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# Influence of stage-wise nutrient (NPK) application on available soil and leaf nutrients on yield of sapota var. Kalipatti

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**Abstract**
Sapota yield quality, soil and leaf nutrients were investigated during 2018-2019 at Department of Fruit Science, Kittur Rani Channnamma College of Horticulture, Arabhavi in sapota var. Kallipatti orchard to understand the stage wise application of N, P & K relationship between sapota yield quality, leaf & soil nutrition. Before harvest the maximum available of nitrogen (266.34 g and 264.54 g), phosphorous (19.95 g and 19.67 g) was recorded in $T_3$ and $T_4$ and potassium (326.36 g and 322.75 g) was recorded in $T_3$ and $T_4$. After harvest maximum available of nitrogen (269.00 and 267.59 kg/ha) was recorded in $T_5$ and $T_4$, phosphorous in $T_3$ (20.45), potassium (327.49 g and 323.12 g) was recorded in $T_3$ and $T_4$. The maximum leaf nitrogen content (2.36), phosphorous (0.26) and was recorded in treatment $T_3$ and potassium (2.58) content was noticed in the treatment $T_4$. Minimum leaf nitrogen content (2.25), lowest phosphorous (0.19), potassium (2.47%) was noticed in control $T_5$. highest yield per tree 17.35 kg and yield 0.13 (t/ha) was recorded in treatment $T_3$. Stage wise application of N, P, K and organic manure is important to soil fertility, which may increase yield and improve quality in field-grown sapota orchard.

**Keywords:** Sapota var. kalipatti, NPK stage wise application, leaf nutrients and soil fertility

## Introduction
Sapota or Chiku (*Manilkara achras* L.) is one of the prominent dessert fruits 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. 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).

Understanding soil fertility and leaf nutrients is the basis for optimizing fertilization, and it is very important for improving sapota quantity and quality. Singh *et al.* (2009) [7, 8] reported that the leaf nutrient contents were higher in treatments where their respective doses were higher which was applied in three spilt doses in apple in cv. Red delicious. Joshi *et al.* (2016) [4] studied the stage-wise nutrient status of leaf and soil of Alphonso mango and they concluded higher nutrient content of soil and leaf was observed at orchards having higher and systematic application of nutrients. Khan *et al.* (2018) [5] studied the significance of nutrient application on growth, yield and quality of guava and reported that the application of higher fertilizers in three doses resulted in more uptake of nitrogen, phosphorus and potassium from soil and resulted in higher leaf nutrient status. 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.

The objectives of this study were: 1) To study the influence of stage-wise nutrient (NPK) application on available soil nutrients status before and after harvest of sapota var. Kalipatti. 2) To study the effect of stage-wise nutrient (NPK) application on leaf nutrient status before and after harvest of sapota. 3) To study the effect of stage-wise nutrient (NPK) application on yield and quality of sapota.

## Materials and Methods

Arabhavi is situated in northern dry zone of Karnataka state at 16° 15' north latitude, 74° 45' East longitude and at an altitude of 612.05 m above the mean sea level. Arabhavi, which comes under zone-3 and region -2 among the agro-climatic zones of Karnataka, has benefited from both south-west and north-east monsoon. The command area receives water from Ghataprabha left bank canal (GLBC) from mid-July to mid-march. 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 approximately 529.6 mm and 505.9 mm, respectively. The treatments consist 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 100 g 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. Nitrogen was determined using modified Kjeldahl method, phosphorous was determined colourimetrically according to the procedure outlined by Ryan *et al.* (1996). Potassium was determined using the flame spectrophotometry method Total nitrogen in the plant sample was estimated by microkjeldahk's method. The potassium (K) concentration in the digested samples was determined by Flame photometer method.

## Results and Discussion

**Table 1:** Effect of stage-wise nutrient (NPK) application on available soil nutrients of sapota var. Kalipatti

| Treatments | Soil properties | | | Available soil nutrients (kg/ha) | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Before harvest | | | After harvest | | |
| | Ph | EC (ds/m) | OC (%) | N (g) | $P_2O_5$ (g) | $K_2O$ (g) | N (g) | $P_2O_5$ (g) | $K_2O$ (g) |
| $T_1$ | 8.27 | 0.15 | 0.48 | 261.83 | 19.36 | 321.48 | 261.75 | 19.56 | 321.67 |
| $T_2$ | 8.32 | 0.16 | 0.47 | 263.76 | 19.03 | 322.41 | 264.12 | 19.15 | 322.90 |
| $T_3$ | 8.36 | 0.17 | 0.37 | 266.34 | 19.95 | 326.36 | 267.59 | 20.45 | 327.49 |
| $T_4$ | 8.31 | 0.16 | 0.44 | 264.54 | 19.67 | 322.75 | 265.85 | 19.78 | 323.12 |
| $T_5$ (control) | 8.21 | 0.16 | 0.54 | 260.17 | 18.89 | 318.75 | 269.00 | 18.93 | 318.89 |
| S.Em± | 0.22 | 0.01 | 0.01 | 0.45 | 0.03 | 0.50 | 1.08 | 0.07 | 0.31 |
| CD @ at 5% | NS | 0.02 | 0.02 | 1.39 | 0.09 | 1.53 | 3.32 | 0.22 | 0.95 |

Refer methodology for treatment details

**The influence of stage-wise application of NPK on Soil analysis of sapota**

**Soil Ph, electrical conductivity (Ds/m) and organic carbon**

In the present study, Ph was statistically not significant (8.21 to 8.36) this might be due to no change in OC (Table 1). The ideal EC ranges from 1.2–1.5 ds/m and higher EC hinders the nutrient absorption due to increasing the osmotic pressure whereas lower EC was severely affected the plant health and yield (Anon, 2017) [1]. EC was statistically not significant among the different treatments ranges from 0.15 to 0.17 ds/m and the organic carbon content of soil was significant among the treatments. The minimum organic carbon (0.37) was recorded in the treatments $T_3$ which was statistically on par with all treatments. However, the maximum organic carbon (0.54) was observed in $T_1$, the data in the (Table 1).

**The influence of stage-wise nutrient (NPK) application on available nutrients in soil**

The available nitrogen in soil varied significantly among the different treatments (Table 1) the maximum available of nitrogen (266.34 g and 264.54 g) was recorded in $T_3$ and $T_4$. This might be due to lesser uptake and minimum available nitrogen in soil. After harvest (269.00 and 267.59 kg/ha) was recorded in $T_5$ and $T_4$. This may have facilitated optimum N concentration in the soil for the entire cropping period. Therefore, residual nutrients in the soil may be subjected to lower loss. The increase in its content might be attributed to application of organic and inorganic fertilizers containing nitrogen to the orchards in spilt doses at its critical growth stages. Similar findings were reported by Mengal *et al.* (1996) and Kirkby *et al.* (1996) [9]. The maximum available of phosphorous (19.95 g and 19.67 g) was recorded in $T_3$ and $T_4$. and after harvest the maximum was recorded in the $T_3$ (20.45). This might be due to the application of phosphorous during its vegetative stage. Organic manures increase organic matter content in soil which forms soluble organophosphate complexes and thus increase the phosphorous availability and no addition of phosphorous during flowering stage and fruiting stage. This may be the reason behind the declining trend of phosphorous. The maximum available of potassium observed before harvest was (326.36 g and 322.75 g) recorded in $T_3$ and $T_4$ and (327.49 g and 323.12 g) was recorded in $T_3$ and $T_4$ after harvest this might be due to the the time of application and stage of plant growth determines uptake and translocation of K, application of this nutrient at four critical stages may have provided optimal availability of K in the soil, throughout the growth period, and facilitated better growth. This results are in conformity with the Balamohan *et al.* (2015) [2] in banana; Joshi *et al.* (2016) [4] in mango.

**Table 2:** Effect of stage-wise nutrient (NPK) application on leaf nutrient status before and after harvest of Sapota var. Kalipatti

| Treatments | Before harvest | | | | After harvest | | | |
|---|---|---|---|---|---|---|---|---|
| | Leaf chlorophyll content (mg/g fresh weight) | N (%) | $P_2O_5$ (%) | $K_2O$ (%) | Leaf chlorophyll content (mg/g fresh weight | N (%) | $P_2O_5$ (%) | $K_2O$ (%) |
| $T_1$ | 2.69 | 2.25 | 0.20 | 2.52 | 2.70 | 2.27 | 0.22 | 2.53 |
| $T_2$ | 2.76 | 2.26 | 0.21 | 2.55 | 2.77 | 2.28 | 0.23 | 2.56 |
| $T_3$ | 2.81 | 2.32 | 0.24 | 2.58 | 2.85 | 2.36 | 0.26 | 2.61 |
| $T_4$ | 2.75 | 2.27 | 0.21 | 2.56 | 2.77 | 2.29 | 0.23 | 2.58 |
| $T_5$ (control) | 2.18 | 2.24 | 0.18 | 2.46 | 2.19 | 2.25 | 0.19 | 2.47 |
| S.Em± | 0.05 | 0.02 | 0.01 | 0.02 | 0.02 | 0.01 | 0.01 | 0.02 |
| CD @ 5% | 0.14 | 0.06 | 0.02 | 0.07 | 0.07 | 0.03 | 0.03 | 0.05 |
| Refer methodology for treatment details | | | | | | | | |

**The effect of stage-wise application of NPK on leaf nutrients status**

**The influence of stage wise nutrient (NPK) application on Leaf chlorophyll content:** The influence of stage wise application of NPK on chlorophyll content in leaf of sapota var. Kalipatti has statistically identified significant differences among the different treatments (Table 2).

The maximum total leaf chlorophyll content (2.85 mg/g) was recorded in the treatment $T_3$ and the lowest (2.25mg/g) was recorded in control $T_5$. and this might be due to nitrogen supply has larger effect on leaf growth because it increases the leaf area of plants and therefore it influences on photosynthesis. Phosphorous plays a role in photosynthesis. The results are in conformity with Chadha and Singh (1971) [3].

**Available NPK in leaf**

The stage wise application of NPK had significantly influenced the available nitrogen content in the leaf among the different treatments conducted. The maximum leaf nitrogen content (2.36) was recorded in treatment $T_3$ and minimum leaf nitrogen content (2.25) was noticed in $T_5$. Application of nitrogenous fertilizers in stage wise might be the reason behind increased content of nitrogen in leaves after fertilizer application. This may be due to the availability of N in the soil, favouring higher absorption and translocation by roots due to its requirement for vegetative and floral growth by tree. Whereas the maximum phosphorous (0.26) was noticed in $T_3$ and lowest phosphorous (0.19) was noticed in $T_5$. This may be due to an increased physiological activity in the plant as development proceeded. This indicates that P absorbed during earlier stages accumulates in leaf content, thereby serving as a source during peak vegetative stages for higher photosynthetic activity. The highest potassium (2.58) content was noticed in the treatment $T_4$ at while the potassium (2.47%) was noticed in control. It seems that the application of potassium during flowering and fruiting may also be responsible for its increase in leaves. These results are in conformity with Pareek *et al.* (2018) [6] in date palm: Khan *et al.* (2018) [5] in guava; N.S. Joshi *et al.* (2016) [4] in mango; T.N. Balamohan *et al* (2015) [2] in banana.

**Table 3:** Stage wise application of NPK per tree of sapota and produced maximum yield (kg/tree)

| Treatments | Yield | |
|---|---|---|
| | Kg/plant | (t/ ha) |
| $T_1$ | 95.00 | 9.50 |
| $T_2$ | 112.00 | 11.20 |
| $T_3$ | 124.00 | 12.40 |
| $T_4$ | 102.00 | 10.20 |
| $T_5$ (control) | 93.00 | 9.30 |
| S.Em± | 1.62 | - |
| CD @5% | 4.85 | - |
| Refer methodology for treatment details | | |

Fruit yield of sapota was significantly influenced by stage wise application of NPK per tree of sapota and produced maximum yield (kg/tree) and the data is presented (Table.2). The highest yield per tree (124.00 kg) was recorded in $T_3$ followed by $T_2$ (112.00 kg) which was statistically on par with $T_4$ (102.00 kg). However, the lowest yield per tree was recorded in treatment $T_5$ (93.00 kg) followed by $T_1$ (95.00kg). The highest yield (12.40 t/ha) was recorded in $T_3$ followed by (112.00 t/ha) However, the lowest number of fruits per tree was recorded in treatment $T_5$ (9.30 t/ha) followed by $T_1$ (9.50 t/ha). The yield increased by directly supplying nutrients required for crop growth. Manna *et al.* [26] reported that farmyard manure (FYM) and NPK treatments increased crop yields significantly compared with no fertilizer control in a long-term fertilizer experiment.

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