Research Article

Studies on the Response of Different Commercial Banana Cultivars of Andhra Pradesh to Organic Production

K Mamatha*[1], MM Naidu[2], R Nagalakshmi[1] and BVK Bhagavan[3]

[1]Horticultural Research Station, Kovvur, Dr YSRHU,Andhra Pradesh
[2]Horticultural Research Station, Darsi Dr YSRHU,Andhra Pradesh
[3]Horticultural Research Station, Ambajipet Dr YSRHU,Andhra Pradesh

Abstract

A field experiment was conducted at Horticultural Research station, Kovvur, Dr YSRHU Andhra Pradesh to study the response of different commercial banana cultivars of Andhra Pradesh to organic production. The experiment comprised of seven treatment combinations consisting of four varieties and seven nutrient doses. The results revealed that among all the treatment combinations application of recommended doses of fertilizers in the form of chemical fertilizers has recorded maximum number of fruits per bunch and yield per hectare. However, among the organic treatments, highest plant height (269.83cm) and maximum number of hands per bunch (7.77) was recorded with the application of Poultry manure + *Azospirillum* + AMF whereas, number of fruits per bunch (108.5), number of fruits per hand (13.79) bunch weight (17.37kg) and yield (34.75 tha^{-1}) was maximum with the application of Poultry manure + *Azospirillum* + Phosphobacteria.

Keywords: Banana Organic cultivation, Azospirillum, AMF, Phosphobacteria

***Correspondence**
Author: K Mamatha
Email: mamatha.kathimanda@gmail.com

Introduction

Banana (*Musa* sp.) is widely grown in India for its delicious dessert fruit with great socio-economic significance. India leads global banana production with a share of about 17.30 % [1]. In Andhra Pradesh, it is the third important fruit crop after mango and citrus, occupying 8% of the fruit growing area in the state. The total area under banana in India was 860 thousand ha and the average productivity in country was about 35.4 tonnes per ha. In Andhra Pradesh area under banana was 88165 ha and production of 4672745 metric tonnes with 53 tonnes per ha of productivity [2]. It is cultivated in diverse agro-climatic conditions of the state for its generally assured income. Hitherto, maximization of yield had been the prime objective and the intensity of cultivation demanded the use of inorganic fertilizers and pesticides. Production technology using chemical fertilizers was developed and is being widely followed. In the changing scenario this technology thought to be not so sustainable since the productivity of soils is deteriorating very fast due to continuous use of inorganics without any supplementation of organic manures. In recent years global awareness on health and environmental issues has been growing and sustainability has become the key word particularly in relation to agriculture in developing countries like India. Further the international community is becoming increasingly conscious and the government policies are encouraging organic forms of sustainable agriculture. Besides, organic farming will improve the soil health and reduce environmental pollution besides providing healthier and nutritionally superior food for humans. A wide scope for organic banana production exists in India and adopting a holistic organic banana production will enable India in having a big share in export trade. The benefits of different organic manures like farmyard manure [3, 4], poultry manure [5], vermicompost [6, 7] and neemcake [8] and biofertilizers like *Azospirillum* [9-11], Azotobacter [9, 12] and arbiscular mycorrhizal fungi (also known as VAM fungi) [7] application along with inorganic fertilizers were proved promising in banana. However, studies on exclusive application of different organic manures and biofertilizers and their effects on crop growth, yield and quality aspects are of prime concern in the present sceneario especially in the state like Andhra Pradesh where polyclonal cultivation of banana is very common. Hence, there is a need to develop a holistic and location specific organic banana production technology for the major commercial banana cultivars of the state. Development of organic banana production for all the commercial cultivars like Grand naine(AAA), Kovvur bontha (ABB), Karpura chakkerakeli (AAB) and Tella chakkerakeli (AAA) will enable the farmers to meet the growing demand for organic foods in the international market. With this view an experiment was conducted to study the response of different major commercial varieties of banana to organic system.

Material and Methods

Present investigation was carried out at Horticultural Research station, Kovvur, Dr YSR Horticultural University, west Godavari district. Andhra Pradesh which is located $17^0$00' N latitude, $81^0$43' E longitude and 15.66 m above mean sea level which receives an annual rainfall of 110 cm from south west and north eats monsoons and through summer showers. The soil is black alluvial with good drainage and the soil P^H is varying from 7.74 to 7.77 and EC 0.52 dsm^{-1}. The experiment was conducted in a plot where it is maintained completely as organic plot from the past fifteen years. The varieties under study were Kovvur bontha (ABB), a popular cooking variety of the state which occupies more that 90% of the area under cooking banana, Grand naine (AAA) a Cavendish type mostly grown for export purpose, Karpura chakkerakeli (AAB), a poovan group cultivar mostly grown in almost all the districts for table purpose and preferably used in auspicious occasions, and Tella chakkerakeli(AAA), which is grown mostly in alluvial soils and black cotton soils having high TSS and fetches premium price in the market but have very less yield and poor shelf life. The experiment was laid out in split plot design with seven treatment combinations replicated thrice and planted at a spacing of 2x2m. The treatment combinations are as follows

Fertilizers (F)

- Farmyard manure (9kg/plant) + *Azospirillum*(50g/plant) + AMF(50g/plant) (F1)
- Farmyard manure(9kg/plant)+*Azospirillum*(50g/plant)+Phosphobacteria (50g/plant) (F2)
- Poultry manure (8kg/plant) + *Azospirillum*(50g/plant) + AMF(50g/plant) (F3)
- Poultry manure (8kg/plant) + *Azospirillum* (50g/plant) + Phospho bacteria (50g/plant) (F4)
- Vermi compost (10kg/plant) + *Azospirillum* (50g/plant) + AMF(50g/plant) (F5)
- Vermi compost (10kg/plant) +*Azospirillum*(50g/plant) + Phosphobacteria (50g/plant) (F6)
- Recommended (conventional) package of practices (inorganic fertilizers (200 g N: 50 g P_2O_5: 200 g K_2O) (F7)

Cultivars (V)

- Kovvur Bontha (V1)
- Grand naine(V2)
- Karpura Chakkerakeli (V3)
- Tella Chakkerakeli (V4)

Results and Discussion

The data pertaining to plant height indicated that the nitrogen application through poultry manure along with the application of azospirillum and arbuscular michorhizal fungi has shown maximum plant height (353.33cm, 223, 67cm and 265, 33 cm) of the varieties Kovvur bontha, grand naine and Karpura chakkerakeli respectively where as in tellachakkerakeli variety, the maximum plant height (250.0cm) was recorded with the application of recommended dose of chemical fertilizers. The interaction effects also revealed that maximum plant height (353.33cm) was observed in Kovvur bontha with the application of Poultry manure (8 kg/Pl) + Azospirillum (50g/pl) + AMF(50 g/pl). Similarly, pseudostem girth was maximum (60.65cm, 59.0 cm and 52.5cm) in varieties Kovvur bontha, KC keli and Grand naine with the application of Poultry manure (8 kg/pl) + Azospirillum (50g/pl) + Phosphobacteria (50 g/pl). Number of green leaves at shooting is an important criterion which reflects in bunch filling and yield in banana. There was a significant difference among the varieties and manures with respect to number of green leaves at shooting. Maximum number of green leaves at shooting (15,15 and 12) was observed in the varieties Kovvur bontha, Grand naine and KC keli respectively with the application of Poultry manure (8 kg/pl) +Azospirillum (50g/pl) + AMF(50 g/pl). Whereas in Tella chekkerakeli number of green leaves was high with the application of recommended doses of chemical fertilizers.

The data on yield parameters indicated that number of fruits per bunch was highest in Kovvur bontha with the application of Poultry manure (8 kg/Pl) + Azospirillum (50g/pl) + AMF(50 g/pl),whereas, in Grand naine and KC keli maximum number of fruits per bunch was observed with the application of Poultry manure(8 kg/pl) + Azospirillum (50g/pl) Phosphobacteria (50g/pl). However in Tellachakkerakeli maximum number of fruits was recorded with the application of recommended doses of chemical fertilizers. With regard to bunch weight and yield among the varieties, maximum bunch weight and yield (19.74kg and 39.49t/ha respectively)was recorded in Kovvur bontha and among the fertilizers recommended doses of chemical fertilizers has recorded maximum bunch weight and yield (18.30kg

and 36.61 t/ha respectively).How ever among the organic treatments maximum bunch weight and yield (17.37 kg and 34.75 t/ha respectively) was recorded with the application of Poultry manure(8 kg/pl) + Azospirillum (50g/pl) Phosphobacteria (50g/pl). The interaction effects revealed that the varietal response to organic manures and bio fertilizers differed significantly. Maximum bunch weight and yield (22.0kg and 44 t/ha respectively) was recorded in Kovvur bontha with the application of poultry manure(8 kg/pl) +Azospirillum (50g/pl) +AMF(50g/pl) whereas, in Grand naine (AAA) maximum yield was recorded with the application of poultry manure (8kg/pl) + Azospirillum (50g/pl) + Phosphopacteria(50g/pl). However, in Karpura chakkerakeli (AAB) and Tella chakkerakeli (AAA) maximum yield was recorded with the application of chemical fertilizers. Inoculation of Azospirillum in combnation with the nitrogenous fertilizer positively influenced the growth and yield characters of banan cv Poovan [13].

The study revealed that among the manures, plants added with poultry manure showed higher level in all the parameters than those plants treated with other manures. This could be attributed by higher level of available Phosphorus and potassium content of poultry manure [14]. As manure of animals and other origin is a slow-release fertilizer and valuable source of crop nutrients and organic matter which can improve soil biophysical conditions thereby making the soil more productive and sustainable for food production [15]. Poultry manure also contains useful soil nutrients that are needed for the growth of plants, but their composition is in the crude form that is released slowly to the soil [16].

Table 1. Plant height at shooting (cm)

Treatments	**Varieties**				**Mean**
	V1	**V2**	**V3**	**V4**	
F1	355.00	223.67	229.83	239.62	**261.92**
F2	330.00	199.00	241.67	231.00	**250.42**
F3	353.33	222.33	265.33	238.33	**269.83**
F4	295.67	210.33.	244.00	233.00	**245.75**
F5	333.00	210.67	251.67	246.67	**260.75**
F6	342.33	209.33	247.67	244.0	**260.83**
F7	317.33	218.33	219.67	250.00	**251.33**
Mean	**332.38**	**213.38**	**242.76**	**240.52**	
	SEM CD				
Varieties(A)	2.4 7.8				
Fertilizers(B)	3.6 10.3				
Interaction(AxB)	2.9 20.6				

Table 2. Pseudo stem girth at shooting (cm)

Treatments	**Varieties**				**Mean**
	V1	**V2**	**V3**	**V4**	
F1	58.66	58.5	48.33	44.0	**53.37**
F2	58.33	51.73	49.33	50.5	**53.37**
F3	58.16	59.00	50.66	46.0	**53.45**
F4	60.66	53.66	49.66	50.33	**53.58**
F5	58.66	53.66	48.0	50.33	**52.66**
F6	58.50	54.66	52.5	50.0	**53.91**
F7	55.83	54.50	47.0	51.0	**53.33**
Mean	**58.40**	**55.76**	**49.35**	**48.88**	
	SEM CD				
Varieties(A)	0.39 1.12				
Fertilizers(B)	0.52 1.48				
Interaction(AxB)	1.05 2.97				

Table 3. Green leaves at shooting

Treatments	Varieties				Mean
	V1	V2	V3	V4	
F1	15.0	14.5	12	11	**13.12**
F2	13.38	14.1	12	12	**13.0**
F3	14.83	15.0	11.6	9.5	**12.75**
F4	13.00	15.0	12.3	11.0	**12.83**
F5	12.16	14.83	12.6	10.83	**12.62**
F6	14.0	14.83	12.6	10.5	**13.0**
F7	12.16	15.0	11.0	13.00	**12.79**
Mean	**13.57**	**14.76**	**12.04**	**11.11**	
	SEM CD				
Varieties(A)	0.17 0.30				
Fertilizers(B)	0.23 0.67				
Interaction(AxB)	0.47 1.34				

Table 4. No of fruits per bunch

Treatments	Varieties				Mean
	V1	V2	V3	V4	
F1	62.00	125.00	140.00	65.00	98.00
F2	65.00	135.00	145.00	70.33	103.83
F3	70.00	135.00	140.00	71.66	104.16
F4	69.00	145.00	148.00	72.00	108.50
F5	58.00	136.00	141.00	70.33	101.33
F6	56.33	135.00	145.00	75.33	102.91
F7	71.00	142.00	154.66	87.33	113.91
Mean	**64.47**	**136.23**	**144.80**	**73.14**	
	SEM CD				
Varieties(A)	0.68 1.41				
Fertilizers(B)	0.90 1.86				
Interaction(AxB)	1.81 3.73				

Table 5. Bunch weight (kg)

Treatments	Varieties				Mean
	V1	V2	V3	V4	
F1	17.00	16.00	15.00	7.00	13.75
F2	18.16	17.20	15.00	7.00	14.34
F3	22.00	19.40	18.00	6.16	16.37
F4	21.00	20.50	18.00	10.00	17.37
F5	19.00	18.00	19.00	6.00	15.50
F6	20.00	17.10	16.00	7.80	15.25
F7	21.06	20.16	20.16	11.83	18.30
Mean	**19.74**	**18.33**	**17.31**	**7.96**	
	SEm± CD				
Varieties(A)	0.10 0.29				
Fertilizers(B)	0.13 0.39				
Interaction(AxB)	0.27 0.78				

Table 6. Yield (t/ha)

Treatments	Varieties				Mean
	V1	V2	V3	V4	
F1	34.00	32.00	30.00	14.00	27.50
F2	36.33	34.40	30.00	14.00	28.68
F3	44.00	38.80	36.00	12.20	32.75
F4	42.00	41.00	36.00	20.00	34.75
F5	38.00	36.00	38.00	12.00	31.00
F6	40.00	34.20	32.00	15.26	30.36
F7	42.13	40.33	40.33	23.66	36.61
Mean	**39.49**	**36.67**	**34.61**	**15.87**	
	SEM	**CD**			
Varieties(A)	0.29	0.60			
Fertilizers(B)	0.39	0.80			
Interaction(AxB)	0.78	1.60			

In the present study poultry manure might have played a vital role by acting as a store room for cation exchange capacity and buffering agent against undesirable pH fluctuations [17]. Banana is a long duration crop (11-12 months) and requires adequate nutrition at different stages. The poultry manure releases the nutrients especially K slowly into the soil throughout the crop growth period which might have resulted in increased yield in the treatments combined with poultry manure in different varieties of banana.

Conclusions

Banana is a heavy feeder and hence requires adequate fertilizer for growth and yield. Although chemical fertilizers have been claimed as the most important contributor to the increase in productivity the negative effects of chemical fertilizer on the soil and environment limit its usage in sustainable agricultural system. In the present study it can be concluded that in the varieties Kovvur Bontha (ABB) and Grand naine (AAA) the chemical fertilizers can successfully be substituted with organic manures.

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