Communication in Physical Sciences, 2024, 11(3): 569-575

Seed Yam Multiplication Using Minisett Technique

Cletus O. Ezidi*, Eucharia N. Nwosu, Rita O. Ohakwe, Chukwunonso S. Okeke, Austin E. Aniecheonwu, Okwuchukwu E. Onyekaonwu, Chinyere E. Umeocho and Kingsley T. Agusiobo

Received: 12 March 2024/Accepted: 26 June 2024/Published: 30 June 2024

Abstract: *Yam (Dioscorea spp.) plays a crucial role in West African agriculture, providing food security and income. However, challenges such as high seed yam costs and scarcity hinder production. The yam miniset technology, aiming to increase planting material multiplication, was evaluated in Abagana, Anambra State. The study assessed sprouting rates, growth dynamics, and yield of yam setts from head, middle, and tail tuber regions. Results showed the head region had the earliest sprouting (8-14 days), followed by the tail (14-21 days) and middle (after 2 weeks). Pre-sprouting in a sterilized medium enhanced survival and reduced disease. The technique demonstrated potential for enhancing yam production, suggesting avenues for farmer education, government support, and further research to promote adoption. These steps can bolster yam production, ensuring food security and economic stability in the region.*

Keywords: *Minisetts, Seed yam, Tuber crop, Dioscorearotundata, Planting season*

Cletus O. Ezidi*
Bioresources Development Centre, National Biotechnology Research and Development Agency, Abagana, Anambra State
Email:ezicomeng.@gmail.com

Eucharia N. Nwosu
Bioresources Development Centre, National Biotechnology Research and Development Agency, Abagana, Anambra State
Email:euchariapatricks@gmail.com
Orcid id: 0000-0002-9424-3956

Rita O. Ohakwe
Bioresources Development Centre, National Biotechnology Research and Development Agency, Abagana, Anambra State
Email:ritabenard50@gmail.com

Chukwunonso S. Okeke
Bioresources Development Centre, National Biotechnology Research and Development Agency, Abagana, Anambra State
Email:snollycon@gmail.com

Austin E. Aniecheonwu
Bioresources Development Centre, National Biotechnology Research and Development Agency, Abagana, Anambra State
Email:everaustin@yahoo.com

Okwuchukwu E. Onyekaonwu
Bioresources Development Centre, National Biotechnology Research and Development Agency, Abagana, Anambra State
Email:onyekaonwuokwuchukwu@gmail.com

Chinyere E. Umeocho
Bioresources Development Centre, National Biotechnology Research and Development Agency, Abagana, Anambra State
Email:chinyereumeocho@gmail.com

Kingsley T. Agusiobo
Bioresources Development Centre, National Biotechnology Research and Development Agency, Abagana, Anambra State
Email:agusiobokingsley@gmail.com

1.0 Introduction

Yam, a tuber crop belonging to the family Dioscoreaceae, holds significant economic and cultural importance, particularly in West

Africa. Among the species of economic interest, *Dioscorearotundata* (White Guinea yam) is the most cultivated and preferred, accounting for a substantial proportion of yam production in this region, which contributes to 92% of the world's yam production (FAO, 2022). Yams play a crucial role in enhancing food security and providing income for farmers. Traditionally propagated vegetatively using tubers, yams are prone to disease due to the continuous recycling of planting material (Ikeorgu, 2019). Despite Nigeria being the largest global producer of yams, with an annual production of 27 million tonnes, yam production has been declining (Nwosu, 2005, as quoted in Agbarevo, 2014). This decline is attributed to factors such as the high cost and scarcity of seed yams, high labour demand, pests and diseases, declining soil fertility, and unpredictable weather conditions (Agbarevo, 2014). The high cost of seed yams, which constitutes about 63% of the total production cost, is particularly problematic, leading to competition between edible and seed tubers (Nwosu, 2005, as quoted in Agbarevo, 2014).

This study aims to evaluate the impact of the yam minisett technique on enhancing seed yam production in Abagana, Anambra State. The objectives are to assess the sprouting rates of yam setts from different regions (head, middle, and tail), to compare the growth rates of seed yams produced from different yam regions, to determine the yield performance of seed yams transplanted at various times during the planting season, and to analyze the acceptance rate of the minisett technique among local farmers. While the yam minisett technique has been developed to address the critical issue of planting material scarcity, its adoption among farmers remains low. The reasons for this low acceptance and its impact on yam production in specific regions like Abagana have not been thoroughly investigated. Additionally, there is limited research on the performance of yamsetts from different tuber regions and their subsequent growth and yield (Ikeorgu, 2019).

The minisett technique, developed in 1982 by the National Root Crops Research Institute in Umudike, Nigeria, involves using small setts (less than a quarter of the usual size) to increase the multiplication ratio to about 1:30. This method ensures the availability of quality seed yams and reduces the competition between seed and edible tubers (Ikeorgu, 2019; IITA, 2021). The technique involves selecting clean, healthy tubers, cutting them into rings and further into small bits, treating them with fungicides/pesticides, and then planting them (IITA, 2021; Morse, 2018). Despite its potential, the adoption rate remains low, highlighting the need for further research and farmer education to promote this technique for improved yam production (Ogbonna *et al.*,2011). This study aims to fill the knowledge gap by investigating the performance and acceptance of the yam minisett technique in Abagana, providing insights into how it can be more effectively utilized to boost yam production and address the challenges faced by yam farmers.

2.0 Materialsand Methods

The process of seed yam multiplication using the yam minisett technology involves several steps. First, select healthy tubers without bruises, using yam tubers of 20-25cm in length and 25cm in girth (500-700g), and avoid tubers with a larger girth. Next, cut each yam tuber into horizontal sections (discs) about 2cm thick, and then vertically cut each 2cm thick disc into 2, 3, or 4 pieces, ensuring each minisett weighs 25-30g. Allow 4-5 minutes for ambient air to reduce the mucilage on the cut surface. Then, soak the cut minisetts in a lime-water solution to prevent rot and pest invasion. After soaking, spread the minisetts on a dry floor to dry and cure for a day before planting.

2.1 Preparation of Minisetts for Planting

First, select healthy yam tubers without bruises. Cut off sizeable portions, not less than 2cm thick, from the head and tail regions of the tuber, and group the head and tail portions

separately after cutting them into the required minisett sizes. Finally, cut the remaining middle portion into discs or portions 2-4cm thick, with the discs being thicker for smaller seed yams and thinner for larger seed yams.

2.2 Planting method

The pre-sprouting method was adopted for this research. Field studies were conducted at the farming site of the Bioresources Development Centre, Abagana, Anambra State. Healthy tubers of the Local cultivars of Dioscorea*rotundata* (white yam) were sourced from the local market, washed, and assessed for rapid seed yam multiplication using the minisett technique. The study was carried out from May 2022 to November 2022 in the permanent site of BiodecAbagana.The experimental site was manually cleared, ploughed, harrowed, and ridged.

2.3 Methods

Local cultivars of Dioscorea*rotundata* (white yam) were dissected and weighed. The experiment was conducted in three groups: group A (Head region), Group B (The Middle region), and Group C (Tail Region). This grouping was adopted to assess the yielding capacity of different parts of the mother yam and to assess the rate of growth. The mother yams were dissected into head, middle and tail regions respectively. The field was first ploughed, harrowed, ridged, and divided into three main plots; each plot being assigned to a particular region of the yam.

The yam minisett technology process involves several stages from sourcing of healthy mother tuber from the local market to dissecting of the tuber into mini setts as in Fig 1. Subsequently, the freshly cut minisetts are separated according to the three regions; Head, Middle and Tail regions as shown in Fig 2. And then undergo a treatmet process using lime water solution. The minisetts are soaked in a lime water solution for disinfection and protection against diseases as illustrated in Fig. 3.

After treatment, the cut setts are then spread out and allowed to dry for 12 to 24 hours. This process is called curing and it helps the cut regions to dry up completely thereby preventing rot or any form of decay. Fig. 4 and 5 show the process of curring in minisett technique. Next, the minisetts are presprouted using sawdust medium as the planting medium as displayed in Fig. 6.

Fig. 7 illustrates the staking of the yam minisett seedlings, this ensures better exposure of yam foliage to soil-borne diseases. After staking, the seed yams mature within the period of 5 to 6 months after transplanting. As the leaves turn yellow and dry off, the tubers are dug carefully and the harvested tubers are stored in a shaded place to prevent scorch.

As shown in Fig. 7 and 8, samples of the seed yam plants staked in the farm site. Fig. 8 illustrates the harvested seed yams and the stored seed yams already sprouting for next season planting.

The mother yams were dissected into mini setts weighing 25 g each with a thickness of 3cm. The mini setts were pre-treated by soaking in a mixture of lime and water for ten minutes to prevent rots and invasion of pests. The mini setts were spread evenly in a shaded airy room for 12 to 24 hours; this will help the cut surfaces to dry and cure before being placed in a nursery for pre-sprouting or planted directly on the field. A nursery bed was prepared using sterilized sawdust as the growth medium. The first sprouting occurred on the 7th of June with the head sprouting first followed by the tail region. The sprouted seedlings were transplanted to the main field on 17th June, and each region was planted according to the designated plot. A planting distance of 50cm apart was used and the seedlings were planted 5-7 inches deep. Data collection was done in batches according to groups in other to record the rate of growth. Vines were staked individually, and each plot was kept free of weeds by handpicking.

Fig 1. Dissection of yam tubers into setts

Fig 2. Freshly cut minisetts

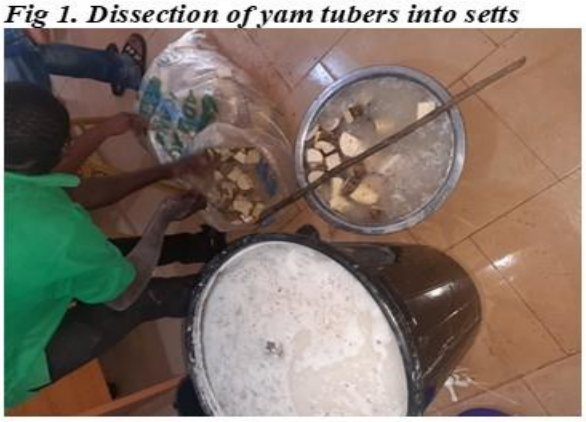

Fig 3. Treatment of mini setts in lime solution

Fig 4. Some mini setts soaked in lime water

3.0 Results and Discussion

The results show that the yam minisett technology is an effective method for mass production of seed yams for both local consumption and commercial purposes.From the experiment conducted and the data collected, there was the maximum percentage of sprouting varied among the different regions of the yam tuber. Group A (head region) was the first to sprout within 8-14 days followed by Group C (tail region) within 14-21 days and Group B (middle region) sprouted two weeks later. This observation was consistent with the report of Orkwo (1998), which confirmed that the head and tail regions of the yam setts sprout faster compared to the middle region due to the differential age of tissues by the tuber section and the apical dominance exhibited by the head of the tuber. However, a reduction in yield was observed among the setts transplanted late inthe planting season due to an insufficient supply of water considering the seasonal fluctuation. This is also in line with the findings of Eruola *et al.* (2012) and Beatrice *et al.* (2021) who in their studies on yam minisett technology reported low yield and rapid loss of foliage because of irregular rainfall.

Earlier studies revealed that pre-sprouting the minisetts in a sterilised medium was found to be the most effective method in fastening the growth of seed yams. Pre-sprouting in a medium free of pests and disease can increase minisett survival. This explains why the pre-sprouted minisetts recorded a high percentage of sprouting and less disease infestation.

Madueke (2000) reported the importance of the disinfection of minisetts before planting because the minisetts themselves are sources of root pathogens. Yam minisetts treated with lime solution produced significantly better sprouting thus indicating that the lime solution

could slow down or prevent minisett rot pathogens thereby improving sprouting of the minisetts irrespective of the yam cultivar. The efficacy of lime in controlling the growth of fungi has been reported by several researchers (Cornelius, 1998; Ogali *et al*., 1991).

Another observation made was on the size of the seed yams harvested, this means that the size of the mini setts is a determining factor for the size of the yam produced. The local cultivar, *Dioscorearotundata* responded well to the yam mini sett technique considering the large quantity of yam harvested within six months. This result suggests that this technique can be a valuable tool for increasing yam production in Abagana.

Fig5.Spreading of the minisett

Fig 6.Presprouting of yam minisett in the nursery

Fig. 7 seed yams staked

Fig. 8 Seed yams staked trellis

4.0 Conclusion

This study evaluated the effectiveness of the yam minisett technology in mass-producing seed yams in Abagana, Anambra State. Yam, particularly Dioscorearotundata (white yam), is crucial for food security and income in West Africa but faces production constraints due to the high cost and scarcity of seed yams. The

minisett technique, which involves cutting yam tubers into small setts and treating them with fungicides/pesticides, was tested for its impact on sprouting rates, growth, and yield of yam setts from different tuber regions (head, middle, and tail). The results showed that setts from the head region sprouted first, followed by the tail and middle regions. Pre-sprouting in a sterilized medium increased the survival rate and reduced disease infestation. The findings suggest that the minisett technique can significantly enhance yam production, although its adoption among local farmers remains low.

Based on the findings from the study, the yam minisett technology demonstrates a promising approach to addressing the scarcity and high cost of seed yams, which are major constraints in yam production. The technique significantly improves the multiplication ratio, ensuring a steady supply of planting materials. Despite its potential to boost yam production and contribute to food security, the low adoption rate among farmers indicates a need for greater awareness and education. The study's results show that setts from the head region sprout faster and more reliably than those from the middle and tail regions, highlighting the importance of understanding the physiological differences within yam tubers.

Given the following, we hereby present the following recommendations

(i) Extensive education and training programs should be organized to inform farmers about the benefits and implementation of the yam minisett technique. Demonstration farms and workshops can be effective in showcasing its advantages.

(ii) Government and non-governmental organizations should provide resources and support for the dissemination of the minisett technique. This could include funding for training programs, distribution of informational materials, and provision of necessary supplies.

(iii) Research is essential to optimize the minisett technique. Studies should focus on refining the cutting and treatment processes, as well as understanding the best conditions for pre-sprouting and curing to maximize yield.

(iv) Subsidies or financial incentives for farmers adopting the minisett technique can help offset the initial costs and make it more accessible, especially for smallholder farmers.

(v) A robust system to monitor and evaluate the adoption and effectiveness of the minisett technique should be implemented. Data collected can inform future improvements and policy decisions, ensuring the technique's sustainability and scalability.

5.0 References

Agbarevo, M. N. B. (2014). An evaluation of farmers' adoption of yam mini-sett technique in Cross-River state, Nigeria. *European Journal of Research in Social Sciences*, 2, 3, pp. 1-9.

Amusa, N.A., Adegbite, A.A., muhammed, S. & Baiyewu, R. A. (2003). Yam diseases and its management in Nigeria. *African Journal of Biotechnology*, 2, pp. 497-502.

Beatrice, A., Norbert, M., Robert, A., Daniel, M., Morufat, B. & Djana, M. (2021) Seed yam production from whole tubers versus minisett.*Journalof Crop Improvement*, 34(, 6, pp. 858-874.

Cornelius, E.W. (1998). *Causes and control of tuber rot of white yam (Dioscorearotundata, Poir varieties Araba, Asana and Puna)*. M. Phil. Thesis, University of Ghana, Legon, pp: 123

Eruola, A. O., Bello, N. J., Ufoegbune, G. C. & Makinde, A. A. (2012). Application of rainfall-potential evapotranspiration model for determining optimum planting date of yam (*Dioscorearotundata*) in a tropical wet-and-dry climate. *International*

Journal of Plant Research, 2, 2, pp. 36–40.

FAO. (2022). Food and Agricultural Organization of the United Nations. Retrieved from http://www.fao.org/statistics/en

IITA. (2021). *Yam Minisett Technique*. International Institute of Tropical Agriculture.

Ikeorgu, J. (2019). *Rapid Multiplication of Yam by Minisett Technique*. National Root Crops Research Institute, Umudike, Nigeria.

Madueke, M. C., Ayichi, D. & Okoli, E. C. (2000). *Issues in Yam Minisett Technology Transfer to Farmers in South-Eastern Nigeria. African Technology Policy Working Paper No. 21*. African Policy Studies (ATPS), Network, Nairobi.

Morse, S. (2018). Analysis of yam minisett technique adoption in Nigeria. *Journal of Crop Improvement* 32, 4, pp. 511-531.

Nwosu, L. (2005). In Agbarevo, M. N. B. (2014). An evaluation of farmers' adoption of yam mini-sett technique in Cross-River state, Nigeria. *European Journal of Research in Social Sciences*, 2, 3, pp. 1-9.

Ogali, E., Opadokun, J. & Okobi, A. (1991) Effect of lime and local gin on post-harvest rot of yams. *Tropical Science*, 31, pp.365- 370.

Ogbonna, M. C., H. N. Anyaegbunam, & G. N. Asumugha. (2011). Price Response Analysis of Yam Tubers in Southeastern Nigeria: Evidence from Two Major Markets in Abia State." *Journal of Farm Management of Nigeria* 12, 2, pp. 34-40.

Orkwo, G. C. (1998). *Seed yam production Technology. Yam minisett Techniques. In 2010. Yam Nutrition*: Nutrient disorder and soil fertility management. ACIAR Monograph No. 144, J.N. O'Sullivan, 112. Canberra: Australian centre for International Agriculture Research

Compliance with Ethical Standards Declaration

Ethical Approval

Not Applicable

Competing interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Funding

The authors declared no source of funding

Availability of data and materials

Data would be made available on request.

Authors' contributions

COE, Conceptualization: designed and field work, ENN & ROO:field work, RTA & OEO:experimental design, ENN: development of draft. All authors were involved in corrections and were supervised by EOC.