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Nitrogen Management in Banana (*Musa Paradisica* L.) Cv. Basrai through Drip under Paired Row System

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Abstract - A field experiment was conducted under south Gujarat conditions at Fruit Research Station, Navsari Agricultural University, Gandevi, Dist. Navsari. The treatments comprised of three levels of nitrogen *viz*., 100, 150 and 200 g per plant and three methods of application *viz* ., 100, 75 and 50 per cent through drip and rest as soil application. In control, recommended dose of 200-90-200 g NPK per plant was applied fully in soil. The phosphorus (90 g plant^{-1}) along with 5 kg FYM per plant were applied at the time of planting, while potassium (200 g plant^{-1}) was applied in three equal splits as soil application at monthly interval from third month onward. The experiment thus included ten treatments, which were replicated four times. The trial was laid out in randomized block design. The banana was planted at 1.0m x 1.2 m x 2.0 m spacing with pair row method (6250 plants ha^{-1}). In the drip system, daily irrigation at 0.75 pan evaporation rate was followed; while in control plot, surface irrigation was given at 12-15 days interval in winter season and at 8-10 days interval in summer.

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Abstract - A field experiment was conducted under south Gujarat conditions at Fruit Research Station, Navsari Agricultural University, Gandevi, Dist. Navsari. The treatments comprised of three levels of nitrogen *viz.*, 100, 150 and 200 g per plant and three methods of application *viz.*, 100, 75 and 50 per cent through drip and rest as soil application. In control, recommended dose of 200-90-200 g NPK per plant was applied fully in soil. The phosphorus (90 g plant^{-1}) along with 5 kg FYM per plant were applied at the time of planting, while potassium (200 g plant^{-1}) was applied in three equal splits as soil application at monthly interval from third month onward. The experiment thus included ten treatments, which were replicated four times. The trial was laid out in randomized block design. The banana was planted at 1.0m x 1.2 m x 2.0 m spacing with pair row method (6250 plants ha^{-1}). In the drip system, daily irrigation at 0.75 pan evaporation rate was followed; while in control plot, surface irrigation was given at 12-15 days interval in winter season and at 8-10 days interval in summer.

Results revealed that the banana plants fertilized with different doses of nitrogen through drip as well as soil application in three different methods were significantly affected on vegetative growth, quality and yield of banana under pair row method of planting. The maximum (103.44 cm) plant height and circumference (43.93 cm) of the pseudostem were registered in the treatment of 150 g N per plant applied through drip only. The number of leaves and leaf area were not influenced by various levels of nitrogen. Early flowering and early maturity were noticed in treatment of 150 g N per plant applied through drip only, while the plants treated with lower and higher levels of nitrogen showed late flowering and late maturity.

Yield and yield attributing characters like bunch length (60.05 cm), number of hands per bunch (8.97), number of fingers per bunch (147.41) and bunch weight (19.60 kg plant^{-1}) were significantly higher in above treatments. Significantly the treatment of 150 g N per plant applied through drip gave highest (122.52 t ha^{-1}) banana fruit yield and net return (Rs. 390167 ha^{-1}) with computing higher (1: 14.78) cost benefit ratio among all the treatments during study.

Keywords : banana, nitrogen, fertigation, yield, economics.

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I. Introduction

One of the major hurdles in development of Indian agriculture is low fertilizer consumption and low fertilizer use efficiency. Day by day prices of fertilizers are kissing to the sky. So in today's perspective, it is essential, especially in crops like banana which are the heavy feeder of nutrients that we study and suggest to the farmers the most efficient method of fertilizer application with its efficient form and splitting to get maximum fertilizer use efficiency and net profit. In recent years, liquid fertilizers are used as a strong alternative to solid fertilizers. The major advantage of liquid fertilizers is that, they are completely soluble in water and can be applied through drip system with an ease, without any harm and in number of splits. The second strong point goes in favour of liquid fertilizer is that they contain major essential nutrients in readily available form. It ultimately increases the FUE by increasing the nutrient uptake and minimizing the losses. Therefore in recent years task before agricultural scientists is that, while suggesting drip method of irrigation to farmer, side by side they also should suggest proper planting technique, which will help in minimizing the system cost and allow mechanization of farming.

Banana and plantain to be the fourth most important global feed commodity after rice, wheat and milk in terms of the gross value of production, are of great socio-economic significance in India. Banana belongs to Musaceae family, its botanical name is *Musa paradisica* L. Banana ranks first in production and second in area among the fruits grown in India. Banana is a tropical mesophyte plant and requires an ample and frequent supply of water. Many previous workers have reported that water deficiency adversely affects the crop growth and yield (Samson, 1980 and Young *et al.*, 1985). Shmeuli (1953) quoted that 66 per cent soil available water as a critical level, below which banana growth and development suffered.

II. Materials and Methods

The field experiment entitled "Nitrogen management in banana (*Musa paradisica* L.) cv. Basrai through drip under pair row method of

planting" was conducted at the Fruit Research Station, Navsari Agricultural University, Gandevi (south Gujarat). The research station belongs to agro-climatic zone-I and agro-ecological situation-III. The experiment was laid out in a Randomized Block Design with ten treatments replicated four times. The treatments comprised of three levels of nitrogen *viz.*, 100, 150 and 200 g per plant. These levels of nitrogen were applied in three methods *viz.*, 100, 75 and 50 per cent through drip and the rest of nitrogen was applied in soil along with phosphorus and potassium as per recommended schedule. In control (T_{10}), total recommended dose 200-90-200 g NPK plant^{-1} was applied in soil.

T_1 100 g N through drip

T_2 75 g N through drip + 25 g N as soil application

T_3 50 g N through drip + 50 g N as soil application

T_4 150 g N through drip

T_5 112.5 g N through drip + 37.5 g N as soil application

T_6 75 g N through drip + 75 g N as soil application

T_7 200 g N through drip

T_8 150 g N through drip + 50 g N as soil application

T_9 100 g N through drip + 100 g N as soil application

T_{10} Control (Recommended 200 g N as soil application)

This experiment was framed out with a view to determine the optimum dose of nitrogen for banana under drip irrigation system, to obtain higher yield of better quality fruits by adopting pair row method of planting and to workout ultimate economics for saving water and fertilizers and its adaptability. Two years' pooled results of the experiment are summarized here.

III. Results and Discussion

The vegetative growth of banana plants like plant height and stem girth were significantly influenced while number of leaves and leaf area were not altered by the various levels of nitrogen applied through drip as well as in soil application (Table -1). The result indicates that the height and stem girth increased with the increase levels of nitrogen. The treatment of 150 g nitrogen per plant applied 100 per cent through drip recorded the highest plant height and stem girth while the lowest value were recorded under treatment 200 g N per plant totally applied in soil up to 180 days after planting (DAP) during study period. It was observed that the plants treated with 100 per cent nitrogen through drip increase the height and girth of the plant, it might be due to increase in formation and elongation of meristematic tissues since nitrogen is responsible for the formation, growth and development of the cells. The nitrogen applied in soil may be lost and less available to plant after longer period as compared to drip method. Under drip system, as the moisture availability and nitrogen levels were increased, stem girth was also increased. Similar results were also reported by Hegde and Srinivas (1991).

Days to flowering and harvest were significantly affected by the application of varying doses of nitrogen applied through drip either fully or partly to banana under high density plantation. The results revealed that the early flowering and harvest were noticed in the treatment T_4 (150 g N per plant applied through drip only) which was statistically at par with all treatments containing application of different levels of nitrogen through drip except control (total recommended dose 200-90-200 g NPK plant^{-1} was applied in soil). In the present investigation various levels of nitrogen were applied through the drip in liquid state after dissolving urea in water. The superiority of liquid fertilizers in advancing the flowering and that will leads to early harvesting over solid fertilizer in banana. The early maturity of banana obtained was in conformity with those reported by Hegde and Srinivas (1991) and Singh and Suryanarayana (1999).

Yield and yield contributing parameters were recorded the overall highest in the treatment with 150 g N per plant applied through drip during experimentation. Similar findings were observed by Srinivas (1977), while studying the effect of N, P and K fertilizers on banana cv. Basrai. Kohli *et al.* (1976) reported that the nitrogen application significantly influenced the fruit yield in all the three crops (plant crop, first ratoon and second ratoon) under closer spacing. Though the treatment T_4 (150 g N per plant) recorded the higher bunch length (60.06 cm) and bunch girth (106.43 cm), however the difference was non-significant. The highest (9.09) numbers of hands per bunch were recorded in the treatment T_7 where 200 g N per plant was applied through drip only. It was at par with T_4 (150 g N per plant). Similarly, higher numbers of fingers was also recorded in T_5 (148.24) and T_4 (147.41). The application of higher levels *i.e.* 200 g N per plant applied in soil registered lowest numbers of hands as well as number of fingers per bunch in banana cv. Basrai. Drip irrigated banana crop supplied with 50 per cent lesser quantity of fertilizer was found superior over the conventional

method as reported by previous workers Hegde and Srinivas (1991). In present investigation, the banana crop fertilized with 150 g N per plant through drip recorded significantly highest (122.52 t ha^{-1}) yield. This effect was obviously due to liquid form of nitrogen, which is in readily available form so as to increase uptake efficiency of plant. These results are in conformity with the previous work done by Arscott (1970).

IV. Economics

High density plantation in banana enabled to achieve higher yields. The trial was planted geometrically in pair row method at the spacing 1.0 m x 1.2 m x 2.0 m which accommodate 6250 plants per hectare. Further, the beneficial effect of drip irrigation was clearly reflected in yield with an application various levels of nitrogen to banana crop cv. Basrai. The nitrogen 100 per cent applied through drip proved its superiority in yield over rest of the other treatments. The treatment 150 g N per plant applied through drip only computed the highest net return Rs. 3,90,167 ha^{-1} with highest (1:14.78) cost benefit ratio. The nitrogen applied through drip was found beneficial, 25 per cent (50 g N per plant) N and 40 per cent irrigation saved and proportionately the yield and income increased were more as compared to cost under drip with pair row method of planting. Similar finding was reported by Hegde and Srinivas (1991).

V. Conclusion

It is clear from the study that the treatment T_4 (150 g N per plant applied through drip only) registered the maximum plant height and stem girth. It also resulted in early flowering and early maturity. The yield attributing characters like bunch length, number of hands per bunch, number of fingers per bunch, bunch weight per plant were also better under the same treatment. All these resulted into the production of maximum banana fruit yield (122.52 t ha^{-1}) under pair row planting method. The fruit quality parameters remained almost unaltered. Further, drip irrigation method saved 51 per cent water and 25 per cent nitrogen. Economically also it gave highest net profit (Rs. 3,90,167 ha^{-1}) with computing higher (1:14.78) cost benefit ratio during both the years of experimentation.

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Table 1 : Effect of different levels of nitrogen on growth, flowering and harvest of banana cv. Grand Nain

Treatments	Plant height (cm)		Stem girth (cm)		No. of leaves		Leaf area (sq. cm)		Days to flowering	Days to harvest
	180 DAP*	At shooting	180 DAP*	At shooting	180 DAP*	At shooting	180 DAP*	At shooting		
T_1	99.77	165.09	40.94	67.12	15.20	24.27	0.449	0.87	358.30	455.66
T_2	100.90	157.33	42.36	66.75	15.20	24.61	0.470	0.84	349.28	445.72
T_3	96.16	158.22	40.71	64.98	15.30	24.37	0.433	0.85	360.83	452.72
T_4	103.80	162.06	43.93	68.58	15.70	24.73	0.479	0.87	336.70	431.27
T_5	100.80	164.20	42.92	68.16	15.86	24.86	0.471	0.87	353.48	449.21
T_6	105.22	159.22	43.66	66.97	15.83	24.75	0.486	0.85	340.52	439.78
T_7	100.08	161.50	42.60	68.36	15.37	24.86	0.452	0.87	351.05	448.78
T_8	100.53	163.09	42.50	68.51	15.67	24.75	0.472	0.86	344.33	441.28

T_9	100.64	159.08	41.63	66.62	15.33	24.83	0.456	0.85	350.39	452.53
T_{10}	83.67	157.86	35.10	65.05	14.91	23.91	0.361	0.82	393.42	486.77
S.Em. ±	2.98	3.07	1.16	1.12	0.232	0.25	0.022	0.02	8.24	7.81
C.D.@5%	8.43	NS	3.27	NS	NS	NS	NS	NS	26.37	24.97
C.V. %	7.89	2.48	7.78	2.75	4.25	1.95	9.21	2.91	2.68	2.16

* Days after planting

Table 2 : Effect of different levels of nitrogen on yield and yield parameters of banana cv. Grand Nain

Treatments	Bunch length (cm)	Bunch girth (cm)	No. of hands/ bunch	No. of fingers/ bunch	Bunch weight/ plant	Finger length (cm)	Finger girth (cm)	Weight of finger (g)	Days taken for ripening	Yield (t/ha)
T_1	57.67	104.22	8.53	131.61	17.35	20.16	11.99	120.76	10.63	108.47
T_2	55.80	98.55	8.74	135.14	16.55	18.63	11.19	112.40	9.80	103.47
T_3	56.48	100.67	8.77	129.36	16.41	19.15	11.53	114.32	10.75	102.55
T_4	60.05	106.43	8.97	147.41	19.60	20.29	12.10	118.78	9.58	122.52
T_5	59.88	102.22	9.01	148.24	18.87	19.50	11.70	112.77	9.97	117.96
T_6	58.32	100.73	8.97	139.16	17.82	19.07	11.47	114.77	9.57	111.39
T_7	59.49	103.11	9.09	141.36	17.97	19.28	11.61	111.90	10.02	112.32
T_8	58.97	102.23	8.91	142.85	17.33	19.54	11.75	114.46	9.43	108.34
T_9	56.02	101.96	8.69	133.33	16.81	19.17	11.56	115.27	9.72	105.09
T_{10}	53.96	99.03	8.10	118.95	13.90	19.18	11.82	106.14	11.12	86.87
S.Em. ±	1.07	2.57	0.13	4.95	0.76	0.63	0.27	4.57	0.35	4.77
C.D.@5%	3.18	NS	0.37	15.83	2.44	NS	NS	NS	0.99	15.27
C.V. %	4.92	2.59	4.06	6.05	8.19	2.14	1.62	4.63	9.59	8.19

Table 3 : Effect of different levels of nitrogen on economics of banana cv. Grand Nain

Treatments	Expenditure on fertilizers (Rs.)	Yield (t ha^{-1})	Gross income (Rs. ha^{-1})	Net profit (Rs. ha^{-1})	Cost benefit ratio (CBR)
T_1	23884	108.47	368798	344914	1:14.44
T_2	23884	103.17	351798	327914	1:13.73
T_3	23884	102.55	348670	324786	1:13.60
T_4	26401	122.52	416568	390167	1:14.78
T_5	26401	117.96	401064	374663	1:14.19
T_6	26401	111.39	378726	352325	1:13.35
T_7	28919	112.32	381888	352969	1:12.21
T_8	28919	108.34	368356	339437	1:11.74
T_9	28919	105.09	357306	328387	1:11.36
T_{10}	28919	86.87	295358	266439	1:9.21

* Price of urea, SSP and MOP were considered Rs. 3.71, Rs. 3.07 and Rs. 3.88 kg^{-1}, respectively

* Market price of banana fruit was considered Rs. 3.40 kg^{-1} (Rs. 3400 t^{-1})

* As per recommendation, 90 g phosphorus and 200 g potash were applied as common in each treatment