Evaluating the potential of three insect-derived soil amendments on plant glucosinolate production

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BACKGROUND

Plant resistance to herbivores is regulated by soil conditions, nutrient availability, and often herbivore identity. Insect-derived soil amendments are a sustainable soil amendment however their impact on plant defenses is not well understood. Specifically, the production of glucosinolates - key defense compounds in brassicas - may be influenced by soil amendments. Studies suggest that organic amendments may increase glucosinolate levels, but none have examined insect-derived organic amendments. Here we add to the growing body of knowledge around insect-derived amendments to specialty crop production, focusing on plant resistance to herbivory.

OBJECTIVE

Compare herbivore susceptibility among plants treated with insect-derived amendments.

METHODOLOGY

Insect-derived soil amendment treatments:
BSF frass, BSF pupal cases, commercial cricket frass (Kickin frass®), unamended substrate (control).
Herbivory treatments:
Green peach aphids (GPA; *Myzus persicae*), cabbage looper larvae (*Trichoplusia ni*), uninfested control.
Substrate preparation:
Growth substrate: equal volume field-collected soil, sand, potting media (BM2®), respective insect-derived soil amendment. Application rates calculated using the nutrient composition of the field soil and amendments and adjusted to meet the NPK requirements of the plant. Synthetic fertilizers were added to all amendment-substrate mixture, including the unamended substrate (Table 1).

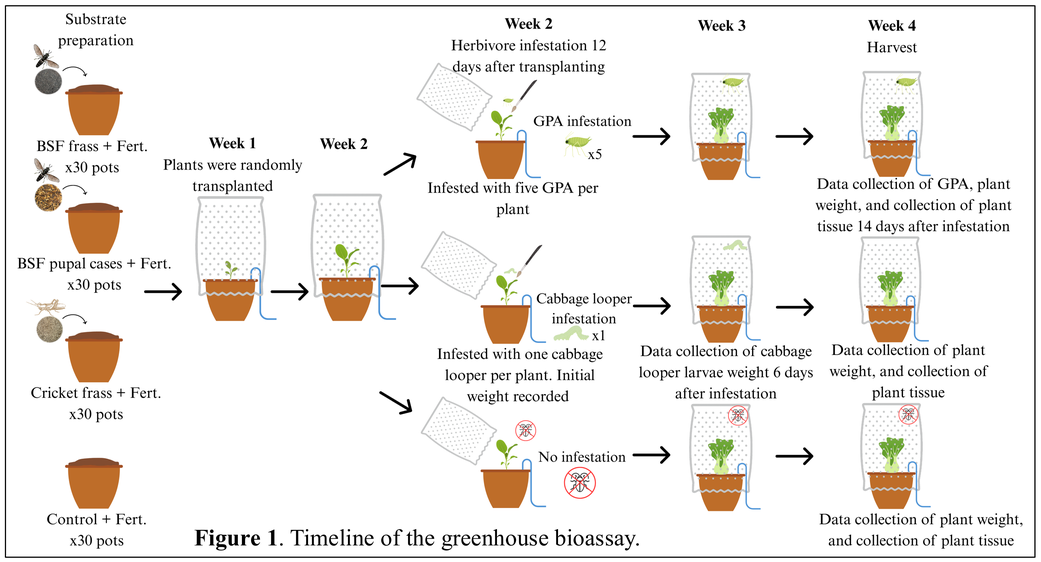

Figure 1. Timeline of the greenhouse bioassay.

Table 1. Fertilizer and amendment application rates.

Treatments	Fertilizer Application (gr/0.0013 sq. ft.)		
	Amendment (trt)	46-0-0	9-23-30
Control + Fert	-	0.00321	0.00414
Cricket frass + Fert	0.0959	0.0029	-
BSF frass + Fert	0.0792	0.0031	-
BSF pupal cases +Fert	0.1383	0.0036	-

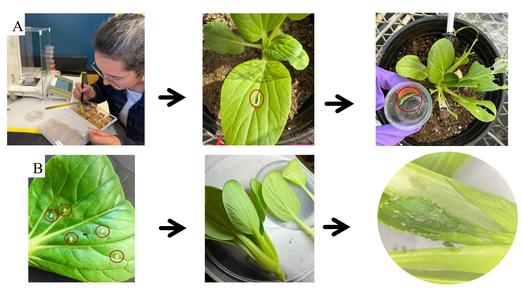

Figure 2. Data collection of (A) loopers and (B) GPA.

Data analysis:
Two-way ANOVA evaluated soil × herbivore interactions against plant weight and total glucosinolates, separately. Linear mixed models analyzed the change in the GPA populations and cabbage looper weight, individually.

RESULTS

No differences were detected in GPA populations ($F_{3,26.4} = 0.79$, $p = 0.51$) nor looper growth ($F_{2,8.6} = 2.62$, $p = 0.13$).

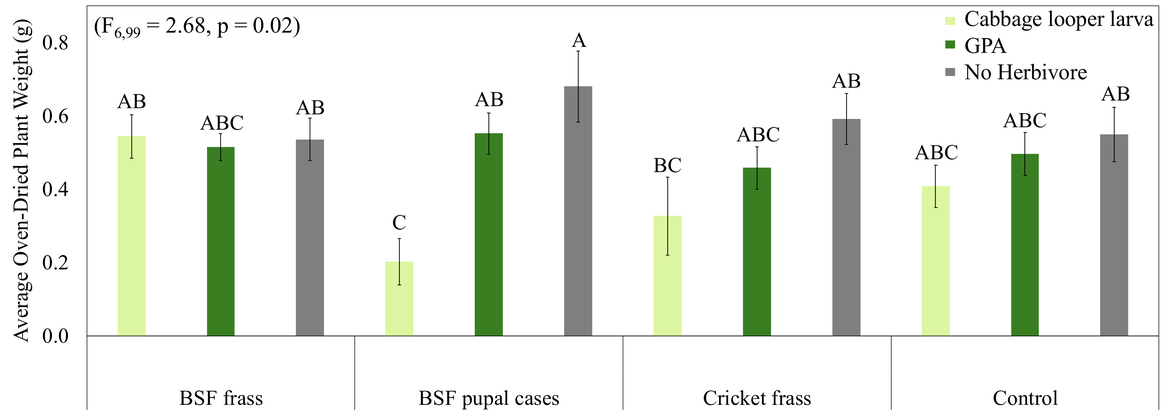

Figure 3. Effect of amendments × herbivore treatment. Data are mean ± SE of 10 replicates.

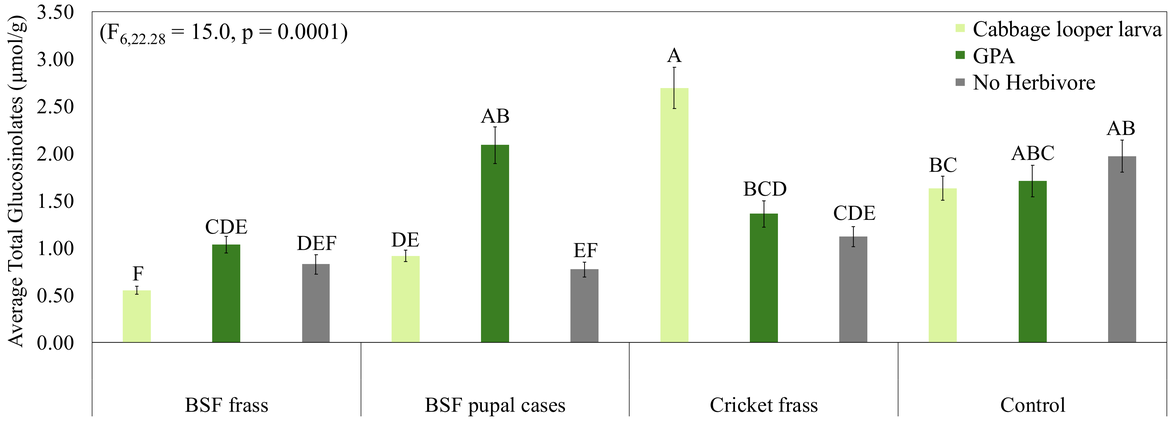

Figure 4. Effect of amendments × herbivore treatment. Data are mean ± SE of 3 replicates.

CONCLUSIONS

- The soil amendment treatments had no impact on plant weight except when cabbage loopers were infested. Plants amended with BSF pupal cases exhibited the lowest plant yield, lower than the no herbivore controls and plants amended with BSF frass.
- Glucosinolate content was highest in plants amended with cricket frass and fed upon by loopers, and lowest in plants amended with BSF frass and fed upon by loopers. Unamended plants had the highest glucosinolate content in the no herbivore controls.