Environment & Ecology 27 (4) : 1592—1595, 2009
 ISSN 0970-0420

Relationship Between Leaf Number and Area on Fruit Development in Kalipatti Sapota

B. G. HANUMANTHARAYA, V. NACHEGOWDA, R.VASANTHA KUMARI, Y. T. N. REDDY AND M. Y. AJAYAKUMAR

Division of Horticulture, University of Agricultural Sciences, GKVK Banglaore 560065, India

Abstract

The optimum leaf number to fruit ratio in Kalipatti sapota was sought by isolating individual fruits with known number of supporting leaves by shoot girdling. The Kalipatti sapota recorded progressive reduction in physical parameters of fruit growth as well as quality parameters of fruit. It was observed that more than 30 leaves were necessary to provide enough assimilates for the growth of a single fruit to normal size. Fruit growth and development depends partially on reserve photosynthates in addition to current photosynthates. The reduction in fruit size was mainly attributed to limitation of leaf area.

Key words : Relationship, Leaf number, Area of leaf, Fruit development, Kalipatti sapota.

Sapota sets fruits throughout the year and these developing fruits from different months of fruit set leads to over crop load on the bearing shoots results in reduced fruit size, fruit quality and takes long duration to reach harvestable maturity. The optimum leaf number and leaf area required for the development of individual fruits have been determined for several fruits by girdling the shoot leaving fixed number of leaves which directly feed the fruit attached to the shoot (Cohen 1975, Kensignton and Epenhuigsen 1989). There is competition among the developed and developing fruits and flowers. Hence, studies were initiated to determine the leaf number and leaf area required for the development of individual fruits of sapota cv Kalipatti and also to determine the role of current and stored photoassimilates on fruit growth and development.

Methods

The study was undertaken in Kalipatti sapota trees grown in the Horticultural Research Station, Gandhi Krishi Vignana Kendra, University of Agricultural Sciences, Banglaore. The study was carried out during 2000 to 2001 on 20 years old sapota trees which received uniform cultural treatments. Five uniform trees were selected and in each tree 150 shoots of uniform size were tagged. There were six treatments namely 10, 15, 20, 25 and 30 leaves per fruit and control. Girdling was done 1 cm wide at a uniform distance in all the treatments except control. when fruits attained the following parameters : Length = 0.9 ± 0.49 cm; diameter = 1.15 ± 0.10; Fresh Weight = 1.59 ± 0.99g (Chacko et al. 1982).

In both treatments and control shoots one fruit was retained. Shoots were defoliated to obtain the desired number of leaves in 10, 15, 20, 25 and 30 leaves per fruit treatments. Shoots with whatever number of leaves available without girdling was taken as control. The study was conducted on randomly selected five trees. The observations on physical parameters viz., leaf number per fruit leaf area, fresh weight of leaf per fruit, dry weight of leaf per fruit, fresh weight of fruit, dry weight of fruit volume, length, diameter, pulp weight , seed weight and average seed number were taken. The quality parameters like titratable acidity, pH, TSS (Brix), reducing sugars, non-reducing sugars, total sugars and number of days taken to reach maturity were recorded. Leaf number per fruit was counted and leaf area estimated by using LI-COR 3000 leaf area meter. Analysis and interpretation of the experiemtnal data were done by employing randomized completely block design method for field studies and for quanlity parameters in the laboratory was done with the method suggested by Suderaraj et al. (1972), Fisher 1963).

Results and Discussion

Leaf to fruit ratio affected the physical param-

Table 1. Effect of various leaf number and leaf area on fruit characters and days taken to maturity in Kalipatti sapota.

Treatments	Leaf characters: Leaf no/ fruit	Leaf area/fruit (m^2)	Fresh wt fruit (g)	Dry wt fruit (gm)	Fruit characters: Fresh weight (g)	Dry weight (g)	Volume
T_1 = 10 leaves/fruit	8.81	171.32	5.93	3.75	26.61	6.74	22.03
T_2 = 15 leaves/fruit	13.51	274.39	10.85	5.78	26.50	6.84	26.17
T_3 = 20 leaves/fruit	18.78	343.07	14.40	7.98	36.76	10.21	39.27
T_4 = 25 leaves/ fruit	24.38	446.95	16.90	9.85	45.24	12.09	40.06
T_5 = 30 leavea/fruit	29.48	590.63	23.97	13.13	58.56	16.67	51.19
T_6 = control leaves/fruit	24.89	433.18	25.72	14.75	68.88	18.50	61.32
F-Test	*	*	*	*	*	*	*
CD at 5%	2.25	55.05	2.37	1.11	6.74	1.97	5.85

Table 1. Continued.

Treatments	Fruit characters: Specify gravity	Length (cm)	Diameter (cm)	Pulp wt (g)	Seed wt (g)	Avg /seed no.1	No. days taken to reach maturity
T_1 = 10 leaves/fruit	1.18	3.97	3.58	25.71	0.81	1.31	255
T_2 = 15 leaves/fruit	1.12	3.99	3.58	29.10	0.88	1.34	255
T_3 = 20 leaves/fruit	0.97	4.58	4.07	35.65	1.10	1.66	255
T_4 = 25 leaves/fruit	1.12	4.99	4.53	41.91	1.32	1.87	240
T_5 = 30 leaves/fruit	1.13	5.29	4.55	57.11	1.45	1.98	225
T_6 = control leaves/fruit	1.03	5.77	4.96	66.50	2.38	2.48	240
F-test	*	*	*	*	*	*	*
CD at 5%	0.12	0.10	0.21	7.49	0.23	0.35	7.02

eters of fruit such as fruit weight, volume, length and diameter in Kalipatti sapota (Table 1). Leaf area and leaf dry weight were affected by different leaf number per fruit. The various physical fruit growth parameters progressively reduced with decreasing leaf number per fruit. Maximum reduction in fruit weight, volume, length and diameter of fruit (26.61 g, 22.03 ml, 3.97 cm and 3.58 cm respectively) was observed with 10 leaves per fruit as compared to other treatments. The reduction in fruit weight was also due to reduced fruit length, diameter and fruit volume. Reddy (1996) also made similar observations in mango. The reduction in fruit weight, volume, length and diameter and fruit size was due to limitation of current and stored photosynthates for growth and development of fruit.

Thus in Kalipatti sapota much larger leaf area and number than 30 leaves were necessary to provide enough assimilates for development of fruit to normal size. The reduction was mainly attributed to limitation of leaf area. Pulp weight, seed weight and seed number progressively decreased leaf to fruit ratio. Similar findings were reported by Chacko et al. (1982). Reddy and singh (1990) and Reddy (1996) in mango. The reduction in seed weight and seed num-

Table 2. Effect of leaf number and leaf area on latex content, scurf content, fruit color, pulp color and seed color of Kalipatti sapota at harvest.

Treatments	Latex content	Scurf content	Fruit color	Pulp color	Seed color
T_1 = 10 leaves/fruit	Low	Adhere at harvest	Greenish brown	Whitish green	Light black
T_2 = 15 leaves/fruit	”	”	”	”	”
T_3 = 20 leaves/fruit	’’	”	Brown	”	”
T_4 = 25 leaves/fruit	’’	”	Light brown	”	Black
T_5 = 30 leaves/fruit	’’	Not adhere at harvest	Potato brown	Yellowish green	”
T_6 = Control	’’	”	”	”	”

ber was attributed to reduced fruit size due to limited source available to normal growth of fruit.

The days taken by fruit to reach maturity differ significantly between leaf to fruit ratio treatments (Table 1) . Increasing the number of leaves per fruit advanced the fruit maturity. Fruit from 30 leaves per fruit reached harvestable maturity first (225 days) followed by leaves per fruit and control treatments (240 days each). Maximum duration to reach maturity was in 10, 15 and 20 leaves per fruit treatment (225 days each). This was attributed to the limitation of source to sink, enhanced the maturity hindrance in development of fruit. Simmons et al. (1996) were also made similar observations in Kensington variety of mango.

Effect of leaf to fruit ratio on latex, scurf, fruit colour, pulp color and seed color are presented in Table 2. Latex content was low in all the treatments, while scurf content at harvest still adhered to the fruit in 10, 15 and 20 leaves per fruit treatments and no scurf was found at harvest in 25.30 leaves per fruit and control treatments. Coombe (1960) working with grapes attributed rapid increase in volume at final stage of berry growth, the cells of the epidermis may excessively streached as such adhering scurf may drop down due to mechanical force. In the present study, the higher volume of the fruit with increasing number of leaves per fruit might have caused the excessive streaching of experimental cells of fruit resulted in drop down of scurf and vice versa.

Kliewer and Weaver (1971) observed that reduction in leaf area below critical values decreased the fruit colouration in grapes. In the present study, the fruits of control and 30 leaves per fruit treatment showed light potato brown color, while greenish in 10, 15 and 20 leaves per fruit treatments indicating limitation for proper maturity and normal size as well colour development.

Effect of Leaf to Fruit Ratio on Fruit Quality

The quality parameters like pH,titratable acidity, TSS, reducing, non-reducing and total sugars as influenced by different leaf to fruit ratio treatments at harvest and at ripening (Table 3). Significant differences were observed in leaf to fruit ratio treatments. There was a gradual decrease in acidity of the fruit as

Table 3. Effect of leaf number and leaf area on quality parameters of Kalipatti sapota at harvest.

Treatments	Titratable acidity (%)	pH	TSS (Brix)	Reducing sugars (%)	Non reducing sugars (%)	Total sugars (%)
T_1 = 10 leaves/fruit	0.49	4.93	16.20	10.90	5.75	16.65
T_2 = 15 leaves/fruit	0.48	4.92	16.50	11.74	5.50	17.24
T_3 = 20 leaves/fruit	0.36	5.22	17.50	13.46	5.42	18.88
T_4 = 25 leaves/fruit	0.21	5.36	19.00	13.92	5.01	18.34
T_5 = 30 leaves/fruit	0.16	5.54	21.20	14.88	4.88	19.62
T_6 = control	0.19	5.39	19.50	13.88	5.18	18.78
F-test	*	*	*	*	*	*
CD at 5%	0.02	0.08	0.54	0.48	0.19	0.95

associated with corresponding increase in pH with increasing supporting leaves per fruit. Minimum acidity and maximum pH of fruit was recorded in 30 leaves per fruit treatment (0.16 and 5.54%, respectively) at harvest. This was attributed to increase in the ratio of acid salts to free acids in the fruit with maximum supporting leaves per fruit. Similar observations were also made by Purohit et al. (1979) in grapes. The decreasing leaf number to 10 leaves per fruit recorded minimum TSS, total and reducing sugars (16.20 Brix, 10.90% and 16.65%, respectively) at harvest. The limiting leaf number and area reduces the fruit quality like TSS due to limitation of source for proper conversion of starch into sugars. While increment in leaf number per fruit was generally accompanied by increment in TSS, total and reducing sugars. Higher brix level was observed with greater leaf number per fruit indicating the plant leaf area, influencing the amount of energy available for sugar development. An increase in TSS with increasing in leaf number and area may be due to accumulation of sugars in fruit by rapid influx into fruit from maximum supporting leaves per fruit as result of storage sink formation by fruit. The reducing sugar content increased with increasing leaf number per fruit could be related to increase in TSS, since the reducing sugars constitute a major part of soluble solids.

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