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Effect of Integrated Nutrient Management on Leaf Nutrient Content in Banana and Nutrient Availability in Soil after Harvest

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Abstract

A field experiment was conducted during 2005-2006 to find out the effect of integrated nutrient management on leaf nutrient status of banana plant at shooting and nutrient availability after harvest of crop. The integrated use of organic and 100% recommended dose of NPK (P as rock phosphate) along with biofertilizers increased nitrogen, phosphorus and potassium concentration in the plant and nutrient availability in soil after harvest.
Key words : Integrated nutrient management, Nutrient uptake, Banana.

Owing to increasing cost of fertilizers, their short supply and sustainability issues gaining importance, it is felt essential to reduce the dependence on chemical fertilizers. Therefore, different sources of plant nutrients, viz chemicals fertilizers, organic manures, biofertilizers, bioagents, crop residues have to be tried for working out their suitable integration. Further, such studies should be based on crop nutrient uptake. Knowledge of the size of various nutrient pools and of the rate of movement between them has practical implications for fertilizer application. The amount of nutrients in the pools is proportional to crop yield so that high yielding crop have large reserve of nutrients in corns and pseudostems (1). Banana is a heavy feeder of nutrients and requires large amount of nutrients for growth and development. This is due to their size, growth rate, rooting pattern and phenomenon of bud differentiation which have relationship with the field. However, the information of integrated nutrient management on leaf NPK and nutrient availability status after harvest of the crop is limited under Assam condition and hence the present investigation was programmed.

Methods

The field experiment was undertaken during 2005–06 in the experimental farm of the Department of Horticulture, Assam Agricultural University, Jorhat. The experiment was laid out in randomized block design with different treatment combinations replicated three times. The treatments were T_0–100% recommended dose (RD) of NPK + FYM; T_1–100% 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 + *Trocoderma harzianum*; T_7–50% RD of N + 100% RD of PK + FYM+PSB. Planting material used for study was sword sucker.The sword suckers of banana cv Jahaji (AAA) about 2 kg weight were planted during March 2005 at a spacing of 1.5 m × 1.5 m. The recommended dose of nitrogen, phosphatic and potassic fertilizers at 110g N, 33g P_2O_5 and 33 g K_2O per plant in the from of urea, SSP and MOP respectively were applied in two split doses, one at third month after planting and other half at fifth month after planting. 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. farm yard manures, vermicompost, biofertilizers and bioagents were applied based on

Table 1. Effect of INM on leaf nutrient concentration at shooting stage.

Treat-ments	Leaf nutrient concentration at shooting stage (%)		
	N	P	K
T_0	2.11	0.45	3.41
T_1	2.23	0.55	3.45
T_2	2.33	0.58	3.51
T_3	2.10	0.39	3.36
T_4	1.79	0.28	2.88
T_5	1.98	0.33	3.31
T_6	1.81	0.31	3.25
T_7	2.04	0.36	3.32
$CD_{0.05}$	0.18	0.04	0.10

treatment schedule. Well rotten farmyard manure (FYM) at 12 kg per pit, vermicompost at 2 kg per pit were applied before planting and rock phosphate at 137.5 g, *Azospirillum*, PSB, at 50 g per plant and *Tricoderma harzianum* at 50 g per plant were mixed with the soil at the time of planting. Recommended packages of practices were followed for other agronomic practices. For estimation of leaf N, P and K, the third leaf from the apex was taken for leaf sample (2). Samples at shooting stage of growth was taken from the middle portion of the lamina to a width of about 45 cm on both sides of the misrib. The collected samples were brought to the laboratory and cleaned, sun dried and oven dried, powdered and used for estimation of total nitrogen, phosphorus and potassium. Total nitrogen was estimated following the Microkjieldhal method as described by Humphries (3), phosphorus estimation was done by colorimetric method as described by Jackson (4) and estimation of potassium from leaf samples were done by Flame photometric method as described by Jackson (4).

For estimation of soil available nitrogen, phosphorus and potassium, soil samples were collected at a distance of 50 cm from the plant and at a depth of 0—30 cm at harvest. The collected samples were air dried, ground with wooden roller and passed through 2 mm sieve and stored in butter paper bag with proper tagging. Available nitrogen of the soil samples was estimated following Jackson (4). Available phosphorus was estimated following the method described by Bray and Kurtz (5) and available potassium content of soil was extracted following the method of Jackson (4). The data thus obtained were subjected to statistical analysis of variance by randomized block design.

Significant and non-significant variances due to different treatments were determined by calculating the respective *F* values following method described by Panse and Sukhatme (6).

Results and Discussion

The data recorded on leaf nutrient concentration as influenced by integrated nutrient management are presented in Table 1. The NPK content of leaf was observed to have highly significant difference among the treatments. The highest NPK content in leaf was recorded in T_2. While it was lowest in T_4. Higher concentration of leaf nutrient viz. NPK at shooting stage was recorded in treatments having integration of organic, inorganic and biofertilizer together. The maximum concentration of leaf nitrogen is ascribed due to presence of beneficial microorganisms in biofertilizers which rapidly mineralizes and nitrifies the organic nitrogen to inorganic form and make it readily available to plant (7). The results are in conformity with the results of Tiwary et al. (8) who reported that double inoculation of *Azotobacter* with 50% fertilizers increased the leaf nitrogen concentration in banana.

The organic sources of nutrients like FYM, oilcake and vermicompost are good source of P and the application of organic manures like FYM (9) helps in reducing the fixation of applied phosphorus and thereby causing an increase in the availability to crop resulting in an increase of phoshate content in leaf. The results of the present study corroborates the earlier work of Singh and Sharma (10) in citrus and Tiwary et al. (11) in banana who noted an increase in leaf phosphorus due to application of fertilizers.

The increase in leaf K as observed in the present investigation due to integrated use of organic, inorganic and biofertilizers sources may be due to higher availability, as the integrated nutrient sources themselves contributed potassium to the nutrient pool. Since banana can uptake hundred per cent applied K (12), minimized the loss due to leaching by retaining K ions on exchange site that would have increased the release of potassium ions resulting in increased uptake (13). The increase in leaf potassium under organic supplements and biofertilizer as observed in the present study is obvious. This corroborates the

Table 2. Effect of INM on available NPK status in soil after harvest.

Treat-ments	N (kg/ha)	P_2O_5 (kg/ha)	K_2O (kg/ha)
T_0	288.51	26.70	214.77
T_1	291.61	27.09	223.98
T_2	297.88	28.29	229.14
T_3	288.23	25.63	181.90
T_4	275.67	24.53	107.56
T_5	285.49	25.82	184.28
T_6	275.92	25.82	168.31
T_7	282.12	27.19	218.82
$CD_{0.05}$	0.73	0.34	0.59

earlier finding of Gubbuk et al. (14) who reported that the organic supplement of nitrogen considerably increased leaf K in banana as compared to fertilizers nitrogen. Increase in leaf potassium due to inoculation of *Azospirillum* have been studied by several workers (10, 15). The leaf nutrient concentration is influenced by nutrient status (16) in banana .

The data relating to available NPK in soil after harvest of the crop are presented in Table 2. Available form of nitrogen was influenced significantly by different treatment combinations. The highest available nitrogen was recorded in 100% recommended dose of PK + FYM + *Azospirillum* + PSB (T_2) which might be due to transformation of unavailable form to available form by the beneficial microorganism present in biofertilizers. This finding was similar to the finding of Gogoi et al. (17) that biofertilizers along with inorganic fertilizers in banana, significantly increased the available NPK status in soil after harvest. This is also in the agreement with finding of Reddy and Reddy (18).

The amount available phosphorus was greally influenced by different treatments. Application of PSB, *Azospirillum* along with rock phosphate significantly increased the available P status in soil compared to other treatment combinations. Availability of phosphorus under PSB and Azospirillum can be attributed to the production of organic acids. These acids act as a chelating agent and form stable complexes with Fe and Al abundantly available in acids soils and thereby release P from the clutches of Fe and Al to the soil solution. Similar findings were also reported. Integrated use of organic manures, biofertilizers with 100% NPK significantly increased the available K_2O of soil compared to other treatments. It could also be ascribed to the reason that combined application of organic and inorganic sources might have caused mineralization by solubilizing the insoluble components through the action of organic acids, released during decomposition and thereby minimize loss due to fixation. The results of Santhy et al. (13) also support to this.

References

1. Lahav E. 1995. Banana nutrition pages 258–315 in Gowen S. editor. Banannas and Plantains. Chapman and Hall Publ.London UK.
2. Murray D. B. 1960. The effect of deficiencies of the major nutrients on growth and leaf analysis of banana. Trop. Agric. Trin 30 : 100—108.
3. Humphries E. C. 1956. Modern method of plant analysis. pp. 468—502.
4. Jackson M. L. 1973. Soil chemical analysis. Prentice Hall of India Pvt. Ltd., New Delhi, India.
5. Bray R. H. and L. T. Kurtz. 1945. Determination of total organic and available forms of phosphorus in soils. Soil Sci.59 : 39—45.
6. Panse V. G. and P. V. Sukhatme. 1985. Statistical methods for agricultural Workers. ICAR, New Delhi, India.
7. Belser L. W. 1979. Population ecology of nitrifying bacteria. Ann. Rev. Microbiol. 33 : 309—333.
8. Tiwary U. S. S. R. Rajidhav, D. D. Jagtap and C. V. Pujari. 1999. Effect of organic and inorganic fertilizers on yield and quality of sweet orange (*C. sinensis* Osbeck). Int Symp. Citricul. 23—27 Nov. N.R. C.C. Nagpur, India, pp. 41.
9. Dhote S. L. and M. P. Kawthaikar. 1996. Effect of application of chopped Lucerne on productivity of cabbage J. Soil Crops 6 : 73—77.
10. Singh C. and B. B. Sharma. 1993. Leaf nutrient compositions of sweet orange as affected by combined use of bio and chemical fertilizer. South Indian Hort. 41 : 131—134.
11. Tiwary D. K., M. A. Hasan and P. K. Chottopadhyay. 1999. Effect of biofertilizer on soil nutrient status and microbial population in banana (*Musa* AAA sub-group Cavendish cv Giant Governor) Plantation. Environ Ecol. 17 : 338–341.
12. Martin-Prevel P. 1962. Mineral elements in banana plants and fruit bunches. Fruits 24 : 193—261.
13. Santhy P., M. S. Velusamy, V. Murugappan and D. Selvi. 1999. Effect of inorganic fertilizer and fertilizer manure combination on soil physico-chemical properties and dynamics of microbial in an inceptisol. J. Indian Soc. Soil Sci. 47 : 479—482.
14. Gubbuk H., S. Paydas and N. Kasak. 1993. Effects of different nitrogen and farm yard manure levels on the stem and finger growth and the durations of fruit development of Cavendish and Basrai banana clones. Doga, Turk, Tarim, ve,Ormancilik, Dergisi 17 :

239–253.
15. Motsara M. R., P. Bhattacharya and B. Srivastava. 1995. Biofertilizer-technology marketing and usage. Fert. Devel. and Consul. Organ, New Delhi, India.
16. Singh A. and S. P. Singh. 2004. Response of banana (*Musa* sp.) to VAM and varied levels of inorganic fertilizers. Indian J. Hort. 61 : 109—113.
17. Gogoi D., U. Katoky and S. Hazarika. 2004. Effect of biofertilizers on productivity and soil characteristics in banana. Indian J. Hort. 61 : 354—356.
18. Reddy G. B. and S. M. Reddy. 1998. Effect of organic manures and nitrogen levels of soil available nutrient status in maize-soybean cropping system. J. Indian Soc. Soil Sci. 46 : 474—476.