Global Journal of Agricultural Research
Vol.6, No.3, pp.35-39, June 2018
Published by European Centre for Research Training and Development UK (www.eajournals.org)

INFLUENCE OF POTASSIUM IODIDE FERTILIZATION RATES ON PERFORMANCE AND FORTIFICATION OF CASSAVA (MANIHOT ESCULENTA) IN SOUTHEASTERN NIGERIA

Ansa J. E. O[1*] and Shiyam J.O[2]

[1]Department of Agricultural Science, Ignatius Ajuru University of Education, Ndele Campus, Rivers State, Nigeria
[2]Department of Crop Science, University of Calabar, Calabar, Cross River State, Nigeria

ABSTRACT: *Pot and field experiments were conducted between November 2011 and May 2013 in Calabar, (Southeastern rainforest agro-ecological zone of Nigeria) to determine the effective rate (0, 0.25, 0.50, & 1.0g KI) on agronomic fortification of two cassava varieties (TME 419 and TMS 30555). The designs were a 2x4 factorial experiment laid out in randomised complete block designed with three replicates. Vegetative parameters measured were plant height, leaf area (LA), tuber weight and tuber weight per plot. Iodine content was determined in cassava tuber and processed products (fufu). In both pot and field, applied doses of iodine did not significantly vary the plant height and LA and tuber weight ($p \geq 0.05$). Plot yield were not markedly influenced by Iodine levels ($p \geq 0.05$). Iodine absorption and retention in tuber flesh and fufu were significantly positively correlated with Iodine doses ($p0 \geq .05$ and 0.01). KI, at 2.5g per plant or 25kg/ha favoured iodine retention in tuber and fufu in TME 419 and for TMS 30555, 0.5g per plant or 5.0kg/ha. TME 419 retained more Iodine in tissues than TMS 30555.*

KEYWORDS: Agronomic Bio- fortification, Cassava, Calabar, Iodine rates

INTRODUCTION

Bio fortification is an approach that targets increasing nutrients in staple food crops for the enhancement of diets composed mainly of carbohydrate staples (Johns and Eyzaguirre, 2007). Bio fortification can be defined as raising the amounts of minerals and vitamins in food crops to enhance the health of consumer's, either by genetic or agronomic means of fertilization (White and Broadley, 2009, Yang et al., 2007, Zhao and McGrath, 2009). It is different from food fortification because it centres on making plants or crops have a higher nutritive value, rather than incorporating minerals or nutrients into the foods when they are being processed McWilliams (2011).

Iodine is an essential micro nutrient in man, required to produce thyroid hormone. It is found in food and human body in the ionized form called Iodide. The thyroid gland unites iodine with tyrosine, an amino acid, to make thyroxin and tri iodo thyronine hormones that control the body relaxing speed (basal metabolic rate) and support normal growth and development. Symptoms of lack of Iodine include sluggishness (hypothyroidism), addition of weight and in most cases an enlarged thyroid gland (goiter) (Abraham et al., 2002).

Addition of iodine in edible salt (iodized salt) has been adopted and it is now the most common, easy and less expensive way to overcome iodine deficiency. However, the high Sodium content in salt is associated with high blood pressure and increased incidence of cardiovascular disease (Jacobson, 2009; Smolen and Sady, 2011). This has led World Health Organization to stipulate

ISSN 2053-5805(Print), ISSN 2053-5813(Online)

drastic reduction in human sodium intake (WHO, 2007). Reduction in iodized salt usage may reduce the occurrence of cardiovascular diseases linked with high salt intake, but will further reduce quantity of iodine intake with consequent increase in its deficiency disease. Therefore fortifying a widely consumed staple like cassava may likely serve as a healthy alternative to, or complement iodized salt and indeed reduce Iodine deficiency disease (IDD) incidence.

Cassava (*Manihot esculenta*) is widely cultivated in the topics and sub tropics including Nigeria were it supplies about 70% of the calories needs of 60 million people (Ezulike 2006) and dietary energy intake in the sub humid tropics (Tsegia and Kornawa 2002). Cassava is utilized as garri, fufu, cassava chips, cassava flour, starch, farina, tapioca, macaroni, pudding, cassava bread and other forms such as akpu, lafun, starch and abacha in traditional meals of Nigerian people. It is thus a good choice of incorporating iodine instead of salt.

The objectives of the experiment were to evaluate the effect of Iodine agronomic fortification on growth and yield of the cassava varieties. Determine the optimum Iodine rate for fortification by cassava and evaluate the level of iodine retained in cassava processed product.

MATERIAL AND METHODS

The experiment was carried out in two phases viz; Pot Experiment and Field Experiment. Plastic basins (24 nos) with bottom diameter of 35 cm and height 50 cm were perforated at the bottom and filled with top soil up to 5 cm from the brim arranged according to experimental design were used for the Pot experiment. Two 20 cm long stem cuttings of each cassava were planted in each container (later thinned to one) in November 2011 and harvested in July 2012. The pots were watered with four litres of tap water when necessary to maintain favourable soil moisture conditions to ensure optimum growth of the plants. Iodine application was ten weeks after planting (10WAP). Measurement of vegetative parameter started 8WAP while the tuber iodine content was analysed after harvest.

In the field, soil was doubled ploughed and sectioned into 3 blocks, each having eight 4 meter by 4 meter plots each randomly allotted with the treatments. Planting was done in November 2012 with two healthy 20 cm cassava stem cuttings later thinned to one. Crop was rain fed and kept weed free. NPK 15:15:15 at 200kg/ha was applied 6WAP, while Iodine as Potassium iodide (KI) was applied 10WAP. Growth and vegetative parameter started 8WAP and iodine content in tuber and fufu was analysed at harvest. Vegetative parameters measured were plant height, LA [formula after, Alves and Setter (200)], tuber weight and tuber weight per plot. Determination of Iodine content in cassava tuber and fufu was analysed using X-ray Fluorescence spectrometer in accordance to Allen (1989). Data analysis was done by the analysis of variance (ANOVA) technique of the factorial experiment and means were separated using the Duncan's Multiple Range Tests (DMRT) at 5 % level of probability, using the GenStat for Window. 8thedition

ISSN 2053-5805(Print), ISSN 2053-5813(Online)

RESULTS AND DISSCUSIONS.

Vegetative Growth and Yield

In both Pot and field experiments, plant height, number of leaves and LA were not significantly varied by iodine rates (Table: 1). There was also no significant difference in average tuber weight and tuber weight per plot due to iodine doses, (Table: 1). This suggests that the slight variation in growth and tuber yield were not due to iodine inclusion. According to Smolen and Sady (2011) small quantities of iodine is beneficial to growth and development in plants though its essentiality in plant growth is not yet confirmed (Zhu et al, 2003). Strzetelski et al, (2010) also reported that excess iodine in plant produce severe physiological symptoms which cause whole plant death in extreme cases. The fact that the yield was not lower than the control in the study indicates that the iodine rates adopted for this research were not in the levels that would cause physiological damage to the cassava plants.

Iodine Agronomic Fortification

Iodine retention in tubers and fufu were significantly positively correlated with iodine supply. In addition plants that received iodine significantly had higher contents than the control plants, in most cases recording value that were twice as much as the control plants (Table:2). This finding is in accordance with Smolen et al (2011) who reported that in carrot storage roots, all treatment combination of iodine had significantly higher amounts of iodine than control plants. Zhu et al (2003) and Stzetelski et al (2009) also reported increasing absorption with iodine rates in tissue content of spinach and radish. The strong effective agronomy fortification of iodine in cassava root tubers can be attributed to translocation of iodine in plants. It has been shown that xylem transport system rather than the phloem account mainly for the accumulation of iodine in vegetative plants. This is why rice plant stores less iodine in the grains which require active phloem transport system for the translocation of iodine from vegetative organs to the grains (Mackowiak and Grossl 1999).

CONCLUSIONS AND RECOMMENDATIONS

Iodine inclusion in fertilizer programme for cassava may not affect the growth and tuber yield of cassava in the humid tropics. Agronomic fortification of iodine in cassava is possible, and recommended for tuber crops. KI, at 2.5g per plant or 25kg/ha and 0.5g per plant or 5.0kg/ha is recommended for cassava variety TME 419 and TMS 30333 respectively. TME 419 is recommended for adoption for agronomic Iodine fortification at a rate of 2.5kg/ha KI.

REFERENCES

Abraham, G.E., Flechas, J.D. and Hakala, J.C. (2002). Iodine sufficiency of the whole human body.The Original Internist 9: 6 – 20. Ezulike 2006

Jacobson, M.F. (2009). Salt the Forgotten Killer. Centre for Science in the Public Interest Washington D.C. (http:// cspinet.org/new/pdf/saltreport/pdf).

Johns, T. and Eyzaguirre, P.B. (2007).Biofortification, Biodiversity and Diet: A Search for Complementary Application against Poverty and Malnutrition. In: Food Policy, 32(1) 11.

ISSN 2053-5805(Print), ISSN 2053-5813(Online)

Mackowiak, C.L. and Grossl, P.R. (1999). Iodate and Iodine Effects on Iodine Uptake and Partitioning in Rice (Oryza sativa L.) Grown in Solution Culture.Plant and Soil 212, 135 – 143.
McWilliams, J. (2011). The case for biofortification. Available on http://www.freakonomics.com. Retrieved 5/8/2011
on Mineral Composition of Spinach Plant. Acta Sci. Pol HortorumCultus. 10 (3):3 – 13.
Smolens, S. and Sady, W. (2011). Influence of Iodine Fertilization and Soil Application of Sucroseon the Effectiveness of Iodine Biofortification, Yield, Nitrogen Metabolism and Biological Quality of Spinach.Acta Sci. Pol HortorumCultus.10 (4): 51-63.
Smolens, S. and Sady, W. (2011). Influence of Soil Application of Iodine and Sucrose
Strzetelski, P., Smolen, S., Rozek, S. and Sady, W. (2009). The Effect of Different Fertilization and Foliar Application of Iodine on Yielding Antioxidant Properties in Radish (RaphanusSativus L). Plant Ecol. Chemistry Eug.
Strzetelski, P., Smolen, S., Rozek, S. and Sady, W. (2010). The Effect of Diverse Iodine Fertilization on Nitrate Accumulation and Content of Selected Compounds in Radish Plants (RaphanussativusL.). Acta Sci. Pol. Hort. Cult.9(2): 65 – 73.
Tsegai, D. and Kormawa, P.C. (2002). Determinants of Urban Household Demand for Cassava Products in Kaduna Northern Nigeria.In: Conference of International Research for Development.,Witzen house 9 – 10 October, 2002
White, P.J. and Broadley, M.R. (2009).Biofortification of Crops with Seven Mineral Elements often Lacking in Human Diets – Iron, Zinc, Copper, Calcium, Magnesium, Selenium and Iodine.New Phytol. 182 (1): 49 – 84.
WHO Forum and Technical Meeting, Geneva.(http://www.who.int./diet physicalactivity /saltreport).
WHO World Health Organization (2007). Reducing Salt Intake in Populations. Report of a
Yang, X.E., Chew, W.R. and Feng, Y. (2007). Improving Human Micronutrient Nutrition through Biofortification in Soil-plant System – China as a Case Study. Environ. Geochem.Health. 29 (5): 413 – 428.
Zhao, F.J. and McGrath, S.P. (2009).Biofortification and Phytoremediation.Curr. Opin.Plant Biol. 12, 373 -380.
Zhu, Y. G., Huang, Y. Z., Hu, Y., and Liu, Y. X. (2003). Iodine Uptake by Spinach (Spinaciaolercea L.) Plants Grown in Solution Culture: Effect of Iodine Species and Solution Concentration. Environmental International 29, 33-37.

ISSN 2053-5805(Print), ISSN 2053-5813(Online)

APENDIX

Table 1: Influence of KI Doses of Growth and Yield in Two Varieties of Cassava (Pot and Field Experiment).

	Pot Experiment		Field Experiment			
varieties	final plant height (cm) 28WAP	Tuber weight (Kg)	final plant height (cm)	LA (cm^2)	Tuber weight (kg)	Tuber weight per plot (kg)
Varieties						
TME 419	110[a]	1.45[a]	266[a]	223[a]	5.83[a]	35.1[a]
TME 3055	131[a]	1.31[a]	300[a]	216[a]	6.03[a]	34.0[a]
SE	0.81	1.11	1.72	4.6	0.34	2.9
Rate						
0g KI (0kg/ha)	130[a]	1.52[a]	288[a]	206.3[a]	5.63[a]	32.5[a]
0.25gKI(2.5kg/ha)	133[a]	1.35[a]	299[a]	216.9[a]	6.04[a]	34.5[a]
0.5g KI (5.0kg/ha)	136[a]	1.5[a]	296[a]	226.2[a]	6.23[a]	36.6[a]
1.0gKI(10.0kg/ha)	145[a]	1.66[a]	293[a]	209.4[a]	5.8[a]	34.6[a]
SE	0.9	1.36	1.69	6.62	0.48	4.1
Interaction						
V & R	NS	NS	NS	NS	NS	NS

Table 2: Effects of Rates of KI Fertilization on Iodine Content (Bio-fortification) of tuber and Processed Product in Two Cassava Varieties.

	Pot experiment		Field experiment		FuFu	
Rate	TME 419	TMS 30555	TME419	TMS30555	TME419	TMS30555
0 kg KI/ha	1.40[a]	1.00[a]	4.50a	3.80a	1.80a	1.70a
2.5 kg KI/ha	12.30[b]	9.37[c]	11.80b	8.30c	5.80b	4.00c
5.0 kg KI/ha	11.30[b]	10.50[b]	10.20c	11.40b	4.00c	5.20b
10.0 kg KI/ha	11.30[b]	10.10[b]	7.40d	4.20d	3.30d	3.00d

ISSN 2053-5805(Print), ISSN 2053-5813(Online)