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Evaluation of Pink Pulped Navalur Guava Selections

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ABSTRACT: *A field experiment was carried out to study the performance of pink pulped Navalur guava selections in relation to growth, yield and quality parameters and to identify the genotype which is rich in lycopene content having dark pink coloured pulp with soft and less seeds. Among seven pink pulped Navalur guava selections, Selection-5 was found vigorous exhibiting higher plant height and spread. It also produced the highest number of fruits yield per plant as well as yield per ha but took maximum days to attain fruit maturity from flowering. The highest pulp weight was recorded in Selection-7. Selection-3 recorded the highest number of seeds per fruit but seeds were soft as they were light in weight. The highest total soluble solid was significantly recorded in Selection-3. Significantly minimum titrable acidity was recorded in Selection-1. Selection-7 recorded maximum content of ascorbic acid. Selection-3 was found superior in total suger, reducing suger and non-reducing sugars. Sugar-acid ratio a criteria for taste was found to be highest in Selection-1. Maximum lycopene content was recorded in Selection-3 which recorded strawberry coloured pulp.*

Key word: *ascorbic acid, Navlur guava, lycopene, yield*

INTRODUCTION

Guava (*Psidium guajava* L.) is the most important and commercially cultivated fruit crop belonging to the family *Myrtaceae*. It is originated in tropical America. It was introduced to India during 17th century by Portuguese (Menzel and Paxton, 1985). It is one of the hardiest fruits in adaptability with more productivity, nutritional quality and hence aptly known as Poor man's apple and Apple of tropics. It is commercially cultivated in India and ranks fourth with respect to area i.e. 204 thousand hectares and production i.e. 22.70 lakh MT. (NHB, 2009). The fruit has 165 mg of vitamin C, as against a mere 69 mg in orange. Pink pulped guava varieties an excellent source of lycopene, potassium, soluble fiber and antioxidants. Lycopene is a key intermediate in the biosynthesis of many important carotenoids, such as beta-carotene and anthophylls. The end product of the biotechnologically engineered pathway is lycopene, but if the plant accumulated lycopene the rice would be red. Recent analysis has shown that the plant's endogenous enzymes process the lycopene to beta-carotene in the endosperm, giving the rice the distinctive yellow colour after which it is named (Anon., 2010b). Lot of genetic variability exists among the guava genotypes with respect to nutritional quality of the fruits. Navalur guava is an excellent eco-type from Navalur region of Dharwad district in Karnataka state.

MATERIAL AND METHODS

A field study was carried out at the Silver Jubilee Orchard, Main Agricultural Research Station, UAS, Dharwad during the year 2009. The experiment was laid out in randomized block design with seven treatments and three replications. The seven treatments were consisting of pink pulped Navalur guava selections.

R-I	*R-II*	*R-III*
Selection-5	Selection-11	Selection-1
Selection-1	Selection-9	Selection-3
Selection-3	Selection-6	Selection-5
Selection-9	Selection-7	Selection-6
Selection-11	Selection-3	Selection-7
Selection-6	Selection-1	Selection-9
Selection-7	Selection-5	Selection-11

Figure 1: Layout map →N

Observations were recorded on yield parameters and quality parameters. Fruit yield per plant both on

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count basis and weight basis was recorded from each of the selected plants. Number of fruits per plant was recorded in each of the treatment the fruits were harvested at maturity stage and the number of marketable fruits was counted. Total weight of fruits per plant harvested weighed, using a balance and the fruit yield was expressed in kilograms per plant. Estimated fruit yield per ha was computed by the formula Fruit yield (q / ha) = Fruit yield (q / plant) × 277 (No. of plants per ha at 6 m × 6 spacing). The fruit length was measured from the stalk end to calyx end using vernier calipers and expressed in cm. The fruit diameter was measured at the widest cheeks of fruit using vernier calipers and expressed in cm. The volume of fruit was measured by the conventional water displacement method, expressed in ml. The fruit shape at stalk end was described with the help of standard descriptor for guava prescribed by UPOV (International Union for the Protection of new Varieties of plants) (Anon., 1987). The fruit weight was recorded by using electronic balance and expressed in grams. The pulp colour was described with the help of Exotica horticultural colour guide (Graf, 1982). The skin of freshly harvested fruits was peeled and pulp was separated and weighed by using electronic balance. Mean weight was computed and expressed in grams. For counting number of seeds per fruit the pulp of fruit was made into pieces and boiled in hot water for 15 minutes. Later, the seeds were separated by using ordinary sieve (< 20 mm) and made counting. A total of 100 seeds were sampled from the extracted seeds and their weight was recorded using an electronic balance. Seed hardness was observed organoleptically and classified into soft, medium hard, hard and very hard. For Chemical parameters total of four ripe fruits were sampled from each tree. The TSS was determined by using Erma hand refractometer (0-32^{0}Brix) and was expressed in ^{0}Brix.

Titrable acidity was estimated by titrimetric method and expressed as percent citric acid as described by Ranganna (1977). Ascorbic acid was estimated by volumetric method by using 2, 6-dichlorophenol indophenol dye as per the procedure suggested by Ranganna (1977) and expressed as mg/ 100 g pulp. The reducing sugars were estimated by following Shaffer Somogi method as described by Ranganna (1977) and expressed as per cent. The quantity of non-reducing sugars was computed by the following formula and expressed as per cent. Non-reducing sugars (%) = Total sugars (%) – Reducing sugars (%). The total sugars were estimated by following Shaffer Somogi method as described by Ranganna (1977). The sugar / acid ratio of guava fruit pulp was calculated by the following formula. Total sugar in the fruit pulp (%) Sugar / Acid ratio = Titrable acidity in the fruit pulp (% Citric acid). For lycopene pigment the fruit pulp was taken and squeezed in a muslin cloth by adding repeatedly acetone to extract the juice. One ml of extracted juice was then taken in 100 ml stoppered conical flask and 20 ml acetone was added and kept on mechanical shaker for 30 minutes. Forty ml of petroleum ether was added to this mixture and the absorbance was measured at 503 nm. Lycopene content (mg / 100 g) was calculated by using the below mentioned formula given by Ranganna (1977). Lycopene content 3.1206 x O. D. of sample (% absorbance) x Volume made up (mg / 100 g of juice) = × 100 Weight of fruit sample x 1000.

RESULT AND DISCUSSION

Yield is known to be a polygenic character. Besides, care and management of orchard, age of plant and season are the other important factors influencing the yield. It is revealed that, the clonally propagated seedling progenies of pink pulped Navalur guava selections, the highest number of fruit per plant was recorded in Selection-5, followed by Selection-3, whereas lowest number of seeds was observed in Selection-11. It might be due to the reason that the different seedling progenies had significant variations with respect to their genetic makeup. This is in conformity with the findings of Marak and Mukunda (2007), Athani *et al.* (2007) and Babu *et al.* (2007). Among the selections, the total weight of fruits per plant was found to vary significantly closely following the number of fruits per plant recorded by them. Such association between the total weight of fruits per plant and the number of fruits produced per plant among various guava selections was also reported by Singh (1988), Aulukh (2005) and Gohil *et al.* (2006).

Length, diameter, weight and volume of fruits were the major components of fruit size under the present study. The maximum fruit length was observed in Selection-5 and minimum in Selection-11. The variation in fruit length can be attributed to genetic constitution of the seedlings. Similar findings were reported by Sadashivaiah (1989) and Pandey *et al*. (2007). Selection-3 recorded maximum fruit diameter followed by Selection-5, whereas minimum diameter was observed in Selection-6. This variation may be due to phenotypic and genotypic interactions among the selections. Similar variations were

observed by Phadnis (1970), Thonte and Chakrawar (1982) and Biradar and Mukunda (2007). The individual fruit weight and pulp weight are important constituents during crop improvement programme in fruit crops while making selections. Among the various pink pulped Navalur guava selections under the present study a significant variation with respect to fruit weight and pulp weight. The maximum fruit weight was recorded in Selection-5, while minimum was noticed in Selection-6. Similarly the highest weight of fruit pulp was found in Selection-7 followed by Selection-3, while minimum in Selection-6. This may be due to phenotypic and genotypic influence over the different selections which is in conformity with the findings of Singh (1988), Ram *et al.* (1997) and Deshpande (2006). There were significant differences among the selections with regard to fruit volume. The fruit volume ranged from 82.57 ml in Selection-6 to 124.63 ml in Selection-5. The fruit volume is closely proportionate with fruit weight. Similar findings were observed by Biradar and Mukunda (2007) in TG Selections and also by Raghav and Tiwari (2008). There were significant differences among the various selections with regard to fruit shape in the study. Selection-1 and Selection-5 had necked type of fruits, whereas Selection-3, 7 and 9 showed round fruits. Among them Selection-5 and Selection-3 had larger fruits as evident from the data on fruit length, diameter and volume. This variation may be due genetic character of the seedling progenies. This is in conformity with the findings of Phadnis (1970), Thonte and Chakrawar (1982) and Santos *et al.* (2008). The pink pulped Navalur guava selections varied with regard to pulp colour. In present investigation the dominant strawberry colour was noticed in the fruits of Selection-3 and Selection-6, while Selection-9 showed inferior shell pink colour. This variation may be due to genotypic constitution that allowed a higher synthesis of lycopene pigment. Similar opinions of pink colouration being associated with pigment composition like lycopene and similar results were also expressed by Jagtiani *et al.* (1988), Preez and Welgemoed (1990) and Santos *et al.* (2008). It is also known in guava that complete seedlessness will result in deformed and misshapen fruits accompanied by reduction in fruit size. Since the presence of seeds determine shape and size of the fruit, it is desirable to have cultivars with few and soft seeds. From the present study it was observed that in general there was a wide variation with respect to these seed characters among the clonally propagated pink pulped Navalur guava selections and these differences were found to be statistically significant. Minimum number of seeds per fruit was observed in Selection-5, whereas maximum seed count was recorded in Selection-3 with lowest seed weight and much soft nature. Such variation among the selections in seed characters may be attributed to genetic makeup of the plants. Seed number is known to be a function of value fertility and effective fertilization. Variations in seed characters of guava fruit were also observed in Apple Colour selections by Marak and Mukunda (2007). Similar results were also recorded by Sadashivaiah (1989), Prakash (1976) and Patel *et al*. (2007).

Among the different factors influencing fruit quality, bio-chemical components in guava fruit are of utmost concern to assess the fruits either for dessert purpose or for fruit processing. Total soluble solids indicates higher sugar content in the fruits and is considered as one of the important criterion for dessert quality whereas lycopene content which causes pink colouration is important determinant of processing quality. In the present study, Selection-3 established its supremacy for total soluble solids (TSS), sugars and lycopene content over the other selections. Selection-3 and Selection-5 contained higher TSS while lower TSS was recorded by Selection-9. It may be due to phenotypic and genetic constitution among the selections which might had necessitated consumption of nutrients and sinking more carbohydrates into the fruits, thus producing larger fruits with more TSS. Also the seasonal conditions were more favourable in these selections for good fruit development. This is in conformity with the findings of Ram *et al.* (1997), Athani *et al.* (2007) and Marak and Mukunda (2007). The sugars present in the fruit impart the sweetness while sugars and organic acids present in the fruit influence its taste and flavour. Moderate acid content coupled with a high total sugar content as observed in the Selection-3 appeared to be favouring good taste and flavour of its fruits, whereas high acidity (0.41%) in Selection-6 resulted in the poor acceptability of its fruits in market. The wide variation in titrable acidity may be attributed to the genetic makeup. This is in conformity with the findings of Tandon *et al.* (1983), Aulakh (2005) and Babu *et al.* (2007). Guava fruits are consumed for the nutritive value offered by ascorbic acid content promoting their dessert quality. Higher ascorbic acid content was observed in Selection-7 and and Selection-6, while Selection-3 and Selection-5 produced fruits with lower ascorbic acid content. Higher ascorbic acid content was found to be

associated with total acidity and *vice versa* among the various selections in the present study. The larger variation in ascorbic acid content may be attributed as a varietal character and due to favourability of seasonal conditions. Similar trend was also reported by Gohil *et al.* (2006), Pandey *et al.* (2007) and Biradar and Mukunda (2007). Entire guava fruit is edible when ripe and freshly harvested will have pleasant taste with higher sugar content. Also sugar is one of the important constituent in the preparation of any product out of guava fruits. Selection-3 scored very well with regard to both reducing and non-reducing sugars and thus recording a higher amount of total sugars per unit of fruit pulp. Selection-11 recorded the lowest total sugars, while Selection-9 recorded the least content of reducing sugars. The significant variation in sugar contents in the fruits of pink pulped Navalur guava selections might have occurred due to genetic or phenotypic features. The sugar-acid ratio showed wide variations among selections. The sugar-acid ratio was found at maximum in Selection-1 followed by Selection-3 indicating better dessert quality. Selection-6 recorded minimum sugar-acid ratio. This variation may be a varietal character associated with total sugar content and titrable acidity of the fruits. Similar findings were also reported by Sadashivaiah (1989) and Marak and Mukunda (2007) in guava selections. Lycopene pigment imparts pink colouration to the fruit pulp in guava. However, there was a wide variation, in lycopene pigment among the pink pulped Navalur guava selections. In general, these values corresponded with the intensity of pulp colour. The highest value of lycopene content was recorded in the fruit pulp of Selection-3 which showed dominant strawberry colour, while it was least in Selection-9 where the intensity of colour was faint. Such variation in lycopene content may be attributed to genetic makeup of the seedling progenies. This is

Table 1
Yield parameters of pink pulped Navalur guava selections

Selections	*Fruit yield per plant*		*Fruit yield per ha (q)*
	Number	*Weight (kg)*	
Selection-1	563.33	53.12	147.14
Selection-3	752.67	91.62	253.78
Selection-5	809.00	101.19	280.30
Selection-6	744.67	62.78	173.91
Selection-7	228.33	23.81	65.96
Selection-9	512.33	53.42	147.98
Selection-11	192.67	21.17	58.63
S.E. m ±	24.13	3.79	10.49
CD (5%)	74.35	11.67	32.31

Table 2
Physical quality parameters of pink pulped Navalur guava selections
a. Fruit length, fruit diameter and fruit volume

Selections	*Fruit length (cm)*	*Fruit diameter (cm)*	*Fruit volume (ml)*
Selection-1	7.10	5.85	97.76
Selection-3	6.70	6.37	122.76
Selection-5	7.73	6.20	124.63
Selection-6	6.70	4.94	82.57
Selection-7	6.88	5.77	99.23
Selection-9	6.96	5.71	104.78
Selection-11	6.62	5.40	107.00
S.E. m ±	0.19	0.10	5.09
CD (5%)	0.58	0.32	15.69

Table 2
Physical quality parameters of pink pulped Navalur guava selections
b. Fruit weight, pulp weight, fruit shape at stalk end and pulp colour

Selections	*Fruit weight (g)*	*Pulp weight (g)*	*Fruit shape at stalk end*	*Pulp colour (colour code)*
Selection-1	94.29	57.42	Necked	Light pink
Selection-3	121.71	45.64	Rounded	Strawberry
Selection-5	125.08	57.84	Necked	Clear pink
Selection-6	84.34	26.42	Pointed	Strawberry
Selection-7	104.13	58.27	Rounded	Deep pink
Selection-9	103.48	51.34	Rounded	Shell pink
Selection-11	109.67	52.33	Pointed	Carmine
S.E.m ±	3.32	2.78		
CD (5%)	10.22	8.57		

Table 2
Physical quality parameters of pink pulped Navalur guava selections
c. Number of seeds/fruit, weight of 100 seeds and seed hardness

Selections	*Number of Seedsper fruit*	*Weight of 100 seeds (g)*	*Seed Hardness*
Selection-1	235.11	1.45	Medium hard
Selection-3	424.40	0.92	Soft
Selection-5	210.39	1.63	Hard
Selection-6	272.11	0.99	Soft
Selection-7	259.99	1.59	Hard
Selection-9	235.07	1.60	Hard
Selection-11	212.07	1.02	Medium hard
S.E.m ±	6.49	0.06	
CD (5%)	19.99	0.19	

Table 3
Chemical quality parameters of pink pulped Navalur guava selections
a. Total soluble solids, titrable acidity and ascorbic acid

Selections	*TSS (^{0} B)*	*Acidity (%)*	*Ascorbic Acid (mg/100g)*
Selection-1	10.19	0.22(0.27)	143.05
Selection-3	12.87	0.37(0.35)	137.49
Selection-5	11.67	0.36(0.35)	109.26
Selection-6	11.05	0.41(0.37)	218.05
Selection-7	11.38	0.36(0.34)	232.02
Selection-9	9.70	0.38(0.35)	165.27
Selection-11	11.21	0.33(0.33)	208.25
S.E.m±	0.29	0.01	4.70
CD (5%)	0.90	0.02	14.47

Note: Figures in parenthesis are arcsine values.

Table 3
Chemical quality parameters of pink pulped Navalur guava selections
b. Reducing sugars, non-reducing sugars, total sugars and Sugar/Acid ratio

Selections	*Reducing sugars (%)*	*Nonreducing sugars (%)*	*Total sugars (%)*	*Sugar/Acid Ratio*
Selection-1	3.72(1.10)	3.21(1.03)	6.93(1.51)	32.96
Selection-3	4.76(1.25)	4.61(1.23)	9.37(1.75)	25.51
Selection-5	4.61(1.23)	4.10(1.16)	8.71(1.69)	24.07
Selection-6	3.31(1.04)	2.51(0.91)	5.82(1.38)	14.18
Selection-7	3.92(1.13)	3.72(1.10)	7.64(1.58)	21.54
Selection-9	3.15(1.02)	3.25(1.03)	6.40(1.45)	16.78
Selection-11	3.16(1.02)	2.64(0.93)	5.80(1.38)	17.55
S.E.m ±	0.01	0.02	0.02	1.08
CD (5%)	0.02	0.05	0.05	3.33

Note: Figures in parenthesis are arcsine values.

Table 3
Chemical quality parameters of pink pulped Navalur guava selections
c. Lycopene content

Selections	*Lycopene (mg 100 g $^{-1}$)*
Selection-1	1.84
Selection-3	5.10
Selection-5	2.52
Selection-6	3.72
Selection-7	2.83
Selection-9	1.70
Selection-11	3.14
S.E.m ±	0.09
CD (5%)	0.28

in conformity with the findings of Nakasone *et al.* (1976), Marak and Mukunda (2005) and Chandrika *et al.* (2009).

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