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FRUIT CRACKING: A PHYSIOLOGICAL DISORDER AFFECTING YIELD AND MARKETABILITY

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INTRODUCTION

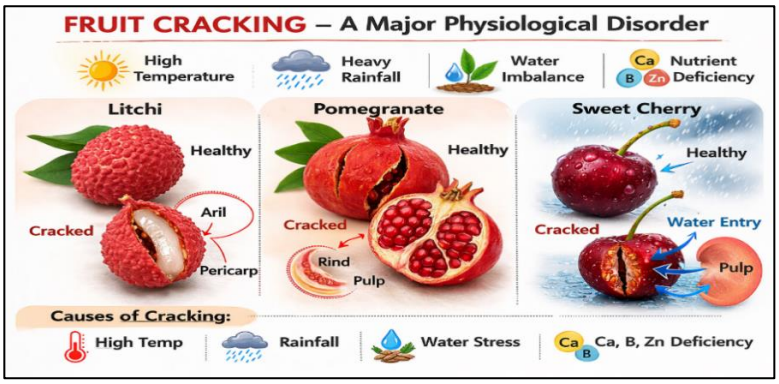
India ranks second in global fruit production after China and is often called the fruit basket of the world due to its diverse climate that supports the cultivation of numerous fruit crops. However, significant losses occur because of physiological disorders, among which fruit cracking is a major problem. Fruit cracking is a pre-harvest physiological disorder characterized by rupture or splitting of the fruit skin or cuticle, sometimes extending deep into the pulp (Rangare et al., 2023). The average loss due to this disorder ranges from 50–85%**,** greatly reducing fruit quality and making the produce unmarketable, leading to substantial economic losses for growers. Fruit cracking commonly occurs in several horticultural crops such as cherry, plum, apricot, apple, litchi, pomegranate, citrus, banana, avocado, grape, persimmon, peach, tomato and pistachio (Khadivi-Khub., 2009). Therefore, understanding the causes of fruit cracking and adopting suitable management strategies are essential for minimizing losses and improving fruit quality.

Fruit cracking in Litchi: High temperature (above 38 °C), low humidity (below 60%) and low soil moisture conditions during fruit development promote this disorder in Litchi. In Litchi, it is associated with the "Ball- skin bladder effect", where the pericarp fails to expand uniformly with aril growth.

Fruit cracking in pomegranate: There are many reasons that causes fruit cracking in pomegranate: hot dry winds, heavy rainfall following a dry spell, difference in day and night temperature, nutritional deficiency especially boron, calcium, zinc and potash (Saei et al., 2014) are directly associated with fruit cracking in pomegranate.

Fruit cracking in Cherry: Two major causes of fruit cracking in Sweet cherries are as follows:

- **Water relation within the tree:** Trees growing in soils saturated from precipitation or over irrigation take up excess water. As the fruit matures, sugar concentration rise, establishing a large osmotic potential and leads to cracking.
- **Free standing rainwater on ripening fruit:** The rise in sugar concentration in ripening fruit sets an osmotic gradient across the surface. Prolonged contact between cuticle and water results in water entering the fruit.



PHYSIOLOGICAL MECHANISM OF FRUIT CRACKING

Cracking due to water imbalance:

Fruit cracking often occurs when abundant water becomes available after a prolonged dry period. During drought conditions, xylem and phloem tissues become hardened and lose their capacity to expand. When water supply suddenly increases, the internal tissues resume rapid growth while the rigid vascular tissues fail to expand accordingly. This difference in growth rate results in rupture of the fruit peel.

Cracking due to environmental stress:

Environmental conditions such as high temperature and low humidity during summer cause the fruit peel to become hard and inelastic. When heavy rainfall occurs during the rainy season, the internal tissues expand rapidly due to increased water uptake. Since the peel cannot expand at the same rate, the fruit skin ruptures, leading to cracking.

MITIGATION STRATEGIES

1. Irrigation Management :

Drought stress followed by a sudden surge of water can increase fruit cracking. (Wang et al., 2021). Light but frequent irrigation that maintain a congenial microclimate within and around

the plant has been found to minimize cracking in Litchi .To prevent cracking, maintaining a consistent water supply through drip irrigation is recommended.

2. Nutrient Management:

Deficiencies in calcium, boron, and phosphorus are strongly associated with increased cracking. Calcium strengthens cell walls by stabilizing pectin in the middle lamella, reducing the likelihood of cracking. Boron is responsible for increasing cell elasticity and prevents breakdown of vegetative tissues.

3. Plant growth regulators

Plant Growth Regulators (PGRs) play a crucial role in controlling fruit cracking by influencing fruit development. Application of NAA enhances fruit set and improves peel elasticity, thereby reduces cracking in citrus fruits .Similarly, GA_3 application delays rind senescence and decreases cracking incidence in *Eureka* lemon. Ethylene, which accelerates ripening and softening, is also linked with cracking susceptibility.

4. Bagging and Mulching

Bagging is a physical protection technique, it reduces the incidence of fruit cracking by altering the microenvironment for fruit development. Mulching, either plastic or organic mulch along with three irrigations, was effective in controlling fruit cracking as it reduces water stress.

5. Tolerant cultivars

Tolerant cultivars should be selected while establishing new orchard. Bedana, Bombai, Elaichi, Kasba and Piazi showed low amount of fruit cracking in litchi. The thickness of the pericarp is reported to impart resistance to cracking in most of the cultivars.

6. Anti- transpirants

Anti-transpirants are chemical compounds that reduce the rate of transpiration from plant leaves and help plants tolerate stress (El Khawaga, 2013). They decrease stomatal opening and increase leaf resistance to water vapor diffusion without significantly affecting carbon dioxide uptake. This helps reduce transpiration, maintain fruit skin elasticity, and minimize fruit cracking.

CONCLUSION

Fruit cracking is a major pre-harvest physiological disorder that occurs due to the combined effects of environmental stresses, irregular water availability, nutrient imbalance, hormonal disturbances and genetic susceptibility of cultivars. Sudden fluctuations in soil moisture, high temperature with low atmospheric humidity, and weak elasticity of the fruit peel increase internal

pressure inside the fruit, which ultimately causes the fruit surface to rupture. In addition, physiological factors such as water imbalance and environmental stress, further increase the susceptibility to cracking. Effective control of this disorder requires an integrated management approach rather than a single practice. Proper irrigation scheduling, balanced nutrient management, foliar application of calcium and boron, mulching, and adoption of cracking-tolerant cultivars can significantly reduce fruit cracking and improve fruit quality and market value.

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