Gashua Journal of Irrigation and Desertification Studies
Available online at www.gjidsfugashua.org.ng
Volume 2, Issue 1

GROWTH AND DEVELOPMENT OF SWEET POTATO AS INFLUENCED BY NPK FERTILIZER RATES INTRA-ROW SPACING AND SEED BED TYPES IN THE NORTHERN GUINEA SAVANNA

Mu'azu, A.
Department of Agronomy
Federal University, Gashua, Yobe State
Corresponding Author: e-mail: muazz44@yahoo.co.uk

Abstract

A two-year field trial was carried out during the 2011 and 2012 rainy seasons at the Research Farm of Institute for Agricultural Research, Ahmadu Bello University, Samaru ($11^0$11' N07^0 38Eand 686m above sea level) in the northern Guinea savanna agro-ecological zone of Nigeria to determine the growth and development of sweet potato as influenced by NPK fertilizer rates, intra-row spacings and seed bed types in the northern Guinea savanna. The treatment consisted of three NPK fertilizer rates (0,200 and 400 NPK kg/ha), three intra-row spacings (20, 30 and 40cm) and three seed bed types (ridge, mound and flat). The treatments were laid out in split plot design with NPK fertilizer rates and seed bed types assigned in the main plot and intra-row spacing in the sub-plot, and replicated three times. Result indicated that application of NPK fertilizer significantly enhanced most of the growth components of the crop in both years namely: Vine length, number of branches per plant, cop growth rate, relative growth rate, leaf area index and tuber yield (t/ha). Varying intra-row spacing from 20 to 40cm significantly increased most of the growth components of the crop in both year. Planting sweet potato on the mound performed better than planting on the ridges or the flat which were statistically similar in both years. Based on the results obtained in this study it could be concluded that application of NPK fertilizer at 200 kg/ha, planting sweet potato on 30cm intra-row spacing and using mounds could support good growth and development of sweet potato in both 2011 and 2012 years, respectively.

Keywords: Sweet potato, NPK Fertilizer rates, Intra-row spacings Northern Guinea Savanna

INTRODUCTION

*Sweet potato (I*pomoea batatas (*L*.) *Lam*) is a member of the convolvuliceae family (Purseglove, 1972). Based on the analysis of key morphological characters of sweet potato and the wild Ipomoea species, Austin, (1988) Postulated that sweet potato originated in the region between the Yucatan peninsula of Mexico and the mouse of the Orinoco river in Venezuela and was possibly introduced from tropical parts of America (Loebenstein and Thottaphilly, 2009) to other parts of the world (Yen, 1982). It is a perennial crop growth as annual (Woolfe, 1992). It is a root crop that provides food to a large segment of the world population,

especially in countries like China, Uganda, Nigeria, Indonesia, Tanzania, Vietnam and India where the bulk of the crops are cultivated and consumed (Opeke, 2006). The worldwide tuber yield was 12,648kg/ha (FAO., 2010).

Globally, sweet potato is a very important food crop which ranks third after Irish Potato and cassava in world root and tuber crops production (Ikeorgu, 2003). Kwara State was reported as the main area of sweet potato production in the North-Central Zone of Nigeria, in Offa and Oyun Local Government areas in particular, it is the staple food crop that is consumed in most households (Tewe *etal*., 2003). It has been reported that the response of sweet potato to varying regimes of N.P and K fertilizer was positive (Dapaah *etal*, 2004). Onwudike (2010), reported that application of NPK at 100kg/ha improved plant growth, tuber yield and soil fertility. Planting of sweet potato on mounds is the most common practice in traditional agricultural Onwueme (1978). Aina (2002) reported that planting crops on ridges, mounds and occasionally on flat cultivated land in Nigeria are used un-restrictly by farmers as standard procedures in crop husbandry. Varying the intra-row spacing between plants has been found to have a great influence on growth development of many cultivated crops (Ramat, 2007). Santos and Gilreath (2005) reported that any plant spacing variation could influence biomass accumulation and subsequent tuber number.

MATERIALS AND METHOD

A two year field trial was conducted during the 2011 and 2012 rainy seasons at the Teaching and Research Farm of the Institute for Agricultural Research Samaru (110 11'N07^0 38^0E and 686m above sea level) in the northern Guinea savanna agro ecological zone of Nigeria. The treatments consisted of 3 NPK fertilizer rates (0,200 and 400kg NPK/ha), 3 seed bed types (ridge, mound and flat) and 3 intra-row spacing (20, 30 and 40cm). The treatments were laid out in a split plot design with the combination of NPK fertilizer rates and seed bed type in the main plot and intra-row-spacing in the sub-plot, and replicated three times. The gross plot size was 11.25m^2 consisting of 5 ridges spaced at 0.75cm a part and 3m in length. The net plot was 6.75m^2 made up of 3 inner ridges spaced at 0.75m and 3m in length in both years.

Fertilizer application was carried out in both years of the experiment in 2 split applications as per the varied treatment rates, NPK 15-15-15 was first applied, the whole of P and K and half of N was applied at 2 WAP while the remaining N was applied at 6 WAP using urea (46%N) to supply the remaining half of nitrogen. The fertilizer was applied using side dressing application method in both years.

Pre-planting weed control was carried out in both years two weeks before planting by the application of round up at 5L ha^{-1}. Two hoe weedings were carried out to control weeds that emerged at 6 and 9 WAP. Sweet potato weevil *Cyclas formicaries* and *Cyclas brunnens* were most common pest that infested the field in both years. The pests were controlled using 0.1% Carbaryl and were applied twice at two weeks interval starting from 4 WAP. There were no diseases incidence observed during the

periods of the trial in both years and therefore no control measure was applied. The crop was harvested manually with the aid of hoe at 12 WAP control when the leaves turned yellow and soil cracked indicative maturity. Data collected were analyzed statistically in accordance with Snedecor and Cockran, (1967) and treatments means were compared using Duncans Multiple Range Test (Duncan, 1965).

RESULTS AND DISCUSSION

The effects of NPK fertilizer rate, intra-row spacing and seed bed type on vine length, number of branches per plant, LAI, CGR, RGR, and Tuber yield (t/ha) in 2011 and 2012 are presented in Table 1 and 2, respectively. Varying NPK fertilizer rates in both years was significant on number of branches per plant, and CGR in 2011 RGR and tuber yield in both years. Increase in NPK fertilizer rate from 0 to 200kg NPK ha^{-1} significantly increased all the above parameters, a further increase to 400kg NPK ha^{-1} were statistically similar except RGR and Tuber yield in 2011 when the parameters were significantly decreased.

NPK fertilization significantly increased growth and development of crops in this study from the control up to 200kg NPK/ha. Chang and Su (1977) reported that NPK fertilizer application significantly increased plant height by increasing the length and number of internodes as well as leaf area index of the crop. Idem (1989) reported a significant increase in the size of all morphological components of the plant with the application of nitrogen.

Variation in intra-row spacing significantly influenced vine length, Number of branches per plant in 2011, LAI in both years and Tuber yield in 2011 as presented in Tables 1 and 2 respectively. Increase in intra-row spacing from 20 to 30cm was statistically similar on vine length in 2012 and LAI in both years, a further increase to 4cm significantly decreased these parameters. Plant population density is an important agronomic character which increases these or decreased yield. Therefore, optimum plant population could be used for the interception of adequate solar radiation necessary for the synthesis of plant food through photosynthesis. In this study, intra-row spacing of 20cm or 30cm resulted in adequate growth and yield of the crop. Roy and Singh (1986) however, reported that productivity per plant could be decreased by increasing plant density due to higher degree of competition for available light, water and nutrients among the crops as well as increase shading effect.

Varying seed, bed type on the above parameters was significant only on number of branches per plant in both year. In all the cases planting sweet potato on mounds significantly produced superior growth and yield attributes than ridge or flat plantings, which were statistically similar. Planting on mound provided conducive environment for the spread of roots as well as proper aeration for growth and development of the tubers.

CONCLUSION

Based on the results obtained in this study it could be concluded that application of NPK fertilizer rate at 200kg/ha, planting sweet potato on 30cm intra-row spacing using

mounds could support good growth and development of sweet potato in both 2011 and 2012 respectively.

REFERENCE

Aina, P.O (2002. Effect of tillage, seed bed configuration and mulching on soil physical properties. *Journal of Agriculture Sciences,* 10:26-31

Aina, P.O. (2002). Effect of Tillage, seed bed configuration and mulching on soil physical properties. Journal of Agriculture sciences, 10:26-31.

Austin, D.F (1988). The taxonomy, evolution and genetic diversity of sweet potatoes and related wild species. In P. Gregory (ed.). Exploration maintenance, and utilization of sweet potato genetic resources, pp, 27 – 60. CIP, Lima, Peru.

Austin, M.E., L. E. Aung and B. Graves (1973). Some observation on the growth and development of Sweet Potato (*ipomoea batatas).Journal Horticultural science,* 45:257-264

Bourke, P.M, (1985). Influence of Nitrogen and Potassium fertilizer on growth of sweet potato (*Ipomoea batatas)* in Papua New Guinea for fish; 33:89-108 *Field Crops Res.* 12, 363-375

Chang, W.L. and Su, H.P. (1977) Nitrogen and Spacing Responses of Semi-dwarf and tall indica rice cultivars at Al-hassa Oasis; Taiwan Agricultural Quarterly Journal, 13 (1) 214-236.

Dapaah, H.K., Enuin, S. A., Safokantanka O., Archirnah V.N.A., Buri M. M., Dankiya A. A., Otoo J.A. (2004). Sweet Potato Production Guide: *Resources and Reference Manual.* IFAD/MOFA Root and Tuber Improvement Programmed (RTIP) Publication. RTIP, MOFA Kumasi, Ghana p. 17.

Duncan, D.B. (1955). Multiple F-test Biometric 11-42pp.

FAO, (2010) FAOSTAT, online:http// faostat.fao.org/site/342/ default.apx.

Hartemink, A. E., Polamo, S. (2000). Yield and decline of sweet potato in the humid lowlands of papua *New Guinea Agric*. *Ecosyst. Environ. 79: 259-269*

Idem, N.U.A (1989) Effect of Nitrogen Rate and time of application on yield and yield components of maize in the northern Guinea Savanna Zone of Nigeria, paper presented at SAF GRAD workshop, Lome-Togo. P.27.

Igbokwe, M. C., J. C. Ogbonnaya (1980). Yield and Nitrogen Uptake by cocoyam as affected by nitrogen application and spacing. In Terry, E.R., Oduro, K.A. Caveness F. (eds.). proceeding of the first Triennial root crops symposium of the International Society for Tropical root crops Africa Branch, 8-12 September, 1980 Ibadan, Nigeria. International Development Research Centre, Ottawa, ont Canada IDRC 163 e, 255-257.

Ijoyah, O. (2004). Effects of seed bed types on yield of white guinea yam *(Dioscorea rotundata)* mini sets in Makurdi Nigeria. *Tropical*

Agricultural Research and Extension. 7: 155 – 160.

Ikeorgu, J.E.G (2003). Effect of size and spacing of mini tuber on yield of selected yam cultivars on the humid tropics of Nigeria. Agric. *Journal Vol.* 34. Pp. 17-20.

Kalu, B.A. (1989). Seed yam production by mini set techniques species in the guinea and derived savanna of Nigeria. *Trapical Agricultur.* 66 (1): 83 – 85.

Loebenstein, G. Thottaphilly (ds.) 2009). The sweet potato, D0110.1007/978-1-4020-9475-0-22© springer science + business media B.V. (2009) pp 1-10

Onwudike, S. O. (2010). Efficacy of Dehydrated Organic Fertilizers on the performance of Amaranthus Cruentus on the Degraded typic hypludult. Science and Nature Organization. 1 JSN-Vol.3 (3) 12 – 26

Onwuenm, I.c and Sinha, T. D.(1978). Field Crop Production in Tropical Africa. Camelot press limited Southampton London Page 267.

Opeke, L.K., (2006)(. Essential of crops: Dicotyledons. London: Longman 2: 10 – 12.

Ramat, M. (2007). Growth and yield of two varieties of sweet potato as affected by transplanting date and intra-row spacing. M.Sc. thesis Department of Agronomy, Ahmadu Bello University, Zaria Pp 40 – 45.

Roy, R.K. Singh, K.S.P. (1986) Response of Popcorn (zeamaize) to plant population and nitrogen Indian Journal of Agronomy, 31 (1):88-92.

Santos, B.M. and J.P. Gilreath (2005). Effects of chemical organic fertilization programs on mango (Mangiferaindica). *International journal of fruit science* 5 (In press). Pp. 16-20.

Sasaki, O. Yuda, A.S. and Ueki, K. (1993). Development of top system in relation to tuberous root formatin in sweet potato. 111. Branching characteristics & its varietal differences. *Japans Journal of crop science* 62: 157 – 163.

Snedecor, G.W. and W.G. Cochran, (1967) Statistical methods (6th ed) Iowa State University press U.S.A 456pp.

Tewe, O. O., O. A. Abu, E.F Ojeniyi and N.H. Nwakocha (2003). In Akoroda M.O. and Ngere J.M. (eds.) Processing of the Seventh Triennial Symposium of the International society for tropical root crop Africa Branch. (ISTRC-AB) pp. 65-74.

Wilson, L.A and S.B Lowe (1973). Quantitative-Morphogenesis of root types in the Sweet Potato (*Ipomoea batatas* (L.) Lam) root systems during growth from stem cuttings, tropical Agriculture 50: 343 – 345.

Woolfe, J.A (1992). Sweet Potato: An untapped food resource. Cambridge University, press, P 307 ISBN 978052.

Yen. D.E. (1982). Sweet Potato in historical perspective in Villareal, R.L. and T.D. Griggs (eds.) sweet potato, pp 17-30, proceedings of the first international symposium, Asian-vegetable Research and Development Centre Shannua, Tainan, Taiwan, China. Pp 17-30.

Table 1: Effect of NPK fertilizer rates, intra-row spacing's and seed bed types on vine length, number of branches/plan and area index at 12 WAP at Samaru during 2011 and 2012 rainy seasons

	Vine Length		No. of Branches		Leaf Area Index	
Treatment	2011	2012	2011	2012	2011	2012
NPK fertilizer rates						
0	124.2	119.1	9.70b	8.59	6.92	4.87
200	136.6	131.7	9.55a	8.70	7.05	4.92
400	129.3	122.5	9.00a	9.00	7.03	4.90
SE±	5.70	6.65	0.21	0.18	0.20	0.19
Intra-row spacing						
20	130.0	125.1a	9.14	8.44b	7.38a	5.34a
30	130.8	125.7a	9.33	8.96a	7.73a	5.37a
40	129.4	122.5b	9.48	8.88a	5.90b	3.99b
SE±	5.40	6.25	0.15	0.13	0.14	0.17
Seed bed type						
Ridge	137.5	131.2	9.25ab	8.74ab	7.15	5.06ab
Mound	131.6	126.2	9.85a	9.14a	7.23	5.10a
Flat	121.1	115.3	8.85b	8.40b	6.62	4.54b
SE±	5.70	6.65	0.21	0.18	0.20	0.19
Interaction						
F x S	NS	NS	NS	NS	NS	NS
F x P	NS	NS	NS	NS	NS	NS
S x P	NS	NS	NS	NS	NS	NS
F x S x P	NS	NS	NS	NS	NS	NS

Means followed by unlike letter(s) in a treatment group are significantly different at 5% level of probability using DMRT
NS = Not significant
CGR = Crop Growth Rate
RGR = Relative Growth Rate

Table 2 : Effect of NPK fertilizer rates, intra-row spacing's and seed bed types on crop growth rate, relative growth rate and tuber Yield at 12 WAP at Samaru during 2011 and 2012 rainy seasons

	CGR		RGR		Tuber Yield	
Treatment	2011	2012	2011	2012	2011	2012
NPK fertilizer rates						
0	7.51b	5.59	0.04b	0.06	12.9b	10.2b
200	9.27ab	6.23	0.06a	0.07	16.1a	13.2a
400	10.9b	7.59	0.02c	0.03	16.8c	13.7a
SE±	0.30	0.75	0.11	0.11	0.19	0.33
Intra-row spacing						
20	10.0	7.26	0.03	0.03	15.0b	12.3
30	9.37	6.92	0.06	0.06	16.4a	13.0
40	8.23	5.23	0.03	0.03	14.4c	11.7
SE±	1.30	1.14	0.10	0.10	0.16	0.13
Seed bed type						
Ridge	9.97	7.00	0.06	0.04	13.4b	11.5
Mound	9.59	6.37	0.03	0.07	17.9a	14.5
Flat	8.12	6.03	0.05	0.03	14.5a	10.9
SE±	0.30	0.75	0.11	0.11	0.19	0.33
Interaction						
F x S	NS	NS	NS	NS	NS	NS
F x P	NS	NS	NS	NS	NS	NS
S x P	NS	NS	NS	NS	NS	NS
F x S x P	NS	NS	NS	NS	NS	NS

NS = Not significant

CGR = Crop Growth Rate

RGR = Relative Growth Rate