# Integrated Application of Wood Ash and Inorganic Fertilizers on The Growth and Yield of Garden Egg (*Solanum aethiopicum* L.)

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ABSTRACT

*Wood ash is one of the commonly available organic wastes in Nigeria because firewood is a common source of fuel for both rural and urban dwellers and can become an important alternative source of inorganic potassium especially for farmers in areas with acidic soils. Treatments consisted of the application of inorganic fertilizer sources (0 kg ha-1, 130.44 kg ha-1 urea and 300 kg ha-1 NPK 20:10:10) and wood ash (0 t ha-1, 5 t ha-1 ash and 10 t ha-1 ash) to garden egg seedlings in the field using 3 x 3 factorial experiment in randomized complete block design with three replications. Main effect of wood ash showed significant ($p \leq 0.05$) fruit yield in this order: 10 t ha-1 of wood ash > control > 5 t ha-1 of wood ash. The main effect of inorganic fertilizer sources on fruit yield followed this sequence: 300 kg ha-1 NPK 20:10:10 > 130.44 kg ha-1 Urea > control. The interaction of 10 t ha-1 of wood ash and 300 kg ha-1 NPK 20:10:10 produced highest fruit yield (57 t ha-1) while 5 t ha-1 of wood ash produced lowest fruit yield (10.70 t ha-1). Therefore, the application of integrated 10 t ha-1 of wood ash and 300 kg ha-1 NPK 20:10:10 for improved growth and yield of garden egg is recommended to farmers in Awka.*

## INTRODUCTION

Garden egg (*Solanum aethiopicum* L.) is a crop of solanaceae family. The leaves and fruits are used as vegetables in local delicacies and can be eaten raw in Nigeria. The fruits are known to have medicinal properties such as anti inflammatory, anti asthmatic, anti-glaucoma, hypoglycemic and fat burning property in human (Ayodele, 2018). These healing properties of garden egg can be attributed to the high presence of fibre, ascorbic acid, anthocyanin, glycoalkaloids and alpha-chaconine (Sanchez-Mata *et al*., 2010). Nutritional studies on garden egg shows that the fruits are rich in fibre, protein and minerals (Yamoah, 2016).

Crop production in tropical zones of Nigeria usually faces the challenge of poor soil productivity because of high rainfall which results in leaching of soil nutrients (FPPD, 1989). Just like nitrogen is very limiting in tropical soil due to its high leaching ability, potassium is also limiting in the rain forest zones because potassium is highly soluble and can also be easily lost through leaching (Thomas *et al.* 2016). Potassium is one of the commonly leached cation because it is easliy displaced in soil solution and it is easliy percolated in sandy soils (Mendes *et al.,* 2016). Fertilizers, lime and humus produce soluble ions are easily lost during rainfall or excessive irrigation through downward percolation of soil water (Thomas *et al.* 2016). Potassium which is a soluble ion can move downwards in the soil profile durring rainfall or excessive irrigation beyond the reach of crop root system.

Wood ash is another source of waste in southeastern Nigeria where the locals and eatery stores rely heavily on wood as source of energy for cooking. These ashes constitute great waste and if not utilized positively can cause environmental pollution. Burning of woods into ash for cooking contributes greenhouse gases to the atmosphere. However, the use of wood ashes in crop production tends to absorb the carbon iv oxide from the atmosphere and convert it into foods by using the ash as lime or manure and wood ash has been reported to improve crop growth and yield in okra (Okoli *et al.,* 2015, Ojeniyi, 2007), cowpea (Ojeniyi and Iderawumi, 2020) . Thus, the utilization of wood ash as lime/manure will reduce contribution of this fossil fuel to climate change and the crops help to reduce carbon iv oxide accumulation in the atmosphere and thereby, purifying our environment.

However, there is lack of awareness, paucity of information on scientific results on the use of wood ash for crop production which has resulted in dumping of these ashes in bushes which are washed into water bodies causing water pollution. When wood ash is used as lime/manure in crop production, wood ash will have increase agricultural and economic value and the threat of indiscriminate dumping of ash to our environment will reduce drastically.

Wood ash can be utilized effectively as lime/manure in garden egg production by integrating it with inorganic fertilizers because, wood ash can only contribute calcium, magnesium, potassium and sodium to the soil with little or no nitrogen, carbon and sulphur (Asadu *et al.*, 2004). High potassium content of wood ash plays a great role in flower and fruit development while inorganic fertilizers which supply nitrogen necessary for vegetative growth (Dursun *et al*, 1999). Therefore, wood ash in the absence of nitrogen fertilizer will not produce optimally high growth and yield in garden egg. Research works on the integrated application of wood ash and inorganic fertilizers have reported improved growth and yield in crops like pepper (Olugbemi, 2019), okra (Iderawumi, 2018), tomato (Ewulo *et al*., 2009) and maize ( Awodun *et al*., 2007). However, there is a great paucity of information on the integration of wood ash and inorganic fertilizers for the production of garden egg.

Therefore, this research was conducted to determine the effectiveness of integration of wood ash with inorganic fertilizers to improve the yield of garden egg in poor soils and in the era of scarcity and high cost of inorganic fertilizers.

## MATERIALS AND METHODS

### Experimental site

The study was carried out in the Teaching and Research Farm of the Department of Crop Science and Horticulture, Nnamdi Azikiwe University, Awka, Nigeria. The research farm lies at the latitude of 06 °15 N and longitude 07 °08 E, with an average annual rainfall of 1810.3 mm and relative humidity of 72.3%. The average minimum and maximum temperatures of the field were 28.74 °C and 28.96 °C with average relative humidity of 63.48% during the experiment (GEOMET-NAU 2021).

### Soil of the experimental site and wood ash laboratory analytical methods

Pre planting soil samples were taken at the depth of 0-20cm. The samples were processed following standard laboratory procedures and analysed for the following parameters: soil pH ($H_2O$) using 1; 1 Soil / water ratio with pH meter, exchangeable bases ($Ca^{2+}$, $Mg^{2+}$. $K^+$ and $Na^+$ ) were determined using 1 N $NH_4$ AOC extractant and the concentration of $K^+$ and $Na^+$ in the extract will be read from a flame photometer , while $Ca^{2+}$ and $Mg^{2+}$ concentration were determined from AAS. Available P were assessed by Bray $^{-1}$ method, as described by Okalebo *et al* .,1993. Organic carbon were determined using dichromate wet oxidation (Walkley-Black) method as described by Rowell, 1996. Micro Kjeldhal method as described by Okalebo *et al* . (1993) were deployed for the determination of the soil total nitrogen.

### Treatments and experimental Design

The treatments consisted of inorganic sources (0, 130.44 kg $ha^{-1}$ urea and 300 kg $ha^{-1}$ NPK 20:10:10) and wood ash (0, 5 t $ha^{-1}$ ash and 10 t $ha^{-1}$ ash) applied in combination to garden egg seedlings. This experiment was carried out in the field and the experimental design was 3 x 3 factorial experimental design in randomized completely block design with three replications. Each rate in the inorganic fertilizer supplied 60 kg $ha^{-1}$ of nitrogen respectively.

### Cultural practices

Garden eggs seedlings were raised in a nursery located at the Teaching and Research Farm of the Department of Crop Science and Horticulture in seedling trays filled standard nursery mixture (Top soil + poultry manure + river sand in the ratio of 3:2:1) and were transplanted when the young seedlings had five leaves and were 20 cm tall by gently lifting up the seedlings with the standard nursery mixture and placing them in their respective holes of raised beds. The seedlings were planted at the spacing of 50 cm between rows and 50 cm within rows. The crop production was carried out under rain-fed condition. The treatments were applied using ring methods one week after transplanting. The nursery and the field were kept weed free by hand pulling and hoeing respectively throughout the period of the experiment. Fruits were harvested from three months after transplanting while still green in colour.

### Data collection and analysis

The following growth and yield data were recorded; plant height (measured with measuring tape from ground level to tip apex), number of leaves (physically counting the number of fully open leaves), girth (using vernier caliper at 10 cm above the ground level), number of branches (physically counting the number of branches), number of fruits (counting the number of fruits per plant) and fruit yield (weighing the fruit weight using electronic scale). Growth parameters were measured at 2, 4, 6 and 8 weeks after transplanting (WAT) while yield parameters were measured from 9 WAT. Data collected were subjected to analysis of variance for completely randomized block design using GENSTAT 2009 version statistical software package and means were separated using least significant difference at 5 % level of probability.

**RESULTS AND DISCUSSION**

**Soil and wood ash chemical properties**

The soil used for planting is slightly acidic, low in organic matter and has very poor nitrogen content. Wood ash is alkaline in nature and contains high potassium, calcium and sodium with low nitrogen content (Table 1).

**Table 1: Chemical properties of soil and wood ash**

| Elements | Soil | Wood ash |
|---|---|---|
| Nitrogen (%) | 0.01 | 1.10 |
| Organic carbon (%) | 0.11 | 6.86 |
| Organic matter (%) | 1.51 | 11.83 |
| Sodium (cmol/kg) | 0.03 | 88.00 |
| Magnesium (cmol/kg) | 0.60 | 21.87 |
| Calcium (cmol/kg) | 0.80 | 68.00 |
| Potassium (cmol/kg) | 0.07 | 440.64 |
| Available phosphorus (ppm) | 9.28 | 38.20 |
| pH in water | 5.80 | 8.20 |

Main effect of wood ash on the garden growth and yield parameters

Wood ash did not significantly affect plant height at 2, 4 and 8 WAT. Tall garden egg plant (102.10 cm) was produced by the control while the application of 10 t $ha^{-1}$ of wood ash produced dwarf garden egg (85.90 cm) at 6 WAT. There was significant difference between the height of garden egg plants produced with 5 t $ha^{-1}$ (91.30 cm) and 10 t $ha^{-1}$ (85.90 cm) of wood ash (Table 2). Stem girth was not significantly affected by wood ash at 2 and 4 WAT (Table 2). Biggest stem girth was produced by control (5.33 mm) while the smallest stem girth was produced by 10 t $ha^{-1}$ of wood ash (4.79 mm) at 6 WAT. Application of 10 t $ha^{-1}$ of wood ash produced smallest stem girth (4.76 mm) whole control produced biggest stem girth (5.91 mm) at 8 WAT.

Number of leaves was highest in garden egg produced with 5 t $ha^{-1}$ of wood ash (9.31) control (7.33) produced lowest number of leaves at 2 WAT (Table 2). Number of leaves was not significantly affected by wood ash at 4 and 6 WAT, however, at 8 WAT, control produced highest number of leaves (182.20) while the application of 10 t ha-1 of wood ash produced the lowest number of leaves (118.70). Number of branches was highest in garden egg produced with 5 t $ha^{-1}$ of wood ash (2.87) while control produced lowest number of branches (1.84) at 2 WAT (Table 3). Application of 10 t $ha^{-1}$ of wood ash produced lowest number of branches while control produced highest number of branches at 4, 6 and 8 WAT. Number of fruits was highest in control (105.00) while garden egg produced with 5 t $ha^{-1}$ of wood ash produced lowest number of fruits (43.50). Lowest yield of garden egg was observed in garden egg that received 5 t $ha^{-1}$ of wood ash (17.80 t $ha^{-1}$) while 10 t $ha^{-1}$ of wood ash (33.00 t $ha^{-1}$) produced highest yield in garden egg (Table 3). Growth parameters such as plant height, stem girth, number of leaves and number of branches were superior in the control while the application of wood ash at 10 t $ha^{-1}$ produced highest fruit yield. The poor performance of growth parameters in relation to the control could be attributed to poor nitrogen content of wood ash (Table 1). According to Okoli *et al*., 2015, palm bunch ash has poor nitrogen and high in potassium with the negative implication on vegetative growth, however, favours fruit yield. This observation of the poor performance of the wood ash on the growth parameters affirms the result of Purwanto *et al*., (2020) who found out that wood ash treatment on pepper significantly affected plant dry weight, root volume, number of fruits per plant and fruit weight per plant but has no significant effect on plant height. The improvement of the fruit weight reiterates the importance of potassium in flowering and fruit development in fruit and fruit vegetable crops. Wood ash has been found to improve pod yield in okra (Ojeniyi, 2007), root yield in carrot (Obidiebube *et al.,* 2022) and cowpea pod yield (Ojeniyi and Iderawumi, 2020).

**Table 2**: Main effect of wood ash on plant height (cm), stem girth (mm) and number of leaves

| **Treatments ($t\ ha^{-1}$)** | **Plant height (cm) WAT** | | | | **Stem girth (mm) WAT** | | | | **Number of leaves WAT** | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2 | 4 | 6 | 8 | 2 | 4 | 6 | 8 | 2 | 4 | 6 | 8 |
| **0** | 19.36 | 52.90 | 102.10 | 126.50 | 1.87 | 3.29 | 5.33 | 5.91 | 7.33 | 40.30 | 90.60 | 182.20 |
| **5** | 21.46 | 49.80 | 91.30 | 120.10 | 1.94 | 3.39 | 5.27 | 5.00 | 9.31 | 41.90 | 88.60 | 128.20 |
| **10** | 21.33 | 48.50 | 85.90 | 104.70 | 1.58 | 3.32 | 4.79 | 4.76 | 7.82 | 41.50 | 84.80 | 118.70 |
| **LSD $_{(0.05)}$** | 3.06 | 7.62 | 9.72 | 18.92 | 0.31 | 0.37 | 0.43 | 0.77 | 1.18 | 6.08 | 6.82 | 36.07 |
| **Significant level** | NS | NS | ** | NS | NS | NS | * | ** | ** | NS | NS | ** |

NS = Non significant, * = Highly significant, ** = Significant

**Table 3**: Main effect of wood ash on no of branches, number of fruits and yield ($t\ ha^{-1}$)

| Treatments ($t\ ha^{-1}$) | No of branches WAT | | | | No of fruits | Fruit yield ($t\ ha^{-1}$) |
|---|---|---|---|---|---|---|
| | 2 | 4 | 6 | 8 | | |
| 0 | 1.84 | 15.11 | 14.89 | 21.11 | 105.00 | 31.10 |
| 5 | 2.87 | 11.53 | 11.53 | 15.13 | 43.50 | 17.80 |
| 10 | 2.07 | 11.20 | 11.20 | 12.38 | 64.90 | 33.00 |
| LSD $_{(0.05)}$ | 0.83 | 2.98 | 3.11 | 4.30 | 44.62 | 12.18 |
| Significant level | * | * | * | ** | * | * |

NS = Non significant, * = Highly significant, ** = Significant

**Main effect of inorganic fertilizers on the garden growth and yield parameters**

Application of 300 kg $ha^{-1}$ of NPK produced significantly tallest garden egg at 2 (23.64 cm), 4 (55.60 cm), 6 (105.80 cm) and 8 (132.20 cm) WAT while control produced dwarf garden egg at 2 (16.26 cm), 4 (42.70 cm), 6 (83.50 cm) and 8 (110.00 cm) WAT (Table 4). Stem girth was not significantly affected by inorganic fertilizer application at 2, 4 and 8 WAT (table 4). Number of leaves was highest in garden egg produced with 300 kg $ha^{-1}$ of NPK (10.76) and lowest in control (6.38) at 2 WAT (Table 4). Number of leaves was not significantly affected by inorganic fertilizers at 4 WAT. Number of leaves was highest in garden egg produced with 300 kg $ha^{-1}$ of NPK (111.80) and lowest in control (73.40) at 6 WAT. Application of 300 kg $ha^{-1}$ of NPK produced highest number of leaves (178.00) while the application of 130.44 kg $ha^{-1}$ of Urea produced lowest number of leaves (124.50) at 8 WAT. Number of branches was highest in garden egg produced with 300 kg $ha^{-1}$ of NPK (3.91), followed by the application of 130.44 kg $ha^{-1}$ of urea (1.91) and lowest in control (0.96) at 2 WAT (Table 5). Number of branches was not significantly affected by inorganic fertilizers at 4, 6 and 8 WAT. Number of fruits was not significantly affected by inorganic fertilizers. Highest fruit yield was produced by the application of 300 kg $ha^{-1}$ of NPK (41.00 t $ha^{-1}$) while the control (13.10 t $ha^{-1}$) produced lowest fruit yield (Table 5). The inorganic fertilizer sources showed a significant effect on the growth and yield parameters in relation to the control. Both urea and NPK fertilizer increased growth parameters with respect to plant height, stem girth, number of leaves and number of branches. The significant effect of inorganic fertilizer sources on the growth and yield parameters could be attributed to the supply of nutrient elements such as nitrogen by urea and NPK fertilizers as well as phosphorus and potassium by NPK fertilizer. This result agrees with the findings of Okoli *et al* (2015) on the improvement of okra height, number of leaves, leaf area and number of pods by NPK 15:15:15 fertilizer with respect to the control. Urea fertilizer significantly outperformed the growth and yield control garden egg. Urea supplied nitrogen element necessary for the growth of the garden egg in a very poor soil. This confirms the work of Masome, (2013) who stated that nitrogen from urea are effective on the growth and reproductive factors of tomato. Increasing rates of nitrogen from urea increased the growth and fresh fruit yield of African eggplant in relation to zero application of urea (Olunloyo *et al.*, 2019). The result shows the superiority of 300 kg $ha^{-1}$ of NPK over 130.44 kg $ha^{-1}$ of urea on the growth and yield performance in garden egg. Both inorganic fertilizers supplied 60 kg $ha^{-1}$ of nitrogen, however, NPK fertilizer also supplied phosphorus and potassium elements which boosted the vegetative and yield parameters of garden egg. Nitrogen is responsible for plant vegetative growth and development, phosphorus is involved in root growth while potassium increases photosynthesis capacity, strengthens cell tissue, activates the absorption of nitrates, stimulates flowering and fruit development in tomato and eggplant (Dursun *et al*., 1999). Deficiency of these nutrient elements in the soil as reported in Table 1 will result in poor vegetative growth, root development and flower initiation and fruit yield. Therefore, garden egg cultivated with NPK fertilizer became superior to garden egg cultivated with urea in terms of plant height, stem girth, number of leaves, number of branches, number of fruits and fruit yield. These findings confirms the results of Adeyeye *et al.*, (2018), who reported that NPK fertilizer increased number of leaves, number of nodes, number of flowers and fruits in tomatoes in relation to urea.

Table 4: Effect of inorganic fertilizer sources on plant height (cm), stem girth (mm) and number of leaves

| Treatments (kg ha$^{-1}$) | Plant height (cm) WAT | | | | Stem girth (mm) WAT | | | | Number of leaves WAT | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2 | 4 | 6 | 8 | 2 | 4 | 6 | 8 | 2 | 4 | 6 | 8 |
| 0 | 16.26 | 42.70 | 83.50 | 110.00 | 1.71 | 3.19 | 4.82 | 4.89 | 6.38 | 40.40 | 73.40 | 127.20 |
| 130.44 kg ha$^{-1}$ of Urea | 22.24 | 52.90 | 90.00 | 109.10 | 1.80 | 3.46 | 4.99 | 5.02 | 7.33 | 39.50 | 78.90 | 124.50 |
| 300 kg ha$^{-1}$ of NPK | 23.64 | 55.60 | 105.80 | 132.20 | 1.88 | 3.34 | 5.58 | 5.76 | 10.76 | 43.80 | 111.80 | 178.00 |
| LSD (0.05) | 3.06 | 7.62 | 9.72 | 18.92 | 0.31 | 0.37 | 0.43 | 0.77 | 1.18 | 6.08 | 6.82 | 36.07 |
| Significant level | ** | ** | ** | * | NS | NS | * | NS | ** | NS | ** | ** |

NS = Non significant, * = Highly significant, ** = Significant

**Table 5**: Effect of inorganic fertilizer sources on number of branches and yield parameters

| Treatments (kg ha$^{-1}$) | Number of branches WAT | | | | No of fruits | Fruit yield (t ha$^{-1}$) |
|---|---|---|---|---|---|---|
| | **2** | **4** | **6** | **8** | | |
| 0 | 0.96 | 11.16 | 11.16 | 15.11 | 53.10 | 13.10 |
| 130.44 kg ha$^{-1}$ of Urea | 1.91 | 12.64 | 12.42 | 15.49 | 80.40 | 27.80 |
| 300 kg ha$^{-1}$ of NPK | 3.91 | 14.04 | 14.04 | 18.02 | 81.70 | 41.00 |
| $LSD_{(0.05)}$ | 0.83 | 2.98 | 3.11 | 4.30 | 44.62 | 12.18 |
| Significant level | * | NS | NS | NS | NS | * |

NS = Non significant, * = Highly significant, ** = Significant

**Interaction effect of wood ash and inorganic fertilizer on the growth and yield of garden egg**

Interaction of 5 t ha$^{-1}$ of wood ash and 300 kg ha$^{-1}$ of NPK produced significantly tallest garden egg (30.23 cm) while control produced dwarf garden egg (16.10 cm) at 2 WAT (Table 6). There was no significant difference between heights of garden egg produced by the interaction of 5 t ha$^{-1}$ of wood ash and 300 kg ha$^{-1}$ of NPK (30.23 cm) and interaction of 10 t ha$^{-1}$ of wood ash and 130.44 kg ha$^{-1}$ of urea (27.20 cm). Interaction of 5 t ha$^{-1}$ of wood ash and 300 kg ha$^{-1}$ of NPK produced tallest garden egg while 10 t ha$^{-1}$ of wood ash produced dwarf plants. Interaction effect of wood ash and inorganic fertilizer did not significantly affect garden egg height at 6 and 8 WAT. Stem girth was broadest in garden egg produced with the interaction of 5 t ha$^{-1}$ of wood ash and 300 kg ha$^{-1}$ of NPK and narrowest in garden egg produced with 10 t ha$^{-1}$ of wood ash at 2 WAT (Table 6). Stem girth was not significantly affected by the interaction of wood ash and inorganic fertilizer at 4, 6 and 8 WAT. Number of leaves was highest in garden egg produced with the interaction of 5 t ha$^{-1}$ of wood ash and 300 kg ha$^{-1}$ of NPK at 2 and 4 WAT while the application of 5 t ha$^{-1}$ of wood ash produced lowest number of leaves at 2 and 4 WAT (Table 6). Highest number of leaves was observed in garden egg produced with the interaction of 5 t ha$^{-1}$ of wood ash and 300 kg ha$^{-1}$ of NPK at 6 and 8 WAT while the application of 5 t ha$^{-1}$ of wood ash and 130.44 kg ha$^{-1}$ of urea produced lowest number of leaves at 6 and 8 WAT. Number of branches was significantly highest in garden egg produced with the interaction of 5 t ha$^{-1}$ of wood ash and 300 kg ha$^{-1}$ of NPK (7.07) and lowest in garden egg produced with 5 t ha$^{-1}$ of wood ash (0.33). However, there was no significant difference on the effect of the interaction of wood ash and inorganic fertilizer on the number of branches at 4, 6 and 8 WAT (Table 7). Number of fruits was significantly highest in garden egg produced with 130.44 kg ha$^{-1}$ of Urea while garden egg produced with 5 t ha-1 of wood ash produced lowest number of fruits. Fruit yield was not significantly affected by the interaction of wood ash and inorganic fertilizer. However, on mean basis, the application of 10 t ha$^{-1}$ of wood ash and 300 kg ha$^{-1}$ of NPK (57.00 t ha$^{-1}$) produced highest yield, followed by urea (39.90 t ha$^{-1}$) while 5 t ha$^{-1}$ of wood ash produced the lowest yield (10.70 t ha$^{-1}$). Interaction of wood ash and NPK fertilizer and interaction of wood ash and urea improved growth and yield parameters than the individual application of urea, NPK fertilizer and wood ash. This is to show that integrated application increased the higher quantity of nutrient availability (potassium, phosphorus and nitrogen) to the garden egg plants in relation to individual application of the other treatments. However, integrated application of wood ash and NPK fertilizer outperformed integrated application of wood ash and urea, even though urea and NPK fertilizer supplied the same quantity of nitrogen (60 kg ha$^{-1}$). The better performance of integrated application of wood ash and NPK fertilizer in relation to the integrated application of wood ash and urea could be attributed to the availability of higher amount of phosphorus and potassium available to the garden plants which improved the growth and yield of the garden egg. The above results confirm the findings of Ayeni (2008) in a multi-locational studies which stated that the combination of 10 t $ha^{-1}$ of cocoa pod ash and 100 kg of NPK 20:10:10 fertilizer gave highest number of leaves, number of branches and fruit yield in tomato at Fagun (trial 1 and 2). Similar results were corroborated by Ewulo *et al.*, 2009 who reported increase in height, number of leaves, stem girth, biomass, number of fruits and fruit weight in tomatoes when cultivated with sawdust ash and urea in relation to single application of urea and sawdust. Olugbemi (2019) reported similar results as observed by Ayeni (2008) and Ewulo *et al*, (2009) in pepper grown with wood ash and urea.

**Table 6:** Interaction effect of wood ash and inorganic fertilizer on plant height (cm stem girth (mm) and number of leaves

| Treatment combination ($t\ ha^{-1}$) | ($kg\ ha^{-1}$) | Plant height (cm) WAT | | | | Stem girth (mm) WAT | | | | Number of leaves WAT | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2 | 4 | 6 | 8 | 2 | 4 | 6 | 8 | 2 | 4 | 6 | 8 |
| 0 | 0 | 16.10 | 49.30 | 95.90 | 126.40 | 2.03 | 3.40 | 5.33 | 5.70 | 7.930 | 40.70 | 76.40 | 191.10 |
| 0 | Urea | 21.90 | 57.40 | 110.70 | 127.50 | 1.87 | 3.27 | 5.23 | 6.13 | 7.93 | 43.30 | 100.50 | 203.70 |
| 0 | NPK | 20.07 | 52.10 | 99.90 | 125.50 | 1.70 | 3.20 | 5.43 | 5.90 | 6.13 | 36.90 | 94.90 | 151.90 |
| 5 | 0 | 16.50 | 57.40 | 76.60 | 101.80 | 1.73 | 3.13 | 4.63 | 4.47 | 5.40 | 36.40 | 66.00 | 94.10 |
| 5 | Urea | 17.63 | 45.20 | 88.10 | 110.00 | 1.70 | 3.53 | 5.23 | 4.70 | 5.67 | 36.90 | 64.40 | 87.10 |
| 5 | NPK | 30.23 | 66.20 | 109.20 | 148.60 | 2.40 | 3.50 | 5.93 | 5.83 | 16.87 | 52.50 | 135.50 | 205.30 |
| 10 | 0 | 16.17 | 40.90 | 78.10 | 101.80 | 1.37 | 3.03 | 4.50 | 4.50 | 5.80 | 44.00 | 77.80 | 96.40 |
| 10 | Urea | 27.20 | 56.20 | 81.90 | 89.80 | 1.83 | 3.57 | 4.50 | 4.23 | 8.40 | 38.20 | 71.70 | 82.80 |
| 10 | NPK | 20.63 | 48.50 | 97.60 | 122.60 | 1.53 | 3.33 | 5.37 | 5.53 | 9.27 | 42.10 | 105.00 | 176.90 |
| $LSD_{(0.05)}$ | | 5.31 | 13.19 | 16.83 | 37.77 | 0.54 | 0.64 | 0.74 | 1.33 | 1.18 | 6.08 | 6.82 | 62.47 |
| F-Probability | | ** | * | NS | NS | ***** | **NS** | **NS** | NS | ** | * | ** | ** |

NS = Non significant, * = Highly significant, ** = Significant

**Table 7:** Interaction effect of wood ash and inorganic fertilizer on number of branches and yield parameters

| Treatment combinations ($t\ ha^{-1}$) | ($Kg\ ha^{-1}$) | **Number of branches WAT** | | | | Number of fruits | Fruit yield ( $t\ ha^{-1}$) |
|---|---|---|---|---|---|---|---|
| | | **2** | **4** | **6** | **8** | | |
| 0 | 0 | 1.60 | 14.87 | 14.87 | 21.33 | 127.20 | 15.80 |
| 0 | Urea | 2.47 | 16.87 | 16.20 | 24.07 | 140.40 | 39.90 |
| 0 | NPK | 1.47 | 13.60 | 13.60 | 17.93 | 47.40 | 37.20 |
| 5 | 0 | 0.33 | 8.93 | 8.93 | 12.20 | 9.00 | 10.70 |
| 5 | Urea | 1.20 | 10.60 | 10.60 | 12.27 | 25.50 | 14.00 |
| 5 | NPK | 7.07 | 15.07 | 15.07 | 20.93 | 101.40 | 28.80 |
| 10 | 0 | 0.93 | 9.67 | 9.67 | 11.80 | 23.10 | 12.80 |
| 10 | Urea | 2.07 | 10.47 | 10.47 | 10.13 | 75.40 | 29.40 |
| 10 | NPK | 3.20 | 13.47 | 13.47 | 15.20 | 96.30 | 57.00 |
| $LSD_{(0.05)}$ | | 1.44 | 5.16 | 5.38 | 7.43 | 77.29 | 21.09 |
| F-Probability | | ** | NS | NS | NS | * | NS |

NS = Non significant, * = Highly significant, ** = Significant

**CONCLUSION AND RECOMMENDATION**

The main effect of wood ash showed that 10 t $ha^{-1}$ of wood ash produced highest fruit yield without commensurate improvement on the growth parameters. The inorganic fertilizer showed the superior effect of 300 kg $ha^{-1}$ of NPK over 130.44 kg $ha^{-1}$ of urea on the growth and yield parameters of garden egg. Integrated application of 10 t $ha^{-1}$ of wood ash and NPK fertilizer gave the best performance on the growth and yield parameters of garden egg. Therefore, the integrated application of 10 t $ha^{-1}$ of wood ash and 300 kg $ha^{-1}$ of NPK fertilizer is recommended for improve garden egg growth and yield in Awka, Anambra State Nigeria.

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