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EFFECT OF SPACING ON BIOMASS PRODUCTION, DRY MATTER PARTITIONING, YIELD AND FRUIT QUALITY IN TISSUE CULTURE BANANA (*MUSA*) [AAB] NENDRAN

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Abstract: The experiment with tissue culture Nendran banana under different plant spacings (2.25 x 2.25 m, 2.0 x 2.0 m, 1.75 x 1.75 m, 1.50 x 1.50 m and 1.25 x 1.25 m) showed that the biomass production, dry matter partitioning and yield per plant decreased with decrease in plant spacing, while on per hectare basis it increased with decrease in spacing. The fruit quality deteriorated with decrease in plant spacing. The time taken for ripening of fruits decreased with increase in spacing, while shelf-life remained unaffected. However, the spacing 1.75 x 1.75 m was found optimum for all the characters studied.

Key words: Banana, biomass production, dry matter partitioning, spacing effect

INTRODUCTION

The planting distance used for banana varies depending on the variety grown and the duration for which a plantation is retained. The spatial arrangement of plants in a plantation is very important and usually involves a choice between physiological efficiency and practical suitability. A proper spacing is of very much important which not only affects the out turn and its quality, but also influences the economic life of the plantation, besides warranting **modifications** in the management practices. By keeping these points in consideration, an experiment using tissue culture Nendran banana was carried out in the College of Agriculture, Vellayani during 1993.

MATERIALS AND METHODS

The plantlets produced through tissue culture were planted during 1992-93. The experiment was laid out in randomised block design with five different spacings of 2.25 x 2.25 m (T1), 2.0 x 2.0 m (T2), 1.75 x 1.75 m (T3), 1.50 x 1.50 m (T4) and 1.25 x 1.25 m (T5) as treatments. The plantlets were maintained as per the recommendations of the Kerala Agricultural University (KAU, 1989) for irrigated Nendran banana.

One plant from each replication of each treatment was uprooted immediately after harvest and separated into corm, pseudostem, leaf and leaf sheath and their weights recorded. Bunch was separated into fingers and peduncle and their weights were taken and added to the total weight. Five hundred grams of each part was dried in hot air oven to calculate the dry matter content. Biomass accumulation per hectare was calculated by multiplying the biomass of individual plants with the number of plants in one hectare under each treatment. Fully ripe fruits collected from bunches of different treatments were used for quality analysis. The middle fruit in the top row of the second hand was selected as the representative sample (Gottriech *et al.*, 1964) for quality analysis as well as for determining shelf-life. Samples were taken from three portions (top, middle and bottom) from each sample and these samples were then pooled and macerated in a warring blender. Three samples drawn from this were used for analysis of the different constituents of fruits namely dry matter content, titrable acidity, total sugars, ascorbic acid, total soluble solids.

RESULTS AND DISCUSSION

The studies on biomass production revealed (Table 1) that in pseudostem, leaf and leaf sheath, there was no significant difference in the biomass accumulation due to the treatment effect. However, in general it was observed that biomass accumulation in these plant parts

Table 1. Biomass accumulation in tissue culture Nendran banana

Treatment		Per plant, kg						Total t ha^{-1}
		Corm	Pseudostem	Leaf	Leaf sheath	Bunch	Total	
T1	FW	6.70	10.80	9.60	11.50	9.50	48.10	95.00
	DW	0.40	0.30	2.40	0.40	4.00	7.50	14.81
T2	FW	6.60	10.50	9.30	10.90	9.25	46.55	116.37
	DW	0.30	0.27	2.40	0.39	3.90	7.26	18.15
T3	FW	5.20	9.40	8.90	9.88	9.00	42.38	138.37
	DW	0.27	0.24	2.30	0.35	3.80	6.96	22.72
T4	FW	5.00	9.20	8.30	9.50	6.70	38.66	171.80
	DW	0.26	0.25	2.10	0.35	2.80	5.75	25.55
T5	FW	4.75	8.80	8.00	9.15	6.05	36.85	235.84
	DW	0.25	0.24	2.10	0.34	2.30	5.23	33.47
CD (0.05)	FW	1.12	NS	NS	NS	1.38	3.65	10.66
	DW	0.06	NS	NS	NS	0.62	0.68	2.86

FW - Fresh weight; DW = Dry weight

Table 2. Fruit quality and shelf-life of tissue culture Nendran banana

Treatment	Dry matter, %	Acidity %	TSS %	Total sugar %	Reducing sugar %	Non-reducing sugar %	Ascorbic acid mg/100g	Sugar/ acid ratio	Time for ripening, days	Storage life of fruits, days
T1	42.5	0.40	24.5	26.8	8.7	18.1	9.4	68.7	3.73	6.13
T2	42.4	0.40	21.2	26.1	8.5	17.6	9.4	65.4	3.80	6.27
T3	41.7	0.42	19.6	22.0	8.5	13.4	9.9	53.2	4.40	6.00
T4	41.6	0.52	18.3	18.9	7.8	11.0	13.9	36.4	4.73	6.33
T5	38.4	0.53	17.4	17.7	7.0	10.7	14.1	33.7	5.20	6.13
CD (0.05)	NS	0.04 **	0.6 **	1.2 **	0.8 **	3.7 **	1.6 **	11.0 **	0.52 **	NS

NS = Not significant ** Significant at 1 per cent level

was more in wider spaced plants. The fresh weight of corms and bunches showed significant differences between treatments. The wider spaced plants recorded the highest value and the closer spaced plants recorded the lowest value. The total biomass accumulation per plant also differed significantly between treatments, wider spaced plants being the highest and closer spaced being the lowest. Similar observations were reported by Reddy

(1982) and Turner (1984). Though the biomass accumulation per plant was lower with closer spaced plants, on per hectare basis, this was more in closer spacings which may be due to more number of plants per unit area. The biomass production in banana is correlated with the photosynthetic rate (Gietema, 1970). It was observed that 80 per cent of photosynthates come from the top 2-5 leaves.

The mutual shading during the late growth phases and reduction in photosyntlietic apparatus due to disease incidence in closer spaced plants would have contributed to the reduction in biomass accumulation. It was also noted that the percentage of biomass accumulated compared to the dry matter was more in bunches in the first three wider spacing, 1.75 m x 1.75 m being the most efficient in diverting more biomass towards bunch.

The dry matter production also followed the same trend of biomass production and it was observed that dry matter production in the individual plants increased with increase in spacings. Highest dry matter accumulation was recorded by T1 (wider spacing) and the lowest dry matter production was recorded by T5 (closer spacing). The total dry matter per plant was also higher in Tl (7.5 kg) and lower in T5 (5.23 kg). However, on per hectare basis highest dry matter production was observed in closer spacing. Loomis and Williams (1963) observed that with increase in leaf area index, there was a corresponding increase in light absorption and dry matter production. This report is in agreement with the trend in dry matter production observed on per hectare basis in the present study as the computed values of leaf area index on per hectare basis was higher in closer spacings due to high plant density. These differences in biomass accumulation and dry matter partitioning ultimately resulted in the bunch yield under different spacings.

The dry matter content of fruits (Table 2) was highest in Tl (42.5 per cent) and lowest in T5 (38.4 per cent) indicating that dry matter content of fruits increased with increase in spacing. The acidity was highest (0.53 per cent) in wider spaced (Tl and T2) plants. However, it was 0.42 per cent in T3 which was middle way between Tl and T5. The same trend was followed in ascorbic acid content of fruits. The highest TSS (24.5 per cent) was observed in Tl followed by T2 (21.2 per cent) and T3 (19.6 per cent). The TSS was least (17.4 per cent) in T5. The total sugars, reducing and non-reducing sugars decreased significantly in closer spacings. Sugar/acid ratio was also highest in Tl (68.7) followed by T2 (65.40) and T3 (53.2) and the least being T5 (33.7). Fruit quality is mainly attributed to the amount of acidity and total sugars present within the fruits. A fruit with an increased acidity percentage along with a decreased sugar content is considered as inferior when the quality is taken into account. In the present experiment it was observed that the acidity increased with decrease in spacing while sugar content decreased with decrease in spacing. Thus it was clear that fruit quality decreased with decrease in spacing. Similar results were reported by Irizarry *et al.* (1978), Chundawat *el al,* (1983) and Morales and Rodriguez (1988).

The time taken for ripening of fruits increased with decrease in spacing. This indicated that decrease in spacing increase the fruit development process. The storage life of fruits at room temperature was not affected by different spacings tried. The shortest duration recorded in T3 was 6.0 days while the longest duration was only 6.33 days in T4. This indicated that the treatment T3 (1.75 m x 1.75 m) did not show much difference either in the time taken for ripening or the total shelf life of fruits from that of T2 and T1, to be considered as important from the practical point of view.

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