Environment & Ecology 29 (2A) : 860—863, 2011
 ISSN 0970-0420

Growth, Yield and Quality of Dwarf Cavendish Banana in Relation to N, P, K Fertigation

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Abstract

Experiments were conducted to standardize the most suitable dose of fertilizer combination for banana cultivation under agro-ecological condition of Jharkhand in randomized block design. The treatments consisted of 200, 300, 400 g/plant of nitrogen through ammonium sulfate respectively, with 150, 300, 450 g/plant phosphorus through single super phosphate and 150, 200, 250 g/plant of potassium through muret of potash and one control without fertilizer. Their effect on the growth parameter revealed that the increasing dose of nitrogen and phosphorus resulted maximum pseudo-stem height whereas increasing dose of phosphorus and potash were found suitable for increase in pseudo-stem girth and advancing the maturity of banana. However, leaf area, number of finger burch^{-1} and fruit yield significantly influenced by the increasing dose of nitrogen and potassium. A fertilizer dose containing medium nitrogen and higher doses of phosphorus and potash enhanced the fruit pulp content with minimum fruit peel percentage. Beside this, higher reducing, sugar and lower non-reducing sugar percentage were in the favour of $N_3P_2K_3$ fertilizer combination. However, maximum cost benefit ratio was achived under fertilizer dose of $N_3P_2K_3$ combination (400, 300, 250 g/plant).

Key words : Banana, NPK dose, Growth, Productivity, Quality.

Among the fruits grown in India, banana (*Musa* spp) ranks first in production and second in area and it is the third largest crop in terms of tonnage after sugarcane and sweet potato. Being easily grown and quickly benefiting the growers, banana has long been most popular fruit crop in India. Banana is surface feeder and nutrient exhausting crop. Farmers in commercial growing areas are often confronted with continieous decline in crop productivity and soil fertility is considered to be the major constraint in the banana based land use system. Among the major nutrients, potash is required in larger quantities for banana (1, 2). Second only to potash, nitrogen is the most used nutrient in plant growth, development and fruit production (3). This nutrient is considered to be in short supply even when the crop is grown on highly fertile soil (4). Previous studies indicate that fertigation is the best application method to match the demand of plant and balanced fertigation is a guarantee of high quality and marketable fruit production. Hence, an attempt was made in the present study with a view to study the effect of different doses of N, P, and K on growth, yield and quality of banana under agro-ecological conditions of Jharkhand.

Methods

The experiment was conducted in a factorial randomized block design with three replication at Birsa Agricultural University Farm, Kanke, Ranchi to determine the most suitable dose of fertilizer combination of banana cultivation (Dwarf Cavendish) for plateau region of Jharkhand. Treatment consisted of three levels each of nitrogen (200, 300, 400/plant), phosphorus (150, 300, 450 g/plant) and potash (150, 200, 250 g/plant) and one control without fertilizer. In all there were 28 treatments. Experimental gross area (28 × 14 m) having a net block size 14 × 8 m^2 surrounded by a bund were facilitated to prevent the movement of water and nutrients. Nitrogen was applied through ammonium sulfate (A/S), phosphorus through single super phosphate (SSP) and potassium through mureat potash (MOP). The total amount of phosphus and potash were applied as a basal dose in July while nitrogen, in two split doses after 45 days and 90 days after planting the suckers respectively. Uniform healthy sword suckers of 30 cm height were planted with a spacing of 2 × 2 m, following the square system of planting in July. All other cultural practices were

Table 1. Growth, shooting and yield of dwarf cavendish banana as affected by rate of nitrogen, phosphorus and potassium.

	Treatments	Pseudostem height (cm)	Pseudostem girth (cm)	Leaf area (cm)	Spreading of leaves NS	Spreading of leaves EW	Number of days taken to maturity	Number of fingers/ bunch	Length of fruits (cm)	Diameter of fruits (cm)
1	$N_0P_0K_0$ (Control)	78.33	37.50	3371.02	177.00	174.00	164.3	29.0	13.46	1.36
2	$N_1P_1K_1$	106.33	47.23	4323.80	223.80	230.43	120.6	56.0	14.33	1.70
3	$N_1P_1K_2$	112.50	47.16	4423.60	200.93	183.40	115.6	45.0	14.12	2.13
4	$N_1P_1K_3$	114.50	49.10	4678.46	221.96	219.66	112.3	50.0	13.81	2.16
5	$N_1P_2K_1$	110.50	49.60	4757.92	220.43	247.06	109.3	56.3	13.66	2.13
6	$N_1P_2K_2$	111.80	47.26	4815.66	182.23	202.96	107.6	64.0	14.80	2.26
7	$N_1P_2K_3$	113.50	50.66	4922.05	179.16	190.46	107.6	74.0	14.69	2.40
8	$N_1P_3K_1$	113.50	53.63	5152.53	178.93	200.36	108.0	78.0	14.58	2.44
9	$N_1P_3K_2$	115.20	48.06	5202.58	208.90	190.76	108.0	71.0	15.03	2.50
10	$N_1P_3K_3$	117.50	55.06	5312.06	226.60	192.10	105.6	85.0	14.05	2.47
11	$N_2P_1K_1$	118.50	49.70	5395.15	218.83	204.06	100.6	110.3	15.40	2.41
12	$N_2P_1K_2$	119.00	47.16	5278.21	207.7	206.33	107.0	96.0	16.46	2.40
13	$N_2P_1K_3$	117.00	47.16	5234.87	209.03	223.76	97.3	101.6	16.72	2.27
14	$N_2P_2K_1$	120.20	53.73	5665.50	213.70	207.16	98.3	99.0	16.96	2.63
15	$N_2P_2K_2$	121.10	53.83	5854.19	236.86	236.26	95.3	126.6	17.57	2.74
16	$N_2P_2K_3$	121.80	50.83	5705.96	239.6	235.50	93.0	109.0	17.13	2.51
17	$N_2P_3K_1$	123.70	55.30	5719.05	232.26	245.50	95.6	96.3	16.62	2.27
18	$N_2P_3K_2$	122.50	50.40	5725.99	230.6	223.73	96.2	108.0	16.95	2.40
19	$N_2P_3K_3$	128.60	57.06	5626.06	221.2	243.66	80.5	106.0	16.15	2.40
20	$N_3P_1K_1$	128.00	54.40	5818.73	211.93	222.16	93.6	108.0	15.90	2.27
21	$N_3P_1K_2$	129.50	53.73	5902.36	227.2	238.80	94.0	102.3	17.36	2.24
22	$N_3P_1K_3$	127.50	51.23	5813.27	209.53	235.43	83.6	112.0	15.43	2.50
23	$N_3P_2K_1$	122.60	51.53	5994.06	222.0	232.23	82.5	114.0	16.70	2.34
24	$N_3P_2K_2$	125.80	55.06	5990.79	225.4	257.03	84.6	148.0	16.90	1.94
25	$N_3P_2K_3$	120.00	56.63	6444.46	240.3	259.73	85.0	163.6	15.86	1.77
26	$N_3P_3K_1$	126.06	50.10	6059.91	232.33	258.43	89.6	158.0	16.63	1.94
27	$N_3P_3K_2$	130.00	55.63	5803.96	233.90	241.73	88.3	155.0	14.16	1.58
28	$N_3P_3K_3$	126.06	51.40	5534.70	216.43	235.53	94.3	156.0	14.10	1.70
	SE (±)	7.03	2.62	357.7	NS	NS	4.76	10.15	0.49	0.13
	CD 5%	19.92	7.41	1013.4	NS	NS	13.45	28.7	1.44	0.29

adopted as per recommended packages. To assess the performance of different combination of fertilizer observations on growth, yield and quality parameter were recorded. Economics of different treatment B-C ratio were calculated. The experimental data on pre- and post-harvest studies were subjected to statistical analysis.

Results and Discussion

The analysis of variance in respect to the height and girth of pseudo-stem in different treatment combination (Table 1) of nitrogen, phosphorus and potash was found highly significant and these were found superior to control. A higher dose of nitrogen and phosphorus with medium dose of potassium ($N_3P_3K_2$) resulted into maximum pseudo-stem height. However, fertilizer dose of $N_2P_3K_3$ (300, 450, 250 g/plant) exhibited maximum increase in pseudo-stem girth (57.06 cm) and took minimum days to banana maturity (80.5), whereas minimum pseudo-stem height and girth with minimum days taken to maturity were noticed under control ($N_0P_0K_0$). Leaf area and spreading of leaves (NS × EW) was significant influenced by the different doses of nitrogen, phosphorus and potash but application of increasing dose of nitrogen and potassium with medium dose of phosphorus (400, 300, 250 g/plant) were found suitable for maximizing the leaf area (6,444.91 cm^2) and spreading of leaves (240.3 × 259.73 cm) of the plant followed by $N_3P_3K_1$ (6,059.91 cm^2 and 232.33 × 258.43 cm) respectively over the control.

Table 2. Fruit quality attributes and economics of dwarf cavendish banana as affected by rate nitrogen, phosphorus and potassium.

	Treatments	Yield/ha (tons)	Pulp (%)	Peel (%)	Reducing sugar (%)	Non-reducing sugar (%)	Acidity (%)	Cost benefit ratio
1	$N_0P_0K_0$ (Control)	7.80	62.35	37.64	11.33	4.03	0.54	0.56
2	$N_1P_1K_1$	10.00	71.29	28.70	12.67	3.66	0.50	0.64
3	$N_1P_1K_2$	10.33	70.44	29.56	13.17	3.43	0.47	0.67
4	$N_1P_1K_3$	11.70	64.64	35.35	14.97	2.21	0.45	0.87
5	$N_1P_2K_1$	13.47	68.83	31.17	13.71	3.50	0.43	1.14
6	$N_1P_2K_2$	14.37	67.89	32.12	14.27	3.37	0.36	1.25
7	$N_1P_2K_3$	16.21	68.03	31.96	16.04	2.26	0.28	1.50
8	$N_1P_3K_3$	17.67	69.91	30.08	13.10	3.63	0.35	1.17
9	$N_1P_3K_2$	17.85	71.55	28.44	14.57	3.5	0.32	1.70
10	$N_1P_3K_3$	18.04	71.56	28.43	15.85	2.5	0.31	1.70
11	$N_2P_1K_1$	19.22	71.10	28.89	12.69	3.8	0.34	2.05
12	$N_2P_1K_2$	20.27	65.32	34.67	14.49	3.1	0.33	2.18
13	$N_2P_1K_3$	20.71	67.59	32.41	16.25	2.39	0.38	2.21
14	$N_2P_2K_1$	21.97	71.38	28.61	12.40	3.80	0.30	2.36
15	$N_2P_2K_2$	25.58	69.57	30.12	14.77	2.87	0.30	2.57
16	$N_2P_2K_3$	23.71	71.44	28.49	16.32	2.26	0.25	2.54
17	$N_2P_3K_1$	23.82	67.67	32.32	13.22	3.67	0.35	2.54
18	$N_2P_3K_2$	24.01	69.82	30.18	14.74	2.50	0.32	2.53
19	$N_2P_3K_3$	25.05	74.38	25.62	16.36	2.23	0.32	2.63
20	$N_3P_1K_1$	26.66	64.52	35.47	13.63	3.73	0.29	3.11
21	$N_3P_1K_2$	28.33	70.29	29.70	15.59	3.40	0.26	3.31
22	$N_3P_1K_3$	30.12	68.10	31.90	17.59	2.30	0.25	3.52
23	$N_3P_2K_1$	31.50	66.80	33.52	17.57	3.76	0.20	3.68
24	$N_3P_2K_2$	33.00	62.69	37.30	18.27	3.30	0.29	3.85
25	$N_3P_2K_3$	35.00	68.73	31.26	20.30	2.20	0.25	4.07
26	$N_3P_3K_1$	32.50	64.07	35.93	17.51	3.73	0.27	3.68
27	$N_3P_3K_2$	31.25	66.74	33.25	19.23	2.70	0.26	3.45
28	$N_3P_3K_3$	29.16	68.51	31.49	19.47	2.14	0.21	3.10
	SE(±)	1.11	2.04	2.19	0.32	0.43	NS	
	CD 5%	3.14	5.78	6.20	0.74	1.21	NS	

Increase in vegetative growth attributes nourished with increased level of nitrogen and phosphorus, which could be due to synergistic effect between nitrogen and phosphorus and increase in vegetative growth in short period resulted into early banana maturity. Similar beneficial effects of higher doses of primary nutrients on vegetative growth were also reported by Corrales et al. (5), Shawky (6), Irizarry et al. (3) and Kumar et al. (7) in banana production.

Medium dose of nitrogen, phosphorus and potassium (300, 300, 200 g/plant) resulted into maximum length and diameter of fruits (17.57 and 2.74 cm respectively) at harvest followed by $N_3P_1K_2$ and $N_2P_2K_3$ respectively. However, least length and diameter was recorded under control. Analysis of variance pertaining to number of fingers per bunch and fruit yield of banana in hectare basis significantly affected by different levels of N, P and K (Table 1). It was observed that in increase in nitrogen and potassium level had significantly increased the number of fingers bunch and fruit yield of banana and it was recorded maximum (163.6 and 35.00 tonnes respectively) under $N_3P_2K_3$ over control. Enhancement in yield attributing parameter could be due to the increased amount of food manufactured by increased foliage with increase in nutritional status of plant. These results were in agreement with the results of Lopez (8), Corrales (5) ; Pawar et al. (9) and Kumar et al. (7) in different banana varieties.

A fertilizer dose containing medium nitrogen and higher dose of phosphorus and potassium significantly increased the fruit pulp content (74.38%) with minimum fruit peel parentage (25.62) followed by fertilizer combination of $N_1P_3K_3$(200, 450, 250 g/plant)

over control, whereas higher dose of nitrogen and potassium with medium dose of phosphorus ($N_3P_2K_3$) proved their superiority among all treatment combination in estimating higher reducing sugar percentage with low percentage of non-reducing sugar over control (Table 2). Application of higher doses of nitrogen, medium dose of phosphorus and minimum dose of potassium resulted into minimum acidity percentage (0.20). However, the maximum benefit cost ratio (4.07) was achieved under $N_3P_2K_3$ combination (400, 300, 250 g/plant) mainly due to higher fruit yield through the increasing level of N, P and K application with increasing levels of K increases the sugar percentage and takes part in stanch transformation with fruit resulting increased quality attributes of fruit has also been reported by Chiang et al. (10) and Kumar et al. (7) in banana cv Rashthali (AAB).

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