Effect of Poultry Manure on the Nutritive Value of *Basella alba*

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Abstract: A field experiment was conducted at the Teaching and Research Farm of Adeyemi College of Education, Ondo, Southwestern Nigeria to determine the effect of Poultry Manure (PM) on the nutritive value of *Basella alba*. Three levels of poultry manure at 0, 5 and 10t/ha were used as treatments. The treatments were replicated three times and arranged in Randomized Complete Block Design (RCBD). Compared with the control, 5 and 10t/ha PM significantly increased (P<0.05) crude protein, fibre, carbohydrate and fat contents of *Basella alba*. *Basella alba* fertilized with 10t/ha PM had the highest increase in crude protein (52%), fat (21%) and carbohydrate (17%).

Keywords: Poultry Manure, *Basella alba*, Randomized Complete Block Design, Crude Protein, Fibre, Carbohydrate

I. Introduction

*Basella alba* is included in the family *Basellaceae* and originates from tropical Asia (India and Indonesia). It is now grown extensively throughout the tropics and in warmer temperate regions of the world. Nutritionally, *Basella alba* is a rich source of calcium and vitamins (A, B and C) also rich in iron [1]. It is low in calories by volume, but high in protein per calorie [2]. Reference [3] highlighted some nutritional importance of *Basella alba* as a source of Vitamin A which is obtained from the leaves and it is essential for normal growth, body maintenance and vigor. Traditionally, *Basella alba* is used for treating hypertension patient in South Western Nigeria.

Manure is relevant for effective growth of high quality variety of *Basella alba*. Manure refers to organic materials such as cattle and chicken waste, and other bulky, natural substances that are applied on the soil with the intention of increasing the productivity of crops. Nutrient content of manure varies depending on source, moisture content, storage and handling methods. Nitrogen content in manure could vary with the type of animal and feed ration, amount of litter, bedding or soil included and amount of urine concentrated with the manure. Manure is an important resource for crop production and soil sustainability. Manures are a source of almost all the essential nutrients [4]. Applied organic materials promote biological activity in the soil, as well as a favorable nutrient exchange capacity, water balance, organic matter content and soil structure [5]. As the soil absorbs manure, nutrients are released. This enriches the soil, which in turn, promotes plant growth and development. Reference [6] stated that the use of organic manure is as old as agriculture itself and will continue to be the best method of maintaining soil fertility because of its safe utilizable qualities to life. Also, reference [7] asserted that manure constituted the chief sources of crop nutrients before 1960s and beyond in maintaining soil fertility in the humid tropics.

Reference [8] submitted that poultry manure has been found to have beneficial effects on soil properties as well as a crop yield because the CEC, organic matter, total Nitrogen and available phosphorus of soil increased at soya bean harvest, while both the seed dry yield and pod yield of melon which was planted as a residual crop were significantly increased.

Poultry manure could be an excellent source of nutrients for Basella as it has been extensively used for the production of other crops such as maize, Amaranthus and tomato. Many studies have shown that poultry manure contains nutrients such as N, P, K and micronutrients that could be used to increase soil fertility [9]. Reference [10] observed increase in yield of vegetables crops with application of poultry manure.

Chicken manure is the organic waste material from poultry consisting of bird feces and urine. Chicken manure is an excellent fertilizer material because of its high nutrient content, especially for Nitrogen (N), Phosphorus (P), and Potassium (K). Manures decompose (mineralize) in the soil releasing nutrients for crop uptake. Considering the relative importance of *Basella alba* mostly in the area of nutrient provision and the treatment of terminal ailments, the need arises for an increased production with a high nutrient content.

Hence, the aim of the study was to assess the impact of poultry manure on the nutrient composition of *Basella alba* with a view of making recommendations towards effective production.
II. Materials and Methods

The experiment was sited at the Teaching and Research Farm of Adeyemi College of Education, Ondo in the South Western part of Nigeria. The field was cleared manually, lined, pegged and ridged. The field was divided into 9 beds with a plot size of 3m x 3m. Planting space used was 90cm x 90cm. Seed of Basella alba were sown in the beds one week after the addition of poultry manure. Weeding was carried out at 4 weeks interval using local hoe. The experiment was laid out in a Randomized Complete Block Design (RCBD) with 3 treatment replicated 3 times. Poultry manure was applied at 0, 5 and 10t/ha and harvesting was done 12 weeks after planting. Leaf samples were oven dried at 60°C to constant weight. Dried samples were ground and passed through 2mm sieve. The ash, crude fibre and ether extract were determined as described by reference [11]. Nitrogen was obtained by microkjedahl method and percentage N was converted to protein by multiplying with 6.25. Data was collected after 12 weeks of planting on the yield parameters. The yield parameters were leaf area, whole plant weight, weight of root, weight of fresh leaves, numbers of stem, weight of dried leaves and weight of dried root.

Leaf area was determined using graphical method by collecting three leaves from each beds which was taken into the laboratory where it was placed on a graph paper of 2mm by 2mm dimension and traced out. The leaf area was calculated in cm² gotten from the traced diagram using the relationship:

\[
\text{No of holes occupied by each leaf x 2mm} \times \frac{100}{100}
\]

The plant height was determined by using tape rule. The fresh weight of the whole plant was determined by weighing on a sensitive scale immediately after harvest. The fresh leaves were collected from the plant and weighed. The root was cut from the plant and also weighed separately.

The dry leaves weight was determined by collecting the fresh leaves from each plot and transported inside a carefully labeled paper envelope to the laboratory and put inside an oven to dry and was weighed after completely dried.

The dry root weight was determined by carefully uprooting the plant, removing it from the stem, and then packing it inside an envelop to be put inside a hot air oven preset to a temperature of 100°C. After drying, it was weighed and the data recorded. The root dry matter was determined by using the relationship.

Root dry matter = Root wet weight - Root dry weight

The nutrient content of Basella alba such as crude fibre, crude fat, crude protein content, ash, carbohydrate and moisture content were carried out as follows.

For crude fibre, 5.0g of the sample was weighed into 500g conical flask. 200ml of boiling 1.25% h₂SO₄ was added, brought to boil within few minutes and then left to boil gently for 30 minutes. This was filtered using filter paper and then rinsed thoroughly using hot distilled water. The sample on top of the filter paper was scooped with spatula back into conical flask and then 200ml of boiling 1.25% of NaoH was included. This was brought to boil within 1min and then boiled gently for 30 minutes. The digest was filtered using filter paper, rinsed about four times using hot distilled water and once with 10% of HCL; four times again with hot water, and then twice with methylated spirit. The residue was salvage into a pre- weight crucible after drained dried in the oven at 105°C. It was cooled in a desiccator and weighed. This was placed in a muffle furnace at about 300°C for about 30mins. It was removed into the dedicator and allowed to cool to room temperature and then re-weighed.

\[
\text{% Crude fibre} = \frac{W_2 - W_3}{W_1} \times \frac{100}{1}
\]

Where
\(W_1 = \text{weight of sample used.}\)
\(W_2 = \text{weight of crucible and wet sample}\)
\(W_3 = \text{weight of the crucible and sample after furnace}\)

In determining total ash, a crucible was placed in a muffle furnace for about 16 minutes at 350°C. It was removed, cooled in a desiccator to room temperature and then weighted (i.e \(W_1\)). 2g of the sample was weighed into the crucible and weighed again (i.e \(W_2\)). The crucible and its content were placed in a muffle furnace and the temperature was slowly increased from 200 – 450°C. The sample was ashed until it became whitish in colour. It was removed from the furnace into desiccator and allowed to cool to room temperature.

The crucible and its content were re-weighed (i.e \(W_3\)). Percentage ash was now calculated as follows:

\[
\text{% Ash} = \frac{W_3 - W_1}{W_2 - W_1} \times \frac{100}{1}
\]

Where
\(W_1 = \text{Weight of the sample}\)
\(W_2 = \text{Weight of the crucible and wet sample}\)
\(W_3 = \text{Weight of the crucible after furnace}\).
The crude protein content of the sample was determined using kjedahl analysis method to determine the total nitrogen, which was multiplied by a factor of 6.25 to give the protein content. The distillate with mixed indicator was titrated with 0.1m standard HCL until the colour change from greenish colour to pink indicating the end point. In getting the carbohydrate content, the most used approach in determining the carbohydrate content of food in a plant was employed. This was given by difference or subtraction of the sum of Ash, crude fibre, protein and fat from 100 on dry matter basis.

\[
\text{% Carbohydrate} = 100 - (\text{% ash} + 10 \text{ protein} + \text{% fat} + 10 \text{ fibre})
\]

**Crude Fat**

The sample was packed in a thimble and inserted into soxhlet extractor. The soxhlet extractor was placed on a round bottom flask containing petroleum ether of 46-60°C boiling point range. The whole set up was placed on a heating mantle. The heat was regulated so that the ether boiled constantly and uniformly. The extraction was allowed to proceed for about (6) six hours. The thimble with its content was transferred into oven, dried at 100°C for 1 hour, cooled in a desiccator and then weighed.

\[
\text{% Crude fat} = \frac{W_1 - W_2}{W_2} \times 100
\]

*Where \( W_1 \) = Weight of sample. \( W_2 \) = Weight of sample after extraction.*

**III. Data Analysis**

The result was subjected to analysis of Variance (ANOVA) and significant means were separated using least significant Differences (LSD) at 5% probability.

**IV. Results and Discussion**

**A. Initial Soil Properties**

The chemical and physical properties of the soil used to conduct the experiments are as shown in Table 1. It is in agreement with the findings of [12], saying that the soil was slightly acidic, low in OM, N, P, K and fairly adequate in Fe, Cu, Zn and Mn. The table shows that the soil needed plant nutrients from external sources.

**Table 1: Initial Soil Properties**

<table>
<thead>
<tr>
<th>Soil properties</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>4.62</td>
</tr>
<tr>
<td>OC%</td>
<td>0.55</td>
</tr>
<tr>
<td>N (%)</td>
<td>1.12</td>
</tr>
<tr>
<td>P (mg/kg)</td>
<td>0.16</td>
</tr>
<tr>
<td>Al + H</td>
<td>5.62</td>
</tr>
<tr>
<td>K Cmol/kg</td>
<td>4.24</td>
</tr>
<tr>
<td>Ca Cmol/kg</td>
<td>6.24</td>
</tr>
<tr>
<td>Mg Cmol/kg</td>
<td>1.82</td>
</tr>
<tr>
<td>Na Cmol/kg</td>
<td>0.12</td>
</tr>
<tr>
<td>Micronutrients (mg/kg)</td>
<td></td>
</tr>
<tr>
<td>Zn</td>
<td>1.20</td>
</tr>
<tr>
<td>Mn</td>
<td>18.42</td>
</tr>
<tr>
<td>Fe</td>
<td>23.40</td>
</tr>
<tr>
<td>Cu</td>
<td>3.62</td>
</tr>
</tbody>
</table>

**B. Nutrient Composition of Poultry Manure**

Table 2 shows the nutrient composition of the poultry manure used as fertilizer in the conduct of the experiment. The poultry manure has reasonable amount of N, P, K Ca, Mg and traces of Fe, Cu, Zn and Mn. This shows that poultry manure could be used to increase soil fertility. This is in line with the work of [9] who submitted that poultry manure contains plant nutrients. The high amount of calcium found in the poultry manure used for the experiment shows that it could be used to lime an acidic soil.

**Table 2: Nutrient Composition of Poultry Manure (%)**

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>3.2</td>
</tr>
<tr>
<td>P</td>
<td>2.4</td>
</tr>
<tr>
<td>K</td>
<td>0.5</td>
</tr>
<tr>
<td>Ca</td>
<td>5.2</td>
</tr>
<tr>
<td>Mg</td>
<td>1.8</td>
</tr>
<tr>
<td>Na</td>
<td>0.72</td>
</tr>
</tbody>
</table>
C. Nutritional Quality of Basella alba Fertilized with Poultry Manure

The nutritional quality of Basella alba fertilized with poultry manure at the rate of 5 and 10t/ha are shown in Table 3. Compared with control, Basella alba treated with 5 and 10t/ha significantly increased (P<0.05) protein, fat and carbohydrate content of the plant. The order of increase in protein was P_{10}>P_5>P_0. Basella alba fertilized with 10t/ha poultry manure recorded the highest protein, fat, total ash, carbohydrate, leaf moisture and dry matter. This is in line with the work of [12] that organic manure increased crude protein, crude fibre, ether extract and ash in the experiment performed to show the effect of organic, organomineral and N P K 15:15:15 fertilizer on nutritional quality of Amaranthus in Lagos, Nigeria. The better performance of Basella alba fertilized with poultry manure than the unfertilized soil should be as a result of the presence of plant nutrients in the poultry manure used for the treatment.

<table>
<thead>
<tr>
<th>Treatment t/ha</th>
<th>Protein</th>
<th>Fat</th>
<th>Total ash</th>
<th>Carbohydrate</th>
<th>Leaf Moisture</th>
<th>Dry matter</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>18.33</td>
<td>11.50</td>
<td>18.73</td>
<td>9.72</td>
<td>9.42</td>
<td>90.20</td>
</tr>
<tr>
<td>5</td>
<td>19.20</td>
<td>12.77</td>
<td>18.34</td>
<td>9.99</td>
<td>9.90</td>
<td>90.61</td>
</tr>
<tr>
<td>10</td>
<td>19.20</td>
<td>12.77</td>
<td>18.34</td>
<td>10.21</td>
<td>9.97</td>
<td>90.67</td>
</tr>
</tbody>
</table>

The better performance of the Basella alba treated with 10t/ha of poultry manure than the Basella alba grown with 5t/ha might be as a result of higher amount of the manure which might have resulted into the release of higher plant nutrients. The soils fertilized with poultry manure had higher percentage increase in all the parameters. This is shown in table 4.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Protein</th>
<th>Fat</th>
<th>Total ash</th>
<th>Carbohydrate</th>
<th>Leaf Moisture</th>
<th>Dry matter</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>14.56</td>
<td>9.49</td>
<td>0.38</td>
<td>9.90</td>
<td>9.42</td>
<td>90.20</td>
</tr>
<tr>
<td>5</td>
<td>14.56</td>
<td>9.49</td>
<td>0.38</td>
<td>9.90</td>
<td>9.42</td>
<td>90.20</td>
</tr>
<tr>
<td>10</td>
<td>14.56</td>
<td>9.49</td>
<td>0.38</td>
<td>9.90</td>
<td>9.42</td>
<td>90.20</td>
</tr>
</tbody>
</table>

V. Conclusion and Recommendations

The experiment conducted to show the effect of poultry manure on the nutritive value of Basella alba shows that:

- Poultry manure contained N,P,K, Mg and N and that the soil used for the experiment was deficient in N, P, K, Ca and Mg.
- Poultry manure increased crude protein, crude fibre, ether extract, carbohydrate, and ash of Basella alba.
- 10t/ha of poultry manure increased the yield of Basella alba most significantly

In conclusion, Poultry manure applied at the rate of 10t/ha to Basella alba recorded to have the highest amount of crude protein, carbohydrate and ash is thereby recommended for optimum production of Basella alba.

VI. References

