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Studies on fruit growth pattern and bio-chemical attributes of commercial cultivars of litchi (*Litchi chinensis* Sonn.) in Bhagalpur district of Bihar

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Abstract

Litchi (*Litchi chinensis* Sonn.) is an evergreen, subtropical fruit tree belonging to the family Sapindaceae. India is the second largest producer of litchi accounting for about one-fifth of the global production and has a good export potential. Of the total production of litchi in India, 40% is contributed by Bihar. An experiment was conducted at BAU, Sabour to study the fruit growth pattern and to analyze the biochemical properties of four cultivars of litchi i.e. Deshi, Bedana, Purbi and Kasba during the year 2016-17. The finding had shown that fruit growth started from seed development and later aril development had started after 17 days from the fruit set. The maximum T.S.S. was found in Bedana (22.10) followed by Purbi (20.00) during the investigation and the minimum was obtained in Kasba (17.10). The minimum acidity percentage was observed in Purbi (0.33) which was at par with Bedana and the maximum acidity was found in Deshi (0.59). TSS/ acid ratio was found to be the highest in cv. Bedana (67.64) followed by Purbi (64.66). The maximum total sugar percentage was found in Purbi (15.62), while the minimum was recorded in Deshi (14.91). Purbi had the maximum percentage of reducing sugar i.e. (11.01) which was at par with cv. Kasba (10.82).

Keywords: Litchi, Bio-chemical, Cultivars, Growth pattern

Introduction

Litchi, a sub-tropical evergreen fruit crop which is confined to only few subtropical countries in the world. Litchi has limited distribution in India particularly in the Indo-Gangetic form Bengal to Punjab. Litchi is known for its taste and flavour and rules the domestic market as "Queen of fruits" during the summer season. India is the second largest producer of litchi next to China. It is cultivated on 84.2 thousand hectares area in India, with an annual production of 585.3 thousand tons with a productivity of 7 metric tons/ha (Anonymous, 2014) [1]. In fruit growth of litchi, seeds develop initially at a high rate, followed by membranous mesocarp and aril, which grow very fast towards the later stage of fruit development. Kanwar and Nijjar (1975) [6] stated that the first phase of fruit growth was manifested by seed development and in the second phase flesh growth occurred in 3 stages lasting 38, 25 and 25 days, and characterized by formation of embryo, rapid growth of pericarp and the rapid growth of flesh respectively. Chandola and Mishra (2015) [2] reported that significant variation in morphological, biochemical and yield characters of various cultivars of litchi which can be used for identification and breeding purpose. The physico-chemical composition which changes during the maturation determines the quality of the fruit. The litchi fruit consists of about 60 per cent juice, 8 per cent rag, 19 per cent seed and 13 per cent skin which varies with variety and climate. The total sugar content of fruit varied from 55.92 to 61.37 per cent and reducing sugar from 41.52 to 43.45 per cent on dry weight basis (Mathew and Pushpa, 1964) [7].

Material and Methods

The present investigation was carried out at BAU, Sabour during the year 2017. The fruit growth pattern of the four cultivars were visually observed to study the development phases of the fruits right from the beginning of fruit set upto the harvest. At 10 days interval from the fruit set, the fruits were collected from each treatment and observed the growth pattern of fruit by cutting it longitudinally as well as transversely. For biochemical analysis, five fruits were

collected at full maturity stage in all the four cultivars for the study. The total soluble solid content of the fruit was recorded by using digital refractometer and was expressed in per cent. Total acidity of litchi fruit was calculated by titrating the pulp extract with N/10 NaOH as per method described in the 'Manual of analyzing fruit and vegetable product' by Ranganna (1986) [8] using phenolphthaleine as indicator. Since the predominating acid of ripe litchi fruit is "Malic acid" (80% of all the acids), the calculation of total acidity was based on the equivalent weight of malic acid. The acidity was expressed in percent by following formula.

$$\% \text{ Total acidity} = \frac{\text{Titred value} \times \text{normality of alkali} \times \text{equivalent weight of acid} \times 100}{\text{Volume of sample taken} \times 1000}$$

The T.S.S./ Acidity ratio was calculated by dividing T.S.S. with the titrable acidity percentage. Total sugars content in fruit juice was determined as per "Lane and Eynon Method" (Ranganna, 1986) [8]. Fifty ml filtered juice was mixed with 100 ml distilled water and neutralized with normal NaOH solution using phenolphthaleine as indicator. Two ml of lead acetate solution (45%) was added in the solution and allowed to stand for ten minutes. Then 8 ml of potassium oxalate solution (22%) was added and total volume was made upto 250 ml by adding distilled water. 5 ml of the extract was taken in burette and titrated against 10 ml mixed Fehling solution (5 ml Fehling solution A + 5 ml Fehling solution B) using methylene blue as indicator. The end point was indicated by decolourization of the solution. The following formula was used for determining the total sugar in fruits.

$$\text{Total sugar (\%)} = \frac{\text{Factor for fehling solution} \times \text{Dilution}}{\text{Titre} \times \text{Weight of sample taken}} \times 100$$

Where, factor for Fehling solution denotes the gram of invert sugar given by, Factor = (titre × 2.5)/100

Reducing sugars were estimated by 'Lane and Eynon' method as described by Ranganna (1986) [8]. The extract was taken and titrated against 10 ml of mixed Fehling solution using methylene blue as indicator. Sufficient amount of extract was run to reduce Fehling solution treated and boiled for 2 minutes. The end point was identified when the discoloration of indicator to reduce. Results were expressed as percentage of reducing sugar.

$$\text{Reducing sugar (\%)} = \frac{\text{Sugar mg of invert} \times \text{Dilution} \times 100}{\text{Titrable value of samples} \times \text{Weight per volume} \times 1000}$$

Results and Discussion

Effect of fruit growth pattern on commercial cultivars of litchi

The fruit growth pattern was observed at 10 days interval from 7 days after fruit set to fruit maturity and the fruit growth stages has been shown in the Plates. From the Plate No.1 it can be clearly noticed that litchi differentiation started with the formation of the pericarp and seed coat developed. At 17 days after fruit set, the pericarp differentiated into epicarp, mesocarp and endocarp and seed enlarged as shown in Plate No.2. During the third growth stages, development of aril had started as shown in all the four cultivars in Plate No.3. The finding had shown that fruit growth started from seed development and later aril development had started after 17 days from the fruit set. Chang *et al.* (2015) [3] had reported that 'Early Big' litchi fruit showed a sigmoid growth pattern.

Development of seed started about week 5 after full female bloom when the embryo was visible. During week 7 after full female bloom, the liquid endosperm was exhausted, and the seed coat turned brown. The aril started to grow rapidly at the same time. Vieira *et al.* (1996) [10] had also reported that from panicle flowering to about 45 days after flowering, 95% of fruit fresh weight was due to the seed coat and skin. Chang *et al.* (2008) [4] had reported that the greatest fruit relative growth rate occurred during 3 to 5 weeks after full bloom. According to Wei *et al.* (2013) [11], during the first growth stage, the pericarp, embryo and seed coat develop. The second stage of growth is characterized by rapid growth of the embryo and the beginning of aril development.

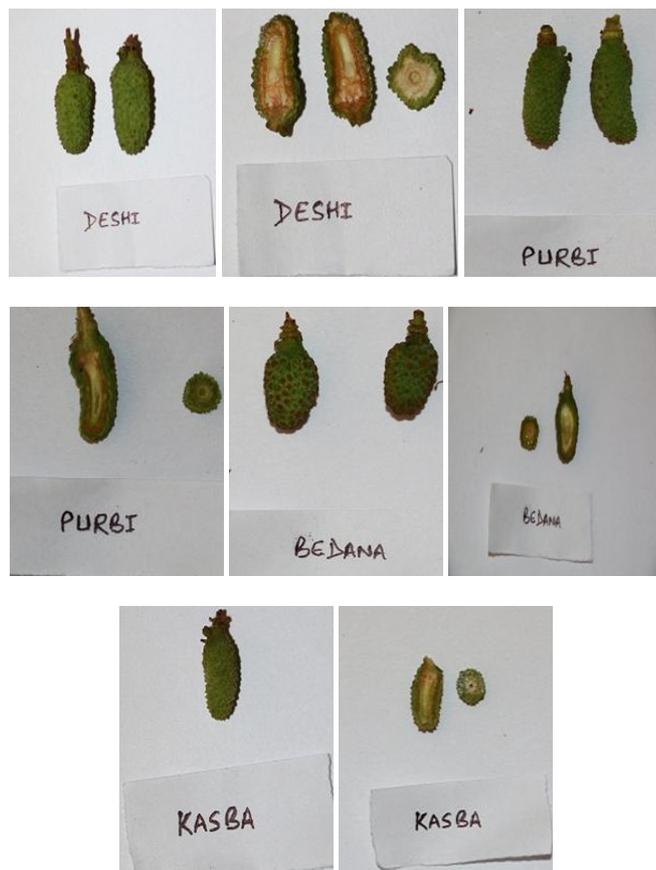


Plate 1: Fruit growth stage of litchi cultivars at 7 days after fruit set





Plate 2: Fruit growth stage of litchi cultivars at 17 days after fruit set



Plate 4: Fruit growth stage of litchi cultivars at 37 days after fruit set



Plate 3: Fruit growth stage of litchi cultivars at 27 days after fruit set



Effect of bio-chemical attributes on commercial cultivars of litchi

The data presented in Table reflected that the maximum T.S.S. was in Bedana (22.10) followed by Purbi (20.00), the minimum was obtained in Kasba (17.10). The report is in accordance with the finding of Rani (2006) [9] who found that total soluble solids differed significantly among various litchi cultivars. The data of acidity percentage have been presented in Table. The data revealed the minimum acidity percentage was observed in Purbi (0.31) which was at par with Bedana (0.33), the maximum acidity was found in Deshi (0.59). The data regarding T.S.S/ Acidity has been depicted in Table. It was found to be the highest in cv. Beadana (67.64) followed by Purbi (64.66). In concurrence with the present finding Dabral and Misra (2007) [5] also enunciated that the TSS: acid ratio was significantly higher in Dehradun and the minimum TSS: acid ratio was observed in Kasba which was at par with Rose Scented, Longia and McLean These differences in TSS and Acid ratio in different cultivars were due to different levels of TSS and acid in different cultivars. A perusal data on total sugar % revealed in Table showed that the maximum total sugar percentage was found in Purbi (15.62), while the minimum was recorded in Deshi (14.91). The data of reducing sugar percentage have been presented in Table. Purbi had the maximum percentage of reducing sugar i.e., 11.01 which was at par with cv. Kasba (10.82), while the minimum was observed in Deshi (9.81).

Table: Effect of different treatments on Fruit Chemical Quality Characteristics

Cultivars	T.S.S	Acidity (%)	T.S.S/ Acidity	Total Sugar (%)	Reducing Sugar (%)
Deshi	19.70	0.59	33.35	14.91	9.81
Purbi	20.00	0.31	64.66	15.62	11.01
Bedana	22.10	0.33	67.64	15.49	10.46
Kasba	17.10	0.51	33.65	15.26	10.82
C.D at 5%	1.24	0.014	0.54	0.06	0.11
C.V.	4.57	2.37	0.79	0.31	0.73

Conclusion

At 17 days after fruit set, the pericarp differentiated into epicarp, mesocarp and endocarp and seed enlarged. During later stage aril development started. The maximum T.S.S. was found in Bedana followed by Purbi and the minimum was obtained in Kasba (17.10). The minimum acidity percentage was observed in Purbi which was at par with Bedana and the maximum acidity was found in Deshi. The maximum total sugar percentage was found in Purbi, while the minimum was recorded in Deshi. Similar results were found in case of

reducing sugar. Differences in biochemical characters might be related to inherent varietal character and climatic influence.

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