Efficacy of Wheat Insecticide Seed Treatments on Bird Cherry-Oat Aphids

Justin Wastler[1,2], Holly Davis[1], and Jeff Whitworth[1]

[1]Department of Entomology, College of Agriculture, Kansas State University
[2]Department of Horticulture, Forestry and Recreation Resources, College of Agriculture, Kansas State University

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Abstract

Bird Cherry-Oat Aphids, *Rhopalosiphum padi (Linnaeus),* (BCOA) are a major agricultural pest for wheat due to their ability to transfer Barley Yellow Dwarf Virus (BYDV), which can stunt growth when introduced to seedlings (Wegulo, 2013). These aphids, which will remain infective throughout their lives, are capable of asexual reproduction thus populations can grow exponentially and BYDV can spread rapidly throughout a field (Whitworth & Ahmad, 2008) "). However, seed treatments, the application of pesticides to "seeds or vegetative propagation materials," are an effective way to defend crops from pests like BCOA during their most vulnerable life cycle stages. (Paulsrud et al, 2001). Chemical companies are always seeking to develop ever more effective treatments. This research compared the effectiveness of an experimental treatment to that of Poncho®, a proven aphid pesticide. The results showed that the BCOA populations on the plants treated with the experimental pesticide did not decline. In fact, they increased at a faster rate than the untreated control. This indicates that the experimental treatment is not suitable for the control of aphids.

Purpose

The purpose of this experiment is to determine the efficacy of an experimental and a standard seed treatment for the control of BCOA.

Questions, Hypotheses, and Predictions

Question: Is the experimental treatment an effective pesticide for BCOA?

Hypothesis: If wheat seeds treated with the experimental treatment are infested with BCOA, then the aphid population will decline.

Prediction: Aphid populations on plants treated with the experimental treatment and plants treated with the mixed treatment will closely resemble the population of plants treated with Poncho®, a seed treatment proven effective against BCOA.

Study System

This experiment examined the effects of various seed treatments on Bird Cherry-Oat Aphids, *Rhopalosiphum padi (Linnaeus),* living and feeding on Hard Red Winter Wheat, *Triticum aestivum* (variety Zenda). Hard Red Winter (HRW) is a wheat high in protein and gluten that is used in a large variety of flour products in the United States and around the world; this wheat "brought to Kansas…in 1874, quickly became the most important crop in the state" (Paulsen et al. 1997). The HRW variety 'Zenda' is designated as intermediately susceptible to BYDV, a virus often carried by BCOA that can cause significant loss of wheat production (De Wolf et al, 2018). While BCOA are rarely capable of causing economic damage on their own, their capacity to rapidly spread BYDV makes them a serious pest (Whitworth & Ahmad, 2008).

Methods and Experimental Design

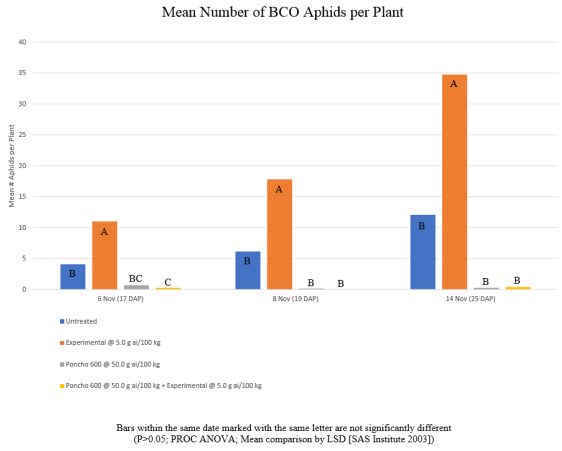
To compare the experimental treatment to Poncho 600®, 4 treatments of wheat were arranged in 3 repetitions. Treatment 1 was an untreated control, Treatment 2 was an experimental, Treatment 3 was Poncho 600®, and Treatment 4 was a combined treatment of experimental plus Poncho®. Five seeds per treatment were planted in a12cm diameter pot filled with growing medium and grown in a growth chamber set to 20ºC, 12:12 L:D, and watered as needed. Fourteen days after planting, each wheat plant was infested with 5 BCOAs and returned to the growth chamber. Counts of the aphid population of each plant were made 17, 19, and 25 days after planting (DAP). The resulting data were analyzed as an ANOVA (SAS 9.1).

Left: Adult and nymph Bird Cherry-Oat Aphid.

Right: Infesting wheat with individual BCOA

Results

The average aphid population per plant in Treatment 2 increased at a rate 2.97 times greater than the control and had an average of 35 BCOA/plant by 25 DAP. Plants from Treatments 3 and 4 consistently had an average of less than 1 aphid/ plant throughout the experiment.



Bars within the same date marked with the same letter are not significantly different (P>0.05; PROC ANOVA; Mean comparison by LSD [SAS Institute 2003])

Conclusions

Rather than causing a decline in the population of BCOA, the experimental treatment seems to have caused a population explosion. This indicates that the experimental treatment is not only unsuitable as a replacement for Poncho 600®, but unsuitable for the control of BCOA in general. However, isolating the compounds that trigger this phenomenon may help further explain BCOA reproduction and lead to treatments that inhibit it.

Future Directions

While the experimental treatment has proven ineffective as a pesticide for BCOA, it may prove effective against other common pests. This experiment can be conducted targeting other significant wheat pests, such as wireworms, cutworms, and wheat mites. If the experimental pesticide proves more effective at targeting any of these pests, it can still be useful. Since there was no statistically significant difference between Poncho 600® alone or combined with the experimental treatment, combining the experimental pesticide with another proven one may create a treatment that is more effective against another pest without sacrificing efficacy against aphids.

References

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