The Pharma Innovation Journal 2021; 10(8): 545-547

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; 10(8): 545-547

www.thepharmajournal.com
Received: 12-06-2021
Accepted: 16-07-2021

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Effect of foliar application of nutrient sources on flowering and yield parameters of sapota cv. Kalipatti

MV Patel, BR Parmar, AB Parmar and HJ Christian

Abstract
The present experiment was conducted during the year 2019-20 and 2020-21 at Instructional Farm, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari. The experiment was laid out in Completely Randomized Design with three repetition and eight treatments. The flowering and yield parameters *viz.*, maximum number of flowers per shoot (10.53, 10.97 and 10.75), fruit set (43.03, 47.17 and 45.10 %), fruit retention (18.67, 19.17 and 18.92 %), number of fruits per shoot (2.60, 2.77 and 2.68), fruit yield (154.47, 163.33 and 158.90 kg/tree) and fruits yield (15.45, 16.33 and 15.89 t/ha) and minimum flower development period (26.77, 26.86 and 26.82 days) was noted in the treatment T_8 [$Ca(NO_3)_2$ @ 0.6 % + Boric acid @ 0.2 % + NOVEL$^+$ @ 1.5 %] during the year 2019-20, 2020-21 and pooled data, respectively. The number of days required for flowering to harvest was not significantly influenced by foliar application of nutrient sources in sapota cv. Kalipatti.

Keywords: Foliar application, nutrient sources, sapota

Introduction
Sapota botanically known as [*Manilkara achras* (Mill.) Fosberg] belongs to family Sapotaceae. It is popularly known as *chiku* and important fruit crop of the tropical region. It is native to Tropical America especially Southern Mexico or Central America. In sapota flowers are small, white about one centimeter in diameter, borne solitary, pendulous on short pedicels (1 to 2 cm length) and are carried in the leaf axils of terminal leaf clusters. In sapota flowering throughout the year in several flushes at short intervals and consequently, the fruit set by these flushes also mature at different times. In India, the main seasons are February to April and October to December through flowering continue round the year. Sapota produces a large number of flowers throughout the year in different flushes, but flowers and fruits tends to drop in different stages of development right from its setting to maturity.
The foliar application of nutrients plays a vital role in improving the quality and comparatively more effective for rapid recovery of plants. The foliar feeding of fruit tree has gained much importance in recent years, as nutrients applied through soil are needed in higher quantity because some amount leaches down and some become unavailable to the plant due to complex soil reactions. Boron plays an important role in fruit setting through encouraging germination and growth of pollen grains. Additionally, Boron increases flower bud formation and decreases dropping of flowers, fruit and the incidence of disorders (Fraguas and Silva, 1998) [2]. Calcium nitrate fertilizer contains nitrogen and calcium, which are two major essential nutrients needed by the plants. Novel organic liquid nutrient formulation is good source of plant nutrient along with growth promoting substances like cytokinin, gibberellic acid *etc.* (Anon., 2014) [1].

Material and Methods
The present experiment was conducted during the year 2019-20 and 2020-21 at Instructional Farm, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari, Gujarat. The uniform trees of sapota cv. Kalipatti were selected for experimentation. All experimental trees were uniformly treated in respect to fertilizers, irrigation and plant protection measures during the course of investigation as recommended by NAU, Navsari. The experiment was laid out in Completely Randomized Design with eight treatments comprising of T_1 - Control, T_2 - $Ca(NO_3)_2$ @ 0.6 %, T_3 - Boric acid @ 0.2 %, T_4 - NOVEL$^+$ @ 1.5 %, T_5 - $Ca(NO_3)_2$ @ 0.6 % + Boric acid @ 0.2 %, T_6 - $Ca(NO_3)_2$ @ 0.6 % + NOVEL$^+$ @ 1.5 %, T_7 - Boric acid @ 0.2 % + NOVEL$^+$ @ 1.5 %, T_8 - $Ca(NO_3)_2$ @ 0.6 % + Boric acid @ 0.2 % + NOVEL$^+$ @ 1.5 % and the treatments were repeated thrice.

The foliar spray of various nutrient sources was done on twice, first spray was done on fifteenth January and second spray was done on fifteenth February.

Fruits set per shoot was recorded by using the following formula and recorded in percentage:

$$\text{Fruit set (\%)} = \frac{\text{No. of fruits set}}{\text{Total no. of flowers}} \text{ x } 100$$

Fruits retention at harvesting stage was estimated by using the following formula and recorded in percentage:

$$\text{Fruit retention (\%)} = \frac{\text{No. of fruits harvested}}{\text{Total no. of fruits set}} \text{ x } 100$$

Results and Discussion

Effect on flowering parameters

A perusal of data on number of flowers per shoot (Table-1) clearly evident that treatment T_8 [$Ca(NO_3)_2$ @ 0.6 % + Boric acid @ 0.2 % + NOVEL$^+$ @ 1.5 %] showed the highest number of flower per shoot (10.53, 10.97 and 10.75) during the year 2019-20, 2020-21 and pooled data, respectively. The treatment T_6 was found at par with the same treatment during the year 2019-20 and 2020-21. This may be due to application of combined foliar spray that the plants remain physiologically more active to build up sufficient food stock for the developing flowers by creating favourable C/N ratio in terminals ultimately resulted into increased number of flowers per shoot. Similar results also reported by Guvvali *et al.* (2017) [4] in sapota and Maji *et al*. (2017) [6] in pomegranate.

Data reflected (Table-1) that the significantly lower flower development period (26.77, 26.86 and 26.82 days) was observed under the treatment T_8 [$Ca(NO_3)_2$ @ 0.6 % + Boric acid @ 0.2 % + NOVEL$^+$ @ 1.5 %] during the year 2019-20, 2020-21 and pooled data, respectively. It was found at par with treatment T_6 during the year 2019-20, 2020-21 and pooled data, respectively. Further, treatment T_7 also at par with same treatment during the year 2019-20. This might be due to calcium nitrate, boric acid and NOVEL$^+$ are major source of macro and micronutrients, it play major role in chlorophyll synthesis, these metabolic activities may help in production of good amount of biomass that leads to early flower development. The present investigation is in conformity with the results reported by Guvvali *et al.* (2017) [4] in sapota and Nehete *et al.* (2011) [7] in mango.

While, number of days required for flowering to harvest was not significantly influenced by foliar application of nutrient sources in sapota cv. Kalipatti.

Effect on yield and yield attributes

It is evident from the data presented in Table-1 & 2 that fruit set (%) and fruit retention (%) were significantly influenced by foliar application of nutrient sources. Maximum fruit set (43.03, 47.17 and 45.10 %) and fruit retention (18.67, 19.17 and 18.92 %) was reported in the treatment T_8 [$Ca(NO_3)_2$ @ 0.6 % + Boric acid @ 0.2 % + NOVEL$^+$ @ 1.5 %] during the year 2019-20, 2020-21 and pooled data, respectively. This may be due to calcium has been reported to act as secondary messenger for flower induction and fruit set. Boric acid contain boron which is essential for stigma receptivity and pollen tube extension by formation of boron sorbitol complex (Nyomora *et al*. 1997) [8]. Increasing fruit retention it might be due to better photosynthesis, greater accumulation of starch in fruits and involvement of auxin synthesis and boron in translocation of starch to fruits which reduces the fruit drop and increased fruit retention (Patel *et al.* 2018) [9]. These results are in close conformity with the findings of Guvvali *et al.* (2017) [4] in sapota; Patel *et al*. (2018) [9] and Tulsi Gurjar *et al.* (2015) [13] in mango and Sarrawy *et al*. (2012) [11] in date palm.

The highest number of fruits per shoot (2.60, 2.77 and 2.68) was registered under the treatment T_8 [$Ca(NO_3)_2$ @ 0.6 % + Boric acid @ 0.2 % + NOVEL$^+$ @ 1.5 %] during the year 2019-20, 2020-21 and pooled data, respectively. The treatment T_8 was statistically similar with T_7, T_6 during the year 2019-20 and T_7 during the year 2020-21. The increase number of fruits per shoot it may be due to increase in number of flower per shoot and better fruit set directly reflect to number of fruits per shoot in sapota. This above result are in agreement with the results of Guvvali *et al.* (2017) [4] in sapota; Patel *et al*. (2018) [9] and Tulsi Gurjar *et al.* (2015) [13] in mango.

The data (Table-2) showed that fruit yield (154.47, 163.33 and 158.90 kg/tree) and (15.45, 16.33 and 15.89 t/ha) was significantly increase with the foliar application of treatment T_8 [$Ca(NO_3)_2$ @ 0.6 % + Boric acid @ 0.2 % + NOVEL$^+$ @ 1.5 %] during the year 2019-20, 2020-21 and pooled data, respectively. Further, it was found statistically at par with T_7 during the year 2019-20 and 2020-21. It may be due to calcium nitrate preventing the abscission of fruit lets it helps in better fruit retained per shoot and fruit yield (Golla *et al.*, 2017) [3]. Boron increased the number of flowers and promoted the fruit set and fruit retention thereby ultimately produced more yield. Moreover, NOVEL$^+$ organic liquid nutrient contains higher amount of macro and micro nutrient which improves photosynthesis, production of carbohydrates and their translocation from source to sink which excreted positive effect on yield (Kalariya *et al*., 2018) [5]. Present study also corroborated with the findings of Guvvali *et al.* (2017) [4] in sapota; Patel *et al.* (2018) [9] and Tulsi Gurjar *et al.* (2015) [13] in mango; Shekhar *et al*. (2010) [12] in papaya and Rathod *et al.* (2017) [10] in pomegranate.

Table 1: Effect of foliar application of nutrient sources on flowering and yield parameters of sapota cv. Kalipatti

Treatments	Number of flowers per shoot			Flower development period (days)			Number of days required for flowering to harvest			Fruit set (%)		
	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled
T_1	7.37	7.53	7.45	30.73	31.37	31.05	310.97	313.77	312.37	26.13	28.03	27.08
T_2	8.27	8.53	8.40	29.57	29.90	29.73	302.07	306.50	304.28	28.53	29.97	29.25
T_3	7.80	7.97	7.88	30.10	30.47	30.28	303.87	308.23	306.05	29.80	32.33	31.07
T_4	8.70	9.00	8.85	29.10	29.40	29.25	300.37	304.53	302.45	33.03	35.27	34.15
T_5	9.23	9.50	9.37	28.50	28.77	28.63	299.37	302.80	301.08	35.97	38.47	37.22
T_6	10.10	10.50	10.30	27.30	27.70	27.50	295.10	297.43	296.27	37.50	41.07	39.28
T_7	9.60	9.97	9.78	27.87	28.17	28.02	298.43	300.80	299.62	40.73	44.27	42.50
T_8	10.53	10.97	10.75	26.77	26.86	26.82	295.53	292.23	293.88	43.03	47.17	45.10
S.Em. ±	0.16	0.16	0.11	0.38	0.29	0.22	6.55	8.58	4.92	1.25	1.33	0.85
C.D. at 5 %	0.49	0.48	0.30	1.14	0.86	0.62	NS	NS	NS	3.74	3.99	2.45

S.Em.± (Y x T)	-	-	0.16	-	-	0.34	-	-	7.63	-	-	1.29
C.D. at 5 % (Y x T)	-	-	NS	-	-	NS	-	-	NS	-	-	NS
C.V. %	3.17	3.00	3.08	2.29	1.70	2.02	3.77	4.90	4.38	6.29	6.21	6.26

Table 2: Effect of foliar application of nutrient sources on flowering and yield parameters of sapota cv. Kalipatti

Treatments	Fruit retention (%)			Number of fruits per shoot			Fruit yield (kg/tree)			Fruits yield (t/ha)		
	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled
T_1	10.87	11.50	11.18	1.57	1.67	1.62	91.07	95.10	93.08	9.11	9.51	9.31
T_2	11.97	12.70	12.33	1.63	1.80	1.72	97.90	102.47	100.18	9.79	10.25	10.02
T_3	13.27	14.10	13.68	1.80	2.07	1.93	104.33	109.07	106.70	10.43	10.91	10.67
T_4	14.33	15.37	14.85	2.17	2.20	2.18	112.67	118.13	115.40	11.27	11.81	11.54
T_5	15.50	16.30	15.90	2.17	2.30	2.23	117.90	123.90	120.90	11.79	12.39	12.09
T_6	17.10	17.80	17.45	2.37	2.43	2.40	133.23	140.57	136.90	13.32	14.06	13.69
T_7	17.23	18.90	18.07	2.37	2.63	2.50	139.50	146.87	143.18	13.95	14.69	14.32
T_8	18.67	19.17	18.92	2.60	2.77	2.68	154.47	163.33	158.90	15.45	16.33	15.89
S.Em. ±	0.47	0.38	0.28	0.08	0.07	0.05	6.86	6.38	4.26	0.69	0.64	0.43
C.D. at 5%	1.42	1.13	0.81	0.25	0.22	0.15	20.56	19.14	12.18	2.06	1.91	1.22
S.Em.± (Y x T)	-	-	0.43	-	-	0.08	-	-	6.63	-	-	0.66
C.D. at 5% (Y x T)	-	-	NS	-	-	NS	-	-	NS	-	-	NS
C.V.%	5.52	4.15	4.85	7.00	5.63	6.31	9.99	8.85	9.41	9.99	8.85	9.41

Conclusion

On the basis of findings, it can be concluded that foliar application of T_8 [$Ca(NO_3)_2$ @ 0.6 % + Boric acid @ 0.2 % + NOVEL$^+$ @ 1.5 %] was found effective for increasing number of flowers per shoot, fruit set, fruit retention, number of fruits per shoot, fruit yield (kg/tree) and fruits yield (t/ha) and minimum flower development period in sapota cv. Kalipatti.

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