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COMPARATIVE STUDIES ON TISSUE CULTURE PLANTLET VERSUS CONVENTIONAL SUCKER VAR. GRAND NAINE BANANA

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Abstract

An experiment was conducted at Instructional Farm of Uttar Banga Krishi Viswavidyalaya, Pundibari, West Bengal (India) during 2012 to 2014. Tissue culture plantlets were superior than conventional suckers in terms of yield and income with better growth and yield parameters. The highest pseudostem height (219.76 cm), pseudostem girth (73.95 cm), number of suckers (8.75), number of leaves (23.37), leaf length (187.76 cm), leaf breadth (53.80 cm), leaf area (1.01 m^2), and yield attributes like bunch length (81.25 cm), bunch diameter (36.24 cm), bunch weight (25.38 kg), hands per bunch (25.38), fingers per bunch (156.13), finger length (16.13 cm), finger diameter (3.61 cm) and finger weight (330.88 g) were also significantly higher in tissue culture plants than the sucker grown plants. The lengthened phyllocron (15.11 days), days taken to shooting (372.25 days) and shooting to maturity (108.50 days) was noted in plantation raised with conventiontional sucker. Tissue culture crop yielded 63.44 t/ha, which was 39.43% higher than the yield of conventional sucker (45.50 t/ha) grown crop and as a result crop grown with tissue culture plantlets had a benefit cost ratio of 2.25 as compared to 1.65 of crop grown with conventional suckers. The farmers of Terai zone of West Bengal can establish their banana plantation using tissue culture plantlets of banana cv. Grand Naine, if available or otherwise can be done through suckers.

Key words : Tissue culture plantlet, conventional sucker, Grand Naine.

Introduction

Banana is an economically important crop, which is extensively cultivated in tropical and subtropical countries (Gowen and Queneherve, 1993). It is one of the major fruit crops forming an important item in the diet of millions of people across the globe (Harish and Nanje Gowda, 2001). Banana is the most important fruit crop in India and accounts for 31.7% of the total fruit production. It is widely cultivated in varying agroclimatic regions under different systems of production (Mustaffa, 2011). In West Bengal, the farmers are cultivating local cultivars, which are low yielders. The productivity in the state is 24.1 t/ha as against 64.1 t/ha in Gujarat (Anonymous, 2013). One of the major problems encountered in banana growing is the low rate of conventional reproduction and the risks of spread of pathogens (Rodriguez, 1994). This problem can be overcome by *in-vitro* propagation methods, which are gaining popularity among the banana growers of West Bengal also. The *in-vitro* banana plants are superior to the conventional suckers due to their vigorous growth (Daniells, 1998), precocity (Drew and Smith, 1998) and higher yields (Pradeep *et al*., 1992). Tissue culture much talked about as a superior means of propagation with plant guaranteed free from pests and diseases. However the potential hazards of the technique such as variety mix-ups susceptibility to pests and diseases and different management requirement are not often publicized (Daniells, 1997). Tissue-cultured banana have high field establishment rate, uniformity in growth ensuring synchronized harvesting, early maturity, better-quality fruits and high production (Rao *et al*., 1996; Robinson, 1996 and Njuguna *et al*., 2007). Bananas have been traditionally propagated using suckers, which are known to perpetuate the spread of banana diseases and pests (Nguthi *et al*., 2000, 2002). Significant differences between tissue-cultured plants and conventional suckers in all the vegetative and phenological growth parameters were reported (Nguthi *et al*., 2009). During all crop cycles

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evaluated plant growth and yield were similar from rapid propagation and tissue culture plantlets. However, the productivity of later was higher than that of former. Plants raised through tissue culture recorded increase in height and girth of pseudostem (Badgujar *et al*., 2005). Unfortunately, the performance of tissue culture Grand Naine plantlets is yet not reported from North Bengal. An attempt was made to standardize the production of tissue cultured Grand Naine banana for Terai zone of West Bengal.

Materials and Methods

This experiment was conducted at Instructional Farm of Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal, India. The area lies under the Terai agro-climatic zone of West Bengal. Geographically, the farm is situated at 26°19'86" N latitude and 89°23'53" E longitude measured with GPS (Garmin-72). Altitude of the area is 43 m above mean sea level. The topography of the land was medium high in situation endowed with good drainage facility. The soil is sandy loam in nature and coarse textured having poor water holding capacity. The composite soil samples from the entire experimental field were collected from different depths and analyzed before planting of the crop (table 1). The soil is high in organic carbon and available nitrogen, medium in phosphorus and potash with acidic reaction. The soil structure at 0-30 cm has 70% sand, 19% silt and 11% clay.

The conventional suckers purchased from the local farmers whereas, the tissue culture plantlets were purchased from Vedic Synergy Biotechnologies Ltd., Durgapur, West Bengal. The suckers planted were of uniform size (2.5 kg), healthy and free from diseases. They were exposed to sunlight for a week prior to their planting. The pseudostem and leaves were cut off and basal sort skin was removed to expose the adventitious root initials so that they come in contact with the soil easily. The suckers were dipped in bavistin solution (1%) to prevent rhizome rot. Suckers were then kept under the shade for a week before planting. The conventional suckers and tissue culture plantlets were planted separately on June 8, 2012. Eight plants each of tissue culture plantlet of Grand Naine and conventional suckers of Grand Naine were planted separately to compare their performance through growth and yield parameters.

The experimental field was thoroughly ploughed and harrowed by repeating cross-wise twice by a power tiller to obtain a leveled land with good till. Simultaneously, laddering was done for breaking clods and removing weeds. Pits of 45 cm × 45 cm × 45 cm size were dug with a spacing of 2 m × 2 m. Well rotten farm yard manure (thoroughly mixed with top soil) at the rate of 5 kg per pit and 300 gm single super phosphate (SSP) was used at the time of planting as basal dose. Afterwards urea (675 g) and MOP (636 g) each was applied in four equal split doses per plant. The first split of urea and MOP was applied 45 days after planting. The second urea and MOP split was applied 100 days after the first split while the third urea split was applied 100 days after the second split application. The fourth urea and third MOP split was applied together nine months (reproductive stage) after planting while the fourth MOP split was applied 60 days thereafter. Before the initiation of shooting, NPK complex (19:19:19) was sprayed while potassium nitrate (KNO_3 @ 5 g per liter) was sprayed on bunches to improve the quality. Extra dose of 100 g urea and 200 g MOP was applied in case of tissue culture banana plantlets because of their faster growth. Micronutrient mix (Transco 5® *i.e.* micro mix with B, Zn, Mn and Cu @ 2 g per litre) was foliar sprayed 5th and 7th month after planting.

The crop was flood irrigated as when necessary *i.e.* four irrigations 5, 7, 9 and 13 months after planting were applied to plants under experiment no 2 and 3. Weeds were controlled by three manual (1, 8 and 11 months after planting) and two weeding with power tiller (3 and 6 months after planting). Bavistin (@ 2g/l) was foliar sprayed twice to control the Sigatoka leaf spot disease 7 and 8 months after planting. Scaring Beetle was controlled through two foliar sprays of Chloropyriphos (@ 2ml/lit), twice leaf axil hand application of Carbofuran 3G (5g/ plant) and two foliar sprays of Ectara (0.5 g/lit) as and when their infestation occurred.Data on plant growth and yield characters were recorded. Yield and yield components measurements were taken after bunch harvesting. The harvested bunches were weighed. The number of hands per bunch was counted. Finger length was determined by measuring the outer curve of individual fruit of the second hand of bunches. Bunch weight was used as an index of fruit yield. The average value of these parameters was tested for their significance with paired t-test. Table value at 15 degrees of freedom in t-test is 2.145 and if calculated value is more than table value the difference between the means is considered as significant and otherwise, it is not significant.

Results and Discussion

The growth parameters yield attributes, yield and benefit cost ration were significantly higher in tissue culture plants than the sucker grown plants (table 2). At shooting the height and girth recorded for tissue culture

Table 1 : Physico-chemical properties of experimental soil.

Particulars	Value	Method employed
pH	5.36	pH meter (Jackson, 1973)
Organic Carbon (%)	0.93	Walkley and Black's rapid titration method (Jackson,1973)
Available N (kg/ ha)	217.21	Modified Kjeldahl method (Jackson, 1973)
Available P (kg/ ha)	18.24	Brays's method-Bray and Kurtz, (Jackson, 1973)
Available K (kg/ ha)	111.89	Flame Photometer method (Jackson, 1973)

Table 2 : Comparative performance of growth and yield characters of tissue culture plantlets and conventional suckers of banana var. Grand Naine.

Parameters	Growth characters (At shooting)			Parameters	Yield characters		
	Suckers	Tissue culture	t-value (table value = 2.145)		Suckers	Tissue culture	t-value (table value = 2.145)
Pseudostem height (cm)	205.57	219.76	4.95 (S)	Bunch length (cm)	65.13	81.25	9.24 (S)
Pseudostem girth (cm)	69.57	73.95	3.05 (S)	Bunch diameter (cm)	34.87	36.34	3.28 (S)
Number of leaves	21.11	23.37	2.20 (S)	Bunch weight (Kg)	18.20	25.38	4.11 (S)
Number of sucker plant	11.25	8.75	2.61 (NS)	Hands/bunch	9.50	10.00	1.18 (NS)
Leaf length (cm)	172.89	187.76	8.05 (S)	Finger length (cm)	14.88	16.13	1.27 (NS)
Leaf breadth (cm)	54.36	53.84	0.63 (NS)	Finger diameter (cm)	3.61	3.70	0.86 (NS)
Leaf area (m^2)	0.94	1.01	3.77 (S)	Finger weight (g)	320.38	330.88	3.39 (S)
Phyllocron (days)	15.11	14.50	1.17 (NS)	Fingers/bunch	147.38	156.13	4.08 (S)
Days to shooting	372.25	350.13	3.94 (S)	Yield (t/ha)	45.50	63.44	4.11 (S)
Days taken from shooting to maturity	108.50	98.00	11.11 (S)	Cost of cultivation (lakh ₹ ha^{-1})	0.93	1.10	-
Crop duration (days)	480.75	448.13	17.50 (S)	Benefit cost ratio	1.65	2.25	-

S-siginicant, NS-non-significant.

plants were 219.76 cm and 73.95 cm, which was 14.19 and 4.38 cm, respectively higher than the plants developed through suckers. At shooting there were 23.37 leaves per plant in tissue culture plant which was on an average 2.26 leaves per plant higher than sucker developed plant. Leaf area of tissue culture plants did not significantly differed at vegetative stage but differed significantly at shooting stage *i.e.* tissue culture plants had higher leaf area than the conventional sucker plants. Tissue culture plants requires on an average 22.12 and 10.5 days, respectively lesser than sucker developed plants to reach shooting and then shooting to maturity which is significantly lesser. The bunch and finger characters were superior incase of tissue culture plantlets. Tissue culture crop yielded 63.44 t/ha which was 39.43 % higher than the yield of conventional sucker grown crop and as a result crop grown with tissue culture plantlets had a benefit cost ratio of 2.25 as compared to 1.65 of crop grown with conventional suckers.

Thus, it is clear that Grand Naine crop grown with tissue culture plantlets than Grand Naine grown with conventional suckers are superior in yield and income with better growth and yield parameters. Similarly, it was reported that *in-vitro* banana plants of Giant Cavendish (Kwa and Ganry, 1990; Robinson, 1990); Williams, Dwarf Cavendish and Grand Naine (Robinson and Anderson, 1995); Nendran (Sheela and Nair (2001); Basrai banana (Badgujar *et al*., 2005) and Dwarf Cavendish and Robusta (Mustaffa and Kumar, 2012) were superior to conventional suckers due to their vigorous growth, early flowering and reduced crop duration and higher yields (Hwang *et al*., 1984; Drew and Smith, 1990; Menon and Premlata, 1996; Mustaffa and Kumar, 2012). Tissue culture technology enabling the rapid production of a large quantity of uniform disease free plants from a single plant showing good genetic potential (Sheela and Nair, 2001) is thus recommended for Terai zone of West Bengal. There is difference in growth and physiology of tissue

culture plants compared to plants from suckers throughout the crop growth stages, which was recorded significantly better in case of tissue culture plantlets as compared to its sucker produced plants. The farmers of Terai zone of West Bengal can establish their banana plantation using tissue culture plantlets of banana cv. Grand Naine, if available or otherwise can be done through suckers.

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