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STUDIES ON INTEGRATED NUTRIENT MANAGEMENT FOR TISSUE CULTURED GRAND NAINE BANANA

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ABSTRACT

A field experiment was conducted during 2002 to 2005 for one plant and two ratoon crops to find out the suitable combination of organic, inorganic and biofertilizers for tissue cultured Grand Naine banana with drip irrigation on medium black soil. Use of organic manure alone was not found beneficial as compared to integrated nutrient management for getting maximum yield. Application of 100 % recommended dose of NPK with 10 kg FYM per plant and biofertilizers (*Azosprillum* and PSB @ 25 g per plant each) were found beneficial in terms of banana yield and monetory returns, which was followed by application of 50 % NPK through organic (i.e. FYM + Green manure) and 50 % NPK through inorganic and biofertilizers.

Key words : Banana, Grand Naine, Integrated nutrient management, Tissue cultured.

INTRODUCTION

Integrated nutrient management (INM) found to be beneficial for maintenance of soil fertility and plant nutrient supply to an optimum level, for sustaining desired crop productivity through optimization of benefits from all possible sources of plant nutrients in an integrated manner. The basic principle of INM is the maintenance of soil fertility, sustainable agricultural productivity and improving farmers profitability through judicious and efficient use of chemical fertilizers, organic manure, green manure, bio-fertilizers, etc. Conjunctive use of FYM with recommended levels of inorganic fertilizers improves the soil fertility with increased yield of the crop. The availability of FYM in adequate quantities for integrated and conjunctive use with inorganic fertilizers to meet the requirement of the banana is a major limitation. However, there is scope for supplementing FYM with green manuring crops, vermicompost, bio-fertilizers, etc.

Grand Naine is a popular variety grown mostly in all export oriented countries of Asia, South America and Africa. This is a superior selection of Giant Cavendish which was introduced to India in 1990's. Due to many desirable traits like excellent fruit quality, immunity to *fusarium* wilt etc, it has proved better variety (Singh and Chundawat, 2002). However, its requirement of nutrients through organic sources along with inorganic fertilizers is not well documented. Keeping these aspects in mind, the present investigation was undertaken to find out the suitable combination of organic, inorganic and bio-fertilizers for tissue cultured Grand Naine banana with drip irrigation on medium black soil.

MATERIAL AND METHODS

The field experiment was conducted during 2002 to 2005 for one plant and two ratoon crops at Banana Research Station, Jalgaon. The crop was planted in *kharif* season for first year in randomized block design comprising of seven treatments replicated three times. Tissue cultured Grand Naine banana were used under drip irrigation system. Recommended fertilizer dose of 200:40:200 g of N, P_2O_5 and K_2O per plant was used. Out of 200 g N, ¾th N was applied in 4 equal splits in vegetative phase at 30, 75, 120 and 165 days after planting and remaining ¼ th N in 3 equal splits in reproductive phase at 210, 255 and 300 days after planting. Total quantity of phosphate was applied at the time of planting while potash was applied in 4 equal splits, at planting, 165, 265 and 300 days after planting. bio-fertilizers i.e. *Azospirillum* and PSB @ 25 g each per plant were amended in the soil at the time of planting. Same fertilizer schedule was adopted for two ratoon crops also. The soil of the experimental field was medium black, having pH 8.20, electrical conductivity (EC) 0.35 dS/m, low in organic carbon content (0.28 %), low in available nitrogen (210 kg/ha), moderate in available phosphorus (19.5 kg/ha) and very high in available potassium (620 kg/ha). Among the different organic sources used, the FYM contains 0.80 % N, 0.65 % P and 0.88 % K. Vermicompost contains 1.80 % N, 0.75 % P and 1.30 % K. Neem cake contains 4.80 % N, 1.00 % P and 1.45 % K. Treatment details was as follows,

1. 50% Recommended dose of NPK through organic source (FYM @ 15 kg/ plant + green manure (sunhemp) @ 25 t/ha) + 50% Recommended dose of NPK through inorganic source + bio-fertilizers.
2. 75% Recommended dose of NPK through organic source (FYM @ 15 kg/ plant + green manure @ 25 t/ha + neem cake @ 1.0 kg/plant) + 25% Recommended dose of NPK through inorganic source + bio-fertilizers.
3. 100 % Recommended dose of NPK through organic source (FYM @ 15 kg/ plant + green manure @ 25 t/ha + neem cake @ 2.0 kg/plant) + bio-fertilizers.
4. 50% Recommended dose of NPK through organic source (vermicompost @ 7.5 kg/plant + green manure @ 25 t/ ha) + 50% Recommended dose of NPK through inorganic source + bio-fertilizers.
5. 75% Recommended dose of NPK through organic source (vermicompost @ 7.5 kg/plant + green manure @ 25 t/ ha + neem cake @ 1.0 kg/plant)+ 25% Recommended dose of NPK through inorganic source + bio-fertilizers.
6. 100 % Recommended dose of NPK through organic source (vermicompost @ 7.5 kg/plant + green manure @ 25 t/ ha + neem cake @ 2.0 kg /plant + bio-fertilizers.
7. 100 % Recommended dose of NPK through Inorganic source + 10 kg FYM + bio-fertilizers

Soil samples were collected initially and after harvest of plant and ratoon crops. Dry and processed soil samples were used to determine chemical properties using standard procedures. Soil samples were analysed for pH and EC in 1:2.5 soil suspension ratio, organic carbon by Nelson and Sommers (1982). Available N by alkaline potassium permanganate method (Subbiah and Asija, 1956), available P as per method given by Olsen *et al.*(1954) and available K determined by flame photo metrically as described by Knudsen *et al.*(1982). Different organic

sources were analysed for their total NPK content by using methods given by Tondon (1993). Plant samples were analysed for total nutrient uptake as per methods given by Parkinson and Allen (1975).

RESULTS AND DISCUSSION

Growth and yield parameters : From the data given in the Table 1 and 2, it is revealed that, among the growth and yield parameters, maximum plant height (216.0 cm), girth of stem (70.92 cm), minimum days required to flower (258.5 days) and crop duration (356.9 days), maximum hands per bunch (9.47), fingers per bunch (167.7), weight of bunch (17.21 kg/plant) and yield (76.5 t/ha) were recorded with the treatment no. 7 i.e. application of 100 per cent recommended dose of NPK (200 g N, 40 g P_2O_5 and 200 g K_2O kg/plant) with 10 kg FYM / plant and bio-fertilizers. Tirkey *et.al.* (2002) also reported increased plant height, pseudostem girth, minimum days for harvesting, increased number of hands per bunch and bunch weight per plant due to use of organics in integrated manner with inorganic fertilizers. Sukhada Mohandas (1996) reported significant yield increase in banana by using PSB and *Azospirillum brasilense*. However, minimum plant height and stem girth, maximum days to flower and harvest, minimum hands per bunch, fingers per bunch, weight of bunch and yield were recorded in the treatments where 100 % nutrients were applied through organics only (i.e. treatment No. 3 and 6).

Soil chemical properties : The pH and electrical conductivity after harvest of banana were decreased slightly in the treatments where organics were used. However, organic carbon content and soil available N, P, K were maintained / improved in almost all treatments where organics were used (Table 3).

Nutrient uptake : In general, 6.67 to 6.95 kg N, 1.25 to 1.48 kg P and 13.79 to 14.40 kg K were required to produce one ton of banana. Uptake of NPK kg/ha and kg/ton was reduced as the percentage of inorganic fertilizers was

Table 1. Effect of integrated nutrient management on growth parameters of Grand Naine banana (Av. of 3 years)

Tr. No.	Treatments	Plant height (cm)	Stem girth (cm)	Days to flower	Days to harvest
T1	50% org (FYM + GM) + 50 % inorg + BF	212.1	69.24	266.1	367.9
T2	75 % org (FYM + GM + NC 1 kg) + 25 % inorg + BF	208.1	68.04	271.3	372.6
T3	100 % org (FYM + GM + NC 2 kg) + BF	205.3	64.02	282.3	391.8
T4	50 % org (VC+ GM) + 50 % inorg + BF	211.1	68.73	267.4	366.6
T5	75 % org (VC+ GM + NC 1 kg) + 25 % inorg + BF	208.3	67.20	272.2	374.4
T6	100 % org (VC+ GM + NC 2 kg) + BF	204.7	65.26	280.4	388.0
T7	100 % inorg + 10 kg FYM + BF	216.0	70.92	258.5	356.9
	SE ±	1.34	0.95	1.69	3.50
	CD at 5%	4.14	2.94	5.21	10.80

Table 2. Effect of integrated nutrient management on yield attributes of Grand Naine banana (Av. of 3 years)

Tr. No.	Treatments	Hands/ bunch	Fingers/ bunch	Bunch weight (kg)	Yield (t/ha)
T1	50% org (FYM + GM) + 50 % inorg + BF	9.03	154.7	16.18	71.9
T2	75 % org (FYM + GM + NC 1 kg) + 25 % inorg + BF	8.53	142.0	15.31	68.0
T3	100 % org (FYM + GM + NC 2 kg) + BF	7.80	113.0	13.63	60.6
T4	50 % org (VC+ GM) + 50 % inorg + BF	8.81	151.2	15.88	70.6
T5	75 % org (VC+ GM + NC 1 kg) + 25 % inorg + BF	8.30	136.6	15.04	66.8
T6	100 % org (VC+ GM + NC 2 kg) + BF	7.72	113.3	13.24	58.8
T7	100 % inorg + 10 kg FYM + BF	9.47	167.7	17.21	76.5
	SE ±	0.10	2.43	0.17	0.77
	CD at 5 %	0.32	7.50	0.53	2.36

Table 3. Effect of integrated nutrient management on soil chemical properties of Grand Naine banana (Av. of 3 years)

Tr. No.	Treatments	pH	EC (ds/m)	Org. C. (%)	Av. nutrients (kg/ha)		
					N	P_2O_5	K_2O
	Initial	*8.20*	*0.35*	*0.28*	*210*	*19.5*	*620*
T1	50% org (FYM + GM) + 50 % inorg + BF	8.13	0.34	0.32	211	21.6	619
T2	75 % org (FYM + GM + NC 1 kg) + 25 % inorg + BF	8.07	0.30	0.37	219	20.2	623
T3	100 % org (FYM + GM + NC 2 kg) + BF	7.98	0.26	0.49	231	19.4	631
T4	50 % org (VC+ GM) + 50 % inorg + BF	8.15	0.32	0.30	211	21.8	619
T5	75 % org (VC+ GM + NC 1 kg) + 25 % inorg + BF	8.06	0.29	0.34	219	20.4	623
T6	100 % org (VC+ GM + NC 2 kg) + BF	8.01	0.27	0.46	231	19.5	633
T7	100 % inorg + 10 kg FYM + BF	8.20	0.37	0.30	228	22.2	622
	SE ±	0.017	0.007	0.005	0.90	0.15	1.09
	CD at 5 %	0.054	0.002	0.016	2.77	0.46	3.37

reduced and percentage of organic was increased. Highest uptake kg/ha and kg/tons was obtained in the treatment where 100 % recommended dose of NPK with 10 kg FYM per plant and bio-fertilizers were applied (Table 4).

Table 4. Effect of integrated nutrient management on nutrient uptake by Grand Naine banana (Av. of 3 years)

Tr. No.	Treatments	Kg/ha			Kg/ton		
		N	P	K	N	P	K
T1	50% org (FYM + GM) + 50 % inorg + BF	486	97	1014	6.76	1.35	14.09
T2	75 % org (FYM + GM + NC 1 kg) + 25 % inorg + BF	456	86	945	6.69	1.26	13.87
T3	100 % org (FYM + GM + NC 2 kg) + BF	407	77	838	6.71	1.25	13.81
T4	50 % org (VC+ GM) + 50 % inorg + BF	474	93	984	6.70	1.32	13.92
T5	75 % org (VC+ GM + NC 1 kg) + 25 % inorg + BF	446	85	922	6.67	1.26	13.79
T6	100 % org (VC+ GM + NC 2 kg) + BF	399	75	819	6.78	1.27	13.91
T7	100 % inorg + 10 kg FYM + BF	531	113	1102	6.95	1.48	14.40
	SE ±	3.84	1.45	7.76	0.04	0.02	0.09
	CD at 5 %	11.83	4.48	23.93	0.12	0.08	0.28

Table 5. Monetary returns as influenced by INM (Av. of 3 yrs)

Treatments	Yield (t/ha)	Monetary Returns (Rs/ha)	Cost of FYM & Fert (Rs/ha)	Cost of Cultivation (Rs/ha)	Total cost (Rs/ha)	Net profit (Rs/ha)	B:C Ratio
50% org (FYM + GM) + 50 % inorg + BF	71.9	2,15,700	53,655	1,05,000	1,58,655	57,045	1.36
75 % org (FYM + GM + NC 1 kg) + 25 % inorg + BF	68.0	2,04,000	75,936	1,05,000	1,80,936	23,064	1.13
100 % org (FYM + GM + NC 2 kg) + BF	60.6	2,09,070	98,200	1,05,000	2,03,200	5,870	1.03
50 % org (VC+ GM) + 50 % inorg + BF	70.6	2,11,800	1,02,655	1,05,000	2,07,655	4,145	1.02
75 % org (VC+ GM + NC 1 kg) + 25 % inorg + BF	66.8	2,00,400	1,24,936	1,05,000	2,29,936	-29,536	0.87
100 % org (VC+ GM + NC 2 kg) + BF	58.8	2,02,860	1,47,200	1,05,000	2,52,200	-49,340	0.80
100 % inorg + 10 kg FYM + BF	76.5	2,29,500	49,910	1,05,000	1,54,910	74,590	1.48
SE ±	0.77	2217	–	–	–	–	0.014
CD at 5 %	2.36	6833	–	–	–	–	0.042

Cost of fertilizers and organics : N = Rs. 10/kg, P_2O_5 = Rs. 21/kg, K_2O = Rs. 7/kg, FYM = Rs. 500/ton, Vermicompost = Rs. 2500/ton, Green manuring = Rs. 1700/ha, Neem cake = Rs. 6000/ton, Cost of cultivation = Rs. 1,05,000/ha, Selling rate of banana = Rs. 3,000/ton, Organic banana = Rs. 3,450/ton

Economics of fertilizer use : Application of 100 % recommended dose of NPK with 10 kg FYM per plant and bio-fertilizers recorded highest yield 76.5 t/ha, monetary returns Rs. 2,29,500 per ha, net profit Rs. 74,590 per ha and B:C ratio 1.48, which was followed by use of 50 % NPK through FYM and green manure crop and 50 % NPK through inorganic source and bio-fertilizers (Table 5). Lowest B:C ratio recorded (0.70) in the treatment where 100 % organic were used through vermicompost and bio-fertilizers which may be due to high prevailing cost of vermicompost. Further, substitution of inorganics by organics resulted in increase in the cost and decrease in the yield of banana.

CONCLUSION

For tissue cultured Grand Naine banana under drip irrigation, use of organic manure alone was not found beneficial as compared to integrated nutrient management for getting maximum yield. Application of 100 % recommended dose of NPK with 10 kg FYM per plant and bio-fertilizers (*Azosprillum* and PSB @ 25 g per plant each at the time of planting) were found beneficial in terms of banana yield and monetary returns. This was followed by application of 50 % recommended dose of NPK through organics (i.e. FYM + green manure) and 50 % recommended dose of NPK through inorganics and bio-fertilizers.

REFERENCES

Knudsen, D., *et.al.* (1982) In : "Methods of Soil Analysis" Part-2. Chemical and Microbiological Properties. Agron. Monograph No.9. (Am.Soc.of Agron., Inc.Madison, Wisconsin, USA), : 225-238.

Nelson, D.W. and Sommers, L.E. (1982) In : "Methods of Soil Analysis" (Page A.L. ed.), II Amer. Soc.of Agron. Inc. and Soil Sci. of Amer.Inc. and Soil Sci. of Amer.Inc. Madison, Wisconsin, USA, : 559-577.

Olsen, S.R., et. al (1954) Estimation of Available Phosphorus in Soil by Extraction with Sodium Bicarbonate, *USDA Circular* : 939.

Parkinson, J.A. and Allen, S.E. (1975). *Commu. Soil Sci. Pl. Anal.,* **6:**1-11.

Singh, H.P. and Chundawat, B.S. (2002) Improved Technology of Banana. Ministry of Agriculture, Government of India. pp 1-46.

Subbiah, B.V. and Asija, G.L. (1956) *Curr. Sci.*, **25:**259-260.

Sukhada Mohandas (1996) In : Proc. Conference on Challenges for Banana Production and Utilization in 21st Century held in Trichy (India) on 24-25 September 1996. pp. 283-287.

Tondon, H.L.S. (ed). (1993) Methods of Analysis of Soils, Plants, Waters and Fertilizers. Fertilizers Development and Consultation Organization, New Delhi, India.

Tirkey T., *et al.* (2002) *South Indian Hort.,* **50(1-3):**19-24.