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Location Specific Nutrient Management for Sweet Potato (*Ipomoea batatas* L.) in Saline Inceptisols of West Bengal

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A field experiment was conducted for two consecutive Rabi seasons during 2009-10 and 2010-11 in order to optimize the doses of nitrogen, phosphorus, and potassium for sustainable production, proximate composition and nutrient uptake of sweet potato in saline Inceptisols West Bengal. The results revealed that Samrat was found superior among the five genotypes in respect of mean tuber yield (19.6 t ha^{-1}) followed by CIP-440127 (18.3 t ha^{-1}), whereas significantly highest mean vine yield was observed in Pusa Safed (23.9 t ha^{-1}) at par with Samrat (22.6 t ha^{-1}). Application of 75-22-63 kg ha^{-1} of N, P, and K (100 % NPK) has recorded significantly highest mean tuber yield (18.3 t ha^{-1}) across all the varieties followed by ¾ NPK (16.8 t ha^{-1}) at par with FYM (16.4 t ha^{-1}). Significantly highest mean starch and dry matter contents (22.8 and 30.9 %, respectively) were recorded in Kishan, while it was highest (21.8 & 30.3 %, respectively) due to application of optimum doses of NPK. Significantly highest total uptake of N, P, and K was observed in Samrat, Pusa Safed and CIP-40127. Incorporation of organic manure i.e. FYM @ 5 t ha^{-1} alone has shown almost equivalent yield response, quality and uptake of nutrients over to that of 3/4 of the recommended doses of NPK. The results emphasized that the genotypes Samrat, CIP-440127 and Pusa Safed are relatively tolerant to salinity stress (10-20 dS m^{-1}) and application of optimum doses of NPK produce sustainable crop yields, quality and uptake of nutrients and it offers good scope for food and nutritional security in the strongly saline soils of eastern India.

(***Key words:*** *Salinity, Yield parameters, Proximate composition, Nutrient uptake, Sweet potato)*

Inadequate and unbalanced supply of mineral nutrients and impaired soil fertility are particular problems, causing decreases in global food production, especially in the developing countries. In addition, crop plants must be capable of satisfactory biomass production in saline environment (yield stability). Salinity stress negatively impacts agricultural yield throughout the world affecting production whether it is for subsistence or economic gain. The plant response to salinity consists of numerous processes that must function in coordination to alleviate both cellular hyperosmolarity and ion disequilibrium (Yokoi *et al.*, 2002). Tolerance and yield stability are complex genetic traits that are difficult to establish in crops since salt stress may occur as a catastrophic episode, being imposed continuously or intermittently, or become gradually more severe, and at any stage during development.

It has been estimated that about one billion hectares of land is affected by salinity, 60% of which is cultivated (Goyal *et al.*, 2003). Sadana (2002) reported that in India, a potential area of 20 Mha of land is affected by varying degrees of salinity or sodicity or both of which 7 Mha are seriously affected by salinity. India has a total coastline of about 8,129 km and the salt affected soils occupy 9.38 Mha, out of which around 5.5 Mha are saline soils including 3.1 Mha of coastal saline soils (constitute 30 per cent of the total salt affected soils of the country) and 3.88 Mha alkali soils (IAB, 2000). These coastal saline soils are rich in soluble salts of chloride and sulphates in conjunction with Na and Mg, but acidic in reaction. Salt content of these soils is generally low i.e. 2 - 3 dSm^{-1} during rainy season due to dilution effect of heavy rains and it rises from 10 - 40 dSm^{-1} during summer. pH of these soils varied from 5.0 - 8.0 and exchangeable Na dominated by 18 - 27 % followed by Mg and Ca. Excess salts interfere with plant nutrition by affecting nutrient availability, uptake, or their physiological role within the plant. Intensive use of chemical fertilizers is being practiced for enhanced crop production, which has become cost intensive and beyond the reach of peasant farmers. It is inevitable to reduce the doses of inorganic nutrients and to use various organic sources especially in this era of organic agriculture that can sustain the crop productivity and to reduce the negative impact of excessive use of chemical fertilizers on climate change.

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Site-specific nutrient management (SSNM) is aimed at dynamic field-specific management of N, P, and K fertilizers to optimize the supply and crop demand for nutrients and the nutrient supply from naturally occurring indigenous sources such as the soil, organic amendments, crop residue, manure, and irrigation water. Selection of suitable crops and efficient genotypes are viable options for sustainable crop production in saline soils besides other management practices like land ploughing, levelling, flushing, draining of excess water, application of amendments, and flooding with good quality irrigation water. Salt stress hampers the rice productivity in *Kharif* as well as it will not allow to grow pulses and other sensitive crops during rabi season. The osmotic stress due to salts is the major reason for low biological activity, which can be significantly influenced by application of organic amendments and growing of salt-tolerant crops/ cultivars. The relative tolerance of different crops to salinity has been evaluated by many workers (Dagar, 2005).

Sweet potato (*Ipomoea batatas* L.) is the fifth most important food crop with high yield potential, highly nutritious and tolerant to adverse environmental conditions such as drought, salinity, low soil fertility and it requires less labour and care compared to other crops (Lim *et al.*, 2007; Abdissa, 2011). Nearly half of the sweet potatoes produced in Asia are used for animal feed whereas it used for human consumption in Africa referring to its importance as a staple and sustainable crop in the world and had immense potential to combat food shortage, malnutrition and poverty (CIP 2008). Despite the added advantages of production and nutrition of sweet potato, its production is affected by various biotic and abiotic stress factors (Guo *et al.*, 2006). Soil salinity is one of those factors that limit sweet potato productivity in many parts of the world. Soil salinity is a serious problem for agriculture in coastal regions, and having immense agronomic significance and needs suitable interventions for sustainable crop production. Screening of salt tolerant genotypes of sweet potato in saline sites is complicated owing to the large spatial variations in the soil salinity level, differential ontogenic reactions of the plant to salinity and a large genotype x environment interactions (Ekanayake and Dodds, 1993). Sweet potato varietal improvement against salinity stress is necessary to improve its potential as a food security and famine relief crop. It produces large amount of fodder which could be utilized for grazing of milch cattle during summer. In view of its significance, the present investigation was carried out to optimize the nutrient requirements for enhanced production of sweet potato under natural saline conditions for food and nutritional security in the saline soils of West Bengal.

MATERIALS AND METHODS

A field experiment was laid out for two consecutive Rabi seasons during 2009-10 and 2010-11 in the farm of the Regional Research Station of Central Soil Salinity Research Institute, Canning Town, South 24 Paraganas district of West Bengal in order to optimize the nutrients for sustainable production of sweet potato in saline soil. Composite soil sample was analyzed for physic-chemical properties by using standard procedures (Page *et al.*, 1982). The experimental soil is silty clay in texture (Typic Ustochrept), almost neutral (pH 6.23), saline (ECe 4.75 dSm^{-1}), and having 0.80 % organic C, 0.131 % total N, and 261, 24.2 and 520 kg ha^{-1} of available N, P and K, respectively. The trial was laid out with 4 white fleshed varieties of sweet potato (Pusa Safed, Kishan, Samrat, and Sree Bhadra) and 1 orange fleshed genotype (CIP-440127) as main treatments and 5 nutrient levels (Control, 50% NPK (38-11-31 kg N, P, and K ha^{-1}), 75% NPK (56-16-47 kg N, P, and K ha^{-1}), 100% NPK (75-22-63 kg N, P, and K ha^{-1}), and farmer's practice i.e. FYM @ 5.0 t ha^{-1}) as sub treatments. The treatments were replicated thrice in a Two Factorial Randomized Block Design.

After harvest of lowland Kharif paddy, the field was ploughed, leveled and imposed the treatments as per the layout. Well rotten farmyard manure (FYM) (contain 0.64, 0.22, and 0.85% N, P, and K, respectively) was applied 15 days in advance of sweet potato planting in the respective plots. One third of nitrogen in the form of urea, full dose of phosphorus as single super phosphate, half of the potassium as muriate of potash before planting, N at 30 days after planting (DAP), and the left over N and ½ K at 45 DAP were applied. The vine cuttings were dipped for half an hour in monocrotophos (35% EC) solution and planted at a spacing of 60 x 20 cm. The crop was grown up to 120 days, and yield parameters (vine length, number of tubers plant^{-1}, average tuber weight, tuber yield and vine yield) were recorded at harvest. It was observed that the soil sanity rose up to 16.0 dSm^{-1} (ECe) from initial level. However, the pH showed no significant changes during the crop growth period.

Plant samples (tubers & vines) were collected at harvest, washed thoroughly, oven dried, ground, digested in diacid mixture (HNO_3: $HClO_4$, 7:3), and estimated total P and K (Page *et al.*, 1982). Tuber and vine samples were digested in conc. H_2SO_4 and analyzed for N content by steam distillation. Uptake of N, P and K was computed by multiplying nutrient content with respect to tuber and vine yields and the values expressed on dry weight basis. Tuber samples were analyzed for bio-chemical constituents. Total sugars were estimated in the alcohol filtrate and the starch was determined in the residue as per the procedure outlined by Moorthy and Padmaja (2002). Dry matter of the tubers was estimated by drying of the samples in the oven at 60°C. The data was analyzed statistically and computed critical difference values for comparison and interpretation of data.

RESULTS AND DISCUSSION

Yield response

The results in Table 1 revealed that significantly highest mean tuber yield was recorded by Samrat (19.57 t ha^{-1}) followed by CIP-4401274 (18.33 t ha^{-1}) and Sree Bhadra (14.92 t ha^{-1}), while the genotype Kishan recorded lowest mean tuber yield (12.16 t ha^{-1}). Significantly highest mean tuber yield (18.27 t ha^{-1}) was observed due to application of 100 % NPK across all the varieties with a yield response of 50 per cent over control followed by 75 % NPK (16.75 t ha^{-1}, yield response of 37 %) at par with FYM (16.38 t ha^{-1}, yield response of 34%). Significantly highest mean vine yield was recorded by Pusa Safed (23.88 t ha^{-1}) at par with Samrat (22.56 t ha^{-1}), while the variety CIP-440127 recorded lowest vine yield (19.51 t ha^{-1}). Among the nutrient levels, addition of recommended doses of NPK (100 % NPK) has recorded significantly highest mean vine yield (24.59 t ha^{-1}) at par with FYM (23.54 t ha^{-1}) and 75 % NPK (22.82 t ha^{-1}). The interaction effect between genotypes and nutrient levels (Table 2) showed that significantly highest mean tuber yield (22.88 t ha^{-1}) was recorded due to application of 75-22-63 kg ha^{-1} of NPK in Samrat (V3T4), whereas highest mean vine yield (28.17 t ha^{-1}) was observed due to application of 75-22-63 kg ha^{-1} of NPK in Pusa Safed (V_1T_4).

Among the genotypes, Samrat, Pusa Safed and CIP-440127 showed higher tolerance for salt stress under natural saline conditions, however, the orange fleshed accessions had relatively low salt tolerance. The activity of antioxidative enzymes like superoxide dismutase (SOD), guaiacol peroxidase (GPX) and catalase (CAT) activities in the leaves of salt tolerant genotypes was increased than that in the susceptible ones, indicating that oxidative stress may play an important role in salt stressed sweet potato plants and that the greater protection of tolerant plants from salt induced oxidative damage results through the increase in the activity of antioxidant enzymes (Dasgupta *et al.*, 2008).

Table 1. *Effect of genotypes and nutrient levels on yield and quality of sweet potato in a saline soil of West Bengal*

Treatment	Tuber yield* (t ha^{-1})			Vine yield* (t ha^{-1})			Proximate composition (Mean of 2 years)		
	2009-10	2010-11	Mean	2009-10	2010-11	Mean	Starch* (%)	Sugars* (%)	Dry matter (%)
Genotypes									
V1 - Pusa Safed	13.85	12.56	13.21	28.65	19.11	23.88	22.41	3.33	28.56
V2 - Kishan	15.15	9.16	12.16	25.92	17.32	21.62	22.84	3.33	30.87
V3 - Samrat	23.11	16.04	19.57	24.78	20.34	22.56	21.27	3.44	29.58
V4 - Sree Bhadra	16.93	12.11	14.92	23.26	16.78	20.02	18.40	3.20	27.10
V5 - CIP-440127	22.51	14.15	18.33	20.47	18.55	19.51	20.24	3.37	28.59
CD (P=0.05)	3.01	1.01	1.91	3.09	1.16	1.55	0.46	0.09	1.18
Nutrient levels									
T1 - Control	14.71	9.69	12.20	19.98	13.61	16.79	19.95	2.98	26.80
T2 - 50% NPK	17.17	11.99	14.58	23.10	16.59	19.84	21.05	3.30	28.86
T3 - 75% NPK	18.39	14.32	16.75	25.32	20.32	22.82	21.72	3.52	29.99
T4 - 100% NPK	22.13	14.42	18.27	27.22	21.95	24.59	21.79	3.58	30.31
T5 - FYM @ 5.0 t ha^{-1}	19.15	13.62	16.38	27.45	19.63	23.54	20.65	3.29	28.74
CD (P=0.05)	2.10	0.95	1.13	1.63	1.06	0.89	0.25	0.12	0.48

* Values expressed in fresh weight basis

Residual effect of fertilizers and organic manure, which were applied to kharif paddy and application of limited doses of chemical fertilizers were found optimum for sustainable production of sweet potato. Incorporation of FYM alone produced higher tuber and vine yields rather than ½ NPK, which might be ascribed to enhanced nutrient transformations and improvement in soil physical properties that contributed in augmenting the crop yields (Ossom and Rhykerd, 2008). The crop response to applied fertilizers depends on soil organic matter which could be enriched either by natural returns through roots, stubbles and crop wastes as well as application of various organic resources (Ayoola and Adeniyan, 2006).

Proximate composition

Significantly highest mean starch content (22.84 %) was observed in Kishan followed by Pusa Safed (22.41 %) and Samrat (21.27 %) (Table 1), whereas Sree Bhadra and orange fleshed sweet potato accession like CIP-440127 showed relatively lower starch content (18.40 & 20.24 %, respectively). However, application of 100% NPK has recorded significantly highest mean starch content (21.79 %) at par with 75% NPK (21.72 %) followed by 50% NPK (21.05 %) and incorporation of FYM (20.65 %). The interaction between genotypes x nutrient levels (Table 2) showed that the mean starch content varied from 18.0 to 23.45 %, however, significantly

Table 2. *Interaction effect of genotypes and nutrient levels on yield and quality of sweet potato in a saline soil*

reatment	Tuber yield* (t ha^{-1})			Vine yield* (t ha^{-1})			Proximate composition (Mean of 2 years)		
	2009-10	2010-11	Mean	2009-10	2010-11	Mean	Starch* (%)	Sugars* (%)	Dry matter (%)
V_1T_1	7.63	9.48	8.56	21.78	14.62	18.20	21.00	2.86	26.74
V_1T_2	11.68	11.84	11.76	25.17	16.44	20.80	23.01	3.29	28.59
V_1T_3	14.80	13.81	14.31	29.27	21.43	25.35	23.29	3.57	30.11
V_1T_4	18.28	14.39	16.34	32.88	23.45	28.17	23.26	3.54	29.57
V_1T_5	16.87	13.27	15.07	34.16	19.62	26.89	21.48	3.37	27.79
V_2T_1	11.50	6.93	9.22	20.73	12.62	16.68	22.13	3.01	28.66
V_2T_2	14.44	7.69	11.07	23.92	15.64	19.78	22.75	3.42	30.83
V_2T_3	15.14	9.08	12.11	27.08	17.53	22.30	23.19	3.54	31.87
V_2T_4	18.16	11.65	14.90	29.36	20.25	24.81	23.45	3.41	31.63
V_2T_5	16.52	10.47	13.50	28.49	20.56	24.52	22.69	3.26	31.36
V_3T_1	17.33	11.81	14.57	19.36	14.51	16.93	19.63	3.16	27.07
V_3T_2	20.58	14.89	17.73	24.26	18.64	21.45	20.54	3.38	28.69
V_3T_3	24.97	18.97	21.97	25.84	23.17	24.50	22.70	3.55	30.85
V_3T_4	27.38	18.39	22.88	26.20	24.96	25.58	22.41	3.77	31.55
V_3T_5	25.29	16.13	20.71	28.24	20.43	24.33	21.08	3.34	29.75
V_4T_1	18.77	8.39	13.58	20.89	12.19	16.54	17.63	2.81	24.96
V_4T_2	18.39	11.52	14.95	23.44	15.67	19.55	18.49	2.96	27.53
V_4T_3	13.51	13.85	13.68	23.98	19.92	21.95	18.82	3.45	27.77
V_4T_4	21.70	13.51	17.61	24.02	19.32	21.67	19.07	3.58	28.98
V_4T_5	12.26	13.28	12.77	23.99	16.78	20.39	18.00	3.17	26.26
V_5T_1	18.32	11.83	15.08	17.15	14.09	15.62	19.35	3.05	26.58
V_5T_2	20.76	14.00	17.38	18.71	16.57	17.64	20.45	3.43	28.67
V_5T_3	23.55	15.87	19.71	20.45	19.57	20.01	20.61	3.48	29.34
V_5T_4	25.11	14.14	19.63	23.66	21.79	22.73	20.77	3.57	29.81
V_5T_5	24.80	14.93	19.87	22.37	20.74	21.56	19.99	3.29	28.54
CD (P=0.05)	4.70	2.13	2.53	3.64	2.29	1.99	0.57	0.26	1.07

* Values expressed in fresh weight basis

V_1 - Pusa Safed, V_2 - Kishan, V_3 - Samrat, V_4 - Sree Bhadra, V_5 - CIP-440127;

T_1 - Control, T_2 - 50% NPK, T_3 - 75% NPK, T_4 - 75% NPK, T_5 - FYM @ 5.0 t ha^{-1}

higher starch content (23.45 %) was recorded in Kishan due to application of 100% NPK (V_2T_4).

Among the genotypes, Samrat has recorded significantly highest total sugars (3.44%) at par with CIP-440127 (3.37 %) followed by Kishan and Pusa Safed (3.33%). Mean dry matter content in the tubers ranged from 25.0 - 31.9 % across all the varieties irrespective of the nutrient levels (Table 2). Significantly highest mean dry matter content was recorded by Kishan (30.9 %) followed by Samrat (29.6 %), CIP-440127 (28.6 %) and Pusa Safed (28.6%). Application of 100% NPK has recorded significantly highest dry matter (30.3 %) with an increase of 13 per cent over control followed by ¾ of the recommended doses of NPK (29.99 %) and ½ NPK (28.9 %). The use of inorganic fertilizers has not only to enhance the crop yields but also had significant effect on bio-chemical constituents of sweet potato, similar to the findings of Mozafar (1993).

Nutrient uptake

The data pertinent to uptake of nutrients by sweet potato (Table 3) revealed that Samrat has recorded significantly highest total uptake of N (83.8 kg ha-1) followed by Pusa Safed (80.7 kg ha^{-1}) and Kishan (76.5 kg ha^{-1}), while it was lowest in Sree Bhadra (72.3 kg ha^{-1}). Application of 100 % of the recommended doses of NPK showed significantly highest total uptake of N (90.5 kg ha^{-1}) with an uptake response of 63 per cent over control at par with FYM (90.0 kg ha^{-1}, uptake response of 62%). Application of 100% NPK in Pusa Safed (V_1T_4) has recorded significantly highest mean uptake of N (98.7 kg ha^{-1}) at par with incorporation of FYM in Pusa Safed (98.7 kg ha^{-1}) (Table 4). It was observed that vines have recorded significantly highest uptake of N in all the varieties irrespective of nutrient levels as compared to tubers, which might be due to higher concentration of N in the foliage rather than tubers. Nitrogen regime had a significant effect on the concentration of N in the leaves of plants, with the higher N regime having higher levels of leaf nitrogen and the concentration of N did not differ significantly among the genotypes, however, the variation in the yield of tubers and vines have contributed variation in the uptake of NPK by the crop. These results are in accordance to the findings of Marti and Mills (2002).

Significantly highest total uptake of P (37.4 kg ha^{-1}) was recorded by Samrat (Table 3) followed by CIP-440127 (32.8 kg ha^{-1}) at par with Pusa Safed (32.7 kg ha^{-1}). Addition of optimum doses of NPK recorded significantly highest total uptake of P (40.3 kg ha^{-1}) across all the varieties. Incorporation of FYM has shown higher response in respect of total P uptake (23.36 kg ha^{-1}) rather than ¾ NPK (39.2 kg ha^{-1}). Interaction between genotypes and nutrient levels showed that significantly highest total uptake of P (46.1 kg ha^{-1}) was recorded in Samrat due to application of 100% NPK (Table 4) at par with incorporation of FYM in Samrat (44.5 kg ha^{-1}). The supplementary and complementary use of organic

Table 3. *Effect of genotypes and nutrient levels on nutrient uptake (kg ha^{-1}) of sweet potato in saline soils (mean of 2 years)*

Treatment	Tubers			Vines			Total uptake		
	N	P	K	N	P	K	N	P	K
Genotypes									
V_1 - Pusa Safed	17.76	13.06	42.01	62.94	19.65	59.53	80.71	32.71	95.18
V_2 - Kishan	17.84	15.25	41.94	58.63	16.49	52.55	76.48	31.74	91.53
V_3 - Samrat	26.54	20.77	62.13	57.22	16.66	55.20	83.76	37.43	119.30
V_4 - Sree Bhadra	16.75	14.01	39.77	55.55	15.88	44.44	72.31	29.89	85.69
V_5 - CIP-440127	21.00	16.32	51.65	51.34	16.49	48.93	72.34	32.81	103.36
CD (P=0.05)	2.77	2.33	7.07	9.60	2.28	4.02	10.27	3.97	14.09
Nutrient levels									
T_1 - Control	13.18	10.12	32.87	42.23	11.63	40.41	55.41	21.76	71.30
T_2 - 50 % NPK	17.59	13.54	43.20	51.30	14.59	47.86	68.89	28.13	89.24
T_3 - 75 % NPK	22.42	17.33	52.91	58.35	17.86	52.30	80.76	35.20	108.85
T_4 - 100 % NPK	24.63	19.88	57.19	65.88	20.44	61.16	90.51	40.31	117.06
T_5 - FYM @ 5.0 t ha^{-1}	22.09	18.53	51.33	67.93	20.64	58.93	90.02	39.17	108.61
CD (P=0.05)	1.36	1.16	3.06	3.71	0.71	4.47	3.88	1.26	4.14

Table 4. *Interaction effect of genotypes and nutrient levels on nutrient uptake (kg ha^{-1}) of Sweet Potato (mean of 2 years)*

Treatment	Tubers			Vines			Total uptake		
	N	P	K	N	P	K	N	P	K
V_1T_1	10.333	7.00	24.59	42.83	13.22	44.74	53.16	20.21	63.73
V_1T_2	15.60	10.59	36.51	52.75	16.02	51.83	68.35	26.60	79.92
V_1T_3	20.11	14.67	47.96	64.52	20.62	63.36	84.63	35.29	104.69
V_1T_4	22.95	17.44	53.75	75.75	24.06	71.12	98.71	41.50	118.49
V_1T_5	19.83	15.60	47.21	78.85	24.32	66.61	98.68	39.92	109.07
V_2T_1	11.75	9.11	27.66	44.43	10.98	40.09	56.18	20.10	62.46
V_2T_2	15.52	12.58	36.46	51.42	14.06	48.04	66.94	26.63	79.63
V_2T_3	18.61	15.24	43.71	60.56	16.93	53.33	79.17	32.17	96.40
V_2T_4	22.42	19.92	52.73	66.83	19.74	60.79	89.25	39.66	113.67
V_2T_5	20.93	19.43	49.14	69.92	20.72	60.49	90.85	40.12	105.50
$V3T_1$	16.72	12.97	43.55	40.16	10.98	41.72	56.89	23.95	84.42
V_3T_2	22.18	16.82	56.04	53.98	14.70	51.28	76.17	31.52	109.09
V3T3	30.55	23.24	70.69	60.07	17.85	59.89	90.62	41.09	134.71
V_3T_4	33.53	26.29	74.30	64.68	19.80	63.04	98.20	46.09	139.90
V_3T_5	29.71	24.55	66.05	67.22	19.96	60.08	96.93	44.51	128.37
V_4T_1	12.74	10.43	31.35	45.71	11.82	38.13	58.45	22.25	68.25
V_4T_2	16.37	13.56	39.83	53.75	14.57	45.39	70.12	28.13	84.76
V_4T_3	18.50	15.34	43.92	56.57	17.21	34.89	75.07	32.55	95.62
V_4T_4	20.34	17.00	46.97	60.30	18.02	52.85	80.64	35.02	96.87
V_4T_5	15.81	13.69	36.77	61.42	17.77	50.93	77.24	31.46	82.95
V_5T_1	14.36	11.10	37.17	37.99	11.17	37.37	52.35	22.27	77.63
V_5T_2	18.26	14.17	47.16	44.59	13.59	42.74	62.86	27.76	92.78
V_5T_3	24.31	18.19	58.24	50.01	16.69	50.02	74.32	34.88	112.83
V_5T_4	23.91	18.73	58.17	61.84	20.56	57.99	85.75	39.30	116.38
V_5T_5	24.18	19.40	57.49	62.25	20.42	56.55	86.42	39.82	117.16
CD (P=0.05)	3.04	2.59	6.85	8.30	1.59	10.00	8.69	2.83	9.26

V_1 - Pusa Safed, V_2 - Kishan, V_3 - Samrat, V_4 - Sree Bhadra, V_5 - CIP-440127
T_1 - Control, T_2 - 50 % NPK, T_3 - 75 % NPK, T_4 - 100 % NPK, T_5 - FYM @ 5.0 t ha^{-1}

and inorganic fertilizers augments the efficiency of both the sources of nutrients to maintain a high level of soil productivity.

The total uptake of K was found highest in Samrat (119.3 kg ha^{-1}) irrespective of nutrient levels (Table 3) followed by CIP-440127 (103.4 kg ha^{-1}) and Pusa Safed (95.2 kg ha^{-1}). Increased levels of NPK showed an increasing trend of total K uptake and application of recommended doses of NPK has recorded significantly highest total uptake of K (117.1 kg ha^{-1}) across all the varieties with an uptake response of 64.2 per cent over control. Incorporation of FYM alone has recorded significantly highest total uptake of K (108.6 kg ha^{-1}, uptake response of 52%), which is almost equivalent to ¾ NPK (108.9 kg ha^{-1}, uptake response of 53%), which might be ascribed to improvement in organic matter of the soil that facilitate higher retention and supply of essential nutrients as well as improvement in soil physical and biological properties. These results are in corroborative with the findings of Ravindran and Bala (1987); Svotwa *et al.*, (2007). The interaction between genotypes and nutrient levels (Table 4) showed application of 100% NPK in Samrat has recorded significantly highest total uptake of K (139.9 kg ha^{-1}) at par with ¾ NPK in Samrat (134.7 kg ha^{-1}). Potassium is essential for many physiological processes, such as photosynthesis, translocation of photosynthates into sink organs, maintenance of turgescence, activation of enzymes, and reducing excess uptake of ions such as Na and Fe in saline and flooded soils (Mengel and Kirkby, 2001). The results emphasized that the genotypes Samrat, CIP-440127 and Pusa Safed have the capability to absorb more potassium from the soil which might have improved the ability to tolerate salt stress and produce higher crop yields and proximate composition. These results are in concurrent with the findings of Marschner (1995) and Ismail (2005).

The present study emphasized that the genotypes Samrat, CIP-440127, Pusa Safed and Kishan were tolerant to salt stress by producing highest tuber and vine yields along with uptake of nutrients as well as biochemical constituents. Application of the recommended doses i.e. 75-22-63 kg ha-1 of NPK was found optimum to obtain sustainable crop yields with good quality tubers, whereas incorporation of FYM @ 5.0 t ha^{-1} has resulted almost equal yield response over that of ¾ NPK, suggesting that application of good amount of organic manure alone could meet the nutrient requirements of the crop. Cultivation of sweet potato with optimum and balanced doses of nutrients offers good scope for livelihood and nutritional security in the strongly saline soils of West Bengal.

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