CARIBBEAN FOOD CROPS SOCIETY

Fortieth
Annual Meeting 2004
COMPOSTED POULTRY LITTER EFFECT ON TILLER DYNAMICS, HERBAGE MASS AND CRUDE PROTEIN CONCENTRATION OF *BRACHIARIA BRIZANTHA* CV. MULATO


ABSTRACT: Composted poultry litter (CPL) applied to field crops can be an important source of nutrients and organic matter to improve soil quality. However, little is known on the effects of CPL on tiller dynamics and forage yield of the tropical grass *Brachiaria brizantha* cv. mulatto. A study was conducted in the fall of 2003 and spring of 2004 to evaluate four CPL rates and their influence on number of tillers, herbage mass (g/plant), and crude protein (CP) concentration of cv. Mulato at three harvests at 30-d intervals. Treatments included 0 (Control; C), 16 (low; L), 31 (Medium; M), and 62 kg/ha of N (High; H) CPL rates. Grass seedlings (6-wk old) were established in pots (1-gl) filled with soil of the Consumo type (Fine, mixed, semi-active, isohyperthermic Typic Haplohumults). Composted poultry litter was broadcast-applied and incorporated into the first 2-cm of the soil in the pots. Plants were irrigated as needed. From first to the third harvest, there was a minimal increase in tiller count (8.4 to 11) for the control. Corresponding increases observed for the L and M CPL rates were 14 to 28 and 21 to 28 tillers/plant. However, the magnitude of change in tiller counts at the H CPL rate was much greater (21, 23, and 44) at first, second and third harvest, respectively. There was also a linear effect (P<0.05) of CPL rates on herbage mass (g/plant on dry matter basis). For C, there were no changes in herbage mass from first to last harvest (mean of 16 g per plant). For the L and M rates of CPL minimal changes in herbage mass were noted from the first to third harvest. Herbage mass increases from 31 to 56, and 81 g/plant at first, second, and third harvest, respectively at the H CPL rate. There were differences in CP of cv. Mulato with increasing rates of CPL. Crude protein averaged 7.2, 6.6, 7.2, and 9.1% for the C, L, M, and H rates, respectively (a 2 percentage unit increase over C with H CPL). An important aspect of this study is that cv. Mulato can serve as a sink for this nutrient-rich compost and can also provide a profitable and environmentally acceptable use of CPL.

INTRODUCTION

Livestock production in Puerto Rico is dependent on tropical pastures to meet their nutritional demand. Nitrogen is the most limiting nutrient for pasture production in Puerto Rico. Most of the soils used for pastures are mainly acidic (Oxisols and Ultisols). These soils have low organic matter content, and are prone to soil erosion. For increase yields, grasses rely on inorganic fertilizers, thus increasing cost of production. Nitrate leaching and subsurface lateral flow toward streams and rivers is a major environmental contamination of groundwater and other water resources in Puerto Rico. Phosphorus is also a major concern (Havlin et al., 1990). According to Hornik (1992), the quality of soil has been mainly associated with its productivity. This definition has now been expanded to include the capacity of a soil to function within...
ecosystem boundaries to sustain biological productivity, maintain environmental quality, and promote plant and animal health. An alternative for improving soil quality is the use of compost. Poultry litter (PL) is generated in large quantities in Puerto Rico. The Department of Agriculture of Puerto Rico reports an average yearly population of 8.2 million broilers, which yield approximately 71,500 metric tons of manure (Muñoz et al., 1990). This manure if composted represents an alternative source of organic matter for the maintenance of low fertility soils. According to Martínez and Guzman (1999), composting is a cost effective and environmentally sound alternative for PL recycling. On clay soils, good quality compost can improve soil structure, reduce surface crusting and compaction, promote drainage, and provide much needed nutrients. In sandy soils, compost increases water and nutrient retention, supplies nutrients, and increases microbial activity.

In an evaluation of time and mode of application of chicken manure for plantain production, an adverse effect was observed during germination with the application of 7.26 kg manure per plant at planting (Muñoz and Martínez, 1991). But other studies with PL was shown to promote faster turf establishment, improved turf density and color, increase root growth, and require less inorganic fertilizer and irrigation (Landschoot, 1996). Composts can supply all or most of the turf's nutrient requirement (i.e. N, P, S, K, Fe, Zn, Cu, and Mg). Studies with biosolids show that only about 10 percent of the N is available to plants during the first growing season. Certain types of compost have a high concentration of soluble salts, such as those made with spent animal manures. Those salts increase the electrical conductivity of the soil with compost additions, sometimes approaching limits considered detrimental to support crop growth (Martínez and Guzmán, 1999; Landschoot, 1996). Another problem is its variation in pH with very high (>8.5) or very low (<5.5) values can be detrimental to turf. The extremes in pH affect the availability of nutrients for plant use. Also, compost made from biosolids was shown to have higher heavy metal concentrations than those made from other sources. Applications of biosolids have showed significant increases in the levels of EDTA extractable metals (e.g., Cu, Zn, Cd, Cr, and Fe) (Martínez and Guzman, 1999).

Information on the use of PL on pasture crops in Puerto Rico is limited. Studies are needed to assess the effects of varying levels of composted poultry litter (CPL) on the chemical and biological properties of soils and their effects on grass growth. The present research investigated CPL litter effects on tiller dynamics, biomass and CP percentage of *Brachiaria brizantha* cv. mulato at 30-d intervals.

**MATERIALS AND METHODS**

This experiment was conducted at the University of Puerto Rico, Mayaguez Campus. Soil type was an Ultisol, Consumo clay, (Fine, mixed, semiactive, isohyperthermic Typic Haplohumults). At the initiation of the experiment in 2003, field soil samples (taken at 0-30 cm depth) and CPL (produced at Vivero Finca Bayamón) were analyzed for major and micro-nutrients (Tables 1 and 2). Treatments included 0 N (control; C), 16 (L), 31 (M), and 62 kg/ha N (H).

Grass seedlings of cv. Mulato (6-wk old) were transplanted in pots (1-gl size) and CPL broadcast applied and incorporated into the first 2-cm of the soil. Plants were maintained in an open greenhouse and irrigated as needed. Plants in each pot were harvested by clipping to a 15-cm height every 30-d. At harvesting, the number of tillers were counted and recorded. The fresh weight of the clipped plants (g/plant) were recorded and full samples were dried in an open-draft...
oven at 60°C for 48 hrs and dry matter percentage calculated. Dried samples were then ground in a Wiley mill to pass a 1-mm screen. Ground samples were analyzed for N following the procedures described by AOAC (1990) and CP calculated (N*6.25).

Treatments (CPL) were arranged in a randomized complete block design and replicated five times. Data were analyzed using the GLM procedure of SAS (1990). Because of changes over time, data were sorted and analyzed by harvest date. Treatment comparisons were made using single degree of freedom contrasts for linear, quadratic, and cubic effects of CPL rates.

RESULTS

There were significant (P<0.05) PL rate, harvest date and PL rates by harvest date interaction effects on tiller dynamics of cv. Mulato. In the data analyzed by harvest date, there was a linear response (P<0.05) to increasing rates of CPL. From the first harvest to the third, there was minimal increase in number of tillers (8.4 to 11). Similar increases were observed for the L and M rates. Major changes, however, were noted for the H rate (21, 23, and 44 tillers per plant) at first, second and third harvest, respectively (Figure 1).

There was also a linear effect of CPL rates on dry matter (DM) yield (g/plant). For the control, there were no changes in DM yield from first to last harvest (average of 16 g per plant). For the L and M rates of CPL minimal changes in dry weight of plants were observed from the first to third harvest. However, at the H rate of CPL, there were major changes in dry matter yield. Yields per plant of 31, 56, 81 g at first, second, and third harvest, respectively were recorded (Figure 2). The increase in DM at third harvest is highly correlated to number of tillers (44 tillers/plant).

There were differences in CP concentration of cv. Mulato with increasing application of CPL. Crude protein averaged 7.2, 6.6, 7.2, and 9.1% for the C, L, M, and H rates, respectively. There was a 2 percentage unit increase in CP with the H rate of CPL.

CONCLUSIONS

Our results show positive linear responses for both number of tiller and DM yield of cv. Mulato to the high rate of CPL (62 kg/ha N). The increased DM yield due to the H CPL rate compared to that of the control at the third harvest may indicate mineralization of N and more N available for plant use. This gives CPL the quality of a slow release fertilizer. The two percentage unit increase in CP with addition of the H rate of CPL can serve to increase the nutritive value of cv. Mulato. Soil analysis is needed to determine changes in soil pH, and P and other minerals accumulating in the soil. Because of the slow release of N from CPL, there would be less leachate of N in the system. An important aspect of this study is that cv. Mulato or other tropical grasses can serve as a sink for this nutrient-rich compost and also provide a profitable and environmentally acceptable use of poultry litter compost.

ACKNOWLEDGEMENTS

Research was funded by the USDA Hispanic Serving Institutions grant “Enhancing the Knowledge of Environmental and Molecular Biology Issues in Potential and Current Animal Science Students”
REFERENCES


Table 1. Soil analysis at two depths (Fine, mixed, semiactive, isohyperthermic Typic Haplohumults) and Composted poultry litter (CPL).

<table>
<thead>
<tr>
<th>Sample Soil</th>
<th>Organic Matter*</th>
<th>K*</th>
<th>Mg*</th>
<th>Ca*</th>
<th>N*</th>
<th>P**</th>
<th>CEC***</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-4” depth</td>
<td>2.1</td>
<td>3.1</td>
<td>21.1</td>
<td>49.6</td>
<td>.2</td>
<td>3</td>
<td>21.4</td>
<td>5.5</td>
</tr>
<tr>
<td>4-6” depth</td>
<td>2.6</td>
<td>6.7</td>
<td>25.2</td>
<td>57.7</td>
<td>.2</td>
<td>21</td>
<td>22.2</td>
<td>6.3</td>
</tr>
<tr>
<td>Poultry Litter</td>
<td>9.9</td>
<td>65.1</td>
<td>14.8</td>
<td>20.1</td>
<td>2</td>
<td>238</td>
<td>46.3</td>
<td>9.1</td>
</tr>
</tbody>
</table>

* Values are in percent, ** P values are in ppm, *** Values are in meq/100g

Table 2. Micro-nutrients and sulfur composition of soil at two depths and of composted poultry litter (CPL).

<table>
<thead>
<tr>
<th>ppm</th>
<th>Soil 0-4”†</th>
<th>Soil 4-6”†</th>
<th>CPL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulfur</td>
<td>139</td>
<td>322</td>
<td>964</td>
</tr>
<tr>
<td>Zinc</td>
<td>2.4</td>
<td>5.4</td>
<td>58.9</td>
</tr>
<tr>
<td>Manganese</td>
<td>55</td>
<td>84</td>
<td>126</td>
</tr>
<tr>
<td>Iron</td>
<td>31</td>
<td>39</td>
<td>60</td>
</tr>
<tr>
<td>Copper</td>
<td>3.9</td>
<td>4.5</td>
<td>4.9</td>
</tr>
<tr>
<td>Boron</td>
<td>0.3</td>
<td>0.8</td>
<td>3.8</td>
</tr>
</tbody>
</table>

† Soil depth

Figure 1. Number of tillers per plant for four CPL treatments at 30 (A), 60 (B) and 90-d (C).
Figure 2. Dry matter yield (g/plot) for four CPL treatments at 30 (A), 60 (B) and 90-d.