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Potato Virus Detection

Potatoes are the fourth most important food crop in the world and the leading vegetable crop in the world.

Potato production relies on planting clean seed, thus seed potato production is an extremely high value and high pressure crop. Seed potatoes undergo rigorous testing and inspection to ensure high quality, disease-free seed potato tubers; however, one disease that continues to impact seed potato production is Potato Virus Y (PVY). Manual roguing is one of the most common methods of managing PVY in seed potato plants, but this process relies on human perception. In this project NWB Sensors will develop an optical non-contact PVY sensor based on hyperspectral sensors and machine vision classification algorithms. Removing the human factor with an automated detection system will provide consistent and reliable detection.

Optical detection of PVY infection is evident in color and textural changes used by roguing crews to identify diseased plants. The development of a machine vision based system has the potential to improve consistency of detection in the field, and improve management of PVY

in potato seed production, and potato production in general. To achieve this, NWB Sensors, Inc. plans to collaborate with researchers at Montana State University to study the relationship between the reliability of machine detectable stress and the estimated viral titer in diseased plants. This will lead to the development of a detection algorithm based on non-contact optical measurements and knowledge of its ability to detect PVY during different stages of the disease cycle, allowing for the development of a sensor systems for automated detection in as second phase of the project. This device would consist of a rugged handheld spectrometer and tablet computer or smart phone as a display device and gateway to a cloud based platform that performs the data analysis. The online classifier would process the infield data and perform an assessment of the presence PVY and the level of infection.

Economic Impact

In the United States 111,351 acres of seed potatoes were grown in 2016 with 11,100 acres of potatoes with 10,398 acres of seed potatoes planted in Montana, most of which were in Southwest Montana near NWB Sensors, Inc. in Bozeman, MT. Assessing the value per acre of seed potato can be estimated using the total value of the Montana seed potato market, valued at \$46 million dollars annually. This an

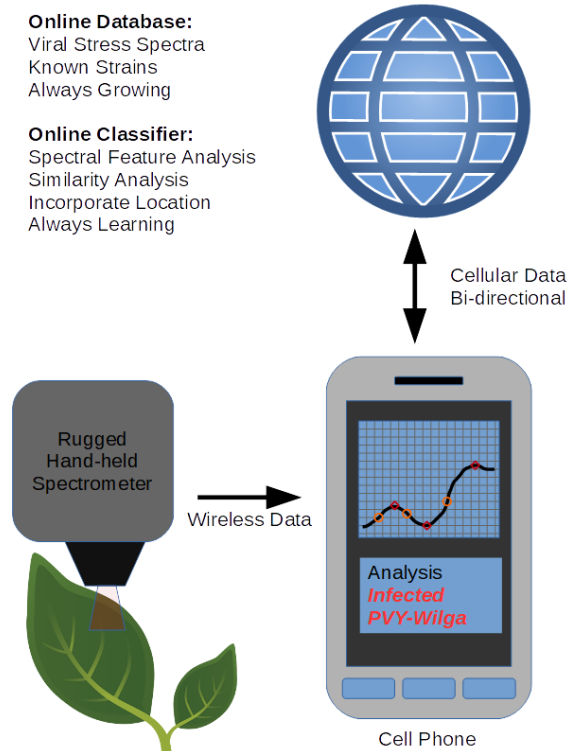


Figure 1. Data Flow for the leaf analysis scouting tool



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estimated value of \$4,200/acre in 2016, with some varieties such as Payette Russet as high as \$7000/acre. Growers have reported losses due to potato virus upwards of 15 acres of crop in a single field. The current best method to manage this problem are roguing crews where workers walk through fields and physically remove potato plants suspected of having PVY. Costs of such crews are estimated at \$10,000 or more per year to the grower. Roguing is labor intensive and complicated by the inherent variability in the human decision of what is infected. This situation is further complicated as new varieties respond to PVY differently causing further variation. An example of this is the increase in Umatilla Russet production in response to their inclusion in the potatoes used for the McDonald's French fry and the low level at which this plant exhibits a visible response to PVY infection. Figure 2, images of PVY infected plants for four of the varieties commonly grown in Montana. There are visible differences between the diseased plants in the center of each frame and the healthy plants surrounding, however the prominence of these difference varies between the different cultivars.

Alturas – PVY



Ranger Russet – PVY



Russet Burbank – PVY



Umatilla – PVY



Figure 2. Images of PVY Infected plants from Montana State Universities visual roguing guide

Potato growers of any size will benefit from having the ability to rapidly and consistently identify PVY in their crops. The current methods used for roguing have a strongly variable human component with inspections completely dependent on human judgement. Removing this variability will revolutionize the seed potato industry.

This project was proposed to the USDA Small Business Innovative Research Program, however the proposal was not selected for funding in the 2018 fiscal year. NWB Sensors is continuing to revise this concept address reviewer concerns and is seeking alternative avenues for funding this project.