

INTERNATIONAL JOURNAL OF AGRICULTURE, MANAGEMENT AND TECHNOLOGY



Vol 8(1) 2024

Published by
Federal College of Agriculture,
Ishiagu Ebonyi State

RESPONSE OF YAM VINE MULTIPLICATION TECHNIQUE UNDER DIFFERENT GROWTH MEDIA

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ABSTRACT

A total of three (3) yam varieties, *obiaoturugo*, *Igim* and *Oko* were evaluated. Clean and healthy tubers of *D. rotundata*, The selected tuber were cut into minisets sizes ranging from 25-30 grams. An average sized tuber were treated in a suspension of Funguran before planting. Thirty (30) freshly cut minisets were planted in the field. Vine collection was done 3-4 months after planting, Vines were cut into pieces (10–12 cm), each bearing a pair of mature leaves and two nodes. Three different growth media: topsoil (5 parts), carbonized rice husk (3 parts) mixture and topsoil (5 parts), Sawdust (3 parts) mixtures were prepared. The experiment was a 4 x 3 factorial, and treatments were arranged in a Complete Randomized Design (CRD) with three replications. Results revealed that vines cutting taken from 3-4 months from parent plants rooted at six (6) (WAP) weeks after planting. A range of 38.07 % - 48.74 %. There is a greater success in carbonized rice husk mixture. *Obiaoturugo* and *Igim* yam varieties exhibited greater potential for success in the yam vine multiplication technique of seed yam production and are recommended for adoption since they recorded higher vine growth, establishment and mini tuber yields.

Keyword: Sprout, Vine, Root. Media

Introduction

Yam belongs to the genus *Dioscorea*, which produces edible tubers. It is a monocot, despite occasional evidence of a second cotyledon (Lawton and Lawton, 1969). Various species of food yams are cultivated in the tropics and sub-tropics (IITA, 1992). The six most economically important species grown as staple foods in Africa are *D. rotundata* Poir (white guinea yam), *D. cayenensis* Lam (yellow yam), *D. alata* L (water yam), *D. dumentorum* (Kunth) Pax (bitter yam) *D. bulbifera* L (aerial yam) and *D. esculenta* (Chinese yam) (Onwueme, 1978). These six species constitute over 90% of the food yams produced in the tropics (Hahn *et al.* 1987). In West Africa, man began to gather yams for domestic use as early as 5000 BC, i.e. during the Paleolithic era (Davies, 1967). Agricultural archaeologists estimate that true yam-based agriculture started in West Africa approximately 3000 BC, as in South East Asia (Alexander and Coursey, 1969; Coursey, 1967; Davies, 1967). Yams are predominantly cultivated in the humid forest, forest savanna transition and the southern guinea savanna (SGS) zones of West Africa. Large percentages of current production are in the SGS (Scott *et al.*, 2006). Yams are usually made into various food items, recipes and confectionary according to individuals' preference or needs. It is an ancient crop in central West Africa and provides a promising avenue for alleviating the current food crises.

Worldwide yam production in 2007 amounted to 52 million tons, of which Africa produced 96%. Most of the world's production comes from West Africa

representing 94%, with Nigeria alone producing 71%, equaling more than 37 million tons. Yam production is declining in some traditional producing areas due to declining soil fertility, increasing pest pressures and the high cost of labor. Agriculture in Africa is also beset by the limited use of good quality planting materials. Planting materials are the basic unit of crop production and as such they are the most crucial input in agricultural production. Good quality planting materials usage and matching applications of other simple agricultural technologies can lead to doubling of current crop yields in Africa and ensure food security. Limited availability and cost of planting materials are major constraints to yam production in Africa. Planting materials account for about 50% of the cost of the production. Large amounts of material (about 10,000 seed yams) are needed to plant 1 hectare. If farmers do not buy new seed yams, they must set aside about 30% of their harvest for the next year planting (Kambaska *et al.*, 2009). In addition, seed yams are bulky and perish quickly. In most tropical countries, food yams are propagated vegetative by planting small whole tubers or pieces cut from large tubers. This means that some marketable tubers must be reserved for planting. This method competes with yam availability for human consumption and at the same time makes the cultivation expensive for large scale production. The cost of planting material is about 50% of the total outlay for yam production, so there is a need to improve the rate of yam multiplication. As a result of

difficulties in propagation, yam is under threat in many traditional areas of production.

The yam mini sett technique which involves the cutting of whole tubers to small pieces (50g) has brought some relief to yam growers in obtaining more seed yam. In spite of this, additional technology called the Vine Multiplication Technique has been proposed as an alternative to quickly multiply seed yams for cultivation. The Vine Multiplication Technique is a newly developed technique introduced by Council for Scientific and Industrial Research-Crops Research Institute of propagating yam seeds through Vine Cuttings. It was developed in partnership with and introduced to farmers since 2008. Yam being a vital crop in Ghana both at the domestic and export markets contributes about 17 % of agricultural gross domestic product (GDP) and plays a major function in household food security with more than 2 million tons harvested each year. In Nigeria, of all tuber crops, yam is the most preferred and the second most widely cultivated, after cassava. Yams are highly desired by consumers in the European and American markets, especially in communities with large numbers of West Africans and Caribbeans. The largest number of yams is exported to England and Neighboring countries

Materials and Methods

The experiment was conducted at National Root Crops Research Institute (NRCRI), Umudike's screen house. A total of three (3) yam varieties, *Obiaoturugo*, *Igim* and *Oko* were experimentt to evaluate the tuberization potentials from vine cuttings.

Preparation for Minisett Planting: Yam is generally planted on ridges and in mounds. Bush clearing was followed by ploughing to loosen up the soil, and harrowing to break up clods and improve the physical condition of the soil. After harrowing, the ridges were made using a tractor-drawn ridger. The ridges were spaced 1-1.2 m apart. Clean, healthy and disease-free mature tubers of (*kpamyo*) were selected from the newly produced tubers. The selected tuber were cut into minisett sizes ranging from 25-30 grams. An average sized tuber gave between 20-40 minisett. The minisett were treated in a suspension of Funguran before planting. Thirty (30) freshly cut minisett were planted in the field. Vine collection was done 3-4 months after planting the yam into the field, when the main stems had produced lateral

branches. Lateral branches (side shoots) were used so as not to disturb the growth of the main plant. Side shoots with more than 3 nodes were selected. Extra care was taken to avoid damaging the main stem. Vines were cut into pieces (10–12 cm long), each bearing a pair of mature leaves and two nodes. The end of each yam vine was inserted into poly bags already filled with the appropriate growth media and the medium was gently firmed around the cutting. An irrigation system was constructed from a small water pond behind the field and water was sucked, powered by a generator into the misting hose and water was distributed to the various planted vine cuttings. Three different growth media: topsoil, topsoil (5 parts): carbonized rice husk (3 parts) mixture and topsoil (5 parts): Sawdust (3 parts) mixtures were prepared. Three different sets of black polythene bags, containing thirty poly bags in each set were filled with the three growth medium and replicated three (3) times. Carbonized rice husk was pyrolyzed at 300-350 °C with a residence time of 1 hour. It was then cooled. The experiment was a 4 x 3 factorial, and treatments were arranged in a Complete Randomized Design (CRD) with three replications. Cheesecloth was used to construct a shade above the poly bags in order to reduce the incidence of sunlight and maintain a higher relative humidity within the chamber.

Data Analysis: All data obtained from the experiment were analyzed with analysis of variance (ANOVA) technique using Genstat statistical package (discovery edition 12). Differences between treatment means were determined using Least Significant Difference (LSD) at 5% level of probability.

Percentage sprouting: This was taken three weeks after planting of vines. It was determined by dividing the total number of sprouted vines by number of planted vines and multiplied by 100. 100 vines planted = number vines sprouted x number % Sprouting.

Percentage root formation

This was taken at six weeks after planting. Five vine cuttings of established vines were picked as samples from the three replications of each yam variety and then monitored for root initiation. The average means were calculated and divided by number of vine cuttings planted and multiplied by 100. 100 vines planted of number vines rooted of number mean formation root percentage.

Table:1 Treatment effects on percentage sprouting of yam vines at 21 DAP

Growth media	Percentage (%) sprouting
Top soil	47.61
Top soil/Carbonized rice husk	64.65
Top soil/Saw dust	43.12
LSD (5%)	2.31
Varieties	
Obiaoturugo	60.67
Igim	52.82
Oko	49.64
LSD (5%)	2.66

Grand mean	51.79
CV (%)	5.3

DAP=Days after Planting

The percentage sprouting of the yam vines differed significantly ($P<0.05$) among the growth media used (Table 1). The highest shooting of the vine was observed in topsoil/carbonized rice husk and this was significantly higher than all other treatments effects. The top soil treatment effect was also significantly

higher than that of the topsoil/saw dust medium. Varietal effect was also significantly ($P<0.05$) different, with the *Kpamy* producing more sprouts than all other varieties tested. The *Asiedu* variety produced more sprouts than *Swaswa* varieties. *Swaswa* was lower in sprout percentage.

Table 2: Treatment effects on percentage vine establishment of sprouted yam vines at 6 WAP.

Growth media	Percentage (%) sprouting
Top soil	38.71
Top soil/Carbonized rice husk	56.89
Top soil/Saw dust	33.88
LSD (5%)	3.11
Varieties	
Obiaoturugo	51.31
Igim	44.8
Oko	41.57
LSD (5%)	3.59
Grand mean	43.16
CV (%)	8.6

WAP= week after planting

Percentage vine survival/establishment

Results of percentage vine survival of sprouted yam vines of four yam varieties at six weeks after planting (6 WAP) under the various treatments are presented in Table 2. The mean percentage vine establishment under the three growth media ranged from 33.88 % to 56.89 % while that of the yam varieties ranged from 41.57 % in *oko* to 51.31 % in *Obiaoturugo*. The growth media significantly ($P<0.05$) affected percentage vine establishment of sprouted yam vines. Higher value was observed in the topsoil/carbonized rice husk media. The topsoil only treatment effect was significantly higher than the topsoil/sawdust mixture.

There was a significant ($P<0.05$) variation in percentage vine survival among the yam varieties. The percentage vine establishment was significantly ($P<0.05$) higher in *obiaoturugo* than in all other varieties. There was no significant difference between *Igim* varieties, but either varietal effect was significantly higher than that of the *Oko* variety.

Percentage root production

The results of percentage root production of established yam vines of four yam varieties at six weeks after planting under the various treatments are presented in Table 3.

Table 3: Treatment effects on established yam vines at 6 WAP.

Growth media	Percentage (%) sprouting
Top soil	36.16
Top soil/Carbonized rice husk	58.48
Top soil/Saw dust	31.05
LSD (5%)	3.78
Varieties	
Obiaoturugo	48.74
Igim	40.72
Oko	38.07
LSD (5%)	4.36
Grand mean	40.23
CV (%)	11.1

WAP= week after planting

Rooting percentage of the yam vines differed significantly ($P<0.05$) among the growth media and yam varieties (Table 3). The highest rooting of vines was observed in topsoil/carbonized rice husk which

was significantly higher ($P < 0.05$) than that of other growth media. The top soil only treatment effect was significantly higher than that of topsoil/sawdust mixture. Among the yam varieties, rooting in

Obiaoturugo was significantly higher than all the other varieties. Root formation in *Igim* were similar but significantly more than that of the *Oko* variety.

DISCUSSION

Increase in yam production in Africa has been achieved dominantly through expansion in cultivated area but little improvement in productivity (Nakasone *et al.*, 2006). The traditional production systems of the regions are under growing pressure to adapt short fallow periods owing to limited availability of new lands to support shifting cultivation. Global annual yam production is probably reaching the region of growth as estimated by Manyong *et al.* (1996) and it decreased by 11.5% in 2007 (FAO, 2010). Majority of yam farmers in Africa are smallholder farmers with limited resources to struggle further with their traditional methods. To meet the ever enlarging demand for food yams of the fast growing population and to tackle the threats that further limit yam production, new technologies that target African smallholder farmers are of urgent need.

Percentage sprouting: In this experiment, the topsoil/carbonized rice husk medium had the highest sprouting of vines (table 1) because it allowed for good aeration of the vines and easy drainage of any excess water thus providing a conducive environment for sprouting. The very high sprouting in this medium compared to others implied that it was ideal for sprouting of yam vines. Carbonized rice husks consist of a very light material with a micro-porous structure and a bulk density of about 0.150g compared with wood shavings. (Haefele *et al.*, 2009). The carbonization process also improves the water-holding capacity of the rice husks (Oshio *et al.*, 1981). Additionally, Schmidt *et al.* (2000) reported that the widespread practice of burning rice straw in the field indicates that black carbon from incompletely burnt (i.e. carbonized) rice residues could be an important source of organic matter in rice soils, as it has been previously shown for a range of other soil types. Williams *et al.* (1972) reported that research has shown that incorporation of carbonized rice husks can significantly improve soil properties by decreasing soil bulk density, enhancing soil pH, adding organic carbon, increasing available nutrients and removing heavy metals from the system, ultimately increasing crop yields. The lowest sprouting of vines under sawdust/topsoil mixture medium was attributed to high heat generation by decomposing sawdust which might have affected growth of vines as reported by Wilson (1989). The higher sprouting in the sole topsoil compared to sawdust/topsoil mixture could be attributed to lower heat generation in the medium. The differences in sprouting by the yam vines in the sprouting media justify the suggestion by Otoo *et al.* (2001) that substitutes to sawdust as a sprouting medium should be found. Muamba J. Kabeya *et al.* (2013) reported that vines of six genotypes of *D.*

rotundata gave a sprouting percentage ranging from 56.9 % to 96.3 %. The generally high percentage sprouting of vines of the yam varieties in this experiment ranging between 58.2 % in *Oko* to 60.67 % in *Obiaoturugo* implies that they could also perform well in the vine technology of production of seed yams. The significant variation in sprouting of the vines among the yam varieties was attributed to genotypic differences as suggested by Ikeorgu and Ogbanna (2009). The high percentage sprouting in *Obiaoturugo* (60.67) implied its good attribute for adoption in yam vine cutting technology. This is a good prospect for the success of the vine technology which is ideal for the production of seed yam to boost yam production. However, the carbonized rice husk was particularly suitable for all the yam varieties in this experiment.

Percentage vine establishment: The non-significant effect of the growth media on percentage vine survival was attributed to the uniform condition under which the sprouted vines were planted. However, the relatively higher percentage vine establishment for vines that sprouted in topsoil/carbonized rice husk medium compared to the other media was attributed to the influence of the earlier better sprouting condition in that medium. The establishment performance was reflective of their media sprouting percentage performance. The significant difference among the yam varieties was attributed to genotypic differences. The higher percentage establishment in *Obiaoturugo* and *Igim* varieties compared to *Oko* varieties implied better genotypic characteristics for adoption in yam vine technique of seed yam production.

Percentage root formation: Acha *et al* (2004) reported that healthy vine cuttings were prepared from branches of two to three months old plants of seven genotypes of *D. rotundata* rooted 50% to 77.1% under intermittent mist in a rooting medium of equal quantities of carbonized rice husk. In this experiment, 38.07 % to 48.74 % rooting was observed on the yam varieties evaluated in table 3. This low performance could be due to the type of varieties of yam evaluated in this experiment or due to the age of the vine cuttings. This could also be attributed to reduction in the activity of the meristem due to age of cuttings. As old aged plant already changed growth phase from vegetative phase to reproductive phase, the growth of new shoots and leaves are hampered which eventually affects rooting of yam vines. Amin *et al.* (1997) reported that in *Shorea leprosul* a plantlet production through vine cutting, rooting decreased when the leaf area increased. it was observed that the higher the percentage of established vines, the higher the percentage of root formation among the varieties and the higher the mini tubers number. It can then be suggested that, root formation among the established vines contributes to mini tuber initiation which affects mini tubers number. The highest rooting percentage

recorded in the topsoil/carbonized rice husk medium eventually produced the highest mini tubers number.

Conclusion

The vine multiplication technology should be considered as an effective yam propagation method. Varieties of both *Obiaoturugo* and *Igim* were successfully propagated in growth media. The result revealed that vines cutting taken from 3-4 months from parent plants rooted at six (6) WAP. A range of 38.07 % - 48.74 % rooting of vine cutting was registered for the yam varieties used. Varieties performed differently in growth media for mini-tuber production. Yam mini-tubers harvested varied from 5.79g to 9.53g. Various sizes of mini-tubers of yam can be generated using vine multiplication technique. Sprouting of vines of the three yam varieties was successful in the three growth media of top soil, topsoil/carbonized rice husk and topsoil/sawdust with greater success in carbonized rice husk mixture. *Obiaoturugo* and *Igim* yam varieties exhibited greater potential for success in the yam vine multiplication technique of seed yam production and are recommended for adoption since they recorded higher vine growth establishment and mini tuber yields.

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