Vegetative Components of Onion (*Allium cepa* L.) as Influenced by Nitrogen, Phosphorus and Locations

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ABSTRACT-***Field trials were conducted using nitrogen (N) (0, 55, 110 and 165 kg ha^{-1}) and phosphorus (P_2O_5) (0, 45, 90 and 135 kg ha^{-1}) rates in two different locations (Bauchi and Kardam) during the 2003/2004 dry season. In each location, treatments were combined and arranged in a randomized complete block pattern with three replications. Results revealed that vegetative components of onion were influenced by nitrogen (N), phosphorus (P_2O_5) and locations. Significant and progressive increase was recorded in plant height and number of leaves as rates of N and P_2O_5 increases.Vegetative yield of onion was significantly increasedby N only. Of all the interactions recorded in plant height, number of leaves and vegetative yield of onions, only the interactive effect of nitrogen and location was significant at 5% level. Plants height and number of leaves, irrespective of N-rates, increased significantly and considerably in Kardam flooded valley when 165kg ha^{-1}was applied. This trend was further recorded in vegetative yield at Bauchi.It was therefore concluded that, as much as 165 kg Nha^{-1} and 135 kg P_2O_5 ha^{-1} are needed to increase yield in onion vegetative components in Bauchifadama areas as well as Kardam flooded valley and their related ecologies.***

Keywords: Fertilizers; locations; vegetative components; onion

1. INTRODUCTION

Onion is a most important bulbous vegetable crop, which may be grown throughout the world (Akoun, 2004; Dantata and Damar, 2008; Dantata, 2011a and b). It is extensively cultivated for its economic reasons and multiplicity of uses (Griffiths *et al.,* 2002;Jilani*et al.,* 2004;McCallumer*et al.,* 2008; Dantata, 2011b; Dantata and Auwalu, 2011). There is a relatively constant demand for onions and its vegetative components all year round (Dantata *et al.,* 2009). The supply of onionshas not been able to meet up with the demand.Reasons for this development may not be unconnected to the fact that large scale cultivation of the crop is localized and restricted exclusively to fadama and irrigable areas of Nigeria (Akoun, 2004; Dantata *et al.,* 2009; Dantata and Auwalu, 2011). The characteristic of the fadama is that, it is flooded once a year. This flood cycle is very important for enriching the onion fields with organic deposits (Akoun, 2004).More reasons for low yields have been attributed to inadequate use of fertilizers under the agro-climatic conditions of an area (Jilani*et al.,* 2004). Fertilizer application is one single cultural practice, which affect onions vegetative growth, yield and bulb quality that demands precise knowledge, especially in the area of nitrogen and phosphorus(Dantata *et al.,* 2009). Inadequate fertilization delays vegetative growth and leads to irreversible yield reduction, while, excessfertilization, interacts with other management, pests and climatic factors to delay maturation, affect quality and yield (Sullivan *et al.,* 2001). Various rates of nitrogen and phosphorus fertilizers for onions development have been reported (Amans, 1982; Currah and Proctor, 1990; Ghaffoor*et al.,* 2003; Muoneke*et al.,* 2003; Dantata, 2006; Dantata *et al.,* 2009; Dantata and Auwalu, 2011).The present work therefore determines vegetativegrowth and developmentin onion as affected by nitrogen, phosphorus andlocations.

2. MATERIALS AND METHODS

Field experiments were conducted during dry season between September 2003 and April 2004 with irrigation at thefadama area of the Teaching and Research Farm, AbubakarTafawaBalewa University, Bauchi (Yelwa campus) and atKardam flooded valley in Dass Local Government Area of Bauchi State. The two locations are situated at the 10^0 $17^/$ N, 9^0 $49^/$ E and 609.3 m above sea level in the northern guinea savanna ecological zone of Nigeria (Kowal and Knabe,

1972). Composite samples of the top soil (0-30cm depth) were taken from the areas and analyzed for physical and chemical properties (Table 2) using standard procedures (A.O.A.C.1980). In the two field experiments, seedlings of *Kano* red onion variety were planted into sunken beds of 1m x 1m at spacing of 15cm x 20cm in November, 2003 at both locations. The treatments consisted of four nitrogen (0, 55, 110 and 165 $kgha^{-1}$) and four phosphorus (0, 45, 90 and 135 $kgha^{-1}$) rates. Factorial combination of the treatments was laid out in a randomized complete block design with three replications in each location. Urea (46% N) and single super phosphate (18% P_2O_5) were used as sources of nitrogen and phosphorus. The phosphorus treatment was applied prior to planting, while the nitrogen fertilizer was applied in two equal split amounts at 2 and 6 weeks after planting (WAP). Data on plant height (cm), number of leaves and vegetative yield (t/ha) were collected and subjected to analysis of variance (ANOVA) using F-test for significant differences of the treatments using Minitab computer software. Differences among mean of the treatments were separated using the Duncan Multiple Range Test (DMRT) at 5% level of probability.

3. RESULTS AND DISCUSIONS

Meteorological data (Table 1) showed a mean temperature range of 21.2 – 33.5C and relative humidity of 22.5 – 57.5%. These appear reasonable for vegetative growth and development in onions. The trend in temperature and relative humidity observed may not be unconnected with the fact that, duration for production of the crop falls within the cold to warm season reported by Norman (1992) as critical.Result of the physical and chemical properties of the soil in Bauchi and Kardamlocations (Table 2) revealed that soils are clay loam (Bauchi) and silt loam (Kardam) with mean pH (both in H_2O and $Cacl_2$) of 5.57 (Bauchi) and 6.46 (Kardam). Other chemical soil properties were generally low according to Babaji (2002); however mean values were higher in Kardam compare to Bauchi. This shows the differences in soil fertility status of the two locations. The silt loam nature of the soil in Kardamlocation was friable enough characterized with high organic material and easily cultivated. These particular soil properties coupled with favourable pH which falls within the range of 5.8-6.5 reported for onions (Norman, 1992), retain sufficient moisture around the roots of the onion crop for progressive vegetative growth and development. The clay loam soil in Bauchilocation with pH level below 5.8 appeared undesirable for onion growth development.This explains partly, the reduced plant height and number of leavesobtained in Bauchi. Clay soils are not suitable for onion growing (Norman, 1992). They contain insufficient organic matter and are prone to crusting and compaction which hinders onion physiological processes, especially,vegetative growth. Bodnar (1998) reported that pH levels below optimum have resulted in winter injury, poor plant vigour and reduced plant stand in garlic. Result of the study further showed that plant height, number of leaves and vegetative yield of onion were influenced by nitrogen (N), phosphorus (P_2O_5) and locations in the current study (Table 3). Significant and progressive increase was recorded in plant height and number of leaves as rates of N and P_2O_5 increases. The tallest plant with significantly high number of leaves was derived with application of N and P_2O_5 at 165 kg Nha^{-1} and 135 kg P_2O_5 ha^{-1}. However, vegetative yield of onion was only increased significantly with N applicationup to 165 kg Nha^{-1}. This observation could be attributed to the fact that nitrogen and phosphorus are essential nutrients necessary for the production of leaf in plant (Samuel, 1980; Morales *et al*., 1992; Vince *et al.,* 2002). A similar pattern of onion response to N and P_2O_5 fertilizer was reported by Narang and Dastani (1971), Hussaini*et al*. (2000), Dantata *et al.* (2009). In a 2-year work done by Muoneke*et al.* (2003), result showed that application of nitrogen up to 135 $kgha^{-1}$ as well as phosphorus up to 90 kg ha^{-1} increased leaf production significantly in both years. Amans (1982), Koriem and Faraq (1990), Amans*et al.* (1990) and Dantata (2006) also recorded increased and significant leaf production with N and P_2O_5rates. Locations had a significant and increasing effect on the vegetative components of onion being assessed (except in vegetative yield). Plants with tallest height and much leaves were produced atKardam flooded valley.Reasons were explained earlier in the physical and chemical properties of soils in the two differentlocations (Table2). Of all the interaction recorded in plant height, number of leaves and vegetative yield of onions, only the interactive effect of nitrogen and location was significant at 5% level (Table 3). Plant height and number of leaves irrespective of N-rates, increased significantly with plants of more considerable height and leaves obtained in Kardam flooded valley when 165kg $ha^{-1}$was applied. Similar trend was further obtained in vegetative yield at BauchiYelwa campus (Table 4). The differences reported in onion responses due to rates of applied N and locationscould be related to many such factors as location variation (Asiegbu, 1989; Dantata *et al.,* 2009) and edaphic reasons earlier discussed (Table 2).

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Table 1: Meteorological data covering the experimental period during the 2003/2004 dry season

Period	Minimum T^O (^oC)	Maximum T^O (^oC)	Mean T^O (^oC)	Minimum RH (%)	Maximum RH (%)	Mean RH (%)
Nov. 2003						
1 – 10	26.0	40.9	33.5	20	53	26.5
11 – 20	23.2	38.4	30.8	20	38	29.0
21 – 30	24.0	39.5	31.8	20	25	22.5
Dec. 2003						
1 – 10	21.3	38.3	29.8	20	31	25.5
11 – 20	21.6	42.8	32.2	20	27	23.5
21 – 31	21.6	37.4	29.5	20	26	23.0
Jan. 2004						
1 – 10	16.8	41.3	29.1	20	95	57.5
11 – 20	10.8	34.5	22.7	20	95	57.5
21 – 31	12.8	38.6	25.7	20	95	57.5
Feb. 2004						
1 – 10	11.5	30.8	21.2	20	95	57.5
11 – 20	15.9	38.9	27.4	20	95	57.5
21 – 29	15.4	43.7	29.6	20	95	57.5
Mar. 2004						
1 – 10	16.3	45.7	31.0	20	95	57.5
11 – 20	19.1	40.0	29.6	20	95	57.5
21 – 31	18.1	41.1	29.6	20	95	57.5

Source: Zero Emission Research Ce4ntre, ATBU, Bauchi. RH. Relative Humidity T^o . = Temperature

Table 2: Physico-chemical properties of the soils at the experimental sites at 0-30cm depths

Soil Characteristics	Location	
	Bauchi	Kardam
Physical analysis		
Particle size distribution (gkg^{-1})		
Sand	120.02	200.12
Silt	230.40	600.13
Clay	640.58	190.75
Texture	Clay loam	Silt loam
Chemical analysis		
pH water (1:1)	5.82	6.88
$pHcacl_2$ (1:2)	5.31	6.03
Organic carbon (gkg^{-1})	1.80	15.42
Total nitrogen (gkg^{-1})	0.18	0.28
C: N	6.43	25.27
Available P ($mgkg^{-1}$)	6.78	12.48
CEC Cmol (+) kg^{-1}	4.52	6.28
Exchangeable bases [Cmol (+) gk^{-1}]		
Ca	2.18	3.02
Mg	0.85	1.58
K	0.37	0.24
Na	0.03	0.06
BS (%)	75.86	77.23

Table 3: Effect of nitrogen, phosphorus and location on plant height of onion during the 2003/04 dry season

Treatments	Plant height (cm)	No.of leaves	Vegetative yield (t/ha)
Nitrogen (kg/ha)			
0	32.32d	8.25d	4.09d
55	40.85c	9.84c	6.21c
110	46.26b	11.04b	7.84b
165	51.73a	12.58a	10.43a
LS	*	*	*
SE±	0.58	0.22	0.22
Phosphorus (kg/ha)			
0	39.97c	9.80c	6.38
45	41.47c	10.21bc	6.79
90	43.70b	10.63ab	7.41
135	46.02a	11.08a	7.99
LS	*	*	NS
SE±	0.58	0.22	0.22
Location			
Bauchi	33.12b	9.52b	7.22
Kardam	52.46a	11.34a	7.06
LS	*	*	NS
SE±	0.41	0.16	0.16
Interaction			
N x P	NS	NS	NS
P x L	NS	NS	NS
N x L	*	*	*
N x P x L	NS	NS	NS

Means in a column followed by the same letter (s) do not differ significantly at 5% probability using DMRT LS. Level of significance * Significant NS. Not significant

Table 4: Interactive effect of nitrogen and location on plant height (cm), number of leaves and vegetative yield (t/ha) of onion during the 2003/04 dry season

Treatments	Locations					
	Plant height (cm)		No. of leaves		Vegetative yield t/ha)	
	Bauchi	Kardam	Bauchi	Kardam	Bauchi	Kardam
Nitrogen (kg/ha)						
0	20.30g	44.34d	6.46e	10.04c	2.92f	5.26e
55	30.76f	50.93c	8.79d	10.88c	6.08de	6.33d
110	37.31e	55.21b	10.56c	11.53b	8.26c	7.43c
165	44.12d	59.34a	12.25ab	12.92a	11.63a	9.23b
SE±	0.82		0.32		0.31	

Means in a column and row followed by the same letter (s) do not differ significantly at 5% probability using DMRT