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Cutworm-crop interactions as the basis of integrated pest management of cutworm pests in Alberta

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Background. What is it all about?

Cutworms (Family Noctuidae) are a complex of at least seven species that affect many crops grown in the Prairie Provinces. Crop losses can approach 100% during outbreaks and be devastating for individual farmers. Detailed information on host preference and larval development for many commonly occurring cutworms in the Prairie Provinces is largely lacking. Environmental effects such as moisture and nutrients available to plants influence herbivore performance in natural and managed ecosystems but have not been studied extensively for cutworms in the Prairie Provinces. Information on host preference and performance of cutworms under different conditions will contribute towards recommendations for crop rotation, crop cultivar selection, the development of trap crops and nutrient management of crops affected by cutworms.

Objectives:

1. Cutworm preference and performance

- a. Assess different monitoring tools to collect adult cutworm moths in different crops.
- b. Test the effect of nutrient and moisture regime on oviposition preference and offspring performance of cutworms.
- c. Test the effect of adult nutrition on female moth fecundity.

2. Cutworm response to nutrient, moisture and insecticidal treatments

- a. Determine the response of cutworm larvae to hosts with contrasting growing degree-day requirements.
- b. Determine the response of cutworms to canola hosts treated with insecticidal seed treatments.
- c. Test the effect of plant nutrition on cutworm larval performance.
- d. Test the effects of BtCorn on cutworms native to Alberta.

What we did: Monitoring tools:

- We compared two monitoring tools (pheromone traps and foodbait traps) for several species of cutworms (Bertha armyworm, pale western cutworm, dusky cutworm, redbacked cutworm). Foodbait traps were baited with 10 ml of a 50:50 mixture of glacial acetic acid and 3-methyl-1-butanol dispensed from a 15 ml nalgene bottle. Traps were positioned at 11 sites across Alberta.

Effect of crop host on cutworm preference and performance:

- Lab experiments were conducted to test oviposition preference and larval performance of several species of cutworm (Bertha armyworm, True armyworm, Redbacked cutworm, Pale Western cutworm) on different crop species. Egg production, larval development, and pupal weight were measured.

Effect of nutrient and water regimes on cutworm preference and performance:

- Lab experiments were conducted to test oviposition preference and larval performance of several species of cutworm (Bertha armyworm, True armyworm, Redbacked cutworm, Pale Western cutworm) on host plants exposed to varying fertilizer regimes. Egg production, larval development, and pupal weight were measured. The impact of water regime was tested only on the True armyworm. A field cage experiment was conducted to test if fertilization of barley field plots influenced larval development of the True armyworm.

Effect of adult moth nutrition on egg laying:

- The impact of moth feeding on egg production and oviposition was tested using bertha armyworm as a model. Moths were provided with 10% (w:v) fructose, 10% sucrose, 10% dextrose or distilled water and egg laying was monitored over 8 days.

Effect of insecticide treatment on cutworms:

- Lab experiments tested the effectiveness of canola seed treatment on bertha armyworm feeding damage and larval survival. Bt transgenic corn was tested against a near isogenic line against True armyworm.

Six key results:

Monitoring tools:

- Pheromone-baited traps can be used to indicate differences in distribution of cutworm species across the province. Food bait traps attract males and females of multiple cutworm species to a single trap and can be used to measure diversity of Noctuid moths in agroecosystems in Alberta.

Effect of crop host on cutworm preference and performance:

- Cutworms are considered generalist herbivores, but all the species tested (Bertha armyworm, True armyworm, Redbacked cutworm, Pale Western cutworm) exhibited a preference-performance hierarchy on different crop plants. Although the preference and performance of these species should be tested under field conditions, the current information could be used by producers for crop species and variety selection when infestation levels are high.

Effect of nutrient and water regimes on cutworm preference and performance:

- Crop fertilization impacts egg laying and larval development of several cutworm species. This illustrates that fertilization could be manipulated to alter the behaviour and development of cutworms. How fertilizer manipulation could be used in cultural control needs to be further tested under field conditions as our initial field study showed no effect of fertilization on insect performance or crop yield in small plots.
- True armyworm moths prefer to lay eggs on drought stressed plants but larvae develop into heavier pupae on the well-watered plants. Drought stressed hosts could serve as a type of dead-end trap crop for True armyworm.

Effect of adult moth nutrition on egg laying:

- Sugars commonly found in canola nectar (dextrose and fructose) increase the fecundity and fertility of female Bertha armyworm moths. This could be one reason why this generalist herbivore is mainly an important pest of canola.

Effect of insecticide treatment on cutworms:

- Insecticidal treatment of canola seed has no effect on Bertha armyworm larvae or plant biomass after larval feeding. Seed treatment is not a strategy that would be recommended for reduction of feeding damage by Bertha armyworm. *Bt* transgenic corn was effective at killing both early and late larval instar True armyworm larvae. *Bt* corn could be used to mitigate feeding damage of True armyworm larvae and should be tested against other lepidopteran pests of corn in the Prairie Provinces.

Take home message for the industry:

Cutworms exhibit variation in host selection and acceptance behaviour and developmental success on different plant hosts under different nutrient and moisture regimes. Further research is needed to determine if this variation can be exploited in the field to mitigate cutworm damage.

Value to the industry:

This research lays the foundation for integrated pest management of cutworms in the Prairie Provinces through increased knowledge of cutworm-host interactions and by directly testing monitoring and control products. As cutworm damage can cause millions of dollars in yield loss and insecticidal control, appropriately timed monitoring and control options need to be available to producers. The information revealed from this study will lay the ground work for the development of several cultural control approaches to cutworm management that has the potential to decrease insecticidal use and maintain crop yield.

Value to the team:

Eleven highly qualified personnel were trained in Entomology, Pest Management, and Chemical Ecology as a result of this work. Six scientific publications will result from this research for dissemination to the scientific community. Ten scientific and seven extension presentations have been presented to stakeholders.