E-ISSN: 2663-1067
P-ISSN: 2663-1075
www.hortijournal.com
IJHFS 2025; 7(1): 06-09
Received: 06-11-2024
Accepted: 08-12-2024

RS Wankhade
Assistant Professor,
Agriculture Research Station,
Dr. PDKV, Achalpur,
Amravati, Maharashtra, India

YD Charjan
Associate Professor,
Agriculture Research Station,
Dr. PDKV, Achalpur,
Amravati, Maharashtra, India

Sonal Nage
SRA and JRA, Agriculture
Research Station, Dr. PDKV,
Achalpur, Amravati,
Maharashtra, India

PN Magare
SRA and JRA, Agriculture
Research Station, Dr. PDKV,
Achalpur, Amravati,
Maharashtra, India

AS Lawhale
SRA and JRA, Agriculture
Research Station, Dr. PDKV,
Achalpur, Amravati,
Maharashtra, India

Corresponding Author:
RS Wankhade
Assistant Professor,
Agriculture Research Station,
Dr. PDKV, Achalpur,
Amravati, Maharashtra, India

Fertigation studies in banana on vertisol of Vidarbha

RS Wankhade, YD Charjan, Sonal Nage, PN Magare and AS Lawhale

DOI: https://doi.org/10.33545/26631067.2025.v7.i1a.235

Abstract
A study was conducted during 2020-21 in randomized block design with four replication and five treatment which include four levels of fertigation (120, 100, 80 and 60 per cent RDF (200:40:200 NPK g/plant) and one soil application (200:40:200 NPK g/plant). The investigation indicated that, 120% RDF (240:48:240 NPK g/plant) recorded highest plant height (189.50 cm), stem girth (59.50 cm), number of leaves (23.50), number of fruits/ bunch (152.50), fruit weight (169.50 g), length and girth of fruit (20.00 and 12.98 cm), bunch weight (25.85 kg), yield (114.77 t/ha), maximum monetary returns (Rs 803390) and net profit (Rs 478794/ha) but at par with 100% RDF (200:40:200 NPK g/plant). Whereas maximum B:C ratio (2.48) found in 120% RDF (240:48:240 NPK g/plant) followed by 100% RDF (200:40:200 NPK g/plant) treatment (2.46). Considering yield, monetary returns, net profit and B:C ratio, application of 100% RDF (200:40:200 g/plant) at fortnight interval in 16 equal splits found beneficial in terms of tissue cultured cv. Grand Naine banana yield through fertigation.

Keywords: Fertigation, banana, water soluble fertilizers, Grand Naine, tissue cultured

Introduction
Banana is being cultivated in an area of 924 thousand hectares with total production of 33065 thousand MT across the country. In the last 5 years, the total area and production of banana in the country is steadily growing at a CAGR of around 1.05%. Madhya Pradesh has the highest productivity with 69.71 MT/Ha followed by Gujarat and Andhra Pradesh with 65.94 MT/Ha and 60.00 MT/Ha respectively. In terms of exports, India exported 232.65 thousand MT with value of 74089.99 Lakh Rupees during 2020-21 (Anon., 2021) [1].
Fertigation refers to the application of solid or liquid mineral fertilizers via pressurized irrigation systems, thus forming irrigation water containing nutrients (Magen, 1995) [10]. Increasing the efficiency of water and fertilizer can itself go a long way in realizing the growing demand for food and other plant products. These multiple requirements led to adoption of fertigation, which very much improves the nutrient uptake efficiency to an extent of 30-40 per cent, prevents soil degradation, and reduces the cost of fertilizer and application besides improving the productivity and quality of the produce. The fertigation results in saving water consumption to an extent of 40-70 per cent and fertilizer use to 25 percent.
Fertigation can save 20 to 30 per cent of fertilizers, besides improving the yield and quality as compared to the conventional methods of fertilizer application (Mustaffa and Kumar, 2012) [12]. Teixeira *et al.* (2011) [23] reported that fertigation resulted in 36 per cent higher nutrient use efficiency compared to conventional fertilization, for either nitrogen or potassium. Keeping this in view, a field experiment was carried out to standardize the fertigation in banana.

Materials and Methods
A field experiment was carried out during 2020-2021 at Agriculture Research Station, Achalpur under Dr. PDKV, Akola (Maharashtra) in randomized block design with four replication and five treatment which include four levels of fertigation (120, 100, 80 and 60 per cent RDF (RDF - 200:40:200 NPK g/plant)) and one soil application (200:40:200 NPK g/plant) level. In soil application, urea, single super phosphate and muriate of potash and through drip soluble fertilizer urea, mono ammonium phosphate (12:61:00) and MOP (white) were applied and common dose of 04 Kg FYM per plant in all treatment were applied. Soluble fertilizer were applied in 16 equal split at 15 days interval through drip whereas soil application treatment were applied at Urea in four split

(3 to 5 week after planting, second, third and fourth month, SSP and MOP at the time of planting. Banana were planted at 5 × 5 feet (4444 plant ha^{-1}). The region belongs to central Vidarbha zone of Maharashtra. Achalpur is located at 21° 18' N, 77° 30' to 77° 35' E longitude and an altitude of 375 meters above mean sea level. The experimental site pH of 7.91. The soil was fertile, with organic content (4.8 g/kg), low available nitrogen (237.00 kg/ha), low available phosphorous (16.90 P_2O_5 kg/ha) and high potassium (570.20 K_2O kg/ha). The statistical analysis of the data in respect of yield was done according to the standard procedure given by Panse and Sukhatme (1984) [16].

Results and Discussion

Growth parameters

The effect of different fertigation levels on plant height (cm), stem girth (cm) and number of leaves at harvest of banana is presented in Table 1. The different fertigation treatments had significant influence on plant height, stem girth (cm) and number of leaves at harvest as compared to control. Treatment 120% RDF (240:48:240 g/plant) was recorded highest plant height, stem girth and number of leaves (189.50 cm, 59.50 cm and 23.50) at harvest but this treatment was at par with 100% RDF (200:40:200g/plant). Pawar and Dingre (2013) [17] stated that the higher plant height, stem girth and greater leaf area is achieved with fertigation.

Yield parameters

Number of fruits per bunch, fruits weight, length of fruit, girth of fruit, bunch weight and fruit yield were significantly influenced by different fertigation levels (Table 1). Maximum number of fruits per bunch, fruits weight, length of fruit, girth of fruit, bunch weight and fruit yield were observed in 120% RDF (240:48:240g/plant) (152.50, 169.50 g, 20.00 cm, 12.98 cm, 25.85 kg and 114.77 t/ha respectively) followed by 100% RDF (200:40:200g/plant) (151.25, 165.75 g, 19.75 cm, 11.83 cm, 25.07 kg and 111.30 t/ha respectively) which were at par except girth of fruit.

Fertigation favoured the growth and development of bunches with better fruit filling resulting in increased length, girth, and weight of finger in banana (Mahalakshmi *et al*., 2001) [11]. Sufficient supply of nutrients like 120% RDF through fertigation (treatment T_1) in the present study could have increased the length, girth, and weight of finger than other treatments. Similar results were also obtained by Kumar *et al.*, (2012) [12], Pawar and Dingre (2013) [17], and Pramanik Patra (2015) [18].

Higher bunch weight was observed at higher levels of N and K by (Oubahou *et al.* 1987) [14]. They also reported that the maximum bunch weight was recorded in the plants treated with higher levels of N per plant, which might be due to higher uptake of N and K by the plants. The maximum yield was due to increase in length, girth, weight of the finger, number of fingers per hand and weight of the bunch in 120% RDF through fertigation. This might be due to the effect of direct application of fertilizers at the accurate time through the drip irrigation system to the area where most of the feeder root develop, results in an increased yield. Drip irrigation always holds the soil moisture and the water accessible to the plant constantly; it helped to improve fruit yield. The lower yield of banana recorded under lower levels of fertigation might be due to the slow growth of plant, small leaf size, delay in flower emergence, less number of hands and fingers per bunch (Hazarika and Mohan, 1991) [5]. Similar results were also obtained by Deolankar and Firake (2001) [4], Srinivas (2001) [22], Tumbare and Bhoite (2001) [24], Reddy *et al.* (2002) [19], Bhalerao *et al.*, (2010) [2], Bhattacharyya (2010) [8], Patel and Tandel (2013) [15], Pawar and Dingre (2013) [17], Naidu *et al.*, (2015) [13] and Senthilkumar *et al.*, (2016) [20].

Soil Properties

The non-significantly higher pH (7.95) recorded with fertigation- 120% RDF (240:48:240 g/plant) treatment followed by 100% RDF (200:40:200g/plant). Non-significantly maximum EC was found in control-soil application (0.37dSm^{-1}).

Significantly higher $CaCO_3$ percent (7.23) recorded with application of 120% RDF (240:48:240g/plant) followed by 100% RDF (200:40:200g/plant), 80% RDF (160:32:160 g/plant) and control which were at par with each other.

Organic carbon (%) was significantly superior with 120% RDF (240:48:240g/plant) (4.95 g/kg) followed by 100% RDF (200:40:200g/plant) and 80% RDF (160:32:160 g/plant) which were at par with each other. Similar result was also obtained by Bhalerao *et al.*, (2010) [2].

Nutrient availability in soil

The data regarding NPK availability in soil at the time of harvest is presented in Table 2. The maximum availability of NPK were observed in 120% RDF and decreased with decreased fertigation level. Whereas, soil application had Significantly higher available N content 249.00 kg/ha recorded with application of 120% RDF (240:48:240 g/plant) treatment followed by 100 and 80% RDF (245.00 kg/ha).

Available P content 20.95 and 19.10 kg/ha recorded with application of 120% RDF (240:48:240g/plant) followed by 100% RDF (200:40:200g/plant) respectively.

Highest available K 445.08 kg/ha and 422.24 kg/ha recorded with 120% RDF (240:48:240g/plant) followed by 100% RDF (200:40:200g/plant) treatment respectively.

The treatments *viz*., drip irrigation 1.00 EpR and 100% recommended dose of N and K through drip resulted in maximum available N (268.55 kg ha^{-1}, 299.43 kg ha^{-1}), P (73.46 kg ha^{-1}, 74.47 kg ha^{-1}) and K (85.81 kg ha^{-1}, 102.40 kg ha^{-1}) at shooting and harvesting stages respectively (Kotoky *et al.*, 2010) [8].

Nutrient uptake

Statistically higher total nitrogen, phosphorus and potassium uptake by banana (651.53, 111.78 and 929.31 kg/ha respectively) recorded with application of 120% RDF (240:48:240 g/plant) followed by 100% RDF (200:40:200g/plant) (598.13, 103.93 and 872.78 kg/ha respectively). Only phosphorus uptake was at par with 120% RDF and 100% RDF. According to Srinivas (1997), the total nutrient uptake (N, P and K) (leaf, stem and rhizome) increased with the increase in Nitrogen application above 100g $plant^{-1}$ through drip irrigation.

Economics

Application of 120% RDF (240:48:240 g/plant) recorded highest yield, monetary returns net profit and B:C ratio (114.77 t/ha, Rs. 803390/ha, Rs 478794/ha and 2.48 respectively) which were at par with 100% RDF (111.30 t/ha, Rs. 779100/ha, Rs 462599/ha and 2.46 respectively)

treatment. Kavino *et al.* (2004) [7] also obtained a higher B:C ratio of 3.32 and 2.65 in banana by fertigation using conventional fertilizers. These results are in conformity with Jane (2019) [6].

Table 1: Effect of different levels of fertigation on growth and yield attributes of banana Cv. Grand Naine

		Growth Parameters			Yield Parameters					
Tr. No.	**Treatments**	**Plant height (cm)**	**Stem girth (cm)**	**Number of leaves**	**Number of fruits per bunch**	**Fruit weight (g)**	**Length of fruit (cm)**	**Girth of fruit (cm)**	**Bunch weight (kg)**	**Fruit yield of banana (t/ha)**
T_1	Fertigation- 120% RDF (240:48:240g/plant)	189.50	59.50	23.50	152.50	169.50	20.00	12.98	25.85	114.77
T_2	Fertigation- 100% RDF (200:40:200g/plant)	188.75	58.75	23.25	151.25	165.75	19.75	11.83	25.07	111.30
T_3	Fertigation- 80% RDF (160:32:160g/plant)	181.00	54.75	21.75	144.50	161.25	18.00	10.73	23.30	103.46
T_4	Fertigation- 60% RDF (120:24:120g/plant)	178.25	52.75	21.50	141.00	160.00	17.75	10.38	22.56	100.17
T_5	Control – Soil Application (200:40:200g/plant)	176.75	51.50	20.50	140.50	156.25	16.00	10.25	21.96	97.49
	SEm ±	1.14	0.57	0.43	1.10	1.21	0.52	0.32	0.28	1.23
	C.D. 5%	3.51	1.76	1.31	3.40	3.74	1.60	0.10	0.85	3.78

Table 2: Effect of different levels of fertigation on soil properties, soil nutrient availability and uptake of nutrients at harvest of banana

Tr. No.	**Treatments**	**pH**	**EC (dSm^{-1})**	**$CaCO_3$ (%)**	**Organic Carbon (g/kg)**	**Av. N (kg/ha)**	**Av. P (kg/ha)**	**Av. K (kg/ha)**	**Total Nitrogen uptake by banana (kg/ha)**	**Total Phosphorus uptake by banana (kg/ha)**	**Total Potassium uptake by banana (kg/ha)**
	Initial	7.91	0.28	7.15	4.8	237.00	16.90	570.20			
T_1	Fertigation- 120% RDF (240:48:240g/plant)	7.95	0.35	7.23	4.95	249.00	20.95	445.08	651.53	111.78	929.31
T_2	Fertigation- 100% RDF (200:40:200g/plant)	7.94	0.35	7.22	4.93	245.00	19.10	422.24	598.13	103.93	872.78
T_3	Fertigation- 80% RDF (160:32:160g/plant)	7.94	0.34	7.20	4.92	243.00	17.90	417.20	539.10	91.48	783.13
T_4	Fertigation- 60% RDF (120:24:120g/plant)	7.92	0.33	7.18	4.90	240.00	17.00	408.80	506.42	81.04	742.51
T_5	Control – Soil Application (200:40:200g/plant)	7.95	0.37	7.17	4.87	247.00	18.10	370.49	510.27	82.52	774.83
	SEm ±	0.12	0.01	0.001	0.001	2.69	0.50	1.18	7.54	2.91	10.36
	C.D. 5%	NS	NS	0.003	0.043	8.28	1.54	3.62	23.22	8.95	31.84

Table 3: Effect of different levels of fertigation on economics of banana

Tr. No.	**Treatments**	**Yield (t/ha)**	**Monetary returns (Rs/ha)**	**Total Cost (Rs/ha)**	**Net Profit (Rs/ha)**	**B:C ratio**
T_1	Fertigation- 120% RDF (240:48:240g/plant)	114.77	803390	324596	478794	2.48
T_2	Fertigation- 100% RDF (200:40:200g/plant)	111.30	779100	316501	462599	2.46
T_3	Fertigation- 80% RDF (160:32:160g/plant)	103.46	724220	308406	415814	2.35
T_4	Fertigation- 60% RDF (120:24:120g/plant)	100.17	701190	300308	400882	2.33
T_5	Control – Soil Application (200:40:200g/plant)	97.49	682430	316501	365929	2.16
	SE m ±	1.23	8583.81		8583.82	
	C.D. 5%	3.78	26445.37		26445.37	

Banana fruit selling rate Rs/ton- 7000, Urea-Rs 5.92/kg, MAP (12:61:00)-Rs 100, MOP- Rs 17.00

Conclusion

Considering yield, monetary returns, net profit and B:C ratio, application of 100% RDF (200:40:200 g/plant) at fortnight interval in 16 equal splits found beneficial in terms of tissue cultured cv. Grand Naine banana yield through fertigation.

References

1. Anonymous. Horticultural statistics at a glance. Indian Horticulture Database, 2021, February 2021. DOI: http://www.nhb.gov.in.
2. Bhalerao VP, Pujari CV, Jagdhani AD, Mendhe AR. Performance of banana cv. Grand Naine under nitrogen and potassium fertigation. Asian J Soil Sci. 2010;4(2):220-224.
3. Bhattacharyya AK. Effect of drip irrigation and fertigation on yield and yield attributing characters of banana cv. Barjahaji (AAA). Adv Plant Sci. 2010;23(2):653-655.
4. Deolankar KP, Firake NN. Effect of water soluble fertilizers on growth and yield of banana. J Maharashtra Agril Univ. 2001;26(3):333-334.
5. Hazarika DN, Mohan NK. Effect of nitrogen on growth and yield of banana cv. Jahaji. The Hort J. 1991;4(1):5-10.
6. Jane Dhanashri G. Effect of fertigation on growth, yield and quality of banana. M.Sc. (Horti.) Thesis (Unpub.) Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, 2019.
7. Kavino M, Kumar N, Soorianatha Sundaram K,

Jeyakumar P. Effect of fertigation on the growth and development of first ratoon crop of banana cv. Robusta (AAA) under high density planting system. Indian J Hort. 2004;61:39-41.
8. Kotoky U, Khound A, Bhattacharyya RK, Devee A, Baruah M. Effect of irrigation and fertigation on soil parameters of banana cv. Barjahaji. Hort J. 2010;23(1):18-21.
9. Kumar D, Pandey V, Nath V. Growth, yield and quality of vegetable banana Monthan (Banthal-ABB) in relation to NPK fertigation. Indian J Hort. 2012;69(4):467-71.
10. Magen H. An overview of some practical aspects. Fert News. 1995;40:97-100.
11. Mahalakshmi M, Kumar N, Jayakumar P, Soorianathansundaram K. Fertigation studies in banana under normal system of planting. South Indian Hort. 2001;49(Spl):80-85.
12. Mustaffa MM, Kumar V. Banana production and productivity enhancement through spatial, water and nutrient management. J Hort Sci. 2012;7(1):1-28.
13. Naidu MM, Mamata K, Lakshmi NR, Bhagavan BVK, Rajashekaram T. Effect of plant density and fertigation on growth and productivity of banana cv. Martaman (AAB). J Agric Eng Food Technol. 2015;2(3):178-180.
14. Oubahou AA, Dafiri M, Ait-Oubahou A. Banana nitrogen and potassium nutrition. PHM Revue Horticole. 1987;276:48-49.
15. Patel UB, Tandel YN. Nitrogen management in banana (*Musa paradisiaca* L) cv. Basrai through drip under paired row system. Global J Sci Frontier Res. 2013;13(8):31-36.
16. Panse VG, Sukhatme PV. Statistical methods for agricultural workers. New Delhi: ICAR, 1984.
17. Pawar DD, Dingre SK. Influence of fertigation scheduling through drip on growth and yield of banana in western Maharashtra. Indian J Hort. 2013;70(2):200-205.
18. Pramanik S, Patra SK. Effect of drip vis-à-vis surface irrigation on fruit yield, nutrient uptake, water use efficiency and quality of banana in Gangetic plain of West Bengal. Indian J Hort. 2015;72(1):7-13.
19. Reddy BMC, Srinivas K, Padma P, Raghupathi HB. Response of Robusta banana to N and K fertigation. Indian J Hort. 2002;59(4):342-8.
20. Senthilkumar M, Ganesh S, Srinivas K, Panneerselvam P, Kasinath BL. Combining fertigation and consortium of biofertilizers for enhancing growth and yield of banana cv. Robusta (AAA). Indian J Hort. 2016;73(1):36-41.
21. Srinivas K, Raghupati HB. Nutrient partitioning in 'Neypoovan' banana under nitrogen fertigation. Indian J Hort. 1997;54(2).
22. Srinivas K, Reddy BMC, Kumar SSC, Gowda ST, Raghupati HB, Padma P. Growth, yield and nutrient uptake of Robusta banana in relation to N and K fertigation. Indian J Hort. 2001;58(4):287-293.
23. Teixeira LAJ, Quaggio JA, Mellis EV. Enhancing nutrient use efficiency in banana due to irrigation and fertigation. Rev Bras Frutic. 2011;33(1):272-278.
24. Tumbare AD, Bhoite SU. Optimization of liquid fertilizer for banana (*Musa acuminata*) under drip irrigation. Indian J Agric Sci. 2001;71(12):772-773.