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A Study on the morphological characters of elite Litchi (*Litchi chinensis*) cultivars in Jorhat, Assam

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Abstract

The present experiment was carried out in the Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat during 2019-2020 to study the morphology and yield of five elite Litchi (*Litchi chinensis*) cultivars viz., Bombay, Seedless, Piajee, Bilati, and Elaichi. Among all the parameters studied under the experiment, the plant height found out to be non-significant whereas others are significantly different. Litchi plants started flowering from the last week of February (in Bombay) till the second week of March (in Elaichi) while maximum number of flowers per panicle was observed in Bilati. The most acceptable time of fruit ripening of litchi was found in the month of May. The cultivar Bilati recorded maximum in the parameters like fruits per branch (53.00), fruit weight (25.40g), fruit diameter (12.92cm), fruit volume (27.35cc) and aril weight (16.62g) while highest aril thickness and aril-peel ratio was found in the cultivar Seedless. Thus, in this experiment, the cultivar Bilati was found out to be the most preferable one in the morphological characters as well as in yield among all the cultivars.

Keywords: Litchi, fruits, cultivars, morphological, yield

Introduction

Litchi (*Litchi chinensis* Sonn.) is the most important member of the Sapindaceae family. It is native to Guangdong and Fujian province of Southern China (Kumar, 2020) [9] and later its cultivation flourished in different parts of the world, from tropical to subtropical, because of its bright colour, excellent flavor and high economic value. Currently, litchi is cultivated in over 20 countries in the tropical and subtropical regions of the world (Sanjay, 2016) [14]. It is an evergreen and perennial fruit plant. Morphological characters of a plant are the first and foremost visual features that helps to differentiate the various cultivars of litchi. Generally, the characteristics that define a perfect and healthy litchi plant are round-topped (crown) with a strong trunk having vigorous branching; light to dark green alternate leaves; long inflorescence with yellowish-white small flowers borne in panicles; pinkish-red pericarp with white juicy fleshy aril and small size seed. A litchi plant produce three flushes of leaves after fruit harvest (June-July) till panicle emergence (Jan-Feb), (Das *et al.*, 2004) [3]. Litchi fruit is a drupe that consists of attractive skin (pericarp), white fleshy translucent aril (MESOCARP) and seed (endocarp).

Keeping these facts in view, an experiment was carried out to describe the various morphological features of a litchi plant from vegetative phase to reproductive phase which mostly includes the description of the plant, flowering and fruiting behavior and also the yield per plant of all the litchi cultivars under the study.

Materials and Methods

The present experiment entitled "A Study on the morphological characters of elite Litchi (*Litchi chinensis*)" was conducted in the Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat, Assam during 2019-2020. The experimental site was found to be located at 26°47' latitude and 94°12' longitude with an elevation of 87.2 m above mean sea level. The site was considered to be well-drained with uniform topography. The soil of the experimental site was recorded to be loamy sand. The experiment involved five treatments, the litchi cultivars viz., Bombay (T₁), Seedless (T₂), Piajee (T₃), Bilati (T₄) and Elaichi (T₅) and was laid out in a simple Randomized Block Design (RBD) with four replications.

The plant height and the canopy area (north-south and east-west direction) was measured through meter scale. The time of flowering was determined from the day of panicle initiation in a plant. The day of opening of first flower to the opening of last flower determine the

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flowering duration in a plant. The physical parameters of fruit such as fruit weight, aril weight, peel weight and seed weight were measured with the help of electronic balance; fruit length and seed length with measuring scale; fruit diameter, aril thickness and seed diameter with vernier caliper. Yield per plant and yield per hectare measured by taking the average fruit weight of litchi and multiplying it with the total number of fruits produced by the plant. Analysis and interpretation of the experimental results were carried out statistically by using OPSTAT developed by CCS HAU, Hisar, India. Significant differences between the treatments were calculated by using critical difference (CD) at a 5% level of significance.

Results and Discussion

Plant characters: Litchi is an evergreen and spreading plant that reaches a height up to 10-12 m at its full grown stage. The height vary according to the growth stage of the plant. Young bearing plants attain a height of about 1.5-2 m and become ready for bearing fruits. T₄ (Bilati) and T₃ (Piajee) attained the maximum plant height and canopy area of about 1.64 m and 3.11 m² respectively whereas, the lowest height (1.37m) and canopy area (2.09m²) were recorded in T₁ (Bombay) (Table 1). This investigation showed no significant

differences among the cultivars in plant height which might be due to the same age of litchi cultivars. Canopy areas among the cultivars was found significantly different from each other which might be due to their different genetic makeup, type of plant and its response to soil type and climatic conditions. Khurshid *et al.* (2004) [8] also reported similar results. Canopy area and plant type are influenced positively by the age of the plant (Sanjay, 2016) [14]. Canopy area and plant type help in influencing the light penetration (Kellomaki *et al.*, 1986) [7] and increase quality fruit production of the crop (Nath *et al.*, 2012) [12]. The plant type under the study were varied from cultivar to cultivar i.e. Irregular shaped (Bombay cultivar), Spherical shaped (Seedless), broadly pyramidal shaped (Piajee), Oblong shaped (Bilati), and Elliptical shaped (Elaichi). Khurshid *et al.* (2004) [8] reported the plant crown shapes of various litchi cultivars viz. symmetrical, non-symmetrical, round and dense shaped, etc. Leaf shape is a genetic trait and it helps to identify the cultivars of plants (Singh *et al.*, 1999) [17]. Leaf shapes of various cultivars differ significantly. In the present study, the leaf shapes such as elliptic oblong, elliptic oval, lanceolate were found. The variation observed in plant type and leaf shape among the cultivars might be due to genetic factors and their interaction with the climatic situation of that area.

Table 1: Variation in Plant characters of the litchi plants

Treatments	Plant height(m)	Canopy area(m ²)	Plant type	Leaf shape
T ₁	1.37	2.09	Irregular	Lanceolate
T ₂	1.62	2.35	Spherical	Lanceolate
T ₃	1.45	3.11	Broadly pyramidal	Elliptic oval
T ₄	1.64	2.75	Oblong	Elliptic oblong
T ₅	1.63	2.80	Elliptical	Elliptic oblong
S.Ed ±	0.17	0.11		
C.D(0.05)	NS	0.24		

Flower characters

Flowering time, duration, flowering to fruit setting period, flowering to harvesting, number of flowers were considered as the flower characters of plants in the present investigation. The initiation of flowering in litchi cultivars started from February to March. T₁ (Bombay) started flowering from the last week of February and is considered to be the early season cultivar. Likewise, T₂ (Seedless) and T₃ (Piajee) flowered from 1st week of March and were the mid season cultivars; and the late season cultivars were T₄ (Bilati) and T₅ (Piajee) which started flowering from the 2nd week of March. Variation in flowering time was observed among different cultivars in different regions due to varied environmental and genetic conditions. The total number of flowers per branch ranged from 164.00 to 456.25. The highest number of flowers per branch was found in the cultivar T₄ (Bilati) while lowest in the case of T₂ (Seedless). From the results, it can predict that the number of flowers per branch might have a direct

influence on the plant height and canopy area. The variation with respect to the total number of male flowers, hermaphrodite female flowers and hermaphrodite male flowers per branch might be due to the factors such as genetical, physiological, and environmental. If the temperature is high during flower initiation, the proportion of female flowers get reduced (Cronje *et al.*, 2009^[2]; Soni and Agarwal, 2017^[18]). The time required by the late flowering cultivar i.e. T₄ (Bilati) in the duration of flowering, flowering to fruit setting and flowering to harvesting was found to be the longest, whereas the shortest time period observed by the early flowering cultivar i.e. T₁ (Bombay) in duration, flowering to fruit setting, flowering to harvesting period. These variations were observed in flower characters might be due to genetical effect of the cultivars as well as the environmental condition of that particular region (Gogoi *et al.*, 2020) [5].

Table 2: Flowering characters of the different litchi cultivars

Treatment	Time of flowering	Number of flowers per plant	Duration of flowering (days)	Flowering to fruit setting (days)	Flowering to harvesting (days)
T ₁	Last week of February	299.50	15.00	26.50	76.00
T ₂	1 st week of march	164.00	19.25	31.75	79.97
T ₃	1 st week of march	401.45	23.00	40.40	86.91
T ₄	2 nd week of march	456.25	25.75	43.62	88.32
T ₅	2 nd week of march	312.75	20.50	36.35	83.13
S.Ed±		21.10	0.72	0.40	0.25
C.D(0.05)		46.48	1.60	0.88	0.55

Morphological characters of fruit

In the present study, the fruits of the cultivars T₁ (Bombay) and T₂ (Seedless) ripe on the second week of May, whereas, T₃ (Piajee), T₄ (Bilati) and T₅ (Elaichi) on the third week of May. The ripening time of cultivars might differ depending on climate and location. The fruit colour is the major indication of maturity (Singh and Nath, 2012) [15]. Basically, the colour of ripened fruits was bright red, dull red, and pinkish red (Ghosh *et al.*, 2000) [4]. There was a lot of variation found among the different litchi cultivars under the present study. The fruit colour varies from Pinkish red (T₅-Elaichi), Orange red (T₁-Bombay and T₃-Piajee), bright brick red (T₂-Seedless) to deep red (T₄-Bilati). T₄ (Bilati) produced a maximum number of fruits while the lowest fruits were produced by T₂ (Seedless). More number of flowers in T₄ (Bilati) might be one of the reasons for the maximum number of fruits in that cultivar. The data were presented in Table 3 shows significant variation in the number of fruits in each of the cultivars.

Table 3: Time of ripening, fruit colour and number of fruits per plant

Treatment	Time of ripening	Fruit colour at ripe	Number of fruits per plant
T ₁	2 nd week of May	Orange red	29.00
T ₂	2 nd week of may	Bright brick	22.00
T ₃	3 rd week of may	Orange red	44.25
T ₄	3 rd week of may	Deep red	53.00
T ₅	3 rd week of may	Pinkish red	38.50
S.Ed±			3.89
C.D(0.05)			8.58

The cultivar with maximum fruit weight and volume was found in T₄ (Bilati) with 25.40g and 27.35cc respectively, while minimum in T₂ (Seedless) *i.e.* 12.35 g and 16.38 cc respectively. Highest fruit weight and volume in T₄ (Bilati) might be due to the maximum accumulation of sugar, carbohydrates, vitamins and other substances. Among the cultivars, the longest fruit length was observed in T₃ (Piajee) while the shortest in T₁ (Bombay). The fruit diameter was found highest in T₄ (Bilati) and lowest in T₅ (Elaichi). It is evident from Table 4 that the fruit length and fruit diameter of each of the cultivars of litchi differed significantly. Variation observed in fruit length and diameter might depend on the shape of the fruit, where the fruit shape of T₄ (Bilati) found be round so its diameter is more than the rest cultivars. Likewise, the fruit shape of T₃(Piajee) was oblong, and that's why, its length was more than other cultivars under study. Variation in the features of fruit pericarp like cell size and intercellular spaces in the tissue might be a possible cause of differentiation in fruit size which contributes to length, diameter, volume and weight (Sahay, 2001) [13].

Table 4: Fruit characters of different litchi cultivars

Treatment	Fruit weight(g)	Fruit volume(cc)	Fruit diameter(cm)	Fruit length(cm)
T ₁	17.82	21.70	10.06	2.88
T ₂	12.35	16.38	11.35	3.00
T ₃	18.17	23.30	9.93	3.64
T ₄	25.40	27.35	12.92	3.32
T ₅	13.07	18.50	8.02	3.07
S.Ed±	0.31	0.30	0.18	0.06
C.D(0.05)	0.68	0.67	0.39	0.13

The fleshy aril is the edible portion of litchi fruit. The aril weight was comparable to the fruit weight were found highest in the cultivar T₄ (Bilati) with 16.62 g and lowest found in T₁ (Bombay) with 10.75g. The weight of aril and peel of the fruit in the cultivar T₄ (Bilati) was found significantly higher than the rest of the cultivars under the present study. The presence of higher boron and calcium content in the peel of T₄(Bilati) might be one of the reasons for high peel weight (Gogoi *et al.*, 2020) [5]. The variation found among the cultivars were might be due to genetic factors (Lal *et al.*, 2018) [10] and nutrition (Cronje *et al.*, 2009) [2]. The data showing variation in peel and aril weight under the study were illustrated in Table 5. The aril-peel ratio varied between 2.96-6.64, where the highest ratio was found in the cultivar T₂ (Seedless) and lowest in T₁ (Bombay). Fleshy aril thickness of the fruit is classified as thick, medium, and thin (Sanjay,2016) [14]. Aril thickness was significantly higher in T₂ (Seedless) while T₄ (Bilati) had the thinnest aril. Highest aril thickness in T₂ (Seedless) might due to the cultivar having the small seed size. The data presented in Table 5 shows wide variation in aril thickness among the cultivars that might depend on their fruit and seed size. Creamy white colour aril was observed in all the cultivars under the study.

Table 5: Aril and peel characters of litchi cultivars

Treatment	Aril weight (g)	Peel weight(g)	Aril-peel ratio	Aril thickness (mm)	Aril colour
T ₁	10.75	3.62	2.96	0.32	Creamy white
T ₂	12.07	1.82	6.64	0.87	
T ₃	13.25	2.85	4.65	0.47	
T ₄	16.62	4.05	4.12	0.70	
T ₅	15.25	2.45	6.22	0.55	
S.Ed±	0.56	0.12	0.38	0.04	
C.D(0.05)	1.25	0.27	0.83	0.10	

Variability observed in the genotypes of litchi with respect to fruit size, seed size and aril characters in various diversity regions were reported by Arora *et al.* (1996) [1]. The seed characters like Seed weight, seed length, seed diameter and seed colour were studied. T₃ (Piajee) recorded the highest value *i.e.* 3.00g of seed weight, 2.80 cm of seed length and 1.20 cm of seed diameter, while T₂ (Seedless) having the lowest seed weight *i.e.* 0.70g, seed length *i.e.* 0.80cm and diameter *i.e.* 0.37cm (Table 6). This indicates that the seed size was larger in T₃ (Piajee) and smaller in T₂(Seedless) cultivar. Similar results were obtained by Gogoi *et al.* (2020) [5]. Some cultivars have the tendency to divert their manufactured food material to endocarp resulting increased seed size. Variation in seed size was also reported by Singh (1999) [17]. All the cultivars under study acquired the brown colour seed (Gogoi *et al.*, 2020) [5].

Table 6: Seed characters of different litchi cultivars

Treatment	Seed weight (g)	Seed diameter (cm)	Seed length (cm)	Seed colour
T ₁	2.10	1.07	2.52	Brown
T ₂	0.70	0.37	0.80	
T ₃	3.00	1.20	2.80	
T ₄	2.37	0.89	2.32	
T ₅	1.67	0.66	1.60	
S.Ed±	0.13	0.06	0.08	
C.D(0.05)	0.29	0.14	0.17	

Yield

Fruit yield per plant and per hectare among the litchi cultivars was highest in T₄(Bilati) statistically at par with T₃(Piajee), followed by T₅(Elaichi) and the lowest yield was found in T₂ (Seedless) which were presented graphically in Fig 1. It was clearly observed from the present study that the maximum number of fruits per plant resulted the highest yield of that cultivar. Also, the cultivar which possesses the highest number of fruits with maximum fruit weight, volume, and

diameter contributes to the highest yield. Yield of the plant depends on various factors such as canopy spread (Huang *et al.*, 1992) [6], nutritional factors (Singh *et al.*, 2012) [16] and management practices (Lal and Kumar, 1997) [11]. Tandon and Sekhon (1988) [19] reported that potassium is known to influence fruit yield and fruit quality, and so high potassium content in T₄ (Bilati) cultivar showed the highest yield. Canopy area also plays an important role in the yield of the plant (Huang *et al.*, 1992) [6].

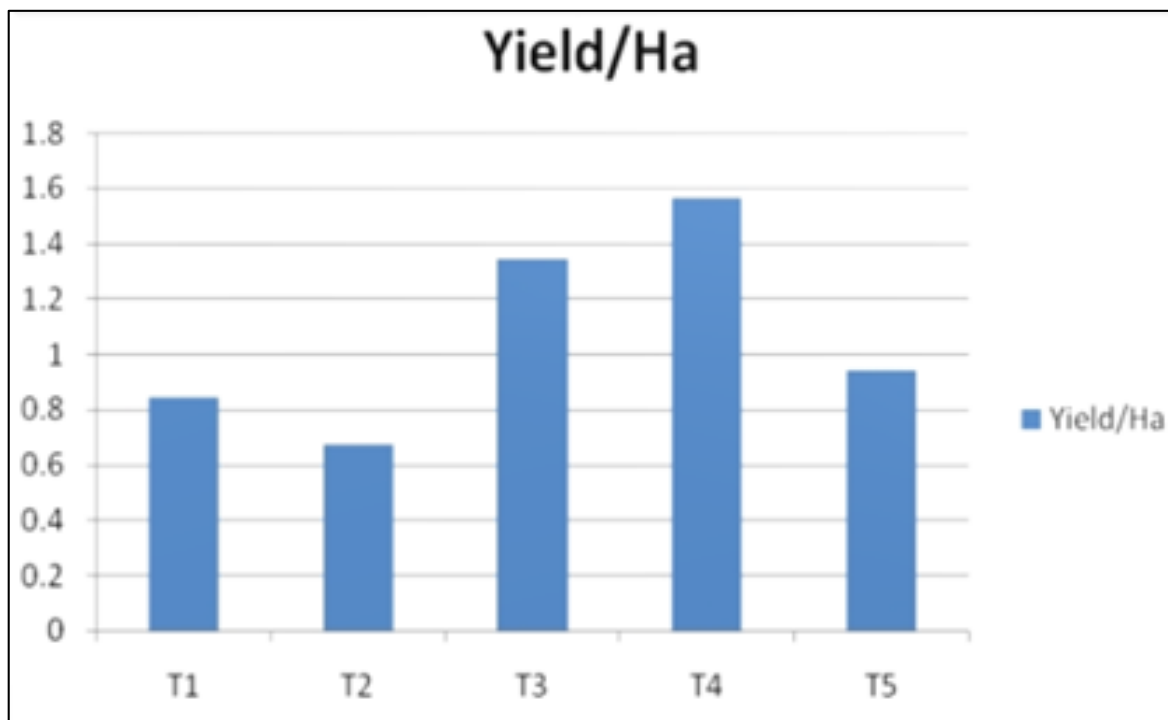


Fig 1: Yield/Ha

Conclusion

From the above discussion, it can be concluded that there is an existence of variation in morphological characters of the selected elite cultivars of litchi. Among the five cultivars under study, T₄ (Bilati) turned out to be the most superior cultivar in terms of quantity and physical parameters of fruit. The fruits of Bilati cultivar was of excellent nature having the highest fruit size as well as produced the maximum number of fruits and gained the highest yield among all the litchi cultivars under study. Hence, T₄ (Bilati) is considered to be the most preferable cultivar in terms of growth, bearing habit and yield. Overall the performance of all the selected elite cultivars of litchi in Jorhat was found to be good based on soil type and climatic conditions.

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