

## POTENTIAL AND TOLERANT GENOTYPES: SOURCES FOR IMPROVING PRODUCTIVITY IN LITCHI

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**L**itchi (*Litchi chinensis* Sonn.) a member of the Sapindaceae family (Lal *et al.*, 2017a) is evergreen an important fruit crop associated with root mycorrhizal association (Lal and Nath, 2020a). It is a good source of Vitamin-C (Lal *et al.*, 2018a) and phenolics (Lal *et al.*, 2018b). Litchi is highly specific to its climatic requirements particularly low temperature for bumper flowering and fruiting, and this is the reason of its restricted cultivation in few countries and limited states in India. Now, it has been reported that litchi is performing well in Southern parts of India, where litchi available during December (Nath *et al.*, 2015). A single inflorescence carries hundreds to thousand flowers (Lal, 2018) and phenol content in plants boost flowering in litchi (Lal *et al.*, 2019e). Pollen grains of M2 flowers are more viable, and fruit set depends on the sources of pollen grains (Lal *et al.*, 2019a and 2019b). However, fluctuation in temperature significantly affects fruit retention (Lal *et al.*, 2017b). Litchi suffers from many problems viz., fruit drop (Lal *et al.*, 2017c and d), seed and fruit borer (Lal *et al.*, 2019c), sunburn and fruit cracking (Lal *et al.*, 2018c), pericarp browning (Purbey *et al.*, 2019) which are responsible for low productivity of litchi. Aberrant weather also influences the productivity and quality of litchi (Lal and Nath, 2020b). There is a need to improve productivity and also widening the genetic base. Concerted research efforts are required to develop suitable cultivars for various climatic conditions. It is also essential to develop promising lines/clones/ hybrids, which have larger fruit size, small/chicken-tongued seeds, higher pulp content, tolerance to sunburn and fruit cracking and having varied maturity groups to avoid the market gluts. Litchi has a very narrow genetic base, and it has to be widened through the selection of genotypes from the existing population. To keep the above points, ICAR-National Research Centre on Litchi, Muzaffarpur, Bihar has started extensive works on improvement in litchi and identified promising genetic stock/genotypes and has released three cultivars of litchi (GandakiSampada, GandakiLalima and GandakiYogita). During selection, the focus has been

given on the most important traits which are responsible for influencing the productivity and quality of fruits. For genetic improvement in litchi, emphasis should be given on length and girth of panicle (Lal *et al.*, 2020c), large fruit (Singh and Nath, 2012), number of fruits per panicle (Nagraj *et al.*, 2019), higher pulp content, precocious in flowering and regular bearer (Lal *et al.*, 2019c), sunburn (Lal *et al.*, 2014, Lal and Sahu, 2017; Lal *et al.*, 2018c), seed and fruit borer (Lal *et al.*, 2017d).

### Varieties developed at ICAR-NRC on Litchi

#### Gandaki Sampada

- Fruits are large in size (36.85 g), conical in shape, vermilion to carmine colour and crack resistant.
- Fruit consist of creamy-white, soft and juicy pulp with 80 to 85 % pulp recovery.
- It is attractive to consumers.
- It has a very high percentage of shrivelled and small-seeded fruits.
- Suitable for the industry due to high pulp content.
- Good yield potential (120-140 kg/tree).
- Panicle girth is high.
- Tolerant to sunburn and fruit cracking.
- A late maturing strain ripens during mid-June.



#### Gandaki Lalima

- A highly nutrient efficient strain possessing dark green leaves and the capability to withstand climatic aberrations.
- Fruits are conical, bright marigold-orange red in colour.
- Fruit contain creamy white pulp and weighs between 28-32 g.
- Heavy yielder with average yield of 130-140 kg/tree.
- Tolerant to sunburn and fruit cracking.
- It does not show hunger symptoms on a leaf near fruit bunch.
- Late maturing cultivar ripens in the second week of June.



- It is attractive to consumers.
- Good compatible with many cultivars in hybridization.
- Good fruit retention capacity as female parent.

### Gandaki Yogita

- It is slow-growing and dwarf plant, tolerant to hot waves and fluctuations in soil moisture.
- The fruit is free from fruit borer, sunburn and fruit cracking.
- Fruits are round in shape; tyrant rose in colour with creamy-white and juicy pulp.
- Good yield potential (70-80 kg/tree).
- It can be recommended for high-density planting as a speciality variety.
- Very late maturity (5<sup>th</sup> – 15<sup>th</sup> June).



### Genetic stocks identified at ICAR-NRC on Litchi

#### NRCL-29

- It is drooping and dwarf growth habit.
- It is most precocious in flowering (3<sup>rd</sup> year of planting).
- It is early ripening genotype.
- It has compact flowering panicle.
- It can be grown under HDP.
- It is easy in peeling.
- The high content of anthocyanin (94.62 mg/100 g)



#### NRCL-59

- Flowering and fruiting started during 5<sup>th</sup> year onward.
- Leaves are similar to Shahi, but fruits are similar to China.
- It is a deep pink colour.
- It is attractive to consumers.



- It is tolerant of sunburn (6.23) and fruit cracking.
- It is late maturing genotype having fruit weight 22.56 g,
- TSS: 21.59 Brix, and high anthocyanin content in peel (96.56mg/100g).

### NRCL-83

- It is slow-growing and dwarf.
- It can be used in HDP.
- Leaves are small, which curved upward from the midrib.
- Average fruit weight is 17.31 g, and the yield is 12.43 kg/plants at 7 years.
- Pulp content is 72.48 %, and seed is small, with an account of 8.73%.
- It is tolerant of sunburn and fruit cracking (3.54%).



### NRCL-85

- It is fast growing with very vigorous growth.
- Trunk surface is very rough.
- High nutrient efficient and does not show hunger symptoms in leaf near fruit bunch.
- It can be grown in marginal land.
- Heavy fruit-bearing intensity (30-40 fruits/cluster).
- Panicle girth is high.
- Tolerant to sunburn and fruit cracking.
- The pulp is dull white, acidic in taste, juicy and is highly suitable for processing industries.



### NRCL-86

- Plant height (5 m) during 12 years old.
- It can be grown under medium density.
- It is regular and heavy bearer (heavy bunch).
- Fruit weight (24.25 g).
- Panicle girth is high.
- High content of pulp (72 %).
- Suitable for the processing industry.
- Chicken tongue seed (6.9%).
- Tolerant to sunburn and fruit cracking.



### NRCL-87

- It is a regular and heavy bearer.
- High fruit weight (29.69 g).
- Panicle girth is high.
- High pulp content (>70 %).
- Tolerant to sun burning and cracking.
- It can be used as a female parent in hybridization.



### NRCL-88

- It is slow-growing, and the plant is dwarf having spreading branches.
- It can be grown under HDP.
- Leaves are small, which curved upward from the midrib.
- Average fruit weight is 16.22 g, and the yield is 16.48 kg/plants.
- Pulp content is 76.38 %, and seed is small, with an account of 7.63%.
- No sunburn is found, and fruit cracking is 6.45%.



## NRCL-89

- It is a regular bearer.
- Leaves were small like Bedana which curved upward from the midrib and a fruit-like Shahi, but the shoulder is similar to Kasba. Fruit shape is oblong, and the colour is pinkish-red at maturity.
- The number of fruits per panicle is 15-18.
- The average fruit weight is 25.63 g, peel weight-3.73 and seed weight is 3.75g.
- The pulp content is more than 70%.
- It is late-ripening genotype which matures in mid-June.
- No sunburn and fruit cracking is observed.



## Conclusion

The limited numbers of cultivars are available in Indian, which is mainly seedling origin and shows a narrow genetic base. The available cultivars are severely affected by fruit drop, sunburn and fruit cracking, seed and fruit borer and possessed low pulp content. There is a need to widen genetic diversity and to select superior genotypes over existing. The breeding efforts have been made by the group of scientist, and three promising cultivars and eight genetic stocks are identified which are precocious, tolerant to sunburn and fruit cracking, early and very late maturing, high pulp content and attractive to the consumers. These genotypes are free from sunburn and fruit cracking which would help to enhance the productivity of litchi.

## References

Lal,N., & Sahu, N. (2017). Management strategies of sun burn in fruit crops-A Review. *International Journal of Current Microbiology & Applied Science*,6(6): 1126-1138.

Lal, N., Pandey, S.K., Nath, V., Agrawal, V., Gontia, A.S., & Sharma, H.L. (2018b). Total phenol and flavonoids in by-product of Indian litchi: Difference among genotypes. *Journal of Pharmacognosy and Phytochemistry*, 7 ( 3 ): 2891 – 2894.

Lal, N., Kumar, A., & Nath, V. (2020c). Quantitative analysis of relationships between panicle size and fruit traits in litchi (*Litchi chinensis* Sonn.). *International Journal of Bio-resource and Stress Management*, 11(4): 381-386.

Lal, N., Marboh, E.S., Gupta, A.K., Kumar, A., & Nath, V. (2019). Fruit drop in litchi (*Litchi chinensis* Linn) influenced by seed and fruit borer. Souvenir cum Abstracts “National Conference on Integrated Plant Health management in fruit crops”, 3-4 September 2019. Pp: 78-80.

Lal, N., Pandey, S.K., Nath, V., Gontia, A.S., & Sharma, H.L. (2018a). Evaluation of litchi (*Litchi chinensis* Sonn.) genotypes for fruit quality attributes. *International Journal of Chemical Studies*, 6(3): 2556-2560.

Lal, N., Singh, S.K., & Nath, V. (2014). Litchi mein phaljhulanvaphatan. *Mrida Darpan*, ICAR-NBSSLUP, Nagpur pp 29-33.

Lal, N., Gupta, A.K., & Nath, V. (2017b). Fruit retention in different litchi germplasm influenced by temperature. *International Journal of Current Microbiology and Applied Science*, 6(12): 1189-1194.

Lal, N., (2018). Genetic studies of litchi germplasm. Ph.D. Thesis, submitted to JNKVV, Jabalpur, MP.

Lal, N., Gupta, A.K., Marboh, E.S., Kumar, A., & Nath, V. (2019a). Effect of pollen grain sources on fruit set and retention in ‘Shahi’ litchi. *Multilogic in Science*, 9(29): 152-156.

Lal, N., Gupta, A.K., Kushwah, N.S., & Nath, V. (2017a). Sapindaceous Fruits: In: Peter KV, Editor. Horticultural Crops of High Nutritive Values. Brillion Publishing, New Delhi.

Lal, N., Gupta, A.K., Marboh, E.S., Kumar, A., & Nath, V. (2019b). Effect of pollen grain sources on success of hybrids in ‘Bedana’ Litchi. *International Journal of Bio-resource and Stress Management*, 10(3), 241–245.

Lal, N., Gupta, A.K., & Nath, V. (2017c). Major challenges in developing of new cultivars in litchi. *GyanManthan*, 6:124.

Lal, N., Gupta, A.K., & Nath, V. (2017d). Fruit drop pattern in some litchi cultivars. *GyanManthan*, 6:132.

Lal, N., Marboh, E.S., Gupta, A.K., Kumar, A., & Nath, V. (2019c). Fruit drop in litchi (*Litchi Chinensis* Linn) influenced by seed and fruit Borer. Souvenir cum abstracts: National Conference on Integrated Plant Health Management in Fruit Crops, 3-4 September, 2019, 78–80.

Lal, N., Marboh, E.S., Gupta, A.K., Kumar, A., Dubedi Anal, A.K., & Nath, V. (2019e). Variation in leaf phenol content during flowering in litchi (*Litchi chinensis* Sonn.). *Journal of Experimental Biology and Agricultural Sciences*, 7(6): 569 – 573.

Lal, N., & Nath, V. (2020a). Effect of plant age and stress on flowering in litchi (*Litchi chinensis*). *Current Horticulture*, 8 (1):24–27.

Lal, N., & Nath, V. (2020b). Aberrant weather influencing the productivity and quality of litchi under changing climatic condition. National Conference on Climate Conclave 2020: Scientific & Environmental Innovation and Implementation of Sustainable Development Goals, 7-8 March, 2020. Organized by SHEFWEL Society and M.P. Council of Science and Technology, Bhopal.

Lal, N., Pandey, S.K., & Nath, V. (2018c). Pericarp morphology influences sun burn in different germplasm of litchi. Book of Abstract, National Conference on Intensification and Diversification in Agriculture for Livelihood and Rural Development May 28–31, 2018, DRPCA, Pusa, Samastipur, Bihar, India, 21.

Lal, N., Singh, A., Gupta, A.K., Marboh, E.S., Kumar, A., & Nath, V. (2019c). Precocious Flowering and Dwarf NRCL-29-A New Genetic Stock of Litchi (*Litchi chinensis* Sonn.). *Chem. Sci. Rev. Lett.* 8 (32): 206-210.

Nagraj, K., Diwan, G., & Lal, N. (2019). Effect of fruit load on yield and quality of litchi (*Litchi chinensis* Sonn.). *Journal of Pharmacognosy and Phytochemistry*, 8(6): 1929-1931.



Nath, V., Kumar, A., Pandey, S.D., &Tripathi, P.C. (2015). Litchi in winter season- a way forward. *Indian Horticulture*, 59: 26-27.

Purbey, S.K., Pongener, A., Marboh, E.S.,&Lal, N. (2019). Advances in packaging of litchi fruit to maintain the quality. *Current Journal of Applied Science and Technology*, 38(1): 1–11.

Singh, A., &Nath, V. (2012). Variability in fruit physico-chemical characters of litchi (*Litchi chinensis*Sonn.): an index for selection of improved clones for processing and value addition. *Indian Journal of Genetics and Plant Breeding*, 72(2): 143-147.