIC (surfactant)	Methyl esters of C16-C18 fatty acids, Polydimethylsiloxane, Alkylphenol-ethoxylate	0.25% v/v	Helena Chemical Company			
4	Bravo	Chlorothalonil	3.6 lbs	Syngenta	M5	50534-201-100	Yes in 2019
5	Inspire super	Difenoconazole/ Cyprodinil	20 fl oz	Syngenta	3/9	100-1317	Yes
6	Kphite 7LP	Salts of phosphoric acid	128 fl oz	Plant Food Systems		73806-1	No

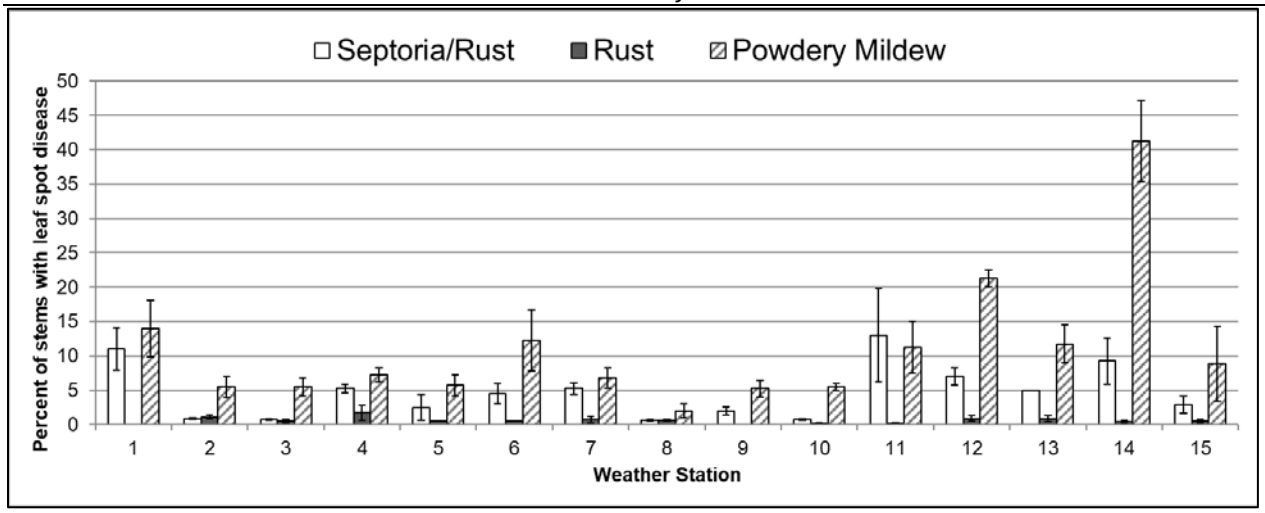

Figure 1. Percentage of leaf area with Septoria (white bars), rust (dark bars), and powdery mildew (striped bars) at each of the weather station fields. Error bars indicate standard error of the mean.

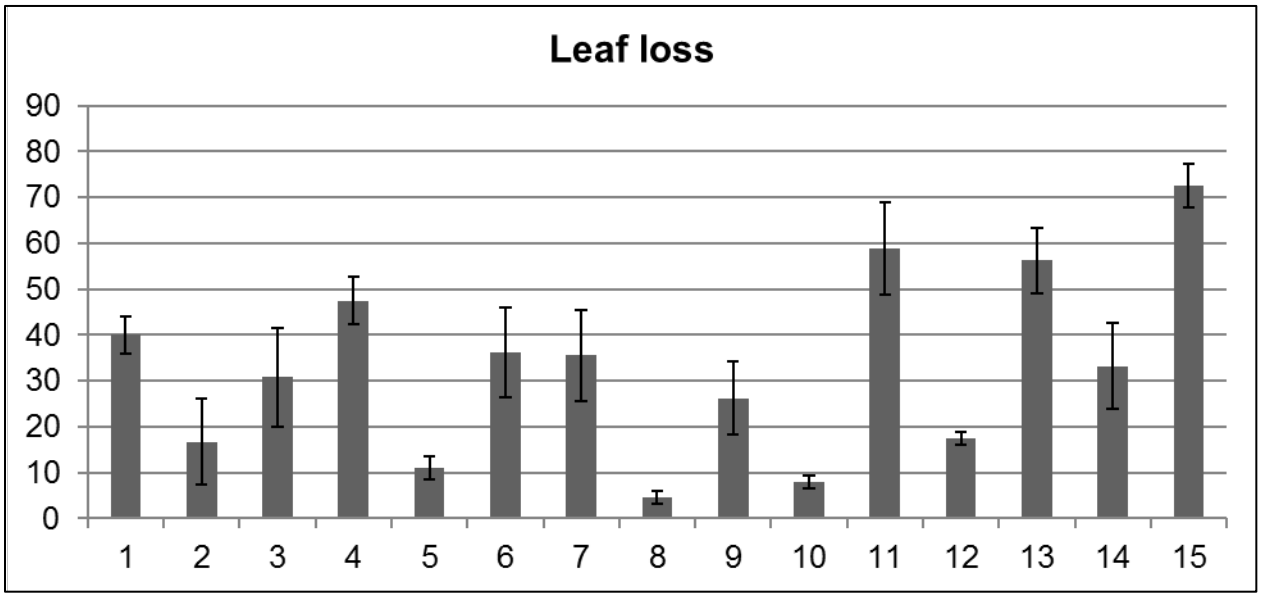

Figure 2. Leaf loss in weather station fields rated from October 3 to October 9, 2019. Error bars indicate standard error of the mean.

Spore Dispersal and Leaf Spot Disease

There were lower levels (less than 10% leaf area through September) of leaf spots including Septoria, leaf rust and powdery mildew than in 2018 in both fields rated in 2019 (Figure 3). Both fields had similar patterns of leaf loss which were lower than 5% until the rating of Sept. 18th. The higher levels of leaf loss in 2019 were one to two weeks later than in 2018.

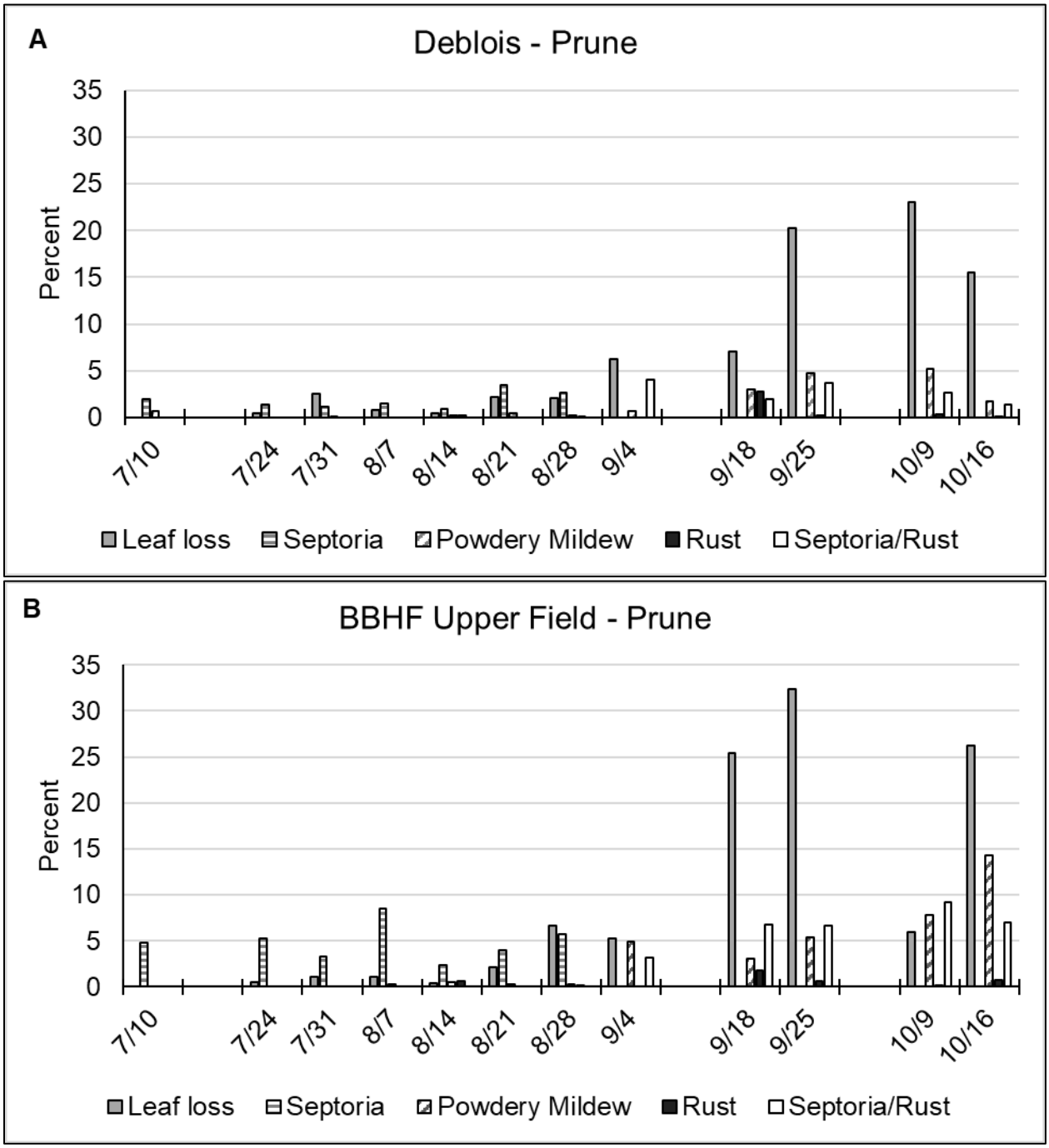

Figure 3. Leaf loss and symptoms of leaf spots (powdery mildew, Septoria, and rust) rated each week in prune fields near Deblois, ME (A) and Blueberry Hill Farm in

Jonesboro (B) where spore traps were located. Leaf loss (gray bar), Septoria (horizontal striped bar), powdery mildew (diagonally striped bar), rust (black bar), Septoria/rust (white bar).

Nghi Nguyen, MS (graduated August 2019), developed a molecular qPCR method of identifying the DNA of the blueberry leaf rust fungus, *Thekopsora minim*a (Nguyen and Annis, 2018). She was able to detect and quantify leaf rust spores on spore trap tapes collected in previous years. She did not find a consistent pattern of weather that coincided with leaf rust spore release. Spore trap tapes collected in 2019 are in the process of being extracted for DNA and will be processed to quantify leaf rust spores using the qPCR molecular method in early 2020.

Fungicide Efficacy Trial

Disease ratings were conducted in July, August and September, and no phytotoxicity was observed at any of the rating times. Some fungicides did decrease leaf loss but there were less clear results for the control of specific leaf spots. In July and August ratings, Propulse, Kenja 400SC, Bravo and Inspire Super had lower levels of leaf loss than the control. In August for the early timing, the Kphite 7LP treatment was also significantly less than the control. In the September rating, Propulse and Bravo treatments had significantly less leaf loss than the control for both timings and Kenja 400SC treatment also had significantly less leaf loss compared to the control for only the later application timing in September.

None of the fungicides significantly decreased Septoria symptoms compared to the control in the July or September ratings. In August, Kenja 400SC and Bravo both significantly decreased Septoria symptoms compared to the control. There were very low levels of powdery mildew and leaf rust and no consistent effect of the treatments or their timings on control of these diseases.

CURRENT RECOMMENDATIONS AND DISCUSSION

Low levels of leaf rust and other diseases in 2019 may be due to increased rainfall in the later summer which may have decreased the stress on the plants from prior years. The timing of *Thekopsora minima* spore dispersal does not appear to be dependent upon concurrent weather conditions and may involve the phenology of its plant hosts. We will use past weather data to try to develop a growing degree day model for spore dispersal timing. Earlier application of fungicides for control of leaf spots, in the first two weeks of June, has usually resulted in better control of leaf loss than later applications. This was not seen in 2019 probably due to the later season. This is the first year of testing of these fungicides for leaf spot control in wild blueberry in Maine. No new fungicides are recommended this year.

NEXT STEPS

- Compare leaf spot disease levels to timing of fungicide applications and weather conditions in growers' fields from 2019.
- Extract DNA from spore trap tapes and determine timing of *Thekopsora minima* spore dispersal.

- Collect spore trap tapes in May and June 2020 for timing of dispersal of spores of leaf spot fungi.
- Test the effectiveness of the molecular method to detect early leaf infections of *Thekopsora minima* and distinguish them from other leaf spots.
- Retest Propulse, Kenja 400SC, Kphyte 7LP, and Inspire Super in 2020 for their effectiveness at preventing leaf loss and their effects on leaf spot diseases.
- Collect samples and start development of a molecular test to detect the fungus that causes Septoria leaf spot.

REFERENCES

Annis, S., Slemmons, C. R. 2013. Effects of management systems on stem and leaf spot diseases in lowbush blueberry. Abstract. Phytopathology. 103(6)Suppl. 2:7-8

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