Effects of Organic Soil Amendments on Soil Physiochemical and Crop Physiological Properties of Field Grown Corn (*Zea mays*) and Soybean (*Glycine Max*)

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Abstract

Water stress is the most critical environmental factor limiting crop production in the US Piedmont. The presence of humic substances in composted organic amendments may increase crop tolerance to water stress through their hormone-like effects on plant metabolism. The objectives of this study were to calculate N mineralization rates of composted and non-composted organic materials used in this long-term field study, and to determine differences in soil physiochemical properties, corn and soybean leaf physical and biochemical properties yield and seed quality between organically amended and inorganically fertilized treatments. Nitrogen mineralization rates were greatest in the poultry litter (21%) and Panorama yard waste compost (4.5%) amended plots. Nitrogen uptake (120 mg/pot, 133 mg/pot, respectively) in these treatments were greater than that in the control (0N) (91.3 mg/pot) treatment. Wolf Creek biosolids compost and Huck's Hen Blend yard waste compost induced N immobilization (-5.0% and 0.18%, respectively), and had N uptake values similar to the control (92.6 mg/pot and 95.7 mg/pot). Rivanna biosolids compost immobilized N (-14.8%) but N uptake (136 mg/pot) was greater than that in the control due to the relatively high inorganic N content in the amendment. The total N concentration and C:N values were less reliable variables in predicting N mineralization when a significant portion of the total N was in the inorganic form.

The annual application of poultry litter, Rivanna biosolids compost, and Panorama yard waste compost at 100% agronomic nitrogen and 30 % agronomic nitrogen rates in the field study improved soil fertility and increased total organic and humified carbon contents relative to the inorganically fertilized and control treatments. The amended treatments had slightly greater plant available water contents (average 10.0 cm/15 cm) than the control (8.38 cm/15 cm). Leaf water potential measurements revealed that neither crop experienced water stress during the sampling season. Treatment differences in leaf antioxidant activity were only observed in corn. All corn plants that were fertilized

with amendments supplying the crop's nitrogen needs, regardless of the source, had greater leaf nitrogen (+29%), chlorophyll (+33%), and protein contents (+37%), lower superoxide dismutase (-29%) and ascorbate peroxidase (-17%) activities, and lower malondialdehyde (-33%) contents relative to the control and low nitrogen treatments. There were no observed differences in catalase activity, which was likely due to the evolutionary advantage of C_4 metabolism. Yield was strongly related to midseason leaf nitrogen contents (R^2=0.87, $p<0.0001$) and not soil humified carbon (R^2=0.02, p=0.0543). There were no observed treatment differences in soybean leaf physiology and metabolism. Differences, however, were observed over time. As the leaves senesced, leaf chlorophyll, protein, superoxide dismutase and catalase activities decreased, and the malondialdehyde content increased. Ascorbate peroxidase activity slightly increased with time. Catalase activity in soybean was primarily driven by the oxidation of glycolate, a product of photorespiration, and not the formation of reactive oxygen species in the chloroplasts. The organically amended treatments had higher yields (9-21% increase), greater protein contents (4-9% increase), and seed weights (5-14% increase) relative to the fertilizer and control treatments. It was concluded that differences in soybean yield and seed quality were due to non-nutritive benefits of the organic amendments and not available water or plant nutrition.

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Peace!

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