



New Brunswick Soil & Crop Improvement Association

Apple Growth & IPM C2021-0283

Final Report

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Project Title: Apple Growth & IPM C2021-0283

Project Collaborators

NBSCIA Coordinators, Central, Kings and Moncton
Amy McFadgen, Crop Development Officer, NBDAAF
Leigha Beckwith, Crop Development Officer, NBDAAF
Garth Nickerson, Tree Fruit Specialist, NBDAAF

ABSTRACT/RÉSUMÉ:

The implementation and use of Davis weather monitoring technology for orchard management in New Brunswick was carried out in orchards in Bear Island, Keswick Ridge and Memramcook in 2020. A new Davis Vantage Pro2 weather station, leaf wetness sensor and soil temperature and moisture probes were installed in Keswick Ridge. The existing weather stations in Bear Island and Memramcook were upgraded with a leaf wetness sensor and soil temperature and moisture probes. The weather station located at the orchard site in Kiersteadville was unable to be upgraded with the mentioned sensors this year due to late arrival of the sensors and logistical difficulties. Because of the late arrival of the new weather station and sensors, weather monitoring and insect/disease pest modelling through the Davis Mobilize app over the complete 2020 growing season was only achieved at the Memramcook site. Despite this, accurate insect pest and disease pest modelling using the integrated pest management (IPM) capabilities of Davis Mobilize was accomplished. The insect and disease pest models and alerts for risk of damage from pests provided by Davis Mobilize were relevant and accurate to New Brunswick. This demonstrates that Davis weather monitoring technology used in this project shows promise it can be utilized by New Brunswick apple producers to improve the efficiency and effectiveness of pest control. Monitoring of soil conditions with the soil temperature and moisture probes can also be used in orchard management decisions regarding tree planting and irrigation. Davis weather monitoring technology used in this project has the potential to improve profitability of New Brunswick apple producers. However, the full 2021 growing season should be monitored with the technology before final recommendations on its effectiveness and usefulness should be made.

La technologie de surveillance météorologique proposée par Davis a été mise en œuvre et exploitée pour la gestion des vergers au Nouveau-Brunswick, précisément à Bear Island, Keswick Ridge et Memramcook en 2020. Une nouvelle station météorologique Davis Vantage Pro2, un capteur d'humidité des feuilles et des sondes de température et d'humidité du sol ont été installés à Keswick Ridge. Les stations météorologiques existantes à Bear Island et à Memramcook ont été mises à niveau et dotées d'un capteur d'humidité des feuilles et de sondes de température et d'humidité du sol. La station météorologique du verger de Kiersteadville n'a pas pu être agrémentée des capteurs susmentionnés cette année en raison de la livraison tardive de l'équipement et de difficultés logistiques. En raison de la livraison tardive de la nouvelle station météorologique et des capteurs, la surveillance météorologique et la modélisation des insectes/maladies nuisibles au moyen de l'application Mobilize de Davis sur l'ensemble de la saison de croissance 2020 n'ont été réalisées que sur le site de Memramcook.



Néanmoins, une modélisation précise des insectes et des maladies nuisibles a pu être effectuée grâce aux capacités de gestion parasitaire intégrée (GPI) de Mobilize. Les modèles relatifs aux insectes et aux maladies nuisibles et les alertes sur les risques de dommages causés par les ravageurs transmis par Mobilize se sont avérés pertinents et précis pour le Nouveau-Brunswick. Il en ressort que la technologie de surveillance météorologique de Davis ayant servi dans ce projet est prometteuse et qu'elle pourrait être utile aux producteurs de pommes du Nouveau-Brunswick dans l'optique d'accroître l'efficacité de la lutte antiparasitaire. La surveillance des conditions du sol à l'aide de sondes de température et d'humidité pourrait également servir aux décisions de gestion des vergers, notamment en ce qui concerne la plantation des arbres et l'irrigation. La technologie de surveillance météorologique de Davis pourrait contribuer à accroître la rentabilité des producteurs de pommes du Nouveau-Brunswick. Toutefois, il conviendrait de surveiller la totalité de la saison de croissance 2021 au moyen de cette technologie avant de formuler toute recommandation définitive sur son efficacité et son utilité.

Summary

The implementation and use of Davis weather monitoring technology for orchard management in New Brunswick was carried out in orchards in Bear Island, Keswick Ridge and Memramcook in 2020. A new Davis Vantage Pro2 weather station, leaf wetness sensor and soil temperature and moisture probes were installed in Keswick Ridge. The existing weather stations in Bear Island and Memramcook were upgraded with a leaf wetness sensor and soil temperature and moisture probes. The weather station located at the orchard site in Kiersteadville was unable to be upgraded with the mentioned sensors this year due to late arrival of the sensors and logistical difficulties. Because of the late arrival of the new weather station and sensors, weather monitoring and insect/disease pest modelling through the Davis Mobilize app over the complete 2020 growing season was only achieved at the Memramcook site. Despite this, accurate insect pest and disease pest modelling using the integrated pest management (IPM) capabilities of Davis Mobilize was accomplished. The insect and disease pest models and alerts for risk of damage from pests provided by Davis Mobilize were relevant and accurate to New Brunswick. This demonstrates that Davis weather monitoring technology used in this project shows promise it can be utilized by New Brunswick apple producers to improve the efficiency and effectiveness of pest control. Monitoring of soil conditions with the soil temperature and moisture probes can also be used in orchard management decisions regarding tree planting and irrigation. Davis weather monitoring technology used in this project has the potential to improve profitability of New Brunswick apple producers, however the full 2021 growing season should be monitored with the technology before final recommendations on its effectiveness and usefulness should be made.

Introduction

The NB apple industry has a history of over 100 years of commercial production. Apple production occurs on about 200 hectares (500 acres) of apples in two main areas: South East region (Cocagne / Memramcook area) and the Central region (St. John River Valley from Woodstock to Gagetown / Queenstown). The industry's economic value is estimated at \$3 million dollars annually.



Detailed monitoring of the environment or weather conditions is critical to understanding the success or failure of a new variety as well as the ongoing production management of a successful orchard. Integrated Pest Management (IPM) in apple production, rather than simply trying to eradicate pests considers all available information, accounts for multiple objectives, and considers every preventive and curative option. Fundamental to an IPM program is a network of weather monitoring devices and the robust delivery of the sensor data for further analysis and interpretation.

Project Objectives

The objective of this project activity is to demonstrate the use of Davis weather monitoring devices in orchard management and the subsequent utility of phenology models to predict the growth stages of apple insect and disease pests.

Project Deliverables

Improved understanding of weather monitoring instrumentation and data analysis for orchard management by orchard owners, NBSCIA coordinators and NBDAAF crop production specialists. Definition of procedures and operating manuals to deliver various models in the 2021 season.

Technical Innovation

Davis weather monitoring and IPM technology was adopted for this project in 2020. This includes:

- **Vantage Pro2 weather station:** used for measuring outside air temperature, humidity, rainfall, wind speed and wind direction. The outside temperature is utilized as the canopy temperature of the apple trees for the IPM phenology models.
- **Weatherlink Live:** connects weather station to the internet for real-time uploads of sensor data.
- **Davis Weatherlink app:** Displays real-time weather data collected by the weather station and sensors as well as past records.
- **Davis Mobilize app:** uses the data collected from the weather station and sensors to provide IPM data. Tracks the development of insect and disease pests and gives alerts when there is risk of damage on a scale of no risk of damage, low risk, medium risk and high risk. Users can select which pests are monitored and which phenology model is used. Displays data in real time. Weatherlink Pro+ subscription is required for access to the IPM program in Davis Mobilize.
- **1 x leaf wetness & soil temperature/moisture station:** collects sensor data from leaf wetness sensors, soil temperature sensors and soil moisture sensors.



- **3 x stainless steel temperature sensors:** Sensors are placed at 6” and 12” soil depth to record soil temperature. One sensor is placed a few inches above ground level to record temperature at ground level.
- **1 x soil moisture probe:** placed at 8” soil depth to measure soil moisture between 0 centibars (saturated soil) and 200 centibars (extremely dry soil).
- **1 x leaf wetness sensor:** measures water sitting on the leaf and placed at the top of the tree canopy. Gives wetness readings on a scale of 0 to 15, where 0 indicates leaf is completely dry and 15 completely wet.
- **1 x radiation shield:** Goes over the stainless steel temperature sensor placed at ground level to prevent sunlight from influencing temperature reading.

Evaluation Plan

The utility of the Davis cloud database and IPM models for application in New Brunswick were evaluated. This was done by consulting with NBDAAF staff and literature if high-risk alerts for insect/disease damage and infection given by the Mobilize app were valid.

Results and Discussion

This year was primarily for acquiring the required technology (weather station and sensors), installation, demonstrating how the technology works and becoming familiar with the technology. The new weather station and sensors for Riverview Orchards was installed and the existing weather stations in Bear Island, Memramcook were upgraded with the new sensors. The weather station in Kiersteadville was not upgraded with the extra sensors due to the late arrival of the sensors, so no IPM or soil temperature or moisture data could be collected. The ground level temperature sensor was not installed on any station due to the equipment supplier sending the wrong type of sensor. The wrong sensors have been returned to the supplier and the correct ones will be sent.

Due to the late arrival of the weather station and sensors and late access to the Davis Mobilize app, weather monitoring for the entire growing season could not be carried out for three out of the four apple orchard sites (Bear Island, Keswick Ridge and Kiersteadville). Without a complete season of data collection from the weather station and sensors, the insect pest models for pests like apple maggot and codling moth were not accurate. This is because Growing Degree Day (GDD) accumulation did not start at the beginning of the growing season so events like emergence and egg laying were reported by the Davis Mobilize app later than these events would actually occur. Because of this, management decisions like spraying for these pests could not be made based on the information provided by the Davis Mobilize app.



Accurate modelling and alerts for insect pests was achieved at the Memramcook site because a full growing season was able to be monitored.

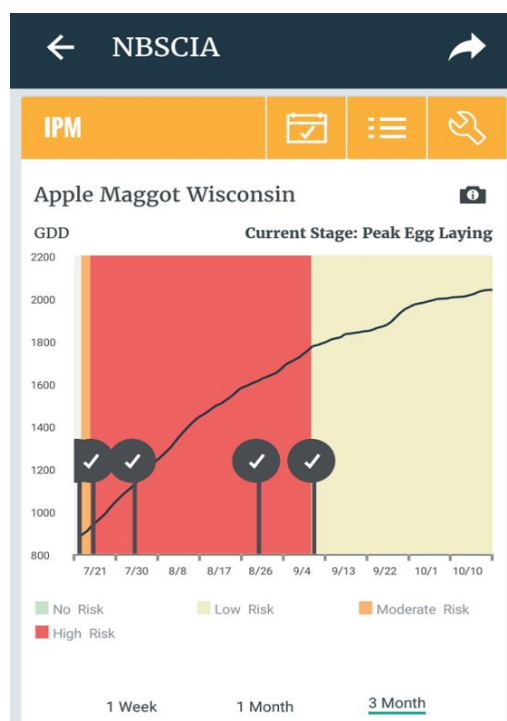


Fig. 1: Model of apple maggot growth stage and risk level as determined by sensor data from July 21 to October 10 at the Memramcook orchard site, as seen from the Davis Mobilize app.

As seen in Fig. 1, risk alerts were given based on the amount of GDD accumulation, which is determined by data collected by the weather station. This information is helpful to the producer as it gives them site-specific dates instead of general dates/recommendations for when to closely monitor potential apple maggot damage in the orchard and help decide when to apply insecticides if necessary. The model also alerts to when the risk of damage from apple maggot is over, which coincides with climate conditions becoming less favorable for the apple maggot and the completion of its lifecycle.



The disease pest models utilized by Davis Mobilize are based on climate conditions and not GDD like the insect pest models. Because of this, accurate alerts of high risk for damage from diseases were achieved in all three orchard sites monitored this year, despite the fact a full growing season of data was unable to be collected in Bear Island and Keswick Ridge.

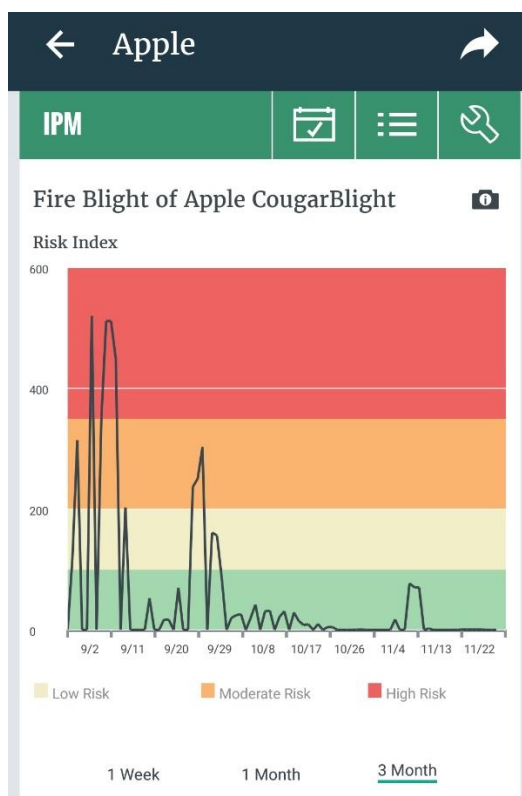


Fig. 2: Model of fire blight risk level as determined by sensor data from September 2 to November 22 at the Bear Island orchard site, as seen from the Davis Mobilize app.

Risk alerts in the model seen in Fig. 2 are based off temperature, humidity and leaf wetness measured by the weather station and leaf wetness sensor. High-risk alerts are given during periods of hot and humid weather. Risk of fire blight infection decreases as temperature and humidity decreases, which is seen in Fig. 2 as fall progresses. These alerts can be useful for the producer so they know when to closely monitor the orchard for new infections or when close monitoring is no longer needed. High risk alerts were given earlier in the growing season in June and July and were confirmed to be valid alerts by NBDAAF project collaborators.

In addition to the IPM capabilities of the new sensors acquired and software, they also can be used for managing the growth of trees. For example, the soil temperature probes can be used to help plan when to plant new trees by planting when the temperature probes report ideal soil conditions. The



soil moisture probes can also be utilized in determining whether to irrigate trees during periods of drought. However, action thresholds for when to irrigate trees still need to be determined.

Conclusions

Most of the new weather monitoring equipment required for the project was acquired, installed and successfully demonstrated to provide useful information for orchard management. Although weather monitoring over the entire 2020 growing season was not possible for three out of four orchard sites, the technology was still able to provide relevant information for use in insect/disease and tree growth management. This can result in more profitable operations by potentially reducing pesticide inputs, less pest damage to trees and fruit, improved tree establishment and growth, higher yields and fruit quality. Project deliverables will be fully met after the 2021 growing season. The technology thus far shows it can be successfully utilized by New Brunswick apple producers.

Required Next Steps

The primary next step will be to begin weather monitoring for all four sites involved with the project at the beginning of the 2021 growing season to fully utilize the IPM capabilities of the Davis Mobilize app as a management tool.

After consultation with the owners of participating orchards, it was identified that an additional two soil moisture probes and one leaf wetness probe should be added to the weather station set up. The additional leaf wetness sensor would be for improved reliability of the IPM data by reducing the chances of outliers. The additional soil moisture probes would allow for soil moisture monitoring throughout the entire root zone of the trees instead of only at the current 8" depth, which would allow for improved irrigation decision making. It was also determined that the addition of wireless signal repeaters would be a useful addition. The location of the weather station in the orchard is limited to about 100 m from an internet source so this prohibits the station and sensors from being placed in the orchard where it would be most effective. With the use of wireless signal repeaters, the distance between the weather station and the internet source can be increased by up to 300 m per repeater. This would allow the weather station to be placed directly in the desired orchard block for more accurate and relevant information coming from the weather station and Davis Mobilize app.

Communication

The final report will be posted on the NBSCIA website. Project team leaders will deliver presentations in early 2021 and/or after the 2021 growing season at commodity professional meetings and to industry professionals. Meetings will likely take place virtually due to the Covid-19 pandemic.

