BIOAg Project Report

Report Type:
Progress

Title:
Mapping Colorado potato beetle to promote proactive management in potato

Principal Investigator(s) and Cooperator(s):

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Co-Investigator: Gengping Zhu (WSU Entomology)
Cooperators: Carrie Wohleb (WSU Extension)
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Abstract:

Potatoes are one of the highest value crops grown in Washington, but growers face threats from pests such as Colorado potato beetle (CPB). Because potatoes are an annual crop that grows for only 4 to 5 months, these pests live outside of crop fields from approximately September to May, and adults migrate into fields in late spring when non-irrigated hosts wilt. Potato growers would benefit from models that predict CPB arrival in fields and when damage is likely to commence. Our project addresses this by assessing the population dynamics of CPB to generate map-based forecasts that predict where and when dispersal will occur. Our project will also provide real-time information to growers to allow them to estimate when key life stages will be present so they can enact successful and targeted management programs.

Project Description:

Potatoes are a high value crop in Washington, accounting for over 20% of US production and a annual value of $4B (USDA 2022). Potatoes anchor many crop rotations in the Columbia Basin, but production is threatened from rising costs associated with pests like Colorado potato beetle (CPB) (Wohleb et al. 2021). Costs from pesticides and fuel have risen, and there is concern that growers may lose their ability to use prophylactic seed treatments with neonicotinoids. This confluence of events has led to a need for potato growers to have new tools that aid them in proactively managing pests such as CPB. Our work addresses this knowledge gap.

As potatoes are an annual crop, after fields are harvested they are typically left fallow from September to May. During this period, insect pests live and overwinter outside of potato fields in shrub-steppe vegetation and weeds. When these plants dry out in the late spring, insects migrate into potato fields and begin to reproduce and damage crops. Growers would

thus benefit from models that predict when key migration events occur across variable landscapes. To address this issue, we launched the WSU Decision Aid System for potatoes (potatoes.decisionaid.systems), which builds on a system for tree fruits. The current system reports weekly data on insect pests from a monitoring network run by Wohleb/Waters. This grant builds on these data to estimate key events related to CPB population dynamics that can guide management. For example, if growers are able to estimate when CPB will arrive in their fields, they could better time their insecticide sprays, leading to better season-long control with fewer total inputs.

Along with tools to estimate dispersal of CPB, we need models to predict phenological events in the field. Because CPB spends 3 weeks pupating in soil, growers should avoid this period for sprays as insecticides will not be effective. In contrast, growers only have a 7-10 d window to apply ovicides or larvicides before those stages develop in the field, and extension scientists recommend growers target 50% egg hatch in the second generation as a key threshold. Systems are needed to estimate key phenological events that show the presence of life stages in the field. These data can be combined with dispersal models to aid growers enact more effective management. Our project addresses these needs with two objectives that estimate dispersal into potatoes across landscapes and link data with phenology models to guide management.

Outputs

Overview of Work Completed and in Progress (2023):

(Objective 1) Create models to estimate key phenological stages involved in CPB management

After CPBs disperse to potato fields they begin reproducing and their offspring develop and can begin feeding on crops. Importantly for management, the phenological development of CPB life stages are predictable based on heat unit accumulation. CPB develop more quickly through each life stage at higher temperatures, and the number of days spent in each stage can be predicted based on the degree day accumulation at a location. In 2023 our team used data from Wohleb and Waters to build a phenology model for potato beetle in the Pacific Northwest. Our model allows us to estimate when adults, eggs, larvae, and pupae are likely to be present across the state at specific locations (Fig. 1). Our current management recommendations suggest that growers target 50% egg hatch in the second generation, which can now be predicted in advance (Fig. 1). We will continue to validate and test the model in 2024.

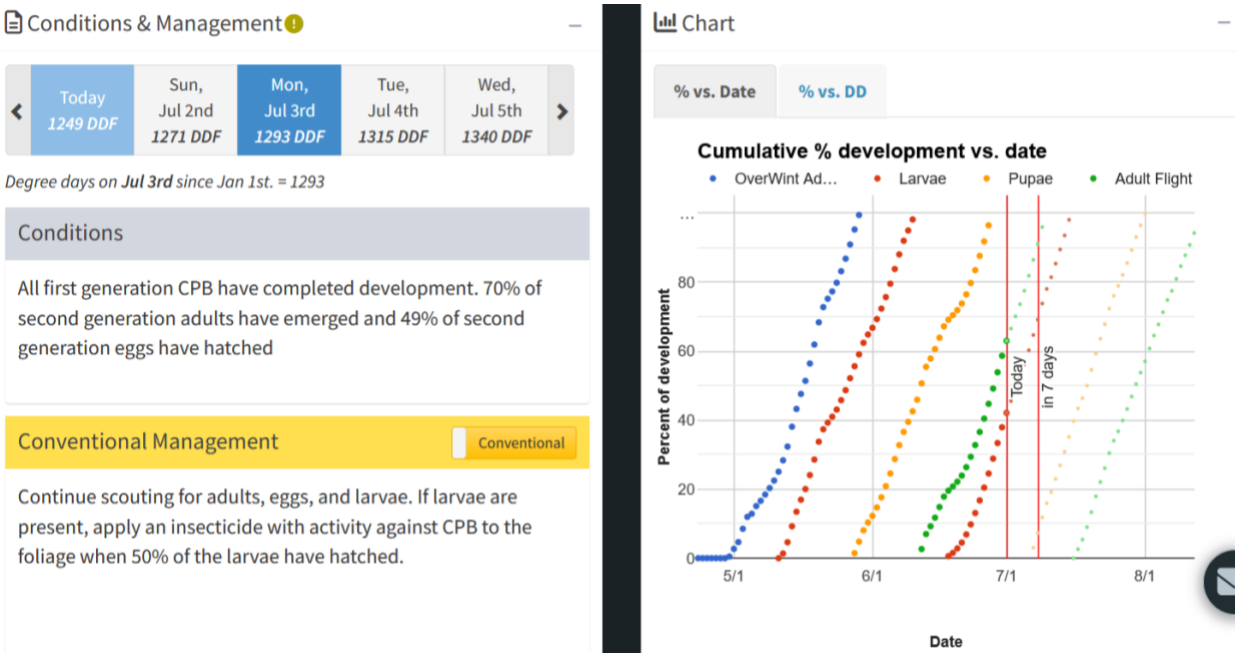

Fig. 1. Output of the CPB model predict phenology in Washington State. Shown is Richland, Washington on July 3rd, 2023. Growers are recommended to target 1,300 degree days as a threshold for management.

(Objective 2) Build species distribution models that link monitoring data and satellite imagery with models to predict variation in CPB abundance across Columbia Basin production regions

To complement our phenology models built in Objective 1, a second objective of the project is to better variation in abundance across the Columbia Basin. Growers must make decisions not only based on phenology but based on the abundance of insects. To this end, in 2023 we gathered data from collaborators in Washington, Oregon, Idaho, and other states. We are working with these data to build models that predict abundance of CPB based on phenology and other factors, such as environmental conditions and landscape factors. This work will be the focus of our 2024 efforts, and we expect to incorporate new models into the DAS in 2024.

Outreach & Education Activities:

To share information from our project, we provided weekly updates through our weekly email alerts that reach over 1,000 subscribers. Through these updates, model outputs were linked to the pesticide spray guide (developed by collaborators Wohleb and Waters) that provide information on products to control each life stage present (Fig. 2). This combination of data address various strategies used to control CPB and give growers tools to make more proactive decisions.

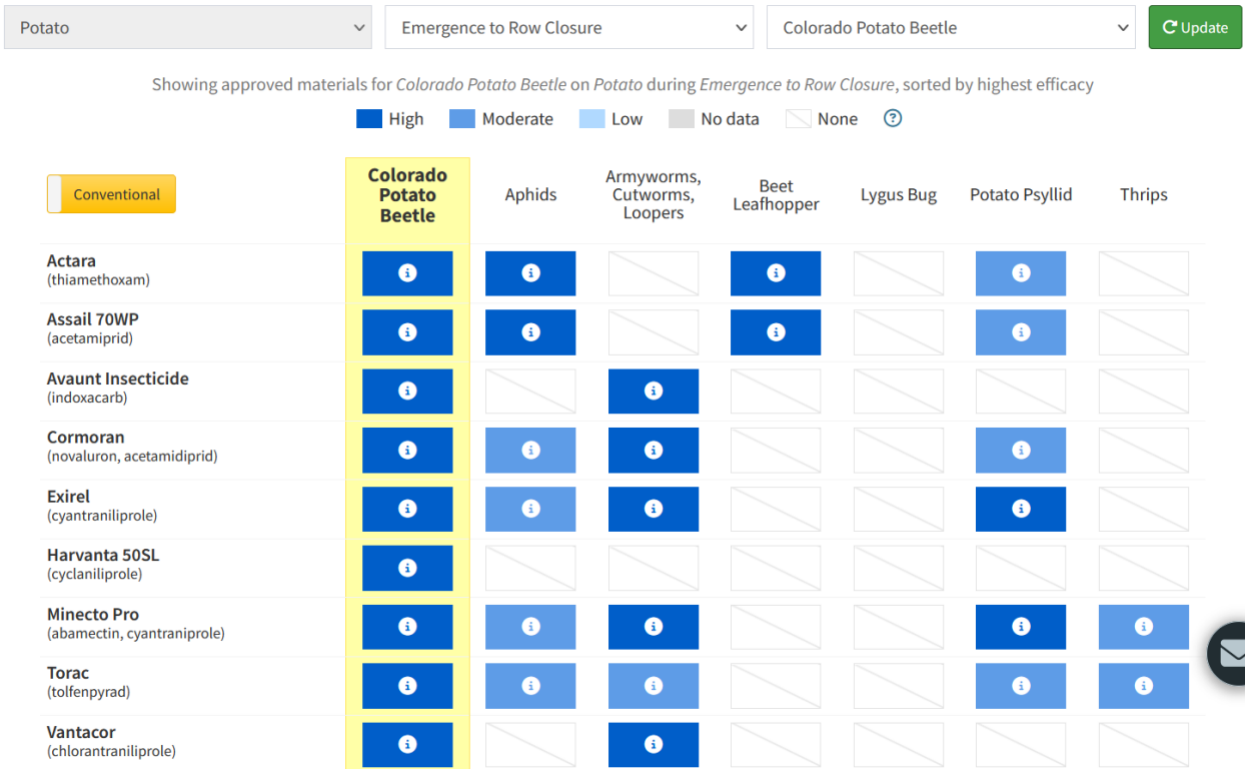

Figure 2. Pesticide spray guide used to show products available for CPB control within our Decision Aid System

Our team also conducted workshops on the Decision Aid System in March and April 2023, which attracted over 100 individuals. At these workshops we showed the phenology tools and discussed future modeling efforts related to Objective 2. Our team also participated in the USA Potato Expo, and have expanded our research on CPB modeling nationwide.

Impacts:

Short-Term (1-2 years): We have built a model that is incorporated into a free decision support system to aid growers predict when CPB will be present and provide a guide on tools that can be used. Over the next year this system will be complemented with bi-monthly maps and associated recommendations for CPB that are based on real-time weather data and satellite imagery. These data will help growers in the short time reduce their total number of insecticide sprays by better timing their first spray of the season while also avoiding windows when only pupae are present. In the short-term, our project will also help growers make the transition to digital tools for pest management using a model insect that can benefit from phenologically-based management.

Intermediate-term (3-5 years): In the intermediate-term our project will provide a catalyst to further development of the potato and vegetable decision aid system. As mentioned previously, our project team has leveraged BioAg funds to expand our research to other land grant schools across the US through an SCRI project. Many regions of the US are affected by

CPB, and our platform can be used to guide management for potatoes nationwide. Moreover, this project will provide a foundation to build similar tools for beet leafhopper, potato psyllid, and Lygus among other species. We will also begin to build our relationships with growers by providing more tools over time that can guide management. This will lead to a greater reliance on models to guide pest management, resulting in an overall reduction of pesticide sprays and increased profits.

Long-term (5+ years): Our project is a component of a larger-term effort by the Crowder lab, and WSU CAHNRS more generally, to build digital decision support tools for growers. The tree fruit DAS saves growers between $75-100 per acre, and is used by over 90% of the tree fruit industry. We hope that we can build the potato DAS to a similar market share, and preliminary surveys indicate we are already saving growers $60 per acre by publishing weekly monitoring results. By building a site that contains more models, we believe we can save the typical grower over $100 per acre through the decision aid tools we will develop, resulting in savings of over $20M per year in Washington. Nationwide, these savings could grow exponentially.

Additional funding applied for/secured:

Our research group was part of a team that applied for and secured an $8M grant from the USDA Specialty Crop Research Initiative to expand decision support tools for potato crops. The models and preliminary data developed from this project provided critical support for the development of this SCRI project, and will allow us to expand this research with partners nationwide.

Graduate students funded:

Emily Rampone, PhD Student in Entomology

Recommendations for future research:

Not applicable, will be addressed in the final report