International Journal of Agricultural Research and Review: ISSN-2360-7971, Vol. 5(3): pp 598-606, March, 2017.

Full Length Research

Interaction of Nitrogen and Potassium of Fertilizers on the Yield and Mineral Compositions of Onion *(allium cepa* l.*)* in Ogbomoso

Atanda, T.T and Olaniyi J. O

Department of Crop Production and Soil Science, Faculty of Agricultural Sciences, Ladoke Akintola University of Technology, P.M.B 4000, Ogbomoso, Oyo State, Nigeria.

Corresponding author's e-mail: atandatoyin85@gmail.com

Accepted 6th April, 2017

Field trials were conducted during 2012 and 2013 cropping seasons to determine the interaction of nitrogen and potassium containing fertilizers on the yield and mineral compositions of onion. The treatments were three nitrogen (N) levels (45, 60 and 75 in kgha^{-1}) and four potassium (K) levels (60, 90, 120 and 150 in kgha^{-1}) from urea and muriate of potash (MOP) respectively. The treatments were laid out in a randomized complete block design replicated three times. Data collected were yield attributes and nutritional values of onion. Data were analyzed using analysis of variance and treatment means compared with least significant difference at 5% probability level. Interaction of N and K fertilizers significantly ($p \leq 0.05$) increased the yield parameters with the optimum values obtained at 60 kg Nha^{-1} x 120 kg K_2Oha^{-1} in 2012 and 2013, respectively. The highest mean marketable yield of 2.6 tons ha^{-1} was obtained with combined application of 60 kg Nha^{-1} by 120 kg K_2Oha^{-1} in both years. The best mineral compositions (N, P, K, Ca and Mg,) were obtained from plant treated with combined application of 60 kg N ha^{-1} and 120 kg K_2O ha^{-1}.

In conclusion, combinations of 60 kg Nha^{-1} and 120 kg K_2Oha^{-1} produced the optimum marketable yield and mineral compositions of onion in the study area.

Keywords: Nitrogen, potassium fertilizer, onion, yield and smineral compositions

INTRODUCTION

Onion *(Allium cepa* L.*)* is a bulbous herb of Alliaceae family which is one of the most important vegetable condiment crops demanded worldwide (Singh and Joshi, 1995). It is a popular vegetable grown for its pungent bulbs and flavourful leaves. Bulb onion is widely grown throughout the world (Randle, 1992). In Nigeria, onion cultivation is confined to the semi-arid northern Guinea and Sudan Savanna zones such as Kaduna, Kano, Jigawa, Sokoto, Plateau and Bauchi states (Amans, 1989). The role of onion in daily diet cannot be over-emphasized due to the fact that it is high in food value, moderate in protein content and rich in calcium and riboflavin. The crop is one of the most important vegetable crops in Nigeria where it is an important condiment in the preparation of curry and spicy dishes (Amans, 1989). Onion is of great benefit to man due to its dietic and medicinal values (Schippers, 2001). It is one of the most important vegetables in the world, whose utility is ranked second to tomatoes (Brice *et al.*, 1997) and it is used in every home virtually on a daily basis (Hussaini and Amans, 2000).

Inadequate mineral nutrition has been reported as one of the major constraints to increase crop yield. N, P and K are deficient in many soils of tropical Africa (Richardson, 1968), which might also be true for many Nigerian soils. Nitrogen is needed for vigorous vegetative leaf and stem growth and dark green leaf colour (chlorophyll production) (Al-Moshileh, 2001).

Nitrogen is essential to growth and yield of onion but excessively high doses cause delay in bulb maturity and encourage bolting which is an undesirable characteristic. Pandey *et al.* (1994) reported that application of nitrogen at the rate of 80 kg ha^{-1} increased the yield of onion bulbs. Wiederfield (1994) also found no additional yield increase from applying N rates higher than 84 kg N ha^{-1}. Al-Moshileh (2001), in Saudi Arabia also reported significant yield increase due to N application at 92 kg N ha^{-1}. But Halvorson *et al.* (2002) in Colorado reported that nitrogen resulted in only small increased in bulb yield. These arguments may be as a result of variations in the soil fertility and weather condition at different locations.

Potassium is essential for root development and when the availability is limited, plant growth is usually reduced. Researches from different parts of the world revealed that potassium nutrition greatly influenced growth and yield of onion. Pire *et al.* (2001) and Salo *et al.* (2002) reported significant effect of potassium on the growth and yield of onion. Potassium deficiency is one of the largest constraints to crop production in many tropical soils, owing to low native content and high K immobilization within the soil (Fairhust *et al.,* 1999). Accordingly, K fertilizer application is usually recommended in these soils. In onions, K deficiencies reduced root and leaf growth, bulb size and yield and caused a delay in maturation (Brewster, 1994; Greenwood *et al.,* 2001). In soils that are moderately low in K, onion growth and yield can be enhanced by applied K. Onions are more susceptible to nutrient deficiencies than most crop plants because of their shallow and unbranched root system; hence they require and often responds well to addition of fertilizers (Brewster, 1994). Despite the importance of onion in Nigerian diet, very limited works on its fertilizer requirement has been reported in Ogbomoso, South Western Nigeria. Yield and mineral qualities realized by farmers are usually lower than what is being reported under experimental condition. In view of this, the study was set up with the objective to determine the effects of N and K fertilizers combinations on onion yield and mineral compositions in Ogbomoso, South west Nigeria.

MATERIALS AND METHODS

Experimental Site

Field trials were conducted during the 2012 and 2013 cropping seasons at the Teaching and Research Farm, Ladoke Akintola University of Technology, Ogbomoso, Nigeria. Ogbomoso is on latitude $8^o10'$N and longitude $4^o10'$E in the guinea savanna zone of southwest Nigeria. The climate of Ogbomoso is mostly influenced by the northeast trade wind, which is characterized with cold wind and a drying effect starting from November till March and south west trade wind, which is warm and moist from April to October. The bimodal rainfall of the area is between 1150 mm and 1250 mm of rain. The temperature regime is high all year round. The mean minimum temperature is 28^oC and the maximum temperature is 33^oC with high humidity of about 74% all year round except in January when the dry wind blows from the north (Olaniyi, 2006).

The soil is moderately drained, ferruginous tropical soil (Bromfield, 1969) with a sandy loam texture. The vegetation cover of the area is characterized with weeds and the prominent weeds in this environment include: *Tithonia diversifolia* (Wild sun flower), *Chromoleana odorata* (Siam weed) and *Cynodon dactylon* (Guinea grass).

Soil Sampling and Laboratory Analysis

Prior to land preparation, soil samples of the experimental plot were collected and bulked. The soil was air dried and sieved through a 2mm sieve and was subjected to physico-chemical analyses. Among the parameters determined are soil particle sizes, which were determined by Bouyoucos method (Bouyoucos, 1962).Soil pH in H_2O (1:1) was determined using laboratory apparatus (IITA, 1982). Soil organic carbon was determined by Walkley black modified method (Black, 1965). Available phosphorus and total nitrogen was determined separately by Technicon method (Technicon, 1975) while exchangeable Ca, Mg, K, Na and effective C.E.C in soils by use of atomic absorption spectrophotometer (IITA, 1982).

Treatments and Experimental Design

One onion variety (Red creoleo) obtained from KAL seed centre, Ogbomoso was used as test crop. The treatments tested were combinations of three levels of N (45, 60 and 75 kg N ha^{-1}) applied as urea fertilizer and four levels of K (60, 90,120 and 150kg$K_2O$$ha^{-1}$) applied as muriate of potash (MOP). The 3 x 4 factorial treatment combinations were arranged in a randomized complete block design with three replicates. The 12 treatments are as follows:

T_1 – 45kgNha^{-1} x 60kg$K_2O$$ha^{-1}$
T_2 – 45kgNha^{-1} x 90kg$K_2O$$ha^{-1}$
T_3 – 45kgNha^{-1} x 120kg$K_2O$$ha^{-1}$
T_4 – 45kgNha^{-1} x 150kg$K_2O$$ha^{-1}$
T_5 – 60kgNha^{-1} x 60kg$K_2O$$ha^{-1}$
T_6 – 60kgNha^{-1} x 90kg$K_2O$$ha^{-1}$
T_7 – 60kgNha^{-1} x 120kg$K_2O$$ha^{-1}$
T_8 – 60kgNha^{-1} x 150kg$K_2O$$ha^{-1}$
T_9 – 75kgNha^{-1} x 60kg$K_2O$$ha^{-1}$

T_{10} – 75kgNha^{-1} x 90kgK$_2$Oha^{-1}
T_{11} – 75kgNha^{-1} x 120kgK$_2$Oha^{-1}
T_{12} – 75kgNha^{-1} x 150kgK$_2$Oha^{-1}

Treatments and Experimental Design

One onion variety (Red creoleo) obtained from KAL seed centre, Ogbomoso was used as test crop. The treatments tested were combinations of three levels of N (45, 60 and 75 kg N ha $^{-1}$) applied as urea fertilizer and four levels of K (60, 90,120 and 150 kg K_2O ha^{-1}) applied as muriate of potash (MOP). These were arranged in a randomized complete block design with three replicates.

Field Preparation and Layout

The experimental site was manually cleared and 36 raised beds were made with the use of hoe. These were divided into three replicates with each replicate containing 12 beds. The size of each bed is 1.2m x 1.2m with the spacing of 0.5 m within replicate and 1m between replicates. The total area of the experimental plot is 165.2m^2.

Cultural Practices

The planting was done by direct seeding; three seeds were sowed per hole at 0.5 cm depth due to small nature of the onion seed. Sixteen stands of plants were planted on a bed at the spacing of 30 cm x 30 cm apart giving a plant population of 576 plants for the whole experimental plot. Supplying was carried out on the field one week after sowing to replace the ungerminated seeds while thinning was carried out to reduce competition by removing excess plants from each plants stand. The fertilizers were applied at 4 weeks after sowing to their respective beds randomly. The field was fumigated against fungus attack in the soil. Supplementary water supply was carried out after sowing and continued during the dry period of the experiment. The watering was done in the morning and late in the evening to ensure better crop establishment in the first four weeks and to minimize the environmental stress.

Mulching was done immediately after sowing with the use of dried *Cynodon dactylon* (guinea grass) and *Andropogon gayanus* (southern gamba grass) which were carefully placed on each bed to help retain soil moisture, reduces weed problems among the plants and improves the soil fertility. Weeding was carried out manually as soon as weeds were noticed around the plant to ensure proper establishment, reduce competition and avoid infestation by pest and diseases Insect pests were controlled with insecticides, sprayed at two weeks interval with the use of Knapsack sprayer. Cypermethrin was used to control insect pests especially when grasshopper was noticed on the field at 10 ml per 10 litres of water.

Data Collection

Data collection on growth parameters commenced at 4weeks after sowing and continued fortnightly till harvesting. Six plants were tagged on each bed. The tagged plants were assessed for number of leaves and plant height. Number of leaves was obtained by counting each green and functional leaf that existed on the plant at each sampling occasion. The plant height was measured through the use of meter rule and recorded. This was carried out for all the tagged plants on each bed and mean was obtained for each treatment. Leaves and bulbs weight were measured separately by the use of sensitive weighing scale and recorded in kg ha^{-1}. Bulb diameter was measured with the use of venier caliper.

Proximate Analysis

Onion bulbs and leaves were collected from six plants in each treatment, dried and analyzed in the laboratory to determine the nutritional quality of onion as affected by treatments. Samples were analyzed according to the official method of analysis described by the Association of Official Chemist (AOAC, 1990). Total N was determined using macro Kjeldahl (IITA, 1982), the P and K contents of the plants were determined by wet digestion in nitric, sulphuric and perchloric acids. P was determined by vanadomolybdate yellowcolometry method. Digested samples were diluted and used to determine the concentration of K using atomic absorption spectrophometer, concentration of nutrients were expressed on the basis of percentage dry plant material (Jones *et al.,* 1991).

The crude protein was determined by multiplying percentage nitrogen by a constant factor of 6.25 i.e. %CP = %N x 6.25.Moisture content was determined using silica gel reagent and Grease by weighing 2g of the sample into a previously weighed crucible. The crucible plus sample taken was then transferred into the oven set at 100^{o}C to dry to a constant weight for 24hours. At the end of 24hours, the crucible plus sample was removed from the oven and transfer to desiccators, cooled for thirty minutes and weighed.

If the weight of empty is W_0

Plus sample is W_1

Weight of crucible plus oven dried sample W_3

$$(\%DM) \text{ of Dry matter} = \frac{W_3 - W_0}{W_1 \quad W_0} \times \frac{100}{1}$$

% Moisture = 100 - %DM

Ash: 2g of the sample was weighed into a porcelain crucible. This was transferred into the muffle furnace set at 550^{0}C and left for about 4hrs. About this time it had turned to white ash. The crucible and its constant were cooled to about 100^{0}C in air, then room temperature indesiccators and weighed. This was done in duplicate. The percentage ash was calculated from the formula below

$$\% \text{ fibre} = \frac{W_1 - W_2 x}{\text{Wt of sample}} \quad \frac{100}{1}$$

The ash of each sample obtained was digested by adding 10ml of INHCL to the ash in the crucible and heat to dryness on a heating mantle. 10ml of INHCL was added again, heat to boil and filtered through a whatman No 1 filter paper into a 100ml volumetric flask. The filtrate was made up of mark with distilled water stoppered and made readily for reading of concentration of calcium on the Jenway Digital flame photometer.

Vit. C: 2-10g of the sample was extracted with about 50 – 100ml of meta-phosphoric acetic acid solution by blending with warming blender for 3minutes. The resulting slurry (JUICE) was then filtered and 50ml of the juice extracts was titrated with Indophenol dye until light by distinct rose pink persists for more than 5 seconds.

Calculation:

$$\text{Ascorbic acid in mg/100g of sample} = \frac{X - B}{E} \times \frac{F \times V}{Y} \times 100$$

Where X = Average volume ml for test solution titration.

B = Average ml for the test blank titration

F = Mg ascorbic acid equivalent to 1.0ml Indophenol Standard Solution

E = Weight of Sample

V = Volume of initial test solution

Y = Volume of test solution titrated.

<u>To Calculate F</u>

2ml Standard Ascorbic Acid = 15ml of dye.

X ml Standard Ascorbic Acid = 1ml of dye

X ml Standard Ascorbic Acid = $\frac{2ml}{15ml} = 0.1333$

F = 0.1333 Standard Ascorbic Acid = 1ml of dye.

Data Analysis

Data collected were subjected to Analysis of Variance (ANOVA) (SAS, 1999) and significant means were separated using least significant difference (LSD) at 5% probability level.

RESULTS

Soil Analysis

The chemical composition of the soil before cropping is shown in Table 1. The soil belongs to the textural class of sandy loam. It contains 2.53 % organic carbon, 0.26 % total N, 6 % available P, 0.31 % exchangeable K, 0.32cmol/kg exchangeable acidity and cation exchange capacities. The soil pH is 5.8 which indicate that the soil is moderately acidic and can be used for onion production.

Yield and Yield Components of Onion

The onion bulb, leaf and total marketable yields are shown in Table 2. The onion bulb yield was significantly ($p \leq 0.05$) influenced by the combined application of nitrogen and potassium fertilizer rates during the two cropping seasons. The onion bulb yield increased as the applied combined N and K rates

Table 1: Chemical and Physical properties of the soil of the experimental site.

Parameters	Values
pH (H_20)	5.8
Organic carbon (g/kg)	2.53
Total N (mg/kg)	0.26
Available P (mg/kg)	6.00
Fe (mg/kg)	11.40
Cu (mg/kg)	2.70
Zn (mg/kg)	1.96
Exchangeable K (C mol/kg)	0.31
Exchangeable Na (C mol/kg)	0.26
Exchangeable Ca (C mol/kg)	3.42
Exchangeable Mg (C mol/kg)	0.70
Exchangeable acidity (C mol/kg)	0.32
Sand (%)	78
Silt (%)	20
Clay (%)	2
Textural class	Sandy loam

Table 2: Onion Bulb and Leaf Yields as affected by N and K fertilizers application

Fertilizer level (kg/ha)	Bulbs yield (kg/ha)		Leaves yield (kg/ha)		Total Marketable Yield (ton/ha)	
	Cropping season					
	2012	2013	2012	2013	2012	2013
45N x 60K	384.44	483.33	224.44	308.89	0.6	0.8
45N x 90K	497.77	577.77	322.22	342.22	0.8	0.9
45N x 120K	1,335.54	1,315.54	727.77	553.33	2.1	1.9
45N x 150K	893.32	1,118.88	444.44	403.33	1.3	1.5
60N x 60K	1,001.10	854.44	334.44	592.22	1.3	1.4
60N x 90K	606.66	834.44	434.44	511.11	1.0	1.4
60N x 120K	1,800.01	1,667.78	779.99	872.22	2.6	2.5
60N x 150K	1,337.76	1,303.32	446.66	333.33	1.8	1.6
75N x 60K	1,247.78	1,163.32	322.22	246.66	1.6	1.4
75N x 90K	1,135.54	1,011.10	597.77	637.77	1.7	1.7
75N x 120K	813.33	1,076.66	267.78	317.78	1.1	1.4
75N x 150K	996.66	1,325.54	447.77	411.11	1.4	1.7
LSD (0.05):						
N x K	0.53	0.12	0.31	0.037	0.27	0.20

increases from 45 kg N ha^{-1} by 60 kg K_20 ha^{-1} to 75 kg N ha^{-1} by 150 kg K_20 ha^{-1} in 2012 and 2013 cropping seasons. The highest bulb yields of 1,800.01 kg ha^{-1} and 1,667.78 kg ha^{-1} were recorded in 2012 and 2013 respectively, for plants that received 60 kg N ha^{-1} by 120 kg K_20 ha^{-1} fertilizer treatment.

The onion leaf yield increased with increases in N and K fertilizer application rates.. The highest onion leaf yields of 779.99 kg ha^{-1} and 872.22 kg ha^{-1} were obtained from the combined application of N and K at the rate of 60 kg N ha^{-1} by 120 kg K_20 ha^{-1} in 2012 and 2013, respectively.

The mean marketable yield of onion plant is shown in Table 2. The total marketable yield was significantly ($P \leq 0.05$) influenced by the combined application of N and K fertilizers. Onion plant produced with the application of 60 kg Nha^{-1} by 120 kg K_20 ha^{-1} recorded the highest total marketable yield of 2.58 tons ha^{-1} and 2.54 tons ha^{-1} in 2012 and 2013, respectively. This was followed by 75 kg N ha^{-1} by 150 kg K_20 ha^{-1} treated plants, which gave 2.33 tons and 2.24 tons in 2012 and 2013, respectively.

Mineral and nutritional compositions of Onion as influenced by Nitrogen and Potassium fertilizers

The mineral composition of onion bulb and leaves were significantly influenced by the combined fertilizer application rates (Table 3). The nitrogen content of onion

Table 3: Effect of N and K fertilizers on Mineral composition of onion bulbs

	Mineral composition of onion bulb (mg/100g)				
	N	**P**	**K**	**Ca**	**Mg**
45N x 60K	4.31	26.92	150.75	18.53	8.70
45N x 90K	4.34	26.94	152.85	18.56	8.76
45N x 120K	4.47	27.92	154.84	18.71	8.82
45N x 150K	4.58	28.60	155.88	18.76	8.80
60N x 60K	4.61	28.78	156.20	18.84	8.90
60N x 90K	4.63	28.92	156.42	19.29	8.95
60N x 120K	5.22	31.15	157.73	19.73	9.71
60N x 150K	5.24	31.88	157.76	20.20	9.82
75N x 60K	5.26	22.77	158.72	20.19	9.89
75N x 90K	5.27	32.93	160.60	20.23	10.31
75N x 120K	5.39	33.73	164.50	20.32	10.62
75N x 150K	5.42	34.20	164.92	20.48	10.68
LSD (0.05):					
N x K	0.008	0.95	0.065	0.151	0.012

Table 4: Effect of N and K fertilizers on Mineral composition of onion leaves

Mineral composition of onion leaves (mg/100g)					
	N	**P**	**K**	**Ca**	**Mg**
45N x 60K	0.20	17.43	124.93	12.72	4.71
45N x 90K	0.21	17.62	125.23	12.86	4.74
45N x 120K	0.21	17.83	125.63	12.91	4.81
45N x 150K	0.22	17.88	125.71	13.43	4.84
60N x 60K	0.22	18.43	126.66	13.52	5.50
60N x 90K	0.22	18.54	127.65	13.63	5.61
60N x 120K	0.23	18.67	128.72	13.72	5.75
60N x 150K	0.23	18.73	130.40	13.83	6.25
75N x 60K	0.23	19.43	135.60	13.90	6.60
75N x 90K	0.23	20.53	137.89	14.10	7.10
75N x 120K	0.24	21.62	140.80	14.62	7.42
75N x 150K	0.24	21.78	142.62	14.71	7.61
LSD (0.05)					
N x K	0.003	0.048	0.014	0.0009	0.0003

bulb increased as the fertilizer rate increases and the highest value obtained at 75 kg N ha^{-1} by 150 kg K_20 ha^{-1} was 5.42 g/mg.

The phosphorus content of the onion bulb was improved by the interactive effect of Nitrogen and Potassium fertilizers application. The percentage of phosphorus content increased as the fertilizer rate increases with the highest value (34.20 g/mg) obtained at 75 kg N ha^{-1} by 150 kg K_2O ha^{-1} treated plants

The interactive effect of Nitrogen and Potassium fertilizers application improved the potassium content of the onion plants. The potassium content increased as N and K fertilizer application rate increased with the highest value obtained at 75 kg N ha^{-1} by 150 kg K_20 ha^{-1}

The calcium content of the onion bulb was influenced by fertilizer application rates. The calcium content increased as the N and K fertilizer rates increased with the highest value (20.48 g/mg) obtained at 75 kg N ha^{-1} by 150 kg K_20 ha^{-1}.

The magnesium content of onion bulb was highly significant by fertilizer application rates ($P \leq 0.05$). The percentage of magnesium content increased as the combined fertilizers rate increased with the highest value obtained at 75 kg N ha^{-1} by 150 kg K_2O ha^{-1}.

The mineral composition of onion leaves was highly significant by fertilizer combinations (Table 4). The nitrogen content of onion leaves increased as the fertilizer rate increases and the highest value obtained at 75 kg N ha^{-1} by 150 kg K_20 ha^{-1} was 0.24 g/mg.

The interactive effect of Nitrogen and Potassium significantly improved the phosphorus content of onion leaves. 75 kg N ha^{-1} by 150 kg K_2O ha^{-1} treatments recorded the highest value of 21.78 g/mg.

The potassium content of the onion leaves was improved by fertilizer application rates. The highest value (142.62 g/mg) was obtained from the combined application of Nitrogen and Potassium at 75 kg N ha^{-1} by 150 kg K_2O ha^{-1}.

The calcium content of the onion leaves was highly significant ($p \leq 0.05$) by fertilizer application rates. The calcium uptake increased with increase in the fertilizer rates. The highest value of 14.71 g/mg was obtained from the combined application of Nitrogen and Potassium at 75 kg N ha^{-1} by 150 kg K_2O ha^{-1}.

The magnesium content of onion leaves was highly significant by ($p \leq 0.05$) the fertilizer applied. The percentage of magnesium content increased as the N and K fertilizers rate increased with the highest value obtained from the combined application of Nitrogen and Potassium at 75 kg N ha^{-1} by 150 kg K_2O ha^{-1}.

DISCUSSION

The increase in yield and yield components of onion as the plant aged might be due to the increase in the cell number and size. This result is similar to the report of Olaniyi and Akanbi (2008) who reported that there was increased in the yield and yield components of cabbage as the plant aged. Yamasaki and Tanaka (2005) reported that nitrogen fertilizer application of 60-92kg Nha^{-1} extends the vegetative growth of onion compared to control. This positive response may be due to the role of N in promoting the growth of onion plant and replacement of dead cells. This result is in agreement with Kadayifli *et al*, 2005 who reported that increasing N application generally increase growth parameters and nutrients uptake of onion plant. The optimum rate of 60kgNha^{-1} obtained in this study reconfirmed the earlier work of Cizauskas*et al.* (2003) who reported that application of 60kg Nha^{-1} gave the highest bulb yield of onion. The significant increase in the nutrient uptake and yield parameters of onion with K fertilizer application is in accordance with the findings of other researchers (Greenwood *et al.* 2001). The highest total marketable yield obtained when 120kgK_2Oha^{-1} was applied is similar to the report of some researchers who reported bulb yield improvement in response to K fertilization (Singh *et al.,* 1995; Patel and Patel, 1990; Pandey and Ekpo, 1991; Vachhani and Patel, 1993b; Patel and Vachhani, 1994).

In the same manner, the significant influence of applied K rates on onion yields and nutritional qualities reconfirmed the work of researchers that K nutrition greatly influenced nutrient uptake and yield of onion (Brice *et al.,* 1997). Pire *et al.* (2001) and Salo *et al.* (2002) reported significant effect of K on the nutrient uptake and yield of onion. Greenwood *et al.* (2001) reported that K deficiency in onion resulted into reduced root and leaf growth, bulb size and yield and caused a delay in maturation. Woldetsadik (2003) in Ethiopia reported that K fertilization at the rate of 120kg K_2Oha^{-1} increased yield and bulb weight of onion even when soil analysis did not show deficiency.

The significant increase in the yield parameter and nutrient uptake of onion with combined application of N and K at 60kgNha^{-1} and 120kg K_2Oha^{-1} support the report of Nasreen *et al.*(2007), who recommended the combined application of 60kgNha^{-1} and 120kg K_2Oha^{-1} as best rate for onion production.

The positive interaction of N and K may offer the opportunity for considerable savings in the cost of N fertilizer and food security for the rapidly expanding human population. Therefore, N and K fertilizers should be applied with optimal ratios at the right time and right rate according to the nutrient uptake pattern of the crops, soil nutrient status, soil texture and climate changes, in order to reach the target yields with good quality and minimize K and N losses to the environment. A good understanding of the mechanisms of N-K interactions may serve as a guide to best nutrient management practice in agriculture.

CONCLUSION AND RECOMMENDATION

In order to investigate the interactive effects of nitrogen and potassium fertilizers on yield and nutritional values of onion, field experiments were conducted in the cropping season of 2012 and 2013 at the Teaching and Research Farm, Ladoke Akintola University of Technology, Ogbomoso, Nigeria. The result of this experiment showed that onion can be produced successfully in this region of Africa with appropriate fertilizers application rates especially N and K fertilizers. The combined application of N and K significantly ($p \leq 0.05$) improved the yield and nutritional values of onion in both years. The onion plants treated with 60 kg N ha^{-1} by 120 kg K_20 ha^{-1} produced optimum yield and nutritional values compared to plants treated with other N and K fertilizer rates. Therefore, application of nitrogen and potassium fertilizers at the rate of 60 kg N ha^{-1} by 120 kg K_20 ha^{-1} is recommended for high yield and optimum nutritional values of onion in Ogbomoso Southwestern, Nigeria.

REFERENCES

Al-Moshileh, A. M., (2001). Effect of nitrogen, phosphorus and potassium fertilizer on onion productivity in central region of Saudi Arabia.Assiut.*Journal of the Horticultural Science,* 32: 291 – 305.

Amans, E. B. (1989). Effect of intra-row spacing and nitrogen application on early and late irrigated onions. 1. Growth and bulb yield. Ph.D Thesis, Ahmadu Bello University, Zaria.Pp 38.

Black, C.A. (ed.) (1965). Methods of soil analysis.Agronomy No. 9 part 2, American society of Agronomy, Pp. 5 – 10.

Brewster, J. L. (1994). Onions and other vegetable allium (1st ed). CAB International Wallingford, UK. Pp. 236.

Brice, J., Currah, L., Malins, A., and Baneroft, R. (1997). Onion storage in the tropics, A practical guide to methods of storage and their selection. Chatham Resources Institute, UK. Pp 3.

Bromfield, (1969).Uptake of phosphorus and other nutrients by maize in Western Nigeria.Published by Cambridge University press, 5: 91 – 100.

Bouyoucos, G.J. (1962). Hydrometer method improved for making particle size analysis. *Agronomy Journal,* 53: 464 – 465.

Cizauskas, A., Viskelis, P., Dris,R., and Oladele, O.I. (2003). Influence of nitrogen rates on onion yield, quality and storability. *Moor Journal. AgriculturalResource.,* 4(1): 85-89.

Fairhurst, T., Lefroy, R., andMutert, E. (1999). The importance, distribution and causes of phosphorus deficiency as a constraint to crop production. Agroforestry Forum, 9: 2-8.

Greenwood, D. J., Stones, D. A., and Barnes, A. (2001). Root development of vegetable crops. *Plant Soil,* 68: 75 – 96.

Halvorson, A. D., Follet, R. F., Bartolo, M. E., and Schweissing, F. C. (2002). Nitrogen fertilizer use efficiency of furrow-irrigated onion and corn. *Agronomy Journal,* 94: 442-449.

Hussaini, M. A. and Amans, E. B. (2000).Yield, bulb size distribution and storability of onion (Allium cepa L.) under different levels of N-fertilization and irrigation regime. *Tropical Agriculture. (Trinidad),* 77 (3), 145-149

I.I.T.A. (1982).Automated and semi-automated methods of soil and plant analysis manual, Ibadan, Nigeria.Series No. 7. Pp. 4 – 15.

Jones, J.B., Benjamin, W. and Harry, A.M. (1991). Plant Analysis Handbook; a practical sampling preparation analysis and interpretation guide micro – macro publishing Inc. NSA pp. 30 – 36.

Nasreen, S., Haque,M.M., Hossain,M.A. and Farid, A.T.M. (2007). Nutrient uptake and yield of onion as influenced by nitrogen and sulphur fertilization.*Bangladesh Journal of Agricultural Resource,* 32(3): 413-420.

Olaniyi, J. O. (2006). Influence of Nitrogen and Potassium fertilizers on seed yield and quality of Egusi melon (*Citrulluslanatus* (Thunb) Mansf) in Ogbomoso, Southwestern Nigeria. Ph.D Thesis, University of Ibadan. Pp. 57 – 155.

Olaniyi, J.O. and Akanbi, W.B. (2008).Effect of cultural practice on mineral compositions of cassava peel compost and its effect on the performance of cabbage (*Brassica oleracea L.)Journal of Applied Biosciences*, 8(1): 272-279.

Kadayifli A., Tuylu, G.T., Ucar, Y., and Cakmak, B. (2005).Crop water use of onion (*Allium cepa L.)*in Turkey. Agric Water Manage. 72: 59 – 68.

Pandey, U. B., Panwar. D. S and Sharma, V. P. (1994). Effects of spacing and levels of Nitrogen on growth and seed yield of Kahrifonion.*Seed Resource,* 20: 147-148.

Pandey, U.C. and Ekpo, U. (1991).Response of nitrogen on growth and yield of onion (*Allium cepa L.*) in Maiduguri region of Borno State.*Nig. Res. Dev. Rep.,* 8:5 – 9.

Patel, J.J. and Patel, A.T. (1990).Effect of Nitrogen and Phosphorus levels on growth and yield of onion.*Gujrat Agricultural University Resource Journal,* 15: 1 – 5.

Patel, Z.G. and Vachhani, M.U. (1994).Effect of NPK fertilization on the yield and quality of onion. Horticultural Journal, 7(1): 75 – 77.

Pire, R., Riera, J., Ramirez, H. and Gomez, T. N. (2001).Removal of N.P.K and Cabjan onion crop (*Allium cepa*) in a silly-clay soil, in a semiarid region of Venezuela.*Acta Horticulture,* 555: 103-109.

Randle, W. M. (1992). Onion germplasm interacts with sulphur fertility for plant sulfur utilization and bulb pungency. *Euphytica*, 59: 151-156.

Salo, T., Suojala, T. and Kallela, (2002).The effect of fertigation on yield and uptake of cabbage, carrot and onion.*Acta Horticulture,* 571: 235 – 241.

SAS, (1999).Statistical Analysis Systems, Version 8 of SAS Institute.Inc. Cary, NC.

Schippers, R. R. (2001). Domestication of indigenous vegetables for Sub-Saharan Africa.Chattam, U.K. National Resource Institute.(Technical report).Pp 201-222.

Singh and Joshi, (1995). Alteration of growth and development in leaf skeletonizer due to variation in teak leaves of different maturity. *Indian Journal of Experimental Biology,* 33(3): 227 – 229.

Singh, F., V.V. Singh, and Malik, R.V.S. (1995). Effect of different doses and sources of sulphur on yield and uptake of sulphur by garlic.*Journal of Indian Society Soil. Science,* 43: 130 – 131.

Technicon Instrument Corporation, (1975). Industrial method. Tarry Town New York. Pp. 155 – 712

Vachhani, M.U., Patel, Z.G. (1993b). Effect of Nitrogen, Phosphorus and Potash on bulb yield and quality of onion (*Allium cepa) .Indian Journal Agronomy,* 3: 333 – 334.

Wiederfield, R. (1994). Nitrogen rate and turning effects on onion growth and nutrient uptake in a subtropical climate.*Subtropical Plant Science,* 46: 32-37.

Woldetsadik, K. (2003). Shallot (*Allium cepa L.)* responses to plant nutrients and soil moisture in a sub-humid tropical climate.Ph.D Thesis, Swedish University of Agricultural Sciences.