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Development of the Potato Pest Mapping System

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Potato growers must manage a suite of pests, including insects, diseases, and weeds. Sampling networks, where pests are monitored regularly across a broad region, allow growers to visualize “hot spots” of high pest activity and anticipate mobile pest populations. In Washington, Wohleb and her team conduct weekly monitoring of about 50 potato fields throughout the Columbia Basin for pests including aphids, beet leafhoppers, potato tuberworms, and potato psyllids (Figure 1). These data were sent to growers and other members of the potato industry through weekly e-mail updates.

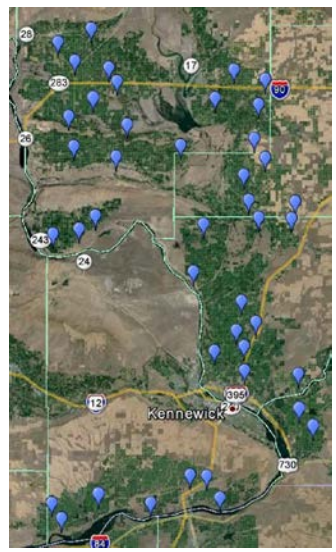

Figure 1. Location of fields sampled for pests during 2016

Beginning in 2013, with support from a two-year grant from the WSU Extension Initiative, our team began to develop a decision-support tool using the data from the potato sampling network. Using geographical information systems (GIS) technology, we generated weekly predictions of pest densities based on the sampling data using a technique called “interpolation” (Figure 2). Briefly, to predict the density of a given pest at any location throughout the Columbia Basin, the GIS program calculates a weighted average of the number of insects from nearby monitoring sites; sampling sites that are closer to the location being estimated are given higher weight because they are assumed to have more similarity in insect densities. This produces a continuous prediction of insect densities throughout the region, where areas of similar pest density are grouped together and shown on our maps using the same color (Figure 2).One benefit of this approach is that for the first time growers could get targeted predictions on expected pest densities in their specific field(s), regardless of where they were located in the state (Fig. 2b). This is in contrast to the previous output of the sampling network, where only the densities at sampled locations were shown (Fig. 2a). Moreover, by showing interpolated surfaces rather than densities from particular fields, growers involved in the network remain anonymous. In 2017 we hope to extend our mapping approach into Oregon and Idaho.

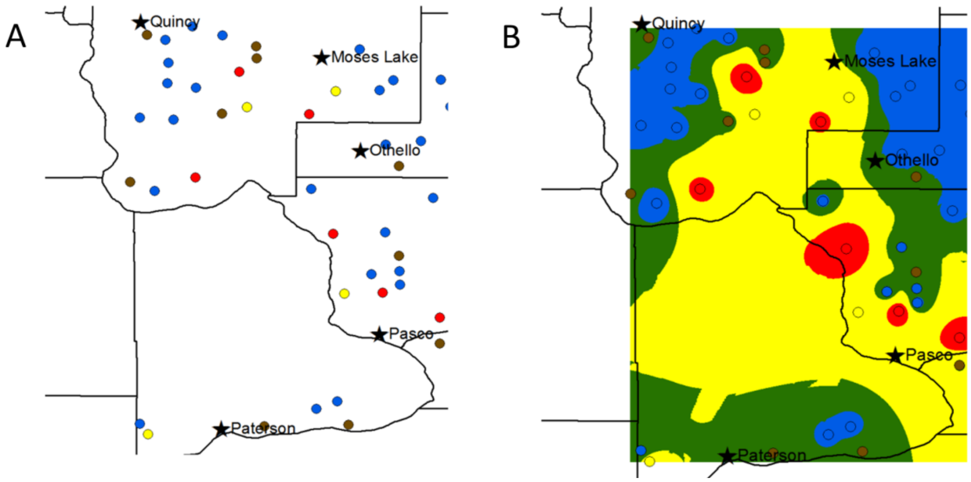

Figure 2. (A) Example of the output of the potato sampling network prior to 2013 (showing aphid pests) and (B) the output that was developed as part of our project. These interpolations in panel B show pest predictions throughout the region based on data from the sampling network (panel A). The various colors are based on major action thresholds for each pest species. Blue = pest not present; green = pest at low density; yellow = pest at medium density; red = pest at high density. Locations with the same color are expected to have similar densities.

Our predictive models are based on over 8 years of data, and we conducted extensive validation of our approach. This was done by comparing predicted pest densities from the interpolations with actual pest densities observed through sampling. In the validation stage, we used a portion of the sampling data to develop the interpolation models, and the rest to validate the models. We have demonstrated that our simple GIS approach produces approximately 70% congruence between predictions and observed pest densities. This is a high degree of precision, considering that many factors (such as insecticide use) can influence pest densities, and our predictions are based solely on monitoring data from 50 fields. However, it should be noted that the insect maps should be used as a guideline for what to expect, and not a definitive count of the number of insects in any given field at any given point in time. Variability in many factors, including grower management strategies, could cause predictions to vary from observed counts.

Once the models were validated, we began to publish these "heat maps" of insect densities in 2014 through the e-mail alerts. When maps across multiple weeks are plotted, it allows users to visualize how mobile insect pest populations are moving across the landscape; this information can be used to better anticipate when insect pests will arrive in certain regions and guide management decisions. In the coming year (2017) we will integrate these heat maps into a Google Earth mapping framework. This will allow individuals to enter in the location of their specific field(s) and get targeted predictions on their insect pest densities. This feature will be coded for both desktop and mobile devices. Making the tool accessible on mobile devices will improve access and usage over time.

Overall, we will continue to refine our model approaches as we gather more data on each insect pest. In the coming years we also hope to link the pest maps with management recommendations. Thus, when a grower zooms in to see the predictions for his/her field, they will also receive management tips based on the expected number of insects. Our hope is that as the tool develops, growers can use it to better anticipate pest populations, lower their need for insecticide sprays, and increase their profits.

Questions about the pest mapping project can be directed to David Crowder (dcrowder@wsu.edu) or Carrie Wohleb (cwohleb@wsu.edu).