Aphid Alert: A Brief History of Apprehending Aphids.

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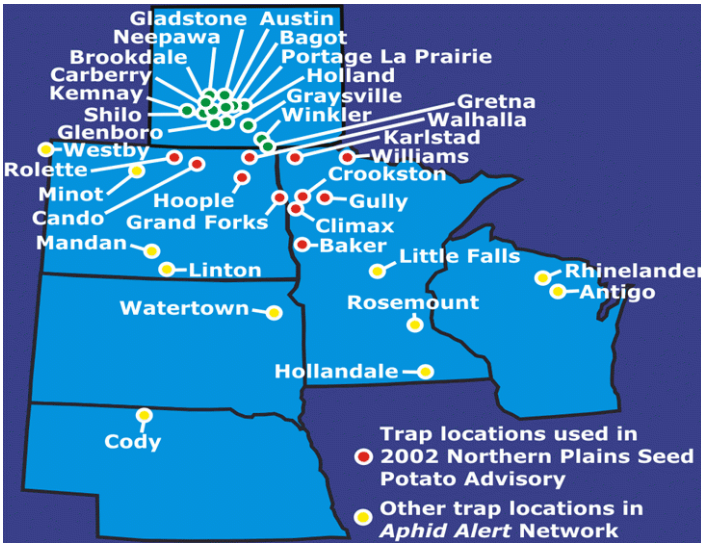
Aphid Alert 1992-2003

Just like comedy, in pest management appropriate timing is everything; applying management tactics at the right threshold can prevent significant loss. When dealing with insects that transmit diseases, these thresholds are generally very low, so information on the numbers of these disease vectors is doubly important. In Minnesota and North Dakota a system of suction traps called the ***Aphid Alert Network***, has been used to monitor the regional presence of aphids that can transmit PVY in seed potatoes. The system was first established in 1992 and in that iteration ran until 2003. At its height in this period it became a cooperative effort incorporating trap sites that monitored populations of the aphid species that vector PVY in Minnesota, North Dakota, Manitoba, South Dakota, and Nebraska. The project involved grower hosts, provincial and state personnel from the Depts of Agriculture in each state and university personnel from the University of Minnesota. Each trap site hosted 2 pan traps that held a yellow-green tile and a 3m tall suction trap powered by a 12V deep cell marine battery. These traps were changed weekly by an employee of the University of Minnesota or the cooperating state/province. Employees would make the rounds each week, collecting the trap samples, replacing trap pans, jars and batteries. The trap material and batteries would be returned to the MN Dept. of



Aphid Alert trap sites run from 1992-2003. Not all sites were run in each year.

Traps and reports used in Aphid Alert 1992-2003.

Agriculture's Seed Potato Certification lab in East Grand Forks, MN. Batteries would be recharged for re-use and UMN graduate students would sort and identify the aphids and prepare a weekly report on trap catch at each location.

The system was the basis for the research that led to many aphid management advances including: the use of border crops, the effect of fungicides on aphids, refining the use of refined oils, the role of aphid behavior on PVY epidemiology, transmission efficiencies of certain aphid species, and identification of PVY strains then present in MN.

Eventually, however, the system became unsustainable for a number of reasons. PVY is a difficult problem to solve and while trap data can support management decisions, impacts can still occur. In addition, the information was distributed as a printed newsletter sent out via mail, making the information less timely. The bulk of the work, including servicing the traps, also fell to graduate students whose tenure with the university is limited, leading to turnover in staff. And because the identification of the winged aphids required specialized training and knowledge, transferring the project to a different entity was problematic.

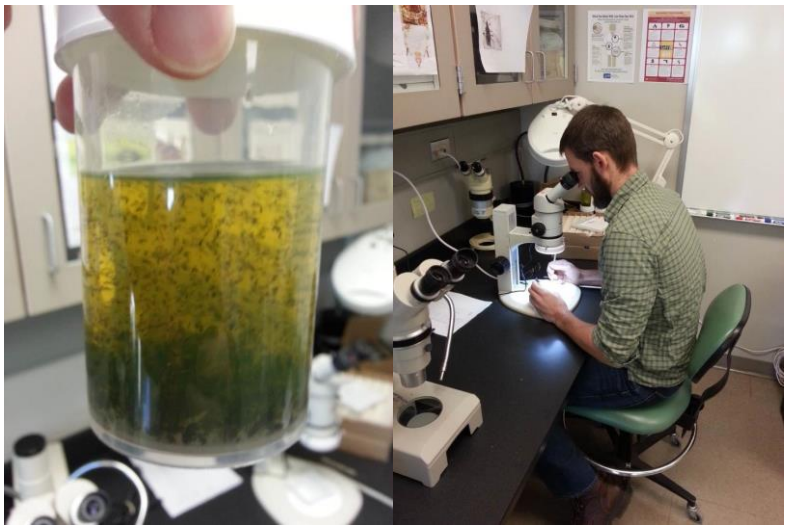
Solar powered suction trap in use 2012-present.

Aphid Alert 2011-2017

In 2011, MN and ND seed potato growers indicated they were interested in re-establishing the ***Aphid Alert Network***, but the system would have to be more sustainable over the long term. After discussion with seed potato growers and the Seed Certification directors of both states, it was decided to develop a collaborative system that would be maintained and serviced by volunteer grower-cooperators, with identifications and information distribution coming from the University. The ready support of grower-cooperators was a major factor in improving the sustainability of the system and there is a growing waiting list of volunteers wanting to host a trap site in the network.

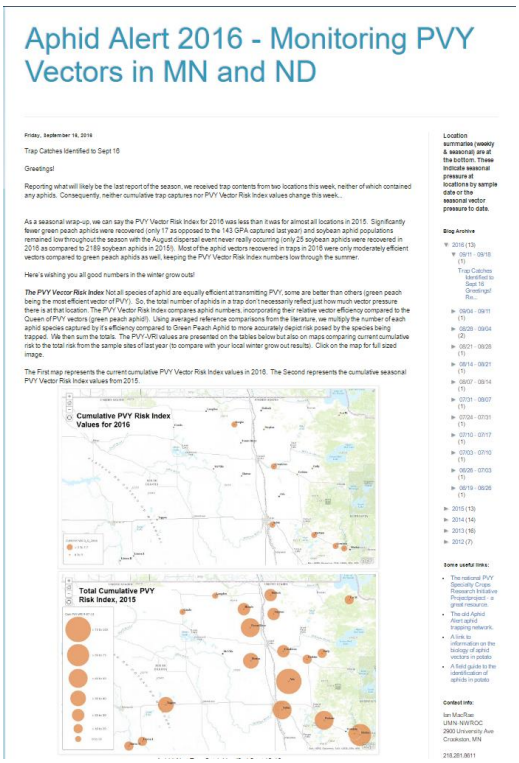
Traps themselves were also made more sustainable. Solar panels were incorporated meaning batteries wouldn't require weekly replacement and weekly charging. The grower-cooperators change the trap jars weekly and use pre-paid, pre-addressed mailers to send the trap contents to the Entomology lab at the UMN Northwest Research & Outreach Center, where the aphids are sorted out and identified by lab personnel. We focus identification on the 15 most important PVY vector species in the NC States, but report other vector and non-vector species as well. Pan

traps have not yet been used as there was no way to conveniently send the contents of such traps back to the lab. However, modified pan traps have been developed that can easily be emptied into jars and mailed with the suction trap contents. These traps will be included in the growing season of 2017.



Trap contents prior to sorting (left) and UMN Entomology technician identifying aphids.

The details of regional aphid population distribution and density is distributed electronically via email, ListServe, websites (aphidalert.blogspot.com and aphidalert.umn.edu), Twitter (@MNSpudBug), and the Northern Plains Potato Growers Assoc. electronic newsletter (**Potato Bytes**), Updates to the electronic sites occur as samples are identified and past issues are archived and available. The hard copy versions were nice to have as reading, but digital delivery means the previous week's aphid population information is available to growers within 3-4 days of the trap being emptied (as opposed to 2 weeks with printed newsletters).



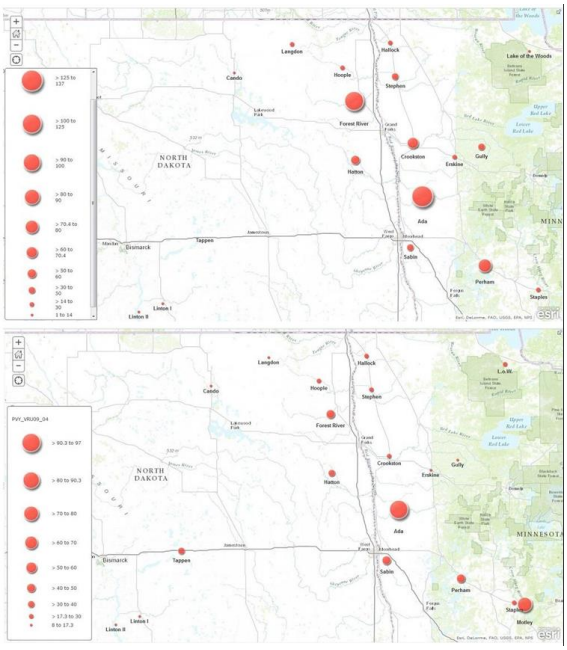
Aphid Alert 2016 - Monitoring PVY Vectors in MN and ND

Aphid Alert blog post, including maps of aphid pressure.

Our digital reports include both the number of aphids that are PVY vectors at each trap location for that week and the running total of the season's catch at each trap location. But not all species of aphid are equally efficient at transmitting PVY, some are better than others (Green Peach Aphid is the most efficient vector of PVY). So, the total number of aphids in a trap doesn't necessarily reflect just the potential for PVY transmission at that site.

We developed the *PVY Vector Risk Index* which compares the numbers of each aphid species, incorporating their relative transmission efficiency (i.e. how well an aphid species can transmit the virus). There's been considerable research published comparing transmission efficiencies, mostly comparing to Green Peach Aphid. We averaged the comparisons (e.g. most publications

show Soybean aphid is about 10% as efficient as Green Peach Aphid in transmitting PVY while Pea Aphid is considered to be about 20% as efficient). By multiplying the number of various species by their proportional efficiency, we estimate the risk of PVY transmission as if all aphids were Green Peach. We then total across all vector species at a site to get the total PVY Vector Risk Index value for that location. For example, if a trap captures 1 Green Peach Aphid, 10 Soybean Aphids (only 10% as efficient) and 3 Pea Aphids (only 20% as efficient, the total PVY Vector Risk Index value for that trap at that date would be 1+(10 x 0.1) + (3 x 0.2) = 2.6.



Cumulative PVY Vector Risk Index maps for 2015 (top) and 2014 (bottom).

The Index values are used to create maps in ESRI ArcGIS Online. Symbols representing the magnitude of the cumulative PVY Vector Risk Index values at each site are used to create a quick and easy to understand visual reference of current and previous years' transmission risk. This allows growers to estimate this year's risk of PVY transmission given the previous year's aphid numbers and the resulting winter rejection rates.

Conclusions

The ***Aphid Alert Network*** continues to be a successful collaboration between University researchers and the seed potato producers of Minnesota and North Dakota. The system's sustainability has been increased through the participation of grower cooperators who monitor the traps, by adapting traps so they require less maintenance, distributing information in a timely manner via digital communications and supplying data that is meaningful and accurately reflects the potential risk of PVY transmission.