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Determination of Shooting Potential and Growth Ability of Plantain Genotypes in Macropropagation Using Saw Dust and Spear Grass (*Impereta Cylindrica* L.)

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ABSTRACT

Plantain (*Musa* spp.) is one of the most important food crops. To obtain seedlings, most farmers rely on natural regeneration which is a very slow process and do not yield adequate amount. Tissue cultured planting materials are highly expensive and unavailable to local farmers. To carry out macropropagation, saw dust being widely used is not easily accessible, hence, the need for accessible substrate. In this study, the use of saw dust and spear grass were evaluated as initiation media using three genotypes as test plants. Sword-sucker corms whose apical dominance was physically destroyed and initiated in test media. The corms were evaluated for shooting and growth parameters. Statistical significant difference was observed for numbers of leaves per corm and leaf width at $P < 0.05$ while at $P < 0.01$, leaf length was significant. There was variable adaptation pattern of genotypes to the initiation media. With saw dust, 'Atagafong' had best adaptation in parameters analysed while 'Mble paul' and 'Atagafong' were better than 'Owom' in spear grass. 'Mble paul' responded poorly in saw dust but showed 100% shooting. From the work, spear grass can be used as macropropagation medium but needs enhancement on its moisture content, water holding capacity and reduction in porosity.
Keywords: Determination, shooting, growth, plantain, genotypes.

INTRODUCTION

Plantains have high nutritional value [1], and can be eaten fresh when ripe or processed through cooking, roasting, frying among other methods. They are staple foods for consumers in the humid tropics and an important source of rural income particularly in some locations where small holders produce them in some compound or home gardens [2]. In the period between 1970 and early 1990's plantain production in the Sub-saharan region declined quite significantly below its potential [3]; [4]. The decline was attributed partly to lack of healthy planting materials. Hence, its cultivation has not measured up with even the domestic demands. Farmers majorly rely on natural plantain regeneration to obtain seedlings for expanding or establishing new farms, according to [5], the process is slow and often do not yield adequate amounts. As described by [6], suckers from farm have high risk of pests and disease spread between farms, leading to reduced productivity and short life time of new plantations. To aid supply of adequate certified planting materials, some practices which include several micro and macropropagation methods are employed. However, invitro propagation materials are expensive and not easily available to Nigerian farmers. Besides, somaclonal variations which arise from repeated subculturing lead to low adoption of the technology [7].

Plantain production in Nigeria can be improved by increasing availability of affordable clean planting material through macropropagation. This technology can use whole suckers, large pieces of parent corms or sword suckers to produce planting material [8]. It relies on simple cost effective methodology that could be easily implemented with good training and very small resources.

Currently, peasant farmers in rural locations who will want to commercialize plantain production by generating healthy plantlets through macropropagation may encounter difficulty due to their proximity to rice mills, saw mills and their disposal sites which are sources of their propagative substrate. And this has made plantain propagation through macropropagation difficult and expensive, thereby limiting production of plantain. Also, commercial utilization of these alternative media as soil amendment materials will partly solve the environmental needs and limit their availability as initiation media. Therefore, there is need for researchers to discover an initiation media that is costless and easily accessible for farmers as this will enhance commercialization of plantain propagation and production.

Spear grass (*Imperata cylinderica* L.) is a perennial rhizomateous grass with high fibre. It serves as forage for ruminants, pigs, horses, fish and crustaceans [9], soil stabilization to check erosion and for thatching the roofs of traditional homes. The dead leaves remain standing and resist decay. Rather than waste this plant, it should be incorporated into use as a medium for macropropagation as it grows on all soil types, easily accessible and can serve as a substitute for saw dust. Therefore, this study aims at investigating the applicability of spear grass as macropropagation initiation media and its possible effect across plantain genotypes.

METHODOLOGY

Study Area

The study was carried out in the green house of biotechnology research institute, Department of Biotechnology, Faculty of Sciences, Ebonyi State University, Abakaliki. The research lasted for 8 weeks.

Sample Collection

Twenty four corms of sword suckers, eight of each genotype ('Atagafong', 'Owom' and 'Mble paul') were obtained from *Musa* germplasm, Ebonyi State University, Abakaliki.Spear grasses filled in two 100kg bags were assembled from the surrounding. One hundred and fifty kilograms (150kg) of sawdust was sourced from a timber shop at Abakpa main market, Abakaliki. The spear grass was chopped into small pieces (2 inches). Each substrate was separately steam-sterilized for 45 minutes and allowed to cool for 24 hours before being transferred into two separate wooden propagators measuring 2 m × 1 m × 0.3m.

Corm Preparation and Planting

Corms were partially pared to remove all roots and psuedostem thereby exposing their buds. The apical meristem was excised from every corm using a sharp knife to arrest its activity on the corm. The corms were then washed in sterile water (0.20% sodium hypochlorite) and allowed to air dry for a day before planting. Four corms per genotype per initiation medium were planted with a depth of 16 cm. Watering was done twice per week with 12litre of water for each media to avoid water logging.

Analysis of substrates

Both initiation media were analysed to assess their water holding capacity which was determined using the method described by Soil Testing Procedure Manual (2008). Their bulk density was determined using the method described by [10]. To assess moisture content, the standard method being oven-drying was adopted. Their pH value was examined using the method described by [11]. While determining electrical conductivity, method described by [12] was employed. Organic carbon was assessed following rapid titration method [13]. For nitrogen content of substrates, alkaline permanganate method was used [14]

Data Collection and Analysis

Data was collected on the following parameters; Number of shoots, shoot

height, number of roots, percentage sprouted corms, number of leaf, leaf width and length. Analysis of variance (ANOVA) and Least Significance Difference (LSD) analysis were done using SPSS version 20 statistical software. The significant difference among the plantain genotypes and different substrates was assessed at $P < 0.05$.

RESULTS

The result of the physiochemical properties of the propagation media as shown in Table 1 showed the alkalinity of saw dust(pH = 7.75), while spear grass was acidic (pH = 6.83). Higher bulk density (0.323g/cm^3), moisture (70.12%) and water holding capacity (728.51) was observed in saw dust whereas spear grass was higher in porosity (92.14%), nitrogen content (400.0kg/ha), phosphorus (20.2), organic matter (15.34) and organic carbon (8.9). Both media had same electric conductivity (30cm^3).

From table 2, the analysis of variance showed that the variations in parameters measured were significantly different in some variables being number of leaves per come, leave length and leaf width. Highest shoot yield was gotten from 'Atagafong' propagated in saw dust with the least gotten from 'Owon' in spear grass. 'Atagafong' in spear grass produced highest number of roots while highest performance was observed in same genotype in saw dust for parameters number of leaves per corm, shoot length and leaf length. Highest leaf width was observed in 'Owom' initiated in saw dust.

During the first six week of propagation, 100% of corms from 'Mble paul' produced shoot while in in spear grass, 25% produced shoot (Table 3). Other genotypes in spear grass showed 50% response. High shooting response was observed in 'Mble paul' initiated in spear grass after eight weeks with the same frequency maintained in same media for other genotypes. Highest shooting potential was observed in 'Owom' after ten weeks with a decrease in shooting ability of 'Mble paul'. Consistency in shooting of Atagafong and Owom in spear grass media was observed across the weeks.

Table 1: Physiochemical Properties of the Propagation Media

Media	Saw dust	Spear grass
pH	7.75	6.83
Bulk density (g/cm^3)	0.323	0.21
Electric conductivity (cm^3)	30	30
Porosity (%)	87.83	92.14
Moisture (%)	70.12	54.9
Water holding capacity	728.51	12.72
Nitrogen (kg/ha)	287.1	400.03
Phosphorus	13.82	20.2
Organic matter	12.76	15.34
Organic carbon	7.40	8.9

Table 2: Mean and Standard deviation of the shooting and growth parameters for the genotypes propagated in spear grass and saw dust

genotype	Initiation media	No of shoots per corm	No of roots per corm	No of leaves per corm*	Shoot length	Leaf length**	Leaf width*
'Mble paul'	Saw dust	2.33±1.53	2.67±1.53	7.00±4.58	32.00±20.52	51.67±28.68	25.00±16.00
	Spear grass	2.33±1.15	2.67±2.52	5.67±3.21[a]	42.67±28.57	32.00±20.07[b]	24.33±16.86
'Atagafong'	Saw dust	3.66±1.53	6.33±2.89	11.67±4.04[a]	51.00±13.75	78.00±16.46[b]	35.00±4.36[c]
	Spear grass	2.66±1.15	7.67±4.04	6.33±2.31	37.67±2.52	28.33±2.52[b]	17.00±1.00[c]
'Owom'	Saw dust	3.00±0.00	5.33±3.21	9.67±3.21	44.67±8.08	77.33±10.02[b]	38.00±3.46[c]
	Spear grass	2.00±0.00	5.33±2.08	6.33±1.15	34.33±14.74	25.33±5.86[b]	19.33±6.43[c]

Result shows Mean±SD. Significance determined at $P < 0.05$. Means with the same subscript on the same column are significantly different. * = significant; ** = highly significant

Table 3: Percentage sprouted corm in response to the initiation media

Readings	Initiation media	'Mble paul'	'Atagafong'	'Owom'
Week 6	Saw dust	100%	75%	50%
	Spear grass	25%	50%	50%
Week 8	Saw dust	50%	50%	75%
	Spear grass	75%	50%	50%
Week 10	Saw dust	25%	50%	75%
	Spear grass	50%	50%	50%
Mean percentage	Saw dust	58%	58%	67%
	Spear grass	50%	50%	50%

DISCUSSION

The result obtained from this study revealed that spear grass (*Impereta cylinderica* L.) and saw dust possess the qualities of a good propagation media. This is in line with [15], who suggested that any growing media should consist of 20% air and 20 to 30% available water by volume. As stated by [16], the three of the main components that contribute to a media's chemical make-up are pH, cation exchange capacity (CEC), and electrical conductivity (EC). This was also supported by the report of [17]. Specifically, many plant characteristics are influenced by pH [18]. But the pH of both media is not within the range for most crops and native plants, which have an optimum for pH mostly ranging from 5.5 to 6.5 [19]; [20].

Spear grass is more acidic and according to [21], most micronutrients are more available to plants in acidic mediumthan in neutral-alkaline medium, generally favouring plant growth. But its high porosity may have highly reduced its water holding capacity, hence, lacking enough moisture to make nutrients available and leading to poor shoot yield and growth performance (Table 2). According to [22], the role of pH on adventitious root formation is associated with acidic pH and this may have resulted to highest number of roots observed in 'Atagafong' propagated in spear grass (Table 2). The root is responsible for the absorption of water and nutrients, anchorage, synthesis of some plant hormone and storage [23]. Plantlets from both media had roots at the point of

detachment, therefore will be more reliable [4]. The poor performance observed in most of the genotypes in spear grass (Table 2) could be attributed to water stress (Table 1) imposed by the media. This moisture lack may have affected nutrient release and intake in plant. This is in accordance with the work of [15] which reported higher potassium uptake by plants at higher moisture level. This high nutrient uptake in saw dust due to moisture availability may have enhanced speedy shooting on most genotypes propagated through the media (Table 3). Although, in all the parameter assessed, significant difference was observed only in number of leaves per corm, leaf length and leaf width.

CONCLUSION

From the study, availability of healthy plantain planting materials can be enhanced by use of macropropagation, with the aid of spear grass as the initiation media. This will improve productivity of plantain both in rural and developed areas at large. It will help peasant farmers who cannot gain access to saw dust being common medium for macropropagation, to use an alternative medium that is easily available and regarded as weed to improve the production and availability of plantain planting materials.

RECOMMENDATION

To enhance the use of spear grass in macropropagation, further work should be done on increasing its moisture content, water holding capacity and reduction of porosity.

REFERENCES

1. Baiyeri, K. P. and Aba, S. C. (2005).Response of Musa species to macro-propagation. I: Genetic and initiation media effects on number, quality and survival of plantlets at prenursery and early nursery stages. *African Journal of Biotechnology*, **4** (3): 223-228
2. Bunt, A. C. (1988). Media and Mixes for Container Grown Plants. A Manual on the Preparation and Use of Growing Media for Pot Plants (2nd Edn), Uwing Hyman Ltd, London. Pp 307.
3. Faturoti, B., Tenkouano, A., Lemchi, J. and Nnaji, N. (2002). Rapid Multiplication ofPlantain and Banana: Macropropagation Techniques. A pictorial guide. Ibadan, Nigeria: IITA.
4. Heuze, V., Tran, G., Ginger-Reverdin, S. and Lebas, F. (2015). Spear grass. Feedipedia, a programme by Food and Agricultural Organization. www.feedipedia.org/node/433. Retrieved 8th October, 2016.
5. Kahangi, E.M., Muthee, A.M. and Chege, B.K. (2002). Constraints and sustainable solutions for adoption of TC banana technology and marketing. *Acta Horticulture*, **638**:441–447.
6. Karamura, E., Frison, E., Karamura, D.A. and Sharrock, S. (1998). Banana Production systems in Eastern and Southern Africa. Bananas and food security. Montepellier. INIBAP P. 401-412.
7. Mwangi, M. and Muthoni, S. (2008). Implementing Banana Macropropagation in Kenya – potential and Challenges. Proceedings of the 1st International e-conference on Agricultural Biosciences 2008, Book of Abstracts: Volume 1. http://www.e – conference.elewa.org/agriculture
8. Nkendah, R. and Akyeampong, E. (2003). Socioeconomic data on the plantain commodity chain inWest and Central Africa. *Infomusa* , **12**: 8 - 13.
9. Olsen, S. R. and Sommers, L. E. (1982). Phosphorous in method ofsoil analysis, Part-2, Chemical and microbiological properties – Agronomy monograph number 9 (2nd Ed.)American Society of Agronomy, Inc, Soil
10. Sahijram, L., Soneji, J.R., and Bollamma, K.T. (2003). Invited

Review: Analyzing Somaclonal Variation in Micropropagated Bananas (Musa spp.). *In Vitro Cellular and Developmental Biology – Plant,* **39**(6): 551-556.
11. Sengendo S., Nalukwago J., Mwangi M., and Nakato V. (2006). Reducing food insecurity through technology transfer: Macropropagation. Experience in bxw worst hit areas of Uganda. Crop crisis Control project.
12. Seshu Reddy, K. V., Ngode, L, Ssenyonga, J. W., Wabule M., Onyango M., and Adede T. O. (1999). Management of pests and diseases of banana in Kenya: A Status Report. Mobilizing IPM for suitable banana production in Africa. Proceedings of a workshop held in Nelpursuit 1998/11/23 - INIBAP. Montepellies.
13. Simmonds, N. W. (1996). Bananas, Musa (Musaceae), In: Smartt J, Simmonds NW (eds) Evolution of crop plants. Longman Scientific and Technical, UK, pp 370–375
14. Tenkuoano, A., Hauser, S., Coyne, D. and Coulibaly, O. (2006). Clean plantingmaterials and management practices for sustained production of banana and plantain in Africa. *Chronica Horticulturae*, **46** (2): 14-18.
15. Verdonck, M., Dhanarajan, M. S., Uma, S. and Durai, P. (1983).Macro Propagation for Regeneration of Wild Bananas (Musa spp.). *Advanced Biotechnology*, **12**:161-181.
16. Viljoen, A. (2010). Protecting the African Banana (*Musa* spp.): Prospects and Challenges Proc. IC on Banana & Plantain in Africa Eds.: T. Dubois et al. *Acta Horticulture*, 879, ISHS.
17. Wall, M. (2006). Ascorbic acid, Vitamins A, and mineral composition of banana (*Musa* sp.) and Papaya (Carica papaya) cultivars grown in Hawaii. *Journal of Food Composition and Analysis,* **19** (5): 434-445.
18. Lončarić Z., Karalić K., Popović B., Rastija D., Vukobratović M. (2008). Total and plant available micronutrients in acidic and calcareous soils in Croatia. Cereal Res. Commun. 36, 331–334. 10.1556/CRC.36
19. Islam A. K. M. S., Edwards D. G., Asher C. J. (1980). pH optima for crop growth. Plant Soil 54, 339–357. 10.1007/BF02181830
20. Köpp M. M., Passos L. P., da Silva Verneue R., da Silva Lédo F. J., Meirelles Coimbra J. L., Costa de Oliveira A. (2011). Effects of nutrient solution pH on growth parameters of alfalfa (*Medicago sativa* L.) genotypes. Commun. Sci. 2, 135–141.
21. Jiang Y., Li Y., Zeng Q., Wei J., Yu H. (2017). The effect of soil pH on plant growth, leaf chlorophyll fluorescence and mineral element content of two blueberries. Acta Hort. 1180, 269–276.
22. Stone OM (1963). Factor affecting the growth of carnation plants from shoot apices. Ann. Apt. Boil. 52:199-209
23. Mack AR (1965). Effect of soil temperature and moisture on yield and nutrient uptake by barely. Can. J. Soil Sci. 45, 337-345