INSECTICIDE EFFECTS ON PEST AND BENEFICIAL ARTHROPODS IN POTATO

Stuart Reitz, Ian Trenkel, Kyle D. Wieland, Erik B. G. Feibert, and Alicia Rivera, Malheur Experiment Station, Oregon State University, Ontario, OR

Introduction

A wide range of arthropod pests reduce yield and quality of potatoes throughout the Pacific Northwest (PNW). However, their distribution, intensity of infestations, and damage vary by location and year. Certain species are primary pests because of the potential for extensive damage each year. The potato psyllid, which transmits the zebra chip pathogen, has been one of the most important primary pests in recent years. The potato aphid and green peach aphid remain primary pests because of their ability to transmit viruses, such as PVY. The Colorado potato beetle is a primary pest in the Columbia Basin and eastern Idaho, but it is infrequently encountered in Malheur County.

Other species are considered secondary pests because outbreaks may not occur every season. When outbreaks do occur, they often follow insecticide applications targeting other primary pests. Two-spotted spider mites and thrips can be considered secondary pests of potato in the PNW. Populations of these secondary pests often are held in check by a complex of predatory insects.

Other species have recently emerged as concerns. Lygus bugs have been receiving greater attention as a pest in the PNW because of their direct feeding damage. Increasing Lygus populations have been correlated with reduced sugars and specific gravity in tubers of ‘Umatilla’ potato. Beet leafhopper is known to transmit beet curly top virus and more recently has been identified as the vector of BLTVA (beet leafhopper transmitted virescence agent), which causes purple top disease, which has been found sporadically in the Treasure Valley.

Given the range of pests that affect potato and the wide range of natural enemies that help suppress pest species, it is important to evaluate the effect that different insecticides have on various species.

Procedures

Insecticide Efficacy Trial

Potato plots (‘Ranger Russet’) were planted in a randomized complete block design on April 19, 2019, at the Malheur Experiment Station, Ontario, Oregon. The flat-topped beds were on 72-inch centers. The two rows of potatoes within the bed were spaced 36 inches apart. Seed was planted at a 6-inch depth with 9-inch within-row spacing. 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 a 3-inch depth. Soil moisture was monitored with Watermark sensors, and irrigation was initiated when the soil water tension (SWT) reached 30 cb. Plants began to emerge on May 10, 2019. A tank mix of metribuzin and Matrix® was sprayed on May 13. Sprinklers were used on May 14 to activate the herbicides. Other cultural practices followed standard practices for commercial production in the Treasure Valley.

Each experimental plot was four rows wide (12 ft) and 25 ft long. There was a 5-ft buffer between ends of each plot. There were four replications for each of the 12 treatments for a total of 48 plots (Table 1). Results for one experimental insecticide are not shown. Insecticides were applied with a CO_2 powered backpack sprayer operating at 20 gal/acre and 30 psi.

Sampling

Two sampling procedures were used to monitor pest and beneficial species. The first sampling procedure involved vacuum sampling and targeted relatively large, mobile insects, including adult potato psyllids, adult beet leafhoppers, winged aphids, Lygus, Colorado potato beetle, and beneficial predators (bigeyed bugs, lady beetles, lacewing adults, pirate bugs, spiders). An inverted leaf blower was run along the border rows of each plot for 2 minutes. A mesh screen inside the leaf blower nozzle collected insects. At the end of the sampling interval for each plot, insects were transferred into Ziploc bags and returned to the lab for analysis.

The second sampling method involved collecting 10 potato leaves from the mid-canopy throughout the interior rows of each plot. Leaves were placed in Ziploc bags and returned to the lab for analysis. This sampling method targeted small, soft-bodied arthropods, including spider mites, thrips, whitefly nymphs and eggs, potato psyllid nymphs and eggs, and wingless aphids.

Sampling was conducted weekly once insecticide applications began on July 15. Data were analyzed with the Agricultural Research Management (ARM) software. Graphs of the results show weekly means for each treatment in a stacked format. Therefore, each bar serves as an index of the seasonal performance of each treatment.

Table 1. Insecticides and their adjuvants used in the potato efficacy trial at the Malheur Experiment Station, Oregon State University, Ontario, OR, 2019.

Trt No.	Type[a]	Treatment name	Formulation	Rate (units/acre)	Other Rate (units/acre)	Application date code[b]	pH
1	CHK	Untreated check					
2	INSE	Radiant	SC	8 fl oz	8 fl oz	ABC	7.0
	ADJ	Dyne-Amic	SL	0.7 pt	11.2 fl oz	ABC	
3	INSE	Transform	WG	2.25 fl oz	2.25 fl oz	ABC	7.0
4	INSE	Aza-Direct	SL	2 pt	32 fl oz	ABC	6.0
	INSE	M-Pede	SL	2 % v/v	51.2 fl oz	ABC	
5	INSE	Beleaf	SG	2.8 oz wt	2.8 oz wt	ABC	6.0
	ADJ	NIS	SL	0.25 % v/v	6.4 fl oz	ABC	
6	INSE	Brigade	EC	6.4 fl oz	6.4 fl oz	ABC	6.5
	ADJ	NIS	SL	0.25 % v/v	6.4 fl oz	ABC	
8	INSE	Brigade	EC	6.4 fl oz	6.4 fl oz	ABC	6.5
	INSE	Agri-Mek	SC	3.5 fl oz	3.5 fl oz	ABC	
	ADJ	NIS	SL	0.25 % v/v	6.4 fl oz	ABC	
9	INSE	Agri-Mek	SC	3.5 fl oz	3.5 fl oz	ABC	6.5
	ADJ	NIS	SL	0.25 % v/v	6.4 fl oz	ABC	
10	INSE	Agri-Mek	SC	3.5 fl oz	3.5 fl oz	ABC	6.5
	INSE	Movento HL	SC	2.5 fl oz	3.5 fl oz	ABC	
	ADJ	NIS	SL	0.25 % v/v	6.4 fl oz	ABC	
11	INSE	Movento HL	SC	2.5 fl oz	3.5 fl oz	ABC	6.5
	ADJ	NIS	SL	0.25 % v/v	6.4 fl oz	ABC	
12	INSE	Exirel	SC	20.5 fl oz	3.5 fl oz	ABC	5.0
	ADJ	NIS	SL	0.25 % v/v	6.4 fl oz	ABC	

[a] INSE = insecticide; ADJ = adjuvant; NIS = non-ionic surfactant.
[b] Application dates—A: 2019/07/15, B: 2019/07/30, C: 2019/08/13.

Results

Although large numbers of potato psyllids were found in commercial fields in 2019, there were too few potato psyllids at the experimental site to make meaningful comparisons. Most plots had no psyllids collected throughout the season. The greatest number of psyllids from any plot was six.

Few green peach aphids were collected (an average of <1 per sample). Potato aphid populations remained low until the last two sample dates, when numbers began to increase in plots treated with the tank mix of Brigade® (bifenthrin) + Agri-Mek® (abamectin). On the last sample date, which was 10 days after the third insecticide application, potato aphid populations were at least five times greater in the Brigade + Agri-Mek treatment than in any of the other treatments (Figure 1).

Other aphid species were much more abundant than either of the two major pest species were (Figure 2). As with the potato aphid, numbers were low until after the third insecticide application. On the last sample date, there were significantly more aphids in the Brigade treatment than in other treatments. The tank mix of Brigade + Agri-Mek had fewer aphids than the Brigade treatment, but still significantly more aphids than the other treatments. Agri-Mek by itself did not lead to increased aphid populations, suggesting that Brigade, a synthetic pyrethroid, resulted in the increase in aphid abundance.

Few Lygus were collected during the trial. Numbers were higher at the beginning of the sampling period than later (Figure 3). On the second sample date, which was 10 days after the first application, there were significantly fewer Lygus in the Brigade + Agri-Mek, Brigade, Beleaf® (flonicamid), and Transform® (sulfoxaflor) treatments than in the other treatments. The higher numbers of Lygus in the Agri-Mek and Agri-Mek + Movento® (spirotretramat) treatments suggest that Brigade has greater efficacy against Lygus than does Agri-Mek. Relatively few nymphs were collected through the season, suggesting that potato may not be a significant reproductive host and adults are transient in potato. Fewer than one Lygus nymph was collected on average per plot each week.

Thrips collected from foliage samples were almost exclusively western flower thrips. Adult thrips abundance declined significantly for all insecticide treatments following the first insecticide application on July 10 (Figures 4 and 5). Subsequently, adult and larval thrips numbers remained significantly higher in the Brigade treatment than all other treatments, including the control. Six times as many larval thrips were present in the Brigade treatment as in the untreated control. The other insecticides significantly reduced thrips abundance relative to the control. Radiant® (spinetoram), Transform, and Exirel® (cyantraniliprole) performed well in managing adult and larval thrips. Agri-Mek also showed good activity against thrips, as evidenced by the treatment where Agri-Mek was applied in combination with Brigade (Figures 4 and 5).

Spider mite populations were low until late in the sampling period (Figure 6). The highest number of spider mites occurred in the Transform treatment at 10 days after the second and third applications. Agri-Mek by itself significantly reduced spider mite abundance over the season. Movento also significantly reduced spite mite abundance. Spider mite numbers were also low after the third application of Aza-Direct® (azadirachtin) + M-Pede® (potassium salts of fatty acids), which was probably a result of its minor effect on natural enemies.

Whitefly nymph and egg numbers were lowest in the Brigade + Agri-Mek treatment. The lack of control seen with Agri-Mek itself indicates that the efficacy was due to Brigade. Brigade by itself gave similar results to the tank-mix with Agri-Mek. Beleaf, Movento, and Exirel also gave similar effective results for controlling whiteflies. (Figures 7 and 8).

Insecticides had variable effects on natural enemies. Treatments that included the synthetic pyrethroid Brigade were the most detrimental to predator populations (Figures 9). Aza-Direct + M-Pede and Agri-Mek were the least disruptive to predator populations.

Conclusions

A number of pest species occur throughout the growing season in potato, and each species has its own seasonal dynamics. Populations of potato psyllids and other key pests of concern were too low to evaluate insecticide efficacy this season.

Growers should consider the benefits versus the costs of insecticides when deciding which one to apply. Some products are effective against one pest but disrupt management of other species. Notably, synthetic pyrethroids appear effective against Lygus but tend to lead to increases in aphid and thrips populations.

Acknowledgments

We appreciate the technical assistance of Hannah Rose, Kelsey Alexander, Brooke Bezona, Allison Simmons, and Bo Bourasa.

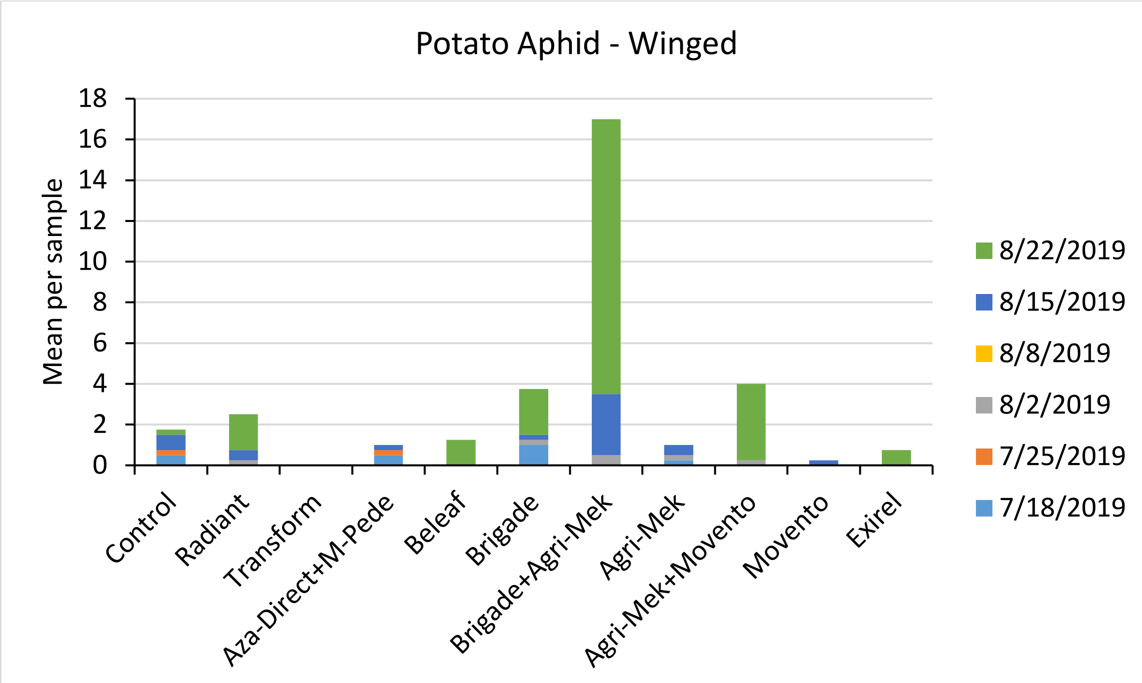

Figure 1. Weekly abundance of potato aphids across treatments. Means for different sample dates are shown by different colors within bars. Treatments were applied on July 15, July 30, and August 13, Malheur Experiment Station, 2019.

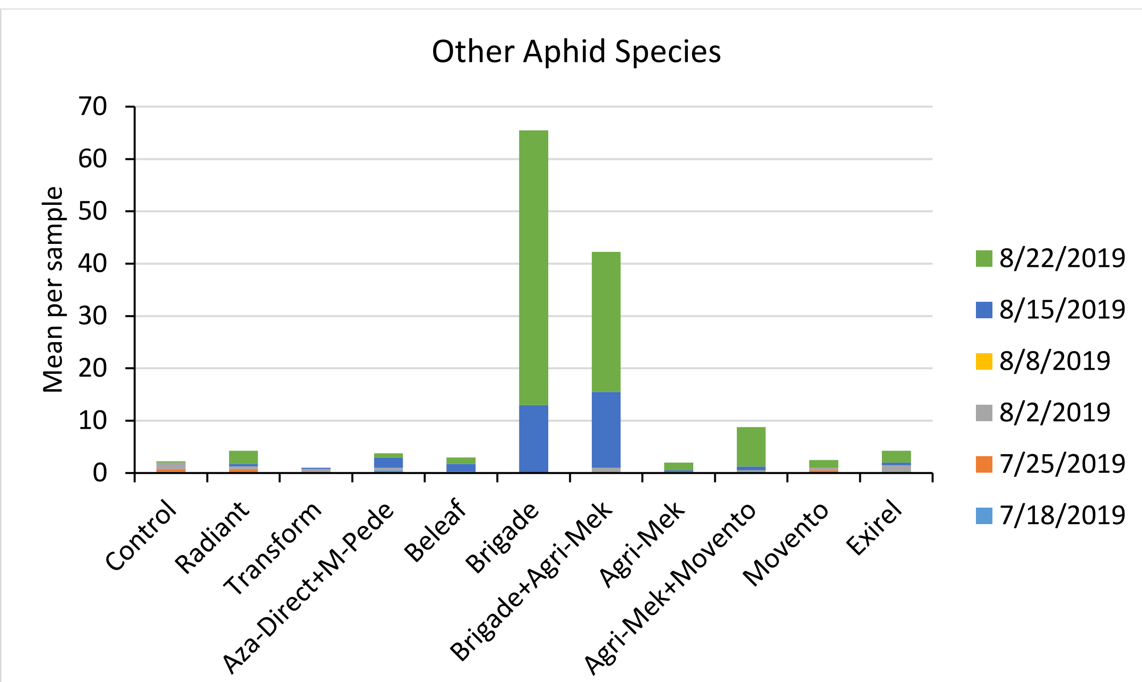

Figure 2. Weekly abundance of all aphid species other than green peach aphid and potato aphid, across treatments. Means for different sample dates are shown by different colors within bars. Treatments were applied on July 15, July 30, and August 13, Malheur Experiment Station, 2019.

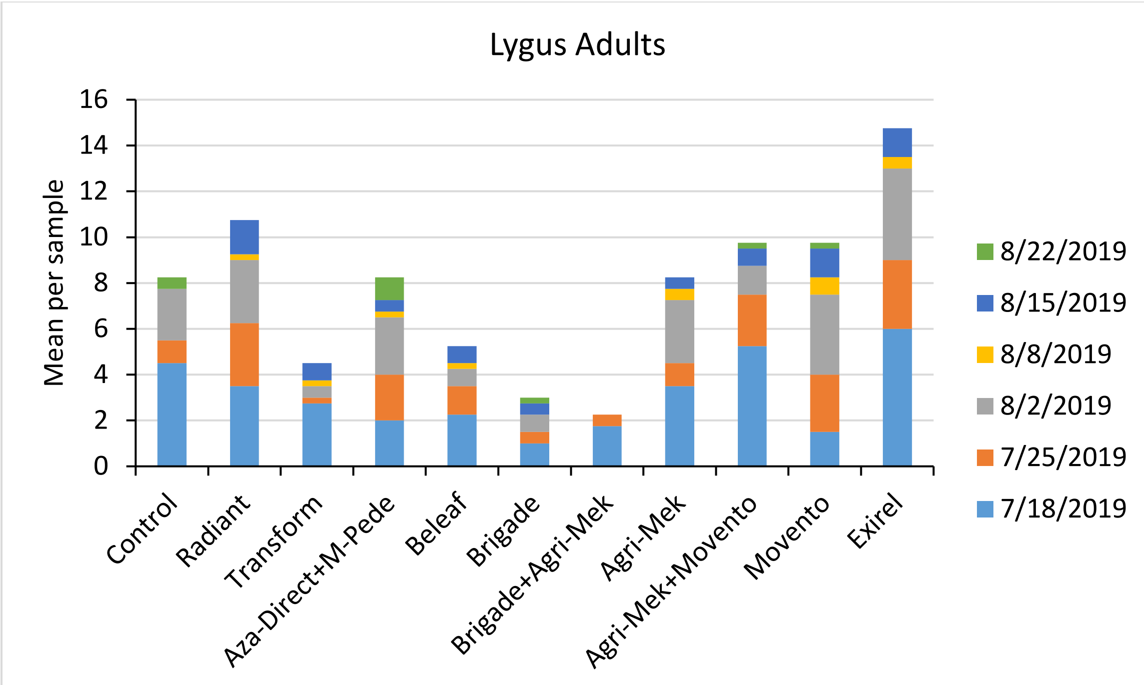

Figure 3. Weekly abundance of adult Lygus bugs across treatments. Means for different sample dates are shown by different colors within bars. Treatments were applied on July 15, July 30, and August 13, Malheur Experiment Station, 2019.

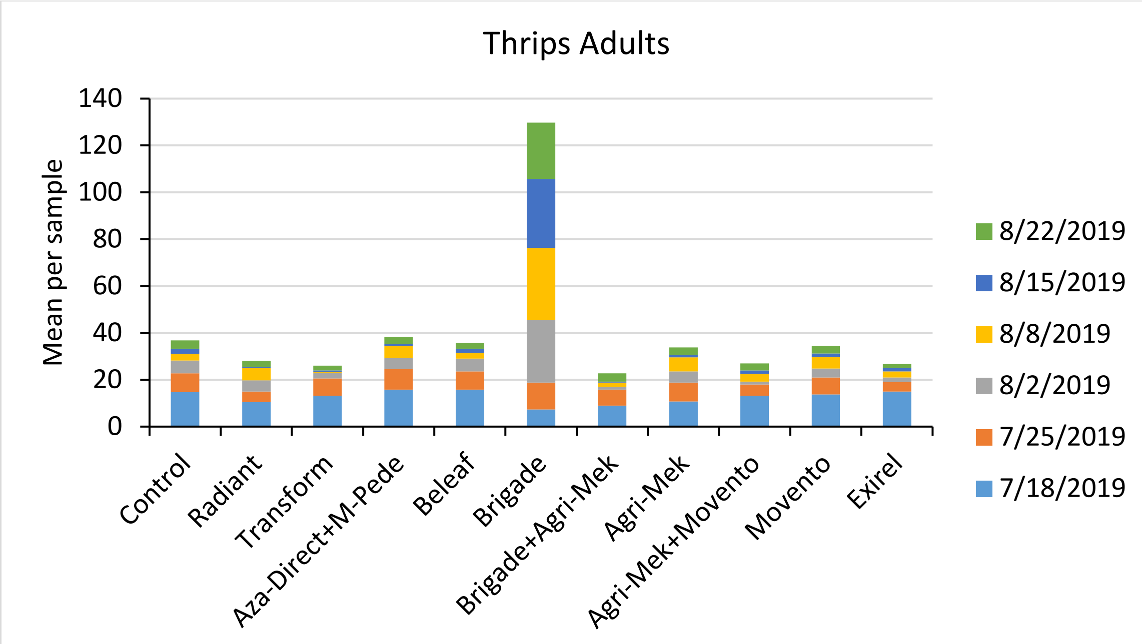

Figure 4. Weekly abundance of adult thrips across treatments. Means for different sample dates are shown by different colors within bars. Treatments were applied on July 15, July 30, and August 13, Malheur Experiment Station, 2019.

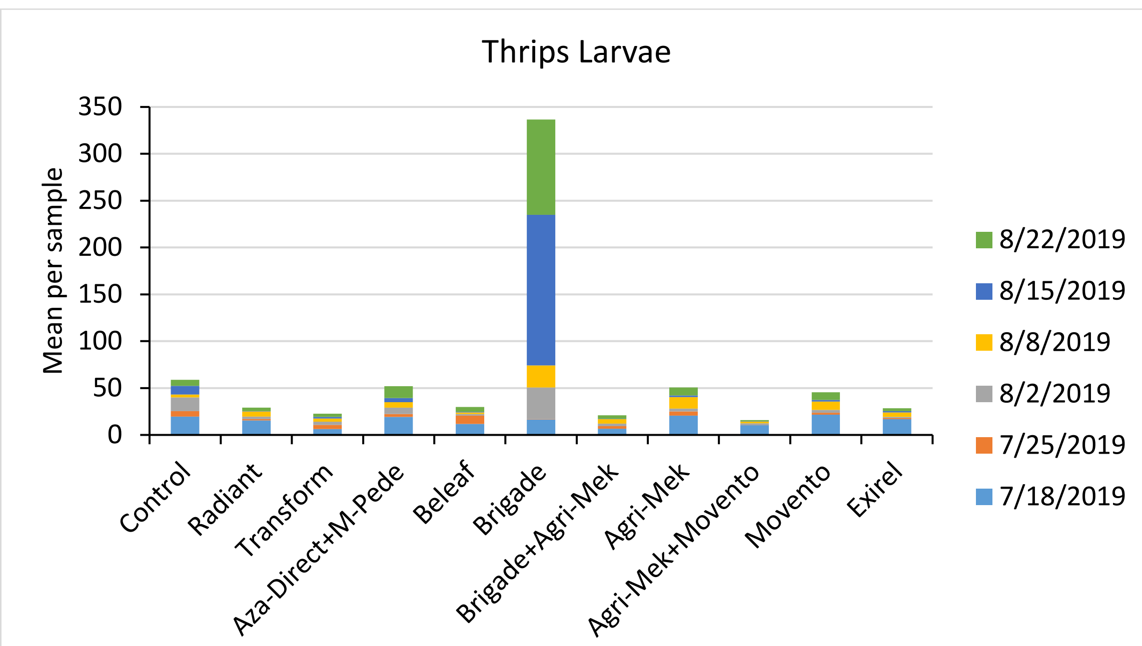

Figure 5. Weekly abundance of thrips larvae across treatments. Means for different sample dates are shown by different colors within bars. Treatments were applied on July 15, July 30, and August 13, Malheur Experiment Station, 2019.

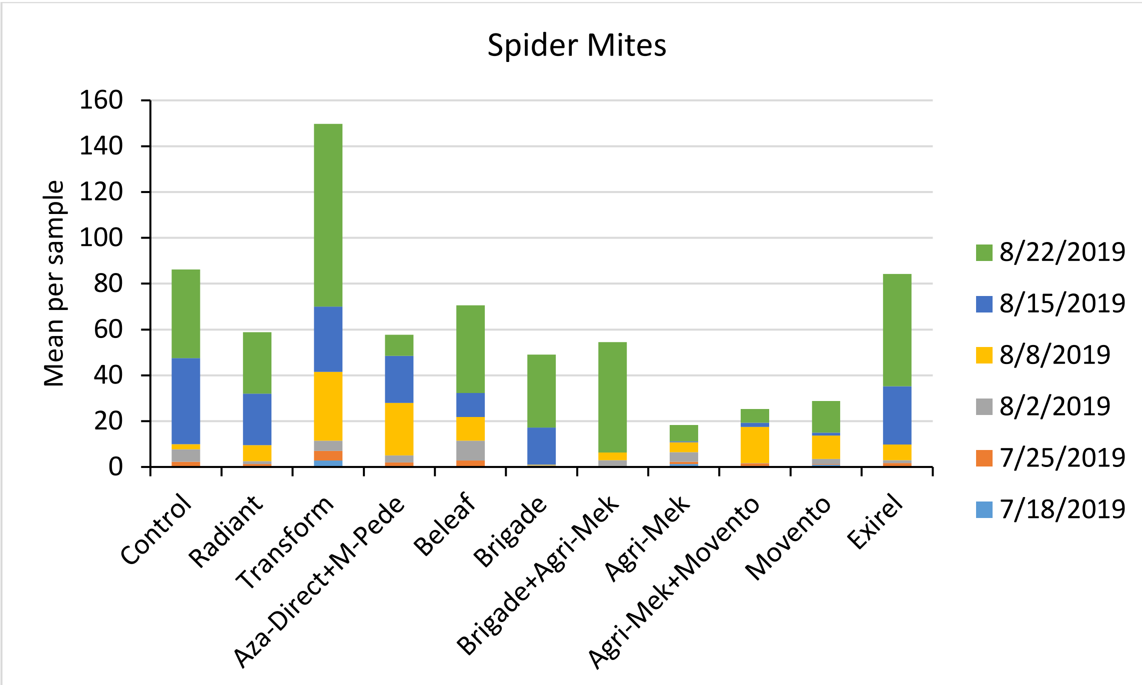

Figure 6. Weekly abundance of two-spotted spider mites across treatments. Means for different sample dates are shown by different colors within bars. Treatments were applied on July 15, July 30, and August 13, Malheur Experiment Station, 2019.

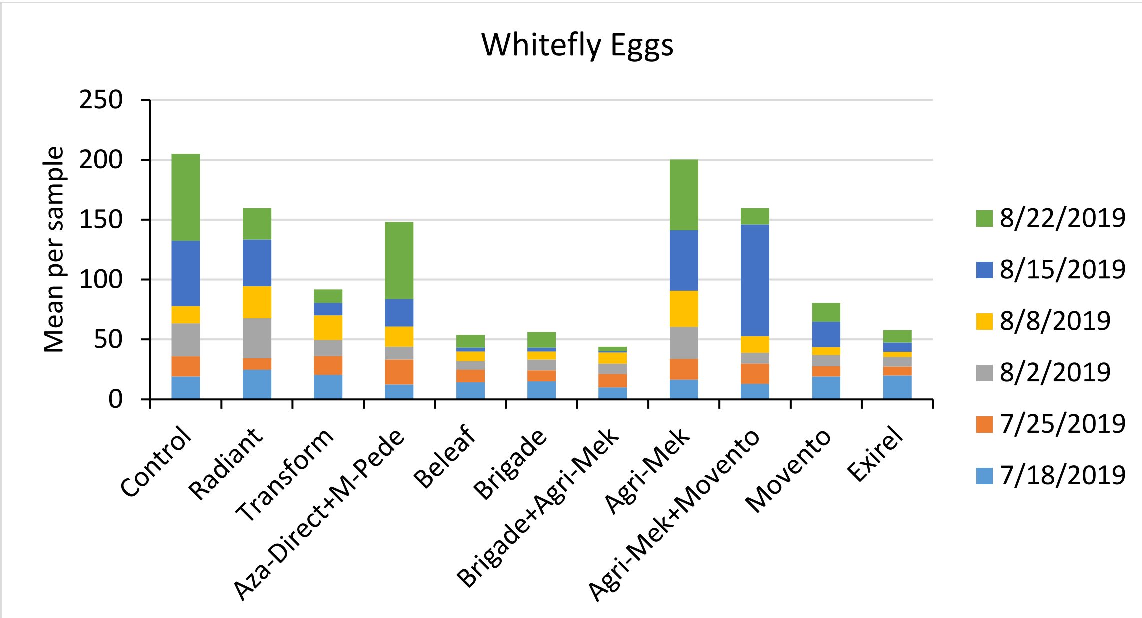

Figure 7. Weekly abundance of greenhouse whitefly eggs across treatments. Means for different sample dates are shown by different colors within bars. Treatments were applied on July 15, July 30, and August 13, Malheur Experiment Station, 2019.

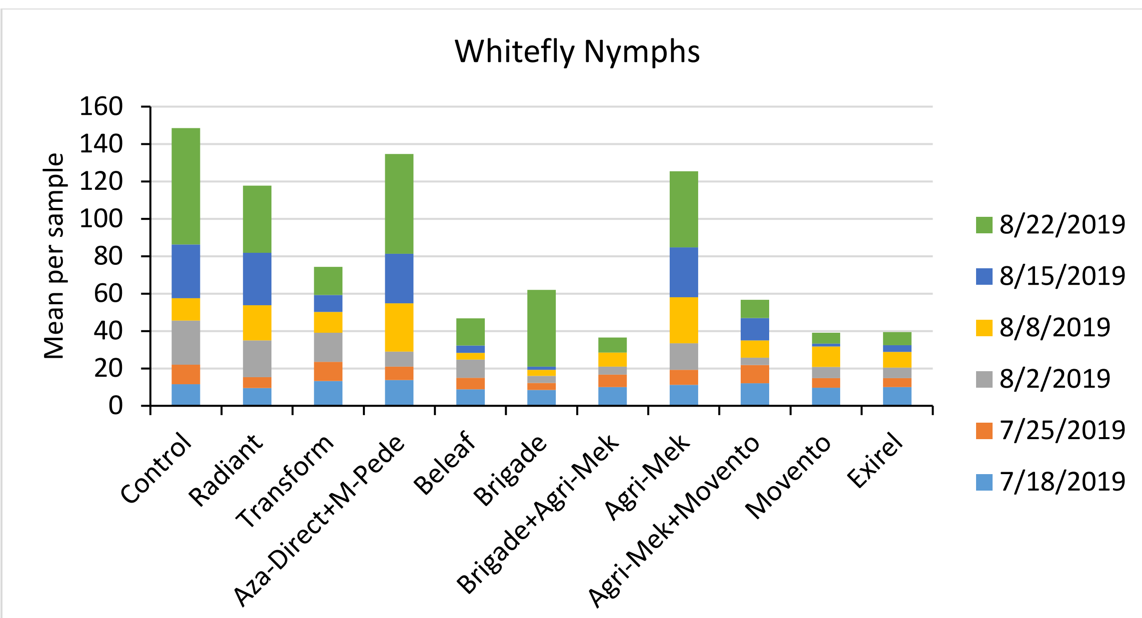

Figure 8. Weekly abundance of greenhouse whitefly nymphs across treatments. Means for different sample dates are shown by different colors within bars. Treatments were applied on July 15, July 30, and August 13, Malheur Experiment Station, 2019.

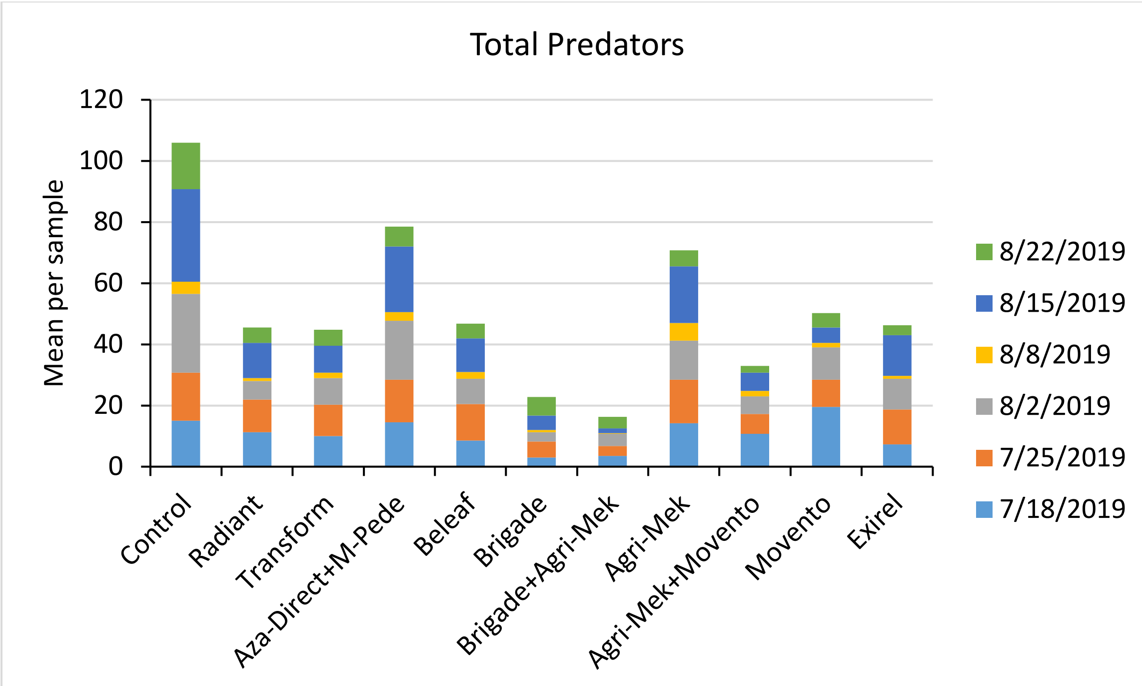

Figure 9. Weekly abundance of total predators across treatments. Means for different sample dates are shown by different colors within bars. Treatments were applied on July 15, July 30, and August 13, Malheur Experiment Station, 2019.