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

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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*. 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) and D_4 (1.5 m x 2.1 m), three sub- treatment of potassium levels, *viz*. K_1 (100 g K_2 O/plant), K_2 (200 g K_2O/plant), K_3 (300 g K_2O/plant) and thus comprising twelve treatment combinations.

From the results obtained in the present investigation, it can be revealed that the lowest acidity (0.085%) was recorded in D_3 1.5 m x 1.8 m (3,703 plants/ha) which was at par (0.089%) with D_2 1.5 m x 1.5 m (4,444 plants/ha), the highest acidity (0.110%) was noted in D_1 1.5 m x 1.2 m (5,555 plants/ha). The effect of potassium levels on acidity in pooled was found to be non-significant. In the interaction effect the lowest acidity (0.064%) was equally recorded in three treatments D_2K_2 (1.5, x 1.5, at 200 g K_2O/plant) D_3K_3 (1.5 m x 1.8 mm at 300 g K_2O/plant), D_4K_1(1.5mx 2.1m at 100 g K_2O/plant), which was at par (0.0075%) with D_2K_3 (1.5 m x 1.5 mm at 300 g K_2O/plant) and then equally at par (0.085%) with three treatments D_1K_2 (1.5 m x 1.2 m at 200 g K_2O/plant)D_3K_1 (1.5 m x 2.1 m at 100 g K_2O/plant) D_4K_2 (1.5 m x 2.1 m at 200 g K_2O/plant)at a time and lastly at par (107%) with D_3K_2 (1.5 m x 1.8 mm at 200 g K_2O/plant). The highest acidity (0.128%) was recorded equally In three treatment D_1K_3 (1.5 m x 1.2 m at 300 g K_2O/plant), D_2K_1 (1.5, x 1.5m at 100 g K_2O/plant) D_4K_3 (1.5 m x 2.1 m at 300 g K_2O/plant) at a time and which is significantly at par (0.117%) with D_1K_1 (1.5 m x 1.2 m at 100 g K_2O/plant).

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:

Titrable acidity of freshly prepared juice was obtained by titration method. Fruit juice was titrated against 0.1 N Sodium Hydroxide and using phenolphthalein as an indicator (the end point was colourless to pink colour). Acidity of juice was calculated in terms of malic acid per 100 ml of juice.

$$\text{Titrable acidity (\%)} = \frac{\text{N/NaOH used} \times 0.0064}{\text{Volume of sample used}} \times 1000$$

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_2O/plant (1/2 dose of RDF)
K_2	:	200 g K_2O /plant (RDF)
K_3	:	300 g K_2O /plant (1.5 dose of RDF)

Treatment		Treatment Details
T1	:	D1K1 (1.5m x 1.2m with 100g K2O/plant)
T2	:	D1K2(1.5m x 1.2m with 200g K2O/plant)
T3	:	D1K3(1.5m x 1.2m with 300g K2O/plant)
T4	:	D2K1(1.5m x 1.5m with 100g K2O/plant)
T5	:	D2K2(1.5m x 1.5m with 200g K2O/plant)
T6	:	D2K3(1.5m x 1.5m with 300g K2O/plant)
T7	:	D3K1(1.5m x 1.8m with 100g K2O/plant)
T8	:	D3K2(1.5m x 1.8m with 200g K2O/plant)
T9	:	D3K3(1.5m x 1.8m with 300g K2O/plant)
T10	:	D4K1(1.5m x 2.1m with 100g K2O/plant)
T11	:	D4K2(1.5m x 2.1m with 200g K2O/plant)
T12	:	D4K3(1.5m x 2.1m with 300g K2O/plant)

Results:

Acidity (%)

The data on acidity (%) of banana fruit as influenced by the dentition of plants and different potassium levels is presented in Table 01. and depicted in Fig 01.

The data during 2011-12, showed that the lowest acidity (0.085%) was recorded in D_2 (1.5m x 1.5m spacing *i.e.* 4,444 plants/ha) and D_3(1.5m x 1.8m spacing *i.e.* 3,703 plants/ha) while the highest acidity was recorded (0.114%) in D_1 (1.5m x 1.2m spacing *i.e.* 5,555 plants/ha). The effect of potassium levels on acidity (%) was found to be non significant. In interaction the lowest acidity (0.064%) was noted in four treatments , D_2k_2 (1.5m x 1.5m spacing *i.e.* 4,444 plants/ha with 200 g K_2O/plant), D_2K_3 (1.5m x 1.8m spacing *i.e.* 3,703 plants/ha at 300 g K2O/plant), D_3K_3 (1.5m x 1.8m spacing *i.e.* 3,703 plants/ha at 300 g K_2O/plant), D_4K_1 (1.5m x 2.1m spacing *i.e.* 3,174 plants/ha at 100 g K_2O/plant), which was at par (0.085%) with two treatments D_3K_1 (1.5m x 1.8m spacing *i.e.* 3,703 plants/ha at 100 g K_2O/plant) D_4K_2 (1.5m x 2.1m spacing *i.e.* 3,174 plants/ha at 200 g K_2O/plant) at a time and at par (0.107%) with three treatments D_1K_1 (1.5m x 1.2m spacing *i.e.* 5,555 plants/ha with 100 g K_2O/plant) D_1K_2 (1.5m x 1.2m at 200 g K_2O/plant) D_3K_2 (1.5m x 1.8m spacing *i.e.* 3,703 plants/ha at 200 K_2O/plant). The highest acidity (0.128%) was recorded in three treatments D_1K_3 (1.5m x 1.2m spacing *i.e.* 5,555 plants/ha at 300 g K_2O/plant) D_2K_1 (1.5m x 1.5m spacing *i.e.* 4,444 plants/ha at 100 g K_2O/plant) D_4K_3 (1.5m x 2.1m spacing *i.e.* 3,174 plants/ha at 100 g K_2O/plant) at a time.

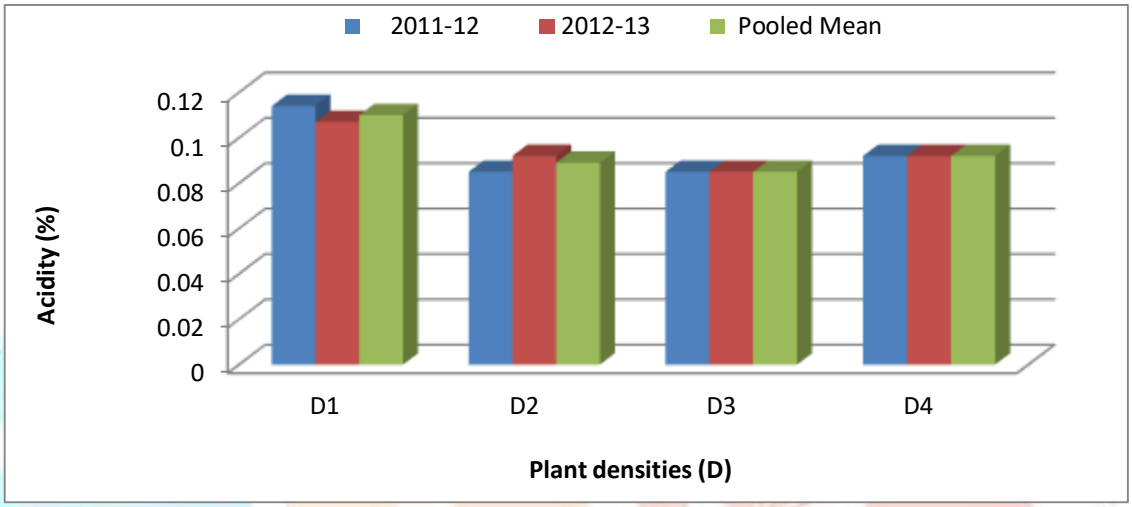
The effect of plant densities and different levels of potassium on acidity (%) was found to be non-significant in 2012-13.The interaction effect of plant densities and the potassium levels indicated that the lowest acidity (0.064%) was noted in four treatments D_1K_2 (1.5m x 1.5m spacing *i.e.* 4,444 plants/ha with 200 g K_2O/plant) D_2K_2 (1.5m x 1.5m spacing *i.e.* 4,444 plants/ha with 200 g K_2O/plant) D_3K_3 (1.5m x 2.1 at 300 g K_2O/plant) and D_4K_1 (1.5m x 2.1m spacing *i.e.* 3,174 plants/ha at 300 g K_2O/plant)at a time , which was equally at par (0.085%) with three treatments D_2K_3 (1.5mx 2.1m at 300 g K_2O/plant), D_3K_1(1.5m x 1.8m spacing *i.e.* 3,703 plants/ha with 100 g K_2O/plant) and D_4K_2(1.5m x 2.1m spacing *i.e.* 3,174 plants/ha with 200 g K_2O/plant) at a time . The highest acidity (0.128%) was recorded by four treatments D_1K_1(1.5m x 1.2m spacing *i.e.* 5,555 plants/ha with 100 g K_2O/plant), D_1K_3 (1.5m x 1.2 m at 300 g K_2O/plant) D_2K_1 (1.5, x 1.3, at 100 g K_2O/plant) D_4K_3 (1.5, x 2.1, at 300 g K_2O/plant) which was at par (0.107%) with D_3K_2(1.5m x 1.8m spacing *i.e.* 3,703 plants/ha at 200 g K_2O/plant).

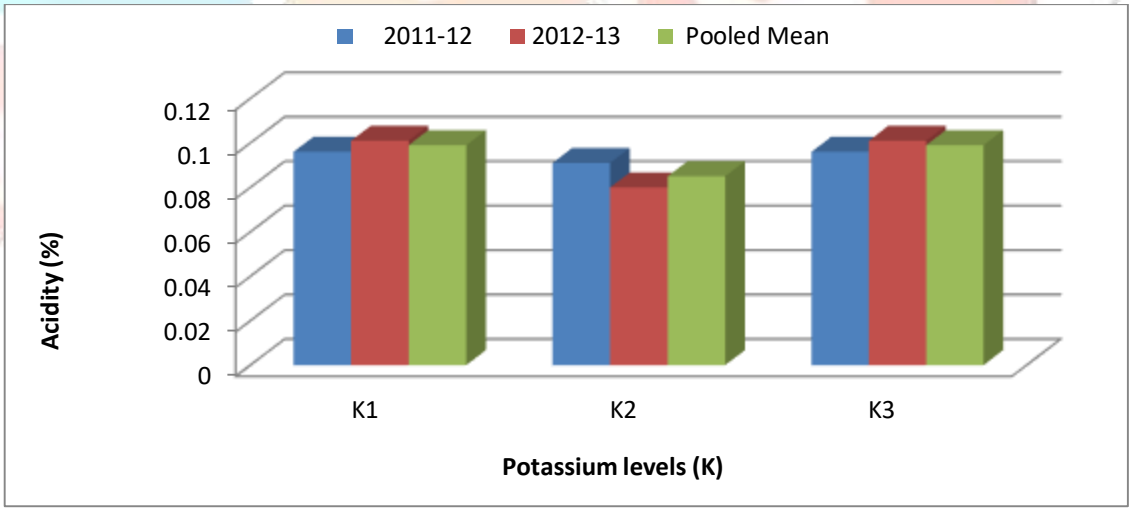
Table 01.Effect of plant densities and different levels of potassium on acidity (%) of banana cv. Ardhapuri

Treatments		Acidity (%)		
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	0.114	0.107	0.110
D_2(1.5 x 1.5)	4,444	0.085	0.092	0.089
D_3(1.5 x 1.8)	3,703	0.085	0.085	0.085
D_4 (1.5 x 2.1)	3,174	0.092	0.092	0.092
S.E.(m) ±		0.005	0.004	0.005
C.D. at 5%		0.019	NS	0.015
Sub-treatment (Potassium levels) (K)				
K_1 (100 g K_2O/plant)		0.096	0.101	0.099
K_2 (200 g K_2O/plant)		0.091	0.080	0.085
K_3 (300 g K_2O/plant)		0.096	0.101	0.099
S.E.(m) ±		0.008	0.007	0.007
C.D. at 5%		NS	NS	NS
Interaction (D x K)				
D_1 K_1		0.107	0.128	0.117
D_1 K_2		0.107	0.064	0.085
D_1 K_3		0.128	0.128	0.128
D_2 K_1		0.128	0.128	0.128
D_2 K_2		0.064	0.064	0.064
D_2 K_3		0.064	0.085	0.075
D_3 K_1		0.085	0.085	0.085
D_3 K_2		0.107	0.107	0.107
D_3 K_3		0.064	0.064	0.064
D_4 K_1		0.064	0.064	0.064
D_4 K_2		0.085	0.085	0.085
D_4 K_3		0.128	0.128	0.128
S.E.(m) ±		0.016	0.014	0.015
C.D. at 5%		0.047	0.041	0.043

The pooled data informed that the lowest acidity (0.085%) was recorded in D_3 (1.5m x 1.8m spacing *i.e.* 3,703 plants/ha) which was at par (0.089%) with D_2 (1.5m x 1.5m spacing *i.e.* 4,444 plants/ha), the highest acidity (0.110%) was noted in D_1 (1.5m x 1.2m spacing *i.e.* 5,555 plants/ha). The effect of potassium levels on acidity in pooled was found to be non-significant. In the interaction effect the lowest acidity (0.064%) was equally recorded in three treatments D_2K_2 (1.5, x 1.5, at 200 g K_2O/plant) D_3K_3 (1.5m x 1.8m spacing *i.e.* 3,703 plants/ha at 300 g K_2O/plant), D_4K_1(1.5mx 2.1m at 100 g K_2O/plant), which was at par (0.0075%) with D_2K_3 (1.5m x 1.5m spacing *i.e.* 4,444 plants/ha at 300 g K_2O/plant) and then equally at par

(0.085%) with three treatments D_1K_2 (1.5m x 1.2m spacing *i.e.* 5,555 plants/ha at 200 g K_2O/plant)D_3K_1 (1.5m x 2.1m spacing *i.e.* 3,174 plants/ha at 100 g K_2O/plant) D_4K_2 (1.5m x 2.1m spacing *i.e.* 3,174 plants/ha at 200 g K_2O/plant)at a time and lastly at par (107%) with D_3K_2 (1.5m x 1.8m spacing *i.e.* 3,703 plants/ha at 200 g K_2O/plant). The highest acidity (0.128%) was recorded equally In three treatment D_1K_3 (1.5m x 1.2m spacing *i.e.* 5,555 plants/ha at 300 g K_2O/plant), D_2K_1 (1.5, x 1.5m at 100 g K_2O/plant) D_4K_3 (1.5m x 2.1m spacing *i.e.* 3,174 plants/ha at 300 g K_2O/plant) at a time and which is significantly at par (0.117%) with D_1K_1 (1.5m x 1.2m spacing *i.e.* 5,555 plants/ha at 100 g K_2O/plant).





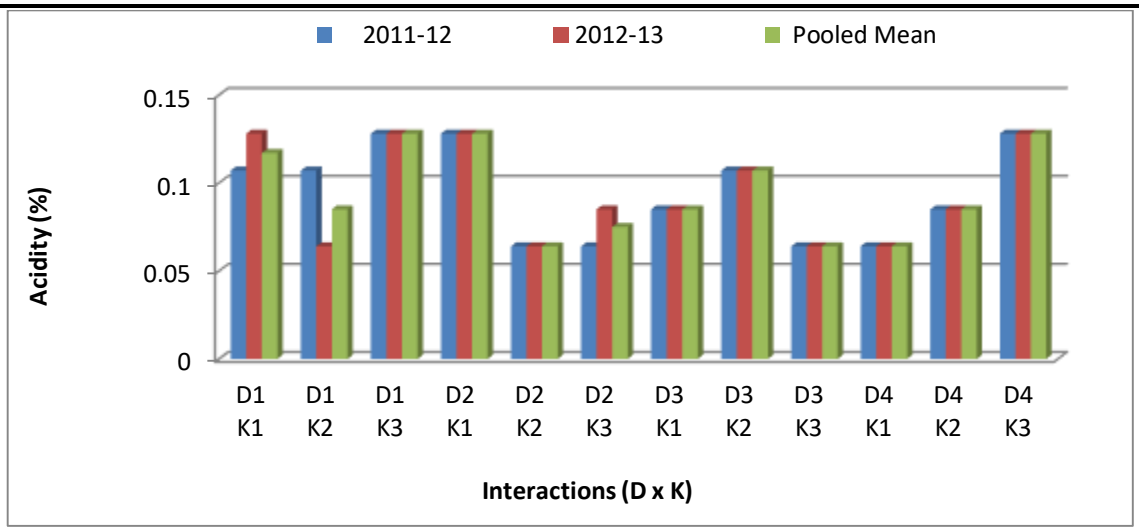


Fig. 01. Effect of plant densities and different levels of potassium on acidity (%) of banana cv. Ardhapuri

Discussion

The data in Table 53 revealed that the lowest acidity (0.085%) was recorded in D_3 (1.5 m x 1.8 m with 3,703 plants/ha) which was at par (0.089%) with D_2 (1.5 m x 1.5 m with 4,444 plants/ha), the highest acidity (0.110%) was noted in D_1 (1.5 m x 1.2 m with 5,555 plants/ha). The effect of potassium levels on acidity in pooled was found to be non-significant. In the interaction effect the lowest acidity (0.064%) was equally recorded in three treatments D_2K_2 (1.5, x 1.5, at 200 g K_2O/plant) D_3K_3 (1.5 m x 1.8 m with 3,703 plants/ha at 300 g K_2O/plant), D_4K_1(1.5mx 2.1m at 100 g K_2O/plant), which was at par (0.0075%) with D_2K_3 (1.5 m x 1.5 m with 4,444 plants/ha at 300 g K_2O/plant) and then equally at par (0.085%) with three treatments D_1K_2 (1.5 m x 1.2 m with 5,555 plants/ha at 200 g K_2O/plant)D_3K_1 (1.5 m x 2.1 m with 3,174 plants/ha at 100 g K_2O/plant) D_4K_2 (1.5 m x 2.1 m with 3,174 plants/ha at 200 g K_2O/plant)at a time and lastly at par (107%) with D_3K_2 (1.5 m x 1.8 m with 3,703 plants/ha at 200 g K_2O/plant). The highest acidity (0.128%) was recorded equally In three treatment D_1K_3 (1.5 m x 1.2 m with 5,555 plants/ha at 300 g K_2O/plant), D_2K_1 (1.5, x 1.5m at 100 g K_2O/plant) D_4K_3 (1.5 m x 2.1 m with 3,174 plants/ha at 300 g K_2O/plant) at a time and which is significantly at par (0.117%) with D_1K_1 (1.5 m x 1.2 m with 5,555 plants/ha at 100 g K_2O/plant).

. In case of quality attributes except pulp to peel ratio, higher values were observed in wider spacing because of maximum canopy of plant exposed to sunlight which resulting maximum photosynthesis and metabolic activities in the cell. This might be supported by application of potassium having role of promoting hormones for different metabolic activities leading to cell multiplication and cell elongation and greater amount of assimilates accumulated in the various organs of the plant which result in higher values of quality attributes. The highest plant populations produce more competition for soil moisture, nutrient and sunshine and also provide less space for individual plant. Chaudhari and Baruah (2010) recorded that the plant density exhibited a significant on quality of fruit in Banana cv. Jahaji (AAA). In that, recorded maximum T.S.S., reducing sugar, sugar acid ratio and titrable acidity was decreasing with increasing plant density.

Similar findings were reported by Athani S.I. and N.C. Hulamani (2000), Nalina *et al*. (2003).

Summery and Conclusion:

From the results obtained in the present investigation, it can be revealed that the lowest acidity (0.085%) was recorded in D_3 1.5 m x 1.8 m (3,703 plants/ha) which was at par (0.089%) with D_2 1.5 m x 1.5 m (4,444 plants/ha), the highest acidity (0.110%) was noted in D_1 1.5 m x 1.2 m (5,555 plants/ha). The effect of potassium levels on acidity in pooled was found to be non-significant. In the interaction effect the lowest acidity (0.064%) was equally recorded in three treatments D_2K_2 (1.5, x 1.5, at 200 g K_2O/plant) D_3K_3 (1.5 m x 1.8 mm at 300 g K_2O/plant), D_4K_1(1.5mx 2.1m at 100 g K_2O/plant), which was at par (0.0075%) with D_2K_3 (1.5 m x 1.5 mm at 300 g K_2O/plant) and then equally at par (0.085%) with three treatments D_1K_2 (1.5 m x 1.2 m at 200 g K_2O/plant)D_3K_1 (1.5 m x 2.1 m at 100 g K_2O/plant) D_4K_2 (1.5 m x 2.1 m at 200 g K_2O/plant)at a time and lastly at par (107%) with D_3K_2 (1.5 m x 1.8 mm at 200 g K_2O/plant). The highest acidity (0.128%) was recorded equally In three treatment D_1K_3 (1.5 m x 1.2 m at 300 g K_2O/plant), D_2K_1 (1.5, x 1.5m at 100 g K_2O/plant) D_4K_3 (1.5 m x 2.1 m at 300 g K_2O/plant) at a time and which is significantly at par (0.117%) with D_1K_1 (1.5 m x 1.2 m at 100 g K_2O/plant).

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