The Effect Of Inorganic Fertilizer On Onion Production

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Abstract

The experiment was carried out in the school botanical garden (Kebbi State University of Science and Technology) using complete block design to determine the effect of inorganic fertilizer on the growth of onion. The experiment consisted of four (4) treatments of NPK fertilizer which include: 5g/poly (T1), 10g/polybag (T2), 15g/polybag and control (T0) respectively. The result showed a significant difference (p<0.05) in response to inorganic fertilizer applied when compared with the control in the parameters studied. In the study, major constraint in onion production was identified, which includes high rate of fertilization which causes mortality or damage in its development, this suggests that cultivation of onion with inorganic fertilizer should not be in excess as high dosage causes damage. Thus it was concluded that application of NPK not below 10g/polybag will boost the performance of onion, therefore onion should be treated with inorganic fertilizer not above/below 10g/polybag.
Introduction:
The origin of onions like the origin of garlic is buried in antiquity. It is known that onions were grown in Ancient Egypt and that eventually they arrived in Rome. It was in Rome that they were given the name unio, which means large pearl. Unio became unyon in Middle English when the Romans introduced the onion into the British Isles. The status of the onion rose substantially after French Onion Soup was made popular by Stanislaus I, the former King of Poland. (FAOSTAT, 2009)

Onion cultivation in Nigeria is confined to semi-arid zones of the country. Borno State is regarded as the foremost onion producing state in Nigeria. Other major onion producing states includes Kebbi, Sokoto, Katsina, Kano, and Adamawa. Onion are mostly transplanted in this region between Octobers to November, and harvested between Januarys to March in dry season under irrigation. Yield obtained in Nigeria are not comparable with those obtained in developed countries. World production of onion has increase steadily from about 62 million metric tons produced on an area above 3.7 million hectare in 2009 (FAOSTAT, 2009).

Onion (Allium cepa) is a vegetable crop belonging to the family of Amaryllidaceae (Fritsch et al 2002). Since onion is essentially an out of season crop, practiced on hydro-agricultural lands, productivity varies depend on the climate as onion is susceptible to various climatic conditions, yield obtain in Nigeria can not be comparable to that in developed countries. In Nigeria, production common northern part of Nigeria, more specifically in the dry tropical zone as onion is susceptible to moisture as the might cause rotting. In this light, the greater part of onion production in Nigeria is undertaken in northern part of the country specifically Kaduna, Kano, Jigawa, Katsina, Sokoto, Plateau, kebbi and Bauchi states. The natural features of these regions, especially the presence of flood prone plains and river basins and above all the development of vast irrigated lands, create conditions that greatly favour the development of this crop (Anyanwu, 2003).

Description:
Onions come in three distinct colors: white, yellow and red. The varieties can be classed into three important groupings: short day, intermediate day and long day varieties. These groupings refer to the number of hours of sunlight required to get the onion to bulb. Short Day onions require 10-12 hours of sunlight and are used in the South for winter production. Because Short Day onions have a higher concentration of water as opposed to solid fiber content, they do not store well and should be eaten fresh. Intermediate Day onions require 12-14 hours of sunlight and are ideal for almost all growing areas in the United States. Long Day onions require 14-16 hours of sunlight and grow better in northern states where there are extended hours of daylight during the summer months. Long Day varieties typically have more pungent flavor and store better than other varieties. Onions may be planted in the fall or the spring similar to garlic. Fall plantings will mature earlier. Onion plants are hardy and can withstand temperatures as low as 20°F (twenty
degrees Fahrenheit) so spring plantings may be made as soon as the soil can be worked. Onion is mainly grown for its bulb, its use lies in flavoring and seasoning of a wide range of dishes. Its popularity is due to its aromatic, volatile oil, the ally-prophlsulphide which imparts a cherished flavour to food. Onion is consumed in different ways by different people and forms an essential part of the tradition daily diet. It can be eaten raw, in salad, fried, boiled or roasted and also used in flavouring soups, canned food products and other savoury dishes. It is used in every home virtually on daily basis (Hussein et al., 2000).

In term of composition, raw onion has a nutritional composition value per 100g as fellows: Most onion cultivars have about 89% water, 4% sugar, 1% protein, 2% fibre and 0.1% fat. They contain vitamin C, vitamin B₆, folic acid and numerous other nutrients in small amounts. They are low in fats and in sodium, and with an energy value of 166kJ (40 kcal) per 100 g (3.5 oz) serving, they can contribute their flavour to savoury dishes without raising caloric content appreciably. Onions contain chemical compounds such as phenolics and flavonoid that basic research shows to have potential anti-inflammatory, anti-cholesterol, anticancer and antioxidant properties. There are considerable differences between different varieties in potential antioxidant content. Medically, onion was found to minimize high blood prepare and other heart disease due to its favourable action on the elasticity of blood vessels. Traditionally a medicinal herb, the bulb are used for the treatment of measles, pneumonia, cold and catarrh. Recent studies have confirmed that onion helps in fighting osteoporosis born losses (Gambo et al., 2005). Fertilizers are chemical compounds applied to promote plant growth. Typically, fertilizers are applied either to the soil (for uptake by plant roots) or by foliar feeding (for uptake through leaves) (Stewart et al., 2005).

Synthetic fertilizers are commonly used for growing all crops, with application rates depending on the soil fertility, usually as measured by a soil test and according to the particular crop. Legumes, for example, fix nitrogen from the atmosphere and generally do not require nitrogen fertilizer (Erisman et al., 2008). Studies have shown that application of nitrogen fertilizer on off-season cover crops can increase the biomass (and subsequent green manure value) of these crops, while having a beneficial effect on soil nitrogen levels for the main crop planted during the summer season. (Sartain, 2011)

Compound fertilizers often combine N, P and K fertilizers into easily dissolved pellets. The N:P:K ratios quoted on fertilizers give the weight percent of the fertilizer in nitrogen (N), phosphate (P₂O₅) and potash (K₂O equivalent). The use of commercial inorganic fertilizers has increased steadily in the last 50 years, rising almost 20-fold to the current rate of 100 million tonnes of nitrogen per year (Glass 2003) without commercial fertilizers it is estimated that about one-third of the food produced now could not be produced. The use of phosphate fertilizers has also increased from 9 million tonnes per year in 1960 to 40 million tonnes per year in 2000. A maize crop yielding 6–9 tonnes of grain per hectare requires 31–50 kg of phosphate fertilizer to be applied, soybean requires 20–25 kg per hectare. Yara International is the world’s largest producer of nitrogen based fertilizers (Vance et al., 2003). Applying excessive amounts of fertilizer has negative environmental effects, and wastes the growers’ time and money. To avoid over-application, the nutrient status of crops should
be assessed. Nutrient deficiency can be detected by visually assessing the physical symptoms of the crop. Nitrogen deficiency, for example has a distinctive presentation in some species. However, quantitative tests are more reliable for detecting nutrient deficiency before it has significantly affected the crop. Both soil tests and Plant Tissue Tests are used in agriculture to fine-tune nutrient management to the crops needs (Aaron, 1984).

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AIM OF THE STUDY
The aim of this research is to:

Comparatively assess the effect of inorganic fertilizer on growth of onion

OBJECTIVES OF THE STUDY
To investigate whether an increase rate application of inorganic fertilizer has an effect on growth and yield of the onion.

MATERIALS AND METHODS

Experimental Site

The research was conducted in botanical garden of Kebbi State University of science and Technology (Latitude 12° 11′ N; Longitude 4° 16′ E), in the Sudan savannah agro-ecological zone of Nigeria, during the 2013/2014 dry season. The climate of the area is semi-arid characterized by erratic and scanty rainfall that last for about four months (May - September) and long dry period of about 7month (October - April). The average rainfall of the area is about 550 – 650 mm per annum. The relative humidity ranges from 21 – 47 % and 51 – 79 % during the dry and rainy seasons, respectively. The temperature averages between 27 – 41° C during dry season and 14 – 30° C during rainy season (NNN, 2012). The soil type and fertility vary from place to place, ranging from sandy loam to clay loam.

Treatments and Experimental Design

The treatments consisted of four (4) treatments 0g NPK (control) 5g/polybag, 10g/polybag and 15g/polybag designated as T₀, T₁, T₂ and T₃ respectively. The treatments were laid out in Complete Block Design (CBD) replicated four (4) times.

Cultural practices

Nursery management.

The nursery was watered every for 4-5 days to stimulate the release of nutrients. The onion seeds were drilled 20 cm apart. The pots were irrigated daily using watering can. Weeds were frequently removed as they emerge in the nursery by hand pulling.

Planting

The seedlings were transplanted when they are 10-15 cm long i.e. 30-35 days of sowing. The intra and inter-row spacing were 10 and 20cm respectively.

Irrigation

The irrigation of seedlings was done by surface irrigation method, where the water will be drawn from the reservoir well using watering can to convey the site and distributed to the
sub pots. The process was carried out at twice a day until harvesting.

3.3.5 Weeding
Weeding was carried out by hand picking.

3.4 Data Collection
Data of the plant emergence and harvest were recorded, plant stand were counted 2WAT records were also made on the following:-
- Number of leaves
- Bulb diameter(cm) and weight
- Plant height
- Rate of mortality
- Statistical analysis

3.4.2 Plant height (cm)
Plant height was measure at 4, 6, 8 and 10 WAT. The process involves measuring the length of the seedlings using meter rule from the base to the aerial point of the plant.

**Table 1. The average plant height (cm) measured in the 4th, 6th, 8th and 10th week after transplanting (WAT)**

<table>
<thead>
<tr>
<th>Treatments</th>
<th>4WAT</th>
<th>6WAT</th>
<th>8WAT</th>
<th>10WAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>T₀ – Control</td>
<td>11.00 ± 1.00&lt;sup&gt;a&lt;/sup&gt;</td>
<td>11.67 ± 1.53&lt;sup&gt;a&lt;/sup&gt;</td>
<td>14.33 ± 1.53&lt;sup&gt;b&lt;/sup&gt;</td>
<td>14.67 ± 1.53&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>T₁ – NPK (5g)</td>
<td>13.00 ± 1.00&lt;sup&gt;a&lt;/sup&gt;</td>
<td>15.00 ± 1.53&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>18.00 ± 1.00&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>20.33 ± 3.51&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>T₂ – NPK (10g)</td>
<td>13.70 ± 1.53&lt;sup&gt;a&lt;/sup&gt;</td>
<td>16.00 ± 1.00&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>18.67 ± 1.53&lt;sup&gt;b&lt;/sup&gt;</td>
<td>23.33 ± 2.52&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>T₃ – NPK(15g)</td>
<td>14.00 ± 1.00&lt;sup&gt;a&lt;/sup&gt;</td>
<td>17.00 ± 1.00&lt;sup&gt;a&lt;/sup&gt;</td>
<td>22.33 ± 4.16&lt;sup&gt;b&lt;/sup&gt;</td>
<td>28.67 ± 3.06&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Means followed by the same letter are not significantly different according to Duncan’s Multiple Range Test at 5 % level.

3.3.5 Bulb weight
Bulb yield was determined at harvest. It involves weighing the onions bulbs harvested from each plot using weighing balance.

3.4 Statistical analysis
The collected and recorded data from all the above parameters were analyzed using analysis of procedure for CBD in accordance with Gomez (1984). Significantly different means among the treatments were further be separated using least significant difference (LSD) at 5 % level of significance.

**RESULTS**
The plant response to treatment in height, bulb and number of leaves.
The result of experiment shows the variation in plant height, number leaves, the bulb diameter and weight of mortality and rate of onion at the 4, 6, 8 and 10 WAT. As presented in table 1, 2, 3 and 4.

**Key:** - WAT: - week after transplanting
Table 2. Number of leaves

<table>
<thead>
<tr>
<th>Treatment</th>
<th>4 WAT</th>
<th>6WAT</th>
<th>8WAT</th>
<th>10WAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>T₀ – CONTROL</td>
<td>3.00±1.00ᵃ</td>
<td>3.00±0.58ᵃ</td>
<td>3.33±0.00ᵃ</td>
<td>5.00±0.00ᵇ</td>
</tr>
<tr>
<td>T₁ – NPK (5g)</td>
<td>3.00±0.58ᵃ</td>
<td>3.33±0.00ᵃ</td>
<td>4.00±0.00ᵇ</td>
<td>7.00±0.00ᶜ</td>
</tr>
<tr>
<td>T₂ – NPK (10g)</td>
<td>4.00±1.00ᵃ</td>
<td>4.00±0.00ᵃ</td>
<td>5.00±0.00ᶜ</td>
<td>7.00±0.00ᶜ</td>
</tr>
<tr>
<td>T₃ – NPK (15g)</td>
<td>3.33±0.00ᵃ</td>
<td>4.00±0.00ᵃ</td>
<td>7.00±0.00ᶜ</td>
<td>10.00±0.00ᵈ</td>
</tr>
</tbody>
</table>

Means followed by the same letter in each column are not significantly different according to Duncan’s Multiple Range Test at 5 % level

Table 3. The weight and diameter of onion (cm)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Average weight of the bulb (g)</th>
<th>Bulb Diameter (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T₀</td>
<td>10.62</td>
<td>4.5</td>
</tr>
<tr>
<td>T₁</td>
<td>17.20</td>
<td>7.00</td>
</tr>
<tr>
<td>T₂</td>
<td>18.10</td>
<td>9.5</td>
</tr>
<tr>
<td>T₃</td>
<td>15.30</td>
<td>8.5</td>
</tr>
</tbody>
</table>
Table 4. Rate of mortality

<table>
<thead>
<tr>
<th>treatments</th>
<th>4&lt;sup&gt;th&lt;/sup&gt; week</th>
<th>6&lt;sup&gt;th&lt;/sup&gt; week</th>
<th>8&lt;sup&gt;th&lt;/sup&gt; week</th>
<th>10&lt;sup&gt;th&lt;/sup&gt; week</th>
</tr>
</thead>
<tbody>
<tr>
<td>T&lt;sub&gt;0&lt;/sub&gt;-control</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>NPK(5g)</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>T&lt;sub&gt;2&lt;/sub&gt;-NPK10g)</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>T&lt;sub&gt;3&lt;/sub&gt;-NPK(15g)</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

DISCUSSION, CONCLUSION AND RECOMMENDATION

DISCUSSION

The result of plant height of the onion at 4, 6, 8, and 10 week showed a significant (p < 0.05) effect of inorganic fertilization, as presented in table 1. At 4<sup>th</sup> and 6<sup>th</sup> week after planting the plant show no significance different (p < 0.05) from each treatment, they were statistically the same in plant height, but at 8<sup>th</sup> week the plant height of onion plants were also observed to be statistically the same (p < 0.05) but the T<sub>1</sub> (5gNPK) show significance difference. Furthermore, at 10<sup>th</sup> week after planting, it was observed that T<sub>1</sub>, T<sub>3</sub> and T<sub>3</sub> are statistically the same but showed significant different (p < 0.05) over the control treatment (T<sub>0</sub>). However, the variation in the treatments may be due to the supply of the inorganic fertilizer at different rates. These could have aided the quick release of nutrient in T<sub>1</sub> and T<sub>2</sub> and responsible for the accelerated growth at the early stage. Furthermore, high mortality was also observed in T<sub>2</sub> and T<sub>3</sub> (Table 6) this could have resulted due to high concentration of the inorganic fertilizer that led to severe lost of many of the plantlets in T<sub>2</sub> and T<sub>3</sub> but the T<sub>0</sub> – control and T<sub>1</sub> was found strong and this also suggest that high dosage can lead to lost of the plant and can only be of advantage if incorporated with organic fertilizer.

The results of number of leaves are represented in table 4, the number of leaves at the 4<sup>th</sup> and 6<sup>th</sup> week show no significant different but at 8<sup>th</sup> week after plantingT<sub>1</sub> (7.00±0.00) showed significance different over the other treatments, T<sub>1</sub> and T<sub>2</sub> were statistically the same but different from T<sub>0</sub> and 10<sup>th</sup> week after planting, it was observed that T<sub>1</sub> and T<sub>3</sub> were statistically the same (7.00 ±0.00; 7.00 ±0.00) but T<sub>3</sub> had a better foliage parameters (10.00± 0.00), as it is said that as number of leaves increase the bulb diameteralso increasesSeranet et al (2010).

The diameter and weight at the time of harvesting shown on table3, present the average bulb of the treatments, which were statistically significant different when compared to the control treatment. The control gave the lowest yield, and the highest yield was obtained in T<sub>2</sub> and also from T<sub>1</sub>, this also suggest that the use of inorganic fertilizer in a considerable amount ensures the quick release of nutrient and provides the plant with what is needed at the appropriate time, therefore plant will face no limitation during the time of yield, inorganic fertilizer are concentrated form of soil nutrient which can be transported much more rapidly, therefore this plants were unable to access required amount of nutrient in critical yield forming period and this may
probably be the reason for higher yield in T₂ and T₃. Thus, the present results agree with the previous work conducted by Seranet al. (2010).

**Conclusion**

The result of the experiment clearly indicates the role of inorganic fertilizer on the performance of onion, treatment supplying inorganic fertilizer show significant difference in the plant height, number of leaves, diameter and weight of onion over the control. The rate of release of nutrient is higher in treatment 1, 2, 3 since they provide the major elements at the early stage. Thus plant exhibited accelerated growth rate than treatment control, however mortality increases as the supply increase as notice in T₃ high mortality was recorded therein.

**RECOMMENDATIONS**

i- Further investigations should be carried out on the heavy metals loads and long term toxicity to ensure the safety of the use of inorganic fertilizer on onion when consumed.

ii- A study to determine the effect of inorganic fertilizer on the proximate composition should be carried out.

iii- The use of combinations of inorganic and organic fertilizer should also be investigated on the growth rate and yield. it is said that addition of organic fertilizer (manure) increases the water holding (Ndukwe et al., 2010) and free aeration especially when the type of the soil in this region is having poor aeration. This result suggests that the combination of organic fertilizer will increase the performance and quick release of the nutrient if properly irrigated.

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