Use of Compost to Produce High Yield Soybean

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Summary

This research study is designed to evaluate the use of solid-separated compost (solids removed from liquid swine manure, composted with urban landscape waste) as a high yield soil amendment for soybean (*Glycine max*) production. The entire experimental site (4 contiguous ha at Illinois State University Farm at Lexington, IL, USA) has uniform soil (Parr-Libson-Drummer Association). The 4.0 ha site has been split into two 'blocks' of 2.0 ha each. One block was planted into corn (*Zea mays*), and the other block into soybean to allow for a corn/soybean rotation between the blocks. Representative agronomic practices for most Illinois producers (except for compost) will be utilized for corn and soybean blocks at this experimental site. For the 2.0 ha block planted to soybean or corn, two 1.0 ha "plots" were established. One 1.0 ha plot was the "control" that did not receive solid-separated compost. The 1.0 ha plot ("high yield") received solid-separated compost (supplied at 17.8 Mg/ha, on dry weight basis). Soil samples and plant tissue and productivity data were collected during the 2010 and 2011 growing seasons. Data were analyzed using a two sample t test (equal variance), with years considered as repeats. Preliminary results indicate that soybean yield was increased by 13.2% (p = 0.21) via the application of compost. The greater yield of the compost treatment could be due to a 15% increase (p = 0.05) in plant dry weight, with concurrent increases in pod and seed number. The annual application of compost also increased soil P levels by 154% (p = 0.07), as compared to the control. Additional data is needed to ascertain seasonal variation and long-term effects of compost application on soybean productivity. The ultimate impact of this study is to improve soybean yield in an environmentally sensitive and sustainable manner.

Objectives

The ultimate impact of this research study is to improve soybean yield in an environmentally sensitive and sustainable manner. In addition, the creation and use of an environmentally friendly, value added product that can be marketed wholesale or retail for various soil improvements will also be investigated. The specific objectives include:

- investigate the feasibility of composting solid-separated livestock waste with urban landscape waste in an agricultural setting
- evaluate solid-separated compost made from urban landscape waste application upon soybean development and high yield sustainable productivity
- determine the effect of solid-separated compost on long-term soil health and quality by monitoring soil pH, organic matter, cation exchange capacity (CEC), and elemental concentrations

Methods

The entire experimental site has uniform soil (Parr-Libson-Drummer Association), with 1 to 2% slope, good drainage, and high fertility. The site has been split into two 'blocks' of 2 each. In 2010, soybean (first block) and corn (*Zea mays*; second block) were planted. In 2011 and beyond, the experimental site will maintain a corn/soybean rotation between these two blocks. Representative agronomic practices for most Illinois producers (except for compost) will be utilized for corn and soybean production at this experimental site. For the blocks planted to soybean and corn, two 1.0 ha "plots" are established. One plot will be a "control" that does not receive solid-separated compost. The other plot ("high yield") will receive solid-separated compost (supplied at 17.8 Mg/ha, on dry weight basis).

The entire experimental site will be soil sampled on a yearly basis to determine the influence of treatment application on soil elements (P, K, Ca, Mg, S, Zn, Mn, and B), organic matter, pH, and cation exchange capacity (CEC). At physiological maturity for soybean, several representative soybean plants will be hand-harvested from each plot (control and high yield), separated into vegetative (leaves and stems) and reproductive (seeds and pods) fractions, weighed, and dried. A dried subsample will be sieved through a 20 mesh screen and analyzed for plant nutrient concentration (N, P, K, Mg, Ca, S, Na, Cu, Mn, Fe, Zn, and B). Seed yield at maturity for soybean will be measured via calibrated scale. Yield and plant data will be analyzed using a two sample t-test, using equal variance (control versus high yield) at 0.05 significance, with years considered as repeats.

Results

Table 1. Influence of annual compost application upon soybean plant and soil productivity factors for 2010 and 2011 growing seasons at Lexington, IL USA

Parameter	Control	Compost	Significance
Seed yield (Mg/ha)	3.8	4.3	*p = 0.21*
Plant population (plants/ha)	332,245	338,346	*n.s.*
Node number per plant	18.5	20.2	*p = 0.16*
Seed number per plant	91	114	*p = 0.21*
Pod number per plant	37	45	*p = 0.23*
Plant dry weight (g)	57.1	66.0	*p = 0.05*
Seed dry weight (mg)	148	144	*n.s.*
Harvest index (%)	47.0	50.4	*n.s.*
Seed nitrogen concentration (%)	6.0	6.3	*n.s.*
Seed phosphorus concentration (%)	0.67	0.64	*n.s.*
Soil phosphorus (kg/ha)	34	84	*p = 0.07*
Soil potassium (kg/ha)	218	254	*n.s.*
Soil pH	6.1	6.2	*n.s.*
Soil organic matter (%)	3.2	3.2	*n.s.*

Figure 1. Research study at Illinois State Farm (Lexington, IL, USA) during 2010 growing season

Impacts

This research study provides many potential benefits for the environment. Composting provides a way converting urban landscape waste into a product that is useful for both agriculture and urban uses. Ideally, you want to partition as many of the nutrients from liquid swine manure into the solid-separated compost as possible. Composting stabilizes these nutrients (like nitrogen and phosphorus), enhancing their availability to crops like soybean while decreasing their susceptibility to leaching. Composting is a relatively simple process requiring little additional labor compared to traditional manure disposal methods. All the waste (including liquid manure) produced by livestock operations can be composted with minimal investment, assuming the producer has access to a carbon source (like corn stalks, straw, urban landscape waste, sawdust, etc…) The solid-separated fraction can be spread to increase soybean crop productivity, while preventing the overapplication of nutrients such as phosphorus.

The ultimate impact of this research study is to improve livestock manure management, which will benefit the livestock producer, and to produce an environmentally friendly, value added product that can be marketed wholesale or retail for various soil improvement needs.

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