Insect pest management strategies in organic brassica production

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Imported cabbageworms (*Pieris rapae*) are pernicious insect pests that are notoriously difficult to manage in organic systems. They are specialists that feed exclusively on species in the Brassicaceae (mustard or cruciferous) family. Larvae can cause damage by chewing large holes in leaves and destroying or contaminating broccoli, cauliflower, and cabbage heads with fecal matter, making them unmarketable. However, pest management options are limited in organic systems. Many organic brassica growers rely on floating row covers or biopesticides to control insect pests. Though effective, these management strategies are not ideal, because they are expensive and increase labor.

The overarching objective of this project is to improve non-chemical management strategies of insect pests in organic brassica production systems, and my research proposes two strategies to do this: 1) diversifying the landscape to increase natural biological control of imported cabbageworms; and 2) understanding the roles that the naturally-occurring defensive compounds called glucosinolates play in mediating plant-insect and plant-insect-parasitoid interactions.

Several studies that have evaluated diversified cropping systems as an approach to management of *P. rapae* and other lepidopteran pests of brassicas have reported varying success. Several studies have suggested that diversified cropping systems do not directly reduce the populations of lepidopteran larvae or have reported mixed results (Broad et al., 2008; Hooks et al., 2002; Philips et al., 2014; Latheef and Orwitz., 1983). However, providing flowering sources that support parasitoids of ICW in a diversified system could be an important strategy in managing ICW populations (Lee and Heimpel., 2005; Zhao et al., 1992). It is not yet completely understood how these parasitoids find their hosts, and it could be related to the brassica plant compounds called glucosinolates, which play a role in herbivory and plant defense. Glucosinolates and their volatile breakdown products, including isothiocyanates and cyanides, may mediate tri-trophic level interactions by helping biological control agents find their insect hosts, but little work has been done in the field to correlate increased parasitism and predation in response to these plant produced volatiles.

An experiment in the field will be conducted to: 1.) determine if previous damage influences defense against lepidopteran pests by inducing GSL; and 2.) determine if previous damage influences parasitism of lepidopteran pests on broccoli.

Moreover, brassicas may respond to insect damage by producing more of these glucosinolate compounds, which may deter further feeding or reduce herbivore fitness. For example, damage on black mustard (*Brassica nigra*) from flea beetles and *P. rapae* reduced subsequent damage from these pests as the plant matured and reduced growth rate and survival of herbivores that were fed new leaves from the plants that were previously damaged (Traw and Dawson, 2002). Induced resistance in the Brassicaceae is well studied, although it is not clear how these mechanisms influence herbivory and resistance.
An experiment will be conducted in the greenhouse to: 1.) determine if artificially damaged broccoli plants respond the same as naturally damaged broccoli plants; and 2.) determine if previous damage influences broccoli defense against lepidopteran pests by inducing GSL.


Winkler, K, F. Wackers, and D.M. Pinto. 2009. Nectar-providing plants enhance the energetic state of herbivores as well as their parasitoids under field conditions. Ecol. Entomol. 34:221-227.