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Standardization of stage wise application of N, P & K on yield and yield attributing characters of sapota (*Manilkara achras* L.) Var. Kalipatti

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Abstract
A field trial was conducted during 2018-2019 at Department of Fruit Science, Kittur Rani Channnamma College of Horticulture, Arabhavi. Standardization of stage wise application of N, P & K on yield and yield attributing characters of sapota var. Kallipatti. Treatment T_3 at four different growth stages. i.e., 20-80- 20, 20-0-20, 20-0-20, 20-0-20 at the Vegetative flush (July), Fruit set (September), Fruit pea stage (November) and Fruit growth (February) stages respectively, the maximum number of flowers per shoots (11.38), per cent of fruit set (18.56 %), per cent of fruits reached to final harvest (83.78 %). And the highest number of fruits per shoot was recorded in T_3 (2.10), maximum fruit weight (90.25 g), fruit length (7.50 cm), fruit girth (5.73 cm) and fruit volume (88.25 ml), seed parameters in respect of number of seeds per fruit (1.67), seed weight (1.02 g) and shelf life (12.65 days) were associated with the treatment T_3. Highest yield per tree (124.0 kg) and (0.13 t/ha) was recorded in treatment T_3. Better quality fruits with high TSS (24.50 °B) and low acidity (0.16%) was also found in treatment T_3. And lowest were recorded in control T_5.

Keywords: *sapota var. kalipatti*, NPK, reproductive parameters, physico-chemical characteristics

Introduction
Sapota or Chiku (*Manilkara achras* L.) is one of the prominent dessert fruit belongs to family sapotaceace. India is leading producer of sapota in the world and sapota ranks fifth in both production and consumption next to mango, banana, citrus and guava. It is mainly cultivated for its fruits in India. While, in South East Mexico, Guatemala, British Honduras and other countries chuckle gum is commercially produced from sapota. Where it is commercially grown in states like Maharashtra, Gujarat, Andhra Pradesh, Karnataka, Tamil Nadu, Kerala, Uttar Pradesh, West Bengal, parts of Punjab and Haryana (Cheema *et al.* 1954; Purse glove, 1968; Singh, 1969). Among all the states, Karnataka is the leading sapota producing state and contributes to about 26.5 per cent of the total production in the country. Karnataka produces 0.38 million MT sapota from an area of 0.03 million hectare with the productivity of 12.3 MT per hectare and the production of sapota is known in Belagavi, Dharward, Chikamangalur, Shivamogga and Hassan districts of Karnataka (NHB 2016-2017).
In fruit crops, it is known that applications of NPK fertilizers are vital for fruit yield and quality Besides, NPK plays an important role in the growth and development of the plant and requirement is high. But, under tropical conditions, soil nutrients are leached/ lost rapidly due to various factors. Therefore, it is important to apply nutrients at the critical stages of tree growth in small doses, at shorter intervals, to minimize loss of nutrients and cost of production and to increase the productivity, better understanding on the importance of stage wise application of fertilizers in sapota cv. Kalipatti is needed to boost sapota production, which minimize the loss of fertilizers and improves nutrient use efficiency.

Material and methods
Soil parameters
A field experiment was conducted during 2018-2019 at Department of Fruit Science, Kittur Rani Channnamma College of Horticulture, Arabhavi. The selected orchard is located in Northern dry tract of Karnataka state at latitude 16°15' N and longitude 74°45' E at an altitude of 612.03 metres above the mean sea level. The twenty four old sapota planted at a spacing of 10 m x 10 m were selected and divided it into 5 treatment plots with each having eight plants. Treatments were allocated in randomized block design (RBD) with four replications in each treatment. Soil type in the experimental field was black cotton soil, and its initial status revealed that it was alkaline (pH 8.29), medium in EC (0.16 dSm-1), available N (265kg ha^{-1}), available K (19.85kg ha^{-1}) and low in available P (325.75 kg ha^{-1}).

The total rainfall received during the year 2018-19 and 2018-19 were approx 529.6 mm and 505.9 mm, respectively. The treatments consists of T_1 N-P-K(g) (32-40-20, 16-0-20, 16-40-20, 16-0-20), T_2 (20-40-32, 20- 0-16, 20-40-16, 20-0-16) T_3 (20-80- 20, 20-0-20, 20-0-20, 20-0-20) T_4 (20- 40- 20, 20-0-20, 20-40-20, 20-0-20) and T_5 (50-100-50, 25-0-25, 25-0-25, 0-0-0). In addition 15kg Vermicompost per tree in July + Micro nutrient spray in October (Zn-0.6%, Fe-0.4%, Mn-0.2%, Cu-0.2%, B-0.2%) + *Azatobacter* 100g and PSB 100g per tree (10^8 cfu/mg) were also applied as common dose for each plant in month of july and RDF according to recommendations of university of horticultural sciences bagalkot.

The NPK were applied under the canopy 30 cm radius from the trunk. The number of flowers per branch was counted on all tagged branches in four sides of plants. The fruit set was calculated at pea size fruit. The average weight of ten randomly selected fruits from each treatment was recorded. The yield was calculated by multiplying the number of fruits with average fruit weight. The fruit and yield data were recorded during harvesting season. For recording the fruit quality observations five mature fruits were randomly selected from each observational plant and same fruits were used for recording the various physico-chemical properties of sapota. Statistical analysis of mean data collected on various parameters during the study was performed using randomized block design as per the methods suggested by Panse and Sukhatme (1967) [5] using OPSTAT statistical software package (Sheoran *et al*., 1998) [6].

Results and Discussion

Yield parameters

Influence of various levels of nutrients applied at different growth stages on yield and quality is presented in Table 1. The maximum number of flowers per shoot (11.38), per cent of fruit set (18.56 %), per cent of fruits reached to final harvest (83.78 %) number of fruits per shoot (2.10) Among the treatments, T_3 (NPK @ 20-80- 20, 20-0-20, 20-0-20, 20-0-20g per tree at four stages of growth) registered maximum yield (124.0 kg/tree) and minimum number of flowers per shoot (9.88), per cent of fruit set (16.29%), per cent of fruits reached to final harvest (62.38 %) number of fruits per shoot (1.59) and lowest yield (93.0 kg/ tree) was observed in control T_5. Increase in yield may be attributed to improved morphological traits such as plant height, and number of tertiary branches higher nutrient-uptake by plants were also observed in this treatment (T_3). This is in conformity with thr results of the hedge and srinivas *et al.* 2001 Increased yield in treatment T_3 could be due to proper supply and transclocation of nutrients throughout the growth flowering and fruiting satge.

Table 1: Effect of stage wise nutrient application (NPK) on yield and yieldof sapota cv. Kalipatti

Treatments	No. of flowers per shoots	Per cent of fruit set	Per cent of fruits reached to final harvest	Number of fruits per shoot	Yield per tree (kg)	TSS (°B)	Titratable acidity (%)
T_1	10.08	16.36	65.86	1.65	95.00	24.00	0.18
T_2	10.68	17.35	75.18	1.82	112.00	23.50	0.17
T_3	11.38	18.56	83.78	2.10	124.00	24.50	0.16
T_4	10.59	16.78	73.46	1.76	102.00	23.00	0.18
T_5	9.88	16.29	62.38	1.59	93.00	23.00	0.18
S.Em±	0.45	0.43	2.52	0.06	1.62	0.25	0.01
CD @ 5%	1.39	1.32	7.76	0.17	4.85	0.75	NS

Well-spread at the four different critical stages of tree growth. Another plausible explanation is the timely availability of required amounts of nutrients for flower-bud initiation, was in confirmity with Basagarahally (1996).

Influence of stage wise application of NPK on physical fruit quality is presented in table 2 in respect of maximum fruit weight (90.25 g), fruit length (7.50 cm), fruit girth (5.73 cm) and fruit volume (88.25 ml), seed parameters in respect of number of seeds per fruit (1.67), seed weight (1.02 g) and shelf life (12.65 days) were associated with the treatment T_3. However, minimum fruit weight (76.30 g) fruit length (6.55 cm), fruit girth (5.05 cm) and fruit volume (73.50 ml) number of seeds per fruit (1.27), seed weight (0.86 g) and shelf life (10.15 days) were recorded under the treatment T_5 (control). The increased fruit weight. Length, girth, volume and seed parameters with stage wise application of NPK might be due to the fact that plants applied with sufficient quantity of nitrogen, phosphorus and potassium. The highest TSS (24.5°B) and low acidity (0.16) was also found in treatment T_3.

Table 2: Effect of stage wise nutrient application (NPK) on fruit and seed characters of sapota cv. Kalipatti

Treatments	Fruit parameters				Seed parameters		
	Length (cm)	Girth (cm)	Volume (ml)	Weight (g)	N. of Seeds/ fruit	Seed weight (g)	Shelf life (days)
T_1	6.85	5.08	80.75	88.32	1.40	0.82	11.63
T_2	7.34	5.25	84.25	87.15	1.54	1.10	12.10
T_3	7.50	5.73	88.25	90.25	1.67	1.02	12.65
T_4	7.50	5.33	84.00	84.10	1.43	1.54	12.23
T_5	6.55	5.05	73.50	76.30	1.27	0.86	10.15
S.Em±	0.22	0.15	3.21	2.76	0.08	0.08	0.30
C D @ 5%	0.67	0.46	9.62	8.51	0.25	0.25	0.94

Have better capability for CO2 assimilation. It would lead to higher rate of synthesis and supply of carbohydrates in the plants. The fruits are very strong sink for carbohydrates, so more carbohydrates would be transported to the fruits. The results of present findings are in accordance with the finding of Kaur and Chahil (2006) [3] and Brar *et al*., (2015) [1] in guava. Increase in shelf life days might be due to increasing application of NPK with timely application of required nutrients as per crop growth stage and increasing level of NPK and which is applied NPK per plant beyond which there

was a decrease in shelf life with higher level of NPK combination in sapota var. Kalipatti. Indra and Nair (2008) reported that shelf life decreased due to the higher level of N content but P and K have no marked effect on shelf life on banana.

Conclusion

The results of the study revealed that application of fertilizers at the rate of N P K four different growth stages. i.e., 20-80-20, 20-0-20, 20-0-20, 20-0-20 at the Vegetative flush (July), Fruit set (September), Fruit pea stage (November) and Fruit growth (February) stages would be optimum for higher yield of sapota var. kalipatti in arrabhavi conditions of belaguam dist in Karnataka.

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