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INFLUENCE OF CATTLE RUMEN-BASED WASTE ON YAM (*DIOSCOREA ROTUNDATA*) MINI-SETT PRODUCTION

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ABSTRACT

The experiment was conducted at the Teaching and Research Farm of the FederalCollege of Education (Technical) Omoku; to examine the influence of cattle rumen-based waste on yam (Dioscorearotundata) mini -sett production. Using a total land area of 0.006 ha, the study was laid out in a completely randomized design with three replicates. The cattle rumen-based organic manure was applied at the rates of 0, 20, 40, 60 and 80 ton ha$^{-1.}$ Application was done two weeks before planting to enhance proper incorporation of the manure into the soil. Readings were taken on sprouting, vine length, number of tubers and tuber weight. Sprouting was suppressed across the various weeks at 20 ton ha^{-1} but enhanced across other treatment levels. Mean vine length increased linearly with the increasing application of the organic manure at 12WAP. Results of ANOVA showed that variation in mean vine length did not differ significantly across duration (12-16 WAP). Mean number of vine increased linearly across the levels of treatment (14 – 16 WAP). Mean number of tubers did not differ significantly at p=0.05. Mean tuber yield did not also differ significantly at p=0.05 across the treatment. Results of this study showed that application of the rumen-based organic manure above 20 ton ha^{-1} may be generally uneconomical.

Keywords: Yam, Minisett, Cattle, Rumen-Waste, Production.

INTRODUCTION

Yam belongs to the genus *Dioscorea.* Various species of yam exist and very many species produce tubers which are of great economic value. Yam contributes over 200 dietary calories per capital daily for more than 150 million people in West Africa (ANB-BIA 2003). Nigeria is the highest producer of yam (FAO, 2002) with 71% of world total output followed by Ghana, Cote d' lovire, Benin and Togo.

Dioscorea species constitute a staple food in the tropics (Han et. al 1987). Yam tubers when peeled are cooked into various forms (boiled and mashed into balls, sliced and fried etc). In Nigeria yam is also roasted and processed into various staple intermediate product forms (Okaka, et. al 1991, Okaka and Anajekwu 1990) and consumed by humans or used for direct consumption by animal.

In the rain forest zone, especially under traditional land use cropping system, yam is usually cropped first after land that have been under fallow was cleared (Coursey, 1967) and suitable seed bed prepared. This is because the plant requires very high soil fertility status. It has a fairly long gestation period, (long period of tuberisation and tuber maturation duration) and as a result has the advantage of utilizing the mineral reserve accumulated during fallow period .

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Yam cultivation requires high inputs. Under traditional farming system, the use of whole yam tuber was adopted in the production of propagules, where mini-setts were used the technology was poor. With the rise in demand for yam, the conventional method of seed yam production became grossly inadequate, giving rise to scarcity and high cost of planting materials. Apart from the fact that the conventional method of producing planting materials involves the use of large yam sett ,the method also does not provide for economy of land space, neither does it support uniformity in sprouting. Where double harvesting method is adopted, problem of harvesting immature seed yam that is often difficult to store often arises. These production constraints in conventional method of seed yam production informed the development of the yam mini sett techniques which was developed through the combined effort of the National Root Crop Research Institute Umudike Nigeria and the International Institute of Tropical Agriculture (IITA) Ibadan, Nigeria. Though other technologies such as tissue culture (in vitro micro-propagation using single nodal cuttings and in vitro production of micro-tubers) exist, their usage is limited to research centers that require it to facilitate delivery of improved germ-plasm. The yam mini – sett technology is no doubt, a quick means of seed yam multiplication. Its major advantages include land economy, production of good quality and health seed yam (IITA 2001) and low production cost. The improved seed yam production technology gives the farmer high quality planting materials within a short time interval than the conventional method.

Generally, yam production requires soil with high nutrients status because yam export substantial proportion of plant nutrients from the soil with the harvested produce but in various parts of the rain forest zones in Nigeria, most yam farmers relies on soil with marginal returns to produce yams. This is done not as a matter of choice but as result of the steady rise in human population leading to the attendant pressure on available land both for agricultural, industrial and other development purposes. The associated increase in demand on land for other purposes has made soil fertility maintenance through prolonged fallow period unattainable. Soil fertility maintenance through synthetic fertilizer usage seems to be the only available option. Inadequate knowledge and poor information on fertilizer use among rural famers, in addition to high cost of chemical fertilizer and other undesirable effects (burning of the plants, increased tuber rots during storage and production of unpalatable of tubers), again constituted a major constraints to the production of small scale farmers against the use of synthetic fertilizer in yam production in the Niger Delta region of Nigeria. In view of these production constraints there is the need to develop a production strategy that is cheap, readily available, farmer friendly and that posses the capacity to produce tubers with desirable qualities.

With the above considerations, the use of organic fertilizer offers a better alternative proposition. The animal /plant base organic material is an animal /plant base organic substance obtained from the rumen of slaughtered ruminant animals. The rumen is not only a store house of microbes that assist in the digestion of roughage in ruminant animals but it is also an important source of nutrient. The death and decomposition of microbes and the bulky plant materials is sure to release nutrient for the benefit of yam if eventually used as nutrient source for yam mini-sett production .According to Isirima, Ezekiel,Iyagba and Akonye (2009), Rumen- base organic mulch material has the ability to ratify the soil thus provide an enabling environment for plant growth and development, absorb moisture and release nutrients to the soil. Rumen- based organic mulch, which is similar to Cattle –rumen-based waste has been used successfully to increase maize grain yield (Isirima,et .al. 2009). The aim of this study therefore is to examine the response of Cattle rumen – base waste to yam mini –sett production.

MATERIALS AND METHODS

Site Description

The study was located at the Research farm of the Federal College of Education Technical Omoku in Rivers State, South –South Nigeria. Omoku is located within the tropical rain forest zones of Nigeria and it has a bimodal rain fall distribution pattern that peaks in June – September and a dry season period that falls between November-March. The experiment was located on a sandy loam soil in a land area that was previously cropped with cassava and left fallow for about 4years. The experiment was located in a plot of land measuring 6 × 10m^2 which was cleared, stumped and marked out into plots. The plots were then divided into five units (sub plots) each measuring 2m × 1.5m and suitable seed beds were than prepared with the aid of a spade. Seed yam obtained from the Agricultural Project Services and Seed Multiplication center of the Total E & P at Oborburu oil field location in OgbaEgbemaNdoni local Government Area of Rivers state, Nigeria. The seed yams were cut into slices weighing 50g. Yam sett so cut were treated with ash to protect it from pest attack and planted on seed beds earlier treated with Cattle rumen-based waste base at the rates of 0,20,40,60 and 80 tons/ha . It was a completely randomize experimental design and was replicated three times. Weeds were removed manually two weeks after planting with the use of a hoe and hand picking, subsequent weeding was done at an interval of two weeks. Sprouting rate was determined by direct counting of sprouted sets, whereas vine length was taken with the aid of a meter rule, number of vines per plant was determined by direct counting of the total number of sprouted and growing vines, tuber yield was determined by use of weighing balance while tuber length and girth was determine with the aid of measuring tape.

Data obtained from the various readings were subjected to statistical analysis using the Data Analysis Toolbar of Microsoft Excel. Response trends are as shown in the tables here-in presented.

RESULTS

Sett sprouting increased linearly as levels of cattle rumen waste increased across weeks (5-9 WAP) during which observations were made (Table 1). Analysis of the observed variation among the means did not show significant effect in mean sprouting rate. Sett sprouting across weeks was suppressed (not significant at p = 0.05) at the 20 ton ha^{-1} application rate. Beyond the 20 ton ha^{-1} treatment level, significant improvement in sett sprouting was recorded. Increase in application rates were accompanied by corresponding increase in mean vine length. (Table 2). However, variation in mean vine length did not differ significantly across the duration. Similarly, number of vines increased linearly across 14 and 16WAP (Table 3) as levels of the cattle rumen waste increased.

Table 1. Effect of Rumen-Based Waste on Sprouting Index (Mean ± SE, n = 3) of Yam Minisett

Duration	Application Rates of Rumen-Based Wastes (kg m^{-2})				
	0	2	4	6	8
5 WAP	0.33 ± 0.33	0.00 ± 0.00	0.33 ± 0.33	1.00 ± 1.00	1.00 ± 0.58
7 WAP	1.00 ± 0.58	0.33 ± 0.33	1.00 ± 0.58	1.33 ± 1.33	2.00 ± 1.15
9 WAP	3.67 ± 1.45	2.67 ± 0.88	4.67 ± 0.88	5.00 ± 0.58	6.00 ± 0.00

Table 2. Effect of Rumen-Based Waste on Vine Length (Mean ± SE, n = 3) of Yam Minisett

Duration	Application Rates of Rumen-Based Wastes (kg m^{-2})				
	0	2	4	6	8
12 WAP	60.6 ± 31.38	44.43 ± 14.33	96.63 ± 27.78	100.87 ± 27.92	89.30 ± 9.69
14 WAP	71.33 ± 27.71	68.40 ± 34.10	104.10 ± 56.92	103.20 ± 58.00	133.47 ± 37.77
16 WAP	125.97 ± 33.75	123.30 ± 19.88	185.63 ± 87.98	237.17 ± 70.52	305.40 ± 134.51

Table 3. Effect of Rumen-Based Waste on Number of Vines (Mean ± SE, n = 3) of Yam Minisett

Duration	Application Rates of Rumen-Based Wastes (kg m^{-2})				
	0	2	4	6	8
12 WAP	6.33 ± 2.85	8.00 ± 2.08	17.33 ± 8.65	15.33 ± 2.19	15.67 ± 4.37
14 WAP	11.00 ± 4.51	13.67 ± 2.33	20.33 ± 7.42	20.00 ± 3.60	18.33 ± 3.18
16 WAP	13.00 ± 5.13	15.00 ± 2.52	21.00 ± 4.04	30.33 ± 10.87	35.00 ± 10.50

Number of tubers increased with increasing application rates (Table 4). However, the observed differences were found to be due to sampling error, as results of ANOVA did not show any significant difference in means ($p > 0.05$). The highest mean value of 6.66 was obtained at the highest application rate (80 ton ha^{-1}) whereas a mean value of 3 was obtained at the lowest treatment level (0 ton ha^{-1}). Tuber yield increased but above 60 ton ha^{-1},tuber yield declined but this did not differ significantly $F(4,10) = 0.692$ at $p= 0.05$. This shows that mean tuber yield (8) obtained at the 0ton ha^{-1} did not differ significantly with the mean tuber yield of 19.5 15 and 8ton ha^{-1} obtained at the respective cattle rumen waste treatment values of 40, 60 and 80ton ha^{-1}.

Table 4. Effect of Rumen-Based Waste on Number of Tubers (Mean ± SE, n = 3) of Yam Minisett

Duration	Application Rates of Rumen-Based Wastes (kg m^{-2})				
	0	2	4	6	8
No of Tubers m^{-2}	3.00 ± 1.15	3.67 ± 1.20	4.33 ± 0.88	5.00 ± 1.00	7.00 ± 0.58

Table 5. Tuber Weight Effect of Rumen-Based Waste on Tuber Weight (Mean ± SE, n = 3) of Yam Minisett

Duration	Application Rates of Rumen-Based Wastes (ton ha^{-1})				
	0	20	40	60	80
Tuber Weight	8.00 ± 3.33	8.50 ± 2.08	16.00 ± 9.29	19.50 ± 8.61	18.67 ± 5.70

DISCUSSION

Results obtained indicate that the application of cattle rumen waste has the capacity to boost sett sprouting and vine length in yam mini sett technology. The capacity of cattle rumen waste to promote sett sprouting is directly related to the ability of the organic material to absorb and retain moisture. Application of manure to soil is known to improve soil fertility, soil structure and increase soil organic matter (Reganold, 1988, Sommerfelat et al., 1988 and Cleric et al., 1998).

Earlier, McAndrews, Liebman., Cambardella and Richard (2006) reporting on the residual effect of composted and fresh solid swine manure observed a significant increase in Soya-bean height and yield in the control experiment. Sett sprouting, number of vines, vine length, number of tubers per stand and tuber yield ha^{-1} increase linearly with application of the cattle rumen waste, variation among the observed means did not differ significantly, probably due to slow mineralization of the organic matter. Though it has been observed that the addition of organic matter increases soil water holding capacity and this means that nutrient would be made available to crops where manure has been added to the soil (Costa et al., 1991) again this also depends to a large extent on the decomposition rate and mineralization of the organic matter. Ayoola and Adeniyan (2006) reported low crop yield under poultry manure application and attributed this to possible low mineralization of the nutrient source. Organic manure use would give maximum effect where crop duration on the field is relative longer. According to Titilayo (1982) organic waste/fertilizer alone can hardly be depended upon as the sole nutrient source for short duration crops like maize. Tuber yield of 8kg obtained at control experiment did not differ significantly in the mean value of 10 and 15 obtained at 40 and 60ton/hacattle rumen waste treatment.

CONCLUSION

Yam mini sett technology is an important Scientific contribution to the production of yam in Nigeria and other yam producing zones of the world .In this study the capability of Cattle rumen based waste to enhance sett sprouting, vine length and boost yield and yield components in yam mini-sett production technology has been demonstrated. The cattle rumen-based application levels used in the current study did not produce any significant increase in the observed parameters. Further study is therefore recommended to determine optimum cattle rumen-based waste requirement for sett sprouting, vine length, tuber yield and other parameters of interest.

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