Study and Control of Pseudomonas Syringae on Blueberry Plants

Final Report for FW12-074

Project Type: Farmer/Rancher
Funds awarded in 2012: $14,120.00
Projected End Date: 12/31/2014
Region: Western
State: Washington
Principal Investigator:

Parmjit Uppal
Fraser Valley Packers (US) Inc.

Project Information

Abstract:

Bacterial blight, caused by Pseudomonas syringae, is a serious blueberry disease in Washington. This project assisted Washington growers in studying and controlling the naturally present environmental bacterium that causes bacterial leaf blight, twig blight and stem cankers on blueberry plants.

Standard cultural controls for the prevention and treatment of bacterial blight include frost protection measures (cover, heating/burning, irrigation) and pruning diseased wood out before fall to remove the source of inoculum. Copper Oxychloride was also used to reduce the incidence of bacterial blight.

Local Washington blueberry growers applied these methods prior to the inception of this project, but the response has been less than acceptable.

Project Objectives:

To investigate methods of reducing the incidence of bacterial blight infections, two technological advancements will be sought:

1) Develop alternative preventative measures, specifically the use of wind machines, for controlling bacterial blight; and

2) Clarify the roles of contributing factors, i.e. environmental conditions, crop management practices, pests and pest management practices, and blueberry cultivars in the development of bacterial blight.

Cooperators

- Bryan Sakuma

bryans@sakumabros.com

Project Investigator

SG Properties LP

15522 Benson Road
Bow, WA 98232

(360) 661-4159 (office)

- Dr. Tom Walters

twwalters@wsu.edu

Technical Advisor

Washington State University

WSU- Mount Vernon Northwestern Washington Research and Extension Center
16650 SR 536
Mount Vernon, WA 98273

(360) 848-6124 (office)

Research

Materials and methods:

Activities / Undertakings
(Research Location:SG Properties, 15522 Benson Road Bow, WA.)

Performed Activities - Planning & Monitoring:

Farm visit to collect data from weather station and monitor and record the yield in the controlled and uncontrolled areas at SG properties on following dates:

19 May 2012

Project team outlines discussion and planning meeting at Sakuma Brothers Processing plant at 1700 Cook Road Burlington, WA.

16 July 2012

Weather station purchase and project task list development meeting at Sakuma Brothers Processing and SG Properties.

8 September 2012

Appointment of employees and discuss their roles and responsibilities towards the project at Sakuma Brothers Processing.

22 September 2012

Farm visit to identify “pseudomonas syringae” and install weather station at SG properties.

23 October 2012

Farm visit to review weather station data collection procedures and monitor

Bacterial blight at SG properties.

10 November 2012

Farm visit to download weather station data (trial) and monitor Bacterial blight at SG properties.

02 February 2013

Farm visit to conduct a meeting for development of action plan for the coming months.

16 February 2013

Farm visit to finalize and implementation of the plan for row numbering and plant labeling.

23 March 2013

Farm visit to get an update on pruning and infestation count.

27 April 2013

Farm visit to collect data from weather station and monitor Bacterial blight at SG properties.

31 May 2013

Farm visit to monitor and record infestation in the controlled and uncontrolled areas at SG properties.

09 August 2013

Farm visit to monitor and record the yield in the controlled and uncontrolled areas at SG properties.

06 September 2013

Farm visit to collect data from weather station and monitor and record the yield in the controlled and uncontrolled areas at SG properties.

Performed Activities - Implementation:

1. Experimental Block Identification: (Picture 1, Picture 2 and Picture 3 as attachment)
   Four wind machines were previously installed and are in working condition.

Controlled and uncontrolled areas were delineated in the month of May 2012. The farm was divided into six blocks in the first week of September 2012, each containing sub-blocks (50 x 50 feet experimental plots).

In the third week of September 2012, the blocks were identified based on variety and their location:

For comparative reasons, one block is located close to the wind machine, which is treated as controlled area (Block 1, Block 3, Block 5), while the other block is located away from the wind machine, which is treated as uncontrolled area (Block 2, Block 4, Block 6) throughout the experiment.

Organic Liberty Variety Field:

“Block 1” (50 X 50 feet Controlled) is close to the wind machine and “Block 2” (50 X 50 feet Uncontrolled) is away from the wind machine.

Toro Variety Field:

“Block 3” (50 X 50 feet Controlled) is close to the wind machine and “Block 4” (50 X 50 feet Uncontrolled) is away from the wind machine.

Bluecrop Variety Field: (Picture 3 and Picture 4 as attachment)

“Block 5” (50 X 50 feet Controlled) is close to the wind machine and “Block 6” (50 X 50 feet Uncontrolled) is away from the wind machine.

For studying and monitoring purposes, these blocks are marked with orange color flags as shown in picture 4. For comparison reasons and counting of disease incidence, in the year 2013, each row was numbered and every plant was named.

2. Weather Station Installation: (Picture 5 as attachment).

In the second week of September 2012, a micro-weather station (Onset Corp, Bourne MA) was installed close to the “Organic Liberty Variety Field.”

The Onset weather station is powered by a six watts solar panel. It is equipped with 15 channels and has five sensors to monitor:

- Temperature
- Relative humidity
- Leaf wetness
- Soil moisture
- Wind speed

3. Data Collection from weather station:

The weather station is continuously recording the data which is downloaded through portable HOBO* shuttle. Data from the weather station was recorded on a continuous basis and collected for interpretation, which was used during the experiment to program and operate the wind machines. These measurements were recorded as following:

- March to May, 2013 (daily)
- June to August, 2013 (once / week)
- September to October, 2013 (two times / week)

(HOBO* - As named by the Supplier)

4. Row Numbering and Plant Labelling (February 2013):

To monitor and count the Bacterial blight infestation, plants in the controlled and uncontrolled area were numbered and labeled as per the excel file attachment named as "Plant Numbering."

5. Pruning (February to April 2013):

Pruning was carried out in 50 x 50 feet experimental blocks. Infected stems were collected and burnt to prevent any source of contamination and disease transfer. Number of stems infected were recorded per block and are recorded in excel file as attachemnt named as "Number of stems infected."

6. Infestation Monitoring & Recording (March to May 2013):

Bud break conditions were monitored, especially bud frost damage which was assessed in the early bloom time with the wind machines in use.

Bacterial blight infestation surveys were conducted across controlled and uncontrolled areas.

Blueberry plants were assessed for tissue damage and bacterial blight (Pseudomonas counts) infection by visually counting the number of blighted twigs on each blueberry plant in the study area. These were recorded as per the excel file attachment named as " Plant Sevearity Level.".

6. Microbiology Testing (July 2013):

Twenty-foursamples were collected from the experimental blocks (fourfruit samples from each block) for microbiology testing (Aerobic Plate Counts, Coliform / E. coli, Yeast & Mold). These test results from the control area were recorded and compared with the test results generated with uncontrolled area.

Twenty-foursamples were collected for microbiology testing (Aerobic Plate Counts, Coliform / E. coli, Yeast & Mold) from other participating growers from Burlington WA, Everson WA and Lynden WA. The micro test results were compared with the research site micro testing.

Microbiology tests (Aerobic Plate Count, Coliform, E. coli, yeast and mold) were also conducted for all study areas during the summer months to determine the growth of other pathogen populations. In July 2012 and August 2012, samples from each controlled blocks, uncontrolled blocks and other participating growers from Burlington, Everson and Lynden were collected and sent for laboratory testing. Results indicated lower counts in the controlled areas, compared to the uncontrolled and other participating growers' areas. It is possible that the use of wind machines not only controls Bacterial Blight infection but also helps in controlling other bacteria over multiple years.

- Picture 1
- Picture 2
- Picture 3
- Picture 4
- Picture 5
- Plant Numbering
- Plant Sevearity Level

- Number of Stems Infected

Research results and discussion:

Benefits and Impacts to Agriculture

This research is among the first attempt in Washington State to control frost damage and Bacterial blight through the use of pole-mounted propellers/wind machines to disrupt temperature inversions and frost pockets. If successful under all conditions encountered, the outcome of this project will demonstrate and document a means of limiting frost damage and leaf wetness, an improvement over conventional methods for frost control.

Knowledge will be gained about the contributing factors to the outbreak of Bacterial blight, i.e. environmental conditions, crop management practices, pests and pest management practices, blueberry cultivars, etc.

Producer Adoption/Reaction

The following workshops were conducted to discuss the ongoing experimental research and its findings:

Date of Workshop: 16 July 2012

Participants: Bryan Sakuma, Ryan Sakuma, Charlie Anderson, Tom Walters

Representive from Sakuma Bros. Farms, Representive from S G Properties, Representive from Atsusa Sakuma Trust

Date of Workshop: 22 September 2012

Participants: Bryan Sakuma, Ryan Sakuma, Charlie Anderson, Tom Walters

Representive from Sakuma Bros. Farms, Representive from S G Properties, Representive from Atsusa Sakuma Trust

Date of Workshop: 02 February 2013

Participants: Bryan Sakuma, Ryan Sakuma, Charlie Anderson, Richard Anderson, Tom Walters

Representive from Sakuma Bros. Farms, Representive from S G Properties, Representive from Atsusa Sakuma Trust

Date of Workshop: 23 March 2013

Participants: Bryan Sakuma, Ryan Sakuma, Charlie Anderson, Richard Anderson, Tom Walters

Representive from Sakuma Bros. Farms, Representive from S G Properties, Representive from Atsusa Sakuma Trust

All participant producers have an opinion that by using wind machines there is great certainity to control bacteria blight infestation. This may also reduce the pruning

time, as there will be less frost damage so labourers do not need to go in and remove damaged crops.

Without funding or financing opportunities, producers may oppose adopting this new method due to the high installation and fuel costs to install and operate the wind machines, but they will understand that by using wind machines for frost protection there is less need for chemical control (which might or might not be effective due to some Pseudomonas syringae bacterial strains developing resistance against Copper Oxychloride). Chemical control agents can damage spring leafs and their application is labour intensive.

Participation Summary

Educational & Outreach Activities

PARTICIPATION SUMMARY:

Education/outreach description:

Growers from Burlington, Everson and Lynden WA were contacted to particiapte in the research. Samples were collected and outcomes werediscussed through field visits.

Project Outcomes

Project outcomes:

In the current year, data collection and monitoring continued. Temperature and relative humidity measurements were carried out daily from March 2013 to May 2013, weekly from June 2013 to August 2013 and twice a week from September 2013 to October 2013 by the weather station and recorded by HOBO shuttle.

Bud break conditions, especially bud frost damage, were assessed in the early bloom time, and blight distribution surveys were carried out across controlled and uncontrolled areas.

Blueberry plants were assessed for tissue damage and bacterial blight infection by visually counting the number of blighted twigs on each blueberry plant in the study area. Pseudomonas counts were carried out and average disease incidence was calculated and compared between controlled and uncontrolled areas. Differences in the susceptibility of the three varietals; Organic Liberty, Toro and Bluecrop to Bacterial Blight were monitored and recorded.

Prior to field tests, heavy pruning was conducted to remove established inoculum load. The infected twigs were identified and visually inspected for tissue damage, Bacterial blight infection and disease incidence on a monthly basis from February to April 2013.

Comparative analysis of the preliminary results showed that there was more disease incidence/Bacterial blight infection measured in uncontrolled area; blocks further away from the wind machines than in the controlled area; blocks that were in close

proximity to the wind machines.

To better understand how Bacterial blight and frost protection measures affected blueberry plants over multiple years, data analysis was extended to compare the yield of selected cultivars for the years 2012 and 2013. It was found that berry yield followed the same pattern as disease incidence and bacteria counts. Greater blueberry yields were found in the controlled area blocks which suffered less Bacterial blight. Further, the yield of the healthier blocks was compared and recorded on the basis of variety. The yield of Toro variety surpassed the yield of Bluecrop variety and which further surpassed the Organic Liberty variety. Findings suggest that the late variety Toro might be more responsive to frost control with the wind machines than the cultivar Bluecrop. This data indicates that either the conditions which favour the incidence of Bacterial blight also affects yield or that Bacterial blight itself affects yield.

In addition, microbiology tests (Aerobic Plate Count, Coliform, E. coli, yeast and mold) were also conducted for all study areas during the summer months to determine the growth of other pathogen populations. In July 2012 and August 2012, samples from each controlled blocks, uncontrolled blocks and other participating growers from Burlington, Everson and Lynden were collected and sent for laboratory testing. Results indicated lower counts in the controlled areas, compared to the uncontrolled and other participating growers' areas. It is possible that the use of wind machines not only controls Bacterial Blight infection but also helps in controlling other bacteria over multiple years.

Conclusion: It was concluded that Bacterial blight infection is completely controlled by the wind machines as the blocks closer to the wind machines show only less disease incidence on average as compared to the blocks away from the wind machines. All participant producers have an opinion that by using wind machines there is great certainity to control bacteria blight infestation. This may also reduce the pruning time, as there will be less frost damage so labourers do not need to go in and remove damaged crops.

Without funding or financing opportunities, producers may oppose adopting this new method due to the high installation and fuel costs to install and operate the wind machines, but they will understand that by using wind machines for frost protection there is less need for chemical control (which might or might not be effective due to some Pseudomonas syringae bacterial strains developing resistance against Copper Oxychloride). Chemical control agents can damage spring leafs and their application is labour intensive.

Recommendations:

Potential Contributions

See Outcomes and Impacts

Future Recommendations

1. Bacterial blight infection is completely controlled by the wind machines, as the experimental blocks closer to the wind machines show less disease incidence, on average, as compared to the experimental blocks away from the wind machines.

2. By using wind machines for frost protection, there is less need for chemical control (which might or might not be effective due to some Pseudomonas syringae bacterial strains developing resistance against Copper Oxychloride). Chemical

control agents can damage spring leafs and their application is labour intensive.

3. By using wind machines, pruning time also decreases, because if there is less frost damage, labourers do not need to go in and remove damaged crops.