The sterile insect technique: A novel tool for control of pepper weevil in greenhouse pepper crops

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Introduction

The pepper weevil (PW; *Anthonomus eugenii* Cano) is an worldwide pest of greenhouse and field pepper production. Pepper weevil larvae cause damage in the pepper fruit leading to fruit drop, which can cause yield losses upwards of 50% in severe infestations. The Sterile Insect Technique (SIT) is an established genetic control strategy applied to a diversity of pests worldwide. In an SIT system, sterilized male pest insects are released in large numbers to mate with wild females, which then fail to produce offspring. This can result in a dramatic decrease in the population in the next generation (Figure 1). **The goal of this research was to determine the dose of gamma-radiation for 100% sterilization of male and female PW while assessing the impacts of irradiation on adult longevity.**

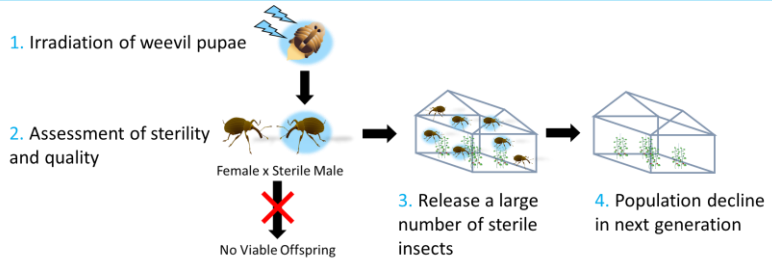

Figure 1: Sterile insect technique system for pepper weevil

Materials and Methods

1. Extract PW pupae from infested peppers (Figure 2)
2. Irradiate pupae at a 50-110 Gy of gamma-radiation
3. Pair irradiated weevils with the opposite sex on immature peppers for up to 7 days
4. Count the number of offspring emerging from immature peppers
5. Monitor daily for mortality

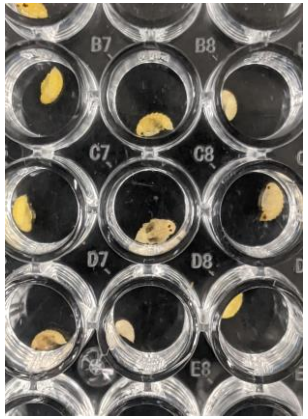

Figure 2: Pepper weevil pupae extracted from infested peppers for irradiation

Results - Irradiated Insect Fertility and Sterility

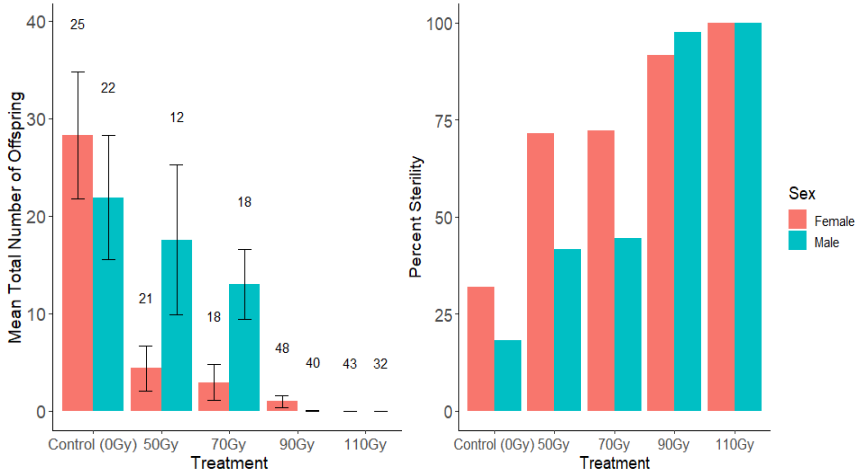

Figure 3: Fertility (mean total number of offspring ± S.E.; left) and percent sterility (percentage of pupae that produced 0 offspring; right) of treated female and male treated PW pupae. Sample size is denoted above each bar.

Irradiated pupae had significantly lower fertility and increased sterility with increased dose compared to unirradiated pupae (Figure 3; Two-way ANOVA, $p < 0.0001$). **Pupae of both sexes irradiated at 110Gy of gamma-radiation were 100% sterilized.**

Results - Irradiated Insect Longevity

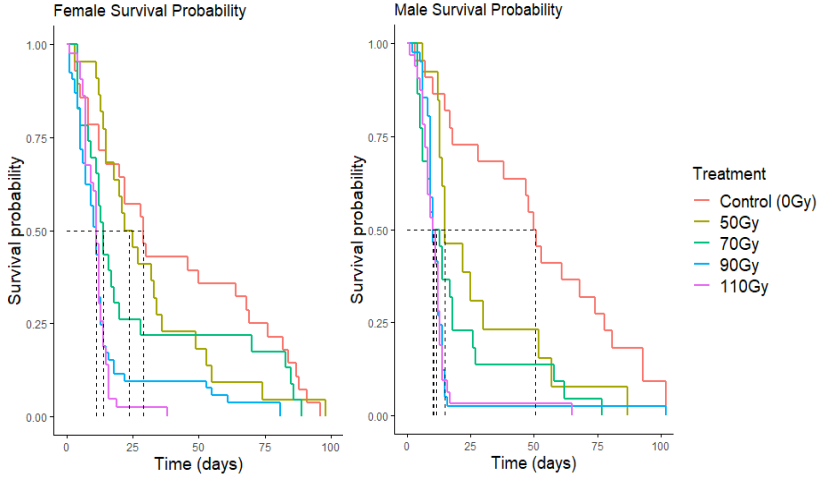

Figure 4: Survival probability from Kaplan-Meier estimates over time for treated PW pupae of both sexes. Dashed lines indicate LT50 for each treatment.

Survival probability curves were significantly different across treatment (Figure 4; Log-rank test; Male: $p < 0.0001$; Female: $p < 0.0001$). **Irradiated weevils lived approximately two weeks, significantly shorter than non-irradiated weevils.**

Significance and Future Work

Male and female PW irradiated at 110Gy are 100% sterile and live for about two weeks. With repeated releases to account for mortality, a PW-SIT system using 110Gy-irradiated weevils could prove to be a sustainable alternative to chemical control of the pepper weevil in pepper crops around the world, including Canadian greenhouses. Future work should focus on the evaluation of sterile male reproductive biology and competitiveness. In addition, modification of the rearing and irradiation processes could increase sterile male quality and improve the efficiency of PW-SIT and should be explored through future research.

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