**Full Proposal Submitted to the Washington State Potato Commission**

**Title:** Maintenance of late blight of potato forecasts

**Year Initiated:** 2021-22. **Current Year:** 2021-22. **Terminating Year** 2023

**Personnel & Cooperators:**

The PIs for this project are David Linnard Wheeler ([david.wheeler@wsu.edu](mailto:david.wheeler@wsu.edu); 215-880-3024), Carrie Wohleb ([cwohleb@wsu.edu](mailto:cwohleb@wsu.edu) ; 509-707-3510), and Tim Waters ([twaters@wsu.edu](mailto:twaters@wsu.edu); 509-545-3511) from Washington State University. Sudha G.C. Upadhaya ([sudha.gcupadhaya@wsu.edu](mailto:sudha.gcupadhaya@wsu.edu); 701-303-0630) serves as the research associate.

**Funding Request for 2021-22:** $12,583.20

**Introduction: Problem Statement, Research Question(s) & Justification:**

Late blight of potato, caused by *Phytophthora infestans*, has caused epidemics in the Columbia basin of Washington at least since 1947 (Anonymous, 1947). After this first recorded epidemic, it was not until 1990 that yearly epidemics consistently compromised potato crops (Johnson, 1996). To manage late blight effectively in potato crops, efficacious fungicides are applied. The cost of these fungicides varies from year to year. In 1998, for example, $22.3 million was spent on state-wide management of late blight (Johnson *et al.* 2000). For 2020, this translates into $35.3 million dollars. To reduce this cost, yield losses, and the risks that strains of *P. infestans* will develop fungicide resistance, accurate forecasts are required.

Late blight forecasts for the Columbia Basin of Washington were first implemented in 1993 by Johnson et al. (1996) following observations by Easton (1982). At first the risk of late blight in a given year was predicted based on the occurrence of late blight in previous years and the number of rainy days in April, May, July, and August for Prosser, Washington (Johnson, 1996). The models were subsequently expanded to include precipitation data from Hanford and Othello, Washington, as well as Hermiston, Oregon (Johnson et al. 1998). Lastly, solar irradiance, the number of cloudy days without rain, and the number of days since the first occurrence of late blight were used to increase the predictive performance of the late blight forecasting models by Johnson et al. (2009). Since the development of these models and deployment of recommendations via a website, phoneline, and emails, stakeholders came to depend on the weekly forecasts.

From 1993-2018, these forecasts were delivered by Dr. Dennis Johnson and colleagues without formal financial support. Upon Johnson’s retirement in 2018, Dr. Gary Grove and colleagues issued forecasts and recommendations. Starting in 2020, Dr. Wheeler issued forecasts and recommendations that were supported with startup funds. For these late blight forecasts to be sustainable, minimal financial support is needed to fund rain forecasts, support travel to and from infested fields, and diagnostics to confirm late blight presence or absence. **From this support, weekly late blight forecasts, recommendations, travel to and from potentially infested fields or storage sheds throughout the growing season, and diagnostics will be provided.** In the long-term, late blight forecasts will be improved to include weather data from various representative potato production regions in Washington and the PNW at large and pathogen abundance data from strategically placed spore traps. Ultimately, this network could serve as an extension of the UI network and produce forecasts and recommendations for various economically important diseases.

**Goal(s), Hypothesis & Objectives:**

The goal of this project is to minimize late blight outbreaks in Washington and maintain the infrastructure needed to support management decisions and diagnostics. To accomplish this goal, the following objectives will be completed in the 2021-2022 funding year and repeated in the 2022-2023 funding year.

**Objectives:**

1. Produce late blight forecasts and recommendations
2. Inspect and collect samples from fields with reports of late blight.
3. Confirm late blight presence with diagnostics and, if necessary, genetic testing.

**Procedures:**

**Objective 1** will be completed by the Drs. Wheeler and Wohleb during the 2021-2022 funding year. Late blight forecasts will be produced using the same methods as Johnson and colleagues. Starting in May and proceeding until September weekly late blight forecasts will be produced using weather forecasts and the models developed by Johnson et al. (1998). Rain forecasts for Prosser, Othello, and Tri-Cities will be used as inputs into Johnson et al.’s model. These models use the product of 5 risk factors to determine the appropriate recommendations for the risk of late blight.

The first risk factor is crop phenology. Phenology data is collected by collaborators across the Columbia Basin and is vital since late blight has only ever occurred in the Columbia Basin after row closure. The second risk factor is the presence or absence of late blight in adjacent fields. If *P. infestans* is nearby, the risk that it will infest proximate fields is higher than if *P. infestans* is absent. The third risk factor is the probability that late blight will occur in Prosser, Othello, and Tri-Cities. These probabilities are calculated from the models developed by Johnson et al. (1998). The probability of the annual occurrence of late blight is modeled as a function of the presence of late blight the previous year as well as the number of rainy days during the spring and summer (Johnson et al. 1996). Probabilities for each location are issued weekly with forecasts and recommendations in the WSU Potato Pest Alerts by PI Dr. Carrie Wohleb. The fourth risk factor is the date. The date is important because the potato canopy is more conducive to late blight in June than in May, July or August (Johnson and Cummings, 2016). Finally, the fifth risk factor is number of rainy days expected in the next 7 days. These fine scale weather data are important because late blight develops faster under wet and cool weather conditions than in hot and dry conditions. Together the product of these risk factors is used to determine weekly recommendations for growers.

**Objective 2** will be completed by all PIs during the 2021-2022 funding year. Drs. Wohleb and Waters will likely be the first informed about late blight outbreaks since they have established extensive networks with the growers and are stationed in the Columbia Basin. Drs. Waters and Wohleb will then inform Dr. Wheeler, who will visit the fields and collect samples. If circumstances arise that constrain Wheeler from visiting a field(s) then the other PIs will mail him samples. Finally, **objective 3** will be completed by Wheeler during the 2021-2022 funding year. Samples will be incubated in artificial conditions to encourage growth of *P. infestans*.The pathogen will then be isolated and identified with genetic markers.

**Collaboration:** Weather forecasts will be obtained from Fox Weather LLC (the same company that provided weather forecasts for Drs. Johnson and Grove). DL Wheeler will produce late blight forecasts and recommendations for objective 1. C Wohleb will then disseminate the forecast and recommendations via WSU’s Potato Pest Alert system. T Waters and C Wohleb will serve as the eyes on the ground for late blight in the Columbia Basin. When outbreaks occur, they will inform DL Wheeler and guide him to the infested field(s). Samples will be collected by C Wohleb, T Waters, and DL Wheeler. DL Wheeler and SGC Upadhaya will isolate *P. infestans* from infested plant debris and genotype isolates.

**Anticipated Benefits/Expected Outcomes/Information Transfer:**

Expected outcomes for this project include (i) weekly late blight forecasts and recommendations issued via WSU’s Potato Pest Alert system from May to September of 2021, and (ii) late blight prevalence and *P. infestans* genotypic data from outbreaks in Washington.

Ultimately, in the longer term, the goal is to expand University of Idaho’s spore trapping network into Washington and Oregon and build predictive models for economically important potato diseases in these areas. Further, these data could be used for Decision Aid Systems across the PNW.

**Project Timeline:**

* Objective 1 will start in March and proceed until the end of September 2021.
* Objective 2 will start after row closure and proceed until harvest in 2021.
* Objective 3 will, like objective 2, start after row closure and, depending on the number of samples end as soon as harvest time or as late as December 2021.

**Literature Cited:**

1. Anonymous. 1947. Discover blight menace to late potato crops. Prosser Record-Bulletin. Prosser, WA. September 25.
2. Easton GD. 1982. Late blight of potatoes and prediction of epidemics in arid central Washington state. Plant Disease. 66:452-455.
3. Johnson DA, Alldredge JR, and Vakoch DL. 1996. Potato late blight forecasting models for the semiarid environment of south-central Washington. Phytopathology. 86: 480-484.
4. Johnson DA, Alldredge JR, and Hamm PB. 1998. Expansion of potato late blight fore- casting models for the Columbia Basin of Washington and Oregon. Plant Dis. 82:642-645.
5. Johnson DA and Cummings TF. 2016. In-canopy environment of sprinkler irrigated potato fields as a factor for late blight management in the semiarid environment of the Columbia Basin. Am J. Potato Res: 93:239-252.
6. Johnson DA, Cummings TF, Abi Ghanem R, and Alldredge JR. 2009. Association of solar irradiance and days of precipitation with incidence of potato late blight in the semiarid environment of the Columbia Basin. Plant Dis. 93:272-280.
7. Johnson DA, Cummings TF, and Hamm PB. 2000. Cost of fungicides used to manage potato late blight in the Columbia Basin: 1996 to 1998. Plant Dis. 84:399-402.

**Budget:**

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| --- | --- | --- | --- | --- |
| **FY 2021-22** | **Wheeler lab** | **Wohleb Lab** | **Waters Lab** | **Total** |
| **1Salaries: Faculty** | $2,400 |  |  | $2,400 |
| Other students |  |  |  |  |
| **2Employee Benefits (OPE): Faculty** | $727.2 |  |  | $727.2 |
| **Operating Expenses** |  |  |  |  |
| Weather forecasts from Fox Weather LLC | $4,600.00 |  |  | $4,600.00 |
| Travel | $1,834.00 |  |  | $1,834.00 |
| Sampling | $387.00 |  |  | $387.00 |
| Shipping samples |  |  | $150 | $150 |
| Culturing *Phytophthora infestans* from plant debris | $275.00 |  |  | $275.00 |
| DNA extraction and sequencing | $2,210.00 |  |  | $2,210.00 |
| **Total** | 12,433.20 | $0 | $150 | $12,583.20 |

1Salary to support research associate for 0.05 FTE of 12 months

2Employee benefits for research associate are 30.30% of salary

**Anticipated Total Requests in Coming Years: 2022-2023: $15,000 2023-2024: $0**

**Other Support of Project, Anticipated Supporting Grant Applications:**

Other support for this project comes from state-based funds in the form of salaries and benefits for project investigators, David Wheeler, Carrie Wohleb, and Tim Waters. This project will serve to produce data for larger regional grants like the USDA Sustainable Agriculture Research and Extension and Western IPM.