Weed Seed Survival as Influenced by Dairy Compost

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Introduction

Farmers are increasing cropping system sustainability by applying compost amendments. Compost improves water holding capacity and nutrient availability by increasing soil organic matter. However, it may also increase weed seed production, viability, mortality, and dormancy.

Objectives

1. Measure soil enzyme activity during seed burial
2. Examine the effect of compost on weed seed mortality and dormancy following seed burial

Materials and Methods

- A field study was initiated in 2010 and repeated in 2011 at the MSU Montcalm Research Center in Lakeview, MI
- Cured dairy manure compost was applied in April at 0, 4, and 8 t C ha^{-1}, and potatoes (*Solanum tuberosum*) were planted in May
- Common lambsquarters (*Chenopodium album;* CHEAL), giant foxtail (*Setaria faberi;* SETFA), and hairy nightshade (*Solanum physalifolium;* SOLSA) were transplanted in June at potato emergence.
  - Seeds from the transplanted weeds were harvested 90 days later from each maternal environment [0 (N), 4 (L), and 8 (H) t C ha^{-1} compost]
  - Initial seed viability and dormancy determined
- 100 seeds of each species from each maternal environment were buried in mesh bags in October in weed-free amended plots
- Soil enzyme activity (Table 1) and volumetric water content was measured monthly
- Seed bags were removed 9 months after burial
- Remaining seeds were evaluated for mortality and dormancy

Statistics

The experiment was a split-plot completely random design with burial environment as whole-plot and maternal environment and species as sub-plots. Data was analyzed using PROC MIXED in SAS (SAS Institute, 2008); means were separated using Fisher's Protected LSD (α=0.05).

Table 1. Soil enzymes evaluated and their functions.

Enzyme	Function
phenol oxidase (PHENOX)	Phenol degradation
peroxidase (PEROX)	Lignin degradation
β-1,4-glucosidase (BG)	Cellulose degradation
β-1,4-*N*-acetyl glucosaminidase (NAG)	Chitin degradation

Results and Discussion

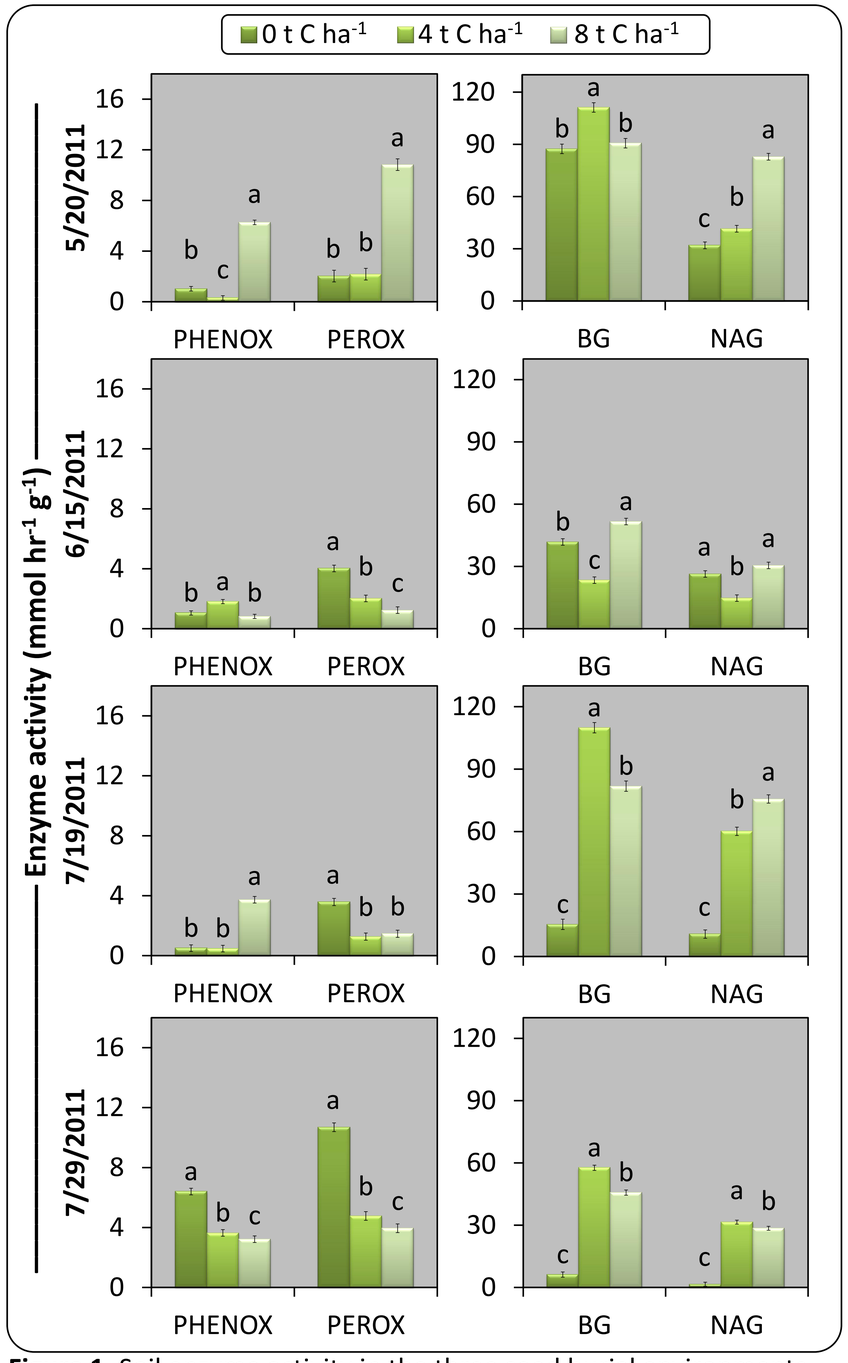
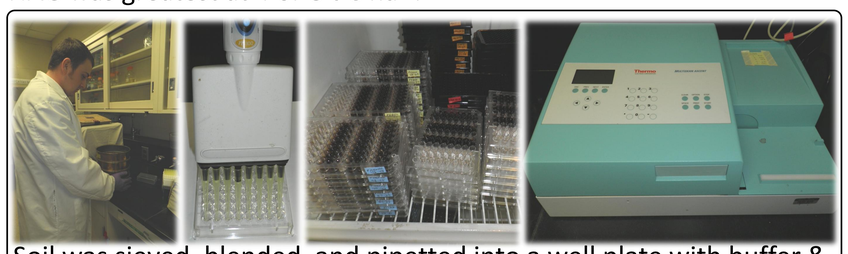


Figure 1. Soil enzyme activity in the three seed burial environments. Letters denote differences within an enzyme at each sampling date. PEROX activity was usually greatest at 0 t C ha^{-1}; activity of BG and NAG was greatest at 4 or 8 t C ha^{-1}.



Soil was sieved, blended, and pipetted into a well plate with buffer & substrate. Plates were incubated for 6 hr at 15°C and read for activity.

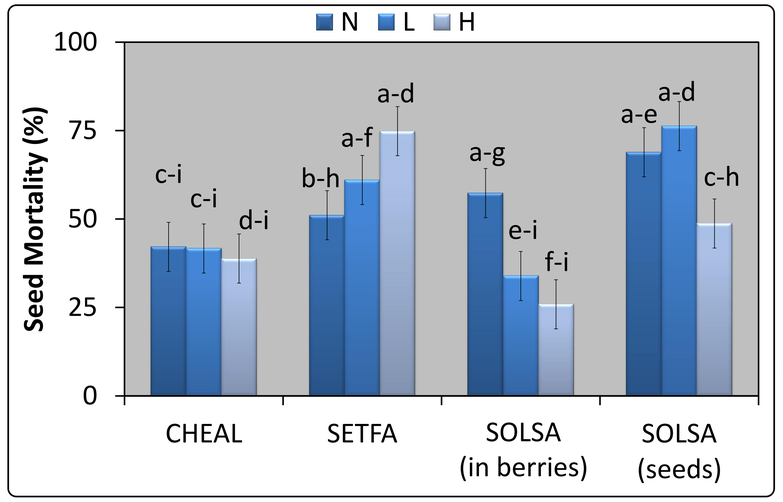
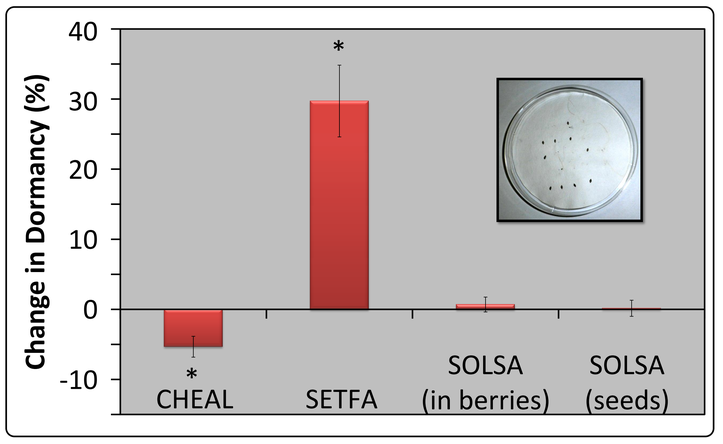


Figure 3. SETFA mortality increased as the compost rate in the maternal environment increased. SOLSA mortality decreased as the compost rate in the maternal environment increased. Mortality of CHEAL was not influenced by compost. Seed mortality was not influenced by burial environment. Soil moisture was similar across burial environments at each sampling date.

Figure 4. SETFA seed dormancy increased over the 9-month burial period. CHEAL dormancy decreased following burial. Both of these species changed significantly from the time of burial. Dormancy of SOLSA remained unchanged over time.



Conclusions

The 9-month seed burial environment did not affect seed mortality or dormancy of any species. The soil enzymes BG and NAG (cellulose and chitin degradation, respectively) were most active when compost was applied, which indicates greater fungal activity and the potential for increased weed seed coat degradation in composted treatments. Conversely, PEROX activity decreased as compost rate increased, suggesting less potential for decay of lignin within the seed coat in composted environments. There was no correlation of weed seed mortality with enzyme activity. The maternal environment influenced seed mortality, but the response was species specific. Future research examining the influence of compost on seed viability and innate dormancy is warranted.