



## Short Communication

# Sunburn and fruit cracking in Litchi (*Litchi chinensis* Sonn.) cv. 'Rose Scented'

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## Abstract


Litchi (*Litchi chinensis* Sonn.) is originally from southern China, but due to its higher adoptability and profitability, it is being cultivated in India. In India, litchi is harvested and sold during April-May and fruits have nutritional and economical values. Litchi cv. 'Rose Scented' is highly preferred in India for its taste, but sunburn and fruit cracking are a major drawback for its cultivation. Studies were conducted to quantify the severity of sunburn and incidence of fruit cracking. Fruits first affected by sunburn and burnt outer skin or peel or cuticle part, later turned into cracking. So sunburn acted as a predisposition to fruit cracking in 'Rose Scented'. Thus, sun burn and cracking can be seen in the same fruit. These types (cracked fruit with sunburn) of fruits were 8.26%, 19.58% and 43.25% in 2017, 2018 and 2019, respectively. Lower thickness of cuticle and spongy layer and higher temperature of fruit surface in burnt and cracked fruit may be accountable for fruit burning and cracking. A close correlation was observed between sunburn, cracking and weather situation over two months. A positive relationship was found between maximum temperature, sunburn and fruit cracking.

**Keywords** fruit cracking, fruit surface temperature, litchi, sunburn

## Introduction

Litchi (*Litchi chinensis* Sonn.) is nutritious fruit crops but it is very specific in its climatic requirement and this might be reason for its cultivation in limited countries. Due to specific climatic demands, litchi is restricted to a few states with 74 per cent of production in Bihar where millions of people depend on it for their livelihood. It is also grown on bunds and homesteads which give additional income. Flowering initiation start in February-March and fruit maturity in April-May when temperature rise in eastern India and at the same time sunburn and fruit cracking starts in litchi, which is cultivar specific and they become the most vulnerable with climate change scenario. Litchi cv. "Rose Scented" is the most popular and widely cultivated variety in the country. It is a regular and prolific bearing fruit with pleasant aroma but highly susceptible to sunburn and cracking. Sunburn and fruit crack are the main limiting factors in litchi cultivation. The extent of sunburn and cracking is affected by various climatic factors, nutritional, genetic and soil condition [1-2]. Damage due to sunburn varies from 0.9-19.13% [3]. Higher temperature and number of sunny days during fruit growth promote sunburn, while dreadful sunburn changes the cuticle and damages epidermal and subepidermal tissues. Low humidity, high temperature and hot wind during fruit development and maturity stage contribute to this problem. Sunburn and fruit cracking are major problems in litchi due to global warming due to high light intensity and temperature. Temperature is one of the main abiotic

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stresses that affect many physiological responses in plants and fruits. Photosystems can be seriously and irreversibly damaged by excessive heat. In addition, high temperature also causes severe drying and consequently the skin of the fruit becomes hard and inflexible. Pre-monsoon rains following this high temperature accelerate the growth processes and expansion of the internal tissues, resulting in cracking of the inflexible skin of the fruit [4]. Temperature and precipitation also affect the physicochemical and anatomical characters of fruits. This study was therefore initiated to assess the severity of cracking and sunburn, and determine the association between sunburn, fruit cracking and environmental stress in litchi due to changes in climatic conditions.

## Methodology

This study was conducted at the National Active Germplasm Site, ICAR-National Research Centre on Litchi, Muzaffarpur during the years 2017-2019. The study site is situated at an altitude of 210 meter and recumbent between 26°5'64" N latitude and 85°26'64" E. The experiment site is designated by a humid subtropical with temperatures ranging from 30°C-43°C during summer and 5°C-10°C during winter. This region is dry and hot in summers and cool in winters with high precipitation in the monsoon. Rains begins in the mid of June and continues in considerable force till the middle of September. Four plants of litchi were randomly selected for observation from fruit set to ripening and twelve trees were considered as replicates. At the end of May, the number of sunburned, cracked and sunburned broken fruit, and normal fruit morphology were counted for each tree. Morphological data of normal and cracked fruit were collected during the 3 years of investigations. Statistical analysis of data was performed using a randomized block design using SPSS software. Weather data including temperature, relative humidity, wind speed, sunshine, evapotranspiration, precipitation, and rainy days were recorded during fruit development from April to May each year. Fruit size (length and diameter) was recorded using a digital calliper, while weight was measured using a digital pan weighing scale. Five branches were marked in four directions and the number of sunburned and cracked fruits was computed from each marked branch and converted in on percentage. Fruit surface temperature (FST) was noted using a probe. The thickness of peel (spongy and cuticle layer) was measured with a vernier caliper and indicated in millimetre (mm). Total soluble solids (TSS) were measured using a Hanna Refractometer and titratable acidity (%) was determined [5].

## Results and Discussion

Morphological description of sunburn and fruit cracking in litchi cv. 'Rose Scented' fruit is given in Table 1. Sunburn started very early, 40 days just after fruit set. Sunburn started with the distal end even near the pedicel, but fruit cracking started with the distal end after two months of fruit set. There is no specific form of sunburn and fruit cracking, but sunburn predisposes to fruit cracking in litchi cv. 'Rose Scented'. The sunburn started from the ventral, distal end and near the petiole and then spread over the entire fruit surface (Figure 1). In the cracked fruit, the pulps were fully exposed. Sunburn and cracks usually occurred in the west and south direction due to more hours of light with high intensity of light. Sunburn and fruit cracking also varied in different years.

**Table 1. Morphological description sunburn and fruit cracking in litchi cv. 'Rose Scented' fruit in India**

| Parameters                         | Sunburn                   | Fruit cracking |
|------------------------------------|---------------------------|----------------|
| Site of Sunburn/cracking           | Distal end, Near peduncle | Distal end     |
| Side of Sunburn/cracking           | Ventral                   | Ventral        |
| Pulp                               | Never exposed             | Exposed        |
| Mean time to start after fruit set | 40 days                   | 62 days        |
| Direction                          | West and south            | West and south |



Figure 1. Sunburn on surface of litchi cv. 'Rose Scented'

Only sunburnt fruits were recorded highest (42.56%) in 2019 due to higher temperature in this year (Table 2 and Figure 2) whereas only cracked fruits were highest (2.68%) in 2017 due to heavy pre-monsoon rains. Cracked fruit with burning were 8.26%, 19.58% and 43.25% in 2017, 2018 and 2019, respectively (Table 2). Normal and affected fruits morphology was significantly differ (Table 3). Fruit weight, cuticle thickness, spongy layer thickness and acidity were somewhat lower in sunburned and cracked fruit than in normal fruit. Higher cuticle thickness was observed in normal fruit as it is reported in fruit cracking tolerant cultivar [6]. In contrast, stone weight, flesh thickness, FST and TSS were higher in affected fruit. FST was higher in tolerant genotypes than susceptible ones [7].

Table 2. The incidence of sunburn and fruit cracking in litchi cv. 'Rose Scented'

| Fruit condition             | Fruit cracking (%) during different years |       |       |
|-----------------------------|---|-------|-------|
|                             | 2017                                      | 2018  | 2019  |
| Sunburn only                | 5.58                                      | 18.65 | 42.56 |
| Cracking only               | 2.68                                      | 0.93  | 0.69  |
| Fruit cracking with sunburn | 8.26                                      | 19.58 | 43.25 |
| CD (P = 0.05)               | 0.124                                     | 0.204 | 0.802 |

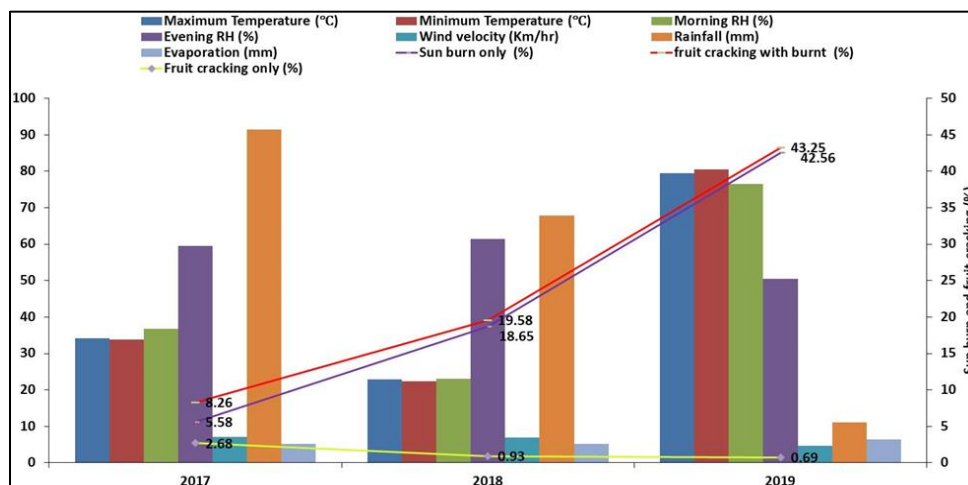


Figure 2. Relation of fruit cracking with climatic factors in Litchi cv. 'Rose Scented'

Therefore, lower cuticle thickness and spongy layer and higher pulp thickness and FST were associated with sunburn and cracking. Increasing temperature on fruit surface significantly increased the



pressure applied by the flesh on fruit skin and reduced the rigidity and toughness of the skin, thereby increasing the incidence of splitting [8]. In affected fruit, the pulp may be pressed against the skin, resulting in cracking due to reduced thickness and damage to the cuticle. Acidity was lower in affected fruit than normal ones and TSS was higher in affected fruits which might be due to moisture losses from pulp through exposed area to environment.

Fruit cracking was closely related with weather conditions. Fruit cracking was positively correlated with climatic factors during fruit development period were shown (Figure 2). High temperature promoted cracking in mango [9]. High temperature, water scarcity and lower humidity increased cracking in orange [10]. Detailed observation revealed that maximum temperature (34.20 °C, 33.85 °C, 36.85 °C) and fruit cracking (8.26%, 19.58% and 43.25%) have a positive relationship during the study years (Figure 3). Cracking in litchi had positive relationship with total sugar and FST [11]. The rapid pulp growth and colour-breaking in litchi coincides with fruit cracking. However, fruit cracking also occur at green stage in China and Calcuttia Late litchi. The post-harvest life of cracked fruit is reduced due to infection of pathogens. Fruit cracking causes huge losses to the litchi growers.

Table 3. Fruits characteristics in litchi cv. 'Rose Scented'

| Fruit condition | Fruit weight (g) | Seed weight (g) | Pulp thickness (mm) | Cuticle thickness (mm) | Spongy layer thickness (mm) | Fruit Surface Temp. (°C) | Total Soluble Solids ( <sup>0</sup> Brix) | Acidity (%) |
|-----------------|------------------|-----------------|---------------------|------------------------|-----------------------------|--------------------------|---|-------------|
| Normal Fruit    | 21.73            | 3.78            | 5.48                | 1.63                   | 0.14                        | 33.25                    | 19.67                                     | 0.38        |
| Sunburnt fruit  | 21.65            | 3.75            | 5.43                | 1.52                   | 0.12                        | 34.87                    | 20.18                                     | 0.35        |
| Cracked Fruit   | 21.14            | 3.82            | 5.62                | 1.41                   | 0.09                        | 34.82                    | 21.84                                     | 0.32        |
| CD (P = 0.05)   | NS               | NS              | NS                  | 0.102                  | 0.008                       | NS                       | 1.058                                     | 0.016       |

NS- Non significant, Temp.- Temperature

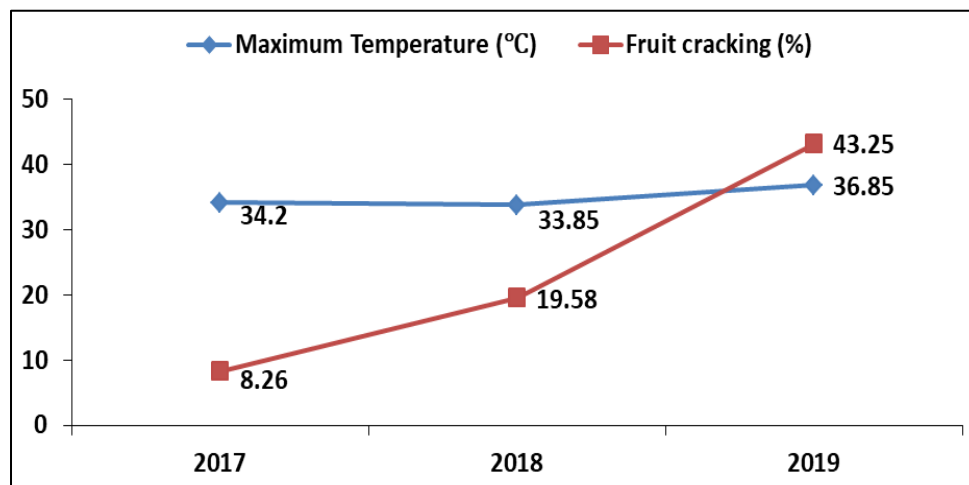


Figure 3. Relation of fruit cracking with temperature in Litchi cv. 'Rose Scented'

## Conclusion

It has been observed that 'Rose Scented' was most sensitive to sunburn and fruit cracking. Sunburn predisposed to fruit cracking in litchi cv. 'Rose Scented'. The unfavorable weather conditions (higher temperature, high precipitation and lower humidity) might be a closely related with sunburn and fruit cracking. Heavy pre-monsoon rain promoted only cracking, not sunburn but higher temperature promoted both sunburn and fruit cracking. The higher temperature during the fruit growth stage was positively correlated with sunburn and cracking. The thickness of cuticle and spongy layer were lower in sunburned



and cracked fruit than normal fruit. Similarly, FST was higher in affected fruit than the normal fruits.

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### Conflict of interest

N. Lal, A. Kumar and S. D. Pandey declare that they have no competing interests.

### References

- [1] L. Schrader, J. Sun, D. Felicetti, J.-H. Seo, L. Jedlow and J. Zhang (2003). Stress-induced disorders: Effects on apple fruit quality. Washington tree fruit postharvest conference, 2<sup>nd</sup> – 3<sup>rd</sup> December.
- [2] E. S. Marboh, A. K. Gupta, N. Lal, S. D. Pandey and V. Nath (2018). An overview of differential response of litchi trees to water stress. *Int. J. Innov. Hortic.*, 7: 17-26.
- [3] G. Singh, V. Nath, S. D. Pandey, P. K. Ray and H. S. Singh (2012). Cultivars and genetic enhancement. *In: The litchi*. M. K. Papademetriou and F. J. Dent (Ed.), Food and Agricultural Organization of the United Nations, New Delhi, India, pp18-24.
- [4] D. Holland, K. Hatib and I. Bar-Yaakov (2009). Pomegranate: botany, horticulture, breeding. *Hortic. Rev.*, 35: 127-191.
- [5] S. Ranganna (1977). Manual of analysis of fruit and vegetable products. Co., Ltd., New Delhi, Tata McGraw-Hill Pub, pp634.
- [6] N. Lal, N. Sahu, A. Kumar and S. D. Pandey (2022). Effect of rainfall and temperature on sun burn and fruit cracking in litchi. *J. Agrometeorol.*, 24: 169-171.
- [7] N. Lal and N. Sahu (2022). Screening of litchi (*Litchi chinensis* Sonn.) genotypes against sun burn. *Bangladesh J. Bot.*, 51: 37-43
- [8] A. Lang and H. During (1990). Grape berry splitting and some mechanical properties of the skin. *Vitis*, 29: 61-70.
- [9] P. L. Saran, R. Kumar, S. Ercisli and R. Choudhary (2015). Fruit cracking in mango (*Mangifera indica* L.) cv. 'Dashehari'. *Erwerbs-Obstbau*, 57: 93-96.
- [10] L. U. Opara, C. J. Studman and N. H. Banks (1996). Fruit skin splitting and cracking. *In: J. Janick* (Ed.), *Horticultural Reviews*. pp217-262.
- [11] N. Lal, Kumar A. Kumar, S. Pandey and V. Nath (2023). Screening of litchi genotypes for fruit cracking and the relationship of cracking to fruit and leaf traits. *Erwerbs-Obstbau*, 65: 479-485.