Wireworm Control in Scallions: Attract-and-Kill Tactic Using *Metarhizium brunneum* granules and Rolled Oats

Hazel Chan

Kwantlen Polytechnic University, Sustainable Agriculture and Food Sysems

Introduction

Wireworms *(Agriotes lineatus)* are click beetle larvae that reside in the soil. Being generalist feeders, wireworms attack a wide range of crops, including scallions.

Options for wireworm control have been very few and limited to broad-spectrum chemical insecticides, many which have been deregistered from use due to their negative environmental impacts. Consequently, wireworm damage has been an increasing issue across many parts of the world and has created the need for more environmentally sustainable alternatives, such as biopesticides.

Metarhizium brunneum is a fungal biopesticide fatal to wireworms that has been tested in field experiments and found to reduce wireworm damage for potato and wheat crops. Since wireworms are attracted to sources of carbon dioxide such as rolled oats, an attract-and-kill strategy that places rolled oats alongside *M. brunneum* granules can be an effective way to control wireworm larvae.

This experiment tested the effectiveness of the attract-and-kill strategy based on *Metarhizium* granules and rolled oats in reducing wireworm damage on scallions.

Fig 1. Study area at the Kwantlen Polytechnic University Orchard.

Methods

This experiment took place over a 35 m x 0.6 m study area at the Kwantlen Polytechnic University Orchard (Fig. 1). The experimental subjects were scallion plants and naturally occurring wireworms at the KPU Orchard.The three experimental treatments were *Metarhizium* and rolled oats, rolled oats, and an untreated control.

The experiment took form of a randomized complete block design with 6 replicates for each of the 3 treatments, for a total of 18 (1 m x 0.8 m) experimental plots. Each plot contained 3 rows of scallions, 10 scallion plants per row, and 4 inter-row band applications of assigned treatment (Fig. 2). Plants were spaced 0.07 m apart, rows were spaced 0.20 m apart, and plots were spaced 1 m apart.

Fig 2. Experimental plot containing scallion plants.

10 g of Oats and 1.109 g of *Metarhizium* were weighed into individual solar cups, for a total of 480 g of oats and 26.62 g of *Metarhizium* (May 30, 2018).Treatments were band-applied between the plant rows at their respective plots (May 31). Oats were applied at a target rate of 10 g / 1 m row, and *Metarhizium* granules were applied at a target rate of 1.109 g/ row. Scallion transplants were planted at each plot 2 weeks following treatment application (June 14). Plots were weeded manually each week, up until July 24.

Scallion stems were counted before harvest (July 25-26, 2018). Wireworm larvae (Fig. 3) and feeding holes in scallions (Fig. 4) were counted at harvest (July 31). Harvested scallions were oven dried for 24 hours at 55 degrees celcius before dry weight was recorded on August 2.

Data were analyzed by Analysis of Variance ($\alpha = 0.05$) and TukeyHSD ($\alpha = 0.05$), using the R statistical software.

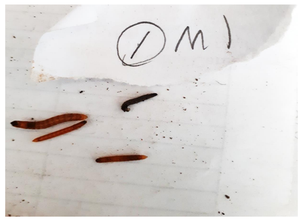

Fig 3. Wireworm larvae from scallions harvested from a plot treated with *Metarhizium* and rolled oats.

Fig 4. Feeding hole near the base of a harvested scallion plant.

Results

Treatment had a significant effect on dry weight of scallions: Scallion dry weight was significantly higher in the *Metarhizium* treated plots than in the control plots (p=0.011) (Fig. 5).
The effect of treatment approached statistical significance for the number of holes per scallion stem (p=0.0604) (Fig. 8) and for the dry weight per scallion stem (p=0.068) (Fig. 7): Scallions in the *Metarhizium* treated plots tended to have a higher number of stems (Fig. 6), higher dry weight (Fig. 7), and fewer feeding holes (Fig. 8) than scallions in the untreated control or oats treated plots, although these effects were marginally significant (p<0.1).

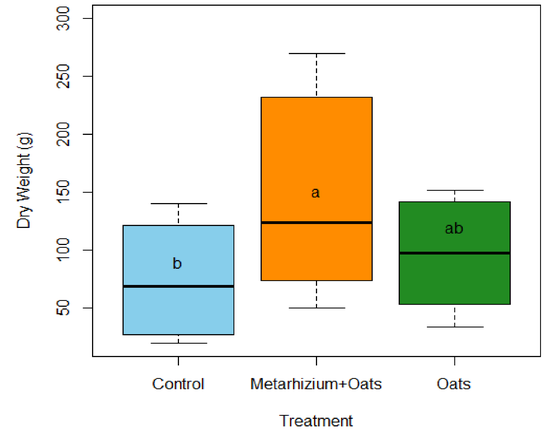

Fig 5. Dry weight of scallions harvested from untreated plots (Control), and plots treated with *Metarhizium* and rolled oats (Metarhizium+Oats), or rolled oats alone (Oats). Treatments labeled with the same letter do not differ significantly (Tukey's HSD test, α = 0.05.)

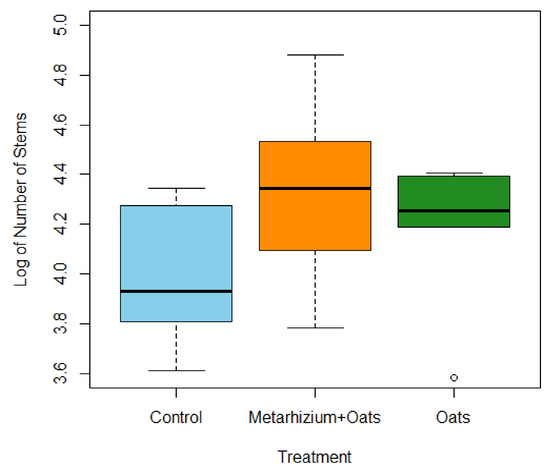

Fig 6. Number of stems for scallions harvested from from untreated plots (Control), and plots treated with *Metarhizium* and rolled oats (Metarhizium+Oats), or rolled oats alone (Oats). Data were log-transformed for normalization. No significant difference was found between treatments.

Results (cont.)

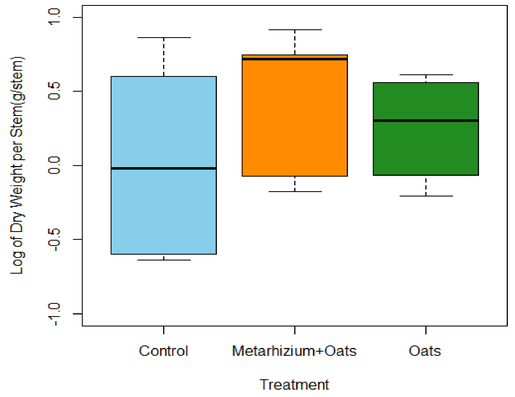

Fig 7. Dry weights of scallions per stem of scallions harvested from untreated plots (Control), and plots treated with *Metarhizium* and rolled oats (Metarhizium+Oats), or rolled oats alone (Oats). Data were log-transformed for normalization. No significant difference was found between treatments.

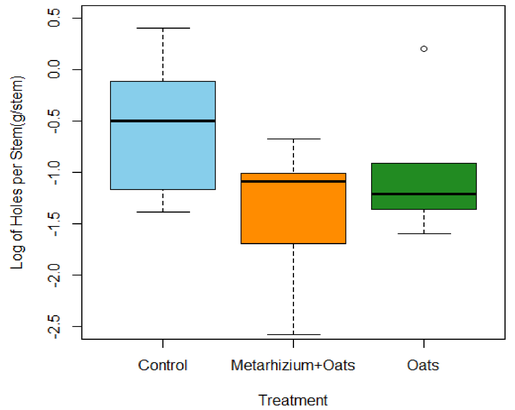

Fig 8. Number of feeding holes per scallion stem for scallions harvested from untreated plots (Control), and plots treated with *Metarhizium* and rolled oats (Metarhizium+Oats), or rolled oats alone (Oats). Data were log-transformed for normalization. No significant difference was found between treatments

Conclusion

The combination of *Metarhizium* and rolled oats increased yield and tended to reduce wireworm damage to scallions, relative to untreated controls.

Acknowledgements

Mike Bomford provided support and guidance throughout the study. Todd Kabaluk provided support throughout the study and provided the *Metarhizium* and experiment supplies.Torin Boyle and James Reinert assisted with transplanting, spreading compost, and setting up irrigation. Lindsay Dodds procured the *Metarhizium* and supplies.