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Different application methods of nutrients and plant growth regulators enhances yield and yield parameters of banana cv. Grand Naine

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Abstract
An investigation was carried out in banana cv. Grand Naine with aiming to improve the yield and yield related characters. The present investigation consists of foliar application and bunch feeding of nutrients (Banana special 0.5%, KH_2PO_4 0.5% and SOP 2%) and plant growth regulators (GA_3 50 ppm and Brassinosteroids 2 ppm) and their combinations. The foliar application of SOP 2% and BR 2 ppm significantly increased the weight of hand, girth of finger, length of finger, weight of finger of first hand and last hand and average yield per hectare.

Keywords: Bunch feeding, foliar spraying, sulphate of potash, brassinosteroids, banana special, potassium dihidrogen phosphate

Introduction
Banana plant is supplied with nutrients through soil, foliar spraying and post-shoot feeding of nutrients through the distal stalk end of rachis to achieve high yields (Anitha *et al.*, 2005) [1]. During fruit development, the plant nutrient status and uninhibited flow of nutrients to the developing bunch influence the bunch size and quality of fruits (Mulagund *et al.* 2015) [6]. Soil characters and environmental factors may cause considerable loss to the soil applied nutrients leading to insufficient supply of nutrient after shooting to meet the nutrient demand of developing bunch (Kumar and Kumar, 2009) [4]. Hence, bunch feeding or foliar feeding of nutrients provides a considerable scope not only for the effective utilization of nutrients but also to safeguard the economy of the farmer by improving the yield potential and quality of the produce (Sreekanth *et al.*, 2017) [8].

Material and Methods
The present investigation was carried out at Banana Research Station, Nanded during 2016 - 2017. Four plants per treatment were selected and each plant was performed with above treatments in factorial randomized block design with two replications. Two factors *i.e.* method of application (M) and nutrients/ plant growth regulators (N) were used. Two application methods (M_1 - foliar spraying and M_2- bunch feeding) were used. Different nutrients, plant growth regulators (N_1-banana special, N_2-sulphate of potash, N_3-KH_2PO_4, N_4-GA_3 and N_5-brassinosteroids), their combinations (N_6-banana special + GA_3, N_7- banana special + brassinosteroids, N_8-SOP + GA_3, N_9-SOP + brassinosteroids, N_{10}-KH_2PO_4 + GA_3, N_{11}-KH_2PO_4 + brassinosteroids and N_{12}- control) was used as second factor.
For the foliar spraying, the solution was prepared with water for the required strength of the spray. The first spray will be given after complete emergence of inflorescence and the second spray was given 30 days after first spray the entire plant canopy was sprayed including the developing bunches. The combination was mixed with "sandovit" at the rate of 1 ml per litre of water as a sticking agent.
Bunch Feeding (M_2) was done immediately after the fruit set or bunch formation and shedding of 7-8 flower petals (spathes), the male bud was denavelled at the stalk end of the bunch by cutting with knife at 60^0 in such way that about 15 cm long rachis/ stalk-end is available after the last hand of the bunch. The nutrient/PGR solution was placed in a plastic bag of 200 guage (15cm X 25cm) and tying the bag with strong thread such that about 8-10cm of the distal end of the rachis was immersed in the solution and remaining 8-10cm of the rachis is visible above the tied portion. The data obtained was analyzed statistically as per the method suggested by Gomez and Gomez (1984). The standard error of mean (S.Em.) was worked out and the critical difference (C.D.) at 5 per cent was calculated whenever the results were found significant.

Result and Discussion

Weight of Hand

Significantly maximum weight of hand (2.92 kg) was recorded in treatment M_1 (foliar application of nutrients and plant growth regulators) whereas minimum weight of hand (2.78 kg) was found in M_2 (bunch feeding).

The maximum weight of hand (3.09 kg) was recorded in treatment N_9 which was 30.38 per cent more as compared to control (2.37 kg). However, it was at par with N_8 (2.99 kg), N_{11} (2.99 kg), N_{10} (2.98 kg) and N_7 (2.97 kg) during the year 2016-17.

The maximum weight of hand (3.20 kg) was recorded in treatment combination of M_1N_9 *i.e.* foliar application of sulphate of potash (2%) + brassinosteroid (2 ppm) which was (36.75%) more as compared to control and minimum (2.34 kg,) was recorded in treatment combination of M_1N_{12}. Nutrients and plant growth regulators given as a foliar spray, the absorption of both SOP and brassinosteroid could have played a key role in assimilate partitioning and diversion to the rapidly developing hands. These results are in accordance with the findings of Mulagund *et al.*, 2015 [6].

Table 1: Effect of nutrients and plant growth regulators on weight of hand of banana

Nutrients/ PGRs	Methods of application		Mean
	M_1	M_2	
N_1	2.86	2.72	2.79
N_2	2.92	2.76	2.84
N_3	2.84	2.80	2.82
N_4	2.80	2.67	2.74
N_5	2.85	2.77	2.81
N_6	3.06	2.53	2.79
N_7	3.01	2.94	2.97
N_8	3.05	2.94	2.99
N9	3.20	2.99	3.09
N_{10}	3.01	2.94	2.98
N_{11}	3.04	2.94	2.99
N_{12}	2.34	2.39	2.37
	2.92	2.78	
(M) S.E N±	0.02		
C.D. at 5%	0.05		
(N) S.E N±	0.05		
C.D. at 5%	0.13		
(M X N) S.E N±	0.07		
C.D. at 5%	0.19		

Finger attributes

Girth of finger (cm)

Application methods do not show significant variations whereas nutrients, plant growth regulators and their interaction show significant variations. Significant variations with respect to finger girth of banana were observed, maximum finger girth (13.10 cm) was observed in treatment N_9 *i.e.* application of sulphate of potash (2%) + brassinosteroid (2 ppm) while minimum (10.99 cm) in N_{12}. The maximum finger girth (13.96 cm) was recorded in treatment combination M_1N_1 *i.e.* foliar application of Banana special (0.5%) which was statistically at par with treatment combination of M_1N_{11} (13.82 cm), M_2N_9 (13.43 cm), M_2N_6 (13.41 cm), M_1N_7 (13.14 cm), M_2N_4 (12.96 cm), M_2N_8 (12.95 cm), M_1N_8 (12.94 cm) and M_2N_3 (12.90 cm) and minimum (10.95 cm) finger girth was recorded in treatment combination M_1N_{12}.

Table 2: Effect of nutrients and plant growth regulators on finger girth of banana

Nutrients/ PGRs	Methods of application		Mean
	M_1	M_2	
N_1	13.96	12.05	13.01
N_2	12.41	12.64	12.52
N_3	12.17	12.90	12.53
N_4	11.96	12.96	12.46
N_5	12.25	12.53	12.39
N_6	12.54	13.41	12.98
N_7	13.14	12.71	12.93
N_8	12.94	12.95	12.94
N9	12.76	13.43	13.10
N_{10}	12.50	12.58	12.54
N_{11}	13.82	12.06	12.94
N_{12}	10.95	11.04	10.99
	12.62	12.60	
(M) S.E N±	0.11		
C.D. at 5%	NS		
(N) S.E N±	0.26		
C.D. at 5%	0.76		
(M X N) S.E N±	0.37		
C.D. at 5%	1.08		

Length of finger (cm)

Significantly, maximum finger length (19.03 cm) was observed in treatment M_2 *i.e.* bunch feeding over M_1 *i.e.* foliar spraying (18.71 cm) during pooled mean. The significantly highest finger length (19.84 cm) was recorded in treatment N_9 *i.e.* application of sulphate of potash (2%) + brassinosteroid (2 ppm) which was 23.26 per cent more as compared to control, however and statistically at par with treatment N_{11} (19.53 cm), N_8 (19.45 cm), N_7 (19.36 cm), N_{10} (19.24 cm) and N_6 (19.23 cm) as compared to rest of the treatments under study (2016-17).

Significantly highest finger length (20.11cm) was recorded in treatment combination of M_1N_9 (foliar application of sulphate of potash 2% + brassinosteroid 2 ppm) and lowest (15.91 cm) was recorded in M_2N_{12}. Increase in length of finger may be also due to application of brassinosteroid which has growth promoting effects similar to auxin and gibberellins and found to have promising effects on cell elongation by increasing the cell permeability to water and osmotic solutes of the cells (Mulagund, *et al.*, 2015) [6].

Table 3: Effect of nutrients and plant growth regulators on finger length of banana

Nutrients/ PGRs	Methods of application		Mean
	M_1	M_2	
N_1	16.53	18.42	17.47
N_2	18.88	18.31	18.59
N_3	16.37	17.24	16.81
N_4	16.98	18.67	17.82
N_5	18.04	18.78	18.41
N_6	18.77	19.69	19.23
N_7	19.32	19.39	19.36
N_8	19.36	19.54	19.45
N9	20.11	19.57	19.84
N_{10}	19.59	18.88	19.24
N_{11}	19.87	19.20	19.53
N_{12}	16.26	15.91	16.08
	18.34	18.63	
(M) S.E N±	0.12		
C.D. at 5%	NS		
(N) S.E N±	0.31		
C.D. at 5%	0.88		
(M X N) S.E N±	0.43		
C.D. at 5%	1.25		

Weight of finger of first hand (g)

Significantly, maximum finger weight of first hand (147.00 g) was recorded in treatment N_9 (application of sulphate of potash 2% + brassinosteroid 2 ppm), which was 21.70 per cent more as compared to control and statistically at par (144.16 g) with treatment N_7 (application of Banana special 0.5% + brassinosteroid 2 ppm) and N_8 (142.37 g). The minimum finger weight of first hand (120.79 g) was recorded in N_{12} *i.e.* control during the year 2016-17.

Significantly, maximum finger weight of first hand (151.43 g) was recorded in treatment combination of M_1N_9 *i.e.* foliar application of sulphate of potash (2%) + brassinosteroid (2 ppm) which was (26.25) per cent more as compared to control. The minimum finger weight of first hand (119.56 g) was recorded in M_1N_{12} Significantly maximum weight of finger is due to foliar application of sulphate of potash 2% and brassinosteroid 2 ppm which play a vital role in cell elongation, multiplication like auxin. The increase in weight of finger might be due to increased finger size along with the accumulation of sugar and higher pulp content resulting in increased weight of finger. These results are inconformity with the findings of Kumar *et al.* (2008) [5], who recorded maximum weight of finger (167.3 g) with two foliar sprays of sulphate of potash (1.5%) in banana cv. Robusta.

Table 4: Effect of nutrients and plant growth regulators on weight of finger of first hand (g) of banana

Nutrients/ PGRs	Methods of application		Mean
	M_1	M_2	
N_1	131.23	136.26	133.74
N_2	138.41	140.23	139.32
N_3	134.83	129.75	132.29
N_4	128.33	132.22	130.27
N_5	133.80	135.81	134.81
N_6	132.23	138.00	135.11
N_7	146.88	141.44	144.16
N_8	145.68	139.06	142.37
N9	151.43	142.58	147.00
N_{10}	141.99	136.14	139.06
N_{11}	145.20	131.10	138.15
N_{12}	119.56	122.03	120.79
	137.46	135.38	
(M) S.E N±	0.78		
C.D. at 5%	NS		
(N) S.E N±	1.93		
C.D. at 5%	5.56		
(M X N) S.E N±	2.72		
C.D. at 5%	7.87		

Weight of finger of last hand (g)

Significantly, the maximum weight of finger of last hand (99.98g) was recorded in treatment M_2 *i.e.* bunch fed and minimum (94.47g) was observed in M_1 during the year 2016-17.

The significantly maximum finger weight of last hand (112.30 g) was recorded in treatment N_9 (application of sulphate of potash 2% + brassinosteroid 2 ppm) which was 39.23 per cent more as compared to control and which was significantly superior over rest of the treatments. However, minimum finger weight of last hand (80.66 g) was observed in control during the year 2016-17.

Significantly maximum weight of finger last hand (114.06 g) was observed in treatment combination of M_2N_9 *i.e.* bunch fed with of sulphate of potash (2%) + brassinosteroid (2 ppm) respectively which was (42.54) per cent more as compared to control. However, minimum finger weight of last hand (80.02 g) was observed in treatment combination M_2N_{12}.

Significantly highest finger weight of last hand is due to bunch feeding with sulphate of potash and brassiniosteroid. The bottom portion of the bunch lies closer to the exogenously applied nutrients, accounted for 46% of the total weight, relative to that of the top portion of the bunch (19-57%) which is located farther from the applied nutrient blend (Kotur and Murthy, 2010) [2]. Bunch feeding of SOP (1.5%) and brassinosteroid (2 ppm) were tying at the rachis promoted the weight of last hand because of the availability of SOP and BR in aqueous form at later stages for a prolonged period. This indicated that proximity of the lower portion of bunch to the source of direct nutrient feed caused higher enhancement of the fruits relative to that of the top portion that was farther away in location Kotur *et al*. (2014) [3].

Table 5: Effect of nutrients and plant growth regulators on weight of finger of last hand (g) of banana

Nutrients/ PGRs	Methods of application		Mean
	M_1	M_2	
N_1	93.16	95.41	94.28
N_2	97.79	99.67	98.73
N_3	90.33	94.72	92.53
N_4	87.92	98.28	93.10
N_5	88.31	100.58	94.45
N_6	88.59	102.12	95.36
N_7	99.88	106.08	102.98
N_8	100.52	107.08	103.80
N9	110.54	114.06	112.30
N_{10}	96.55	103.46	100.01
N_{11}	98.74	98.33	98.53
N_{12}	81.30	80.02	80.66
	94.47	99.98	
(M) S.E N±	0.62		
C.D. at 5%	1.78		
(N) S.E N±	1.51		
C.D. at 5%	4.37		
(M X N) S.E N±	2.14		
C.D. at 5%	6.19		

Average yield (Mt/ha)

The maximum yield (91.92 Mt/ha) was found in M_1 *i.e.* foliar application over M_2 *i.e.* bunch feeding of nutrients and plant growth regulators (87.64 Mt/ha) which was (4.88) per cent more as compared to control.

The significantly maximum average yield (109.73 Mt/ha) was recorded in treatment N_9 *i.e.* application of sulphate of potash (2%) + brassinosteroid (2 ppm) over rest of the treatments. The treatment N_9 was 45.63 per cent more as compared to control. The lowest average yield (75.35 Mt/ha) was recorded in treatment N_{12}.

The interaction effect of application method of nutrients and plant growth regulators adduced the significant maximum average yield (113.15 Mt/ha) recorded in treatment combination M_1N_9 *i.e.* foliar application of sulphate of potash (2%) + brassinosteroid (2 ppm), which was 50.30 per cent more as compared to control. It was followed by M_2N_9 (106.32 Mt/ha), M_1N_8 (103.24 Mt/ha) and M_1N_{11} (101.75 Mt/ha). The lowest average yield (75.28 Mt/ha) was recorded in treatment combination M_1N_{12} *i.e.* control. Apart from these physiological responses, brassinosteroids has growth promoting effects similar to auxin and gibberellins and found to have promising effects on total yield improvement (Rajni *et al.*, 2007) [7].

Mulagund *et al.* (2015) [6] also reported that, increase in length of finger, circumference of finger, weight of bunch and yield per hectare is due to sulphur present in the sulphate of potash (SOP) might be responsible for the formation of ferridoxin in plants which might have direct impact in activating the catalase and perodoxidase enzymes Presence of sulphur in SOP had a synergistic effect with zinc, which is essential for carbon dioxide absorption and utilization, synthesis of RNA and auxin.

Table 5: Effect of nutrients and plant growth regulators on weight of ave. yield/ ha (mt/ha) of banana

Nutrients/ PGRs	Methods of application		Mean
	M_1	M_2	
N_1	83.33	80.66	81.99
N_2	93.99	83.08	88.54
N_3	83.35	83.44	83.39
N_4	81.10	80.82	80.96
N_5	84.73	82.39	83.56
N_6	90.17	83.06	86.62
N_7	95.19	86.39	90.79
N_8	103.24	97.90	100.57
N9	113.15	106.32	109.73
N_{10}	97.79	96.50	97.15
N_{11}	101.75	95.66	98.70
N_{12}	75.28	75.42	75.35
	91.92	87.64	
(M) S.E N±	0.49		
C.D. at 5%	1.42		
(N) S.E N±	1.20		
C.D. at 5%	3.47		
(M X N) S.E N±	1.70		
C.D. at 5%	2.68		

References

1. Anitha R, Jeyakumar P, Devi D, Bangarusamy U. Effect of plant growth regulators and chemicals on morphological traits and yield of banana cv. Grand Nain. Madras Agric. J. 2005; 92(1-3):35-41.
2. Kotur SC, Murthy KSV. Enhancing fruit yield in 'Ney Poovan' banana (*Musa paradisiaca* L.) by de-navelling and feeding N, K and S through distal stalkend of the bunch. J Hortil. Sci. 2010; 5(1):53-56.
3. Kotur SC, Ramesh PR, Venugopalan R. Evaluating direct feeding of de-navelled banana bunch with nutrient content. J of Hortl. Sci. 2014; 9(2):166-171.
4. Kumar AR, Kumar N. Effect of post-shooting spray of certain nutrients on yield and quality of banana cv. Nendran (AAB-Plantain). The Asian J of Hortic. 2009; 4(2):328-331.
5. Kumar AR, Kumar N, Jeyakumar P. Effect of post-shooting spray of sulphate of potash (SOP) on yield and quality of banana cv. Robusta (AAA- Cavendish). Res. J. Agric. and Biol. Sci. 2008; 4(6):655-659.
6. Mulagund J, Kumar S, Soorianathasundaram K, Porika H. Influence of post-shooting sprays of sulphate of potash and certain growth regulators on bunch characters and fruit yield of banana cv. Nendran (French plantain Musa AAB).The Bioscan. 2015; 10(1):153-159.
7. Rajni R, Gaikwad SS, Gotur M, Joshi CJ, Chavda JK. Effect of post shooting bunch spray of chemicals on maturity and quality of banana (*Musa paradisiaca* L.) cv. Grand Naine. Inter. J of Chemical Studies. 2017a; 5(4):1676-1679.
8. Sreekanth HS, Thippesha D, Akshay KR, Deepak TM. Bunch feeding can improve the quality of banana cv. Robusta (AAA-group) under hill zone of Karnataka (Zone- 09). Intern. J of Pure and Applied Biosci. 2017; 5(6):358-362.