ACTA SCIENTIFIC AGRICULTURE (ISSN: 2581-365X)

Volume 3 Issue 4 April 2019

Review Article

A Chronic Problem of Fruit Cracking in Fruit Crops: A Review

AM Butani[1]*, HP Purohit[2], Rutu Solanki[2], Pooja Mishra[2] and Disha Dadhaniya[2]

[1]Assistant Professor, Department of Horticulture, College of Agriculture, Junagadh Agricultural University, Junagadh, Gujarat, India

[2]Department of Horticulture, College of Agriculture, Junagadh Agricultural University, Junagadh, Gujarat, India

***Corresponding Author:** AM Butani, Assistant Professor, Department of Horticulture, College of Agriculture, Junagadh Agricultural University, Junagadh, Gujarat, India.

Received: March 01, 2019; **Published:** March 22, 2019

Abstract

Fruit cracking is a serious physiological disorder that severely affects the quality fruit production. Cracks on the fruit surface permits infection by fungi and also facilitate rapid moisture loss and excessive shriveling and thereby reduce market quality and storage life. Fruit cracking takes place when there is plenty of water is available to the plants following a prolonged drought and also due to high temperature and low humidity in summer. Fruit cracking is controlled by different methods in different fruit crops viz. application of water through the drip, use of mulches, fertilizer management, use of resistant cultivars, bagging, use of different packaging material and timely harvesting, spraying of micronutrients and growth regulators.

Keywords: Fruit Cracking; Fruit Crops; Plant

Introduction

India ranks 2nd in fruit production in the world after China and is known as the fruit basket of the world. Among the various pre-harvest problems in fruits, cracking of peel and splitting of the underlying pulp of the fruit, while it is still attached to the plant is a physical defect limiting the production and delivery of sound and blemish-free fruits to the market. Fruit cracking is a serious problem in many fruits and the severity of damage varies with the cultivar. Fruit crops which have a major loss due to fruit cracking are cherry, lemon, litchi, grapes and pomegranate (up to 75%). Cracked fruits are also more prone to chemical injury. The presence of cracks on the fruits also permits the infection by fungi, like *Aspergillus, Penicillium* etc. Cracks or splits in the peel of fruit facilitate rapid moisture loss and excessive shrivelling, which usually lowers the fruit quality and storage life. There are three types of cracking occurs in most of the fruit crops: (1) Peel cracking (2) Star cracking and (3) Splitting. Fruit cracking generally occurs in three ways: It may be Radial (longitudinal), Transverse or Concentric cracking.

Mechanism of fruit cracking

Fruit cracking takes place when plenty of water is made available to the plants following a prolonged drought. The explanation for which is that during prolonged drought, both xylem and phloem get further strengthened, as a result, they lose their ability to divide and enlarge and when after a dry spell, water supply is increased, the meristematic tissues resume growth, but not the xylem and phloem. As a result, the harder tissues get ruptured, causing the fruit to crack. Further, due to high temperature and low humidity in summer, the peel of fruits become hard and inelastic and the heavy rains during rainy season accelerate the growth and expansion of internal tissues at a faster rate, whereas, the peel remains inelastic. Thus, the growth of peel doesn't coup up with the growth of the internal tissues, resulting in the cracking of the inelastic fruit peel.

Causes of fruit cracking

The problem of fruit cracking has been studied extensively in many fruits from centuries and different factors contributing to fruit cracking are:

Biotic factors

- In citrus, cracking is associated with the diseased tissues, such as lesions.
- In general, rupture of fruit peel occurs first at the weakest point, as a consequence of physiological disorder or damage by disease, insect or mechanical injury.
- These diseased tissues absorb water exceptionally when water supply is plentiful and cause rupture through abnormal swelling.

Varietal factors

Different varieties of fruits have differential response to fruit cracking and thus, susceptibility to fruit cracking is considered to be under genetic control.

Litchi

- **Cultivar free from cracking:** Swarna Roopa
- **Cultivar susceptible to cracking:** Dehradun

Lemon

Almost all the cultivars of lemon are affected by cracking but the problem is very severe in Italian, Eureka, Pant Lemon-I and Kagzi Kalan cultivars.

Peel abnormalities

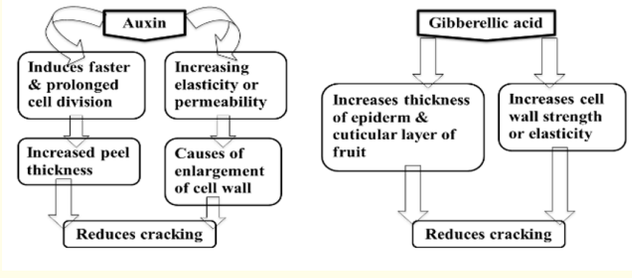
- Physical defects on the fruit surface constitute the points of weakness where ruptures generally occur first.
- These defects may arise from physiological disorders, diseases, insect or mechanical injury.
- Fruit splitting is associated with the disintegration of the cuticular layer.

Environmental factors

- Prolonged period of high relative humidity, especially when the fruits are small, may modify the composition of the cuticle sufficiently to cause it to lose its protective capacity.
- Thus, increased water supply and decrease in water loss from leaves due to saturated relative humidity may promote, fruit cracking in many fruits.
- In general, when relative humidity is well below 90 per cent, there may not be any cracking of fruits, but if it is between 99 and 100 per cent, there may be intensive cracking.
- Further, due to high temperature and low humidity in summer, promotes cracking.

Hormonal factors

- Hormones also a play vital role in the cracking of fruits in different fruits crop.
- Among different growth regulators, auxins and gibberellic acid play regulatory role in fruit cracking.



Figure

Cultural factors

Nutritional status of tree and fruit

- The nutrients, like calcium, nitrogen, potassium, copper, boron etc., appear to be involved in some physiological processes during the fruit development period and thus their deficiencies may result in cracking.
- In general, the deficiencies of Ca and B and excess of N lead to the development of cracking in many fruits.

Pesticidal sprays

- Spraying of fruit plants with pesticides has been reported to aggravate fruit cracking in many fruits.
- Surfactants, like Tween-20, often used with herbicides, fungicides or insecticides as emulsifying, dispensing, and spreading agents usually cause increased uptake of water and thereby aggravate fruit cracking.

Internal factors

- Thickness of cutin also has some correlation with fruit cracking.
- For example, the red side of the apple fruit is subjected to less cracking, primarily because of thin cutin, the shaded side, the cuticle is thicker and is subjected to greater incidence of cracking.
- The physiological condition of the tree and branches has also autonomy to fruit cracking.
- For example, the fruits in a particular branch of a tree may show more cracking than the other.

Measures to reduce fruit cracking incidence in some fruit crops

Pomegranate

Prasad., *et al.* [1] studied that drip irrigation at 12 l/h resulted in minimum fruit cracking in both the years (18.5%) and (18.7%) and maximum yield/plant in both the years (30.4 kg) and (29.8 kg) respectively. Khawaga [2] observed that when cv. Manfalouty sprayed with paclobutrazol 150 ppm at first week of June (9-10 weeks before fruit harvest) resulted in minimum splitting fruit in both the years (26.5%) and (24.1%) respectively. Ahmed [3] studied that irrigation at 14 days + 0.75% borax which is applied in soil at the time of fruit setting in pomegranate cv. Ganesh resulted in minimum cracked fruits/plant (2.01%). Belsare [4] noticed that minimum fruit cracking (2.38%) and maximum fruit yield (21.13 kg/tree) was found with CPPU 5 ppm applied in May in pomegranate cv. G-137. Lal., *et al.* [5] studied the different chemicals and varietal interaction effect on percent fruit cracking in Jyoti, Dholka, Kandhari, Bedana and G-137 pomegranate varieties grown under Karewa condition of Kashmir valley and found that foliar appli-

cation of $CaSO_4$ 3000 ppm applied on 15th May (fruit set) and 15th June (fruit active development stage) gave minimum fruit cracking (23.01%) and among the different varieties Jyoti gave minimum fruit cracking (25.16%). Best interaction was obtained with $CaSO_4$ 3000 ppm in G-137 variety which gives minimum fruit cracking (15.28%). Sheikh and Manjula [6] reported that pre harvest spray of boric acid 0.2% in pomegranate cv. Ganesh showed minimum percentage of cracked fruits (3.33%) and maximum yield of healthy fruits/plant (34.05 kg). Abubakar., *et al*. [7] observed the effect of biostimulants on fruit cracking of pomegranate cv. Kandhari kabuli and revealed that application of biostimulants, particularly cytozyme 4 ml/l applied at 45 days after bud burst and repeated 10 days after fruit set resulted in minimum fruit cracking (11.33%). Ahmed., *et al*. [8] reported that four foliar application of salicylic acid + all nutrients in cv. Manfaulty at the 1st week of March (growth start setting), April, May and June showed significantly higher gross yield/tree (126.9 and 135.3 kg), marketable yield/tree (124.41 and 126.9 kg) and significantly minimum fruit splitting (4.3 and 4.2%). Wafa [9] studied that when cv. Wonderful bagged with prgmen bag at 21 days after fruit set and continued until harvest (1st week of October) resulted in significantly minimum fruit cracking (1%) and sun burnt fruits (2%) in both the years. Kumar., *et al*. [10] revealed that when cv. Jodhpur Red sprayed with 2, 4-D 10 ppm at 15 days after fruit set and 30 days after fruit set resulted in minimum premature (5.21%) and mature cracking (3.09%) in pomegranate.

Litchi

Kaur [11] observed that foliar application with borax 0.4% on new growth flushes before initiation of inflorescence in cv. Dehradun resulted in a minimum number of fruit cracking (2%). Singh., *et al*. [12] concluded that minimum fruit cracking (4.50%) was found with an application of urea 1% + borax 1% which is applied in the month of April and again in the month of May in cv. Rose scented.

Citrus

Sandhu and Bal [13] observed that irrigation at 20% ASMD and mulching in cv. Baramasi gave significantly minimum fruit cracking in both the years (7.21%) and (8.28%) respectively. Sandhu and Bal [13] revealed the effect of organic and inorganic nutrient sources on the fruit cracking in lemon cv. Baramasi and noticed that {FYM (94 kg/tree) + Inorganic fertilizer (438 g/tree N) + Azotobacter (18 g/tree)} in which FYM is applied in December and N in two split, 1st in February and 2nd in April after fruit set and biofertilizer applied through drenching, resulted in minimum fruit cracking in both the years (18.89%) and (19.93%) respectively. Khehra and Bal [14] studied that foliar spray of NAA (40 ppm) + K_2SO_4 (8%) + Borax (1%) during May at an interval of 15 days during forenoon (2 sprays) in cv. Baramasi resulted in minimum per cent fruit cracking in both the years (13.84%) and (11.64%) respectively. Bhatt., *et al*. [15] reported that when cv. Pant Lemon-1 sprayed with GA3 20 ppm at full bloom stage during spring in morning showed maximum fruit set (3.12%), days to maturity (148.23) and minimum fruit drop (33.58%) and fruit cracking (8.45%).

Mango

Saran and Kumar [16] observed that among the different cultivars maximum fruit cracking (4.12%) and cracked fruits (no.) (157) was found in cultivar Dashehari. Saran and Kumar [16] revealed that foliar spray of Boron (0.10%) in cv. Dashehari at pea stage, in the 3rd week of April, followed by 2nd and 3rd sprays at 15 days intervals resulted in minimum fruit cracking (0.47%). Saran [17] observed that among the two types of cracking in cv. Dashehari, longitudinal cracking most commonly occurs. Saran [17] noticed that cracked fruit of cv. Dashehari contains minimum fruit fresh weight (122.40 g), pulp thickness (1.76 cm), stone breadth (6.24 cm) and maximum stone fresh weight (25.75 g). Rathore and Pal [18] observed that pre harvest bagging of mango cv. Mallika with blue paper bag gave minimum no. of diseased fruits (3), insect infested fruits (2) and cracked fruit (0).

Grape

Ramteke., *et al*. [19] revealed that grape bunches cv. Fantasy seedless when sprayed with Silixol (4 ml/l) + Ca gluconate (2 g/l) + Boron (0.5 g) resulted in minimum cracking (4.08%) and maximum skin thickness (0.30 µm) whereas maximum berry length (22.12 mm), berry diameter (16.33 mm) and yield (20.43 t/ha) was obtained with Silixol (4 ml/l) and maximum skin thickness was also found maximum (0.30 µm) with Silixol (4 ml/l) + Ca nitrate (2 g/l) + Boron (0.5 g). In these, grape bunches were sprayed thrice at an interval of 10 days in veraison stage.

Apple

Costa., *et al*. [20] studied that Alar (2000 ppm × 4 times) resulted in minimum fruit cracking (8.4%) whereas Alar (1000 ppm × 4 times) resulted in minimum fruit russeting (16.2%) in apple cv. Stayman Red.

Cherry

Bhat., *et al*. [21] found that significantly minimum cracking index was obtained with 2% $CaCl_2$ in cv. Makhmali. Yildirim and Koyuncu [22] studied the effect of GA_3 doses on fruit cracking rate in the '0900 Ziraat' sweet cherry cultivar and noticed that lowest cracking index (5.60%) with 20 ppm GA_3 which is applied when the fruits were at the straw-yellow stage (about 30 - 40 days prior to the harvest).

Bael

Singh., et al. [23] revealed that application of Boron (1%) + Copper sulphate (0.25%) + Carbendazim (0.1%) at pea stage

followed by one month after first application resulted in lower incidence of fruit necrosis (15.10%), fruit cracking (17%) and fruit drop (14.70%).

Banana

Evelin and Sathiamoorthy [24] observed that air packing of banana cv. Rasthali dipped in GA_3 150 ppm along with harvested at 80% maturity gave minimum peel-split (0.17%) [25].

Fruit crop	Variety	Chemical	Dose	Frequency
Citrus	Pant lemon-I	Borax	0.2%	Three sprays during fruit development
	Pant lemon-I	Copper sulphate	0.3%	-do-
	Pant lemon-I	Potassium sulphate	4%	-do-
	Kagzi Kalan	Calcium chloride	0.5%	One spray at a half-grown stage of fruit development
	Kagzi Kalan	Calcium nitrate	1%	Three sprays
Apple	Delicious group	Copper sulphate	500 ppm	One spray
		Borax	4,000 ppm	One spray
	Stayman Winesap	Boric acid	0.4 %	One spray
Pear	Bartlett	Borax	0.5%	Two sprays after flowering
Pomegranate	All known cultivars	Borax	0.1%	One spray in June
Cherry	Bing, Lambert	Calcium chloride	0.3%	Four sprays at weekly interval
Litchi	Dehradun	Zinc sulphate	1.5%	Sprays at weekly interval starting from pea stage of fruit development

Table 1: Reducing the incidence of fruit cracking in different fruits by foliar application of different chemicals.

Source: Fruit production 'Problem and solution' by R. R. Sharma

Fruit crop	Growth regulator	Concentration	Spray condition
Litchi	2, 4, 5-T	10 ppm	One spray at pea stage of fruit development
	NAA	10 ppm	-do-
	2, 4-D	10 ppm	One spray at pea stage of fruit and other one month later
	GA_3	40 ppm	One spray at pea stage of fruit development
Lemon	NAA	20 ppm	Two sprays (one at fruit-set and other 20 days afterwards)
	GA_3	10 ppm	One spray 1 month before harvest
	NAA	10 ppm	Three-sprays (monthly interval starting from 15 May)
Pomegranate	GA_3	120 ppm	One spray at half-grown stage of fruit development
Apple	Paclobutrazol	250 ppm	One spray or soil application
Sweet cherry	Paclobutrazol	750 ppm	One spray after fruit set or soil application

Table 2: Growth regulators in reducing fruit cracking and splitting in different fruit crops.

Source: Fruit production 'Problem and solution' by R. R. Sharma

Conclusion

From the foregoing discussion it can be concluded that fruit cracking severely affects the quality fruit production. Fruit cracking is controlled by different methods in different fruit crops viz. application of water through the drip, use of mulches, fertilizer management, use of resistant cultivars, spraying of micronutrients and growth regulators. Appropriate fertilizer management (Citrus) also control cracking incidence. Foliar sprays of some micronutrients like B (Pomegranate, mango, litchi, bael), Ca (Cherry, pomegranate) and K (Citrus) and hormones like GA3 (Cherry, citrus), 2, 4-D (Pomegranate), NAA (Citrus) also reduces cracking. Application of silixol in grapes reduces cracking incidence. In pomegranate, paclobutrazol, CPPU, cytozyme and salicylic acid reduce cracking. Bagging (Mango, pomegranate), different packaging material with timely harvesting beneficial in reducing fruit cracking in banana and application of paclobutrazol reduces cracking incidence in apple.

Bibliography

1. Prasad RN., *et al.* "Effect of drip irrigation on growth, yield and quality of pomegranate in arid region". *Indian Journal of Horticulture* 60.2 (2003): 140-142.

2. Khawaga AS. "Reduction in fruit cracking in Manfaluty pomegranate following a foliar application with paclobutrazol and zinc sulphate". *Journal of Applied Sciences Research* 3.9 (2007): 837-840.

3. Ahmed B. "Fruit cracking and yield of pomegranate as affected by borax with irrigation at different intervals". *Annals of Agricultural Research New Series* 30.3 (2009): 148-149.

4. Belsare CR. "Effect of plant bio-regulators and nutrients on yield, fruit cracking and quality in pomegranate (Punica granatum L.) cv. G-137". M. Sc. Thesis, University of Horticulture and Forestry, Nauni, Solan (2011).

5. Lal S., *et al.* "Effect of different chemicals on fruit cracking in pomegranate under karewa condition of Kashmir valley". *Indian Journal of Plant Physiology* 16.3 (2011): 326-330.

6. Sheikh MK and Manjula N. "Effect of chemicals on control of fruit cracking in pomegranate (Punica granatum L) var. Ganesh". Options Méditerranéennes, II International Symposium on the Pomegranate 103 (2012): 133-135.

7. Abubakar AR., *et al.* "Effect of plant biostimulants on fruit cracking and quality attributes of pomegranate cv. Kandhari kabuli". *Scientific Research and Essay* 8.44 (2013): 2171-2175.

8. Ahmed FF., *et al.* "Controlling fruit splitting and improving productivity of Manfalouty pomegranate trees by using salicylic acid and some nutrients". *World Rural Observations* 6.1 (2014): 87-93.

9. Wafa M. "Effect of bagging type on reducing pomegranate fruit disorders and quality improvement". *Egyptian Journal of Horticulture* 41.2 (2014): 263-278.

10. Kumar K., *et al.* "Effect of growth regulators and micronutrients on fruit cracking and fruit yield in pomegranate". *Indian Journal of Agricultural Research* 51.3 (2017): 272-276.

11. Kaur S. "Effect of micronutrients and plant growth regulators on fruit set, fruit retention, yield and quality attributes in litchi cv. Dehradun. Chemical Science Review and Letters 6.22 (2017): 982-986.

12. Singh SP., *et al.* "Improving fruit set, yield and fruit quality of litchi (Litchi chinensis cv. Rose Scented) through foliar spray of different concentrations of macro and micro nutrients". *International Journal of Chemical studies* 6.1 (2017): 2146-2150.

13. Sandhu S and Bal JS. "Quality improvement in lemon (Citrus limon (L) Burm) through integrated management of fruit cracking". *African Journal of Agricultural Research* 8.27 (2013): 3552-3557.

14. Khehra S and Bal JS. "Influence of foliar sprays on fruit cracking in lemon". *International Journal of Plant, Animal and Environmental sciences* 4.4 (2014): 124-128.

15. Bhatt BB., *et al.* "Effect of foliar application of bio-regulators and nutrients on growth and yield characters of lemon (Citrus limon Burma) cv. Pant lemon-1 under subtropical condition of garhwal region". *Plant Archives* 16.2 (2016): 821-825.

16. Saran PL and Kumar R. "Boron deficiency disorders in mango (Mangifera indica): field screening, nutrient composition and amelioration by boron application". *Indian Journal of Agricultural Sciences* 81.6 (2011): 506–510.

17. Saran PL., *et al.* "Fruit cracking in mango (Mangifera indica L) cv. 'Dashehari'". *Erwerbs-Obstbau* 5.2 (2014): 93-96.

18. Bhat AR., *et al.* "Effect of pre-harvest sprays of calcium and potassium on some quality characteristics of cherry 'cv' Makhmali". *Indian Journal of Horticultur*e 54.1 (1997): 19-24.

19. Costa G., *et al.* "Influence of growth regulators on apple fruit cracking cv. Stayman Red". *Acta Horticulture* 137 (1983): 366-369.

20. Evelin MA and Sathiamoorthy S. "Effect of packing treatments on green life and peel-split of banana cv. Rasthali (AAB)". *Indian Journal of Agricultural Research* 37.1 (2003): 72-75.

21. Ramteke SD., *et al.* "A study on impact of silixol (OSA) on berry cracking in fantasy seedless grapes". *International Journal of Agriculture Innovations and Research* 6.4 (2018): 46-47.

22. Rathore AC and Pal AK. "Pre-harvest fruit bagging improves fruit quality of mango in doon valley". *HortFlora Research Spectrum* 5.1 (2016): 84-85.

23. Sharma RR. "Fruit production: Problems and solutions". International Book Distributing Company, Lucknow, India (2007).

24. Singh MK., *et al.* "Effect of micronutrients and fungicide application on internal fruit necrosis, cracking and fruit drop in bael". *HortFlora Research Spectrum* 5.3 (2016): 258-260.

25. Yildirim AN and Koyuncu F. "The effect of gibberellic acid applications on the cracking rate and fruit quality in the '0900 Ziraat' sweet cherry cultivar". *African Journal of Biotechnology* 9.38 (2010): 6307-6311.

Volume 3 Issue 4 April 2019