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Impact of integrated nutrient management on soil fertility status of tissue culture banana cv. Grand Naine (*Musa* AAA, Cavendish)

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ABSTRACT

A field experiment was laid out in a randomized block design with 5 treatments and 4 replications consisting of recommended dose of fertilizers (RDF) and RDF was combined with organic manures (FYM and vermicompost) and biofertilizers [Azotobacter, Azospirillum and phosphate solubilising bacterial (PSB)] at different combinations to know their impact on yield and soil fertility status of tissue culture banana during 2013 and 2014. The experiments consisted of five treatments T_1 (control), T_2 (100% RDF (300:100:300 g NPK plant^{-1}), T_3 (100% RDF +75 g biofertilizers), T_4 (100% RDF +100 g biofertilizer) and T_5 (100% RDF +125 g biofertilizer). The biofertilizers are applied in form of Azotobacter, Azospirillum & PSB inoculated with organic manure (FYM & Vermicompost). The study indicates the best results in post harvest soil characteristics like organic C, EC, pH, available N, P and K value.

Keywords: Banana, bio-fertilizer, Grand Naine, TC plants

Banana (*Musa* spp.) is one of the most important staple foods in the globe. It is known for its antiquity and is interwoven with Indian heritage and culture. The plants are considered as the symbol of prosperity and fertility. In India, banana is the second largest growing fruit crop next to mango and the leading producer in the world contributes more than 20 per cent of global production.

As banana is a heavy consumer of nutrients and requires large quantities of nutrients for its growth, development and yield (Hazarika and Ansari, 2010). The requirements of these nutrients are generally supplied by inorganic fertilizers. But this often results in extreme situations for the soil, crop and climate involved. The soil has lost its biological dynamic owing to repeated and indiscriminate use of chemical fertilizer. Chemical fertilizers have some deleterious effects on fruit quality besides adverse effects on soil, water and environmental conditions (Dutta *et al.*, 2010). On the other hand, organic and microbial sources of nutrients have advantage of consistent and slow release of nutrients, maintaining ideal C:N ratio, improvement in water holding capacity and microbial biomass of soil profile, without having any adverse residual effects (Yadav, 2010). In recent years, a new approach for utilization of available resources *viz* organic, inorganic and microbial inoculants with an integrated approach for sustainable economic yield termed as INM has emerged which has already been receiving wide attention and are contributing substantially towards acceleration of crop productivity by maintaining chemical, physical and biological balance in soil plant system.

Keeping these aspects in mind, the present research work was carried out to evaluate the suitable combination of organic, inorganic and biofertilizers for tissue cultured cv Grand Naine to increase nutrient availability in the soil, reduce disease, reduce nutrient losses, and help degrade toxic compounds (Subba, 1998). The present experiment was planned as an attempt in this direction

MATERIALS AND METHODS

The field experiment was conducted in the Regional Research Technology and Transfer Station (RRTTS) situated at Chiplima, Sambalpur, Odisha, India during 2013 and 2014 to investigate the Impact of INM on yield and soil fertility status of tissue culture banana cv. Grand Naine. The experiment was designed in randomized block design with four replications. *viz*; T_1-control T_2-100% recommended dose of fertilizer,T_3- 100 per cent RDF + 75 g of biofertilizers, T_4- 100 per cent RDF + 100 g of biofertilizers, T_5- 100 per cent RDF+ 125 g of biofertilizers. The required dose of organic and inorganic manures and biofertilizers as Azospirillum, *Azotobacter* and PSB was calculated and applied in 3 split doses at the 3rd, 5th, and 7th month after planting as per the treatments. The recommended dose of fertilizer for banana at the rate of 300:100:300 g N: P: K plant^{-1}. N, P and K was applied to the respective plants in form of urea, diammonium phosphate, murate of potash in split doses. In addition with recommended dose of inorganic

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fertilizer, biofertilizer *viz*. *Azotobactor*, *Azospirillium* and PSB were applied. Before application of biofertilizer it was mixed with FYM and vermicompost @ 25 kg in the ratio of 1:1:1 and kept for inoculation for 7 days. The mixture was applied when the ratoon plants were 90 days old. The plants of experimental plots were irrigated through flood irrigation with in an interval of 7 days.

The soil samples were collected randomly from the experimental field at 0-15 cm depth using tube at the time of harvest and the composite samples were air dried, grounded and sieved through 2 mm sieve and subjected to analysis to determine the mechanical, physical and chemical properties of the soil. Soil pH was determined by potentiometric method (Jackson, 1973). Organic carbon content of the soil was estimated by the "Wet digestion method" as described by Walkley and Black (1934) and expressed in percentage. Available nitrogen of the soil sample was determined by Modified Kjeldhal's method as described by Jackson (1973) and the amount of available nitrogen present in the sample was expressed as Kg ha^{-1}. Available phosphorus in soil sample was extracted by Bray's I (0.03 N NH4F + 0.025 N HCl) method as described by Bray and Kurtz (1945). The phosphorus was determined colorimetrically and expressed as available P_2O_5 (kg ha^{-1}). Available potassium content of the soil was extracted by neutral normal ammonium acetate as outlined by Jackson (1973). The potassium content of the sample was determined with the help of Flame photometer and expressed as available K_2O (kg ha^{-1}). The data were analyzed statistically as per the methods of Panse and Sukhatme, 1989.

RESULTS AND DISCUSSION

Data presented in table 1 showed that, the soil analysis also reveal that the soil pH, EC, organic carbon, and available NPK (Table 2) were improve after the application of biofertilizer *viz*; *Azotobacto*r, *Azospirillum*, PSB. The pH of the soil increase highest 5.69 to 6.80 in treatment T_4. It may be due to combined use of organic and inorganic inputs along with biofertilizer. Similarly the organic carbon content and electrical conductivity of the soils were significantly influenced by the treatment. The organic carbon increase 0.51 to 0.75 in T_5 which was significantly higher than all other treatments. This might be due to the fact that the presence of organic sources led to stabilized C:N ratio increasing the organic carbon content of the soil (Parr and Papendick, 1978).

Table 1: Effect of biofertilizer on soil physical parameters

Treatments	Soil P^H		Electrical conductivity		Organic carbon C (%)	
	Preharvest	Post harvest	Preharvest	Post harvest	Preharvest	Postharvest
T_1	5.53	5.85	0.03	0.04	0.38	0.59
T_2	5.54	5.14	0.08	0.11	0.45	0.62
T_3	5.65	6.34	0.05	0.07	0.48	0.65
T_4	5.69	6.80	0.05	0.05	0.5	0.68
T_5	5.63	6.72	0.05	0.09	0.51	0.75
SEm(±)	**0.06**	**0.44**	**0.01**	**0.02**	**0.02**	**0.10**
LSD (0.05)	**0.13**	**0.50**	**0.02**	**0.05**	**0.04**	**0.21**

Table 2: Effect of biofertilizer on soil chemical parameters

Treatments	Available N (kg ha^{-1})		Available P_2O_5 (kg ha^{-1})		Available K_2O (kg ha^{-1})	
	Pre	Post	Pre	Post	Pre	Post
T_1	189.21	267.40	16.14	24.40	175.00	162.25
T_2	192.56	308.53	16.87	26.63	180.00	210.75
T_3	229.32	322.40	23.54	30.95	182.00	190.25
T_4	229.82	341.20	24.12	35.17	183.11	215.00
T_5	230.50	360.81	24.95	37.89	184.00	239.50
SEm(±)	**2.40**	**8.94**	**0.26**	**0.43**	**12.3**	**24.06**
LSD (0.05)	**5.23**	**19.47**	**0.58**	**0.95**	**27.25**	**52.43**

Here the highest soil available nitrogen was ranges from 230.50 to 360.81 kg ha^{-1} was recorded in 100 per cent RDF + 125g *Azotobacto*r+ 125g *Azospirillum* + 125g PSB in (T_5). Such increase in available soil nitrogen in the treatment T_5 could be attributed to the ability of *Azospirillum, Azotobactor* to fix atmospheric nitrogen throughout the cropping time. It is witnessed from the table 2 that, *Azospirillum*, PSB increased the soil P_2O_5 as compared to control. The highest soil P_2O_5 ranges from 24.95 kg ha^{-1} to 37.89 kg ha^{-1} was recorded under T_5 which was significantly differed from rest of the treatments. Similarly, significantly the highest range of available K_2O was found under T_5 184.00 kg ha^{-1} to 239.50 kg ha^{-1}. This increase in P_2O_5 and K_2O may also be attributed to the initial content of potash and phosphorus in the organic supplements which on decomposition contributed to the available P, K.

The result of this investigation showed that the treatment T_5 consisting of 100 per cent RDF +125 g biofertilizer gave highest yield of banana cv Grand Naine simultaneously increasing soil fertility trend.

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