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Studies on sources of potassium on yield and post harvest soil characters of banana

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ABSTRACT

The experiment on assessment of sources and levels of K to improve the yield of banana cv. ROBUSTA resulted in increased bunch weight and its attributes such as number of hands, total number of fingers per bunch, finger length, finger circumference, finger weight and pulp:peel ratio by application of 150 per cent potassium as Sulphate of Potash. The soil pH and EC were found to be lowered at harvest wherever SOP was used as K source. Thus, the results clearly indicated the benefit of SOP in sustaining the soil quality in long run. Hence, it is recommended to integrate SOP in banana nutrition, by supplying recommended dose of K through SOP at 2, 4, 6 and 8 months after planting.

Key words : Banana, Bunch weight, Potassium, Sources, Sulphate of Potash, Soil pH, Soil electrical conductivity, Balance sheet.

Banana is considered as a potassium loving crop, as it requires high amount of K followed by N and P for proper growth and fruit production (Walmsley and Twyford, 1968 and Twyford and Walmsley, 1974). Thus, large quantity of nutrients has to be replenished in order to maintain soil fertility and sustain continuous production of higher yields. Besides, with the introduction of hitech horticultural practices for banana such as use of vigorous tissue culture derived plants, high density planting coupled with fertigation etc. accentuated banana researchers to fine tune the fertilizer schedule of banana. In tissue culture Robusta banana application of 150 per cent of recommended dose of K_2O *i.e.* 495 g per plant helped to get higher yield potentials (Nalina, 2002). But application of this higher dose may result in chloride accumulation in soils especially in sodic soils, when MOP is used as K source. These results in impairment of soils in long run, thus hindering the uptake of other nutrients, which ultimately reflect on yield of banana. This prompted to try alternate source of, Sulphate of Potash (SOP) *vis a vis* MOP on improving the yield of banana as well as soil quality.

MATERIALS AND METHODS

Initial soil analysis :

Before initiating the experiment, soil samples were collected and subjected for available potassium, pH and electrical conductivity and the contents were given below:

Available Potassium	: 423.52 (kg / ha)
pH	: 7.36
Electrical conductivity	: 0.19 (dSm^{-1})

The present investigation was undertaken with Ten treatments, T_1 = No potassium (Control), T_2 = 100% of RDK through MOP (3rd, 5th, and 7th months after planting), T_3 = 100% of RDK through SOP (3rd, 5th, and 7th months after planting), T_4 = 100% of RDK through MOP (3rd and 5th months after planting) + SOP (7th month after planting), T_5 = 100 of RDK through MOP (3rd month) + SOP (5th and 7th months after planting), T_6 = 150% of RDK through MOP (2nd, 4th, 6th and 8th months after planting), T_7 = 150% of RDK through SOP (2nd, 4th, 6th and 8th months after planting), T_8 = 50% of RDK through MOP (2nd and 4th months) + 50% of RDK through SOP (6th and 8th months after planting), T_9 = 75 % of RDK through SOP alone (3rd, 5th, and 7th months after planting), T_{10} = 50 % of RDK through SOP alone (3rd, 5th, and 7th months after planting)

Note :

– RDK- Recommended Dose of K_2O and hereafter it will be referred as RDK.

– The recommended K_2O adopted was 330 g per plant per year.

– Wherever 3 and 4 splits involved, RDK was applied in three and four equal split doses, respectively.

The observations on yield characters *viz*., bunch weight, number of hands, total number of fingers, finger length, finger circumference, finger weight and pulp: peel ratio were recorded. Soil samples were collected at the time of harvest. The samples were air dried in shade, ground with wooden mallet, passed through two mm sieve and used for following analysis. The pH of 1:2 soil and water suspension was determined using a pH meter model

- 3310 of Jenway Company (Jackson, 1973). The salt concentration of soil samples was estimated by measuring the electrical conductivity of 1:2 soil- water suspensions in Elico Conductivity Bridge and expressed in dSm^{-1}(Jackson, 1973). The available potassium in soil was estimated after extraction with neutral N ammonium acetate, using Flame Photometer and the values were expressed in kg ha^{-1} (Hanway and Heidal, 1952). Potassium uptake was computed by using leaf potassium content and dry matter production at harvest and expressed in kg / ha. In order to study the potassium loss or gain in the experiment, balance sheet was worked out. Net loss or gain was worked out by subtracting potassium uptake by crop (kg ha^{-1}) with total potassium added to the soil including initial soil potassium status (Sadanandan and Mahapatra, 1973). The statistical analysis of data was done by adopting the standard procedures of Snedecor and Cochran (1967).

RESULTS AND DISCUSSION

Yield in banana is a function of bunch weight and number of plants per hectare. Hence, any nutrient management study should aim at producing maximum bunch weight, so that, the productivity could be enhanced reasonably. Significant differences were noticed for bunch weight due to varying levels and sources of potassium. The highest bunch weight was recorded by T_7 *i.e.* 150 per cent of RDK as SOP, closely followed by T_3 (SOP at 100 per cent of RDK). The per cent increase in bunch weight in T_7 over control was 10.05. When the sources were compared at the same level of K, SOP was found to be superior. Though the difference seemed to be narrow, it was statistically significant. The varying sources and number of splits of potassium was found to affect the number of hands and the number of fingers per bunch significantly. The highest values were recorded for both the parameters by T_7 which was at par with T_6 . It could be inferred from the data (Table 1) that the finger length exhibited significant differences among the various treatments. The treatment T_7 comparatively recorded maximum finger length which was at par with other treatments excepting T_1. Similar trend was noticed for other finger parameters like finger circumference, finger weight and pulp: peel ratio also.

Status of nutrients in soil and balance sheet :

In drawing the budget for available potassium, the generated information on initial soil available K, nutrient addition and crop removal were taken into account and finally the expected balance was arrived at. This expected balance was computed with actual balance estimated through laboratory soil analysis values. Increased levels of K recorded higher potassium removal by banana against lower doses, which recorded lesser values because of differences in applied quantity (Table 2). Between the sources at equal K levels, SOP recorded the highest post harvest available K in soil while the lowest in control (Fig. 1). This is due to the role of sulphur in enhancing the availability of other nutrients including K, which is not possible by chloride. Banana removed more K from soil that is normally applied through fertilizers and this may bring about a reduction in K status of soil. This was in line with the findings of Suchdeva (1973).

The other plausible explanation for increased K status of soil at higher levels of K is due to the inherently available higher K status in these soils (Anon., 2004). This may be true in the present experiment as the

Table 1: Effect of sources of potassium on yield characters of banana cv. ROBUSTA

Treatment	Bunch weight (kg)	No. of hands	Total no. of fingers	Finger length (cm)	Finger circumference (cm)	Finger weight (g)	Pulp: peel ratio
T_1	26.84	8.63	165.56	19.74	13.30	171.31	2.91
T_2	27.08	9.33	171.83	20.02	13.54	185.15	3.11
T_3	29.04	9.88	175.58	20.94	13.68	198.18	3.29
T_4	27.18	9.33	169.38	19.98	13.55	188.28	3.09
T_5	28.68	9.88	173.14	20.08	13.58	189.28	3.10
T_6	28.85	10.00	180.36	21.34	13.83	202.15	3.38
T_7	29.84	10.35	185.28	21.83	14.10	208.30	3.58
T_8	28.31	9.50	173.18	20.33	13.64	185.43	3.18
T_9	27.18	9.33	170.14	20.03	13.44	180.18	3.15
T_{10}	27.10	9.33	170.14	20.00	13.40	179.81	3.10
S.E. $\pm$	0.83	0.23	6.66	0.11	0.29	5.49	0.10
C.D. (P= 0.05)	1.73	0.48	13.82	0.22	0.61	11.39	0.21

Table 2: Balance sheet for soil available potassium (kg ha^{-1}) as influenced by sources of potassium of banana cv. Robusta

Treatment	Initial soil available K	Addition of potassium through fertilizers	Total (4)=(2)+ (3)	Removal of potassium by crop	Expected balance (6)=(4-5)	Actual balance	Net loss (-) or gain (+) (8)=(6-7)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
T_1	423.52	-	423.52	692.16	-268.64	166.66	-435.30
T_2	423.52	990	1413.52	917.91	495.61	250.14	+245.47
T_3	423.52	990	1413.52	948.40	465.12	260.71	+204.41
T_4	423.52	990	1413.52	931.19	482.33	240.14	+242.19
T_5	423.52	990	1413.52	934.16	479.36	235.18	+244.18
T_6	423.52	1485	1908.52	1056.10	852.39	455.58	+396.81
T_7	423.52	1485	1908.52	1082.80	825.77	470.83	+354.94
T_8	423.52	1485	1908.52	941.16	967.36	445.81	+521.55
T_9	423.52	742.50	1166.02	892.45	273.57	238.63	+34.94
T_{10}	423.52	495	918.52	864.16	54.36	228.71	-174.35

Route Mean Square Error (RMSE) value for actual balance: 56.62

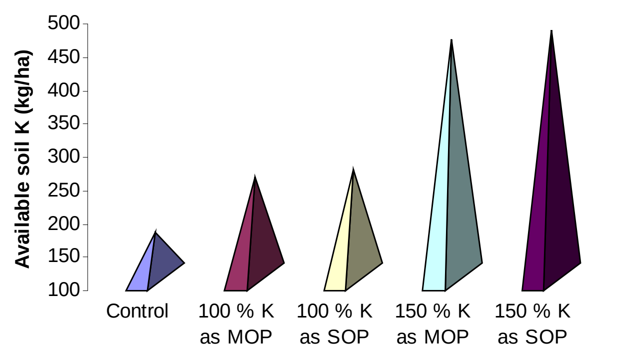

Fig. 1: Effect of sources and levels of K on post harvest available soil potassium (Kg/ha)

experimental sites had relatively higher soil status of K besides only plant crop was allowed. Ratooning of banana in the same field probably may well utilize the available soil K status and exhaust the soil K in the long-run (Turner, 1970; Holder and Gumbs, 1983, Ray *et al.*, 1993 and Mahalakshmi, 2000). The balance sheet of potassium indicated a gain in potassium except T_1 which did not receive any K and T_{10} which received only half the dose of K. The gain in rest of the treatments may be related to the shifting of dynamic equilibrium of K in soil. There is less gain in SOP treated plot which is due to effective utilization and increased uptake of K. Gain in K might be due to the release of K from the labile pool. Thus, it is evident from the present study that a high rate of K application is necessary to check further depletion of K reserve in soil.

Post harvest soil pH and EC :

The post harvest status of soil EC and pH indicated that there was a shift in pH towards neutrality and also reduction in soil electrical conductivity (EC) in SOP treated plots. This is due to acidifying property of SO_4 ions whereas chloride in excess tended to increase the pH and EC which is due to its osmotic effect on soil, restricting the uptake of other nutrients such as nitrate and sulphate. Besides, it easily combines with Na^+ ions causing shoot up in pH levels (Table 3).

Table 3: Effect of sources of potassium on post harvest soil pH and electrical conductivity (dSm^{-1})

Treatment	pH	Electrical conductivity
T_1	8.64	0.38
T_2	8.71	0.39
T_3	8.43	0.32
T_4	8.67	0.39
T_5	8.66	0.39
T_6	8.75	0.42
T_7	8.40	0.31
T_8	8.66	0.39
T_9	8.48	0.33
T_{10}	8.50	0.33
S.E. $\pm$	0.12	0.023
C.D. (P= 0.05)	0.24	0.05

In comparison to MOP, the application of SOP results in a pH reduction in rhizosphere (Roemheld, 1983). In alkaline soils, the lower pH possibly improves the availability of nutrients such as Zn, Mn, iron and boron, which are commonly present in the soil, but not available to the plants due to fixation. The excess chloride ions induces water deficit in soil, by combining with toxic Na^+ ions and thus causes salinity, resulting in imbalanced nutrient uptake, Under such situations, SOP is found to be superior, because it is virtually free of chloride, and has a lower salt index (46) than MOP (116). This chloride induced salinity causes impairment of water balance due to high osmotic pressure and correspondingly low soil water potential. Further, chloride induced salinity causes unavailability of nutrients, such as, K, Mg, Fe, Zn and Cu.

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