



INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

“A Study of Levels of Potassium and Plant Geometry on Yield per Hectare 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. 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 K₂ O/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 highest (67.79 t/ha) yield was recorded in treatment density D₄ 1.5 m x 2.1 m (3,174 plants/ha) while the density D₁ 1.5 m x 1.2 m (5,555 plants/ha) given the lowest (59.81 t /ha) yield. In potassium levels, the highest yield (69.39 t/ha) was recorded in potassium level K₃ (300 g K₂O/plant), while the potassium level K₁ (100 g K₂O/plant) noted the lowest (58.21t/ha) yield. The effect plant densities and potassium levels informs that, the highest yield (73.16 t/ha) was recorded on treatment D₄K₃ (1.5 m x 2.1 m at 300 K₂O/plant), which was followed (63.42 t/ha) by treatment D₂K₂ (1.5 m x 1.5 mm 200 g K₂O/plant).The treatment D₁K₁(1.5 m x 1.2 m 100 4 K₂O/plant)given the lowest (53.97 t/ha) yield, which was followed (56.01 ts/ha) by D₂K₁(1.5 m x 1.5 mm at 100 g K₂O/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:

First of all bunch weight was recorded and then multiplied by number of plants per plot. Thus yield in t/ha was calculated.

Details of Experiment:

- | | | |
|-------------------------------------|---|------------------------|
| a) Name of crop | : | Banana |
| b) Botanical Name | : | <i>Musa</i> 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 | : | Ardhपुरi |
| j) Season | : | 2011-12 and 2012-13 |
| k) Fertilizers | : | As per mentioned later |

Treat. Symbol. 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) |

RESULTS:

Yield per Hectare (t/ha)

The data on effect of plant densities and potassium levels and their interaction effect on yield during 2011-12, 2012-13 and in pooled is statically significant.

During 2011-12, the plant density D₄ (1.5m x 2.1m spacing *i.e.* 3,174 plants/ha) recorded the significantly highest yield (69.48 t/ha), while the density D₁ (1.5m x 1.2m spacing *i.e.* 5,555 plants/ha) gave the lowest yield (59.84 t/ha). The potassium level, K₃ (300 g K₂O/plant) was recorded the highest yield (71.22 t/ha), while the potassium level, K₁ (100 g K₂O/plant) noted the lowest (59.24 t/ha) yield. The interaction effect of plant densities and potassium levels gave information that the highest (75.65t/ha) yield was molded in treatment D₄K₃ (1.5m x 2.1m spacing *i.e.* 3,174 plants/ha 300 g K₂O/plant), while the treatment D₁K₁ (1.5m x 1.2m spacing *i.e.* 5,555 plants/ha with 100 g K₂O/plant) had gave the lowest (52.12t/ha) yield, which was par (58.74 t/ha) with D₂K₁ (1.5m x 1.5m spacing *i.e.* 4,444 plants/ha 100 K₂O/ plant)

During 2012-13, the significantly highest yield (66.11 t/ha) was recorded in density D₄ (15m x 2.1m), while the density D₁ (1.5m x 1.2m spacing *i.e.* 5,555 plants/ha) noted the lowest (59.79 t/ha) yield. In potassium levels, the K₃ (300 g K₂O/plant) had recorded the significantly highest (65.55 t/ha) yield, while the lowest yield (57.17 t/ha) was noted in potassium level K₁ (100 g K₂O/plant). The interaction effects of plant densities and levels of potassium gives information, that the treatment combination D₄K₃ (1.5, x 2.1m with 300 g K₂O/plant) recorded the highest (70.68 t/ha) yield , while this yield was followed (67.72 t/ha) by treatment D₂K₃ (1.5m x 1.5m spacing *i.e.* 4,444 plants/ha with 300 g K₂O/plant).The treatment D₂K₁ (1.5m x 1.5m spacing *i.e.* 4,444 plants/ha with 100 g K₂O/plant) noted the lowest (53.29 t/ha) yield, which was followed (55.82 t/ha) by the treatment D₁K₁ (1.5m x 1.2m spacing *i.e.* 5,555 plants/ha with 100 g K₂O/plant) The data in pooled showed that, that the significantly highest (67.79 t/ha) yield was recorded in treatment density D₄ (1.5m x 2.1m spacing *i.e.* 3,174 plants/ha) while the density D₁ (1.5m x 1.2m spacing *i.e.* 5,555 plants/ha) gave the lowest (59.81 t/ha) yield . In potassium levels, the significantly highest yield (69.39 t/ha) was recorded in potassium level K₃ (300 g K₂O/plant), while the potassium level K₁(100 g K₂O/plant) noted the lowest (58.21 t/ha) yield. The effect of plant densities and potassium levels informs that, the significantly highest yield (73.16 t/ha) was recorded by treatment D₄K₃ (1.5m x 2.1m spacing *i.e.* 3,174 plants/ha with 300 K₂O/plant), which was followed (63.42 t/ha) by treatment D₂K₂ (1.5m x 1.5m spacing *i.e.* 4,444 plants/ha with 200 g K₂O/plant).The treatment D₁K₁ (1.5m x 1.2m spacing *i.e.* 5,5055 plants/ha

Table 01. Effect of plant densities and different levels of potassium on yield per hectare (t/ha) of banana cv. Ardhapuri

Treatments		Yield per hectare (t/ha)		
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	59.84	59.79	59.81
D ₂ (1.5 x 1.5)	4,444	64.76	61.29	63.02
D ₃ (1.5 x 1.8)	3,703	66.49	63.89	65.19
D ₄ (1.5 x 2.1)	3,174	69.48	66.11	67.79
S.E.(m) ±		0.051	0.047	0.05
C.D. at 5%		0.176	0.162	0.15
Sub-treatment (Potassium levels) (K)				
K ₁ (100 g K ₂ O/plant)		59.24	57.17	58.21
K ₂ (200 g K ₂ O/plant)		64.96	63.58	64.27
K ₃ (300 g K ₂ O/plant)		71.22	67.55	69.39
S.E.(m) ±		0.063	0.058	0.060
C.D. at 5%		0.188	0.172	0.173
Interaction (D x K)				
D ₁ K ₁		52.12	55.82	53.97
D ₁ K ₂		59.81	59.33	59.57
D ₁ K ₃		67.58	64.21	65.90
D ₂ K ₁		58.74	53.29	56.01
D ₂ K ₂		63.99	62.85	63.42
D ₂ K ₃		71.55	67.72	69.64
D ₃ K ₁		62.09	59.57	60.83
D ₃ K ₂		67.27	64.49	65.88
D ₃ K ₃		70.11	67.60	68.86
D ₄ K ₁		64.01	60.02	62.02
D ₄ K ₂		68.77	67.64	68.21
D ₄ K ₃		75.65	70.68	73.16
S.E.(m) ±		0.125	0.115	0.120
C.D. at 5%		0.376	0.345	0.347

with 100 g K₂O/plant) given the lowest (53.97 t/ha) yield, which was followed (56.01 t/ha) by D₂K₁ (1.5m x 1.5m spacing i.e. 4,444 plants/ha with 100 g K₂O/plant).

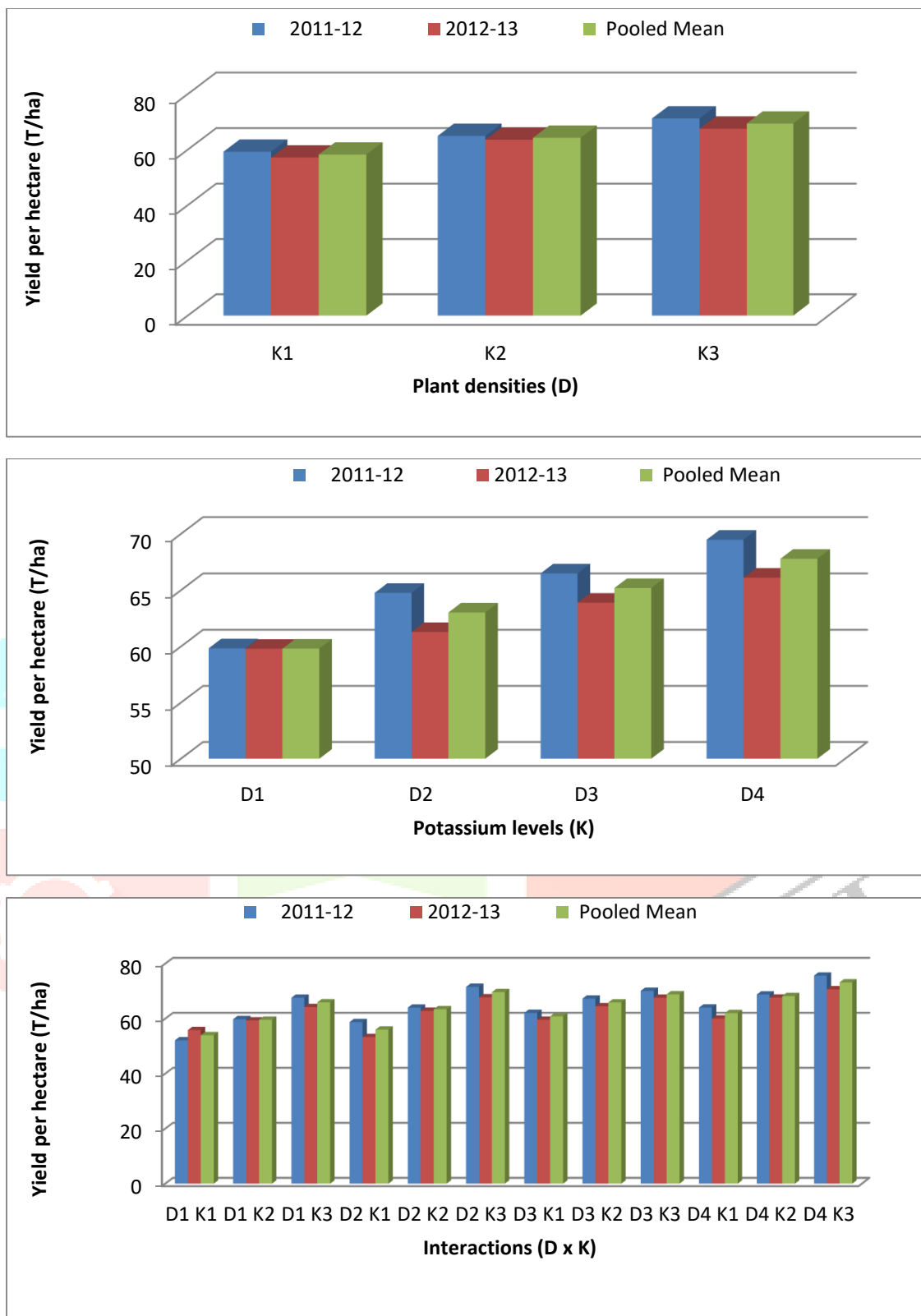


Fig. 01. Effect of plant densities and different levels of potassium on yield per hectare (t/ha) of banana cv. Ardhapuri

Discussion:

The data in Table 01.revealed that the highest (67.79 t/ha) yield was recorded in treatment density D₄ (1.5 m x 2.1 m with 3,174 plants/ha) while the density D₁ (1.5 m x 1.2 m with 5,555 plants/ha) gave the lowest (59.81 t/ha) yield. In potassium levels, the highest yield (69.39 t/ha) was recorded in potassium level K₃ (300 g K₂O/plant), while the potassium level K₁ (100 g K₂O/plant) noted the lowest (58.21 t/ha) yield. The effect plant densities and potassium levels informs that, the highest yield (73.16 t/ha) was recorded on treatment D₄K₃ (1.5 m x 2.1 m with 3,174 plants/ha at 300 K₂O/plant), which was followed (63.42 t/ha) by treatment D₂K₂ (1.5 m x 1.5 m with 4,444 plants/ha 200 g K₂O/plant).The /ha 100 4 K₂O/plant)gave the lowest (53.97 t/ha) yield, which was followed (56.01 t/ha) by D₂K₁(1.5 m x 1.5 m with 4,444 plants/ha at 100 g K₂O/plant).

In above experiment, the highest yield was recorded in the wider spacing, it might be due to morphological traits, maximum interception of light by enhanced canopy which results in maximum photosynthesis and metabolic activities in cell leading to increasing in vegetative as well as quality attributes; where there was wider spacing maximum leaf surface was exposed to sunlight and indirectly maximum amount of assimilates accumulated in the various organs of the plant. This might be supported by application of potassium having role of promoting hormones for different metabolic activities which resulting in cell multiplication and cell elongation which result in to obtaining maximum yield.

Similar result observed by Mustaffa (1988) reported that potassium application significantly influenced the banana yield and fruit quality with dose of 300 g k/plant there was significant increase in the number of fingers (123), bunch weight (114.6kg) and yield 18.98 t/ha.

Baruha and Sharma (2000) reported that highest yield/ha (82.00 t/ha) was observed in treatment 1.5m x 1.8 m) plant spacing compared with other spacing.This is in accordance with also Chattopadhyaya (1980)Similar findings were reported by Athani and Hulamani (1999), Abu Hasan *et al* (1999), Singh *et al* (1990), and Patel *et al.* (2000).

Summery and Conclusion:

The highest (67.79 t/ha) yield was recorded in treatment density D₄ 1.5 m x 2.1 m (3,174 plants/ha) while the density D₁ 1.5 m x 1.2 m (5,555 plants/ha) given the lowest (59.81 t /ha) yield. In potassium levels, the highest yield (69.39 t/ha) was recorded in potassium level K₃ (300 g K₂O/plant), while the potassium level K₁ (100 g K₂O/plant) noted the lowest (58.21t/ha) yield. The effect plant densities and potassium levels informs that, the highest yield (73.16 t/ha) was recorded on treatment D₄K₃ (1.5 m x 2.1 m at 300 K₂O/plant), which was followed (63.42 t/ha) by treatment D₂K₂ (1.5 m x 1.5 mm 200 g K₂O/plant).The treatment D₁K₁(1.5 m x 1.2 m 100 4 K₂O/plant)given the lowest (53.97 t/ha) yield, which was followed (56.01 ts/ha) by D₂K₁(1.5 m x 1.5 mm at 100 g K₂O/plant).

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