EVALUATION OF POTATO INSECT PEST MANAGEMENT PROGRAMS

Stuart R. Reitz and Josh Noble, Malheur County Extension, Oregon State University, Ontario, OR, 2016

Clinton C. Shock, Erik B. G. Feibert, Joey Ishida, and Lamont Saunders, Malheur Experiment Station, Oregon State University, Ontario, OR

Introduction

A number of insect pests reduce yield and quality of potatoes throughout the Pacific Northwest (PNW), although their distribution and intensity of infestations vary by location and year. Unfortunately, the number of insect pests has been increasing in recent years. In the early 1990s, the major insect pests of potatoes in the PNW were limited to wireworms, Colorado potato beetles, aphids, and two-spotted spider mites. Other species that have emerged as pests more recently (since the mid-1990s) include thrips, cutworms, loopers and armyworms, potato tuberworm (2004), beet leafhopper (2005), potato psyllid (2011), stink bug (2013), and potentially *Lygus* bug. This increase in pest species coupled with rapid changes in registered insecticides have severely complicated management of potato insects in the PNW.

Most importantly, the potato psyllid has emerged as a serious threat to PNW potato production because of its ability to vector the bacterium that causes zebra chip disease. The pest and disease have fundamentally changed insect management strategies and effectively ended traditional integrated pest management programs. Although the urgency regarding potato psyllid and zebra chip have receded slightly, they remain the cornerstone for pest management in potatoes because processors have virtually zero tolerance for zebra chip defects. Detection of potato psyllids at any level can trigger a season-long insecticide treatment program, especially for long-season potato cultivars. Consequently, many growers at risk of potato psyllid are designing their insect management programs around this one pest and fitting management of other insect pests around psyllid management strategies.

Given this situation, there is a critical need to develop and refine psyllid management within the context of overall insect pest management programs to ensure that potato production in the PNW remains viable and economically sustainable. Most insecticides with psyllid efficacy also are effective, and are currently used against other pests, including aphids, thrips, and Colorado potato beetles. Therefore, it is critical to determine what insecticides would be most suitable for psyllid management and would be suitable for other pests. This information will enable growers to make better informed choices regarding their insecticide selections and will help develop appropriate insecticide resistance management programs for potatoes in the PNW.

Laboratory trials have demonstrated the ability of certain insecticides to control psyllids, yet robust management recommendations based on field-level research remain lacking, primarily because little research exists on the most appropriate experimental design and layout to test for the efficacy of insecticides against the potato psyllid in open-field situations. A review of the literature shows that research plots comparable to the sizes we have used in our previous trials may be suitable for detecting treatment differences in egg and nymph stages of the psyllid but larger plots will provide results that will be more statistically reliable and powerful for detecting treatment differences. Few studies other than our previous trials have attempted to test for treatment differences against adult psyllids. It is nevertheless critical to understand how different insecticides affect all of the life stages of the psyllid.

We addressed these knowledge gaps in understanding insecticide efficacy and experimental design by conducting an insecticide efficacy trial at the Malheur Experiment Station. This trial was part of a regional trial conducted at three other locations across the PNW.

Hypothesis and Objectives

1) Generate efficacy data on products/programs for control of potato psyllids.

2) Examine the effects of insecticides that target potato psyllid on chemical control strategies for other insect pests.

3) Determine if potato psyllid control induces outbreaks of other insect pests.

4) Determine the effect of potato psyllid control on natural predators.

Materials and Methods

The Ontario, Oregon trial evaluated 11 registered insecticide treatments for their effect on psyllid populations, and on other insect pests and beneficial insects (Table 1). ‘Ranger Russet’ potatoes were planted in two rows per bed on April 20. The flat-topped beds were on 72-inch centers. Rows of potatoes within the bed were 36 inches apart. Seed was planted at a 6-inch depth. Plants were irrigated by drip irrigation. A drip line was placed approximately 6 inches from each row of potatoes and shanked in the soil to about a 3-inch depth. Soil moisture was monitored with Watermark soil moisture sensors (model 200SS, Irrometer Co., Inc., Riverside, CA) and irrigation was initiated when the soil water tension (SWT) reached 30 cb. Other cultural practices followed those typical for Malheur County.

Foliar applications were initiated after adult psyllids were detected on yellow sticky cards placed in the field. Applications were made on a 2-week interval basis. Application dates were June 27, July 14, July 28, and August 11. Insecticides were applied with a CO_2-powered backpack sprayer, delivering 20 gal/acre. The application of Admire® was made at planting and no other insecticides were applied in this treatment’s plots. Plots were 25 ft long and 12 ft wide, with a 5-ft buffer between the ends of adjoining plots. Border plots, which were the same size as the experimental plots, surrounded the research field on all sides.

Insects were sampled weekly by two methods. Adult insects were sampled by taking vacuum samples: an inverted leaf blower was slowly run through the canopy of plants in outer rows of each plot for 2 min. Psyllid nymphs and eggs were sampled by collecting 10 potato leaves from the mid-canopy of plants in the interior two rows of each plot. Leaf samples were also used to assess thrips and spider mites populations. Vacuum and leaf samples were analyzed under dissecting microscopes to identify and count specimens. One hundred tubers per plot were examined for visual symptoms of zebra chip. Suspect tubers and plants were tested by molecular diagnostics to determine the presence of Lso (the pathogen that causes zebra chip). Count data were analyzed by ANOVA. Seasonal means are presented.

Results

Adult psyllids were detected from the second half of June through the end of the season. There were no significant differences in adult psyllids numbers among treatments any of the samples dates or over the entire season ($P > 0.05$, Fig. 1).

There were significant differences among the insecticide treatments for psyllid eggs detected in leaf samples (Fig. 1). The Movento®, Beleaf®, and Brigade® treatments had the lowest numbers of psyllid eggs. Exirel had higher numbers of eggs but the mean for Exirel® was still significantly lower than the untreated control. None of the other treatments had significant effects on the number of psyllid eggs compared to the untreated control. Movento and Brigade appeared to have the longest residual activity. When analyzing data for samples collected 2 weeks after insecticide applications, we found that means for these two treatments were significantly lower than for the untreated control.

There were also significant differences among the insecticide treatments for psyllid nymphs detected in leaf samples (Fig. 1). The seasonal means for Movento, Brigade, Beleaf, and Exirel were significantly lower than the mean for the untreated control. None of the other insecticides had significantly affected nymph counts. Movento was the only treatment that appeared to have 2-week residual activity. It was the only treatment found to be significantly lower than the untreated control when samples collected 2 weeks after insecticide treatments were analyzed for nymphs.

Few aphids were collected in either vacuum or leaf samples. Consequently, no significant differences in aphid numbers were observed among treatments.

There were no treatment effects on the numbers of adult beet leafhoppers collected in vacuum samples over the season ($P > 0.05$, Fig. 2). This lack of a difference may reflect the highly mobile nature of these insects. Four plants infected with beet leafhopper transmitted virescence agent (BLTVA), which causes purple top disease, were identified in the field. This is the first known detection of BLTVA in Malheur County.

There were no significant differences among the treatments over the course of the season for adult Lygus bugs ($P > 0.05$, Fig. 3). However, there were some short-term treatment differences based on samples collected 1 week after insecticide treatments ($P < 0.05$). For these samples, the means for Movento, Beleaf, and Brigade, adult Lygus bugs were significantly lower than for the untreated control. These differences were not apparent for samples collected 2 weeks after insecticide applications.

Although the pyrethroid Brigade reduced immature psyllid populations, it resulted in significantly higher populations of other pests. Populations of thrips (predominantly western flower thrips) were more than double in the Brigade treatment compared to any other treatment, including the untreated control (Fig. 4). Thrips populations were lowest in the Blackhawk®, Exirel, Transform®, and Radiant® treatments.

The insecticide treatments had varied effects on populations of natural predators. Ladybird beetle populations were significantly lower in the Brigade, Beleaf, Exirel, and Movento treatments than in the untreated control (Fig. 5). There were no differences among the other treatments and the untreated control for Ladybird beetle. Big-eyed bugs were the most abundant natural enemy collected during the season. However, there were no differences in big-eyed bug, lacewing, or minute pirate bug populations among the insecticide treatments.

No tubers were found to be infected with Lso.

Accomplishments and Conclusions

1. *Generate efficacy data on products and application method for control of potato psyllids and other important potato pests.*

   Our regional trial demonstrated how pest and beneficial insect populations vary across the PNW potato production regions.

   Determining insecticide efficacy against psyllids has proven challenging. This has been especially true for adult psyllids because of their mobility and relatively low densities in the environment.

   Immature psyllids also tend to occur in low numbers in potatoes fields. Our results indicate that Movento was the most effective product tested in our trials. Exirel and Beleaf also showed some effect against immature psyllids in this year’s trial.

2. *Determine if insecticides targeting potato psyllids or other pests foment secondary pest outbreaks.*

   This year’s trials demonstrated again the disruption that synthetic pyrethroids can cause in potato pest management. In some of our trials, there were outbreaks of some pests (e.g., aphids and thrips) in response to pyrethroid applications.

3. *Determine the effect of insecticides for potato psyllid control on the natural enemy complex in potato.*

   Natural enemies are often abundant in potato fields and likely contribute to the suppression of pest populations. In our trials, populations of natural enemies were often reduced after pyrethroid applications.

4. *Deliver results and recommendations to growers and the general potato industry in a timely manner.*

   We have presented our results at grower conferences (e.g., WA-OR Potato Conference and the Idaho Potato Conference) in addition to local meetings and one-on-one discussions with growers and crop advisors. We will incorporate this year’s results in a revised PNW Potato Pest Management guide.

Table 1. Insecticides used in the efficacy trial against potato psyllids and other potato pests, Malheur Experiment Station, Oregon State University, Ontario, OR, 2016.

Treatment	active ingredient	IRAC[a] group	Rate/acre	Adjuvant
Untreated check			-	
Movento (+Agri-Mek SC at 1st Application)	spirotetramat	23	5 fl oz	MSO 0.5% v:v
	abamectin	6	6 fl oz	
Agri-Mek SC	abamectin	6	6 fl oz	MSO 0.5% v:v
Transform	sulfoxaflor	4C	2.25 oz	
Aza-Direct	azadirachtin	Unknown	1.5 pt	-
Beleaf	flonicamid	9C	2.8 oz	-
Brigade	bifenthrin	3	6.4 fl oz	Preference 0.25% v/v
Exirel	cyantraniliprole	28	13.5 fl oz	MSO 0.5% v:v
Blackhawk	spinosad	5	3.5 oz	Dyne-amic 0.7 pt
Radiant	spinetoram	5	6 fl oz	Dyne-amic 0.7 pt
Admire Pro (at plant treatment)	imidacloprid	4A	8.7 fl oz	

[a] Insecticide Resistance Action Committee mode of action classification.

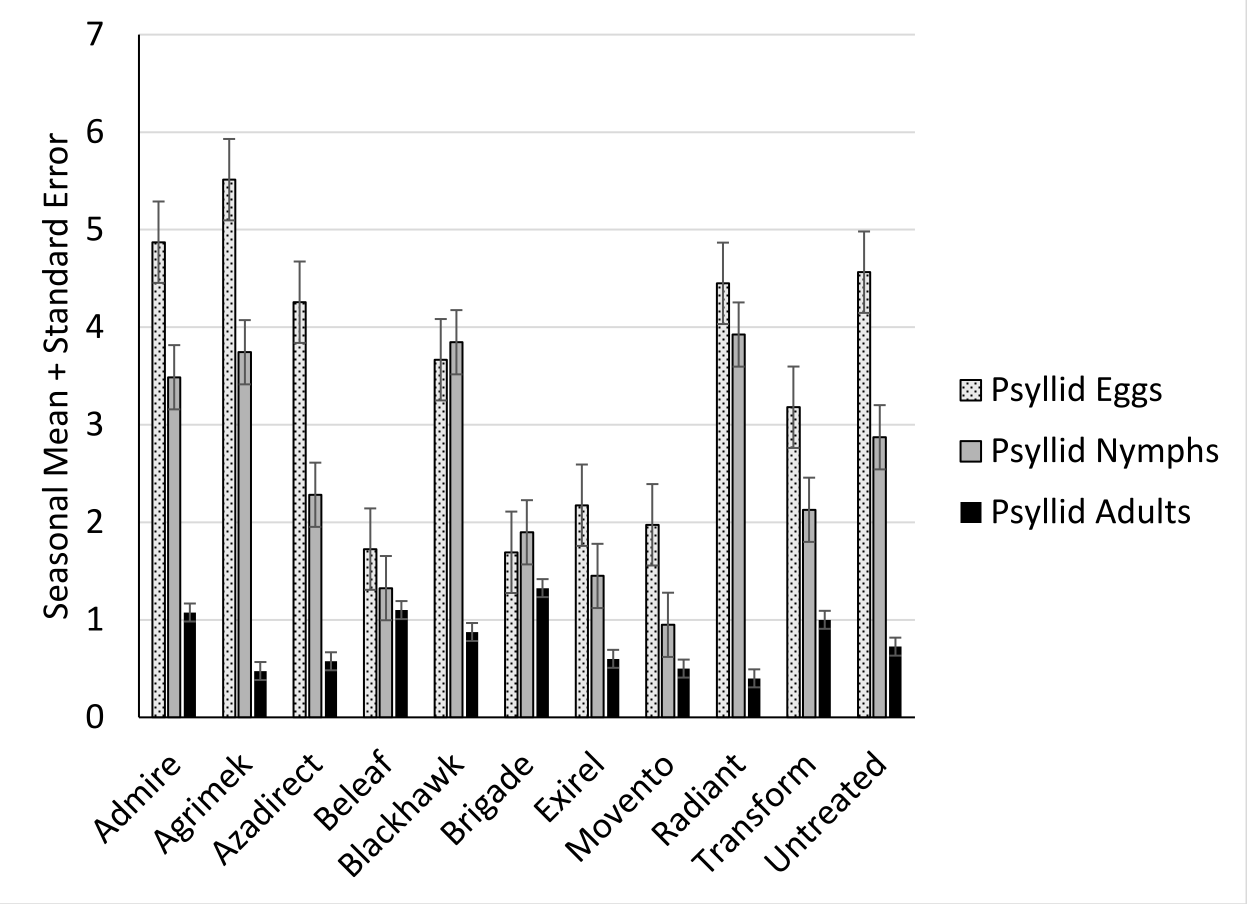

Figure 1. Seasonal means per treatment for potato psyllid eggs, nymphs, and adults in the Ontario, OR trial. Egg and nymph counts are based on leaf collections. Adult counts are based on vacuum samples. 2016.

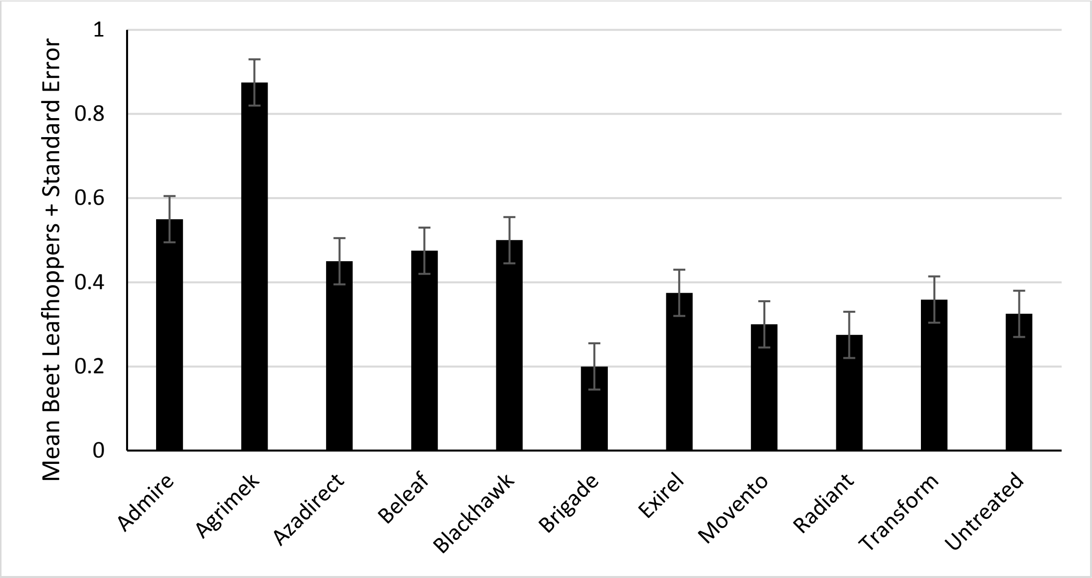

Figure 2. Seasonal means per treatment in potato for adult beet leafhoppers in the Ontario, OR trial. Counts are based on vacuum samples. 2016.

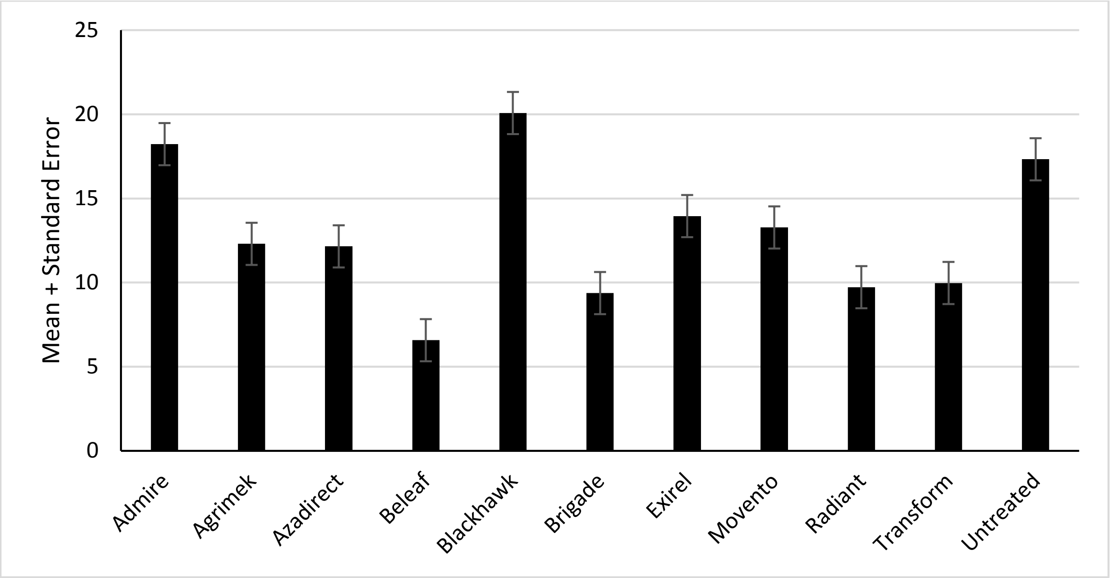

Figure 3. Seasonal means per treatment in potato for Lygus bugs in the Ontario, OR trial. Counts are based on vacuum samples. 2016.

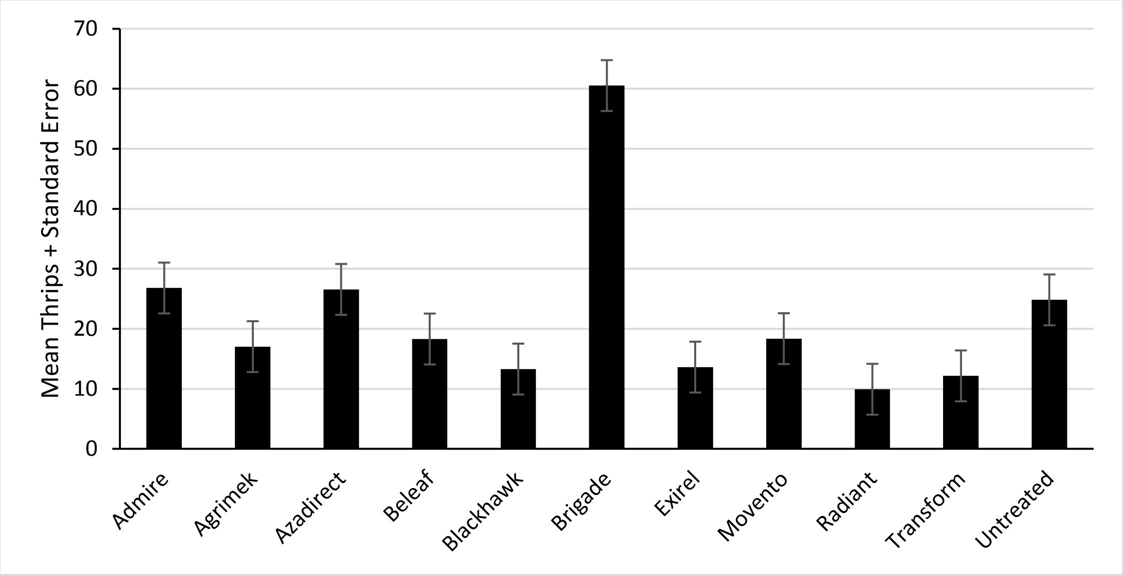

Figure 4. Seasonal means for thrips in potato in the Ontario, OR trial. Counts are based on leaf samples. 2016.

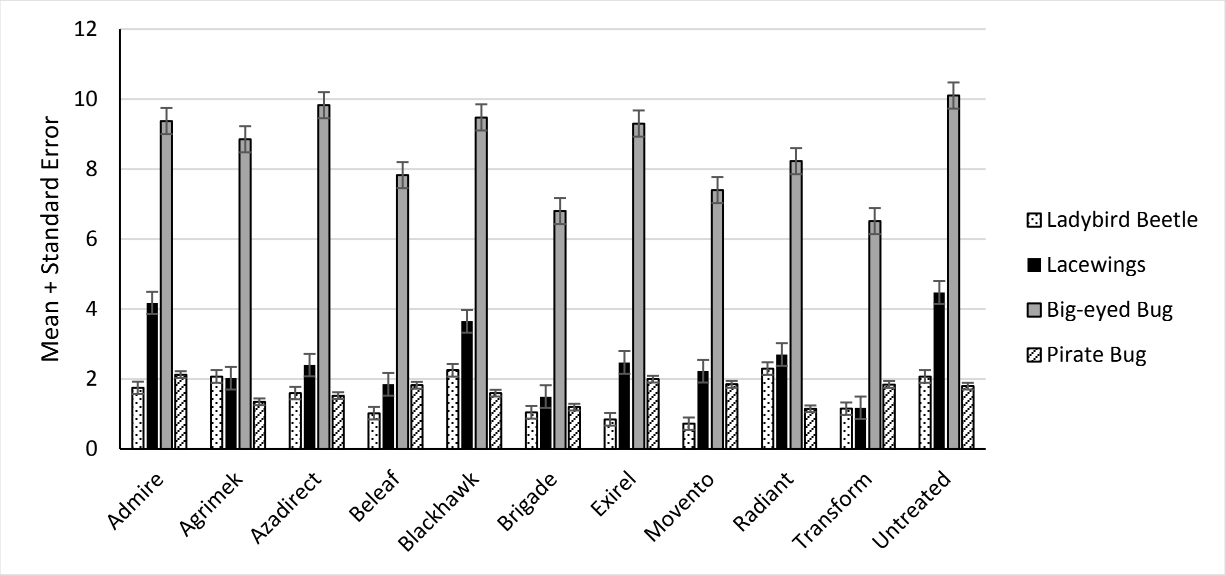

Figure 5. Seasonal means for natural enemies in the Ontario, OR trial. Counts are based on vacuum samples. 2016.