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Nitrogen and potassium nutrition in sapota grown in laterite soil

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Sapota (*Manilakra achras*) (Mill Forberg), is a sweet, delicious fruit found in tropical and subtropical climatic region. However, it performs better in humid tropical climate. In West Bengal, it is widely cultivated in 24 Parganas (both North and South) and Purba Midnapore (Contai sub-division). Due to its wider adaptability, less management cost, less susceptibility to pest and diseases and regular fruit yield, the cultivation of sapota is gaining popularity in the region. Sapota although cultivated in coastal belt of West Bengal, however it can also be grown in laterite zone (Mathew *et al.*, 2001) where vast barren area could be utilized with this crop. The crop is an evergreen tree with continuous growth flushes, flowering and fruiting all the year round. For better yield, fruit size and quality, the crop requires judicious manuring which need to be standardized for a set of agro-climatic condition. As no such attempt has been made in laterite zone or other parts of West Bengal, a long term investigation was, therefore, made to standardize the nitrogen and potassium requirement for higher production with quality fruits.

The present investigation was carried out on 10 year old sapota plants cv. Cricket Ball, planted at a distance 7 x 7 m spacing having uniform growth and vigour at MPS Farm, Jhargram during the years 2006 to 2010. The soil of the experimental orchard was laterite having pH 6.1, cation exchange capacity 17.0 mg 100^{-1} g soil, available nitrogen was 0.018 percent, phosphorus 33 kg per ha, potassium 110 kg per ha. Three levels of nitrogen viz., 200, 300, 400 g (N_1, N_2, N_3) and potassium 200, 300, 400g (K_1, K_2, K_3) $plant^{-1}$ $year^{-1}$ were applied in a factorial randomized block design with four replication. All the all plants were fertilized with constant dose of 100g P_2O_5 $plant^{-1}$ $year^{-1}$. The sources of N, P and K were urea, rock phosphate and muriate of potash respectively. The fertilizers were applied in two equal split doses in June and September.

Yearly increment of growth was recorded and total increment during three years was expressed as per cent increase. Due to continuous flowering and fruiting behaviour of the crop, fruit yield was recorded at 3 months interval and four harvests in a year was sum up and presented in the table. The physico-chemical characteristics of fruits were determined following standard techniques (A.O.A.C., 1970). For estimation of foliar N, P and K content, 10^{th} leaf from growing tip in September from four direction of each plant was collected (Bhargava, 1999). Leaf N was determined by using micro-Kjedahl method, P by vandomolbdophosphoric acid method and K by flame photometer.

Application of nitrogen at 300 g $plant^{-1}$ $year^{-1}$ enhanced plant growth in terms of height, basal girth and plant spread in East-West direction (Table 1). The highest dose (400g N) was not effective for further increment in growth. The potassium at lowest level *i.e.* 200g $plant^{-1}$ $year^{-1}$ was effective in increasing the growth of the canopy in East-West and North-South direction. It was calculate that effect of different levels of nitrogen and potassium either singly or in combination on different growth parameters was statistically non-significant. Non-significant effect of different levels of N and K may be due to adult age of the plant where vegetative growth phases seemed to be completed. The growth in plant, which takes place every year due to natural phenomenon, fertilizer application at different levels resulted less variation among the treatments.

The date in table-2 clearly indicated that application of nitrogen significantly enhanced fruit yield throughout the period of investigation. Highest yield $plant^{-1}$ was recorded from the plants, which received highest dose of nitrogen (400g $plant^{-1}$). In a fertilizer trial on Cricket Ball cultivar of sapota in Haryana, Singh *et al.*, (2000) noted increase number of fruits per tree with nitrogen rate from 400g to 800 g tree-1. Potassium application on the other hand helped to harness significantly enhanced fruit yield upto 300g K_2O $^{-1}$ $plant^{-1}$ $year^{-1}$. The differences in the fruit yield per plant due to interaction of N and K were, also significant in all the four years of study.

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It was interestingly noted that fruit yield increased with the increase in plant age, which reached to maximum in 2009 and then decreased irrespective of the treatments. These observations indicated that at least four consecutive years' of yield data is to be required for fertilizer recommendation to a fruit crop like sapota.

From the consumer's point of view, fruit weight is one of the important criteria in sapota. Application of nitrogen significantly increased the individual fruit weight and the highest level (N_{400}g) produced the heaviest fruit (Table 2), which was more by 8.0 per cent as compared to the lowest level (N_{200}g). Increased fruit weight due to application of higher levels of nitrogen was also noted by Singh *et al.* (2000). Potassium application at 300 g plant^{-1} was also significantly effective in increasing fruit weight. However, interaction effect (N × K) on fruit weight was found non-significant.

Table 1: Effect of nitrogen and potassium on growth and leaf N, P, K status in sapota cv. Cricket Ball

Treatments	Per cent increase (three years) (2007-08 to 2009-10)				Foliar content			
	Plant height	Basal girth	Plant spread		N	P	K	N/K ratio
			East-West	North-South		(mg %)		
N_1	8.7	9.9	27.2	19.1	1.1	-	-	-
N_2	11.2	13.5	29.4	17.9	1.4	-	-	-
N_3	10.2	11.9	25.8	15.3	1.7	-	-	-
K_1	9.1	12.4	30.6	20.8	-	-	0.9	-
K_2	10.5	12.9	24.4	16.9	-	-	0.9	-
K_3	10.5	9.9	27.4	14.6	-	-	0.6	-
Interaction (N × K)								
N_1K_1	7.8	7.7	28.9	24.6	1.1	100	0.6	1.8
N_1K_2	8.1	11.1	26.3	17.0	1.2	110	0.8	1.5
N_1K_3	10.3	10.8	26.4	15.6	1.0	117	0.5	2.0
N_2K_1	10.5	8.3	48.0	18.5	1.4	103	0.8	1.8
N_2K_2	12.5	15.1	21.4	18.7	1.6	114	0.9	1.8
N_2K_3	10.5	7.0	18.7	16.6	1.3	120	0.7	1.9
N_3K_1	8.9	11.3	14.8	19.2	1.6	130	0.9	1.8
N_3K_2	11.0	12.5	25.5	15.1	1.8	135	1.0	1.8
N_3K_3	10.7	12.0	37.0	11.6	1.7	135	0.8	2.1
SEm (±)								
N	**1.1**	**0.8**	**1.8**	**1.7**	**0.2**	**3.4**	**0.1**	-
K	**1.1**	**0.8**	**1.8**	**1.7**	**0.2**	**3.4**	**0.1**	-
N×K	**1.9**	**1.4**	**3.5**	**3.2**	**0.4**	**6.2**	**0.2**	-

Note: NS= Non significant

The different quality parameters like pulp percentage, T.S.S., total sugar and Vit. C content was improved with the increase level of nitrogen but the result was statistically not significant. The potassium application on the other hand also improved the quality parameter and the result was not significant (Table 2). This observation was in consonance with the findings of Singh *et al.* (2000).

Application of nitrogen significantly increased the leaf N content to varying proportions upto the highest level (Table 1). The potassium application on the other hand found to increase the leaf K upto medium level (300 g plant^{-1}) and at highest level (400 g), it was decreased and the differences were found non-significant. Singh *et al.*, (2003) also observed that the foliar nitrogen content was increased significantly while P and K contents were not affected significantly by different levels of nitrogen, phosphorus and potassium in Cricket Ball variety of Sapota. The highest fruit yield was recorded with the N_{400} K_{300} treatment having leaf N/K ratio was 1.8.

Table 2: Effect of nitrogen and potassium on yield and physico-chemical characteristics of fruits in sapota cv. Cricket Ball

Treatments	Fruit yield plant^{-1} (kg)					Fruit weight (g)	Pulp content (%)	T.S.S. (^{0}B)	Acidity (%)	Total sugar (%)	Vit. C (mg 100^{-1} g pulp)
	2007	2008	2009	2010	Average						
N_1	43.7	56.5	84.0	42.4	56.6	99	96.4	15.9	0.14	11.1	4.0
N_2	44.9	63.3	85.8	46.1	60.1	102	96.4	16.2	0.10	11.7	4.2
N_3	47.3	66.1	86.4	52.0	62.9	107	96.7	16.3	0.08	12.3	4.5
K_1	38.7	52.8	71.2	37.2	50.0	96	96.1	15.5	0.12	10.9	3.2
K_2	49.7	74.4	98.4	57.9	70.1	110	96.8	16.6	0.10	12.7	5.3
K_3	47.6	58.6	86.6	45.4	59.6	103	96.6	16.3	0.10	11.5	4.2
Interaction (N × K)											
N_1K_1	36.9	48.2	71.5	34.7	47.8	94	96.1	15.4	0.15	10.2	3.0
N_1K_2	48.1	64.9	97.4	51.3	65.4	106	96.7	16.4	0.11	11.8	5.0
N_1K_3	46.2	56.3	83.1	41.1	56.7	98	96.4	16.0	0.15	11.4	4.0
N_2K_1	38.5	54.5	72.2	35.9	50.3	96	96.1	15.5	0.13	11.3	3.2
N_2K_2	49.7	75.6	98.1	58.5	70.5	108	96.6	16.6	0.09	12.4	5.3
N_2K_3	46.6	59.7	87.2	44.0	59.4	102	96.5	16.4	0.09	11.5	4.1
N_3K_1	40.7	55.6	69.8	40.9	51.8	97	96.2	15.6	0.08	11.3	3.4
N_3K_2	51.2	82.8	99.8	63.9	74.4	115	97.1	16.8	0.09	13.9	5.5
N_3K_3	49.9	59.9	89.5	51.2	62.6	110	96.8	16.6	0.07	11.6	4.5
SEm (±)											
N	**0.31**	**0.38**	**0.27**	**0.20**	**0.24**	**1.0**	**0.40**	**0.08**	**0.002**	**0.06**	**0.50**
K	**0.31**	**0.38**	**0.27**	**0.20**	**0.24**	**1.0**	**0.40**	**0.08**	**0.002**	**0.06**	**0.50**
N×K	**0.48**	**0.72**	**0.41**	**0.31**	**0.34**	**1.9**	**0.60**	**0.10**	**0.003**	**0.08**	**0.80**
LSD (0.05)											
N	**0.9**	**1.1**	**0.8**	**0.6**	**0.7**	**3.0**	**NS**	**NS**	**NS**	**NS**	**NS**
K	**0.9**	**1.1**	**0.8**	**0.6**	**0.7**	**3.0**	**NS**	**NS**	**NS**	**NS**	**NS**
N × K	**1.4**	**2.1**	**1.2**	**0.9**	**1.0**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

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