International Journal of Agricultural Sciences
Volume 9 | Issue 1| January, 2013 | 289-292

RESEARCH PAPER

Studies on effect of growth regulators on flowering, fruiting and quality of sapota

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Abstract : The results of experimentation confirmed the efficiency of the growth regulators for better flowering, fruit set, fruit retention reduced fruit drop and quality of sapota variety Kalipatti. The study revealed that CCC at 450 ppm significantly increased the number of flowers and number of fruits per tree. Treatment NAA 200 ppm proved better for reducing flower and fruit drop and ultimately increasing fruit set and fruit retention, respectively. The treatment GA_3 at 150 ppm was effective for weight of fruit, highest per cent of mean total sugar.

Key Words : Sapota, Flowering, Fruiting, Quality, CCC, NAA, GA_3

View Point Article : Bhujbal, D.S., Naik, D.M. and Kale, S.A. (2013). Studies on effect of growth regulators on flowering, fruiting and quality of sapota. *Internat. J. agric. Sci.*, **9**(1): 289-292.

Article History : Received : 07.09.2012**; Revised :** 05.11.2012**; Accepted :** 16.12.2012

INTRODUCTION

Sapota [*Manilkara acharas* (Mill) Forsberg] popularly known as chiku in India, is an evergreen fruit tree native of tropical America and probably originated in the southern Mexico (Papenoe, 1974). How and when this fruit was introduced into India is not very well known but Ghlowad village in Thane district of Maharashtra state has the evidence of first sapota plantation in 1898 (Cheema *et al*., 1954).

India is considered to be the largest producer of sapota in the world. It is mainly cultivated in the coastal areas of Maharashtra, Gujarat, Andhra Pradesh, Karnataka, Tamil Nadu, Kerala, West Bengal, Uttar Pradesh, Punjab and Haryana. India is leading producer of sapota and area under sapota is estimated to be 156 lakh ha with a production of 1308 million tonnes (Anonymous, 2009). In Maharashtra area under sapota is about 65.4 lakh ha with a production of 298.7 million tonnes (Anonymous, 2009).

Sapota is cultivated for its delicious sweet fruits. The fruits are good source of digestible sugar (12 to 18 per cent).Sapota also ingredient of fruit salad and milk shakes. The milky latex secreted by unripe sapota fruits, known as Chuckle forms the base for making chicklet and ice cream.

The another major problem regarding sapota crop is heavy flower and fruit drop (Patil and Narwadkar, 1974; Farooqui and Rao, 1976; Kawadiwale, 1988). Sapota produces large number of flowers thrice in a year with different flushes. But flowers and fruits tend to drops down at different stages of development right from its setting to maturity. However, fruit drop at later stages of development drastically reduces the yield causes the losses to farmers. In recent years considerable attention has been given to increase fruit set and to check fruit drop of many fruit crops with the help of plant growth regulators. Different group of plant growth regulators like auxins, gibberlins and growth retardants at various concentrations have been reported to influence flowering, fruit set, retention, development and quality characters of several fruit crops (Singh, 1961; Maiti *et al*., 1972; Das and Mahapatra, 1975). Hence, the objective was to study the effect of growth regulators on flowering,fruiting and quality of sapota cv. KALIPATTI.

MATERIALS AND METHODS

The present investigation was undertaken during the year 2009-10 at the Department of Horticulture, Marathwada

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Krishi Vidyapeeth, Parbhani. The experiment was carried out with Randomized Block Design with ten treatments and three replications.

The experimental trees used were 35 years old grafts of chiku var. Kalipatti grafted on Khirni (*Manilkara hexandra* Roxb.) root stock spaced at 10 x 10 meters. The growth regulators CCC, NAA and GA_3 sprayed at one month before flowering and at pea stage. The treatments comprised of CCC 250 ppm, CCC 350 ppm, CCC 450 ppm, GA_3 50 ppm, GA_3 100 ppm, GA_3 150 ppm, NAA 100 ppm, NAA 150 ppm, NAA 200 ppm and control (No spray).

The observations on flowering and fruiting parameters like days to initiation of flowering from application of treatment, number of flowers per shoot, per cent flower drop and fruit set, number of fruits per shoot, per cent fruit drop and fruit retention, days required to fruit maturity, total number of fruits per tree, physical parameters of fruit like weight of fruit, number of seeds per fruit and weight of seed and quality parameters like TSS (total soluble solid) and total sugar percentage(reducing and non reducing sugar percentage) were recorded as per standard procedures and statisticaly analyzed.

RESULTS AND DISCUSSION

Effect of growth regulators on flowering and fruiting is presented in Table 1. The data in Table1 indicated that the treatment NAA200 ppm T_9 required minimum number of days for flower initiation(25.14 days) and treatment T_8 and T_7 which were found to be statistically at par with treatment T_9. The treatment T_3,T_2,T_1,T_6 and T_5 were found statistically at par to each other and significantly superior over treatment T_4 and T_{10}.

The treatment CCC 450 ppm recorded more number of flowers per shoot (9.87) followed by treatment CCC 350 ppm (9.72). The treatment control recorded least number of flower per shoot (7.28). Thus promotion of flowering by higher concentration of cycocel could be due to suppressive effect on vegetative growth and creating favourable C/N ratio in terminals. These results are in agreement to those reported by Joumien (1981) with pear and Khader and Rao (1983) with grape vine. Treatments of GA_3 and NAA did not influence the flower production.

The percentage of flower drop was reduced significantly by application of NAA 200 ppm which increase the fruit set ultimately. The NAA 200 ppm reduced the flower drop upto 54.98 per cent and fruit set increased upto 45.02 per cent. The treatment CCC 450 ppm (55.15 per cent) was at par with NAA 200 ppm. The control recorded highest flower drop (63.84 per cent) (Table 1). The results shown in Table1 indicated that the treatment CCC 450 ppm produced more number of fruit per shoot(4.446) foolowed by treatment NAA 200 ppm (4.044).

The fruit retention was increased with the treatment NAA 200 ppm and CCC 450 ppm. The treatments T_3,T_8, and T_7 were at par with T_9(NAA 200ppm). Among the growth regulators sprayed, NAA increased the fruit retention than GA_3 and control. The treatment T_{10}(control) has highest fruit drop (86.42 per cent) and ultimately resulted poor fruit retention (13.58 per cent). The percentage of fruit drop was reduced by application of NAA 200 ppm which increased the fruit retention ultimately (Table 1).

The presence of auxin in abscission zone may be the

Table 1 : Effect of growth regulators on flowering and fruiting parameters: days to initiation of flowering, number of flowers per shoot, per cent flower drop and fruit set, number of fruits per shoot, per cent fruit drop and retention, days required to fruit maturity and total number of fruits per tree

Tr. No.	Treatments	Days to initiation of flowering	Number of flowers per shoot	Flower drop (%)	Fruit set %)	Number of fruit/ shoot	Fruit drop (%)	Fruit retention (%)	Days required to fruit maturity	Total number of fruits per tree
T_1	CCC 250 ppm	28.22	9.18	60.74	39.26	3.624	85.78	14.42	248.82	2205.10
T_2	CCC 350 ppm	28.10	9.72	59.31	40.69	3.975	84.74	15.26	248.74	2422.30
T_3	CCC 450 ppm	27.94	9.87	55.15	44.85	4.446	82.84	17.36	248.01	2625.00
T_4	GA_3 50 ppm	30.02	8.28	62.28	37.72	2.809	85.89	14.11	249.98	2018.60
T_5	GA_3 100 ppm	29.24	8.39	61.54	38.46	3.246	85.92	14.08	249.29	2030.60
T_6	GA_3 150 ppm	28.35	8.42	59.86	40.14	3.399	84.87	15.13	248.92	2055.40
T_7	NAA 100 ppm	26.82	8.52	58.16	41.84	3.584	83.92	16.08	247.86	2084.00
T_8	NAA 150 ppm	26.41	8.58	56.74	43.26	3.731	83.12	16.88	246.17	2298.20
T_9	NAA 200 ppm	25.14	8.94	54.98	45.02	4.044	82.61	17.39	245.08	2480.20
T_{10}	No spray (control)	31.18	7.28	63.84	36.16	2.652	86.42	13.58	250.33	1918.60
	Mean	28.14	8.71	59.26	40.74	3.551	84.59	15.40	248.32	2213.80
	S.E. $\pm$	0.48	0.27	1.58	1.58	0.302	0.63	0.63	0.87	72.36
	C.D. at 5%	1.44	0.80	4.70	4.70	0.898	1.88	1.88	2.60	214.67

major deterrent to flower/fruit drop (Leopold, 1958). The significance of exogenous application of auxin in fruit setting has been well recognized in number of fruit crops. Pramanik and Bose (1974), Das and Mahapatra (1975) and Rathod and Amin (1981) reported the beneficial effects of NAA in chiku crop. The favourable effects of CCC on fruit retention was reported by Das and Mahapatra (1975) in sapota. Rao and Livingstone (1984) also recorded more number of fruits with CCC treatment in mango.

From the results (Table1) it is seen that the application of NAA at 200ppm induced maturity of fruits earlier than GA_3 and control. At Akola, Kawadiwale (1988) observed that the fruit in both seasos *viz.*, July-September and october-December took nine months to reach maturity.

The treatment CCC 450 ppm produced more number of fruit per tree (2625.00) which was at par with treatment NAA 200 ppm which produced (2480.20) fruits per tree. The less number of fruits per tree (2018.60) were recorded in treatment GA_3 50 ppm next to control (1918.60). Agarwal and Dikshit (2008) reported that the application of CCC 400 ppm applied at FBD stage produced significantly more number of fruits per tree.

The effect of growth regulators on physical parameters and quality is presented in Table 2.The treatment GA_3 150 ppm produced significantly superior fruit weight (87.28 g) followed by treatment T_5($GA_3$100 ppm) (86.64). Looney and Pharis (1986) stated that the GA_3 effect on fruit size in seeded fruits is indirect and that the primary effect is to delay fruit ripening. Patil (2006) found application of GA_3 and NAA at fruit development stage, GA_3 treatment increased diameter and weight of fruit as compared to NAA but effect were within the statistical limit as compared to control.

The data on number of seeds and weight of seeds per fruit are given in Table 2, revealed that the effect of various growth regulators at various concentration were non-significant over control. There was decrease in seed number and weight of seed due to NAA and GA_3. Gibberelic acid was more effective than NAA to cause reduction in seed number and weight of seed.Hartman and Anvari(1986) found GA_3 treated plum fruits with no seeds or aborted seeds.

The maximum TSS (21.92 ^oB) was recorded in CCC 450 ppm, the next best treatment in regard to TSS was NAA 200 ppm (21.86 ^oB) (Table 2). Control recorded least TSS (19.14 ^oB). The results of Thonte (1983) showed that cycocel (500 ppm) treated fruits of Fig numerically were high in TSS and sugar content. Rathod (1977) in his investigation used NAA (25-100 ppm) on Kalipatti variety of sapota and observed that all concentration of NAA helped to increase the reducing, non-reducing and total sugars of the fruit while TSS were increased at higher (75 to 100 ppm) concentration only.

The treatment GA_3 (150 ppm) was found significantly superior in respect of total sugar (16.24 per cent). The next best treatment in this regard was $GA_3$100 ppm (15.73 per cent). The control recorded lowest sugar (13.27 per cent).

Patil (2006) reported that reducing, non-reducing and total sugars were more in GA_3 as compared to NAA. The treatment GA_3 (150 ppm) recorded highest percentage of reducing sugar (10.28 per cent) and non reducing sugar (5.96 per cent).While the treatment GA_3 (100 ppm) recorded 9.95 per cent reducing sugar (5.78 per cent), non-reducing sugar. The treatment control recorded least per cent of reducing sugar (9.02 per cent) and non-reducing sugar (4.25 per cent).

Table 2 : Effect of growth regulators on physical parameters and quality: weight of fruit, number of seeds per fruit, weight of seed, total soluble solid(TSS), total sugar percentage, reducing sugar percentage and non reducing sugar percentage

Sr. No.	Treatments	Weight of fruit (g)	Number of seeds per fruit	Weight of seed	Total soluble solids (B)	Total sugar percentage	Reducing sugar percentage	Non reducing sugar percentage
T_1	CCC 250 ppm	79.38	1.465	1.212	20.78	14.68	9.42	5.26
T_2	CCC 350 ppm	80.24	1.460	1.203	20.88	15.11	9.58	5.53
T_3	CCC 450 ppm	84.64	1.440	1.191	21.92	15.39	9.71	5.57
T_4	GA_3 50 ppm	85.04	1.454	1.194	18.53	15.43	9.82	5.72
T_5	GA_3 100 ppm	86.64	1.433	1.188	19.34	15.73	9.95	5.78
T_6	GA_3 150 ppm	87.28	1.420	1.181	19.68	16.24	10.28	5.96
T_7	NAA 100 ppm	80.89	1.475	1.227	19.80	13.83	9.16	4.67
T_8	NAA 150 ppm	83.38	1.468	1.229	20.12	14.08	9.21	4.87
T_9	NAA 200 ppm	84.96	1.430	1.231	21.86	14.45	9.30	5.15
T_{10}	No spray (control)	78.14	1.482	1.240	19.14	13.27	9.02	4.25
	Mean	83.06	1.452	1.209	20.20	14.82	9.54	5.27
	S.E. $\pm$	0.95	0.02	0.09	0.56	0.28	0.27	0.26
	C.D. at 5%	2.83	NS	NS	1.68	0.85	0.82	0.78

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