Influence of *Gluconacetobactor diazotrophicus* inoculation on growth and yield of banana cv Grand Naine

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ABSTRACT

A field study was conducted with experiment laid out in randomized block design having 11 treatments and three replications. The treatments consisted of recommended dose of fertilizer (RDF) and GRDF ie RDF combined with different bio-fertilizers to know their effects on growth and yield of banana cv Grand Naine. The plant growth characters viz pseudo-stem height, girth and number of leaves per plant were influenced significantly due to different treatments. The yield contributing parameters viz number of hands per bunch, fingers per bunch and bunch weight per plant also differed significantly due to different treatments. It was observed that the application of 75 per cent recommended dose of nitrogen along with recommended dose of phosphorus and potassium through chemical fertilizer with 10 kg FYM + 25 g *Acetobactor* + 25 g phosphate solubilizing bacteria per plant proved superior over other treatments in respect of improvement in plant growth and yield attributes and highest monetory return mainly due to saving of 25 per cent nitrogen.

Keywords: Banana; Grand Naine; *Gluconoacetobactor diazotrophicus*; sustainable yield index; nutrient use efficiency

INTORDUCTION

Banana is a popular, cheap and most acceptable fruit of India. The crop is known for its good nutritive value and is inter-woven with Indian heritage and culture. It is heavy feeder of nutrients for optimum growth, development and yield. Per metric tonne of banana requires 7 to 8 kg of nitrogen, 0.7 to 1.5 kg of phosphorus and 17 to 20 kg of potassium (Anon 2004). In order to maintain the fertility of soil and continuous production, these nutrients must be added every year through organic fertilizers, inorganic fertilizers and bio-fertilizers. Efficient nutrient management plays a very important role for better production of banana (Mustaffa et al 2009).

The fertile soils become degraded under the influence of indiscriminate and uncontrolled use of inorganic fertilizers and it is one of the causes of pollution in ground and surface water. The indiscriminate and imbalanced use of chemical fertilizers in agriculture is the main reason for depletion of productivity and loss of soil fertility.

A new concept for utilization of available nutrient inputs has come that is use of organic, inorganic and bio-fertilizers with an integrated approach for sustainable economic yield with the objective to maintain soil fertility to an optimum level, sustaining the increased productivity and profitability of banana growers through judicious use of different sources of nutrients. Integrated nutrient management of banana crop is ecologically sound and viable system providing maximum fertilizer use efficiency and also improving the physical, chemical and biological status of the soil. Inclusion of beneficial microbes increases the nutrient availability, reduces diseases and nutrient losses and helps to degrade the toxic elements (Subba Rao 1988).

The present investigations were conducted with the objective to minimize the doses of nitrogen and phosphorus fertilizers and to assess the influence of *Gluconoacetobactor diazotrophicus* on growth and yield of Grand Naine banana.

MATERIAL and METHODS

The present investigations were carried out at Division 2 of National Agricultural Research Project, Ganeshkhind, Pune, Maharashtra during 2012-13, 2013-14 and 2014-15.

Eleven treatments were applied viz T_1 [75% N + RPK (recommended P_2O_5 and K_2O) + *Acetobactor* 25 g/plant + PSB (phosphate solubilizing bacteria) 25 g/plant], T_2 [RDF (recommended dose of fertilizer) + *Acetobactor* 25 g/plant + PSB 25 g/plant], T_3 [GRDF (RDF + *Azoapirillum* @ 25 g/plant + PSB @ 25 g/plant) + VAM (*G mossae* + *G fasciculatum*) 25 g/plant], T_4 (GRDF), T_5 [75% N + 75% P + RK (recommended K_2O) + *Acetobactor* 25 g/plant+ PSB 25 g/plant], T_6 [RN (recommended nitrogen) + 75% N + RK + *Acetobactor* 25 g/plant + PSB 25 g/plant], T_7 (RDF + *Acetobactor* 25 g/plant), T_8 (75% N + RPK + *Acetobactor* 25 g/plant), T_9 (RN + 75% N + RK + *Acetobactor* 25 g/plant), T_{10} (RN + 75% N + RK + PSB 25 g/plant), T_{11} (75% N + 75% P + RK + *Acetobactor* 25 g/plant).

The treatments were replicated thrice in a randomized block design. The fertilizers, bio-fertilizers and FYM were applied in split as per recommendation at 30, 75, 120, 210, 255 and 300 days after planting. The recommended dose of fertilizers used in present study was 200:40:200 g NPK/plant. Sustainable yield index was calculated as per guideline given by Singh et al (1990) and Badgujar et al (2018).

RESULTS and DISCUSSION

The data given in Table 1 reveal that the pooled performance of different treatments was statistically significant for all the growth parameters viz pseudo-stem height, pseudo-stem girth and total number of leaves per plant. The highest pseudo-stem height (226.96 cm) and pseudo-stem girth (76.40 cm) were recorded under treatment T_1 (75% N + RPK + *Acetobactor* 25 g/plant + PSB 25 g/plant) which was superior over rest of the treatments. Highest number of leaves per plant was recorded in T_1 to T_6 which were on par. Increase in plant height could be attributed to the higher uptake of nitrogen. Palfi (1965) reported that nitrogen is a major constituent of chlorophyll and protein and amino acids are accelerated through its increased supply at appropriate time to the plant. The positive response of bio-fertilizer treatments on increase in plant girth might be due to more accumulation of the

Table 1. Effect of different treatments on various growth and yield parameters of Grand Naine banana (pooled means of 2012-13, 2013-14 and 2014-15)

Treatment	Pseudo-stem (cm)		Number of leaves/plant	Number/bunch		Bunch weight (kg)	Average yield/ha (MT)	SYI
	Height	Girths		Hands	Fingers			
T_1	226.96	76.40	22.73	10.48	174.92	27.51	122.26	0.96
T_2	225.48	73.72	22.76	10.26	171.01	26.70	118.65	0.93
T_3	222.20	73.37	22.13	9.99	168.77	25.14	111.71	0.87
T_4	215.90	72.86	21.87	9.39	168.22	24.91	110.72	0.86
T_5	211.38	72.28	21.37	9.34	165.01	25.28	112.36	0.88
T_6	208.64	72.17	21.29	9.22	164.09	25.38	112.81	0.88
T_7	208.64	71.89	20.90	9.19	160.86	25.54	113.50	0.89
T_8	207.42	70.97	20.72	9.03	160.51	24.92	110.74	0.86
T_9	206.29	70.76	20.66	8.35	153.79	25.28	112.36	0.88
T_{10}	196.13	69.25	20.37	8.09	152.17	24.69	109.73	0.86
T_{11}	196.61	68.94	20.07	7.85	146.11	22.87	101.62	0.79
SE±	0.44	0.25	0.41	0.36	2.94	0.61	2.71	-
$CD_{0.05}$	1.24	0.71	1.95	1.01	8.33	1.72	7.65	-

T_1 [75% N + RPK (recommended P_2O_5 and K_2O) + *Acetobactor* 25 g/plant + PSB (phosphate solubilizing bacteria) 25 g/plant], T_2 [RDF (00:40:200 g NPK/plant) + *Acetobactor* 25 g/plant + PSB 25 g/plant], T_3 [GRDF (RDF + *Azoapirillum* @ 25 g/plant + PSB @ 25 g/plant) + VAM (*G mossae* + *G fasciculatum*) 25 g/plant], T_4 (GRDF), T_5 [75% N + 75% P + RK (recommended K_2O) + *Acetobactor* 25 g/plant+ PSB 25 g/plant], T_6 [RN (recommended nitrogen) + 75% N + RK + *Acetobactor* 25 g/plant + PSB 25 g/plant], T_7 (RDF + *Acetobactor* 25 g/plant), T_8 (75% N + RPK + *Acetobactor* 25 g/plant), T_9 (RN + 75% N + RK + *Acetobactor* 25 g/plant), T_{10} (RN + 75% N + RK + PSB 25 g/plant), T_{11} (75% N + 75% P + RK + *Acetobactor* 25 g/plant)
Note: 10 kg FYM/plant was applied in all the treatments

polyhydroxybutyric acid resulting in rise of the vegetative cells and production of useful growth substances. Similarly the increase in number of leaves might be due to more vegetative growth owing to application of bio-fertilizers along with chemical fertilizers.

Yield attributes

The pooled data in respect of yield attributes presented in Table 1 reveal that there were significant differences for the characters viz number of hands per bunch, fingers per bunch, bunch weight, yield per hectare and sustainability yield index. Significantly highest number of hands/bunch were recorded in treatments T_1 to T_3 viz 10.48, 10.26 and 9.99 respectively. The highest number of fingers per bunch was recorded in treatments T_1 to T_4 with 174.92, 171.01, 168.77 and 168.22 respectively. The bunch weight was significantly highest in T_1 (27.51 kg) and T_2 (26.70 kg) which were at par. Similar trend was recorded by treatment T_1 and T_2 for yield per ha and exhibited 122.26 and 118.65 MT/ha fruit yield.

The highest sustainability yield index was recorded in T_1 (0.96) followed by T_2 (0.93). In present investigations the treatments T_1 and T_2 recorded the maximum number of hands, fingers, bunch weight and yield which might be due to increased photosynthetic activity and higher accumulation of carbohydrates that promoted growth rate and resulted in increased bunch weight and yield per ha. Due to use of bio-fertilizer, the nutrients available in soil were utilized more efficiently by the plants. Similar results were also reported by Hazarika and Ansari (2010) and Badgujar et al (2018). Banana being an exhaustive crop, availability of more nutrients through the inorganic source might have helped to get better weight of bunch vis a vis yield per hectare. Thus the application of 75 per cent recommended dose of nitrogen along with recommended dose of P and K through chemical fertilizers with 10 kg FYM + 25 g *Acetobactor* + 25 g PSB per plant was beneficial to save 25 per cent of nitrogen and to get highest monetary returns form banana crop.

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