Influence of Different Organic Fertilizers on Growth and Yield of Wheat

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Abstract: Manure not only supply many nutrients for crop production, but it also valuable sources for increasing soil organic matter content and improving soil structure. The field experiment was conducted at Bakrajow Agricultural Research farm which lies between 35°32.36.8” north latitude and 45°21.09.6” east longitude, under rain-fed condition during winter growing season of 2013-2014 to study the influence of different manures on some vegetative growth of wheat variety Semito. The treatments including T1 = control, T2 = 20 t ha⁻¹ sheep manure, T3 = 20 t ha⁻¹ cow manure and T4 = 20 t ha⁻¹ poultry manure, using Randomized Complete Block Design (RCBD) with four replications. The results showed that the poultry manure is the most efficient one compared to sheep and cow manures. The values of grain yield, biological yield and grain protein content were 6.750 t ha⁻¹, 15.666 t ha⁻¹ and 14.955%, respectively, for poultry manure treatment.

Key words: Organic Fertilizers · Manure · Wheat

INTRODUCTION

Wheat (Triticum aestivum L) is the most important cereal crop in the world and it is one of the main sources of carbohydrate and also contains a considerable amount of protein, minerals and vitamins [1]. There is a need to increase the yield of wheat per unit area in the world to fulfill its demands resulted from the rapid growth of the world population. The use of modern varieties of the wheat and judicious fertilization are the important factors which can help the increase of wheat production. It is well recognized that crop productivity depends on adequate plant nutrient and organic matter content of the soil. Manure plays an important role in improving physical, chemical and biological properties of the soil. Manures are content low concentration of plant nutrients and they have a slow acting nature, organic manure alone may fail to tend the high nutritional requirements of crops [2]. Continuous additions of the manures to the soil increase its organic matter content year after year, improving physical and chemical soil properties [3]. This improvement is due to providing of a suitable soil structure, increasing soil cation exchange capacity, increasing the quantity and availability of plant nutrients in addition to furnishing the microbial activities.

Organic fertilizers including sheep manure, cow manure and poultry manure are may be used for crop production as substitute of chemical fertilizers because the importance of organic manures cannot be overlooked [4]. Using manure in wheat production cropland is an alternative method to reduce feedlot environmental impact [5] and thus to achieve an integrated farming system [6]. The prolonged and over usage of chemicals has, however, resulted in human and soil health hazards along with environmental pollution. Farmers in the developed countries are, therefore, being encouraged to convert their existing farms into the organic farm [7]. Organic materials act as chelating agents and hold the minerals desorbed from the soil. During the decomposition of organic matter acids are also produced which increase the availability of minerals nutrients in the soil for plants [8].

The aim of this study was to evaluate the use of sheep manure, cow manure and poultry manure in partial or total replacement of inorganic fertilizers in wheat production and assess their impact on soil properties.

MATERIALS AND METHODS

The proposed research study was conducted at Bakrajow Agricultural Research Farm which lies between 35°32.36.8” north latitude and 45°21.09.6” east longitude,
under rain-fed condition during winter growing season of 2013-2014. Soil samples were drawn before sowing the crop kernel to the depth of 30 cm and were subjected to physic-chemical analysis. The analysis report of soil samples was showed that the ratio of sand (115.4 g kg$^{-1}$), silt (523.6 g kg$^{-1}$) and clay (361.0 g kg$^{-1}$) indicated the soil texture class is silty clay loam (SCL), having pH= 7.27, EC0.17 ds m$^{-1}$, organic matter 1.33%, available P 14.44 ppm, total CaCO$_3$ 24.5%, available total nitrogen 0.11%, soluble Ca$^{2+}$ 1.9 meq L$^{-1}$, soluble Mg$^{2+}$ 1.7 meq L$^{-1}$, soluble K$^+$ 0.056meq L$^{-1}$, soluble Na$^+$ 0.056meq L$^{-1}$, soluble HCO$_3$ 2.0 meq L$^{-1}$, soluble Cl$^-$ 0.2 meq L$^{-1}$ all physical and chemical analysis were determined according to the methods of soil analysis described by [9]. The sheep, cow and poultry manures were also subject to nutrient analysis. They were analyzed according to [10] and the observations were as follows:

The experiment was laid out in Randomized Complete Block Design (RCBD) having a net plot area 2 x 3 m with four replicates. The experiment comprised of four treatments; $T_1$= control, $T_2$= 20 t ha$^{-1}$ sheep manure, $T_3$= 20 t ha$^{-1}$ cow manure and $T_4$= 20 t ha$^{-1}$ poultry manure. Wheat cultivar *Semito* was sown with hand drill on 28th December 2013, using seeding rate of 140 kg ha$^{-1}$. The crop was harvested on 10th Jun 2014 and individual samples were threshed manually. The data was collected and analyzed according to Fischer’s analysis of variance technique with the least significant difference test (LSD) at 5% level of probability [11].

**RESULTS AND DISCUSSION**

The presented data in Table 2 shows the effect of manures on some vegetative growth, biological yield and some of the yield components as follow:

**Plant Height:** Data obtained showed that, $T_1$ had significant difference in plant height with $T_2$, $T_3$ and $T_4$ and also $T_1$ had significant difference with $T_2$. While there was no significant difference between $T_2$ and $T_3$ for this trait. The poultry manure treatment had increased plant height by 10.7% compared to control treatment (no organic fertilizer application). Similar results were found by [12] and [13]. They concluded that the yield components of wheat crop were significantly affected by the treatments which were treated with organic matter over control.

**Number of Tiller per Plant:** Analysis of data for number of tiller/plant showed that $T_1$ was different from $T_2$, $T_3$ and $T_4$, significantly. The treatment $T_3$ also had a significant difference with $T_4$, while $T_2$ and $T_4$ showed similar number of tiller per plant. The number of tiller per plant for $T_4$ was increased by 70.59% compared to control treatment.

**Number of Grains per Spike:** The results showed that the number of grain per spike obtained at all treatments were similar statistically. Our finding is disagreeing with the results obtained by [2]. They found that the different levels of organic fertilizer application significantly increased number of grains per spike.

**1000 Grain Weight (g):** Data analysis showed that there were no significant differences between the treatments for 1000 grain weight of wheat. Different results regard this trait were found by [2]. They found that the different levels of organic fertilizer application significantly increased 1000 grain weight.

**Biological Yield:** Similar to other traits, the biological yield obtained from $T_4$ had the highest value, which was different significantly with the data obtained from $T_1$, $T_2$ and $T_3$. The highest biological yield may be due fact that the poultry manure supplies directly available nutrients such as NPK to the plants more than other fertilizer sources. Organic manures are an excellent source for multi nutrient supply to crop plants, although in a variable manner are depending on their type and quality [14]. Among the organic manure treatments, application of poultry manure was performed better than the others through improving plant characters. This may be due to the fact that in poultry manure the mineralization is rapid. A large portion of nitrogen in poultry manure is in organic fraction, but 20 to 40 percent of the total nitrogen is present in inorganic form [15]. Our results are in agreement with the results of [16]. They reported that the high biological yield may be due to fact that the organic manures supplies direct available nutrients such as nitrogen to the plant and the organic manures improve the proportion of water stable aggregates of the soil.

**Grain Yield:** Wheat grain yield under different manures application are presented in Table 2. The data showed that poultry manure had a significant difference with all other treatments, the maximum value of grain yield was 6.750 t ha$^{-1}$ from $T_4$, while the minimum value was 5.425 t ha$^{-1}$ for $T_2$. The high concentration of NPK in poultry manure compared to other treatments might be a reason for the superiority of grain yield value for $T_4$ (Table 1). Similar results are in agreement with those obtained by [17]. Who found that farm yard manure significantly increased grain yield of wheat.
Table 1: Some chemical properties of manures used in the study

<table>
<thead>
<tr>
<th>Organic fertilizers</th>
<th>pH</th>
<th>EC dS m⁻¹</th>
<th>N%</th>
<th>Available P ppm</th>
<th>soluble K⁻ meq L⁻¹</th>
<th>soluble Na⁺ meq L⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sheep manure</td>
<td>7.78</td>
<td>2.04</td>
<td>1.48</td>
<td>273.43</td>
<td>12.05</td>
<td>12.05</td>
</tr>
<tr>
<td>Cow manure</td>
<td>8.05</td>
<td>5.36</td>
<td>1.17</td>
<td>448.85</td>
<td>25.38</td>
<td>23.38</td>
</tr>
<tr>
<td>Poultry manure</td>
<td>7.36</td>
<td>12.51</td>
<td>1.72</td>
<td>451.61</td>
<td>117.95</td>
<td>117.95</td>
</tr>
</tbody>
</table>

Table 2: Effect of manure application on some growth characteristics of wheat plant grown in calcareous soil

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Plant height (cm)</th>
<th>No. of tillers plant⁻¹</th>
<th>No. of grains spike⁻¹</th>
<th>1000-grain weight (g)</th>
<th>Biological yield (t ha⁻¹)</th>
<th>Grain yield (t ha⁻¹)</th>
<th>Harvest index%</th>
</tr>
</thead>
<tbody>
<tr>
<td>T₁</td>
<td>78.50</td>
<td>4.250</td>
<td>53.00</td>
<td>46.473</td>
<td>11.291</td>
<td>5.473</td>
<td>49.30</td>
</tr>
<tr>
<td>T₂</td>
<td>80.55</td>
<td>5.275</td>
<td>54.00</td>
<td>46.850</td>
<td>11.666</td>
<td>5.425</td>
<td>46.50</td>
</tr>
<tr>
<td>T₃</td>
<td>83.05</td>
<td>5.875</td>
<td>54.00</td>
<td>42.658</td>
<td>12.791</td>
<td>5.615</td>
<td>43.90</td>
</tr>
<tr>
<td>T₄</td>
<td>86.90</td>
<td>7.250</td>
<td>49.00</td>
<td>45.450</td>
<td>15.666</td>
<td>6.750</td>
<td>43.10</td>
</tr>
</tbody>
</table>

Means of each category followed by the same latters are not significantly different at 5% level of probabilities.
Means of each category followed by different latters are significantly different at 5% level of probabilities.

Table 3: Nitrogen content%, phosphorus and potassium concentration of grain wheat under different manure application

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Grain Protein protein content%</th>
<th>Con. N (%)</th>
<th>Con. P (ppm)</th>
<th>Con. K (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T₁</td>
<td>12.475</td>
<td>1.996</td>
<td>40.425</td>
<td>2882.00</td>
</tr>
<tr>
<td>T₂</td>
<td>12.400</td>
<td>1.984</td>
<td>42.910</td>
<td>2688.00</td>
</tr>
<tr>
<td>T₃</td>
<td>13.100</td>
<td>2.096</td>
<td>39.060</td>
<td>2688.00</td>
</tr>
<tr>
<td>T₄</td>
<td>14.95</td>
<td>2.392</td>
<td>40.252</td>
<td>2664.25</td>
</tr>
</tbody>
</table>

Means of each category followed by the same latters are not significantly different at 5% level of probabilities.
Means of each category followed by different latters are significantly different at 5% level of probabilities.

Harvest Index%: The statistical analysis of data obtained shows that there are a significant difference between T₁ with T₃ and T₄ and also between T₁ with T₄ for this trait. The highest value of harvest index was 49.3% from T₁ and the lowest value was 43.1% from T₄.

Data presented in Table (3) reveals the effect of manures on, protein and some macro nutrients content in grain wheat plant as follow:

Grain Protein Content%: Statistical analysis of means value of grain protein content% indicated significant difference between T₄ and both of T₁ and T₂ due to different manure application. Results showed that protein content of wheat grain were ranged from 12.475 to 14.95 percent. One important result in our finding was the significant increase in grain protein content when poultry manure was used, because this manure contains high concentration of NPK that acted positively in more uptakes of water and nutrients. The results are in conformity with the findings of [18]. The reported that the application of compost had a significant effect on seed protein and the maximum amount of seed protein was observed in 60 Mg compost ha⁻¹ treatment.

Grain Nitrogen, Phosphorus and Potassium Content: Statistical analysis of means value of nitrogen content% indicated significant difference between T₄ and both of T₁ and T₂ due to different manure application, while the results from all traits showed that there are no significant differences for phosphorus and potassium content at all the treatments studied.

CONCLUSION

Through the results of current study it has been concluded that the poultry manure treatment is the most efficient one among all manure sources used. It showed the highest grain yield, biological yield and grain protein content compared to the other treatments performed. Manure is a nutrient source for agricultural production, however the slow release of nitrogen from manure and building of P and K in soil solution, may cause the potential environmental implications.

REFERENCES


