Effect of cutting orientation on the growth and yield of cassava *(Manihot esculenta* crantz*)* In Obio akpa, Akwa Ibom State

Ofonime R. Akata*, Patrick I. Udounang and Patrick P. Udo
Department of Crop Science Akwa Ibom State University,Obio Akpa Campus Nigeria
Corresponding Author's e-mail: akataofonime@aksu.edu.ng or imeakata@yahoo.com

Abstract

The field experiment was carried out at Teaching and Research Farm of Akwa Ibom State University, Obio Akpa Campus in 2019 to evaluate the effect of planting orientations on growth and yield of two Cassava varieties. The experiment was a 2 x 3 factorial laid out in Randomized Complete Block Design. The treatments consisted of two cassava varieties (TMS 07/0593 and TMS 07/01368) and three planting orientations (180^0, 45^0 and 30^0) making a total of 10 treatment combination which were replicated thrice. Data were collected on the following growth and yield attributes; and subjected to statistical analysis using analysis of variance. Means were compared using Fisher's Least Significant Difference (FSLD) at 0.05 probability level. Result showed that TMS 01/01368 row 198.61cm at 10 months after planting (MAP) whole TMS 07/0593 was 130.77 cm at 10 MAP. TMS 01/1368 had larger leaf area of 136.60 and 138.55 cm^2 at 8 and 10 MAP while TMS 07/0593 had 90.71 and 101.30 cm^2 respectively. TMS 01/136 had 4.05 stems per stand while TMS 07/0593 had 1.62 stems per stand. Comparing the storage root yield, TMS 01/368 had 35.70 t/ha storage yield while TMS 07/0593 had 22.60 t/ha. TMS 01/136 had 37% greater storage root yield compared to TMS 07/0593. Among the planting orientations, the results indicated significant difference ($P<0.05$) in all growth and yield parameters except in leaf area and height at first branching. Tallest plant at 10 MAP, 188.15 cm was recorded in 45^0 produced significant storage root yield of 34.20 t/ha, followed by 29.77t/ha from 30^0 orientations. The least 20.42 t/ha was recorded in the treatment of 180^0 orientation. Farmers were advised to plant TMS 01/1368 at 180^0 orientation for stem production. For storage root yield, farmers were advised to plant TMS 01/368 at 45^0 orientation.

Keywords: Cassava, Planting orientation, growth, yield

Introduction

Cassava, *(Manihot esculenta* Crantz*)*, is a member of the family *Euphorbiaceae*. It is an important crop of Africa, Asia and Latin – America (Ravi *et al.*, (1996). The leaves and tender shoots are important sources of vitamins, minerals, and proteins (Balagopalan, 2002; Nweke *et al*., 2002). Starch of cassava crop has wide industrial applications. It is extensively used in the manufacture of paints (Godfrey *et al*., 2012). Cassava crop is well known for its adaptation to poor soils conditions, and responds well to better management practices. It is also resistant to draught (Chantaprasan and Wanapat, 2003). There exist conflicting reports about the appropriate cutting orientation.Cassava has become an important crop in Nigeria and the world over. According to Amaner (2011), the world annual production of cassava is over

158 billion tons. Yan *et al.* (2001) also confirmed that amount is used for various uses including human consumption (58%), animal feed (22%), and other uses (20%). Cassava-based dishes are widely consumed wherever the plant is cultivated; some have regional, national, or ethnic importance (Frederick *et al.*, 2008). Cassava must be cooked properly to detoxify it before it is eaten. Cassava can be cooked in many ways. The soft-boiled root has a delicate flavor and can replace boiled potatoes in many uses: as an accompaniment for meat dishes or made into purees, dumplings, soups, stews, gravies etc. Deep fried (after boiling or steaming), which can replace fried potatoes, with a distinctive flavor (Pypers *et al.*, 2011).

In spite of differences in the planting orientation on the growth and yield of the cassava varieties, published work on effects of cutting orientation on the growth and yield of cassava are limited. Adequate research attention has been to cassava to boost its productivity in the major producing area but such attention is still lacking in some Agricultural zone where the cultivation of the crop is becoming popular among peasant farmers. The study was conducted to evaluate the differences in growth, yield and the root quality of the two cassava varieties and evaluate the differences in cassava growth and yield as affected by the three-planting orientation (180^0, 45^0 and 30^0).

Research Methodology

The research was conducted at the Research Farm of the Department of Crop Science, Faculty of Agriculture, Akwa Ibom State University, Obio Akpa Campus, in Oruk Anam Local Government Area, Akwa Ibom State, during August, 2018 planting season. Obio Akpa lies between Latitude 4^030^S and 5^030N and Longitudes 7^030W and 8^00E (Slus, 1989). Mean annual rainfall ranges from 2000 mm to 2600 mm with a bimodal pattern, with peak in June and October (Slus, 1989). The annual temperature ranges from 24^0c to 30^0c, being highest in the month of February and April, while relative humidity ranges from 75 – 79% (Slus, 1989). The experiment was in a 2x3 factorial laid out in a Randomized Complete Block design. The treatments consisted of two cassava varieties namely; TMS 07/0539 designated as V_1 and TMS 01/1368 designated as V_2 and three planting orientations 180^0, 45^0, and $30^{0.}$ Each treatment combination was replicated three (3) times.

All the growth and yield data collected were subjected to analysis of variance, using GENSTAT discovery, 2012 version model. Significant means were compared using least significant differences at 5% levels.

Results and discussion

Cassava height as affected by cassava varieties and planting orientation

Cassava plant height as influenced by varieties and planting orientation are shown in Table 1. The result showed that TMS 01/1368 produced

significantly (P<0.05) taller plants than TMS 07/0539. TMS 01/1368 had taller plants at 2, 4, 6, 8 and 10 months after planting (MAP), while TMS 07/0539 was 26.30, 53.60, 96.18, 123.50 and 130.77cm respectively. At 10MAP, TMS 01/1368 was 34% taller than TMS 07/0539.

The cassava stems planted at 45^0 grew significantly (P<0.05) taller compared to 30^0 orientation while the shortest plants were recorded in the 180^0 orientation. The interactions between cassava varieties and planting orientation on plant height were not significantly different (P>0.05) at all the sampling periods.

Leaf area (cm^2) as influenced by cassava varieties and planting orientation

The effect of cassava varieties and planting orientation on leaf area are shown in Table 1. Leaf area showed significant difference (P<0.05) at 2, 4, 6, 8 and 10 MAP. TMS 01/1368 had large leaf area of 86.10, 131.50, 101.42, 138.60 and 136.55 cm^2 at 2, 4, 6, 8 and 8 MAP. TMS 07/0539 had 71.50, 41.40, 62.14, 90.1 and 101.30 cm^2 respectively. Leaf area of cassava was not significantly (P>0.05) influenced by planting orientation at all the sampling periods. There were no significant interaction effects between cassava varieties and planting orientation on leaf area at all the sample months.

Number of branches per plant as influenced by cassava varieties and orientation

Number of branches per plant as influenced by cassava varieties and planting orientation showed significant difference (P<0.05) at 2, 4, 6, 8 and 10 MAP (Table 3). The highest number of branches per plant, (3.17, 9.25, 15.60, 25.11 and 29.33 at 2, 4, 6, 8 and 10 MAP, respectively). This was followed by 2.08, 5.51, 10.08, 15.12 and 21.19 branches per plant, respectively, from the 30^0 orientation. The least number of branches per plant (1.88, 3.49, 8.11, 13.35 and 15.09) was recorded in the 180^0 orientation. The interaction effect between cassava varieties and planting orientation on number of branches per plant was not significantly different.

Height at first branching and number of stems per stand at 8 map

The effect of cassava varieties on height at first branching is presented in Table 4. The result indicated significant difference (P<0.05) between the two cassava varieties. TMS 07/0539 was 28.16cm at first branching while TMS 01/1368 was 13.68 cm at first branching. Height at first branching as influenced by planting orientation showed no significant difference (P>0.05). The interaction effect between cassava varieties planting orientation on height at first branching showed no significant difference (P>0.05).Number of stems per stand as affected by cassava varieties varied significantly (P<0.05) (Table 4). TMS 01/1368 had significant higher number of stems per stand, 4.05 while TMS 07/0539 had the least, 1.62.

Among planting orientation treatments, the result showed significant difference (P<0.05).

The highest number of stems per stand, 3.86 was recorded in the treatment of 180^0 planting orientation. The least 1.13 was recorded in the treatment of 30^0. The interaction effect between cassava varieties and planting orientation on number of stems per stand showed no significant difference (P>0.05).

Yield and Yield Components of Cassava as influenced by Varieties and Planting Orientation

Number of stems per hectare as influenced by cassava varieties showed significant difference (P<0.05) (Table 5). TMS 01/1368 produced significant higher number of stem bundles per hectare, 318.50 while TMS 07/0539 had the least, 221.30 bundles. The result showed that TMS 01/1368 had 31% higher stem bundles compared to others TMS 07/0539.

The effect of planting orientation on number stem bundles also indicated significant difference (P<0.05). (Table 5). The treatment of 180^0 produced significant higher number of stem bundles; 314.05. This was followed by 285.50 bundles recorded in the treatment of 45^0. The least number of stem bundle, 230.15 was recorded in the treatment of 30^0. The interaction effect between cassava varieties and planting orientation on number of stem bundles per hectare showed significant difference (P<0.05) (Table 5).

Number of storage roots per plant as influenced by cassava varieties is presented in Table 5.

TMS 01/1368 had the highest number of storage roots, 7.30 while TMS 07/0593 had the least; 4.60. The result of planting orientation of number of storages, root per stand also varied significantly. The treatment of 180^0 produced the highest number of storage roots per stand 7.45, followed by 5.06 recorded in the treatment of 45^0. The least number of storage roots per stand; 3.67 was recorded in the treatment of 30^0. The interaction effect between cassava varieties and planting orientation on number of storage roots per stand showed no significance (P>0.05).

Storage root circumference as influenced by cassava varieties showed no significant difference (Table 5). TMS 01/1368 had 16. 01cm storage circumference while TMS 07/0539 had 13.74 cm storage root length.

Storage root circumference as influenced by planting orientation varied significantly (Table 5). The biggest storage circumference 15.60 cm was recorded in the treatment of 45^0. This was followed by 13.70cm storage circumference recorded in the treatment of 30^0. The smallest storage circumference 10.22 cm was recorded on 180^0 planting orientation. The interaction between cassava varieties and planting orientation on storage root circumference showed no significant difference.

Storage root length as influenced by cassava varieties is presented in Table 38.25 cm. TMS 01/1368 had the longest storage root, 38.25 cm while 21.05cm was recorded in TMS 07/0539. The effect of planting orientation on storage root length indicated significant difference

(P<0.05) (Table5). The longest storage root; 29.40 cm, was recorded in the treatment of 45^0 planting. This was followed by 28.14 cm recorded in the treatment of 30^0. The shortest storage, 16.20 cm was recorded in 180^0 treatment. The interaction effect between cassava varieties and planting orientation on storage root circumference showed no significant difference. Storage root yield as influenced by cassava varieties showed significant difference (P<0.05) (Table 4.5). TMS 01/1368 had the largest storage root yield of 35.70 t/ha while TMS 07/0539 had 22.60 t/ha. The result showed that TMS 01/1368 produced 37% greater storage root yield compared to TMS 07/0539. Among the planting orientations, the result showed significant difference (P<0.05) with 45^0 producing the highest storage yield of 34.20 t/ha, followed by 29.77 t/ha recorded in 30^0 planting orientation. The least storage root yield; 20.42 t/ha, was recorded in the treatment of 180^0. The interaction effect between cassava varieties and planting orientation on storage root yield showed no significant difference (P>0.05).

Interaction effect between cassava varieties and planting orientation on number of stem bundle per hectare

The interaction effect between cassava varieties and planting orientation on number of stem bundles per hectare is presented in Table 6. The result indicated significant difference (P<0.05). The highest number of stem bundles; 377.40 t/ha was recorded on the treatment interaction followed by 350.60 bundle recorded in the treatment of TMS 01/1368 x 45^0 planting orientation. The least number of stem bundles per hectare; 192.80 was recorded in the treatment interaction of TMS 07/0539 x 30^0 planting orientation.

Discussion

Cutting orientation effect differed significantly on growth and yield of cassava. The horizontal orientation (180^0) produced significant higher number of stems per plant which resulted to higher number of stems per hectare while those planted at orientation of 45^0 and 30^0 produced significantly higher storage root. The higher number of stems per plant recorded in the 180^0 oriented plants could be attributed to the fact that all nodes were buried which facilitate a greater number of sprouts per plant and therefore encourages competition among the sprouts which reduces the plant height and storage root yield. The effect of cassava varieties on the growth and yield indicated significant differences in both growth and yield parameters showed that the both cassava varieties could be differentiated based on their morphological characteristics. Akata (2015) had reported different characteristics of two cassava cultivars (TMS30572 and local variety ("obubitokpo"). Result of Akata *et al.* (2016) report significant differences in cassava varieties. Among the planting orientation, 45^0 produced significant higher root yield, followed by the treatment of 30^0. The least

root yield was recorded in the treatment of 180^0. The treatment of 180^0 produced significant higher number of stem bundles per hectare while the least was from 30^0 planting orientation.

Conclusions

Based on findings of the study, the following conclusion were drawn; TMS 01/1368 produced significant higher number of stem bundles and storage root yield compared to TMS 07/0539. The 180^0 planting orientation produced significant higher stem bundles per hectare while 45^0 planting orientation produced significant storage root yield compared to the other treatments. The highest stem bundle per hectare was recorded in the interaction effect between TMS 01/1368 x 180^0 planting orientation. From the research findings, farmers are advised to plant TMS 01/1368 at 180^0 orientation for high stem bundle production. However, for high storage root yield, farmers should plant TMS 01/1368 at 45^0 planting orientation.

References

Carey, B. (2006). Gully erosion:.Fact sheet-L81, Natural Resources Department. The state of Queensland. QNRM

Christopher, M. & Fink, A. H. (2005). Recent rainfall trends across tropical West Akata O. R. (2015): Influence organic manure on soil fertility, weed flora dynamics and performance of cassava in Uyo, Nigeria Ph.D*Thesis in Crop Production*, University of Calabar, Calabar.

Amaner, D.R. (2011). Growth partitioning of crops in West Africa. pages 30-32.

Chantaprasan, B. & Wanapat, M. (2003) Effects of different harvest internals on Cassava foliage (Cassava hay) and root yield. Tropical Feed Resources and Development Center (TROFEREC) Department of Animal Science, Faculty of Agriculture, Khon kaen University, khonkaen 40002, Thailand. http://www.mekarn.org/msc200305/theses 05/chan-p/.pdf, accessed on 10 May, 2012.

Balagopalan, C. (2002). Cassava utilization in foods, feed and industry. Kerala, India: Sreekanyam Trivandrum.

Frederick, K., Douglas, M. & Opie, J. (2008). Soul Food from Africa pages 100-102

Godfrey AI, Ezekiel UU, Donatus Fu (2012) selection criteria for stem and Tuber yield in cassava *(Manihotesculentacrantz).Journal of American Science* 8:1120 – 1124.

Nweke, F. I., Spencer, D. & Lynam, J. K. (2002). Cassava Transformation: Africa's Best kept secret. East Langsing, MI: Michigan State University Press.

O. R. Akata, A. E. Uko, F. A. Nwagwu, N. U. Ndaeyo, A. O. Ikeh & D. M. Essang (2016). Weed Dynamics, Growth and yield of cassava *(Manihot esculenta crantz)* as influenced by organic fertilizer sources and rates in an Ultisol. *Journal of Basic and Applied Research International* 18(2): 68-76.

Pypers, P., Sanginga J.M., Kasereka, B., Walangululu, M. & Vanlauwe, B. (2011). *Increased productivity through integrated soil fertility management in cassava-legume intercropping.* pages 40-44.

Ravi, V., Aked, J. & Blagopalam, C. (1996). Review on tropical root and tuber crops /. storage methods and quality changes. Critical Review in Food science and Nutrition 36: 661 – 709.

Slus-Ak (1989). Physical Background, soil and land use and ecological problems. Technical Report of task force on soil and land use survey Akwa Ibom State, The Government Printer, Uyo.

Yan, H.M, Pottus, R. J. & Fynn, Y. K. (2001). Disease and pest response of cassava in the derived savannah zone. pages 40-44.

Table 1: Plant Height (cm) as affected by Cassava Varieties and Planting Orientation

	Months after planting				
Treatment	**2**	**4**	**6**	**8**	**10**
Varieties					
TMS 07/0539	26.30	53.60	96.18	123.50	130.77
TMS 01/1368	33.80	91.75	135.40	181.51	198.61
LSD (P<0.05)	3.14	4.21	5.90	7.60	7.91
Planting Orientation					
180^0 (flat)	29.40	62.18	87.11	108.26	125.07
45^0 (slant)	38.51	89.66	131.60	162.40	188.15
30^0	20.22	68.10	95.59	137.09	152.00
LSD (P<0.05)	2.80	6.71	7.07	7.45	8.01
Interaction	ns	ns	ns	ns	Ns

*ns = Not Significant

Table 2: Leaf Area (cm^2) as affected by Cassava Varieties and Planting Orientation

	Months after planting				
x	**2**	**4**	**6**	**8**	**10**
Varieties					
TMS 07/0539	71.50	91.40	62.14	90.71	101.30
TMS 01/1368	86.10	131.50	101.42	126.60	128.55
LSD (P<0.05)	2.51	4.63	6.77	8.25	8.90
Orientation (^{0})					
180	75.30	116.80	76.50	112.52	119.20
45	78.14	120.01	77.40	116.13	120.59
30	75.25	118.55	78.09	114.40	119.81
LSD (P<0.05)	ns	ns	ns	ns	ns
Interaction	ns	ns	ns	ns	ns

*ns = Not Significant

Table 3: Number of Branches per plant as influenced by cassava varieties and planting orientation

	Months after planting				
x	**2**	**4**	**6**	**8**	**10**
Varieties					
TMS 07/0539	1.51	3.18	6.47	10.22	12.61
TMS 01/1368	3.30	8.49	14.10	20.18	22.50
LSD (P<0.05)	1.22	2.01	2.59	3.20	3.42
Planting Orientation					
180^0	1.88	3.49	5.11	13.35	15.09
45^0	2.17	9.25	15.60	25.11	29.33
30^0	2.08	5.51	10.08	15.12	21.19
LSD (P<0.05)	1.60	2.26	3.11	3.76	4.01
Interaction CxP	ns	ns	ns	ns	ns

*ns = Not Significant

Table 4: Height (cm) at first Branching and Number of Stems per stand at 8MAP

	Height at first Branching	**Number of Stems per stand**
Cassava varieties		
TMS 07/0539	28.16	1.62
TMS 01/1368	15.21	4.05
LSD (P<0.05)	3.17	1.50
Planting Orientation		
180	18.19	3.86
45	19.25	1.75
30	18.70	1.13
LSD (P<0.05)	Ns	Ns
Interaction	Ns	Ns

*ns = Not Significant

Table 5: Yield and Yield Components of Cassava as influenced by Varieties and Planting Orientation

Treatment	**Number of stem Bundle/ha**	**Number of storage Roots/ stand**	**Storage root circumference (cm)**	**Storage root length (cm)**	**Storage yield (tlha)**
Cassava unit					
TMS07/0539	221.30	4.60	13.74	21.05	22.60
TMS 01/1368	318.50	7.30	16.01	38.25	35.70
LSD (P<0.05)	5.22	1.87	ns	3.14	
Planting Orientation					
180	314.05	7.45	10.22	16.20	20.42
45	285.50	5.06	15.60	29.40	34.20
30	230.15	3.67	13.70	28.14	29.77
LSD (P<0.05)	6.40	1.56	2.50	2.77	4.49
Interaction	2.55	ns	ns	ns	ns

*ns = Not Significant