

Effect of Fruit Orientation on the Quality of Litchi (*Litchi chinensis* Sonn) under the Agro-Climatic Conditions of Dera Ismail Khan–Pakistan

KASHIF WASEEM, ABDUL GHAFFOR AND SAIF-UR-REHMAN†

Department of Horticulture, Faculty of Agriculture, Gomal University, Dera Ismail Khan–Pakistan

†Agriculture Research Institute, Ratta Kulachi, Dera Ismail Khan–Pakistan

ABSTRACT

Effect of fruit orientation on the quality of litchi (*litchi chinensis*. Sonn) was studied in five cultivars viz; Purbi, Bedana, Bombai, Serai and Gola. Fruit was picked from upper and lower half portions of the tree and was subjected to physio-chemical analysis. Significant difference was found for all the parameters studied. The fruit at lower half was heavy in weight, pericarp and flesh with high acidity. However, stone weight, pH value, Vitamin C content and non-reducing sugars were found more in fruits collected from upper half of the tree. Picking might be started from lower half of the plant to get superior quality fruits.

Key Words: Litchi; Fruit orientation; Fruit quality

INTRODUCTION

The litchi (*Litchi chinensis* Sonn.) is a tropical fruit and belongs to the family Sapindaceae. It is considered as one of the best fruits due to its high nutritive value. Its spread from China to other parts of the world was slow due to its peculiar climatic requirements. Other commercial producers are Indonesia, Australia, USA, New Zealand, South Africa, India and Bangladesh.

Besides a rich source of vitamin C, litchi contains a fair amount of Phosphorus, Calcium, Iron, Vitamins A and B. Litchi fruit contains 15.9% seed, 9.6% pericarp, 74.5% edible portion, 78.2% moisture, 1.2% acid, 0.97% oil, 0.94% protein, 0.69% ash, 6.89% free reducing sugars, 6.68% hydrolyzable sugars and 13.75% total sugars (Ahmad, 1956).

The sugar contents in different varieties ranges from 6.74-20.6% (Singh & Singh, 1964). Cabin (1954) also reported that the chemical composition of litchi revealed that it had the edible portion 74.5%, moisture 78.5%, citric acid 1.2%, ash 0.69% and sugar 13.57%. The effect of fertilizer and orientation of fruit on the quality/composition has been reported previously (Van Horn, 1936; Randhawa, 1945; Mustafa, 1961; Rehman *et al.*, 1982; Sharma *et al.*, 1990).

This paper describes the effect of fruit orientation of litchi on its quality in agro-climatic conditions of Dera Ismail Khan (Pakistan)

MATERIALS AND METHODS

The experiment was carried out to study the effect of sunlight exposure on the quality of litchi fruit. Fruit of five cultivars of litchi i.e., Purbi, Bedana, Bombai, Serai and Gola was collected from the orchard of Fruit and Vegetable

Development Board, Dera Ismail Khan. The experiment was replicated thrice using two factor in RCBD with varieties and exposure. The following parameters were carefully studied.

Physical characteristics. Fruit size (cm), Fruit weight (g), pulp or edible portion (g) and pulp percentage were determined.

Chemical characteristics. Total acidity of the extracted juice (Ruck, 1978), pH, vitamin C and TSS (A.O.A.C., 1984) were determined. Total and reducing sugars were estimated by Lane and Eynon (1923) method as described in A.O.A.C. (1984). Non reducing sugars were calculated as:

Non Reducing Sugar= (% Total Sugars -- % Reducing Sugars) x 0.95

Statistical analysis. Data on various parameters were subjected to the Analysis of Variance Technique (Steel & Torrie, 1980) and Duncan's Multiple Range Test (Duncan, 1955) to check the differences among the various treatments.

RESULTS AND DISCUSSION

Physical characteristics

Fruit size (cm). All the means of the various parameters studied showed significant differences ($p < 0.005$). Gola cv. depicted maximum fruit weight (17.02 g) followed by Bombai (14.58 g), while the cv. Serai showed fruit weight (11.57 g). Fruit positioned at the lower half had greater fruit weight (13.98 g) than the upper half of the plant (Table I). Similar results in other fruit crops like citrus were recorded by Rehman *et al.* (1982) who reported higher fruit weight in citrus fruits located at lower half portion. However, Randhawa (1945) concluded that orientation had no effect

on the fruit weight of sweet orange. The difference in results may be due to the changes in climatic conditions.

Peel/pericarp weight (g). Gola cv. contained the maximum pericarp weight (2.66 g) followed by Bedana (2.24 g). The lowest peel weight (1.38 g) was noted in Serai cv (Table I). Peel weight of litchi fruit was significantly ($p>0.005$) affected by orientation. Fruit peel was more in fruit located at the lower half of the tree.

Stone weight (g). The results in cv. Gola showed significantly high stone weight (3.79 g) followed by cv. Bombai (3.66 g), while cv. Serai showed minimum stone weight (3.13 g). Stone weight of fruit positioned at the upper half of the tree was greater (Table I). These results contradictory to the findings of Mustafa (1961) who had not observed any affect of orientation on the quality of mango fruits.

Pulp/flesh weight (g). Maximum pulp weight (10.6 g) was found in cv. Gola followed by Bombai (9.10 g), while the lowest pulp weight (7.07 g) was observed in cv. Serai. Significant ($P<0.005$) effect of fruit orientation was observed at lower half. It had more pulp weight than the fruit collected from the upper half of the tree (Table I). These results are similar to Van Horn (1936) whereas Mustafa (1961) found no effect of orientation on the fruit quality. Soil variation, fertility, varietal differences may be responsible for this contradiction.

Chemical Characteristics

Total acidity (%). Significant ($P<0.005$) high acidity (1.99%) was recorded in cv. Bedana followed by cv. Gola (1.59%) whereas, the lowest acidity (1.36%) was observed

in cv. Purbi. Fruit harvested from lower half had greater acidity (1.56%) than the upper half of the plant (Table II).

pH of fruits. Means pH values were found to be highly significant ($P<0.005$). Out of five cultivars, Purbi showed maximum pH value (4.06) while lowest pH (3.23) was observed in Bedana cv. The effect of orientation on the pH values of the litchi fruit showed that they were less acidic when they are located at the upper half portion of the tree (Table II). These results contradictory to the findings of Ghaffoor *et al.* (1999) who reported the maximum (4.20) pH in Bedana cultivar.

Vitamin C (mg/100 g of pulp). Fruit of Purbi cultivar contained maximum Vitamin C content (56.19 mg/100 g) followed by Bombai cv. (54.93 mg/100 g). Minimum vitamin C content was observed in Bedana cv. (47.87 mg/100 g). Fruit had high Vitamin C content when located at the upper half of the tree. These results are strengthened by Singh and Chadha (1961), but are controversial to Rehman *et al.* (1982) who found non significant effect of orientation on the fruit quality. The differences might be due to variations in climatic conditions, varietal differences and analytical procedures adopted.

Total sugars. Total sugar percentage was the highest (10.95%) in fruits of Purbi cv followed by the Bombai cv. (10.68%). The least percentage of total sugars was recorded in Bedana cv. (8.70%). Results obtained for total sugars percentage revealed that orientation factor had no effect on fruit quality. Van Horn (1936) concluded identical results, but these results do not coincide the findings elaborated by Mustafa (1961) and Rehman *et al.* (1982) who reported that

Table I. Physical characteristics of litchi as affected by fruit orientation on the tree

Cultivars	Average fruit weight (g)	Pericarp weight (g)	Stone/Seed weight (g)	Pulp/Flesh Weight (g)
Purbi	12.20 c	1.40 d	3.55 c	7.30 d
Bedana	13.76 b	2.24 b	3.46 d	8.72 c
Bombai	14.58 b	1.78 c	3.66 b	9.10 b
Serai	11.57 c	1.38 d	3.13 e	7.07 e
Gola	17.02 a	2.66 a	3.79 a	10.61 a
Low:half	13.98 N.S	1.89 N.S	3.51 N.S	8.59 a
Upp:half	13.66	1.88	3.52	8.51 b

Any two means in the column having common letter(s) are non-significant at 5% level. ; L.S.D Value for Average fruit weight (Varieties) = 0.906 ; L.S.D Value for Average fruit weight (Orientation) = 1.238; L.S.D Value for Pericarp/ Peel weight (Varieties) = 0.038; L.S.D Value for Pericarp/Peel weight (Orientation) = 0.054; L.S.D Value for Stone/ Seed weight (Varieties) = 0.038; L.S.D Value for Stone/ Seed weight (Orientation) = 0.054; L.S.D Value for Pulp/ Flesh weight (Varieties) = 0.093; L.S.D Value for Pulp/ Flesh weight (Orientation) = 0.133

Table II. Chemical Characteristics of fruits of different cultivars of Litchi as affected by fruit orientation on the tree

Cultivars	pH	Total Acidity (%)	Vitamin C mg/100 g pulp
Purbi	4.06 a	1.36 d	56.19 a
Bedana	3.23 d	1.99 a	47.87 d
Bombai	3.91 b	1.41 c	54.93 ab
Serai	3.94 b	1.43 c	53.67 b
Gola	3.48 c	1.59 b	51.44 c
Low:half	3.70 b	1.56 N.S	52.62 N.S
Upp:half	3.72 a	1.54	53.02

Any two means in the column having common letter(s) are non-significant at 5% level. ; L.S.D Value for pH (Varieties) = 0.038; L.S.D Value for pH (Orientation) = 0.054; L.S.D Value for Total Acidity (%) (Varieties) = 0.038; L.S.D Value for Total Acidity (%) (Orientation) = 0.054; L.S.D Value for Vitamin C gm/100 gm Pulp (Varieties) = 1.547; L.S.D Value for Vitamin C gm/100 gm Pulp (Orientation) = 2.188

higher sugars percentage in fruits oriented at upper half portion of the tree. Soil condition and temperature fluctuation play a leading role in the variation of sugars contents in fruits.

Reducing sugars. Results shown in Table III regarding reducing sugars revealed non-significant effects. Purbi cv. was at the top position with maximum percentage (6.58) of reducing sugars, followed by Bombai cv. with reducing sugars of 6.13%. The least percent reducing sugars (4.85%) was recorded in Bedana cv. The results showed that the orientation had a non-significant affect on the total reducing sugars percentage.

Non-reducing sugars. Mean differences for the non-reducing sugars are presented in the Table III, which are significant for the cultivars but non-significant for the orientation. The results showed that Bombai cv. had the maximum non-reducing sugars (4.50%) followed by the Purbi cv. containing (4.40%) non-reducing sugars. The lowest percentage of non-reducing sugars (3.85) was recorded in Bedana cv. The results indicated that fruits if oriented at the upper half of the tree had comparatively more non-reducing sugars i.e. 4.24.

Total soluble solids percentage (TSS %). The data recorded for the above mentioned trait are presented in Table III. Mean difference are highly significant for the

Table III. Chemical Characteristics of fruits of different cultivars of Litchi as affected by fruit orientation on the tree

Cultivars	Total sugars (%)	Reducing sugars (%)	N. Reducing sugars (%)	TSS (%)
Purbi	10.95 a	6.58 a	4.40 b	13.48 a
Bedana	08.70 e	4.85 e	3.85 e	10.08 d
Bombai	10.68 b	6.13 b	4.50 a	13.38 b
Serai	10.06 c	5.94 c	4.11 d	12.08 c
Gola	09.94 d	5.62 d	4.32 c	12.05 c
Low:half	10.06 N.S	5.82 N.S	4.22 N.S	12.21 N.S
Upp:half	10.06	5.82	4.24	12.21

Any two means in the column having common letter(s) are non-significant at 5% level. ; L.S.D Value for Total Sugars (%) (Varieties) = 0.038; L.S.D Value for Total Sugars (%) (Orientation) = 0.054; L.S.D Value for Total Reducing Sugars (%) (Varieties) = 0.038; L.S.D Value for Total Reducing Sugars (%) (Orientation) = 0.054; L.S.D Value for Non-Reducing Sugars (%) (Varieties) = 0.066; L.S.D Value for Non-Reducing Sugars (%) (Orientation) = 0.094; L.S.D Value for Total Soluble Salts (%) (Varieties) = 0.038; L.S.D Value for Total Soluble Salts (%) (Orientation) = 0.054

cultivar factor but non-significant for the orientation. The results indicated that the Purbi cv. had the maximum total soluble solids percentage (13.48). The next to follow was Bombai with (13.38%) TSS. Bedana cv. with (10.08%) total soluble solids contained the lowest TSS amongst all. No significant effect on the orientation relating total soluble solids (%) in litchi fruit had been observed in this research, which is against the findings of Rehman *et al.* (1982) who found less amount of total soluble solids (%) in fruit for orientation factor.

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