

EFFECT OF INFLORESCENCE TYPES ON FRUITS QUALITY OF OWARI CULTIVAR OF SATSUMA MANDARIN (CITRUS UNSHIU, MARC.)

Nasar Iqbal, Naveed Anwar Virk and Mahmood Khan
Horticultural Research Institute, AARI, Faisalabad, Pakistan

Abstract

Present studies were envisaged to determine the effect of inflorescence pattern on the fruit quality of Satsuma mandarin grafted on Troyer citrange (TR), Sour orange (SO) and Trifoliolate orange (TF) in the orchard of the Department of Horticulture, Ege University, Izmir Turkey. Physical fruit quality characteristics such as fruit weight, diameter and height for fruits developed from leafy inflorescence were significantly higher as compared with leafless fruits. Fruit peel color (L, a, b, and a/b ratio), specific gravity and electrical conductivity percentage (EC %) was significantly higher in leafless fruits than leafy fruits but peel thickness and peel thickness index were higher for leafy fruits than that of leafless ones. Fruit internal quality parameters such as fruit juice percentage and vitamin C contents were significantly higher in leafless fruits as compared with leafy ones.

Key words; Leafy and leafless inflorescence, satsuma mandarin and fruit quality

1. INTRODUCTION

Citrus is the most important fruit crop of the world and production of fresh and processed citrus surpasses that of banana, apple, grapes or mangoes. Citrus is also being grown extensively in Turkey and Pakistan due to its medicinal, nutritive and economic values. Citrus is the leading fruit crop of the Turkey as well as Pakistan; Oranges and mandarins are main growing species in both countries.

The importance of understanding flowering of citrus is paramount since it is first step in the reproductive process. Physiological differentiation is followed by morphological differentiation during citrus flowering process. Physiological differentiation might start as early as September-October (Iwahori et al, 1990) while morphological differentiation of floral organs does not occur until bud sprouting, shortly before flowering. Generally flowering shoots in citrus may either be mixed or generative.

Mixed shoots are composed of leafy inflorescence bearing either one terminal flower or many single axillary flowers on a short leafy shoot. Generative shoots are composed of compact, cymose inflorescence bearing one or more flowers without developing leave (Davenport, 1990). In case of satsuma mandarin four types of flowering shoots may be observed which are; A) single flower leafy shoots B) many flowers leafy shoot C) One or more than one flower with leafy shoots D) Vegetative shoot (Brammeier, 1978). The flowers with out leave are in abundance, open earlier in the season as compared with leafy ones but fruit set is favoured in case of latter, as it has been noted in case of sweet orange and mandarin, but in contrast to this crop of some species such as 'Tahiti' lime are set primarily on leafless shoots. Various nitrogenous compounds may influence the determination of leafiness or affect growth rate of ovaries on leafy

inflorescence since these show higher polyamine content (Lovat et al., 1992).

Environmental conditions particularly temperature and light may influence carbohydrate supply, translocation rate and sink strength at the stage of fruit development giving rise to seasonal variations in fruit size and composition because it has been observed that elevating canopy air temperature throughout fruit development substantially increased the size and total soluble solids: titratable acidity ratio of fruit at harvest (Richardson et al., 1997).

Rootstocks used affect the fruit set, fruit drop and fruit quality characteristics of the scion variety. For satsuma mandarin trifoliolate is normally used as rootstock which is cold resistant but shallow rooted. So high temperature during the summer has more adverse effect on fruit quality. Rootstocks significantly influenced the yield, fruit weight, rind thick, rind colour, juice contents, total soluble solids and titratable acidity of "Owari" satsuma mandarin when grafted on 16 different rootstocks (Constantin et al., 1979). The rough peel disorder is characterised by excessively thick rough peel and large fruit size and is found in Shamouti orange growing under less than optimal conditions such as heavy soils, low relative humidity and on sour orange rootstock (Erner et al., 1976). It has also been observed that fruits developed from leafy inflorescence in satsuma mandarin have greater size, thick and rough skinned less juice percentage and late color development. Inflorescence leafiness may also influence total soluble solids and acid contents of fruits. All these characters are undesirable from quality point of view. In May and June if temperature is higher and relative humidity is lower, (as in Ege region) yield of satsuma mandarin is severely reduced due to heavy drop and this

ultimately results in more leafy inflorescence bearing low quality fruit during the next fruiting season, development under warmer condition and low temperature lead to increased proportion of leafy inflorescence (Moss, 1969). In satsuma mandarin as it has been elaborated earlier, fruits those developed from leafy and leafless inflorescence have great difference in respect of quality. Fruit born on leafless inflorescence are of superior quality as compared with those from leafy ones and at the same time later type of inflorescence experience more fruit set than the former ones especially in areas having high temperature and low relative humidity during the early summer but this has not been substantiated by proper research work.

Present studies are, therefore, envisaged to find out the effect of inflorescence leafiness on fruit quality of satsuma mandarin grafted on Troyer, Trifoliolate and Sour orange root stocks.

2. MATERIALS AND METHODS

Present studies were carried out during 1997-1999 in Citrus Experimental Garden and Department of Horticulture, Faculty of Agriculture, Ege University, Bornova, Izmir, Turkey. This region has semi-mediterranean type climate. Generally summer is hot and dry with cold and rainy winter.

Plant Material

Plant material used in this research work consisted of 25 years old satsuma mandarin plants cultivar Owari (*Citrus unshiu*, Marc.) grafted on trifoliolate orange (*Poncirus trifoliata*, (L.) Raf.), Sour orange (*Citrus aurantium*, L.) and Troyer citrange (*P. trifoliata* x *C. sinensis*, (L.) Osbeck) rootstocks. Three healthy looking, well bearing and plants of same size from each rootstock were selected. During the course of experiment cultural practices

such as weeding, hoeing, irrigation, fertilisation and insect pest control were done normally. Single plant was considered as one replication.

Inflorescence type

Inflorescence are flowering shoots arising from axillary buds. Inflorescence may be mixed, or generative. Three plants from each of the rootstock cultivar having uniform size were selected and tagged. Four branches one from each of the four sides i.e. south, east, north and west having almost same size at shoulder height were marked before the onset of flowering. On marked branches, number of leafy (LY) and leafless (LS) inflorescence were counted.

Physio-chemical analysis of fruits

Fruits were collected from plants selected for experiment in the 2nd week of November. All the fruits for leafy and leafless inflorescence were harvested same day. Twenty fruits born on leafy and leafless inflorescence were collected separately in polyethylene bags from shoulder height by walking around the periphery of the tree and taken to laboratory. Fruits brought to laboratory were used for studying various physical and chemical properties.

Average fruit weight

Fruits samples were weighed and weight per fruit was determined by dividing with the number of fruits.

Fruit diameter, height and shape index

Fruit diameter was measured at the equator of each fruit while height was measured between stem and stylar end. From these values fruit shape index was calculated.

Fruit shape index = Fruit diameter/Fruit height

Specific gravity

For determining specific gravity, each sample contained 10 fruits. Fruits from each sample were weighed individually. To find the volume of

fruit, the lower sieve of the hand citrus press was tied with plastic string and connected with under side of the balance. Its weight was noted inside the beaker filled with distilled water having few drops of detergent. Then each fruit was put in the beaker under sieve connected with balance and thus weight of each fruit was found. The fruit volume was calculated with the help of this formula (Fucik, 1973);

$$V = t + (K - Km)$$

Where:

V = Sample volume in cm.³

t = Sample weight gram).

K = Weight of Sieve inside water (gram).

Km = Weight of fruit in water under the sieve (gram).

The specific gravity was calculated by dividing fruit weight with fruit volume.

Peel colour and peel thickness

Peel colour was measured with MINOLTA CR.300 (Japan) colorimeter. Colour values (L, a, and b) were measured for 10 fruit sample at the equator from two opposite points and the total values obtained from all fruits measurements were divided by the number of values measured. In this way mean L, a, and b values for each sample were determined. where as;

L = Lightness

a = Green - red

b = Blue - yellow

Peel thickness was measured with Vernier Calliper by cutting the fruit in to two halves at the equator and peel thickness index was calculated;

Peel thickness index = Peel thickness x 2 x 100 / Fruit diameter

Electrical conductivity

Twenty peel discs (10 mm), two from each of the 10 fruit were taken and weighed. Discs were first dipped in tap and then in distilled water in order to remove dust or any other foreign material. Discs were then put

in the flask and added 100 ml of distilled water. Samples were shaken for four hours at 40 revolutions per minute (rpm) with the help of stirrer and electrical conductivity (EC) values were measured with. EC meter. The samples were then placed in the autoclave at 120 °C for 1 hour and again EC was measured.

Fruit juice percentage

Every fruit was cut into two halves at the equator and after weighing fruit sample, fruit juice was extracted by the use of Conti Electric Citrus press. The extracted juice was then weighed and fruit juice percentage was calculated.

Total soluble solid percentage and total acidity

The extracted juice was filtered by muslin cloth and few drops from the juice were put on hand refractometer. The reading noted was considered as TSS percentage.

For Total acidity, five ml from the filtered juice was taken and after adding two drops of phenolphthalein indicator was titrated against 0.1N NaOH. The amount of total acids was expressed as gr. citric acid/100 ml fruit juice by taking into account the factor of NaOH used.

TSS/TA ratio

Total soluble solids percentage (TSS) was divided by total acidity (TA) to obtain this ratio.

Vitamin C contents

For determining the vitamin C contents 1 ml from fruit juice prepared for TSS measurements was taken and added 9 ml of oxalic acid as stabiliser. After this, 1 ml from these samples was taken and after mixing with 0.0012 percent 2-6 dichlorophenol phthalein indicator was read at 518 nm wave length with spectrophotometer. Same readings were taken with standard ascorbic acid solutions and stabiliser. With the help of standard graph, the amount of ascorbic acid was calculated as mg/100 ml of fruit juice

from the absorbance values of the analysed samples.

3. RESULTS

Fruit weight

Data pertaining to fruit weight of fruits developed from LY and LS inflorescence are presented in Table-1. It is evident from the table that differences in relation to types of inflorescence turned out to be significant ($P<0.001$) during both years. A significantly higher fruit weight (145.07g.) was recorded for LY inflorescence as compared with LS ones (110.48 g. /fruit) during 1997. Fruit weight for LY and LS inflorescence was 104.98 and 82.70 gm, respectively, in 1998. Data regarding rootstocks indicated that non significant differences existed among rootstocks in respect of fruit weight. While data in relation to interaction between inflorescence types x rootstocks also indicated non significant differences during both the years.

Fruit diameter and height

Information procured on this parameter of study was subjected to statistical analysis and results obtained are presented in the table-1. One would visualize from the table that there were significant difference ($P<0.001$) between two types of inflorescence in respect of fruit diameter in the both years. Fruit diameter was 6.46 and 5.83 cm for LY and LS inflorescence, respectively, in 1997. While a comparatively lower diameter was recorded (6.14 cm) for LY and LS (5.67 cm) fruits during 1998. Significant differences were present regarding fruit diameter among three rootstocks in 1997 but non significant during 1998. The mean values for interaction revealed that TF and TR stood at par with each other but they exhibited significant superiority over SO in case of LY inflorescence while mean values for LS inflorescence

presented a some what different outlook as compared with leafy ones in 1997.

Data regarding fruit height for fruits developed from LY and LS inflorescence are summarized in the table- 1. It can be noted from the table that highly significant ($p < 0.001$) differences existed between types of inflorescence in respect of fruit height in 1997 as well as in 1998. Leafy and leafless inflorescence presented 6.56 and 5.62 cm in 1997 and corresponding values for 1998 were 5.54 and 5.01 cm, respectively. The differences among three rootstocks regarding fruit height were found non-significant in 1997 as well as in 1998. The interaction in relation to fruit height was found non-significant during both the years.

Fruit shape index

Data pertaining to fruit shape index for fruits developed from LY and LS inflorescence are portrayed in table-1. It is evident from the data that there was significant difference ($P < 0.05$) between two types of inflorescence during 1997 and non significant during 1998. A higher shape index value (1.04) was noted for leafless inflorescence as compared to leafy ones (0.99) during 1997. The comparison of three root stocks among themselves, regarding this parameter spelt out significant differences ($P < 0.01$) during both the years. The mean values for inflorescence type x rootstocks interaction showed that significant differences ($P < 0.05$) existed in 1997 but non significant during 1998

Specific gravity

Informations pertaining to specific gravity for fruits developed from LY and LS inflorescence are presented in table-1. Observation of specific gravity values for both year indicated that significant differences ($P < 0.001$) between two types of inflorescence.

The specific gravity which is closely related to puffiness was significantly lower (0.84 gm/ cm^3) in fruits developed from LY inflorescence as compared with LS inflorescence (0.87 gm/ cm^3) in 1997. Comparatively higher values (0.88 and 0.92 gm/ cm^3) for LY and LS inflorescence were noted in 1998. Data regarding specific gravity in respect of rootstocks showed non significant differences among three rootstocks. Data in relation to inflorescence type x rootstocks interaction portrayed significant differences in 1997 but non significant during 1998.

Peel colour a/b ratio

Data in relation to peel colour a/b ratio for LY and LS inflorescence are presented in table-2. This ratio provides information regarding establishing relation of yellow color of fruit peel with green or red color. In this way it is possible to generalize the all color elements. A perusal of the data indicated that significant differences ($P < 0.001$) existed between fruits from two types of inflorescence. The LS inflorescence behaved significantly better (0.28) than LY (0.16) inflorescence. Significant differences ($P < 0.05$) were also observed among rootstocks.

Peel thickness and peel index

Data regarding peel thickness and peel thickness index for fruits developed from LY and LS inflorescence are presented in table-2. Data in relation to peel thickness showed that LY and LS inflorescence differed significantly ($P < 0.01$) from each other in 1997 as well as in 1998. The peel thickness for fruits from LY and LS inflorescence was 4.34 and 3.30 mm in 1997 while the corresponding values were 3.47 and 2.56 mm respectively, in 1998.

Results regarding peel thickness index are presented in Table-2. By calculation of this ratio the effect of

fruit weight on peel thickness can be abolished. Results concerning peel thickness index indicated significant differences existed between LY and LS inflorescence in both the year. The peel thickness index for LY and LS inflorescence was 13.45 and 11.39, respectively in 1997 and 11.33 and 9.08 for LY and LS, respectively in 1998.

Electrical conductivity percentage

It can be visualised from data regarding EC percentage (Table-2) that significantly higher (46.51) value was noted for LS inflorescence as compared with (41.08) LY ones. The results for rootstocks were found non significant. The interaction also presented non significant differences.

Juice percentage and total soluble solids percentage

Data regarding juice percentage for fruits obtained from LY and LS inflorescence are presented in table-3. One would visualized from the data that differences for fruit juice percentage turned out to be significant ($P<0.001$) for both the years. In 1997 fruit juice percentage was 39.62 and 45.85 which indicates the significant superiority of LS inflorescence over LY ones. While in 1998 relatively higher fruit juice values were noted as that of in 1997. The extracted juice percentage was 44.92 and 51.36 for LY and LS inflorescence, respectively. Perusal of results for rootstocks indicated that statistically significant differences existed in 1997 but non significant in 1998.

Data regarding TSS percentage for fruits obtained from LY and LS inflorescence are presented in table-3. It is evident from the data that there were significant differences in 1997 but non significant in 1998. The TSS percentage for LY and LS inflorescence was 10.66 and 11.64, respectively, in 1997.

Total acidity and TSS/TA ratio

Data in respect of total acidity for fruits developed from LY and LS inflorescence are presented in table-3. The data showed that there were non significant differences between total acidity for LY and LS inflorescence during both the years but significant differences ($P<0.05$) were found among rootstocks in 1997 as well as in 1998.

Data regarding TSS/TA ratio for fruits developed from LY and LS inflorescence are presented in table-3. A view of the data indicated that non significant differences ($P<0.05$) existed between two types of inflorescence in 1997 as well as in 1998. The comparison of rootstocks mean presented significant differences in both the years but the interaction turned out significant in 1997 but non significant in 1998.

Vitamin C contents

Data in relation to vitamin C contents for fruits obtained from LY and LS inflorescence are presented in table-3. It is evident from the data that significant differences ($P<0.05$) were found between LY and LS inflorescence during both the years. Significantly higher vitamin C contents (29.20) were noted for LS inflorescence as compared with (26.01 mg/100 ml) for LY ones in 1997. While vitamin C contents for LY and LS inflorescence in 1998 were 22.93 and 25.51 mg/100 ml, respectively. Comparison of rootstocks presented significant differences in 1997 whereas non significant in 1998.

4. DISCUSSION

Physical fruit characteristics

Significantly higher fruit weight, fruit diameter, and fruit height, and lower fruit shape index and specific gravity were found in LY inflorescence born fruits as compared with LS ones.

Fruit size in general is function of several factors including cultivars, rootstocks, crop load, inflorescence type, and cultural practices such as irrigation and nutrition. Difference in fruit size may also results from differences in fruit growth which is determined by the sink strength of the fruit (its capacity to accumulate metabolites) and metabolite supply (Guardiola, 1993). Differences in size of LY and LS inflorescence are clear at the time of flowering and increased markedly during post bloom until past June drop, to remain until fruit maturity. While in another study it was reported that cross sectional area of the grapefruit pedicel was highly correlated with final fruit weight, suggesting that transport capacity effect the growth of the fruit (Bustan et al, 1995). Although no data were collected on pedicel width but on the basis of personal observations it can be said that LY fruits have thicker pedicel as compared with LS ones. The other factor which can play role in determining the size of the fruit is temperature. Because it has been reported that satsuma mandarin in higher temperature conditions have greater size as well as pedicel diameter as compared with those grown under lower temperature (Richardson et al, 1997) while Karaçali (1978) observed that fruit at the top of the tree have higher fruit weight, diameter and height as compared with other position of the trees. As the LY inflorescence are present normally around the periphery of the tree and the temperature at periphery is thought to be higher than the inside of the tree where LS inflorescence are generally present. So, the high temperature might have contributed to some extent to higher fruit weight, diameter and height in LY inflorescence. Fruit shape index was lower in LY fruits that means that LY born fruits were collard

i.e. having more height than diameter while LS were somewhat rounder. Similar trend was noted in Shamout orange that with the progressive increase in roughness the fruit become longer because increasing peel roughness accentuated at the stem end (Erner *et al*, 1975).

The specific gravity of fruit which is closely related with puffiness was significantly lower in LY in comparison with LS fruits. As the specific gravity of the fruit indicates the largeness of the cavity inside the fruit, so factors those increase the fruit volume and peel growth decrease and factor those increase uptake of water increase specific gravity (Karaçali, 1978). In this context it can be said that LY fruits having less specific gravity are low quality fruits.

External fruit quality

The 'a'/'b' ratio which provide information regarding establishing relation of yellow colour of fruit with green or red colour, was also higher in LS fruits than in LY ones. This indicated that LS fruits attained better peel color than LY fruits. Peel roughness in orange fruit was due to increased gibberellin and cytokinin of the flavedo and albedo tissues (Erner et al, 1976) and our findings also indicated that LY fruits have more gibberellins contents as compared with LS ones. The external application of gibberellins also delay color development by delaying chlorophyll degradation and senescence in citrus (Coggins and Hield, 1968). The other hormone which counts in colour development is the amount of ABA in the flavedo. Abscissic acid contents increase throughout the course of color development and reached a maximum at the time of color break. A decline in the ABA concentration occurred concomitantly with the full expression of color (Richardson and Cowan, 1995), so it may be assumed that LS

fruits have attained ABA peak earlier than the LY ones and showed better colour development.

Significantly higher peel thickness and peel index was noted in LY as compared with LS fruits (table-2). The peel thickness is directly related with fruit weight (Karaçali, 1978, McDonald and Hillebrand, 1980). Leafy fruits were bigger in size and hence presented thicker peel and higher peel index. Significantly higher peel thickness in 1997 may also have resulted from higher fruit weight in 1997 than that of in 1998.

Significantly higher electrical conductivity % noted in LS fruits as compared with LY fruits was independent of rootstocks (table-2). A typical behavior of senescence is the increase in electrolyte leakage (Sasson and Monselise, 1977). As it has been elaborated earlier that rough developed fruit have higher flavedo gibberellin content (Erner et al, 1976). Secondly, GA₃ improved the viability of mechanically isolated protoplast and in the excised mesocarp tissue of pummelo, the electrolyte leakage and K⁺ efflux was significantly reduced in the presence of GA₃. So, the less electrical conductivity of leafy fruits can be explained in this context.

Internal fruit quality

Data regarding juice percentage indicated that significantly higher juice percentage was obtained from LS as compared with LY fruits during the both year (table-3). Fruit weight is negatively related with juice percentage (Karaçali, 1978, Karaçali, 1980). The leafy fruits were bigger in size with less juice percentage than the LS ones those were smaller in size but juice yield was higher.

Significantly lower TSS percentage in LY fruits compared with LS may also be explained (table 3) with reference to the fruit weight because TSS is also negatively related with

fruit weight, so the higher fruit weight in LY fruits was responsible for lower TSS. Differences between LY and LS fruits regarding total acidity were found non significant during both the year (table-3) but differences among rootstocks were found significant. It has been reported that Sour orange rootstock for satsuma mandarin gave maximum acidity while Trifoliate and Troyer citrange stood at par with each other (Izdal and Karaçali, 1988) while Mendilcioglu (1986) obtained different results with the same rootstocks. This indicated that various factors such as microclimate, cultural practices and nutrition may also influence the total acidity of the fruit. The total acidity is positively related with total soluble solids (Karaçali, 1980) but this cannot be verified by our results.

Total soluble solids/ total acid ratio presented non significant for LY and LS fruits but significant for rootstocks. No proper pattern was followed by different rootstocks regarding TSS/TA ratio during both the year. Others workers also reported different results (Izdal and Karaçali, 1988 and Mendilcioglu, 1986). Significantly higher vitamin C contents were found in LS as compared with LY fruits during both the year. Significantly lower vitamin C contents were found in 1998 as compared with in 1997. High temperature of May, September, October increase vitamin C contents (Karaçali, 1982) but our results do not substantiate these findings because during these months temperature was higher in 1998 but vitamin C contents were higher in 1997. The vitamin C contents were positively related with TSS%. So, the LS fruits have comparatively higher TSS % as well as in vitamin C contents (Karaçali, 1980)

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Table 1. Effect of Leafy and Leafless Inflorescence on Fruit Weight, Diameter, Height, Fruit Index and Specific Gravity.

Parameters	Year	Fruit type		Mean.	Rootstocks			Fruit type	Fruit Type x Rootstocks		
		LY	LS		TR	SO	TF		TR	SO	TF
Fruit Weight.(g)	1997	145.07a	110.48b	127.78*	122.78	124.67	135.89	LY	132.78	141.45	161.00
	1998	104.98a	82.70b	93.84*	91.55	96.33	93.64	LS	112.78	107.89	110.78
Fruit Diameter (cm).	1997	6.46a	5.83b	6.15 *	6.54 a	5.67c	6.23b	LY	6.62ab	5.82c	6.96a
	1998	6.14a	5.67b	5.90*	5.70	6.01	6.00	LS	6.47a	5.53bc	5.50c
Fruit Height (cm)	1997	6.56a	5.62b	6.09**	6.12	5.96	6.11	LY	6.52	6.35	6.80
	1998	5.54a	5.01b	5.28**	5.52	5.37	5.23	LS	5.71	5.56	5.59
Fruit Index	1997	0.99b	1.04a	1.01*	1.07 a	0.96c	1.01b	LY	1.02ab	0.92c	1.02a
	1998	1.11	1.13	1.12*	1.09bc	1.12ab	1.15a	LS	1.13a	1.00b	0.99bc
Specific Gravity (g/cm ³)	1997	0.84b	0.87a	0.85*	0.85	0.85	0.86	LY	0.83b	0.82bc	0.85a
	1998	0.88b	0.92a	0.90*	0.89	0.89	0.91	LS	0.87bc	0.88a	0.87ab
								LY	0.87	0.87	0.89
								LS	0.91	0.91	0.93

Table 2. Effect of Leafy and Leafless Inflorescence on Peel Color L, a, b, a/b ratio, Peel thickness, Peel Index and Peel EC Percentage

Parameters	Year	Fruit type		Mean.	Rootstocks			Fruit type			Fruit Type x Rootstocks		
		LY	LS		TR	SO	TF	TR	SO	TF	TR	SO	TF
Peel Color L	1998	62.40b	66.14a	64.27	64.34	64.14	64.34	LY		62.92	62.20	62.07	
Peel Color 'a'	1998	9.86b	18.93a	14.40	16.79a	13.28b	13.15bc	LS		65.75	66.07	66.61	
Peel Color 'b'	1998	59.95b	66.78a	63.37	64.33	62.70	63.08	LY		13.08	8.78	7.77	
Peel Color a/b	1998	0.16b	0.28a	0.22	0.26 a	0.21 b	0.20bc	LS		20.50	17.78	18.52	
Peel Thickness (mm)	1997	4.34a	3.30b	3.82 *	3.81	3.67	3.99	LY		61.28	59.37	59.21	
	1998	3.47a	2.56b	3.02 *	3.11	2.97	2.98	LS		67.37	66.02	66.95	
Peel Index	1997	13.45a	11.39b	12.42 *	11.61	12.89	12.76	LY		0.21	0.15	0.13	
	1998	11.33a	9.08b	10.20 *	10.87	9.86	9.88	LS		0.30	0.27	0.28	
Peel EC (%)	1998	41.08b	46.51a	43.78	44.78	42.54	44.07	LY		4.30	4.11	4.61	
								LS		3.31	3.23	3.37	
								LY		3.48	3.52	3.42	
								LS		2.74	2.41	2.54	
								LY		12.97	14.11	13.25	
								LS		10.24	11.67	12.26	
								LY		11.69	11.45	10.84	
								LS		10.06	8.26	8.92	
								LY		41.43	38.46	43.36	
								LS		48.12	46.63	44.78	

Table 3. Effect of Leafy and Leafless Inflorescence on Juice Percentage, TSS %, TA, TSS/TAA and Vitamin C Contents.

Parameters	Year	Fruit type		Mean.	Rootstocks			Fruit type	Fruit Type x Rootstocks		
		LY	LS		TR	SO	TF		TR	SO	TF
Fruit Juice (%)	1997	39.62b	45.85a	42.73*	39.93c	43.64ab	44.63a	LY	35.29	40.53	43.03
	1998	44.92b	51.36a	48.14*	48.71	46.47	49.24	LS	44.58	46.75	46.22
TSS %	1997	10.66b	11.64a	11.15	11.34	10.83	11.28	LY	10.95	10.53	10.48
	1998	11.41	11.93	11.67	11.50	11.37	12.17	LS	11.73	11.12	12.07
TA (g/100 ml)	1997	1.67	1.81	1.79	1.79ab	1.56bc	1.88a	LY	1.86	1.59	1.55
	1998	1.69	1.68	1.69	1.55bc	1.57b	1.94a	LS	1.71	1.52	2.20
TSS/TA	1997	6.44	6.57	6.51	6.41ab	6.98a	6.13bc	LY	5.90bc	6.66ab	6.76a
	1998	6.88	7.25	7.06	7.50a	7.35ab	6.34c	LS	6.91ab	7.30a	5.51c
Vitamin C (mg/100 ml)	1997	26.01b	29.20a	27.61*	29.72a	29.28ab	23.82c	LY	27.58	26.84	23.60
	1998	22.93b	25.51a	24.22*	24.55	27.34	20.76	LS	31.86	31.71	24.04
								LY	23.56	25.93	19.31
								LS	25.53	28.76	22.22