EVALUATING SEASON-LONG INSECTICIDE PROGRAMS TO IMPROVE POTATO INSECT IPM

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Abstract
Potato crop managers routinely make decisions regarding when and what insecticide to use on their fields to protect the crops profitability. Those decisions are influenced by one or more sources of information. Typically, a potato field has a diverse array of insects in the field when these decisions are made, complicating an already difficult and expensive decision. This aim of this project is to establish the impact of specific insect management programs on pestiferous and beneficial insects in potato fields in the Columbia Basin of Washington State. Too often insecticide efficacy trials focus on evaluating one pest insect, when often times numerous pests and beneficial insects occur on and around the potato plant during these trials. The overall objective is to evaluate insecticide management techniques based on insect densities to establish season long management tactics. Pest insect densities varied with treatment as will be discussed further. Also, overall yield, quality, and economic returns varied with treatment numerically, but not statistically.

This project aims to investigate the direct and indirect impact of specific insect management programs on the population abundance of pest and beneficial insects in Columbia Basin potatoes. Key targets will include Colorado potato beetle, aphids, psyllids, leafhoppers, caterplillars, and spider mites. Traditionally, insecticide efficacy trials have focused on evaluating single pest species, in single-insecticide-per-treatment experiments. Developing robust IPM strategies requires us to consider the full range of pest and beneficial insect species in the potato agro-ecosystem. Our overall objective is to evaluate insecticide management techniques based on sampling and insect thresholds in season long management programs and subsequently use tools available from the WSU Potato Horticulture program and private potato processing collaborators to quantify yield and quality impacts on potatoes grown under these various integrated pest management programs.

Materials and Methods
The project was established and maintained to mimic a commercial Ranger Russet potato field in the Columbia Basin. All plots received a fungicide seed treatment, post plant pre-emergence herbicide, and foliar fungicides as needed to avoid disease outbreaks. Plots were arranged in a Latin Square design. Plots were four rows wide and twenty five feet in length with 4 feet in between tiers and one blank row adjacent to each plot. The four treatments evaluated in this study were as follows: an untreated check plot, the ‘Risk Adverse’ treatment, the ‘Inexpensive Choice’ treatment, and the ‘Most Effective Choice’ treatment. The products used and date applied are listed in Table 1. Treatments were be applied by CO2 backpack sprayer at a water carrier rate of 20 gallons per acre.

Evaluations of plots were made weekly with the following methods: Yellow sticky traps, 20 leaf/plot samples, and vacuum samples. Each arthropod captured with the aforementioned methods were quantified weekly during the growing season in order to make treatment decisions. At the end of the season, 10 foot by 2 row sections of each plot were dug and harvested to quantify yield and grade. Additionally, a subset of 25 tubers per plot were cut into fries and cooked to assess internal defects that can result from some insect vectored disease. The remaining sample was then graded at the WSU Othello Research Station using their automated system.

Date Applied	4/17/2013	6/21/2013	6/27/2013	7/3/2013	7/10/2013	7/24/2013	7/31/2013	8/6/2013	8/15/2013	8/23/2013	9/4/2013	Total Cost $/Acre
Untreated												0
Risk Averse	Cruser Maxx ST	Movento	Movento	AgriMek	Fulfil	AgriMek	AgriMek	Oberon	Oberon	Warrior + Rimon	Coragen	361
Inexpensive Choice						Warrior	Warrior		Warrior	Warrior	AgriMek + Coragen	85
Most Effectice Choice	Cruser Maxx ST			AgriMek		AgriMek	Fulfil		Oberon	AgriMek + Warrior	Coragen	209

Table 1. Treatment programs by date with trade name of insecticides applied. Costs included in the last column do not include costs of surfactants or application, just insecticide.

Results/Discussion

Figure1 illustrates the total numbers of potato psyllids per treatment for the entire season by trapping method. This figure gives a good impression of the overall psyllid pressure on the plots and the relative effectiveness of each method. The sticky traps were an effective means of measuring psyllid emigration into the plot areas, but do not seem to be an effective metric for measuring efficacy of treatments. It is my opinion based on this trials and others conducted (data not included) that yellow sticky cards will be helpful in determining when infestations of psyllids begin, but are probably not an effective measure of success of insecticide applications as psyllids seem to continually infest fields. Figure 2 further supports this premise and seems to illustrate a peak period of emigration into the field toward the middle and end of August, shortly after nearby commercial fields were desiccated and harvested.

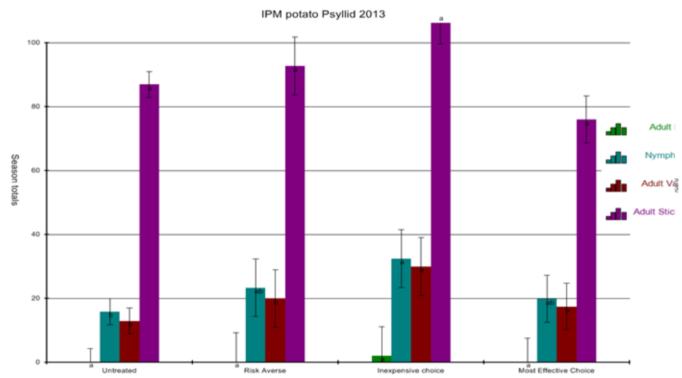

Figure 1. Potato psyllid total numbers by treatment and sampling method for adults and nymphs. Means with different letters are statistically significant from one another (p=.05 Student-Newman-Keuls test).

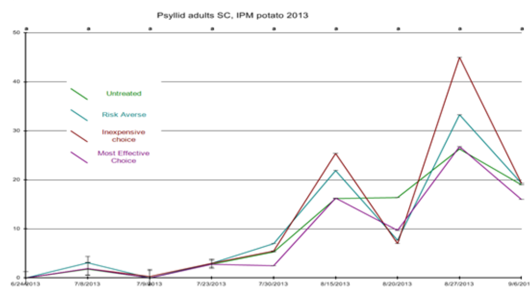

Figure 2. Potato psyllid adults collected using yellow sticky cards by date and treatment. Means with different letters are statistically significant from one another (p=.05 Student-Newman-Keuls test).

Adult psyllids were also sampled using a vacuum sampler (Fig. 3) and leaf samples (data not shown). The leaf samples had very low numbers of adult psyllids and were highly variable. Adult psyllids tend to jump readily when disturbed and the leaf collection method does not lend itself to be an effective method for collecting adults and discerning insecticide treatment efficacy. Prior to the sharp increase in adult psyllids collected in the Inexpensive Choice treatment plots on August 19th, 3 successive applications of Warrior insecticide were applied (Fig. 3). The data is not significantly significant, but the trend indicates that Warrior insecticide was ineffective for psyllid control (Fig. 3). The adult psyllid numbers sharply declined in all treatments in the beginning of September, likely as a result of the foliage beginning to senesce and significant defoliation in the untreated check plots as a result of Colorado potato beetle (CPB) feeding. Figure 4 further illustrates the previous statement regarding psyllid increases in the Inexpensive Choice treatment following 3 Warrior applications, as psyllid nymph numbers sharply incline at the same time period and are statistically in significantly higher numbers than in the other treatments. The untreated check numbers drop dramatically and do not rebound as they did in the treated plots, largely due to the extensive defoliation from CPB.

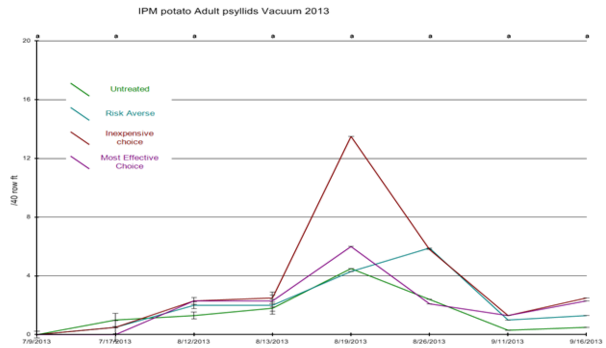

Figure 3. Potato psyllid adults collected using vacuum sampling by date and treatment. Means with different letters are statistically significant from one another (p=.05 Student-Newman-Keuls test).

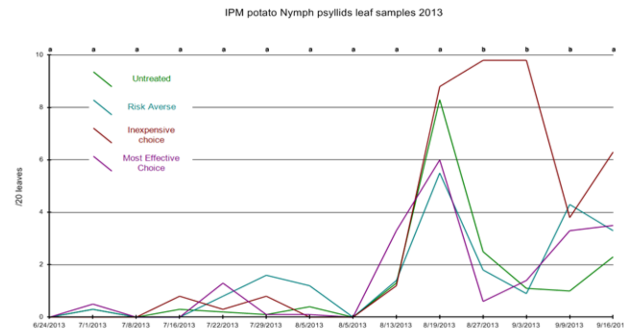

Figure 4. Potato psyllid nymphs collected using leaf sampling by date and treatment. Means with different letters are statistically significant from one another (p=.05 Student-Newman-Keuls test).

Figure 5 is a cumulative pest insect count for the sampling season by treatment. This figure illustrates how low the overall pest pressure at our site was, with the only overall statistically significant difference being in total CBP larvae numbers. The Risk Averse and Most Effective Choice treatments were treated with a neonicotinoid seed treatment (Cruiser, thiamethoxam) and were essentially free of CPB colonization. The Inexpensive choice treatment became colonized, but numbers were quite low. Though total wingless aphid counts did not differ statistically from one another, there was a sampling point where treatments varied significantly. There were very low aphid numbers in the two treatments with Cruiser applied as a seed treatment until the end of June when wingless aphid counts increased. An application of Fulfill at the end of July eliminated aphids from the Most Effective choice treatment for two weeks while the application of Warrior and Agri-Mek in the Inexpensive Choice and Risk Averse treatments respectively had no affect on wingless aphid counts. As was the case with most producers in the Columbia Basin, we were primarily targeting potato psyllids with our applications. Leafhopper numbers did not vary significantly on any sample dates (data not shown).

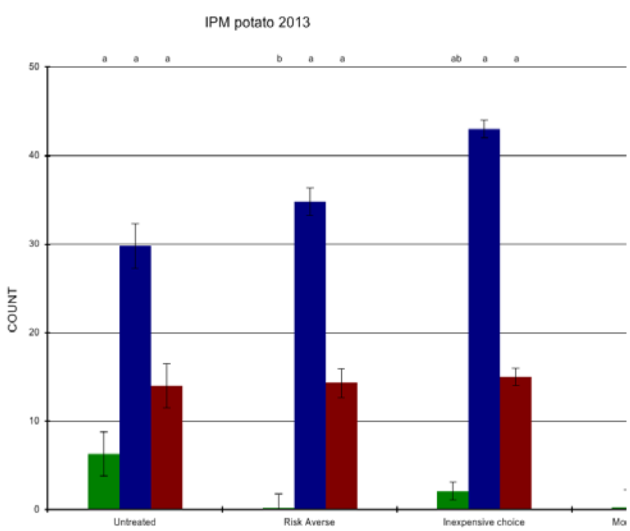

Figure 5. Cumulative pest numbers for the entire season for CPB, aphids, and leafhoppers.
Means with different letters are statistically significant from one another (p=.05 Student-Newman-Keuls test).

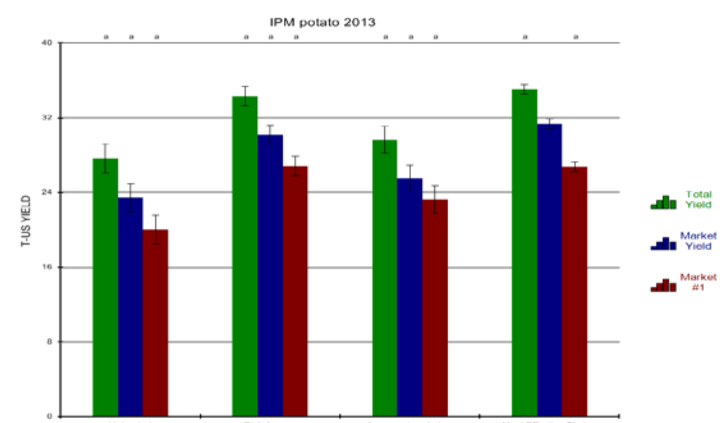

Figure 6. Total yield, market yield, and Market US No. 1 by treatment in tons/acre. Means with different letters are statistically significant from one another (p=.05 Student-Newman-Keuls test).

One of the main goals of this project was to determine how insect management impacts yield and quality. Figure 6 shows total yield, market yield, and market yield of US No. 1 tubers in tons per acre. There were no statistically significant differences, but the numeric trends favor using the Risk Averse and Most Effective Choice programs over the untreated and Inexpensive Choice treatments. High variability among plots caused the results to not vary statistically, but the trend in my opinion warrants further investigation. Additionally, Table 2 illustrates the gross increase in potential profitability of the insecticide treatment programs. These estimates are based on a processing contract for Ranger Russet potatoes, and do not include deductions for internal defects and other maladies not detected with the potato sizing machine. These are merely estimates to compare treatment programs to an untreated control, but the data, though not statistically significant, makes an indication that insecticides should be chosen carefully in order to sustain profitability.

Treatment	Insecticide Cost $/A	Gross Increase Over Untreated ($/A)			
Untreated Check	0	0			
Inexpensive Choice	85	312			
Risk Averse	361	823			
Most Effective Choice	209	1,101			

Table 2. Insecticide product cost per acre and estimated gross increase over untreated treatments using processing contract Ranger potatoes.

Conclusion

One season of data is not sufficient to draw significant conclusions or make solid recommendations, but several trends were noted that will be evaluated in coming seasons. For example, we found good evidence that sticky cards are a good indicator of emigrating psyllids, which is good information for growers and field men, but they are not a good indicator of product efficacy. Leaf samples appear to be a good metric for evaluating psyllid nymphs and product efficacy against psyllids. Additionally, we found that pyrethroid insecticides, although inexpensive are not an effective management strategy for potato psyllid. Seed treatments of neonicotinoids did appear to provide good early season control of both aphids and Colorado potato beetle, while Fulfill appeared to be an effective aphid control when applied to foliage. Monitoring of natural enemies needs to be refined as overall capture of those insects was quite low with the vacuum sampler. Potato yields did not differ significantly, but the trends indicated that programs that utilized more effective insecticides may increase yield and quality over ineffective inexpensive compounds. Further, the economic data indicates that careful selection of pesticides based on insect densities (Most Effective Choice Program) may increase economic returns to growers while calendar based programs (Risk Averse Program) and the least expensive alternative (Inexpensive Choice) may not be the best choice for producers to remain profitable.

Acknowledgements:

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