Journal of Agricultural Engineering and Food Technology
p-ISSN: 2350-0085; e-ISSN: 2350-0263; Volume 3, Issue 1; January-March, 2016 pp. 8-11

http://www.krishisanskriti.org/Publication.html

Field Performance of Tissue Culture Banana Plants Produced from different Aged Explants

L. Rama Murthy[1], B.V.K. Bhagavan[2], M. Muthyala Naidu[3], K. Uma Krishna[4], K. Mamatha[5], T. Rajashekaram[6] and R. Nagalaxmi[7]

Dr.Y.S.R.Horticultural University, West Godavari District-507002, A.P.
[1]Department of fruit science, Venkataramannagudem, A.P.
[2]Prinicipal scientist and Head, HRS,Kovvur, A.P
[3]Senior scientist and Head, HRS, Darsi, A.P
[4]Department of Statistics, Venkataramannagudem, A.P.
[5]Scientist, Horticultural Research Station, Kovvur, A.P.
[6]Scientist Citrus Research Staion, Tirupati, A.P.
[7]Scientist, Horticultural Research Station, Kovvur, A.P.

Abstract—*The present investigation was carried out during 2014-15 at HRS Kovvur to study the crop duration and yield of tissue cultured plants obtained from different ages of explants varying from one month old explants to six months old explants. In field experiment, twelve treatment combinations in which P_1 and P_2 (Factor 1) are main crop and ratoon crop suckers respectively. Whereas, A_1 to A_6 (Factor 2) are age of the suckers from one month old explant to six months old explant collected from both main crop and ratoon crops and the same were subjected to tissue culture multiplication up to six cycles. Sixty days hardened plants were planted and evaluated for growth and yield potential under field conditions. The experimental design adopted is Factorial RBD. The total number of functional green leaves, total leaves and leaf areawere the highest in plants obtained from three months old (A_3) explant at shooting stage. Among the plants obtained from different aged explants, early shooting was observed in plants from five months old (A_5) explant. Regarding yield attributes, the highest bunch weight and yield were recorded in plants obtained from three months old (A_3) explant. Similar trend was observed in case of the number of fruits per bunch, hands bunch-1 and number of fingers per hand and it was followed by two months old (A_2) explant plants.In banana cv.Grandnaine three months old (A_3) explant and two months old (A_2) explant can be recommended for production of tissue culture plants.*

Keywords*: Explant, Invitro*

1. INTRODUCTION

Banana (*Musa spp*) is the oldest fruit of tropical countries and is the second most important fruit crop next to mango. Owing to its multifaceted uses of various parts, it is referred to as 'Kalpataru'(the divine tree of life). Bananas are rich source of energy since it contains sugars such as fructose, glucose and sucrose and minerals like potassium, phosphorus, calcium and magnesium and considered as a complete food. It grows well in humid tropical lowlands and is predominantly distributed between 300 N and 300 S of equator. Bananas are perennial monocotyledonous tropical herbs that belong to the Eumusa series of the genus *Musa* (Simmonds, 1966). The majority originated in south-east Asia from two wild diploid parent species *Musa acuminata*(A genome) and *Musa balbisiana* (B genome) (Simmonds & Shepherd, 1955; Simmonds, 1976). Cultivated *Musa* are predominantly triploids (2n = 3x = 33), almost sterile and they develop their fruit parthenocarpically.

The recent advances in plant biotechnology had a great impact on crop improvement and cultivation which is alternative method for propagation of banana is tissue culture. Tissue culture technology enabling the rapid production of a large quantity of uniform disease free plants from a single plant showing good genetic potential has gained importance in recent days. There is difference in growth and physiology of tissue culture plants compared to plants from suckers especially at different developmental stages. It was thus essential to make a critical evaluation of such plants, especially of a leading commercial variety like Grand Naine under field conditions.

Selection of explant is very important in tissue culture. Presently, two to three months old sucker is selected from the main crop (plant crop) and used for explant preparation. Apparently, the physiological and ontogenic age of shoot tip doesn't influence the behaviour of explant in culture. Nor are there any reports on effects on culture performance of season in which the explants are obtained.

2. MATERIALAND METHODS

The Experiment was conducted at Horticultural Research Station, Kovvur, which is located at 17° 00' North latitude, 81° 43' East longitude and 15.66 m above mean sea level.The experimental site receives an annual average rainfall is

1100mm from South-West monsoon, North-East monsoon and also through summer showers.The Godavari black alluvial soil at the experimental site is endowed with good drainage and with the pH of 7.6 and EC 0.42dSm-1. Before laying out experiment, soil samples were collected at four randomly selected spots at a depth of 30 cm from the experimental site and samples were analyzed for chemical analysis. In field experiment, twelve treatment combinations in which P_1 and P_2 (Factor 1) are main crop and ratoon crop suckers respectively. Whereas, A_1 to A_6 (Factor 2) are age of the suckers from one month old explant to six months old explant collected from both main crop and ratoon crops and the same were subjected to tissue culture multiplication up to six cycles. Sixty days hardened plants were planted in the field for evaluating the growth parameters, crop duration and yield potential under field conditions. The experimental design adopted is Factorial RBD.

A fertilizer schedule of 200:50:200 N-P-K g/plant was followed and phosphorus was applied as basal dose and 80% of nitrogen and potassium were applied in equal splits starting from 15 days after planting to 180 days after planting. Remaining 20% of nitrogen and potassium were applied at 50% of shooting. During the crop period micronutrient spray was given twice in 3 and 6 MAP.In the experiment there are nine plants per plot at a spacing of 1.8×1.8 m out of which six plants selected in the centre of the plot for recording the growth and yield parameters in main as well as ratoon crop. Other cultural practices like weeding, earthing up, desuckering, propping, irrigation, insect-pest and disease management were common in all treatments.

3. RESULTS AND DISCUSSION

Vegetative parameters

Among the plants obtained from different aged explants, at different growth stages of banana higher number of functional green leaves and total number of leaves were observed in plants from three months old (A_3) explants compared to all other treatments. Many workers reported that a fairly constant number of leaves remained emerged inside the pseudostem at any stage before floral initiation (Summerville, 1944, Champion, 1961 and Barker and Steward, 1962 and Turner, 1970). Summerville (1939), Jagirdir et al. (1963) and Turner (1971) observed that leaf production in banana was influenced by environmental factors and nutrition. Similar results were also observed by Nambsian (1972) regarding total number of leaves/plant, for predominant accumiante clones ranging from (31.80-38.40) prior to bunch initation. Similar results were also observed by Sailaja et al.(2013) regarding total leaves/plant ranging from (31.76-36.23) at the time of shooting. The higher number of leaves in A_3 may be attributed to initial vigour of the plant.

Regarding leaf area, at 3 MAP, plants from five months old (A_5) explant attained maximum leaf area (1.97 m^2/plant) which was significantly superior over A_3, A_1 and A_4 (Table 3). However, these treatments were on par with A_2 (1.65 m^2/plant) and A_6 (1.56 m^2/plant). Plants from three months old (A_3) explant has recorded maximum leaf area (11.34m^2/plant) at 5 MAP, (13.85 m^2/plant)at 7 MAP and at shooting (14.88 m^2/plant) than other treatments.

Apart from the number of leaves and rate of leaf production, total leaf area at any stage of growth is very crucial in banana as it has relation with photosynthetic efficiency. Greater leaf area aids the plant to synthesize more metabolites, exhibiting high photosynthetic rate during the period of growth and development (Mahadevan, 1988) by playing an important role in synthesis of food material for the growth and vigour of the plant. Robinson and Nel (1989b) have suggested that continuous production of leaves as well as maintaining optimal leaf area are requirements for better productivity and for earlier crop cycle, as this leads to better light interception and high assimilation. The number of leaves present at different growth stages as well as the estimates of leaf area will provide the information relating to the influence of explant age on banana yield.

Days taken from planting to shooting and harvest

Among plants obtained from different age group of explants, plants from five months old (A_5) explant recorded early shooting as compared to other treatments and it was on par with plants from six months (A_6) and four months age old (A_4) explant. It can be inferred from the present investigation that in banana the time of appearance of the eleventh last leaf indicates approximately the time of transformation of the growing point into the inflorescence i.e. approximately at an age of 5 to 5 ½ months. Early shooting was observed when 5^{th} and 6^{th} months age old suckers were used as explants due to the reason that at the time of collection of explants, the plants might have already reached the stage of shoot bud initiation in which the physiological stage is carried over. (Summerville, 1944).

These findings were in conformity with the findings of Kulapati et al. (2010) in banana cv. Dwarf Cavendish (AAA), who reported that earliness in fruit maturity might be ascribed to the maintenance of more functional leaves which might have supported the developing fruit by translocation of photosynthates effectively when compared to the plants that maintained lesser number of functional leaves. In banana, the rate of leaf emission is considered as a measure of the progression of plant towards maturity, when combined with total number of leaves produced, it can give an estimate of bunch emergence for any given planting date and the banana plants tend to flower with same number of leaves under similar conditions (Turner, 1970)

With regard to crop duration, the early crop duration was observed in the plants obtained from five months old (A_5) explant, among different aged explants. However, it was on par with six months old (A_6) explant.

Yeild parameters

With respect to number of hands per bunch, number of fruits in 2nd hand and number of fruits per bunch, plants from three months old (A_3) explants recorded higher values compared to other treatments. The increase in the number of hands probably due to maintenance of higher growth potential (viz., number of green leaves and leaf area) by the plants. There is a positive correlation among bunch weight, number of fruits per bunch and number of hands per bunch (Simmonds, 1959).Regarding bunch weight and yield, plants from three month old (A_3) explant reported higher bunch weight (21.06 kg) and yield (56.85 t) among the different ages of explant. Only, two months old (A_2) explant was on par (20.66 kg) with the three month old explant.

Days taken to shooting and harvesting of banana cv. Grand Naine (AAA)			
Age of explant	Crop duration		Mean
	Source of sucker collection		
	P1	P2	
A1	300.74	293.54	297.14
A2	310.87	301.13	305.99
A3	323.85	304.04	313.95
A4	297.10	294.34	295.72
A5	287.32	284.08	285.70
A6	279.18	292.58	285.88
Mean	299.84	294.95	
	P	A	P× A
SEm±	1.96	3.39	4.79
CD at 5%	N.S	9.94	N.S

Yield of banana cv. Grand Naine (AAA)			
Age of explant	Yield (t/ha)		Mean
	Source of sucker collection		
	P1	P2	
A1	52.07	49.38	50.73
A2	57.96	53.59	55.78
A3	61.75	51.95	56.85
A4	53.02	44.85	48.93
A5	52.75	47.89	50.32
A6	50.58	49.28	49.93
Mean	53.77	48.77	
	P	A	P× A
SEm±	0.82	1.42	2.01
CD at 5%	2.42	4.18	N.S

A1- One month old explant	A2- Two months old explant
A3- Three months old explant	A4- Four months old explant
A5- Five months old explant	A6- Six months old explant
P1- Main crop(Plant crop)	P2-Ratoon crop

In general, more number of functional green leaves resulted in maximum leaf area which results in more photosynthetic rate in which it is directly proportional to the bunch weight. Greater leaf area in the treatment with plants from three months old (A_3) explant might be aids the plant to synthesize more metabolites exhibiting high photosynthetic rate during the period of growth and development leading to more bunch weight and yield. The more bunch weight in one month (A1) to three months old (A3) explant might be due to leaf initiation rate, number of functional green leaves and leaf area were more in plants obtained from one month, two months and three months age old suckers than four months, five months and six months age old explants, thereby increasing the photosynthetic activity and dry matter production. Later, this dry matter production was partiontioned into reproductive organs such as number of hands/ bunch, number of fruits/ hand and number of fruits/ bunch thereby increasing the bunch weight. The results obtained in the present study with respect to bunch weight are in agreement with the results of Symal and Mishra (1989), Deo et al. (1999), Biswal et al. (2004) and Tejinder et al. (2009) who reported that the increase in bunch weight is associated with corresponding increase in number of hands bunch-1 and number of fingers hand-1.During finger development phase, the growing bunches act as a heavy sinks and better assimilate partitioning will result only if the physiological efficiency is maximized. Better development of the finger results with high assimilates flow from the built-up reserves, primarily from the number of green leaves. The better performance of A3 in terms of vegetative parameter particularly during 5 MAP to shooting may attributed to higher vigour of young tissues. The results obtained in the present investigation are in agreement with previous research findings by Deshmukh et al. (2004), Baruah et al. (2007) and Njuguna et al. (2008) who stated that higher yield for a particular treatment could be due to more number of hands/bunch, number of fruits/bunch and higher bunch weight.

4. CONCLUSION

From the foregoing results, it can be concluded that the plants produced from three months old (A_3) explant under field evaluation showed better performance in terms of number of hands per bunch, number of fingers in 2nd hand, number of fruits per bunch and bunch weight which finally resulted in higher yield of 56.8 tonnes per hectare compared to other treatments. The above treatment was closely followed by A_2 i.e. plants produced from two months old explant.

REFERENCES

[1] Barker, W.G. and Steward, F.C. 1962.Growth and development of banana plant.The growing regions of the vegetative shoot.Annals of Botany. 26 (103):38998.

[2] Biswal, M.K., Lenka, P.C. and Dash, D.K. 2004.Evaluation of culinnary banana genotypes.The Orissa Journal of Horticulture.32(1).

[3] Baruah, K., Sarma, B.J. and Debajit, S. 2007. Genetic variability in banana cultivars under Assam conditions.Indian Journal of Horticulture. 64(3): 282-85.

[4] Champion, J. 1961. Indications preliminaries sur la croissance du bananier.Poyo Fruits. 16: 191-94.

[5] Deo, D.D., Manohar, V.K., Sadawarte, K.T. and Shelke, B.D.1999. Growth and yield performance of banana (Musa

paradisiaca) types under Akola conditions. Agriculture Science Digest.19: 278-80.

[6] Deshmukh, S.S., Badgujar, C.D. and Dusane, S.M. 2004. Comparative evaluation of banana varieties under Jalgaon condition of Maharastra state. Agriculture Science Digest.24(2): 118-20.

[7] Kulapati, H., Narayana, J. and Venkatesha, J.2010. Effect of organic,inorganic and bio fertilizer manuring on growth and yield of ratoon crop of banana cv.Dwarf Cavendish (AAA). Asian Horticulture.6(2):38-40.

[8] Mahadevan, V.C. 1988. Effect of foliar nutrition of NPK on banana cv. Nendran (AAB). M.Sc.(Hort.) thesis, Tamil Nadu Agricultural University, Coimbatore.

[9] Nambisan, K.M.P. 1972. The influence of bispecific origin on certain lamina and fruit characters and constituents in some banana clones. Ph.D Thesis, Tamil Nadu Agricultural University, Coimbatore.

[10] Njuguna, J., Nguthi, F., Wepukhulu, S., Wambugu F, Gitau, D., Karuoya, M. and Karamura, D. 2008. Introduction and evaluation of improved banana cultivars for agronomic and yield characteristics in Kenya. African Crop Science Journal. 16(1): 35-40.

[11] Summerville, W.A.T. 1939. Root distribution of the banana. Old Agriculture Journal. 52: 376-92.

[12] Summerville, W.A.T. 1944. Studies in nutrition as qualified by development in Musa cavendishii Lambert. Queensland Journal of Agricultural Sciences. 1, 1-127.

[13] Simmonds, N.W., and Shepherd, K. 1955. The taxonomy and orgins of the cultivated bananas.New phytologist. 115: 567-71.

[14] Simmonds,N.W.1966.Bananas

[15] 2nd Edition.Longmans,London.

[16] Simmonds,N.W.1976. Bananas, In“Evolution of crop plants”, 211-15.

[17] Syamal, M.M. and Mishra,K.A. 1989 Studies on some dessert banana (Musa sapientum L.). Indian Journal of Horticulture. 46: 316-18.

[18] Sailaja, K.S, Naidu, M.M., Padma, E. and Uma Krishna, K. 2013. Effect of plant density and fertigation on productivity and quality of banana cv. Martaman.M.Sc Thesis, Dr.Y.S.R.H.U, Andhra Pradesh.

[19] Turner, D.W. 1970. The growth of banana.Journal of Australian Institute of Agriculture Science. 36 (2): 102-110.

[20] Turner, D.W. 1971. Effect of climate on growth rate of banana leaf production. Tropical Agriculture,Trindad 48(3): 283-87.

[21] Tejinderkaur Gill, M.I.S. and Dhaliwal, U.S.2009. Effect of different levels of Nitrogen and Phosphorous on ratoon crop of banana cv.GrandNaine.Journal of Horticultural Sciences. 4(1): 68-70.