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# Morphological and biochemical variability of litchi in Meghalaya

***H.D. TALANG, H. RYMBAI, R. SANGMA, M.B. DEVI, S.R. ASSUMI, P. CHOUDHURI AND S. HAZARIKA**

*ICAR Research Complex for NEH Region,*
*Umroi Road, Umiam – 793 103, Meghalaya*

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## ABSTRACT

*A survey was conducted in the state of Meghalaya,covering four districts, i.e., East Khasi Hills, RiBhoi, West Jaintia Hills and East Jaintia Hills to ascertain the morphological and biochemical variability in litchi. Significant variations among the genotypes were observed for morphological parameters of fruits. The fruit weight ranged between 15.16 gm to 23.89 gm; fruit length (3.21-3.56 cm); fruit diameter (2.87-3.39 cm); peel weight (2.36-4.12g); aril weight (10.14-16.34 g);aril:seed ratio (2.36-11.73) and seed weight (1.35-4.32g). A significant variation was also observed for biochemical parameters of fruit. The genotype Umsyiem recorded the highest TSS (20.8±0.95%), total sugar (15.97±0.24%) and ascorbic acid (35.84±1.59 mg 100g$^{-1}$), while, titratable acidity was maximum in UmniuhTmar (0.77±0.06%). Therefore, litchi genotypes such as Umsyiem and Nongkhrah may have unique potential for further enrichment of genetic improvement in litchi germplasm.*

***Keywords*:** Biochemical variablity, litchi, Meghalaya, morphological variability, quality

Litchi (*Litchi chinensis* Sonn.) is one of the most important and popular subtropical evergreen fruit tree which belongs to the family Sapindaceae. It is known as the "queen of the fruit" because of its attractive deep pink or red colours and its deliciously flavored, sweet and juicy aril. Litchi was introduced during the 17$^{th}$ century in Tripura state of India from Myanmar, from where it spread to the subtropical and tropical areas of the country (Ghosh, 2000). Litchi has now become one of the commercial fruit crop in India due to its high demand, both in the domestic and international markets. India is the second largest producer of litchi in the world, only after China. It is cultivated in 96,000 hectares area with an annual production of 930,000 metric tonnes and an average productivity of 6.1 t ha$^{-1}$ (Anon., 2020). However, due to its exacting climatic requirements, its cultivation in large scale is restricted to a few states like Bihar, Jharkhand, West Bengal, Eastern U.P., Haryana, Uttarakhand, Assam, and Tripura. In India, maturity of litchi fruits begins in April to June in the eastern states, whereas they mature in December to January in south India. Because of the difference in the harvesting season in India and other parts of the world, there is great demand for litchi in the international market. However, a meager quantity of litchi is exported from India due to limited production (Sahni *et al*., 2020). Therefore, there is a lot of scope to increase the production of litchi for export to other countries. This can be met by expanding the area of cultivation to non-traditional areas comprising the north-eastern states as well as in the southern part of the country (Anon., 2011).

Meghalaya, situated at 25° 30' N latitude and 91° 00' E longitude, with an altitude ranging from 45 metres to 1961 meters, covering a total geographical area of 22,429 square kilometers, is a small state in north-eastern India. The state with wide climatic condition comprising sub-temperate,tropical and sub-tropical climates, offers an excellent scope for growing various horticulture crops such as litchi (Patel *et al*., 2009). Though there is no data on the area and production of litchi in Meghalaya, it is found growing in the lower and mid-hill altitudes as homestead trees or as isolated trees in arecanut plantations. Further, limited literature has mentioned regarding the morphological and biochemical quality of the litchi fruits, which are currently being marketed by farmers in local markets at a premium price. Keeping this in mind, a survey was made in different litchi-growing areas in the state with the objective of finding out the variability in the morphological and biochemical qualities of litchi fruits.

## MATERIALS AND METHODS

A survey was conducted in different litchi growing areas in the north-eastern state of Meghalaya (altitude ranging from 45-1014 m), covering four districts, namely East Khasi Hills, RiBhoi, West Jaintia Hills and East Jaintia Hills (Fig. 1). A total of 18 genotypes having desirable fruit characteristics and bearing behaviour were collected using the standard random sampling

*Email: hammylliende@gmail.com*

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method (Arora and Paroda, 1991). Twenty fruits each were randomly collected from different directions of the tree of each genotype to record the morphological and biochemical qualities. Morphological parameters such as fruit weight (g), fruit diameter (cm), fruit length (cm), aril weight (g) and peel weight (g) were measured as per standard procedures. Biochemical characteristics were analyzed for total soluble solids (TSS) using digital refractometer (expressed $^0$Brix), titratable acidity (%) and total sugars (%) was estimated as per A.O.A.C. (1984). The determination of ascorbic acid was carried out according to Freed (1966).

## RESULTS AND DISCUSSION

### *Morphological parameters*

Result showed significant variations among genotypes of litchi in Meghalaya (Table 1). The fruit weight varied from 15.16-23.89 g, fruit length 3.21-3.56 cm and fruit diameter 2.87-3.39 cm. Umiam genotypes had maximum fruit weight (23.89±1.29 g) and fruit diameter (3.39±0.12 cm), while, genotype Umniuh recorded the maximum aril weight (16.34±1.72 g). Furthermore, genotype Priang showed minimum seed weight (1.35±1.38g) and other seed traits. Singh *et al.* (2012) pointed out that fruits with small or aborted seeds and high percentage of aril is considered good quality parameters of litchi, which is the major area of focus in the breeding programme of litchi. Variability in litchi with regards to yield, physico-chemical qualities was also reported by Yadav *et al.* (2010) and Tripathi *et al*. (2017). The variation among fruit morphology might be due to genetic effect, agro-climatic conditions on different and cultural management practices (Rymbai *et al*., 2014).

### *Biochemical parameters*

The different genotypes also showed a significant variation for biochemical traits (Fig. 2). The TSS ranged from 15.50 °Brix to 20.80 °Brix; acidity, 0.29-0.77%; total sugar, 9.79-15.97% and ascorbic acid, 23.00-35.84 mg100g$^{-1}$. Result indicated that Umsyiem genotype had the highest TSS (20.8±0.95%), total sugar (15.97±0.24%) and ascorbic acid (35.84±1.59 mg 100 g$^{-1}$), while, titratable acidity was maximum in Umniuh Tmar (0.77±0.06%). Varietal differences in litchi have also been observed by Tripathi *et al*. (1987), Jain *et al*. (1988), Islam *et al*. (2003) and Haq and Rab (2012). These differences in TSS and titratable acidity of litchi might occur due to varietal differences, changed environment, as well fruit production inputs (Sayal *et al*., 1999). Similarly, Haq and Rab (2012) also observed a wide variation in total sugars content of litchi. The variations in total sugars content of the litchi genotypes could have been caused by conversion of starch into sugar which may be due to inherent varietal character. The present finding is in line with Tripathi *et al*. (1987), Ghosh *et al*. (1988) and Jain *et al*. (1988). The different in ascorbic acid content in fruit of litchi has also been observed by Singh *et al.* (2010) who recorded the highest ascorbic acid in cv. Rose Scented (41.29 mg100 g$^{-1}$) and lowest in cv. Kasba (19.94mg100g$^{-1}$). Similarly, Lee and Kader (2000) pointed out that ascorbic acid content can vary due to microclimatic conditions such as warm days and cool nights.

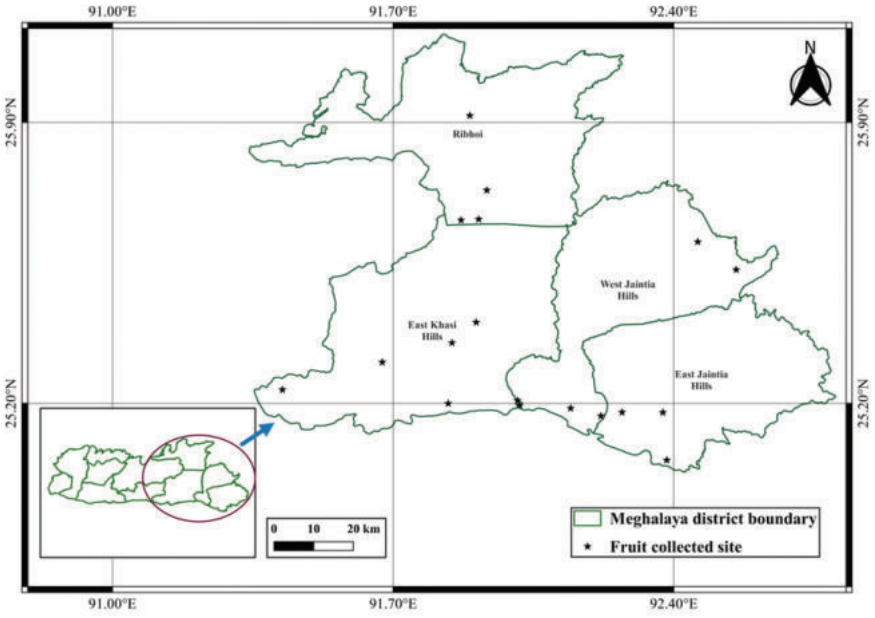
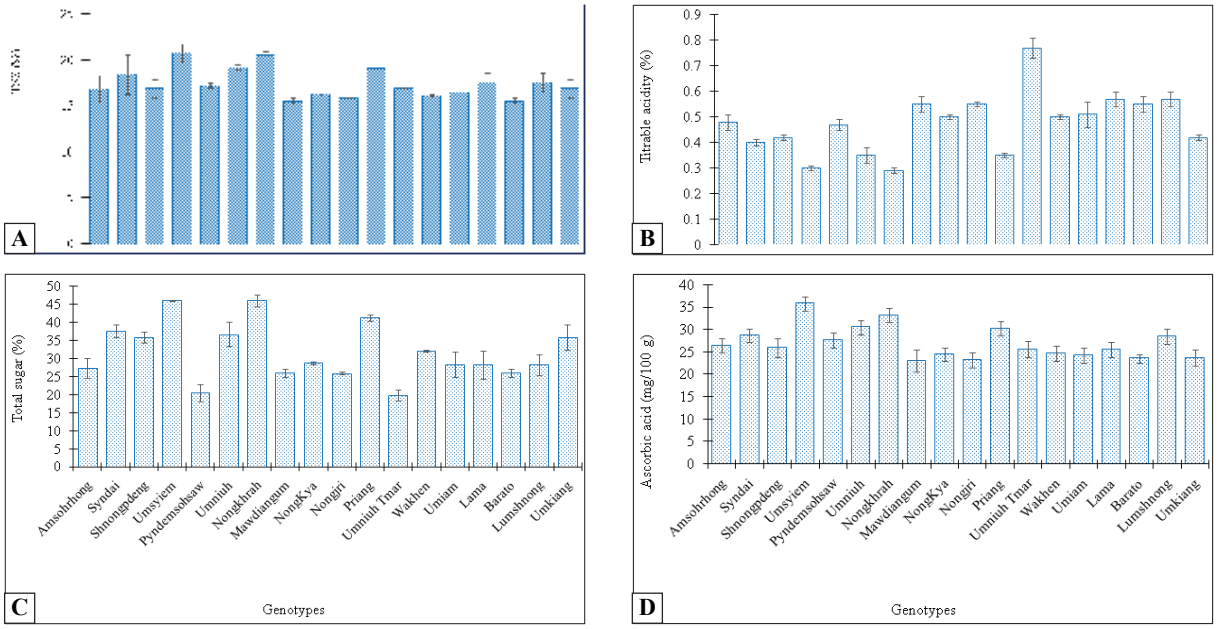



**Fig. 1: Litchi growing areas surveyed in Meghalaya**

**Table 1: Physical characteristics of fruits of different collections of litchi in Meghalaya**

| Collection | Fruit length (cm) | Fruit diameter (cm) | Fruit weight (g) | Peel weight (g) | Seed length (cm) | Seed diameter (cm) | Seed weight (g) | Aril weight (g) | Aril / seed |
|---|---|---|---|---|---|---|---|---|---|
| Amsohrhong | 3.52±0.1ab | 2.97±0.21ab | 21.02±1.7abc | 2.97±0.25cd | 2.39±0.12ab | 1.46±0.12a | 3.4±0.54ab | 14.65±1.79abcd | 4.4±1.04ab |
| Syndai | 3.21±0.14b | 3.07±0.21ab | 18.09±1.97bc | 3.06±0.19bcd | 2.43±0.12ab | 1.6±0.08a | 4.29±0.05a | 10.73±1.81cd | 2.50±0.42b |
| Shnongpdeng | 3.31±0.08ab | 3.14±0.19ab | 19.62±1.77bc | 2.7±0.31d | 2.11±0.17abc | 1.35±0.24a | 2.73±1.33ab | 14.19±0.29abcd | 5.99±2.48ab |
| Umsyiem | 3.35±0.14ab | 2.95±0.06b | 17.37±0.82cd | 2.95±0.28cd | 2.03±0.13bc | 1.24±0.37a | 2.24±1.46ab | 14.85±1.01abcd | 11.5±11.29ab |
| Pyndemsohsaw | 3.31±0.07ab | 3.06±0.28ab | 19.57±2.03bc | 2.36±0.34d | 2.07±0.12bc | 1.49±0.53a | 2.37±0.76ab | 12.18±1.67abcd | 5.4±1.35ab |
| Umniuh | 3.51±0.05ab | 3.38±0.08a | 22.54±1.78ab | 3.75±0.21abc | 2.27±0.22abc | 1.31±0.15a | 2.44±1.19ab | 16.34±1.72a | 8.07±4.30ab |
| Nongkhrah | 3.31±0.1ab | 3.01±0.14ab | 18.3±2.9bc | 3.18±0.55abcd | 2.42±0.06ab | 1.57±0.09a | 3.87±1.04ab | 11.25±2.60bcd | 3.04±0.92b |
| Mawdiangum | 3.43±0.09ab | 2.98±0.09ab | 16.77±0.42cd | 3.08±0.54abcd | 2.37±0.07abc | 1.53±0.05a | 3.55±0.31ab | 10.14±0.44d | 2.88±0.35b |
| NongKya | 3.21±0.1b | 2.87±0.06c | 15.16±0.5d | 3.02±0.27cd | 1.74±0.67c | 1.06±0.46a | 1.53±1.16b | 10.61±1.61d | 13.09±13.61ab |
| Nongjri | 3.42±0.11ab | 2.98±0.14ab | 16.91±2.89cd | 3.37±0.27ab | 2.24±0.07abc | 1.14±0.04a | 1.43±0.67b | 12.11±2.39abcd | 10.15±5.52ab |
| Priang | 3.28±0.07ab | 2.98±0.07ab | 20.2±0.5bc | 2.96±0.31cd | 2.00±0.25bc | 1.00±0.38a | 1.35±1.38b | 15.88±1.22ab | 22.05±15.74a |
| UmniuhTmar | 3.66±0.17a | 2.94±0.1b | 17.31±0.32cd | 2.79±0.32cd | 2.78±0.08a | 1.53±0.10a | 4.32±0.24a | 10.20±0.33d | 2.37±0.18b |
| Wakhen | 3.52±0.25ab | 2.98±0.62ab | 22.59±2.5ab | 4.12±0.49a | 2.45±0.10ab | 1.69±0.03a | 3.67±0.48ab | 14.80±3.05abcd | 4.12±1.29ab |
| Umiam | 3.55±0.06ab | 3.39±0.12a | 23.89±1.29a | 4.12±0.36ab | 2.42±0.08ab | 1.68±0.09a | 4.20±0.30a | 15.56±1.84abc | 3.73±0.65b |
| Lama | 3.33±0.09ab | 2.95±0.07b | 17.46±0.72cd | 2.72±0.17cd | 2.36±0.13abc | 1.40±0.18a | 3.4±0.72ab | 11.34±0.40bcd | 3.45±0.86b |
| Barato | 3.31±0.07ab | 3.06±0.28ab | 19.57±2.03bc | 2.36±0.34d | 2.07±0.12bc | 1.49±0.53a | 2.37±0.76ab | 14.85±1.01abcd | 6.61±1.63ab |
| Lumshnong | 3.33±0.09ab | 2.95±0.07b | 17.46±0.72cd | 2.72±0.17cd | 2.36±0.13abc | 1.4±0.18a | 3.40±0.72ab | 11.34±0.40bcd | 3.45±0.86b |
| Umkiang | 3.43±0.09ab | 2.98±0.09ab | 16.77±0.42cd | 3.08±0.54abcd | 2.37±0.07abc | 1.53±0.05a | 3.55±0.31ab | 10.14±0.44d | 2.88±0.35b |




Mean value of three replications (each replication consisted 10 fruits) with±S.E

**Fig. 2 : Biochemical characteristics of fruits of different genotypes of litchi in Meghalaya. a – Total soluble solids (%), b – titratable acidity (%), c – total sugar (%), d – ascorbic acid (mg100g$^{-1}$).**

## CONCLUSION

It is concluded that a wide variation of litchi genotypes are existing in Meghalaya with regards to morphological and biochemical qualities.Litchi genotypes such as Umsyiem,Umniuh and Priang may have unique potential for further utilization in genetic improvement of litchi germplasm.

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