PROGRESS REPORT

Understanding Factors Interfering with Successful Suppression of Potato Virus Y – Year 2

Name and Address of Applicant:

Principal Investigator: Andrei Alyokhin
School of Biology and Ecology
5722 Deering Hall
University of Maine
Orono, ME 04469

Co-Principal Investigators: Aaron Buzza
Aroostook Research Farm
University of Maine
Presque Isle, ME 04769

Executive Summary:

We continued our investigations of factors encouraging potato virus Y (PVY) epidemics in Maine. PVY is capable of infecting approximately 120 plant species in five different taxonomic families. It is also transmitted by a wide variety of aphids, including both colonizing species living on potato plants and transient species passing through potato fields in search of hosts.

Our studies did not find any evidence for interference between commonly used fungicides and aphicides. Tank mixes of Fulfill® with crop oil resulted in higher aphid populations following the first application. However, PVY incidence on the plots treated with the tank mix was the lowest compared to other treatments.

Considerable number of dandelions tested positive for PVY. However, infection was virtually absent early in the season, suggesting that dandelion is not an important overwintering host. Furthermore, PVY built up throughout the summer was much more pronounced in the areas adjacent to potato fields compared to an ornamental lawn.

Background

Potato virus Y (PVY) is transmitted by at least 50 different aphid species. In relation to potato plants, aphids can be divided into colonizing and non-colonizing species. Potato aphid (*Macrosiphum euphorbiae* (Thomas)), buckthorn aphid (*Aphis nasturtii* Kaltenbach), and green peach aphid (*Myzus persicae* (Sulzer)) commonly colonize potato plants (*Solanum tuberosum* L.) in Northeastern U.S. and Canada. Other North American aphids do not colonize potato plants because they are unsuitable hosts for their development. However, rejection of non-host plants does not take place until aphids probe them with their mouthparts. As a result, dispersing winged adults of non-colonizing species commonly land on potato plants, insert their stylets into plant tissue, and then leave in search of a more appropriate host. Direct damage caused by probing is negligible. However, probing may result in the transmission of certain viruses to healthy plants.

PVY transmission is non-persistent, i.e., the mouthparts of the aphid may get contaminated with viral inoculum in the brief process of probing the epidermal tissues of infected plants. There is no latent period between acquisition and inoculation, and the entire transmission process may take only a few seconds. However, infectivity is lost after several probes.

Although non-colonizing aphid species are often held responsible for most PVY transmission, colonizing aphids also contribute to spreading this disease. Therefore, their control is essential for an overall success of the virus management program. Growers increasingly rely on relatively new foliar aphicides, including Fulfill® and Movento®) for aphid control. These chemicals have a number of serious advantages, including a relatively low toxicity to aphid natural enemies.

Unfortunately, there is a possibility that translaminar and/or systemic activity of Fulfill® and Movento® may be compromised by spreader-stickers contained in common fungicide formulations (e.g., Bravo®) and by oil films on treated leaves. Concurrent application of these compounds may interfere with insecticide penetration into potato tissue.

Our studies conducted during the 2013 growing season indicated possible interference between Fulfill® and crop oil, and Movento® and Revus Top®. Also, percent harvested tubers infected with PVY were significantly higher on plots treated with Bravo® compared to the untreated control plots. To the contrary, plots treated with Fulfill® and Bravo® had significantly lower infection with PVY. In 2014, we conducted additional testing of these combinations to determine whether the observed differences could be attributed to treatment effects.

Another problem is that PVY is capable of infecting approximately 120 plant species in five different taxonomic families. This includes many common weed species found within and near potato fields. Understanding where reservoir hosts are located, and when most disease transmission takes place, will potentially open an opportunity for their suppression by chemical and mechanical means.

Accomplishments:

Objective 1. *Confirm compatibility of relatively new foliar aphicides Fulfill® and Movento® with commonly used fungicides and crop oils.*

Experiment 1. Experiment was conducted on 30-feet long and 4 row wide plots set up on Aroostook Research Farm. Plots were planted with certified seed potatoes and arranged in a randomized complete block design (five plots per treatment). To prevent virus transmission between the plots, they were separated from each other by strips of small grain (ten-foot wide between the blocks, and six-foot wide between the plots within each block). The plots were sprayed with spinosad as needed to prevent potato defoliation by the Colorado potato beetles.

Before furrow closure, one certified seed piece in each row of each plot was manually replaced with seed pieces deliberately infected with PVY. Infected pieces were marked at planting, so that the tubers produced by infected plants would not be sampled at harvest. Unmarked plants developing from accidentally infected seed pieces and showing PVY symptoms after emergence from the soil were rogued out.

Twenty potato plants were randomly selected from the middle two rows of each plot at weekly intervals and visually examined for the presence of potato-colonizing aphids. Winged and wingless aphids were recorded separately.

Chemicals were applied at high label rates. Insecticides were applied when aphid densities reached threshold levels recommended by the UMaine Cooperative Extension. Fungicides were applied following the schedule recommended by the UMaine Cooperative Extension for late blight control.

We did not find any evidence of fungicides interfering with insecticidal activity of the tested compounds (Table 1). Revus Top did not appear to have any insecticidal activity.

(Table 1)

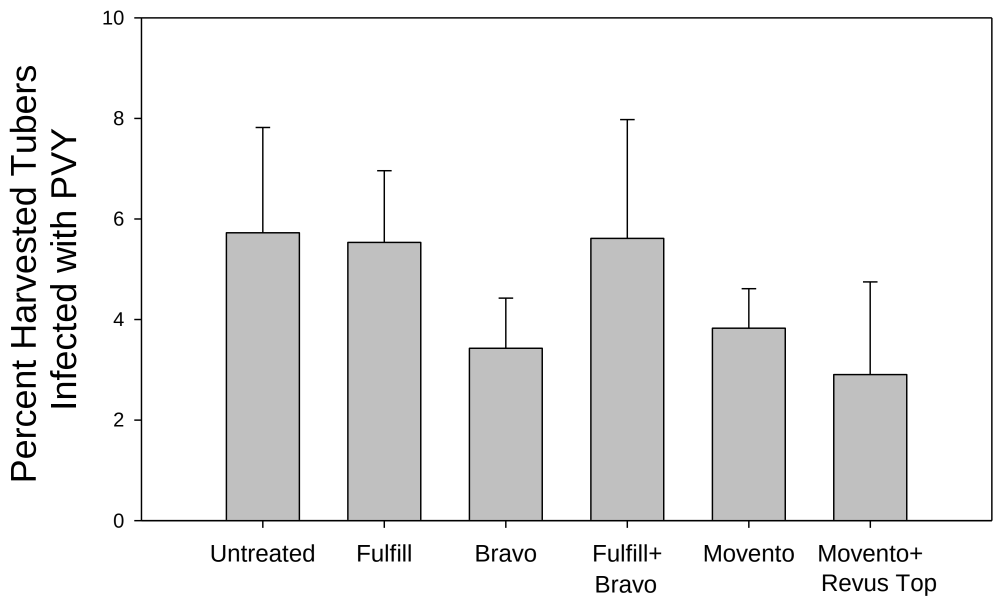
	Material	Rate/acre		Application Date	22-Jul		29-Jul		4-Aug		11-Aug		13-Aug		18-Aug	
1	Untreated Check	----	----	-----	3.4	a	9.7	ab	2.8	ab	0.0	a	0.2	a	0.4	a
2	Fulfill	5.5	oz	23 Jul, 5 Aug	6.8	a	10.5	a	2.1	ab	0.2	a	0.6	a	0.2	a
3	Bravo Weather Stick	16.0	fl oz	23 Jul, 5 Aug	6.9	a	12.5	a	4.5	a	0.0	a	0.4	a	0.0	a
4	Fulfill	5.5	oz	23 Jul, 5 Aug												
	Bravo Weather Stick	16.0	fl oz	23 Jul, 5 Aug	6.1	a	9.6	ab	6.3	a	0.0	a	0.2	a	0.4	a
5	Movento	5.0	fl oz	23 Jul, 5 Aug												
	LI 700	0.25	% v/v	23 Jul, 5 Aug	7.7	a	2.9	c	1.2	ab	0.2	a	0.0	a	0.0	a
6	Movento	5.0	fl oz	23 Jul, 5 Aug												
	LI 700	0.25	% v/v	23 Jul, 5 Aug												
	Revus Top	7.0	fl oz	23 Jul, 5 Aug	8.1	a	3.4	bc	0.2	b	0.2	a	0.0	a	0.4	a

Means in a column followed by the same letter are not significantly different (LSD, P>0.05).

To evaluate virus transmission, a subsample of 52 tubers (13 tubers selected at random from each row of each plot) was harvested and stored at 4°C. In December 2014 – January 2015, the tubers were treated with ethylene to encourage sprouting and then checked with ELISA for the presence of PVY.

There were no statistically significant differences in PVY infection rates among the treatments based on the results of logistic regression (Fig. 1). Furthermore, altogether the treatments accounted only for about 5% of the observed variation in tuber infection.

(Figure 1)



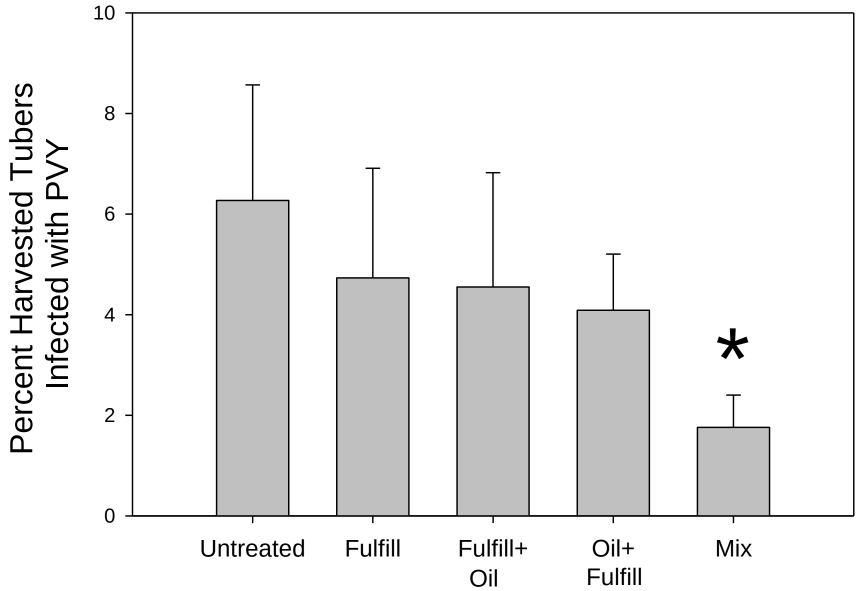
Experiment 2. Experiment followed the same design as described above. The following treatments were tested: untreated control, Fulfill®, Fulfill® + weekly applications of JMS stylet oil applied 24 hours after oil, Fulfill® + weekly applications of JMS stylet oil applied 24 hours before oil, and Fulfill® + weekly applications of JMS stylet oil applied as a tank mix.

There was apparent interference when oil and Fulfill were mixed together in a tank (Table 2). Applying oil before or after the insecticide did not have such an effect.

(Table 2)

	Material	Rate/acre	Application date	22-Jul	28-Jul	5-Aug	12-Aug	18-Aug
1	Untreated Check	--- ----	-----	11.7 a	12.2 ab	2.7 a	0.2 a	0 a
2	Fulfill	5.5 oz	23 Jul, 5 Aug					
	LI 700	0.25 % v/v	23 Jul, 5 Aug	7.4 a	10.7 ab	1.1 a	0 a	0.2 a
3	Fulfill	5.5 oz	22 Jul , 5 Aug					
	LI 700	0.25 % v/v	22 Jul , 5 Aug					
	JMS Sty. Oil 24hr after Fulfill	0.75 % v/v	8, 15, 23, 30 Jul, 6, 14, 21, 26, 3 Sep	11.2 a	5.1 b	1.6 a	0.8 a	0 a
4	JMS Sty.Oil 24hr before Fulfill	0.75 % v/v	8, 15, 22, 30 Jul, 5, 14, 21, 26, 3 Sep					
	Fulfill	5.5 oz	23 Jul, 6 Aug	8.7 a	6.8 b	1.9 a	0 a	0.4 a
5	Fulfill	5.5 oz	23 Jul, 5 Aug					
	JMS Sty. Oil tank mixed	0.75 % v/v	8, 15, 23, 30 Jul, 5, 14, 21, 26, 3 Sep	9.3 a	24.4 a	0.6 a	0.2 a	0 a

However, tank mix provided the best control of PVY spread (Fig. 2).



<u>Objective 2.</u> *Develop a better understanding of the role played by non-crop vegetation in potato virus Y (PVY) epidemics on potato fields*

Experiment 1. Dandelion (*Taraxacum officinale*) leaves were collected from three locations: edge of a commercial field, edge of a research field with a known PVY infection rate, and a regularly mowed lawn. Collected samples were be analyzed for PVY using ELISA.

PVY incidence early in the season was low at all three sites. Later on, percent infected plants increased at two sites adjacent to potato fields, but not on the lawn (Fig. 3).

(Figure 3)