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Full Length Research Paper

Preliminary Evaluation of Effects of Herbicide Types and Rates on Growth and Yield of Cassava (*Manihot esculenta* Crantz)

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Abstract
A field experiment was conducted at the University of Uyo Teaching and Research Farm, located at Use-Offot, Uyo, Akwa Ibom State of Nigeria between September, 2007 and August , 2008.cropping season. to evaluate the effects of type and rate of herbicides on growth and yield of cassava (*Manihot esculenta* Crantz). The experiment was laid out in a randomized complete block design with a split plot arrangement and replicated three times. The main treatments were types of herbicides viz: Primextra (*Atrazine* +*Metolachlor*) (2-*chloro*-4(*ethylamino*-6-(*isopropylamino*-*s*-*triazine* and 2-*chloro*-N-(-2-*ethyl*-6-*methy*-*phenyl*-N-(2-*methozyl*-*methylethyl acetamide*), Atrazine (2-*chloro*-4-(*ethylamino*)-6-(*isopropylamino*) *s*-*triazine*) and Diuron (N-(3,4-*dichlorophenyl*)-N, N-*dimethlurea*, while the sub-treatments were rates of application of the herbicides (1.0, 2.0, 3.0, and 4.0 kga.i ha ¹ applied as pre-emergence as well as control treatments where no herbicide was applied. Results showed that type and rate of herbicides had significant effects on , stand establishment, plant height leaf area index, number of tubers /stand, tuber length(cm), weight of tuber per plant and tuber yield(t/ha) at (P<0.05). Primextra at 2.0kga.i/ha had the significantly superior growth and yield (19.8tha) than Atrazine (17.3t/ha) and Diuron (16. 8t/ha). Based on the findings, this study suggests that Primextra at 2.0kga.i/ha is effective for weed control in cassava due to low phytotoxicity, better crop growth, and higher storage root yield.

Keywords: *Herbicides, type, rate of application, cassava.*

Introduction
Cassava (*Manihot esculenta* Crantz) is one of the most important root crops in the tropic and was introduced to Africa in the 16th century, but its production took take off seriously in the 20th century (Onwueme,1982 ; Hillocks 2002). Cassava constitutes a major food staple for over 50 million Nigerians, providing more than 70% of their daily energy requirements (]Nnodu *et a*l., 2006). Its products are of great importance and are consumed in various forms by humans and livestock. It grows over a wide range of ecological conditions and is more tolerant to low soil fertility, drought, pest and disease (Udoh *et. al.*, 2005; Nnodu *et al*.., 2006).]) In addition, cassava has an advantage of being available all year round since it can be left in the ground after maturity for up to three years before harvesting without significant spoilage. It also has high productivity per unit area of land (30-40 tha-^{1}) with minimal inputs (Nnodu, 1998; IITA,1993; Fermont, 2009).

In the past five decades, total cassava production in Africa has almost quadrupled from 31 to 118 million tonnes per year (FAO, 2009) and is frequently cultivated on marginal soils (Dixon *et al* .,2007; Hillocks, 2002; FAO ,2004). Cassava is typically perceived to be grown by resource poor small farmers (Alves, 2002; FAO ,2004; 2007) as it can be produced with family labour and basic inputs only and with low production risk (Nweke ,2005). According to FAO (2009), average cassava yield in Africa has gradually increased from 6 to10 tha-^{1} over the past five decades. However, at present the average African farmers harvest approximately 20% less cassava per hectare than the world average o12.2 tha^{-1} (Fermont , 2009). Various constraints such as abiotic and biotic factors as well as human activities have contributed to keeping the average yield of cassava in Africa at a low pace. Nevertheless, there is a potential for higher yields in Africa as on-farm germplasm trials average yields of 15 to 40 tha-^{1} have been obtained (Fermont *et al*., 2007 ;.2008) Although there is a trend of increases in cassava production in the humid tropics (FAO 1993; 2009), management practices e. g. weed management technique are variable and in most systems inappropriate for the expression of the yield potentials of the improved cassava genotypes (Eke-Okoro *et al* .,2001).

In large scale cassava farms, herbicides are used and they affect plant growth by their direct and indirect effects on one or more plant components (Akobundu, 1987). Some herbicides interaction within plant may result in spectacular good weed control at dosages considerably below those normally utilized in single application. Others may result in moderate increase in phytotoxicity, while others may cause no effect or produce a level of phytotoxicity that is below the normal toxicity level. Plant responses to herbicide interactions can be measured on the basis of stand reduction or several growth parameters (Akobundu, 1981). Cassava is sensitive to *atrazine* but in the *primextra* formulation the *atrazine* components in a 2.5 kga.i ha^{-1} of the mixture is less that 1.0kga.i/ha which is tolerated by cassava. Herbicide interference with metabolic processes affects the physiological processes and the overall growth and development of plants (Akobundu, 1987). The increase dependence on cassava as a source of carbohydrate and raw material for most industries in many parts of the tropics has led to increase in farm sizes and cultivation of large hectares, hence the need for development of sustainable methods of weed control. Chemical weed control has the potentials to reduce labour requirements thereby reducing cost of production (Khan *et al*., 1985). However, the use of chemicals may have negative effects on crop growth and yield as well as the environment (Ogundola and Liasu, 2006). This study was therefore conducted to evaluate the influence of type and rate of some herbicides on growth and yield of cassava in Uyo, South-eastern Nigeria.

Materials and Methods

The experiment was conducted at the University of Uyo Teaching and Research Farm,located at Use-Offot- Uyo, Akwa Ibom State of Nigeria between September, 2007 and August , 2008.,cropping season. The site is located at Latitude 5º17^{I} and 5º27^{I} N, Longitude 7º27^{I} and 7º58^{I} E and on altitude of 38.1m above sea level. This rainforest zone receives about 2500 mm rainfall annually. The rainfall pattern is bimodal, with long (March - July) and short (September – November) rainy seasons separated by a short dry spell of uncertain length usually during the month of August. The mean relative humidity is 78% and the atmospheric temperature is 30ºC. The mean sunshine hour is 12. Pre- planting soil analysis revealed the following physico-chemical characteristics: pH in water of 5.71 2.16% organic matter, 0.10 % total nitrogen, 96.91 mg/kg available P while exchangeable bases values were 0.10, 3.40 and 1.68 cmolkg-^{1} for K, Ca and Mg, respectively. The soil particle distribution was: sand 86.80 %, silt 4.18% and clay 8.71%.

The experiment was laid out in a randomized complete block design with a split plot arrangement and replicated three times. The main treatments were types of herbicides viz: Primextra (*Atrazine* +*Metolachlor*) (2-*chloro*-4 (*ethylamino*-6-(*isopropylamino-s-triazine* and 2-*chloro*-N-(-2-*ethyl*-6-*methy-phenyl*-N-(2-*methozyl-methylethyl acetamide*), Atrazine (2-*chloro*-4-(*ethylamino*)-6-(*isopropylamino*) *s-triazine*) and Diuron (N-(3,4-*dichlorophenyl*)-N, N-*dimethlurea*,), while the sub-treatments were rates of application of the herbicides (1.0, 2.0, 3.0, and 4.0 kg a.i ha^{-1} applied as pre-emergence as well as control treatments where no herbicide was applied. Each main plot measured 9m x 4m while sub plot size was 3m x 2m. One metre path separated one subplot from the other while main plot and replicate were separated from the other by a path of 2m. The field was ploughed, harrowed and ridged with tractor drawn implements between 21 and 22 September, 2007. Cassava cultivar TMS 30572 was planted on 24 September, 2007 at a distance of 1mx1m giving a total plant population of 10,000 stands ha^{-1}. This cultivar was chosen because of its good branching ability and canopy formation. The herbicides were applied as pre emergence one day after planting the cassava in the plots which received the herbicide treatments. The herbicides were applied using a lever operated knapsack sprayer calibrated to deliver each spray volume. At 2 months after planting (MAP), 120kg of N P K (15:15:15) was applied using ring method to all treatments including the control treatment.

Data Collection and Analysis

The number of established stands (plants) was counted and the percentage of establishment calculated based on the total number of stems planted at 1MAP and 9MAP. Growth parameters assessed were plant height, and leaf area index (LAI) (Ramanujam and Indira 1978). Cassava tubers were harvested and the yield components (number of tubers, tuber length, tuber circumference, tubers, tuber yield) were determined. Data collected were subjected to analysis of variance) and the means compared using least significant difference (LSD) at $p < 0.05$ (Wahua, 1999)

Results and Discussion

Cassava Stand Establishment and Survival Percentage

Results showed significant differences ($P<0.05$) among the herbicide type for stand establishment (Table1). Primextra showed the highest stand establishment (85.7%) at 1MAP and high survival percentage (83.0%) at 9MAP. Similarly, application rate of 4.0kga.i ha^{-1} had the least survival percentage irrespective of herbicide type. Primextra at 2.0kga.i/ha^{-1} had the highest number of survivors (95.0%) through out the sampling periods. Interaction was only significant for survival of the plant with survival rate reducing with increase in herbicide application rate.

Cassava leaf area index was significantly affected herbicide type and not on height (Table 2). The 2.0kga.i ha^{-1} rate had the tallest plant and LAI irrespective of herbicide type.

Primextra at 2.0kga.i ha^{-1} had the tallest plant and the highest leaf area index. The application rate of 4.0kga.i ha^{-1} produced the shortest plants and the lowest leaf area index irrespective of herbicide type. These may be attributed to the higher rate of application of 4.0kga.i ha^{-1} of the herbicide which might have had phytotoxic effect on the plant thereby inhibiting its growth. Interaction was only significant for plant survival with survival rate reducing with increase in herbicide application rate.

Yield and Yield Components of Cassava

Significant differences were observed among herbicide types, and rates for number of tubers per stand, tuber length, weight of cassava tubers per plant and tuber yield (Table 3). *Primextra* had the highest yield and yield components while *Diuron* had the least (Table 3). The interaction of the two components indicated that *Primextra* at 2.0kga.i ha^{-1} with the highest number of tubers (19.0), longest tuber (52.4 cm), heaviest tuber per plant (7.9kg) and highest tuber yield (19.8t/ha). Thus, primextra at 2.0kga.i ha^{-1} produced the best yield irrespective of herbicide type while *Diuron* had the lowest yield. This result is similar to the observation of IITA (1990) *that Atrazine* + *Metolachlo*r (Primextra) at 2-3kga.i ha^{-1} favours good root yield in cassava. It also agrees with the report of Alabi *et al*. (1999) that cassava yield from both *atrazine* and *metolachlor* at 2.0kga.iha^{-1} gave excellent storage root yield. It is also similar to the recommendation of NACWC (1994) of 2.0kga.i ha^{-1} of primextra for the control of weeds in cassava.

Table 1: Influence of type and rate of some herbicides on stand establishment and survival percentage of cassava

Treatments		**Establishment (%) at 1 MAP***	**Survival (%) at 9 MAP**
Herbicides	**Rate of application (kga.i ha^{-1})**		
Primextra	0	83.8	83.8
	1.0	83.3	83.3
	2.0	95.0	95.0
	3.0	87.5	82.5
	4.0	78.8	70.0
Mean		85.7	83.0
Atrazine	0	71.5	71.3
	1.0	62.5	62.5
	2.0	75.0	62.5
	3.0	62.5	57.5
	4.0	57.5	50.0
Mean		65.8	60.8
Diuron	0	71.3	66.3
	1.0	58.8	50.0
	2.0	52.5	57.5
	3.0	66.3	62.5
	4.0	57.5	50.0
Mean		63.3	57.3
LSD ($P< 0.05$)Type of herbicides	3.4	2.8	
LSD ($P < 0.05$)Rate of application	NS	1.0	
LSD ($P< 0.05$) Interaction	NS	1.3	

*MAP= Months after planting

Table 2: Influence of type and rate of some herbicides on height and leaf area index of cassava

Treatment: Herbicide	Treatment: Rate of application (kga.i ha^{-1})	Plant height (cm) at 6 MAP	Leaf area index at 6 MAP
Primextra	0	124.8	3.1
	1.0	132.2	3.2
	2.0	139.9	5.7
	3.0	138.9	3.9
	4.0	123.5	4.9
Mean		131.8	4.9
Atrazine	0	93.3	2.7
	1.0	105.5	2.7
	2.0	129.0	4.3
	3.0	106.2	3.2
	4.0	104.2	3.7
Mean		107.6	3.3
Diuron	0	109.2	3.5
	1.0	127.8	3.1
	2.0	130.3	4.0
	3.0	123.8	3.3
	4.0	110.2	3.3
Mean		120.2	3.2
LSD ($P< 0.05$) Type of herbicides		NS	0.9
LSD ($P < 0.05$)Rate of application		14.8	1.0
LSD ($P< 0.05$) Interaction		2.1	0.4

Conclusion

This study has shown that application rate of 2.0kga.i ha^{-1} encourages establishment, growth, and development of cassava better than other rates 0, 1.0, 3.0 and 4.0 kg a.i/ha^{-1}. Generally, Primextra at 2.0kga.i/ha^{-1} gave excellent root storage yield and did not affect crop growth compared to *Atrazine* and *Diuron.* It also showed that herbicides applied at higher rate of 4.0kga.i/ha^{-1} affect cassava growth and yield. However, long term studies are needed. .

Table 3: Effects of type and rate of herbicides on yield and yield components of cassava

Herbicides	Rate of application (kga.i ha^{-1})	No. of tubers/stand	Tuber length (cm)	Weight of tuber/plant (kg/ha)	Tuber yield (t/ha)
Primextra	0	14.3	38.6	5.7	14.3
	1.0	16.7	42.5	5.8	14.5
	2.0	19.0	52.4	7.9	19.8
	3.0	17.7	47.5	6.4	15.0
	4.0	13.3	37.2	5.3	13.3
Mean		16.2	43.6	6.2	15.6
Atrazine	0	13.3	33.7	4.5	11.3
	1.0	16.8	35.9	5.5	13.8
	2.0	16.2	40.2	6.9	17.3
	3.0	13.8	38.2	6.9	13.3
	4.0	12.8	34.5	5.3	13.0
Mean		14.6	36.5	5.5	13.7
Diuron	0	8.5	24.6	3.9	9.8
	1.0	13.3	37.3	5.2	13.0
	2.0	17.0	38.7	6.7	16.8
	3.0	15.5	35.1	5.2	13.0
	4.0	10.3	36.6	5.1	12.8
Mean		12.9	34.5	5.7	13.1
LSD(P<0.05)type of herbicide		1.6	8.2	1.1	3.1
LSD(P<0.05)rate of application		2.9	4.3	1.6	2.9
LSD(P<0.05) interaction		1.7	5.8	1.2	2.0

References

Akobundu, I.O. (1981). Weed control in cassava cultivation in the subhumid tropic. Tropical pest management, 26: 420 – 426.

Akobundu, I. O. (1987). Weed Science in the Tropics; Principles and Practices. John Weiley, New York.

Alabi, B. S., Ayeni, A. O. and Agboola, A. A. (1999). Effect of selected herbicides on the control of thorny Mimosa in cassava. Nigeria Journal of Weed Science, 12: 51-57.

Alves, . A.C. (2002). Cassava botany and physiology. In: Hillocks RJ, Thresh JM, Bellotti A. (Eds).Cassava: Biology, Production and utilization, CABI, Wallingford, UK,: 67- 90. Cited 4 March, 2007.

Dixon,A.G.O. ,Ngeve, J.M and Nukenine, E.N. (2007) Genotype x Environment Effects on Severity of Cassava Bacterial Blight Disease caused by *Xanthomonas axonopodis* pv. Wanihotis .Eur. J.Plant Pathol. 108: 763 - 770.

Eke-Ooro, O.N. Okereke, O.U. and Okeke ,J..E. (2001) Influenceof Shoot Number Per Stand on Growth and Yield Stability in Cassava (*Manihot esculenta*)In: Proc. of 7th Triennial Symposium of the nternational Society for Tropical Root Crops -African Branch (ISTRC - AB) centre International des conferences, Contonou, Benin Rep. 11- 17 October, 1998:260 - 265.

Feront, A.M. (2009). Cassava and Soil Fertility in intensifying smallholder farming systems of east Africa. Thesis Wageningen University,Wageningen, N. L. 197

Fermont, A.M,., Obiero,,H.M, van Asten, P.J.A.,,Baguma ,Y, and Okwuosa ,E.(2007). Improved cassava varieties increase the risk of soil nutrient mining: an ex-ante analysis for Western Kenya and Uganda. In: Bationo A, Waswa B., Kihara ,J., Kimetu, J. (Eds), Advances in integrated Soil fertility management in sub-Sahara Africa: challenges and Opportunities, Springer, Dornrecht. 511 - 520.

Fermont, A.M., Van Asten, P.J.A. and Giller ,K.E. 2(008). Increasing land pressure in East Africa: The changing role of cassava and consequences for sustainability of farming systems. Agric. Ecosyst. Environ. ,128: 139 - 250.

Food and Agriculture Organization (FAO) (2004) Scaling Nutrient Balances; Enabling Meso- level application for African Realities. FAO Fertilizer and Plant Nutrition Bulletin 15. Food and Agriculture Organization, Rome, Italy,: 70.

FAO (Food and Agriculture Organization) (2004).The Global Cassava Development Strategy and Implementation Plan, Volume 1. Proceedings of the Validation Forum on the Food and Agriculture Organization, Rome, Italy,: 70.

FAO (Food and Agriculture Organization). (009).WWW.Faostat.fao.org. 2009 Cited 20 January,

Hillocks, R.J... (2002). Cassava in Africa. In: Hillocks R.J.,Thresh JM, Belloti A. (Eds), Cassava: biology, production and utilization, CABI, Wallingford,UK,: 41 - 54.

IITA (International Institution of Tropical Agriculture), (1990). Cassava in Tropical Africa. A reference manual, (IITA), Ibadan, Nigeria, pp. 1- 10.

IITA (International Institution of Tropical Agriculture), (1993).Root and Tuber Improvement Programme Archival Report (1989 - 1993) part1, Ibadan, Nigeria.

Khan, F. A., Bajiva, M. A., Quershi, M. H. and Rauf, A. (1985). Influence of Weedicides on Wheat Yield Rachis 4, 19-21.

NACWC (National Advisory Committee on Weed Control). (1994). Weed Control Recommendations for Nigeria (Series No. 3).
Nnodu ,E.C. (1998). Storage of cassava planting material. NRCRI Annual Report 1998: 11- 19.
Nnodu, E.C, Ezulike ,T.O.,and Asumugha, G.N. Cassava.In: Idem NUA, Showemimo FA (eds.). (2006). Tuber and Fibre Crops of Nigeria: Principles of production and Utilization (XXII),239
Nweke, F.I. (2005). The cassava transformation in Africa. In: Anonymous (Ed), A Review of Cassava in Africa, with case study on Nigeria, Ghana, the United Republic of Tanzania, Uganda and Benin, Proc. Validation Forum on the Global Cassava Development Strategy. Volume 2.IFAD/FAO, Rome,Italy.
Ogundola, A. F. and Liasu, M. O. (2006). Herbicidal effects of effluent from processed cassava on growth performances of *Chromolaena odorata* weeds population. African J. of Biotech., 6(6):685-690.
Onwueme, I .C. (1982). The Tropical Tuber Crops. John Willey and sons. Chichester.
Ramanujam, T. and Indira, P. (1978). Linear measurement and weight methods for estimation of leaf area in cassava and sweet potato. Journal of Root Crops, 4; 47-50
Udoh, D.J., Ndon, B.A, Asuquo, P.E. and Ndaeyo, N.U. (2005) .Crop Production Techniques for the Tropics. Concept Publication Limited, Lagos, Nigeria..464p.
Wahua, T .A. T. (1999). Applied Statistics for Scientific Studies. Africa-Link Books pp.355