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Short communication

Effect of integrated nutrient management on growth and yield of banana cv. Jahaji

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Banana is a heavy feeder of nutrients and requires a large quantity of nutrients for its growth, development and yield. This is due to their size, growth rate, rooting pattern and phenomenon of bud differentiation which have relationship with the yield. Application of inorganic fertilizer though increased the yield substantially, but cannot sustain the fertility status (Bhardwaj and Omanwar, 1). In recent times much attention is given to the integrated use of organic or green manure and mineral nutrition for meeting the economic need of the farmers as well as for sustainability in terms of productivity or soil fertility. Therefore, the highest possible efficiency in use of available alternative sources of nutrients are need to be ensured. The information on integrated nutrient management in banana under climatic conditions of Assam is very limited. Keeping this in view the research gaps, the present research work was undertaken to evaluate the effect of integrated nutrient management in a commercial banana cultivar.

The field experiment was undertaken in the experimental Farm of the Department of Horticulture, Assam Agricultural University, Jorhat. The physico-chemical properties of the soil were analysed before planting the crop. The soil was sandy loam, organic carbon (0.60%), available NPK (25 kg/ha), 19.33 kg/ha and 138 kg/ha respectively. The experiment was laid out in randomized block design with different treatment combination being replicated three times. The treatments were *viz.,* T_0 - 100% recommended dose (RD) of NPK + FYM; T - 100% RD of NPK + vermicompost; T_2 - 100% RD of NPK (P as rock phosphate) + FYM + *Azospirillum* + PSB; T_3 - 75% RD of NPK (P as rock phosphate) + FYM + *Azospirillum* + PSB; T_4 - 50% RD of NPK (P as rock phosphate) + FYM + *Azospirillum* + PSB; T_5 - 50% RD of NPK (P as rock phosphate) + vermicompost + *Azospirillum* + PSB; T_6 - 50 RD of NPK (P as rock phosphate) + FYM + *Azospirillum* + PSB + *Trochoderma harzianum;* T_7 - 50% RD of N + 100% RD of PK + FYM + PSB.

The sword suckers of banana cv. Jahaji (AAA) weighing about 2 kg were planted during March 2005 at a spacing of 1.5 m × 1.5 m. The recommended dose of nitrogen, phosphatic and potassic fertilizers @ 110 g N, 33 g P_2O_5 and 330 g K_2O per plant in the form of urea, SSP and MOP respectively were applied in two split doses. The whole amount of phosphatic fertilizer along with half nitrogenous and half potassic fertilizers were applied at third month after planting. Rest half of the nitrogenous and potassic fertilizers were applied at fifth month after planting. The organic sources of nutrients *viz.*, farmyard manures, vermicompost, biofertilizers and bioagents were applied as per treatment schedule. Well rotten farmyard manure (FYM) @ 12 kg per pit, vermicompost @ 2 kg per pit was applied before planting and rock phosphate @ 137.5 g, *Azospirillum,* PSB @ 50 g per plant and *Trichoderma harzianum* @ 50 g per plant were mixed with the soil at the time of planting. Recommended packages of practices were followed for other agronomic practices. Growth and yield attributing characters and yield data were recorded at different stages. Pseudostem height was recorded 15 cm above the ground level to the first leaf axils. Pseudostem girths were recorded at 15 cm above the ground level. Leaf area of the third leaf from the apex was calculated by multiplying the product of length and breadth of the lamina with the factor 0.8 (Murray, 7). Observations recorded during field experimentation were subjected to statistical analysis of variance by randomized block design (RBD). Significance and non-significance of variances due to different treatments were determined by calculating the respective 'F' values as per the method described by Panse and Sukhatme (8).

Effects of integrated nutrient management (INM) treatment on growth of banana are given in Table 1. Analysis of variance in relation to the effect of integrated nutrient management on pseudostem height and pseudostem girth indicated significant effect of various treatment conditions. The highest pseudostem height and girth were recorded in the treatment with integration of organic manure and biofertilizers along with 100% recommended dose of NPK (T_2). The lowest pseudostem height and girth at shooting stage were recorded in T_4 (50% RDF of NPK + FYM + *Azospirillum* + PSB). The increase in plant height and girth may be

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Table 1. Effect of integrated nutrient management on growth characters of banana cv. Jahaji.

Treatment	Pseudostem height (cm)		Pseudostem girth (cm)		Total leaf area (m^2)		Leaf area index (LAI)		No. of functional leaves		Total leaf production (per plant)	Days taken for shooting	Days taken from shooting to harvest	Total crop duration (days)
	Large stage	Shooting stage	Large stage	Shooting stage	Large stage	Shooting stage	Large stage	Shooting stage	Large stage	Shooting stage				
T0	98.43	131.02	45.93	66.29	3.02	11.32	1.34	5.03	9.06	12.13	29.58	212.12	98.59	310.71
T1	103.01	134.64	46.38	66.55	3.64	11.96	1.62	5.31	10.26	12.46	29.72	211.13	97.61	308.74
T2	108.33	139.86	46.86	67.14	3.77	12.76	1.67	5.67	10.53	13.24	30.25	210.52	95.95	306.47
T3	96.83	130.64	46.00	65.53	2.83	11.10	1.26	4.93	9.04	12.01	29.43	213.89	107.01	320.90
T4	92.63	122.08	42.84	63.24	2.42	8.43	1.11	3.74	7.49	9.06	28.36	224.18	113.01	337.19
T5	96.41	125.44	44.36	64.93	2.54	9.49	1.13	4.22	8.44	9.69	29.10	217.87	112.73	330.60
T6	93.57	122.94	43.04	63.62	2.48	8.57	1.10	3.81	8.00	9.04	28.37	227.33	116.69	344.02
T7	95.17	129.66	44.54	65.08	2.66	10.8	1.18	4.80	8.59	12.10	29.33	217.57	109.41	326.98
$CD_{0.05}$	2.14	4.46	1.62	1.56	0.37	0.77	0.15	0.34	1.03	0.84	1.05	5.46	6.97	8.99

due to improvement of physical properties of soil, higher nutrient uptake and increased activity of microorganisms which were manifested in the form of enhanced growth and higher carbohydrates production as explained by Kumar *et al.* (6) and Hassan *et al.* (5). These effects might also be due to production of phytohormones produced by *Azospirillum* near root morphology and in turn influencing assimilation of nutrients. Available NPK status, organic carbon and microbial biomass and dehydrogenase activity increased due to application of inorganic fertilizers and biofertilizers along with organic manures help in increasing height and girth of the banana plants. Integrated application of biofertilizers along with 100% inorganic fertilizers and organic manures have considerably increased the leaf production with increased leaf area and leaf area index at large and shooting stage. It can be attributed to the fact that the increase in nutrient levels of NPK specially nitrogen enhanced the vegetative growth and simultaneously also increased the leaf area. Similar trend was also reported by Gogoi *et al.* (4) in banana. The shortest crop duration was observed in the same treatment which might be due to higher net assimilation rate on account of better growth leading to the production of endogenous metabolites earlier in optimum level enabling early flower bud initiation and thereby early shooting. The earliness in flowering was attributed to simultaneous transport of growth substances like cytokinin to the auxiliary bud and breaks the apical dominance. This result was similar with the findings of Sharma (9) in banana. In the present experiment, the phyllochron which serves as a good index of vegetative growth, however, could not significantly influenced by treatments The phylochron was maximum under the treatment T_6 (50 % RDF of FYM + *Azospirillum* + PSB + *T. harzianum*), which might be due to lower dose of NPK.

The yield and yield attributing characters were significantly influenced by INM treatments (Table 2). The yield and the yield attributing characters were mainly dependent on growth character of the plant. The leaf growth characteristics decide the duration of the crop and also the grade of the bunch in regards to their size and weight which finally results in production. Greater accumulation of dry matter conferred greater ability to give higher yield. The highest bunch weight, number of hands per bunch and yield was recorded in 100 percent RDF of NPK + FYM + *Azospirillum* + PSB (T_2) followed by 100% RDF of NPK + vermicompost (T_1) treatment. This was obviously due to the vigorous plant growth character. In these treatments increased number of leaves might have increased the photosynthetic activity resulting in higher accumulation of carbohydrates. Relatively higher amount of carbohydrates could have promoted the growth rate and in turn increased the bunch weight. This was in accordance with the result of Chezhigen *et al*. (2) in banana.

The investigation revealed that the treatment having the 100 per cent recommended dose of NPK (P as as rock phosphate) in combination with farmyard manure and biofertilizers significantly influenced plant growth and yield of banana besides shortening the crop cycle.

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Table 2. Effect of integrated nutrient management on yield and yield attributing characters of banana cv. Jahaji.

Treatment	Bunch weight (kg)	No. of hands/ branch	Fingers per hand	Weight of second hand (kg)	Yield (t/ha)
T0	15.61	8.89	20.80	2.23	67.56
T1	16.11	9.07	22.12	2.40	72.05
T2	16.50	9.32	23.04	2.58	73.96
T3	15.30	8.66	20.55	2.22	67.44
T4	14.42	7.95	18.62	1.56	64.08
T5	14.86	8.50	19.26	2.16	66.05
T6	14.67	8.23	18.90	1.94	65.18
T7	15.11	8.58	19.33	2.19	66.83
$CD_{0.05}$	0.72	0.45	2.44	0.24	2.61

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