Indian J. Hort. 67(1), March 2010: 26-29

Relationship of pseudostem cross-sectional area with bunch weight, fruit quality and nutrient status in banana cv. Rasthali (Pathkapoora - AAB)

Dinesh Kumar* and V. Pandey**

Central Horticultural Experiment Station, Indian Institute of Horticultural Research, Bhubaneswar 751 019

ABSTRACT

A field experiment was conducted during 2005-07 to find out the relationship between pseudostem cross-sectional area (PCA) with bunch weight, physico-chemical characteristics of banana fruit, dry matter and nutrient content in leaf, pseudostem and fruit of banana. The pseudostem cross-sectional area (321.58, 327.96, 338.31, 344.20, 348.82, 354.14, 365.57, 376.49, 386.18 and 396.70 cm^2) were calculated at 30 cm above the ground level. The bunch weight and physico-chemical properties of fruits improved with increasing the pseudostem cross sectional area from 321.58 to 396.70 cm^2. Maximum bunch weight (13.22 kg), number of hands and finger (8.2 and 104.65 /bunch), TSS (24.97 °Brix), TSS/acid ratio (227.00); leaf, fruit and pseudostem dry matter content (30.50, 27.58 and 9.42% respectively), leaf nutrient content (N- 2.21%, P- 0.21% and K- 2.04% respectively), fruit nutrient (N- 1.16%, P- 0.079% and K- 1.23% respectively) and pseudostem nutrient content (N- 0.66%, P- 0.042% and K- 1.16%) were recorded in plants with maximum pseudostem cross sectional area. Positive and linear relationship were recorded between pseudostem cross-sectional area and bunch weight, number of fingers, TSS and TSS/ acid ratio, whereas negative correlation was observed between pseudostem cross-sectional area and fresh and ripe finger weight, peel and pulp weight and fruit acidity. The maximum fresh and ripe finger weight (152.23 and 137.45 g/finger), peel and pulp weight (18.24 and 119.21 g/finger), finger size (14.75 × 4.38 cm) and titratable acidity (0.16%) were recorded with lowest trunk cross-sectional area.

Key words: Banana, pseudostem cross-sectional area, fruit yield, quality, dry matter.

INTRODUCTION

Banana is an important fruit crop of tropical and sub-tropical regions of the country. India is the largest producer of banana contributing 19.71 per cent share to the global production with a total production of 19.19 million tonnes from an area of 0.562 million ha (Singh, 9). In Orissa, the people have developed traditional taste for local banana variety Pathkapoora (Rasthali-'AAB') owing to its peculiar eating and keeping quality. Though it is a paying crop but its low productivity is a limiting factor for commercial cultivation in the region. Trunk cross-sectional area of banana plant is a useful index for estimation of fruit yield and quality characters, dry matter as well as nutrient content in plant. Several variations have been observed in the pseudostem cross-sectional area of plant even when a single cultivar is planted on a commercial scale, which is mainly due to differences in root characteristics leading to nutrient uptake. The differences in plant size have shown differences in their performances in respect of bunch weight and fruit quality. The pseudostem cross-sectional area of the plant is positively correlated with transport of nutrient from root to different aerial parts of the plant and the distribution of photosynthates from site of production to site of utilization, which ultimately influences the vegetative growth and also fruit yield (Hartmann and Kester, 3; Vaile, 12). The present investigation was, therefore, undertaken to develop relationship between pseudostem cross-sectional area of plant and bunch weight, fruit quality and nutrient content of banana under eastern Indian conditions.

MATERIALS AND METHODS

The experiment was conducted at the Central Horticultural Experiment Station (IIHR), Aiginia, Bhubaneswar (Orissa) during 2005-07. The experimental site is situated at 200°15' N latitude, 85° 50' E longitude and 25.5 m above mean sea level. The soils of the area are red lateritic with low water holding capacity and poor organic matter content which leads to poor plant stand. Micro-propagated plants of banana were planted in pre-filled pits (60 cm × 60 cm × 60 cm size) during November 2005 at a spacing of 2m × 2m. The plants were selected for observations at the time of shooting. Ninety plants were selected and classified into 10 different pseudostem cross-sectional area groups (321.58, 327.96, 338.31, 344.20, 348.82, 354.14, 365.57, 376.49, 386.18 and 396.70 cm^2) with three replications in randomized block design. The pseudostem cross-sectional area of tree was calculated by using formula: PCA = Girth^2 / 4 π.

The fertilizer doses of NPK (250: 100: 300 g/plant/ crop cycle) were applied in banana field for better yield

*Corresponding author's present address: Central Institute of Temperate Horticulture, Rangreth, Srinagar (J&K); E-mail: dkches@rediffmail.com

**NRC for Banana, Trichy, Tamil Nadu

and quality. The source of fertilizer was urea as nitrogen and muriate of potash as potassium were applied in three splits at 3rd, 5th and 7th month after planting. Phosphorus as single superphosphate was applied in full as basal dose. Weeding was done manually as and when required. The crop was uniformly irrigated through drip irrigation daily during summer and alternate days during winter. Two emitters of 4 lph (litre per hour) capacity placed at a distance of 30 cm on either side of the plant were provided for irrigation (Srinivas *et al*., 10). The mature bunch was harvested and observations on bunch characters were recorded. The pulp of ripe fruits was extracted through muslin cloth and TSS of fruit was estimated by hand refractometer (0-32 °B range). The titratable acidity was recorded by titrating 2 ml of juice against N/10 sodium hydroxide using phenolphthalein indicator and expressed in terms of percentage of citric acid. Three plants were sampled in each treatment at harvest and partitioned into leaf, fruit and pseudostem (Bhargava, 1). The samples were dried in digital hot air oven at 65 °C for 72 hours. After drying, the weight of leaf, pseudostem and fruit was recorded and values presented on per cent basis. The dry leaves, fruits and pseudostem were milled to a powder for nutrient analysis. The nitrogen, phosphorus and potassium content were determined as per Page *et al.* (7). The data were analyzed statistically for interpretation of results.

RESULTS AND DISCUSSION

The bunch weight, fruit and quality characters as influenced by pseudostem cross-sectional area of banana plants have been presented in Table 1. The bunch weight increased significantly with increasing the PCA of banana plants. The highest bunch weight was recorded when trunk cross-sectional area was highest and minimum bunch weight was recorded with lowest PCA. Maximum number of hands per bunch was recorded with highest pseudostem cross-sectional area. The fresh finger and ripe finger weight, pulp and peel weight decreased with increasing the trunk cross-sectional area. Maximum fresh and ripe fruit weight, pulp and peel weight of finger was recorded with lowest pseudostem cross-sectional area. Number of fingers per bunch increased with increasing the trunk cross-sectional area of banana plant. Maximum number of fingers per bunch was recorded with highest trunk cross-sectional area. The finger size increased with decrease in the trunk cross sectional area. Maximum finger size (length and diameter) was recorded with lowest trunk cross-sectional area. The improvement in fruit size due to lower trunk cross-sectional area might be attributed to the reduction in fruits/tree and yield, which in turn diverted more nutrients to the limited number of fruits (sink) available on plant. Increase in carbohydrate levels leads to the increase in reproductive growth but fruit size is reduced due to higher fruit set/tree with the reduced vegetative growth as reported by Khan (4).

The fruit quality characters such as total soluble solids (TSS), acidity and TSS/acid ratio as influenced by pseudostem cross-sectional area of banana plant is presented in Table 1. The TSS and TSS/acid ratio in banana fruits increased as the pseudostem cross-sectional area increased. Maximum TSS content and TSS/acid ratio were recorded in trees having the maximum pseudostem cross-sectional area. Similar results were also reported by Salvador *et al*. (8). Fruit acidity decreased with an increase in the trunk cross-sectional area. Maximum fruit acidity was recorded with the lowest pseudostem cross-sectional area. Observations indicated that the increase in acidity of fruits was due to decrease in pseudostem cross sectional area of tree. The fruit size decreased with an increase in the pseudostem cross-sectional area, which might be due to the availability of lesser nutrients for the development of more number of fruits per tree.

The dry matter content in leaf, fruit and pseudostem of banana at harvest as influenced by the pseudostem cross-sectional area of banana plant is presented in Table 2. The dry matter content in leaf, fruit and pseudostem of banana increased by increasing the pseudostem cross sectional area. Maximum dry matter content in leaf, fruit and pseudostem was recorded with highest pseudostem cross-sectional area which was 10, 7.36 and 23.03% more over lowest pseudostem value. Similar findings have been reported by Kumar *et al.* (5). In general, dry matter content was more in leaf followed by fruit and pseudostem, respectively. Higher dry matter contents were due to more uptake of nutrients from the soil and translocation through trunk cross-sectional area, which increased the dry matter content in leaf, fruit and pseudostem.

The leaf, fruit and pseudostem nutrient content as affected by pseudostem cross-sectional area in banana at harvest have been presented in Table 2. The leaf nitrogen and potassium content increased significantly with increase in the trunk cross-sectional area in banana. Maximum leaf N and K content was recorded with plants having highest pseudostem cross sectional area. The leaf phosphorus content increased with increase in the pseudostem cross-sectional area but the variations were non-significant among different pseudostem cross-sectional area. The fruit NPK content increased with increase in the pseudostem cross sectional area of banana. Maximum leaf NPK content was recorded with highest cross-sectional area. The nitrogen and potassium content increased significantly with increase in the pseudostem cross-

Table 1. Effect of pseudostem cross-sectional area on fruit yield and quality in banana Rasthali Pathkapoora.

Pseudo-stem cross-sectional area (cm^2)	Bunch wt. (kg)	No. of hands/ bunch	Fresh finger wt. (g)	Ripe wt. (g)	Peel wt. (g)	Pulp wt. (g)	No. of fingers	Finger size (cm)		TSS (°B)	Acidity (%)	TSS/ acid ratio
								Length	Dia.			
321.58	8.75	5.2	152.23	137.45	18.24	119.21	57.39	14.75	4.38	22.59	0.16	141.18
327.96	9.25	5.5	149.45	134.55	17.94	116.61	61.81	14.65	4.34	22.76	0.16	142.25
338.31	9.45	5.8	145.34	130.84	17.72	113.12	64.82	14.31	4.19	22.98	0.15	153.20
344.20	10.25	6.2	143.94	129.55	17.51	112.04	71.52	13.95	4.12	23.12	0.14	165.14
348.82	10.54	6.5	140.78	126.71	17.21	109.50	74.98	13.78	3.96	23.25	0.13	178.84
354.14	11.24	6.9	136.87	123.19	16.67	106.52	82.21	13.45	3.67	23.54	0.13	181.07
365.57	11.97	7.1	133.24	119.92	16.52	103.40	89.81	13.23	3.52	23.82	0.12	198.50
376.49	12.32	7.4	131.12	118.01	16.21	101.80	93.46	12.76	3.49	24.23	0.12	201.91
386.18	12.67	7.8	129.45	116.51	15.98	100.53	97.63	12.45	3.45	24.67	0.11	224.27
396.70	13.22	8.2	126.56	113.91	15.74	98.17	104.65	12.23	3.52	24.97	0.11	227.00
CD (P=0.05)	2.12	1.1	12.23	8.25	0.55	8.75	15.67	0.45	0.21	0.43	0.06	20.82
r with TCA	0.985*	0.990*	-0.984	-0.983	-0.983	-0.984	0.990*	-0.994	-0.928	0.994*	-0.987	0.976*

r = Co-efficient of correlation; *Significant at 5%

Table 2. Effect of pseudostem cross-sectional area on dry matter and nutrient contents in banana plants at bunch harvest.

Pseudo-stem cross-sectional area (cm^2)	Dry matter content (%)			Leaf nutrient content (%)			Fruit nutrient content (%)			Pseudostem nutrient content (%)		
	Leaf	Fruit	Pseudo-stem	N	P	K	N	P	K	N	P	K
321.58	27.45	25.55	7.25	1.85	0.10	1.79	0.92	0.056	0.98	0.45	0.021	0.89
327.96	27.95	25.65	7.41	1.90	0.12	1.82	0.95	0.058	1.02	0.47	0.025	0.93
338.31	28.25	25.92	7.68	1.93	0.15	1.85	0.96	0.061	1.06	0.49	0.026	0.94
344.20	28.42	26.27	7.93	1.98	0.15	1.88	0.98	0.064	1.08	0.51	0.029	0.97
348.82	28.75	26.44	8.12	2.02	0.16	1.92	0.99	0.068	1.11	0.53	0.031	0.99
354.14	28.98	26.72	8.31	2.06	0.18	1.94	1.01	0.069	1.13	0.55	0.033	1.05
365.57	29.12	26.89	8.54	2.11	0.19	1.96	1.05	0.072	1.15	0.57	0.035	1.11
376.49	29.45	27.21	8.89	2.15	0.20	1.97	1.11	0.074	1.17	0.59	0.037	1.12
386.18	29.87	27.42	9.17	2.18	0.21	2.01	1.14	0.076	1.19	0.61	0.039	1.15
396.70	30.50	27.58	9.42	2.21	0.21	2.04	1.16	0.079	1.23	0.66	0.042	1.16
CD (P=0.05)	0.45	0.39	0.23	0.13	NS	0.11	0.12	NS	0.10	0.11	NS	0.14
r with TCA	0.989*	0.987*	0.997*	0.986*	0.959*	0.980*	0.990*	0.983*	0.980*	0.993*	0.987*	0.975*

r = Co-efficient of correlation; *Significant at 5%

sectional area but the fruit phosphorus content showed non-significant variations as far as trunk cross sectional area is concerned. The pseudostem NPK content was also influenced by trunk cross sectional area. The pseudostem NPK content increased with increase in the pseudostem cross-sectional area. Maximum NPK content was estimated with highest pseudostem cross sectional area. The N and K contents in pseudostem were significantly higher with maximum cross-sectional area. The present findings are in conformity with the findings of Turner and Barkus (11). The phosphorus content in pseudostem showed marginal variations with different pseudostem cross-sectional area. The plants having higher trunk cross-sectional area might be responsible for higher uptake and translocation of nutrients from the soil and thus better fruit set.

Correlations drawn between different dependent and independent variables of bunch characters in banana revealed that the bunch weight, number of hands, number of fingers and fruit quality characters were inter-related. Positive and significant correlation was observed between pseudostem cross-sectional area and bunch weight (0.985) and pseudostem cross-sectional area and number of hands (0.990). Similarly, significant positive correlation was observed between PCA and fruit number (0.990) while, there was negative correlation between pseudostem cross-sectional area and fresh and ripe fruit weight (-0.984 and -0.983), pseudostem cross-sectional area and peel and pulp weight (-0.983 and -0.984), fruit size (-0.994 and -0.928). Positive correlation was obtained between pseudo- stem cross-sectional area and TSS (0.994) and TSS/acid ratio (0.976), whereas, negative correlation (-0.987) was observed for fruit acidity. There was significant and positive correlation between pseudo stem cross sectional area of plant and dry matter content of leaf, fruit and pseudostem, pseudostem cross-sectional area and N, P, K content of leaves, pseudostem cross-sectional area and NPK of fruits and pseudostem cross-sectional and NPK of pseudostem were observed. It is evident from the results that the cross-sectional area of a banana plant had a pronounced effect on the bunch weight, number of fingers and quality in addition to leaf, fruit and pseudo-stem dry matter content and NPK content of banana var. Rasthali Pathkapoora. Similar, findings were made by Dhaliwal and Dhillon (2) and Kumar and Pandey (6). Therefore, pseudostem cross-sectional area of banana plant should be monitored to improve bunch weight and quality as it determines the carbohydrate levels and thus greatly influences the yield and quality parameters.

REFERENCES

1. Bhargava, B.S. 1999. Leaf analysis for diagnosis nutrient need in fruit crops. *Indian. J. Hort.* **43**: 6-8.

2. Dhaliwal, G.S. and Dhillon, S.K. 2003. Effect of tree size on physico-chemical characteristics of fruits of guava cv. Sardar. *Indian J. Hort*. **60**: 312-17.

3. Hartmann, H.T. and Kester, D.E. 2002. *Plant Propagation: Principles and Practices*, 4th edn. Prentice Hall of India Private Limited, New Delhi. pp. 377-79.

4. Khan, Z.U. 1998. To control vigour and to explain physiological causes in an ultra high density planting system for apples. Ph.D. thesis, Lincoln University, Canterbury, New Zealand.

5. Kumar, D., Pandey, V., Anjaneyulu, K. and Vishal Nath. 2008. Relationship of trunk cross-sectional area with fruit yield, quality and leaf nutrient status in Allahabad Safeda guava (*Psidium guajava*). *Indian J. Agric. Sci.* **78**: 337-39.

6. Kumar, D. and Pandey, V. 2008. Effect of NPK fertigation on growth, yield and quality of banana 'Rasthali' (AAB-Pathkapoora) in coastal agro-climatic conditions of eastern India. *Indian J. Agric. Sci.* **78**: 798-800.

7. Page, A. L., Miller, R.H. and Keeney, D.R. 1982. **In**: *Methods of Soil Analysis, Part II, Chemical and Microbiological Procedures*. American Society of Soil Science Inc., Madison, Wisconsin, USA.

8. Salvador, F.R.D., Fisichella, M. and Fontanari, M. 2006. Correlation between fruit size and fruit quality in apple trees with high and standard crop load levels. *J. Fruit Orn. Plant Res.* **14**: 113-22.

9. Singh, H.P. 2007. Research and development of banana and plantain in India. *National Conference on Banana- Production and Utilization of Banana for Economic Livelihood and Nutritional Security,* NRC for Banana, Tiruchirapalli (Tamil Nadu), October 25-28, 2007.

10. Srinivas, K., Reddy, B.M.C., Chandra Kumar, S.S., Gowda, S.T., Raghupati, H.B. and Padma, P. 2001. Growth, yield and nutrient uptake of Robusta banana in relation to N and K fertigation. *Indian J. Hort.* **58**: 287-93.

11. Turner, D.W. and Barkus, B. 1983. The uptake and distribution of minerals nutrients in the banana in response to supply of K, Mg and Mn. *Nutrient Cycling in Agro-Ecosys.* **4**: 89-99.

12. Vaile, J.E. 1938. The influence of rootstocks on the yield and vigour of American grapes. *Proc. American Soc. Hort. Sci.* **35**: 471-74.

Received: October, 2008; Revised: November, 2009; Accepted : December, 2009