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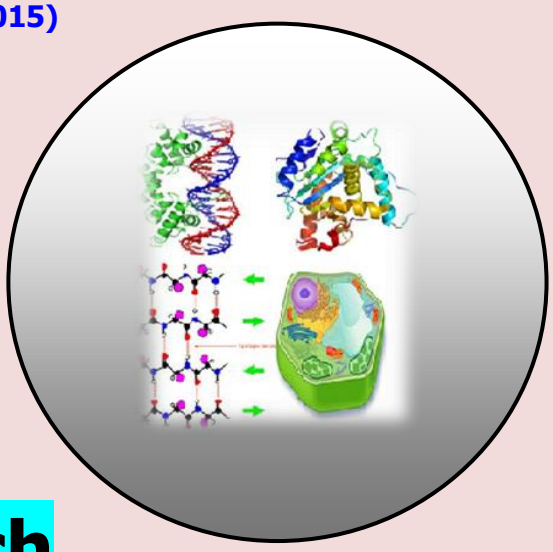

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RESEARCH PAPER

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Effects of Fertilizer Types on Growth, Nutrient Uptake and Yield of Onion (*Allium cepa*) Under Rain-Fed Alfisols of South Western Nigeria

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ABSTRACT

Field experiment was carried out at the arable experimental plot located at the back of Bee House lecture Hall, Ladoke Akintola University of Technology, Ogbomoso, to assess the influence of different sources of fertilizers on performance of onion (Allium cepa) under low fertile soil conditions. The six (6) treatments introduced were, T0= No fertilizer application, T1= NPK fertilizer, T2= Poultry manure, T3= Organo mineral, T4= Cow dung, T5= Cassava peel. All fertilizers were applied at the recommended N –rate of 60Kg Nha^{-1}. The treatments were laid out in Randomized Complete Block Design (RCBD), replicated three times. All data collected on growth and yield parameters were analyzed following the procedures of Analysis of Variance (ANOVA) and Duncan Multiple Range Test (DMRT) was used to separate treatment means, at 5% probability level. Application of fertilizers (irrespective of the sources), significantly improved growth, yield and nutrient uptake of Allium cepa, since the control had the least value except in number of tillers and stem girth. Application of either cow dung or poultry manure or cassava peel is therefore recommended for improved nutrients availability and onion performance in the study area.
Keywords: Fertilizer types, Growth, Nutrient uptake, Onion and Yield.

INTRODUCTION

Onion (*Allium cepa L.*) belongs to the genus Allium of the family Alliaceae. Onion is the most important of the bulb crops cultivated commercially in nearly most parts of the world. The crop is grown for consumption both in the green state as well as in mature bulbs. Onions exhibit particular diversity in the eastern Mediterranean countries, through Turkmenia, Tajikstan to Pakistan and India, which are the most important sources of genetic diversity and believed to be center of origin (Brewster, 2008). This underground bulb is known for its distinct pungent flavor and aroma. It has

taken part in most of the Sri Lankan curry dish. It is reach in vitamins and minerals and has several medicinal values as well. Onion is also classified as high valued cash crop because of high cost of production probably next to chilli. (Seran et al, 2010). But its use is not only confined to the non-vegetarian items, it also mixes well with various vegetables. Needless to explain its utility in preparing the soup, stew, stir fry, salad and sauce. According to purseglove (1985), onions can be grown on a wide range of climatic conditions but thrives best in mild climate without excessive rainfall or extreme heat and cold. It requires a land with optimum soil pH of 6.0-7.0 with good tilth and high moisture content. Onions are sensitive to photoperiod. Long days are favourable to onion production as this enhances leaf development and formation which, in turns, is directly related to bulb size. Early varieties require thirteen (13) hours for bulb initiation while late varieties require sixteen (16) hours for bulb initiation. Onions begin to form bulbs when day length reaches the appropriate duration for cultivar, providing temperatures are high enough. Onion is consumed in different ways by different people and it forms an essential part of the traditional daily diet. It is the major species in terms and ranks among the top vegetables in Nigeria. It can be eaten raw in salad, fried, boiled or roasted and also used in flavoring soups, canned food product and other savory dishes. It is used in every home virtually on daily basis; the bulb is used traditionally as preservative and medicinal herbs in the treatment of measles, pneumonia, cold and catarrh. Recent studies have confirmed that onion helps in fighting osteoporosis or bone loss (Biochemist, 2005). Despite the ranking of onion as the second most important vegetable in Nigeria, the present production levels do not meet the demand of the teaming populace. Limited changes in the traditional production may still be lagging behind the national demand. Though the consumption of onion caught across the nation, its production is limited to the northern part of the country, where even in the north; production is restricted to fadama areas and grown mostly during the dry season under irrigation. Similarly the production level at present is below the optimum realized for other countries for example, while it is 45t ha^{-1} in India; it is just 15t ha^{-1} in Nigeria, 3.45t ha^{-1} in Bangladesh (FAO, 2005). Continuous usage of inorganic fertilizer affects soil structure. Hence, organic manures can serve as alternative to mineral fertilizers as reported by Naeem *et al* (2006) for improving soil structure (Dauda *et al*.,2008) and microbial biomass (Suresh *et al*., 2004).

Application of organic manure improves economic yield and it is vital to apply organic than inorganic fertilizer, to obtain financially viable yield of crops and lesser chemical load on soil (Jeyuathla *et al*, 2006). Despite the huge advantages and various uses of onion, It has some production constraints. Soil fertility status place higher constraints on onion production. Therefore, it is necessary to determine the alternative, locally sourced organic fertilizer that are inexpensive, sustainable and environmentally compatible to improve the yield of onion. This experiment was carried out to assess the performance of onion under application of different of fertilizer types (Organic and Inorganic).

MATERIALS AND METHODS

This experiment was carried out at the experimental plot, behind Bee-Hall, Ladoke Akintola University of Technology, Ogbomoso in guinea savannah zone of Nigeria. Ogbomoso lies on latitude (8º N I0ºS) and longitude (4ºW, 10ºE). The maximum temperature is 28º C. The humidity is high at about 76% all the year round except in January when dry wind blows from the North, annual rainfall is over 1000mm (Babajide *et al.,* 2008). The materials used; seeds of *Allium cepa*, (Rouge de tana variety), plot of land, watering can, kegs, rake, hoe, cutlass, shovel, cassava peel, poultry manure, NPK fertilizer, cow dung, Organo-mineral, water, rubber pipes, insecticide, knapsack sprayer, storex tank etc. The land was cleared manually of the existing vegetation and the area was fenced with wire mesh. Beds (1. 6m 2) in size were prepared manually with a spacing of 40cm by 60cm before transplanting, soil sample were taken for physico-chemical analysis.

Six treatments were introduced; To (Zero application of fertilizer), T1 (NPK fertilizer) application, T2 (Poultry manure) application, T3 (Organomineral fertilizer) application, T4 (Cow dung) application, T5 (Cassava peel compost) application. The trial was factorial arrangement laid out in Randomized Complete Block Design (RCBD), replicated three times. All fertilizer treatments were applied at recommended N rate of 60Kgha^{-1}. Nursery technique; sowing of seeds was done by broadcasting and the seeds were mixed with the soil lightly in the nursery. The nursery was watered and transplanting was done four weeks after sowing in the nursery. Watering continued throughout the experimental period with the use of watering can which was done as required. Except NPK fertilizer which was applied at third week after transplanting (3WAT), Poultry manure, Organo mineral, Cow dung and Cassava peel compost were incorporated into the soil at two weeks before transplanting. Weeding of the plot was done with the use of hoe on weekly basis. Cypeforce (cypementhrin) was used for the control of insect pests by spraying with knapsack sprayer. Data collection commenced at four weeks after transplanting (4WAT). The growth parameters determined were plant height, number of tillers, stem girth and yield parameters. Number of tillers was determined by visual observation and direct counting of fully developed tillers per plant, Plant height was determined using measuring tape by placing at the stem base and run it to the tip of the plant. Stem girth was determined using venier caliper to measured diameter and multiplied by (3.142). Biomass yield parameter such as bulb and shoot dry weight were determined by weighing before and after oven drying of plant samples at 80^0 C for 72 hours respectively using electronic weighing balance MP500H (Citizen). All data collected were analyzed following the procedures of analysis of variance (ANOVA). Means were separated using Duncan Multiple Range Test (DMRT), at 5% level of probability.

RESULTS AND DISCUSSION

The pre-cropping chemical and physical analyses of the soil sample showed that the soil is slightly acidic with pH of 6.1. The soil sample is very low in essential nutrients N (0.19gkg- 1), K (0.21cmolkg-1) and P (5.57mgkg^{-1}). The result corresponds with the earlier findings of Babajide *et al*., 2008 which indicated that the soil samples in the study area are grossly low in essential nutrients. At 4WAT, application of NPK fertilizer had higher significantly value of plant height, but not significantly different from other fertilizer treatments while the control had the least (Table 2). At 5WAT, application of NPK fertilizer had the higher significantly value of plant height, but not significantly different from application of cow dung and poultry manure, the value obtained at the application of organomineral and cassava peel was significantly lower, while control had the least significant value(Table 2). At 6WAT, application of poultry manure had the higher significantly value of plant height but not significantly different from cow dung, NPK had the lower significantly value of plant height, but not significantly different from organomineral and cassava peel, while control had the least significantly value (Table 2). At 7WAT, cow dung had significantly higher value of plant height, application of NPK had lower significant value but not significantly different from poultry manure, cassava peel and organomineral, while control had the least significant value of plant height (Table 2). At 8WAT, application of cow dung had the significantly higher value of plant height (Table 2), application of poultry manure had significantly lower value but not significantly different from cassava peel, application of NPK had significantly least value but not significantly different from organomineral and control(Table 2). At 9WAT, application of cow dung had significantly higher value of plant height but not significantly different from poultry manure, while control had significantly least value of plant height (Table 2). At 4WAT, application of NPK fertilizer had significantly higher value of number of tillers, but not significantly different from poultry manure (Table 3), application of organomineral had significantly lower value, but not significantly different from cow dung and cassava peel, while control had significantly least value of number of tillers(Table 3).

Table 1. Physiochemical analysis of the soil sample used.

Soil Characteristics	Value
pH (H_2O)	6.10
Organic Carbon(gkg^{-1})	4.42
Total N (gkg^{-1})	0.19
Available P ($mgkg^{-1}$)	5.57
Fe (mgk^{-1})	11.10
Cu ($mgkg^{-1}$)	2.36
Zn ($mgkg^{-1}$)	2.87
Exchangeable K ($Cmolkg^{-1}$)	0.21
Exchangeable Na ($Cmolkg^{-1}$)	0.22
Exchangeable Ca ($Cmolkg^{-1}$)	19.52
Exchangeable Mg ($Cmolkg^{-1}$)	3.11
Sand (%)	75.03
Silt (%)	14.15
Clay (%)	10.82
Textural class	Sandy loam

Table 2. Effect of different fertilizer types on plant height of onion at different weeks after sowing (WAS).

Treatments	4WAT	5WAT	6WAT	7WAT	8WAT	9WAT
T0	14.43b	16.13b	18.63b	20.70b	22.00b	19.80ab
T1	18.17a	20.83a	21.50ab	21.50ab	22.03b	12.73c
T2	17.97a	21.70a	24.47a	25.33ab	24.93ab	20.17a
T3	15.87ab	18.17ab	20.47ab	22.03ab	21.73b	14.77c
T4	17.47ab	21.50a	24.27a	26.50a	27.50a	21.13a
T5	15.00ab	18.03ab	19.97ab	22.00ab	22.83ab	17.60abc

Means followed by the same letter on the same column are not significantly at p=0.05, using DMRT. T0= no application, T1= NPK, T2= Poultry manure, T3= Organomineral, T4= Cow dung, T5= Cassava peel

Table 3. Effect of different fertilizer types on numbers of tillers of onion at different weeks after sowing (WAS).

Treatments	4WAT	5WAT	6WAT	7WAT	8WAT	9WAT
T0	3.0b	3.33a	3.33ab	3.33a	3.33ab	3.00a
T1	4.0a	3.67a	3.33ab	3.33a	2.33b	2.00a
T2	4.0a	3.33a	4.00a	4.00a	4.00a	3.00a
T3	3.66ab	3.33a	3.00b	3.33a	3.00ab	2.00a
T4	3.66ab	3.66a	4.00a	3.66a	3.66a	2.66a
T5	3.33ab	3.33a	3.66ab	3.66a	3.33ab	3.00a

Means followed by the same letter on the same column are not significantly at p=0.05, using DMRT. T0= no application, T1= NPK, T2= Poultry manure, T3= Organomineral, T4= Cow dung, T5= Cassava peel.

At 5WAT, 7WAT and 9WAT no significantly different from all the treatments applied, at 6WAT and 8WAT, cow dung had significantly higher value of number of tillers, but not significantly different from poultry manure, application of organo mineral had significantly least value but not

significantly different from cassava peel and control.(Table 3). At 4WAT, 5WAT, 6WAT, 7WAT, 8WAT and 9WAT, no significantly different from all the treatments applied on value of stem girth. All treatments applied had no significantly different on value of fresh bulb weight from each other, including control. (Table 5). Akoun (2004) confirmed that organic manure increases the nutrient status of a soil, which leads to increase in onion yield. Application of organo-mineral fertilizer and cow dung significantly improved N uptake (Table 6). T4 (Cow dung) and T3 (Organo-mineral) had significantly higher value of P uptake compared to other treatments applied which has the significantly low value of P uptake (Table 6). The same trend follows for Potassium (K), Magnesium (Mg) and Copper (Cu). Application of NPK significantly improved Na, Mn and Zn uptake compared to other treatments applied which has significantly lower value (Table 6). Application of T2 (Poultry manure) had significantly higher value of Zn uptake and T4 (Cow dung), T5 (Cassava peel) has significantly lower value, while control had least significantly value of Zn uptake.(Table 6). Generally, N, P, and K uptakes were significantly higher in both organically and inorganically fertilized plants than their unfertilized counterparts (Babajide *et al*, 2008). The role of nutrients is one of the paramount importances in boosting productivity and quality of onion which is a heavy feeder of mineral element.

CONCLUSION AND RECOMMENDATION

Since all the organic fertilizer types which were applied significantly influenced the growth and nutrient uptake of onion. It is there recommended that farmers can apply organic fertilizer materials at the recommended rate of 60KgNha^{-1}. This may improve the performance of plants, and soil quality.

Table 4. **Effect of different fertilizer types on stem girth of onion at different weeks after sowing (WAS).**

Treatments	4WAT	5WAT	6WAT	7WAT	8WAT	9WAT
T0	0.63a	0.60a	1.20a	1.13a	1.13a	1.43a
T1	0.97a	1.73a	1.47a	1.43a	1.43a	0.90a
T2	0.80a	1.33ab	1.60a	1.77a	1.77a	1.30a
T3	0.67a	1.10ab	1.10a	1.23a	1.23a	1.03a
T4	0.77a	1.20ab	1.89a	1.90a	1.90a	1.47a
T5	0.80a	1.23ab	1.50a	1.47a	1.47a	1.53a

Means followed by the same letter on the same column are not significantly at p=0.05, using DMRT. T0= no application, T1= NPK, T2= Poultry manure, T3= Organomineral, T4= Cow dung, T5= Cassava peel.

Table 5. **Effect of different fertilizer types on bulb weight of onion at different weeks after sowing (WAS).**

Treatments	11WAT
T0	34.67a
T1	23.50a
T2	53.57a
T3	24.70a
T4	53.87a
T5	50.37a

Means followed by the same letter on the same column are not significantly at p=0.05, using DMRT. T0= no application, T1= NPK, T2= Poultry manure, T3= Organomineral, T4= Cow dung, T5= Cassava peel.

Table 6. Effect of different fertilizer types on nutrient of onion.

	g Kg^{-1}			Mg Kg^{-1}						
	N	P	K	Ca	Mg	Na	Fe	Cu	Mn	Zn
T0	6.43d	1.23c	0.57d	0.80d	0.80d	1.63a	63.73f	2.47c	50.50b	17.40c
T1	42.97c	0.90c	9.4c	3.23d	0.80d	1.60a	123.90e	3.10bc	58.93a	27.20a
T2	67.30b	11.23b	14.30b	8.57c	3.53c	0.43b	167.60c	6.17a	28.10c	27.17a
T3	78.40a	16.43a	19.90a	16.87a	6.40a	0.47b	199.73a	6.23a	23.97d	27.73a
T4	78.57a	16.00a	17.57a	13.73b	7.00a	0.47b	187.20b	6.33a	22.40d	24.67ab
T5	48.30c	10.43b	11.70c	8.77c	4.57b	0.57b	140.43d	3.80b	24.86cd	22.47b

Means followed by the same letter on the same column are not significantly at p=0.05, using DMRT. T0= no application, T1= NPK, T2= Poultry manure, T3= Organomineral, T4= Cow dung, T5= Cassava peel.

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