



A Study Of Plant Geometry And Levels Of Potassium On Number Of Leaves Of Banana (*Musa Acuminata* L.) Cv. Ardhapuri

Dr. A. V. Jadhav

Yeshwant Mahavidyalaya, Nanded – 431602 (M.S.), India

ABSTRACT

The present investigation was carried out at Banana Research Station, Nanded. “Studies on plant geometry and levels of potassium on growth, yield and quality of banana (*Musa acuminata* L.)”, for two trial years. In the present experiment, there were four main treatments of plant density, viz. D₁ (1.5 m x 1.2 m), D₂ (1.5 m x 1.5 m), D₃ (1.5 m x 1.8 m) and D₄ (1.5 m x 2.1 m), three sub- treatment of potassium levels, viz. K₁ (100 g K₂O/plant), K₂ (200 g K₂O/plant), K₃ (300 g K₂O/plant) and thus comprising twelve treatment combinations.

From the results obtained in the present investigation, it can be revealed that the vigorous vegetative growth in terms of plant height, were the highest in plants with plant density 1.5 m x 2.1 m followed by plant density 1.5 m x 1.8 m, while in case of different potassium levels the vegetative growth were the highest in plants with application of 300 g K₂O/plant followed by 200 g K₂O/plant. In interaction, the plant density 1.5 m x 2.1 m with combination of 300 g K₂O/plant as well as 200 g K₂O/plant showed the highest vegetative growth and number of leaves.

Introduction:

Banana belongs (*Musa* spp.) to family Musaceae and it is the most important fruit crops of the world as well as India. It is pleasing flavoured, nutritious, cheap and known as “poor man’s apple”. The banana crop determines the socio-economic status of the farmer’s and called as Kalpataru (Plant of heaven) due to its socio-economic and multiple uses. The number of banana cultivars are variable, there are about 250-300 cultivated cultivars in India. Ardhapuri (*Musa* sp.)

Advantages of high density planting (plant geometry) includes precocity in bearing, high yield, high average yield, high returns per unit area, early returns, easy management, reduction in labour cost, low reduction cost, mechanization of fruit crop, production and facilitates more efficient use of radiation, fertilizers, fungicides, herbicides, pesticides, insecticides etc.

To ensure high yield of superior quality bananas, adequate application of nutrients is of paramount importance, Potassium regulates many vital functions like carbon assimilation, translocation of proteins and sugars, water balance in plants, maintain turgor pressure in the cell, root development, improving the quality of fruits by maintaining desirable sugar: acid ratio, ripening of fruits and many other processes. The banana requires more potassium for its growth, production and quality compared to nitrogen and phosphorus Croucher and Mitchell (1940). Considering these facts the research topic entitled “Studies on plant geometry and levels of potassium on growth, yield and quality of banana (*Musa acuminata* L.)” is related to the present studies.

Materials and Methods:

During the present studies different treatments of plant density and potassium levels were taken for observation during two trial years. The actual number of leaves on the plant was counted and average was calculated and the mean was expressed initially at 60, 90, 120, 150, 180 and 210 days.

Details of Experiment

- a) Name of crop : Banana
- b) Botanical Name : *Musa* spp.
- c) Family : Musaceae
- d) Number of main treatments : 04
- e) Number of sub treatments : 03
- f) Number of treatment combinations: 12
- g) Number of replications : 03
- h) Experimental design : Split plot design
- i) Variety : Ardhapuri
- j) Season : 2011-12 and 2012-13
- k) Fertilizers : As per mentioned later

Treat. Symbol.		Treatment details	
Plant density (D)			
D ₁	:	1.5 m x 1.2 m	
D ₂	:	1.5 m x 1.5 m	
D ₃	:	1.5 m x 1.8 m	
D ₄	:	1.5 m x 2.1 m	
Potassium levels (K)			
K ₁	:	100 g K ₂ O/plant (1/2 dose of RDF)	
K ₂	:	200 g K ₂ O /plant (RDF)	
K ₃	:	300 g K ₂ O /plant (1.5 dose of RDF)	
Treatment	Treatment Details		
	T1	:	D1K1 (1.5m x 1.2m with 100g K ₂ O/plant)
	T2	:	D1K2(1.5m x 1.2m with 200g K ₂ O/plant)
	T3	:	D1K3(1.5m x 1.2m with 300g K ₂ O/plant)
	T4	:	D2K1(1.5m x 1.5m with 100g K ₂ O/plant)
	T5	:	D2K2(1.5m x 1.5m with 200g K ₂ O/plant)
	T6	:	D2K3(1.5m x 1.5m with 300g K ₂ O/plant)
	T7	:	D3K1(1.5m x 1.8m with 100g K ₂ O/plant)
	T8	:	D3K2(1.5m x 1.8m with 200g K ₂ O/plant)
	T9	:	D3K3(1.5m x 1.8m with 300g K ₂ O/plant)
	T10	:	D4K1(1.5m x 2.1m with 100g K ₂ O/plant)
	T11	:	D4K2(1.5m x 2.1m with 200g K ₂ O/plant)
	T12	:	D4K3(1.5m x 2.1m with 300g K ₂ O/plant)

Number of Leaves

The highest number of leaves (20.02) was produced by plants in D₄1.5 m x 2.1 m (3,174 plants/ha). The lowest number of leaves was observed (19.22) in case of D₁1.5 m x 1.2 m (5,555 plants/ha). In case of effect of different levels of potassium the treatment K₁(100 g K₂O/plant) produced maximum number of leaves (19.70) while treatment K₂ (200 g K₂O/plant) produced minimum number of leaves (19.55) which was at par with treatment K₃ (300 g K₂O/plant) (19.66). In interaction effects of plant densities and potassium levels the highest number of leaves obtained in treatment D₄K₁(1.5 m x 2.1 m with 100 g

K₂O/plant)(20.45).The lowest number of leaves obtained in treatment D₂K₁(1.5 m x 1.5 mm with 100 g K₂O/plant) (19.07) which was at par with treatment D₁K₂(1.5 m x 1.2 m with 100 g K₂O/plant)(19.10), D₁K₃(1.5 m x 1.2 m with 300 g K₂O/plant) (19.17), D₂K₂(1.5 m x 1.5 mm with 200 g K₂O/plant)(19.20).

Table 1. Effect of plant densities and different levels of potassium on number of leaves per plant of banana cv. Ardhapuri at 60 DAP

Treatments		Number of leaves per plant at 60 DAP		
Main treatments (Plant densities) (D)		2011-12	2012-13	Pooled Mean
Spacings (m ²)	No. of plants/ha			
D ₁ (1.5 x 1.2)	5,555	10.40	10.39	10.39
D ₂ (1.5 x 1.5)	4,444	10.47	10.45	10.46
D ₃ (1.5 x 1.8)	3,703	11.21	11.20	11.21
D ₄ (1.5 x 2.1)	3,174	11.18	11.24	11.21
S.E.(m) $\pm$		0.033	0.033	0.03
C.D. at 5%		0.116	0.116	0.10
Sub-treatment (Potassium levels) (K)				
K ₁ (100 g K ₂ O/plant)		10.91	10.88	10.90
K ₂ (200 g K ₂ O/plant)		10.70	10.81	10.75
K ₃ (300 g K ₂ O/plant)		10.83	10.77	10.80
S.E.(m) $\pm$		0.032	0.032	0.032
C.D. at 5%		0.097	NS	0.093
Interaction (D x K)				
D ₁ K ₁		10.60	10.57	10.58
D ₁ K ₂		10.00	10.10	10.05
D ₁ K ₃		10.60	10.50	10.55
D ₂ K ₁		10.20	10.33	10.27
D ₂ K ₂		10.40	10.37	10.38
D ₂ K ₃		10.80	10.66	10.73
D ₃ K ₁		11.33	11.07	11.20
D ₃ K ₂		11.00	11.20	11.10
D ₃ K ₃		11.30	11.33	11.32
D ₄ K ₁		11.50	11.56	11.53
D ₄ K ₂		11.40	11.57	11.48
D ₄ K ₃		10.63	10.60	10.62
S.E.(m) $\pm$		0.065	0.065	0.065
C.D. at 5%		0.195	0.195	0.187

Table 2. Effect of plant densities and different levels of potassium on number of leaves per plant of banana cv. Ardhapuri at 90 DAP

Treatments		Number of leaves per plant at 90 DAP		
Main treatments (Plant densities) (D)		2011-12	2012-13	Pooled Mean
Spacings (m ²)	No. of plants/ha			
D ₁ (1.5 x 1.2)	5,555	12.10	12.12	12.11
D ₂ (1.5 x 1.5)	4,444	12.07	12.12	12.09
D ₃ (1.5 x 1.8)	3,703	12.79	12.89	12.84
D ₄ (1.5 x 2.1)	3,174	12.93	12.93	12.93
S.E.(m) ±		0.101	0.083	0.09
C.D. at 5%		0.350	0.286	0.28
Sub-treatment (Potassium levels) (K)				
K ₁ (100 g K ₂ O/plant)		12.53	12.61	12.57
K ₂ (200 g K ₂ O/plant)		12.48	12.53	12.51
K ₃ (300 g K ₂ O/plant)		12.40	12.41	12.40
S.E.(m) ±		0.054	0.059	0.057
C.D. at 5%		NS	NS	NS
Interaction (D x K)				
D ₁ K ₁		12.03	12.10	12.07
D ₁ K ₂		12.23	12.23	12.23
D ₁ K ₃		12.03	12.03	12.03
D ₂ K ₁		11.93	11.97	11.95
D ₂ K ₂		12.03	12.10	12.07
D ₂ K ₃		12.23	12.30	12.27
D ₃ K ₁		12.77	12.93	12.85
D ₃ K ₂		12.33	12.43	12.38
D ₃ K ₃		13.27	13.30	13.28
D ₄ K ₁		13.40	13.43	13.42
D ₄ K ₂		13.33	13.37	13.35
D ₄ K ₃		12.07	12.00	12.03
S.E.(m) ±		0.108	0.118	0.113
C.D. at 5%		0.325	0.353	0.326

Table 3. Effect of plant densities and different levels of potassium on number of leaves per plant of banana cv. Ardhapuri at 120 DAP

Treatments		Number of leaves per plant at 120 DAP		
Main treatments (Plant densities) (D)		2011-12	2012-13	Pooled Mean
Spacings (m ²)	No. of plants/ha			
D ₁ (1.5 x 1.2)	5,555	14.63	14.66	14.64
D ₂ (1.5 x 1.5)	4,444	14.67	14.68	14.67
D ₃ (1.5 x 1.8)	3,703	15.26	15.20	15.23
D ₄ (1.5 x 2.1)	3,174	15.31	15.40	15.36
S.E.(m) ±		0.029	0.027	0.03
C.D. at 5%		0.099	0.095	0.09
Sub-treatment (Potassium levels) (K)				
K ₁ (100 g K ₂ O/plant)		14.98	14.97	14.98
K ₂ (200 g K ₂ O/plant)		14.88	14.93	14.90
K ₃ (300 g K ₂ O/plant)		15.04	15.05	15.05
S.E.(m) ±		0.030	0.029	0.029
C.D. at 5%		0.089	0.087	0.085
Interaction (D x K)				
D ₁ K ₁		14.90	14.90	14.90
D ₁ K ₂		14.20	14.30	14.25
D ₁ K ₃		14.80	14.77	14.78
D ₂ K ₁		14.30	14.33	14.32
D ₂ K ₂		14.60	14.60	14.60
D ₂ K ₃		15.10	15.10	15.10
D ₃ K ₁		15.23	15.03	15.13
D ₃ K ₂		15.20	15.23	15.22
D ₃ K ₃		15.33	15.33	15.33
D ₄ K ₁		15.50	15.60	15.55
D ₄ K ₂		15.50	15.60	15.55
D ₄ K ₃		14.93	15.00	14.97
S.E.(m) ±		0.059	0.058	0.059
C.D. at 5%		0.178	0.174	0.169

Table 4. Effect of plant densities and different levels of potassium on number of leaves per plant of banana cv. Ardhapuri at 150 DAP

Treatments		Number of leaves per plant at 150 DAP		
Main treatments (Plant densities) (D)		2011-12	2012-13	Pooled Mean
Spacings (m ²)	No. of plants/ha			
D ₁ (1.5 x 1.2)	5,555	15.64	15.79	15.72
D ₂ (1.5 x 1.5)	4,444	15.80	15.81	15.81
D ₃ (1.5 x 1.8)	3,703	16.33	16.59	16.46
D ₄ (1.5 x 2.1)	3,174	16.57	17.28	16.92
S.E.(m) ±		0.075	0.075	0.07
C.D. at 5%		0.259	0.260	0.23
Sub-treatment (Potassium levels) (K)				
K ₁ (100 g K ₂ O/plant)		16.10	16.37	16.23
K ₂ (200 g K ₂ O/plant)		16.03	16.33	16.18
K ₃ (300 g K ₂ O/plant)		16.13	16.41	16.27
S.E.(m) ±		0.044	0.054	0.049
C.D. at 5%		NS	NS	NS
Interaction (D x K)				
D ₁ K ₁		15.60	15.90	15.75
D ₁ K ₂		15.53	15.80	15.67
D ₁ K ₃		15.80	15.67	15.73
D ₂ K ₁		15.60	15.60	15.60
D ₂ K ₂		15.70	15.60	15.65
D ₂ K ₃		16.10	16.23	16.17
D ₃ K ₁		16.30	16.37	16.33
D ₃ K ₂		16.20	16.53	16.37
D ₃ K ₃		16.50	16.87	16.68
D ₄ K ₁		16.90	17.60	17.25
D ₄ K ₂		16.70	17.37	17.03
D ₄ K ₃		16.10	16.87	16.48
S.E.(m) ±		0.088	0.107	0.098
C.D. at 5%		0.264	0.321	0.282

spacing *i.e.* 5,555 plants/ha with 100 g K₂O/plant), (15.67), D₁K₃(1.5m x 1.2m spacing *i.e.* 5,555 plants/ha with 300 g K₂O/plant) (15.73), D₁K₁(1.5m x 1.2m spacing *i.e.* 5,555 plants/ha with 100 g K₂O/plant)(15.75).

Table 5. Effect of plant densities and different levels of potassium on number of leaves per plant of banana cv. Ardhapuri at 180 DAP

Treatments		Number of leaves per plant at 180 DAP		
Main treatments (Plant densities) (D)		2011-12	2012-13	Pooled Mean
Spacings (m ²)	No. of plants/ha			
D ₁ (1.5 x 1.2)	5,555	17.23	17.51	17.37
D ₂ (1.5 x 1.5)	4,444	17.34	17.64	17.49
D ₃ (1.5 x 1.8)	3,703	18.06	18.97	18.51
D ₄ (1.5 x 2.1)	3,174	18.13	19.25	18.69
S.E.(m) ±		0.026	0.048	0.04
C.D. at 5%		0.089	0.165	0.12
Sub-treatment (Potassium levels) (K)				
K ₁ (100 g K ₂ O/plant)		17.78	18.52	18.15
K ₂ (200 g K ₂ O/plant)		17.63	18.16	17.89
K ₃ (300 g K ₂ O/plant)		17.68	18.35	18.01
S.E.(m) ±		0.022	0.050	0.039
C.D. at 5%		0.067	0.149	0.111
Interaction (D x K)				
D ₁ K ₁		17.40	17.63	17.52
D ₁ K ₂		17.00	17.40	17.20
D ₁ K ₃		17.30	17.50	17.40
D ₂ K ₁		17.13	17.60	17.37
D ₂ K ₂		17.20	17.33	17.27
D ₂ K ₃		17.70	18.00	17.85
D ₃ K ₁		18.07	19.00	18.53
D ₃ K ₂		17.90	18.50	18.20
D ₃ K ₃		18.20	19.40	18.80
D ₄ K ₁		18.50	19.83	19.17
D ₄ K ₂		18.40	19.42	18.91
D ₄ K ₃		17.50	18.50	18.00
S.E.(m) ±		0.045	0.100	0.077
C.D. at 5%		0.134	0.298	0.222

Table 6. Effect of plant densities and different levels of potassium on number of leaves per plant of banana cv. Ardhapuri at 210 DAP

Treatments		Number of leaves per plant at 210 DAP		
Main treatments (Plant densities) (D)		2011-12	2012-13	Pooled Mean
Spacings (m ²)	No. of plants/ha			
D ₁ (1.5 x 1.2)	5,555	18.63	19.81	19.22
D ₂ (1.5 x 1.5)	4,444	18.83	20.08	19.46
D ₃ (1.5 x 1.8)	3,703	19.40	20.32	19.86
D ₄ (1.5 x 2.1)	3,174	19.60	20.44	20.02
S.E.(m) ±		0.018	0.030	0.02
C.D. at 5%		0.064	0.104	0.08
Sub-treatment (Potassium levels) (K)				
K ₁ (100 g K ₂ O/plant)		19.20	20.21	19.70
K ₂ (200 g K ₂ O/plant)		19.05	20.06	19.55
K ₃ (300 g K ₂ O/plant)		19.10	20.23	19.66
S.E.(m) ±		0.020	0.027	0.024
C.D. at 5%		0.061	0.082	0.070
Interaction (D x K)				
D ₁ K ₁		18.80	20.00	19.40
D ₁ K ₂		18.50	19.70	19.10
D ₁ K ₃		18.60	19.73	19.17
D ₂ K ₁		18.60	19.53	19.07
D ₂ K ₂		18.70	19.70	19.20
D ₂ K ₃		19.20	21.00	20.10
D ₃ K ₁		19.40	20.40	19.90
D ₃ K ₂		19.20	20.17	19.68
D ₃ K ₃		19.60	20.40	20.00
D ₄ K ₁		20.00	20.90	20.45
D ₄ K ₂		19.80	20.67	20.23
D ₄ K ₃		19.00	19.77	19.38
S.E.(m) ±		0.041	0.055	0.048
C.D. at 5%		0.122	0.164	0.139

Table 7. Effect of plant densities and different levels of potassium on *cumulative number of leaves % of banana cv. Ardhapuri

Treatments		Cumulative number of leaves at DAP				
		60 – 90	90 -120	120 –150	150 - 180	150 – 180
Main treatments (Plant densities) (D)						
Spacings (m ²)	No. of plants/ha					
D ₁ (1.5 x 1.2)	5,555	16.55	20.89	07.37	10.50	10.65
D ₂ (1.5 x 1.5)	4,444	15.58	21.33	07.77	10.62	11.26
D ₃ (1.5 x 1.8)	3,703	14.54	16.61	08.07	12.45	7.29
D ₄ (1.5 x 2.1)	3,174	15.34	18.79	10.15	10.46	7.12
Sub-treatment (Potassium levels) (K)						
K ₁ (100 g K ₂ O/plant)		15.32	19.17	8.34	11.82	8.54
K ₂ (200 g K ₂ O/plant)		16.37	19.10	8.59	10.56	9.28
K ₃ (300 g K ₂ O/plant)		14.81	21.37	8.10	10.69	9.16
Interaction (D x K)						
D ₁ K ₁		14.08	23.44	5.70	11.23	10.73
D ₁ K ₂		21.69	16.51	9.96	9.75	11.05
D ₁ K ₃		14.02	22.85	6.42	10.61	10.17
D ₂ K ₁		16.35	19.83	8.93	11.34	9.79
D ₂ K ₂		16.28	20.96	7.19	10.35	11.18
D ₂ K ₃		14.35	23.06	7.08	10.39	12.60
D ₃ K ₁		14.73	17.74	7.93	13.47	7.39
D ₃ K ₂		11.53	22.94	7.55	11.18	8.13
D ₃ K ₃		17.31	15.43	8.80	12.70	6.38
D ₄ K ₁		16.39	15.87	10.93	11.13	6.68
D ₄ K ₂		16.28	16.47	9.51	11.04	6.98
D ₄ K ₃		13.27	24.43	10.08	9.22	7.67

*Figures in percentage indicate the percent increase in number of leaves per plant at an interval of 30 days.

References:

- Anil, B.K.; Nair, C. S. J. and Jayachandran, B.K. (1995). Effect of spacing on biomass production, dry matter partitioning, yield and fruit quality in tissue culture banana (AAB) Nendran. *J. Tropical Agric.*, 33 (1): 32-35.
- Anonymous, (1996). Studies on the effect of planting cum spacing on production of banana cv. Basrai 31st *AGRESCO Hort and Veg Sub Committee*, G.A.U., Navsari, pp 21-29.
- Baruah, P.I. and Mohan, N.K. (1985). Effect of potassium on yield and yield attributing characteristics on Dwarf Cavendish (*Musa AAA*) in Assam. *Banana NewsLetter* 15: 24-25.
- Basagarahally, R. 1996. Microproagation and nutritional studies of tissue cultured banana cv. Grand Naine. Ph. D. Thesis, university of agricultural science. Bangalore.
- Bhalerao, N.M., Patil, N.M., Badgujar, C.D. and Patil, D.R. (2009). Studies on intergrated management from tissue cultured Grand Naine banana. *Indian J. Agric.Res.*, 43: 107-112.
- Croucher, H. H. and Mitchell, M.K. 1940. Fertilizer investigations with Gros Michel banana. *Bull. Dept. Sci. Agric. Jamaica*, 19:30
- Kavino, M., Kumar, N., Sorrianathasundram K. and Jeyakumar P. (2004). Effect of Source of fertilizer for fertigation on yield and quality of banana. cv. Robusta (AAA). *South Indian Hort.*, 50 (4-6): 301-307.
- Mustaffa, M.M. (2009). Effect of spacing in nitrogen on growth, fruit and yield of Robusta banana grown under rainfed conditions. *South Indian Hort.*, 36: 228-231.
- Nalina, L., Kumar, N., Soorianathasundram, K. and Jeyakumar, P. 2009. Effect of different nutrient levels on growth and development of tissue cultured banana cv. Robusta. *Indian J. Horti*, 66 (2):169-174.
- Palker, S.S. (2007) Effect of high density planting on growth, yield and quality of banana (*Musa paradisiacal* L.) Cv. Grand Naine. Thesis submitted to the Navsari Agriculture University, Navsari.
- Pascua, O.C. and Loquias, V.L. (1995). Population density study on cooking banana cv. Cardaba (*Musa balbisiana* L.). *Animal Husband and Agric J. (Philippines)*, 29 (1): 94-101.