Study on macro-propagation of banana cv. Nanjangud Rasabale (AAB) using growth media

Abstract:

Banana is a major food crop globally grown and consumed in more than 100 countries throughout the tropics and subtropics. Banana (*Musa paradisiaca*.) is the world's fourth most important food crop after rice, wheat and maize. Banana is usually propagated vegetatively, since sexual reproduction is difficult due to its vegetative parthenocarpic nature. Traditionally, it is been propagated using suckers, as these are easy to obtain. But the factors limiting the adoption of this method are the lower regeneration capacity of sucker, lack of year round availability of mother sucker, fear of transmission of pests and diseases to the succeeding generation. To overcome these issues and to enable the production of a feasible amount of planting material, macro-propagation technology came into existence. Macro-propagation through the use of growth media has accounted lower cost and higher net returns, on an average cost of production of a single plantlet was only Rs. 6.58/-. From the present study, it is inferred that, a feasible amount of healthy and quality planting materials can be produced with minimum expenditure, harnessing good profitability within shorter time span.

Keywords: Macro-propogation, growth media, Cost of production, BC ratio.

Introduction

Banana is a major food crop globally grown and consumed in more than 100 countries throughout the tropics and subtropics. Banana (*Musa paradisiaca*.) is the world's fourth most important food crop after rice, wheat and maize (Ali *et al*., 2013).

The pulp of a ripe banana is essentially a sugar rich, easily-digested food. The cooked banana is nutritionally similar to that of potato. It contains about 70% water; solid material is mostly carbohydrate (27%), protein (1.2%) and fat (0.3%) contents are generally low. In energy terms, each gram provides one calorie. Eleven vitamins have been recorded and the fruit is considered a good source of vitamins A, B_1, B_2 and C. It is also rich in carbohydrates and fibers and has very low content of fat. The main difference between a banana and a plantain is moisture content. The plantain averages about 65% moisture and the banana about 83%. Although bananas and plantains do not provide a particularly good source of several important minerals in human nutrition, such as calcium, iron and iodine, they are notably high in potassium and low in sodium (Anon., 1999).

Banana is one of the major fruit crops grown in Karnataka. Almost half of the state comes under banana cultivation, since it is a fruit which has demand throughout the year. It is a fruit which has a wide variability in appearance and taste. The popular banana varieties cultivated in Karnataka are Grand Naine, Ney Poovan, Rajapuri, Red Banana (Kamalapur of Gulbarga district), Boodh bale and Kari bale (Mangaluru), Nendran (Kodagu) and Nanjungud Rasabale (Mysuru). Nanjangud Rasabale is known for its unique qualities in terms of taste, pulp quality and aroma that are due to the black clay alluvial saline soil found in its place of origin, Devarasanahalli, Nanjangud. Owing to these properties, it was given the Geographical Indication (GI) protection tag in 2005 under the

Goods (Registration and Protection) Act of 1999. The bunches are small to medium in size of below 10kg with 80-120 medium sized fruits weighing around 150g each.

Banana is usually propagated vegetatively, since sexual reproduction is difficult due to its vegetative parthenocarpic nature. Traditionally, it is been propagated using suckers, as these are easy to obtain. But the factors limiting the adoption of this method are the lower regeneration capacity of sucker, lack of year round availability of mother sucker, fear of transmission of pests and diseases to the succeeding generation. In recent years, the demand for disease free planting material has given tissue culture tremendous scope. However, tissue culture plants are not affordable by small and marginal farmers. To overcome these issues and to enable the production of feasible amount of planting material, macro-propagation technology came into existence.

Macro-propagation is a technology, in which the regeneration of many plants from a single vegetative part can be done in a short span. In banana, sucker is used as the macro part (explant as in micropropagation) for the production of more plantlets. It is a simpler and cost effective technology that could be easily implemented after brief training and requires only little resources. In India, research on this technology has been done on different varieties of banana at NRCB (National Research Centre for Banana), Trichy and other institutes. In Karnataka, Kittur Rani Chennamma College of Horticulture (KRCCH), Arabhavi is working on macro-propagation technology in various cultivars of banana.

Importance of Macro-propagation

Sucker multiplication is possible at the farm level through macro-propagation, as it is relatively easy and can be implemented in a shed or open field to meet the *in situ* requirement of planting material. It is a simple technique and is easily affordable by even those with limited access to resources such as small scale farmers. The technique requires minimum skill and could be easily implemented after brief training. The plantlets obtained through macro-propagation are relatively healthy, if the source of suckers are from disease free healthy mother plants and produces uniform plantlets that are relatively at par with micropropagated plantlets. Since it is carried out within nursery, minimum shade of about 50% is to be provided and regular watering is recommended

The demand for banana is increasing due to population explosion which is not being met in recent years due to the lack of availability of economically affordable planting material by small and marginal farmers who contribute most area under banana cultivation. Therefore, there is a need for increased research and development in this field to yield potential results that can be easily adopted and operated by all the stakeholders especially on farmers preferred banana varieties. With this background the present research work was carried out in banana cv. Nanjangud Rasabale (AAB) with the objective to analyse the influence of growth media on the production of quality planting material and to estimate the cost of production of planting material.

Material and methods:

Research methodology includes study area, preparation of media, proposed treatments and methods to analyse the results.

Study Area: The experiment was carried out at College of Horticulture, Mysuru, during the year 2019-2020. The disease free, healthy, sword suckers of cv. Nanjangud Rasabale, whose corm weight ranging 1-1.5kg were collected from the research field at College of Horticulture, Yelachahalli, Mysuru and was utilized in the experiment. The entire experiment was carried out under a green shade net.

Preparation of media

Substrate media used in this experiment was cocopeat, farmyard manure (FYM) and sawdust. FYM was available in the College of Horticulture, Mysuru and sawdust and cocopeat were procured from sawmill and nearby cocopeat production unit respectively. Since sawdust harbours contain insects and micro-organisms, it was steam sterilized in an autoclave at 121^0C and 15psi pressure for 15 minutes by packing the sawdust in thermo-stable plastic covers. Cocopeat was pre-sterilized in the production unit itself.

Planting material / Sucker

The required quantity of planting material for research studies was procured from COH, Mysuru for the price fixed by UHS, Bagalkote. The selection of suckers plays a crucial role as the quality of planting materials produced depends on suckers. The suckers were authentic, healthy and free from pests and diseases.

Cost economics (Rs.)

Cost economics was calculated in order to study the production cost incurred for each treatment considered in this experiment to review the efficiency of adopting macro-propagation technology which was illustrated by calculating the Benifit-Cost (B:C) ratio which was calculated by dividing gross return by total cost. Benefit-cost ratio reviews the consistency of utilizing this technology. Total cost includes the cost of sawdust, cocopeat, red soil, sand and farm yard manure used in the production of planting material through macro-propagation technology from their respective source of procurement.

Treatments: 7 treatments were imposed

T_1 - Sawdust (3kg/bag)

T_2 - FYM (5kg/bag)

T_3 - Cocopeat (5kg/bag)

T_4 - Sawdust + FYM (1:1)

T_5 - Sawdust + Cocopeat (1:1)

T_6 - FYM + Cocopeat (1:1)

T_7 - Sawdust + FYM + Cocopeat (1:1:1)

Experimental design	CRD
Number of Treatments	7
Number of replications	3
Number of corms per treatment	30 (10/replication)

Source: (Pujar, 2015)

Results and discussion:

Influence of growth media on production of quality planting material and cost of production of planting material through macro-propagation in banana cv. Nanjangud Rasabale is presented in this chapter.

The mean data regarding the economics of cost under different treatments has been worked out and presented in Table 1. The selling price of banana plantlets of cv. Nanjangud Rasabale obtained through macro-propagation technology was kept at the rate of Rs. 15/- per plantlet. Among the seven treatments studied, the best treatment in respect of net returns and B:C ratio was T_7 – Sawdust + FYM + Cocopeat (Rs. 3100.79/- and 2.68 respectively) followed by T_6 – FYM + Cocopeat (Rs. 2650/- and 2.43 respectively). This was due to the highest number of plantlet production in the media combination treatments. The lowest gross and net returns are reported in T_1 – Sawdust treatment and the lowest B:C ratio in T_3 – Cocopeat treatment due to the least plantlet production and high cost spent on cocopeat over sawdust respectively.

Table 1. Calculation of cost economics for effect of growth media on macro-propagation in banana cv. Nanjangud Rasabale (AAB)

Treatments	Number of plantlets / treatment (A)	Gross return / treatment (B=Ax15)	Total cost / treatment (C)	Net return / treatment (D=B-C)	B:C ratio / treatment (E=B/C)
T_1	220	3300	1522.71	1777.29	2.17
T_2	260	3900	1718.71	2181.29	2.27
T_3	245	3675	1805.21	1869.79	2.03
T_4	230	3450	1601.71	1848.29	2.15
T_5	240	3600	1683.96	1916.04	2.13
T_6	300	4500	1849.96	2650.04	2.43
T_7	330	4950	1849.21	3100.79	2.68

Note: The selling price of banana plantlets is Rs. 15/- per plantlet

Cost of production of planting material through macro-propagation using various growth media.

The treatment wise cost incurred in producing macro-propagated banana plantlets using growth media is depicted in Table 2. The least cost expenditure was noticed in T_1 – Sawdust (Rs. 1522.71/-) followed by T_4 – Sawdust + FYM (Rs. 1601.71/-). However, the cost of production was highest for the treatment T_6 – FYM + Cocopeat (Rs. 1849.96/-) and T_7 – Sawdust + FYM + Cocopeat (1849.21).

Table 2. Cost of production of production of macro-propagated banana plantlets using various growth media

Treatments	Number of plantlets/ treatment	Total cost / treatment (Rs.)
T_1	220	1522.71
T_2	260	1718.71

T_3	245	1805.21
T_4	230	1601.71
T_5	240	1683.96
T_6	300	1849.96
T_7	330	1849.21
Total	1825	12031.50

Treatment wise detailed cost of production is provided in Appendix II

Cost of production was calculated on the basis of prevailing market rates of the inputs used in this experiment. The cost calculated for producing banana plantlets of cv. Nanjangud Rasabale through macro-propagation using various growth media was Rs. 12031.5/-. Over 70% of the cost is going towards procurement of planting materials, polybags and media (Cocopeat, FYM and Sawdust) which are the major inputs necessary for production of plantlet material. This is due to the high cost of suckers of cv. Nanjangud Rasabale which was Rs. 15/- and the production of many secondary plantlets increased the need for more polybags and media, where the highest 26.2 per cent of the cost was going towards initial planting materials (suckers) procurement followed by polybags and different media (23.35 per cent and 17.32 per cent respectively). However, the average cost of production of a single plantlet was only Rs. 6.58/-.which was due to high number of plantlet production (Table-3).

Table 3. Cost of inputs in the production of macro-propagated banana plantlets using various growth media

Sl. No.		**Influence of growth media on production of quality planting material through macro-propagation**					
I.		**Variable cost**					
		Particulars		**Required quantity**	**Cost (Rs.)**	**Cost in %**	**Cost per single plantlet (Rs.)**
	a.	**Planting material/ Suckers**		210	3150.00	26.20	1.73
	b.	**Polybags**	**42x40 cm**	8.4kg	1176.00	23.35	0.64
			15x10 cm	14.8kg	1630.00		0.89
	c.	**Cocopeat**		350 kg	962.5.00	8.00	0.53
	d.	**Sawdust**		210kg	420.00	3.50	0.23
	e.	**FYM**		350kg	700.00	5.82	0.38
	d.	**Plant protection**	**Bavistin 0.2%**	100g	144.00	1.04	0.09
			Monocrotophos	100ml	24.00		
	i.	**Weaning/Hardening media**		1825	1825.00	15.20	1
	j.	**Labour charge (7 Man days)**		-	2000.00	16.62	1.09
		Total variable cost			12031.50		6.58
II.		**Fixed cost (*)**					
		-		-	-		-
		Total cost (I + II)			12031.50		6.58

(*) – Fixed cost remains zero

Per unit costs has been mentioned in Appendix I

Conclusion

India is the largest producer of banana in the world. A common limiting factor to large-scale production of bananas and plantains and or expansion of existing plantation is the difficulty in obtaining planting material (Baiyeri and Ajayi, 2000), due to its poor suckering ability (Robinson, 1996). In recent years, the demand for disease free planting material has given tissue culture tremendous scope. However, tissue culture plants are not affordable by small and marginal farmers. To overcome these issues and to enable the production of feasible amount of planting material, macro-propagation technology came into existence.

Macro-propagation through the use of growth media has accounted lower cost and higher net returns. From the present study, it is inferred that, a feasible amount of healthy and quality planting materials can be produced with minimum expenditure, harnessing good profitability within the shorter time span.

On the basis of the results obtained during the course of investigation, macro-propagation technology offers better scope and options for the small and marginal farmers, since it is economical, easy and produces the acceptable number of healthy plantlets and can be considered ideal for taking up by agricultural enterprise for commercialization. However, a large scale application of this technology is hindered by lack of awareness among growers. Further investigations are suggested to confirm the consistency of the results obtained.

References:

Ali, K. S., ELhassan, A. A., Ehiweris, S. O. and Maki, H. E., 2013, Embryogenesis and plantlet regeneration via immature male flower culture of banana (*Musa* sp.) cv. Grand Nain. *J. Forest Prod. Indus.*, **2**(3): 48-52.

Anonymous, 1999, Annual Report 1999, INIBAP Networking Banana and Plantain, France, p. 29-30.

Anonymous, 2018, Horticultural statistics at a glance 2018, Horticulture Statistics Division Department of Agriculture. Cooperation & Farmers' Welfare Ministry of Agriculture and Farmers' Welfare Government of India, pp. 145.

Baiyeri, K. P. and Ajayi, A. R., 2000, Status and constraints of *Musa* spp. production in a sub-humid zone of Nigeria. *Acta Hortic.*, 540: 73-77.

Pujar, D.U., 2015, Studies on macro-propagation in different local cultivars of banana (Musa spp.). M.Sc. (Hort.) *Thesis*, University of Horticultural Sciences, Bagalkot, Karnataka.

Robinson, J. C., 1996, Bananas and Plantains. *CAB Interanational*, UK, p. 238.

Sengendo, S., Nalukwago, J., Mwangi, M. and Nakato, V., 2010, Reducing food insecurity through technology transfer: Macropropagation, Experience in BXW Worst Hit Areas of Uganda, C3P: Crop Crisis Control Project. 1-12.

Appendix I

Cost economics of banana cv. Nanjangud Rasabale through macropropagation using growth media

Sl. No.	**Particulars**		**Unit rate (Rs.)**
1.	Planting material/sucker (per)		15
2.	Polybags	42×40 cm	140/kg
		15×10 cm	110/kg
3.	Sawdust		2/kg
4.	Cocopeat		2.75/kg
5.	FYM		2/kg
6.	*Trichoderma asperellum*		100/kg
7.	*Pseudomonas fluorescens*		100/kg
8.	Arbuscular Mycorrhizal Fungi (AMF)		100/kg
9.	6-Benzylaminopurine (BAP)		853/5g
10.	Indole-3-butyric acid (IBA)		2700/25g
11.	Plant Protection Chemical	Bavistin	144/100g
		Monocrotophos	240/L
12.	Labour (15 Man days)*****		4200

*****: 6 men (Rs. 300/person) and 9 women (Rs. 250/person) + Rs. 150 (Miscellaneous)

Appendix II

Treatment wise cost of production of plantlets of banana cv. Nanjangud Rasabale through macropropagation using growth media

Sl. No.	Input	T1	T2	T3	T4	T5	T6	T7	Total (A)	Per plantlet
	Initial (30suckers)									
1.	Planting material/ Suckers @ Rs. 15/sucker	450	450	450	450	450	450	450	**3150**	1.73
2.	Polybags (large) @ Rs. 5.6/bag	168	168	168	168	168	168	168	**1176**	0.64
3.	Cocopeat @ Rs. 2.75/kg	0	0	412.5 (5kg/bag)	0	206.25 (2.5kg/bag)	206.25 (2.5kg/bag)	137.5 (1.667kg/bag)	**962.5**	0.53
4.	Sawdust @ Rs. 2/kg	180 (3kg/bag)	0	0	90 (1.5kg/bag)	90	0	60(1kg/bag)	**420**	0.23
5.	FYM @ Rs. 2/kg	0	300 (5kg/bag)	0	150 (2.5kg/bag)	0	150 (2.5kg/bag)	100 (1.667kg/bag)	**700**	0.38
6.	Bavistin 0.2%, ~0.4897g/sucker @ Rs.1.4/g	20.57	20.57	20.57	20.57	20.57	20.57	20.57	**143.99**	0.08
7.	Monocrotophos 0.2%, ~0.476ml/sucker @ Rs. 0.24/ml	3.43	3.43	3.43	3.43	3.43	3.43	3.43	**24.01**	0.01
8.	Labour charges ~ Rs.9.5236/plantlet	285.71	285.71	285.71	285.71	285.71	285.71	285.71	**1999.97**	1.09
	For final secondary plantlets produced									
9.	Weaning media @ Rs. 1/plantlet	220	260	245	230	240	300	330	**1825**	1
10.	Polybas (small) @ Rs. 110/kg, 1kg~124 bags	195	231	220	204	220	266	294	**1630**	0.89
	Number of Plantlets produced (No.)	**220**	**260**	**245**	**230**	**240**	**300**	**330**	**1825 (B)**	
	Average number of plantlets produced (No.)	**7.33**	**8.67**	**8.16**	**7.67**	**8**	**10**	**11**	**60.83**	

	Treatment wise total cost (Rs.)	**1522.71**	**1718.71**	**1805.21**	**1601.71**	**1683.96**	**1849.96**	**1849.21**	**12031.47**	
	Treatment wise cost per single plantlet (Rs.)	**6.92**	**6.61**	**7.36**	**6.96**	**7.01**	**6.16**	**5.60**	**6.58**	**6.58**