Vinasse and Biochar Effect on Germination of Three Weed Species

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INTRODUCTION

Vinasse and biochar are byproducts of biofuel production that can be used as soil amendments to return nutrients to the field and improve soil quality. Vinasse is a residue produced after ethanol distillation (Wilkie et al. 2000). Biochar is produced by a pyrolysis process in which the organic material (e.g. plant residue) is heated on minimal oxygen conditions at temperatures between 400 and 700 C (Lehmann and Joseph 2009). Researchers have found that vinasse and biochar can affect germination and seedlings establishment on crops such as ryegrass, mug bean and subterranean clover (Murillo et al. 1992; Solaiman et al. 2011). Currently there is no information about the effect that vinasse and biochar might have on weed populations. We hypothesized that weed seed germination could be affected by biochar and vinasse addition to the soil, and that different weed species would show different responses to these soil amendments.

OBJECTIVE

To determine the effect of vinasse and biochar on the germination of palmer amaranth (*Amaranthus palmeri* S. Watson), sicklepod (*Senna obtusifolia* Irwin & Barneby) and southern crabgrass (*Digitaria ciliaris* [Retz.] Koeler).

MATERIALS AND METHODS

EXPERIMENTAL DESIGN

- Fifty seeds of each species were planted in petri dishes.
- Germinator was set in dark conditions, temperature regime of 12 h at 28 C and 12 h at 25 C.
- Germination, viable and non viable percentage was determined after 14 days of incubation.
- Non-germinated seeds were classified as viable or non viable using a press test (Sawma and Mohler 1993).
- Completely randomized design (CRD).

TREATMENTS

Vinasse: 0, 10, 20, and 40 L m^{-2}

(untreated check, 1X, 2X, and 4X, respectively)

Biochar: 0, 0.5, 2.5, and 12.5 kg m^{-2}

(untreated check, 1X, 5X, and 25X, respectively)

STATISCAL ANALYSIS

- Four replications per treatment. Experiment conducted twice.
- PROC GLIMMIX of SAS was used to conduct an ordinal logistic regression model for seed status (germinated, and non-germinated viable and non-viable) and Tukey's Honestly Significant Difference mean separation (α=0.05).

RESULTS

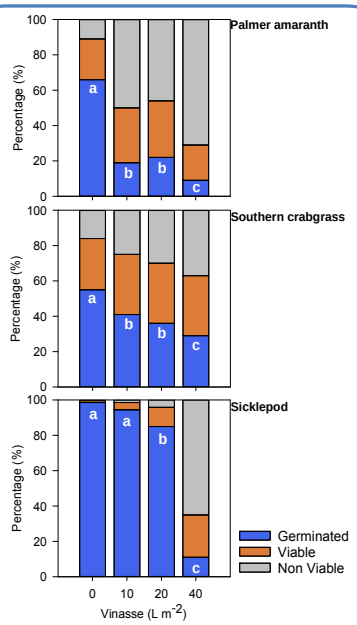

Figure 1. Vinasse effect on germination and viability of non-germinated seeds of palmer amaranth, southern crabgrass and sicklepod. Treatments with the same letter for cumulative proportions (germinated, and non-germinated viable and non-viable seeds) were not significantly different (*P*>0.05).

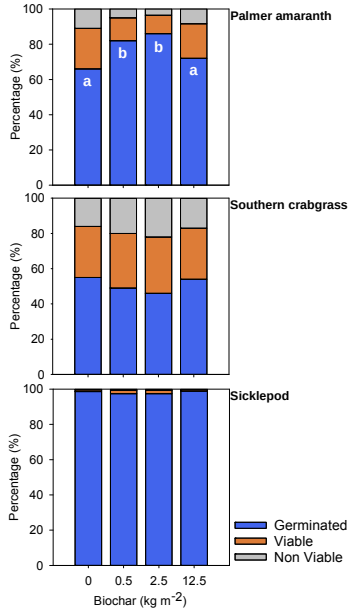

Figure 3. Biochar effect on germination and viability of non-germinated seeds of palmer amaranth, southern crabgrass and sicklepod. Treatments with the same letter for cumulative proportions (germinated, and non-germinated viable and non-viable seeds) were not significantly different (*P*>0.05).

RESULTS

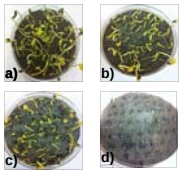

Figure 2. Sicklepod germination after incubation with (a) untreated, (b) vinasse at 10 L m^{-2}, (c) vinasse at 20 L m^{-2} and (d) vinasse at 40 L m^{-2} after 14 days of incubation.

- Seed germination and viability were negatively affected by vinasse (Fig. 1).
- Sicklepod was less affected by vinasse than palmer amaranth and southern crabgrass.
- Vinasse at 10 and 20 L m^{-2} reduced germination of palmer amaranth and southern crabgrass compared to the untreated control (Fig. 1).
- Vinasse at 20 L m^{-2} slightly reduced sicklepod germination (Fig. 1).
- Vinasse at 40 L m^{-2} dramatically reduced seed germination and viability of three species (Fig. 1 and 2).
- Biochar at 0.5 and 2.5 kg m^{-2} slightly increased germination of palmer amaranth compared with the untreated control (Fig. 3).
- The addition of biochar to the soil did not affect the germination and viability of southern crabgrass and sicklepod (Fig. 3).

CONCLUSIONS

- The addition of vinasse to the soil increased seed mortality.
- Sicklepod, which is a large seed species, was more tolerant to vinasse applications than palmer amaranth and southern crabgrass (small and medium seed size).
- Biochar only increased germination in palmer amaranth.
- The results of this study suggest that the use of vinasse as a soil amendment under field conditions could favor changes in weed community structure by differentially modifying germination rates.

ACKNOWLEDGMENTS

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