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Phenomenon of fruit cracking, causes, and methods of control

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Abstract:

Fruit cracking is one of the most important main reasons that lead to serious economic losses due to damage to the fruits and increased susceptibility to fungal and bacterial infections ، Fruit cracking often results from sudden and rapid growth of the fruit. Phenomenon of fruit cracking is often linked to excessive irrigation of water and thus its rapid absorption by the plant. This phenomenon may occur due to changes in environmental conditions, such as changing from cold weather and high humidity to hot and dry weather. Many factors contribute to avoiding this phenomenon, including regular irrigation and balanced fertilization, especially with calcium, as well as planting crack-resistant varieties and using growth regulators and transpiration inhibitors to reduce this phenomenon.

Key Word: Fruit Cracking، Mineral Nutrition, Growth Regulators, Physiological Disorders.

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ظاهرة تشقق ثمار الفاكهة، أسبابها، وأساليب السيطرة عليها

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الملخص:

تشقق الثمار واحد من اهم الاسباب الرئيسية التي تؤدي الى خسائر اقتصادية جسيمة بسبب تلف الثمار وسهولة اصابتها بالأمراض الفطرية والبكتيرية وغالباً ما ينجم تشقق الثمار عن نمو مفاجئ وسريع للفاكهة، وكثير ما ترتبط هذه الظاهرة بالري المفرط للماء وبالتالي سرعة امتصاصه بواسطة النبات. وربما تحدث هذه الظاهرة بسبب التغيرات في الظروف البيئية مثل التغيير من طقس بارد والرطوبة العالية إلى طقس حار وجاف. وهناك العديد من العوامل تساهم في تجنب هذه الظاهرة منها الري المنتظم والتسميد المتوازن خصوصاً بالكالسيوم فضلا عن زراعة اصناف مقاومة للتشقق واستعمال منظمات النمو وموانع النتح للحد من هذه الظاهرة.

الكلمات المفتاحية: تكسير الثمار، التغذية المعدنية، منظمات النمو، الاضطرابات الفسيولوجية.

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Introduction :

Fruit cracking is a physiological disorder that affects both large and small fruits and occurs either longitudinally or accidental or in an oblique shape. Fruit cracking greatly affects productivity and quality of fruits, as marketing value of fruits decreases due to low quality, appearance poor, and short shelf life because it affects the appearance of fruits and increases water loss and susceptibility to infection by pathogens such as Aspergillus, Pencillium, etc.(Ramteke *et al*., 2017)

Especially during the storage period, cracking of the fruit reduces the yield of the trees, as the loss caused by cracking of the fruit is estimated at 50% of the marketing value of the yield (Kasiai *et al*., 2008; Khadivi-Khub, 2009; Clarke *et al*., 2010). Phenomenon of cracking has been described as a physiological deficiency or failure that occurs in the skin of the fruit and is in the form of cracks that appear in the epidermis and skin (the cuticle layer) does not reach to the flesh of fruit as in peach fruits. Cracking may occur during the stage of growth, development and maturity of the fruit, it causes decrease in the moisture content in the flesh of the fruit. Also, aging of the cells in the fruit peel causes a weakening of the cells' ability to absorb water, and as a result there is an increase in pressure on flesh of the fruit that exceeds the ability of the peel to bear it, which ultimately leads to fruit cracking. Fruits may also be exposed to this phenomenon during post-harvest period (Milad and Shacked, 1992; Opara, 1997; Lal *et al*., 2022).

Exposure of fruits to this physiological disease is due to many internal and external factors. Many studies have also indicated that there is a relationship between the characteristics of the fruit, represented by the shape, size, extent of hardness and strength of the peel, and skin characteristics, moisture content, stages of fruit growth, and the extent of fruit's susceptibility to cracking (Khadivi 2019). Also, this phenomenon is a quantitative trait controlled by many genes, which confirms that the reasons why fruits are exposed to this phenomenon are due to strategies, physiological and nutritional conditions, growth regulators, mechanical causes, field practices, and genetic factors (Rangare *et al*., 2023). Phenomenon of fruit cracking can be observed in many fruit crops such as apples, stone fruits, figs, grapes, pomegranates, citrus and other types of fruits.

Although this phenomenon has been studied since thirties century twenty, however, a physiological understanding of this phenomenon has not been achieved for many types of fruits, which led to the difficulty of making decisions to reduce the injury and exposure of fruits to cracking. It is difficult to study this phenomenon even under controlled conditions due to the lack of experimental methods to reduce the cracking phenomenon. Therefore, this scientific article focused on the mechanism of fruit cracking, its causes, and limiting its control.

Fruit crack patterns:

Fruit cracking occurs during growth, development and ripening phase of the fruit. Fruit cracking may be radial or transverse in nature. Basically, there are three different types of cracks in fruit crops, including (Milad and Shacked, 1992).

1. **Concenter Cracking**

It can be observed in form of circular rings around the shoulder of fruit, centered at neck of fruit. These cracks are often superficial and do not go very deep, as in fruits of cherries Prunus avium, and apples Malus domestica. (Khadivi-khub, 2015)

2. **Radical Cracking**

This type of crack is along the length, starting from the tip of the fruit connected to neck toward floral end, and often extends to middle, as in mango fruits Magifera. This type of crack is deep as it penetrates through skin of the fruit. (Kaur *et al.*, 2022)

3. **Side wall cracks**

They are in the form of zigzags that do not connect to neck of the fruit and are deep. This type appears on fully ripe fruits, as in pomegranate fruits. (Khadivi-khub, 2015)

Mechanism of crack formation in fruits:

Many studies have indicated that occurrence of crack arises from stomata at the distal and proximal ends of neck of fruit and from the lenticel area, and during stages of fruit growth, the crack develops, which facilitates the penetration of microorganisms into these cracks and their arrival into the flesh of the fruit, as in pomegranate fruits (Panwar *et al*., 1994).

Causes of cracked fruits and methods of controlling:

1. Climate changes:

Climate changes have a severe impact on food security, not only through global warming, but even through changing rainfall patterns that have caused major weather extremes (IPCC, 2019). Fischer and Melgarejo (2021) has shown that there is a causal relationship between rain and fruit cracking, as cracking is associated with a change in the water relations of the fruit, related to the moisture content of its surface. In addition, heavy rain can cause very watery fruits, as is the case with guava (Psidium guajava L.), with low sugar content, ascorbic acid and measurable acidity, making them more susceptible to cracking. There are other cases, including high levels of available water in the soil, as cracking is closely linked to two other factors, high relative humidity (RH) and low air temperature, which are conditions that reduce fruit transpiration, as the imbalance of soil and air moisture contributes to severe cracking, i.e. factors that have a significant impact on fruit growth and development (Ikram *et al*, 2020). Impact of climate change on fruit trees may be greater in tropical and subtropical regions due to rising temperatures affecting marginal or degraded lands (Yohannes, 2016). Thus, global warming will affect farmers, especially those who depend for their agriculture on rainfall.

Climate changes, such as imbalance of humidity between inner surroundings of the fruits and outer surroundings, as well as rise in temperatures and thus the increase in water loss, transpiration and evaporation, as well as dry winds, rain and other environmental factors are among the external causes that lead to the fruits being exposed to cracking, as cracked fruits lose their commercial value in the markets. It cannot be sold domestically or exported (Clarke *et al*., 2010).

For example, company exporting Alkekeng fruits returns at least 20% of the fruits due to cracking. In times of heavy and prolonged rain, exporters can reject up to 50% of Alkekeng fruits due to cracking (Fischer, 2005).This physiological disorder occurs due to many environmental factors, including soil moisture fluctuation, as well as lack of nutrients, sunstroke, injuries, and pathogens on skin of fruits, all of which were causes of fruit cracking, which has become a source of concern for many countries (Ramteke *et al*., 2017, Fischer and guez-Orduz-Rdr, 2012).

Many studies conducted on apple trees have indicated greater cracking of the fruit as a result of a decrease in possibility of formation or a change in the composition of skin and high relative humidity, which reduces water loss through the fruit. Deep division occurs as a result of observed transpiration for 6 hours or more (Opera *et al*., 1997). On the other hand, Fischer (2005) reported effect low night temperatures in combination with high (Relative humidity), which generates high pressure inside the fruit and thus cracks the skin, especially during long periods of relative humidity between 99% and 100%, alone or combination with Rainfall water (Fischer, 2005 and Fischer *et al*., 2012), In addition, cracking increases more when sudden changes occur between day and night temperatures (Miranda, 2020). The plant's ability to adapt to the environment determines success of its growth, and choosing appropriate varieties is one of things that must be taken into consideration when establishing and cultivating fruit orchards.

2. Irrigation:

Studies have indicated that irregular irrigation leads to the fruits being affected by this physiological disease (fruit cracking). El-Rhman (2010) showed a decrease in rate of cracking by 8-10% when using regular

irrigation during growth and development of fruits. Dry conditions cause the fruits to crack, as 25% of soil moisture must be maintained during summer. If water is abundant in the soil cracking occurs very frequently in combination with two other factors: high relative humidity (RH), low air temperature, and conditions that reduce Fruit transpiration, as in pomegranate fruits Environmental factors, including an imbalance of soil and air moisture, contribute to severe cracking of fruits (Fischer, 2005; Ikram *et al*., 2020; Bahram *et al*., 2022). Water causes a change in water relations of the fruits with moisture of surface of the fruit. It also causes a decrease in sugars, ascorbic acid, and titratable acidity, which makes them more susceptible to cracking, as in guava fruits. Studies have indicated that availability of sufficient moisture, especially during the growth and development of fruits, is essential because humidity has a direct relationship with growth of fruits and thickness of peel. It has been noted that dry conditions lead to thickness and hardness of peel, which enhances cracking of the fruit. It has also been noted that maintaining soil moisture at 25% during summer season reduced exposure of fruits to cracking (Sheikh and Manjula, 2012) To achieve this, it is preferable to follow field practices such as drip irrigation and mulching with organic and inorganic sources, as well as regular fertilization, as all of them lead to maintaining soil moisture and thus reducing evaporation processes and protecting soil from heat and sunlight (El-Rhman, 2010; Fischer and Melgarejo ,2021;Samra and Khalil, 2014). Water balance of fruit trees is linked to several factors that can generate cracks, including environmental factors such as: Change in soil moisture, Heavy rainy season, Water stress at the beginning of fruit growth, High relative humidity, Difference between day and night temperatures, High temperatures. Therefore, irrigation operations must be organized to maintain soil moisture, reduce evaporation, and protect soil from sunlight.

3. Plant nutrition:

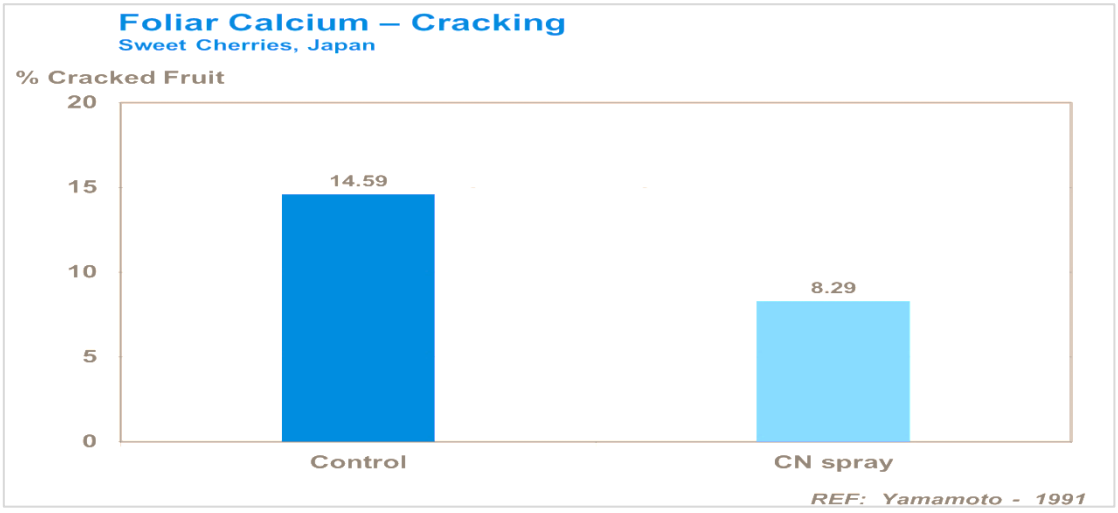
Nutrient elements have an important role in the growth and development of fruits (Jubeir and Ahmed, a2019 and b 2019), as Parvizi and Sepashah (2015) indicated that NPK fertilizer had a significant impact on growth and development of pomegranate fruits. Hepaksoy *et al.* (1997) arrived that nitrogen has the most significant effect on fruit cracking; increasing level of nitrogen favors fruit splitting because leaf and peel nitrogen level are directly correlated. Potassium and calcium ratio in leaves have effect on leaf physiology and functioning. The increasing level of leaf calcium and decreasing level of potassium has effect on leaf succulence and gas exchange properties, ultimately on fruit cracking incidence as varieties with highest leaf succulence and water use efficiency are less prone to fruit cracking..Torshiz and others (2017) also showed role of organic fertilizers in improving quality of fruits, as use of organic fertilizers led to a decrease in the rate of cracking in fruits , Fruit cracking is mainly caused by a lack of mineral nutrients(Khadivi, 2015). Confirm Calcium is one of the most important elements for fruit quality. (Ranty *et al*,2016 and Yu *et al*.2020) lemons (Devi et al .2018), litchis (Martínez *et al*,2017) figs (Aydin and Kaptan,2015) and many other fruit crops Calcium is considered essential for many basic functions in plant physiology, due to its essential role in the structural integrity and stability of cell walls and middle lamellae. Calcium acts as a bridge between pectin molecules and improves the integrity of cell membranes through phospholipid bonds. In addition, it acts as a secondary messenger in stress signaling processes Hepaksoy *et al*. (1997) mentioned role of nitrogen in reducing rate of fruit cracking, in addition to role of potassium and calcium. Mir and others (2012) mentioned that a lack of boron may be a cause of fruits being susceptible to cracking, and this is what Manjuia and Sheikh (2012) indicated when studying effect boron, iron, and calcium in pomegranate fruits. They noted role of these nutrients in reducing rate of cracking in the fruits.

In fruit trees, calcium is one of most important nutrients that determine fruit quality (Conway, Sams and Hickey, 2002). The calcium content in berries should not increase after maturity due to decreased calcium movement in bark and xylem, and decreased transpiration rate in the fruits (Rogiers *et al*, 2006; Rogiers *et al*, 2006; Knipfer *et al.*, 2015) fruit quality, it is necessary to provide calcium during the ripening stage. This is what was indicated by (Erogul, 2014; Michailidis *et al*,., 2017; Davarpanah *et al*,., 2018; Chen. *et al*,., 2014; Wen and Shi, 2012 ; Jubeir *et al*,.,2023) The rate of quantity per tree varies according to the size of the

tree on the one hand and its productivity on the other han Example: If a tree produces 80 kg of fruits / year, it requires 5-7 pounds / batch, If a tree produces 200 kg of fruits / year, it requires 6-8 pounds / batch. When they studied different types of fruit trees such as sweet cherry, pomegranate, and navel orange, respectively.
Calcium reduces occurrence of cracking, as fruits that contain high levels of calcium and boron in their peel are characterized by greater hardness, stronger cell walls, and are less susceptible to cracking. Pre-harvest nutrient spraying will also improve osmotic gradient across fruit peel, reducing water flow to the fruit. Spraying with calcium increased calcium content of fruits and helped reduce cracking in sweet cherries and peaches (Yamamoto, 1991). As found by Davarpanah *et al*. (2018) Reduced cracking rate of pomegranate fruits by use of calcium chloride and calcium nanoparticles، Nano Ca Followed by foliar spraying with calcium chloride has the greatest effect in combating fruit cracking.

4. Growth regulators:

Growth organizations have an important role in improving growth and productivity, as they are an important standard for modern procedures in managing field practices. Ghosh and others (2009) indicated the effective role of NAA in fruits setting and improving productivity. Rawat and V.K. (2024) indicated that adding NAA

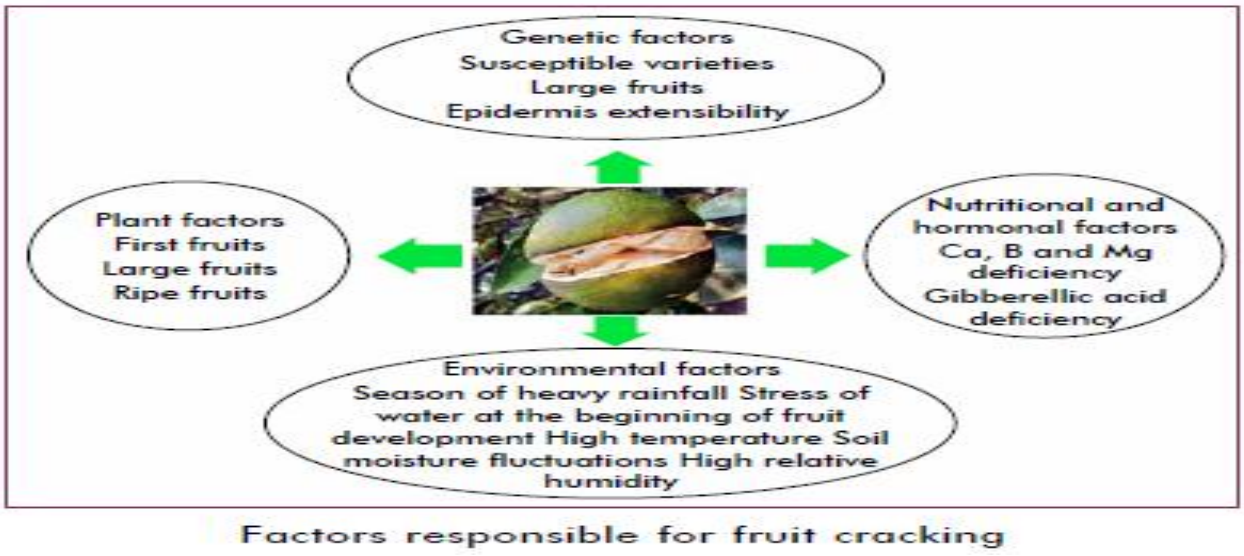


affects fruit cracking it have increased the osmotic pressure of the cell sap, leading to water uptake and a reduction in fruit cracking percentage, also The cellulose, hemicellulose, and pectin contribute to cell enlargement by decreasing the wall pH, so that wall loosening and growth occur auxin has been found to cause cell wall plasticization. This physiological effect of auxin may therefore reduce the cracking of fruit . Khalil and Aly (2013) also noted role of pacloprotrazol. In reducing rate of cracking، It was found that the effect of high rates of paclobutrazol in significantly inhibiting vegetative growth, especially during the peak stage of fruit growth, contributed to increasing yield (Yeshitela ,2004). Sharma and Balsare (2011) indicated role of NAA, GA3, and CPPU in reducing phenomenon of cracking in fruits, as the growth regulator CPPU had the most effective in controlling this phenomenon, also use of synthetic auxins reduced cracking in citrus fruits due to increased peel thickness, In pomegranate, application of 5 mg L-1 of forchlorfenuron (CPPU), a cytokinin, significantly reduced cracking (Sahu and Sharma, 2019), as did applications of paclobutrazol (an anti-gibberellin compound) (Khalil and Aly, 2013). Amézquita et al. (2008) found that applications of 10 mg L^{-1} of GA3 resulted in the lowest cracking in gooseberries Results of various investigations indicate that GA3 can increase cell wall flexibility and subsequent fruit rind extension, so that can be used practically to reduce the occurrence of fruit cracking in many fruit crop (Ozturk et al., 2018). Although CPPU acts similarly to cytokinins and increases fruit size, it is also effective in increasing pericarp thickness and fruit

firmness, as reported in grapes (Zoffoli *et al*, 2009). (Antognozzi *et al*.,1996) also reported that Forchlorfenuron (CPPU) stimulated cell division and growth in Hayward kiwifruit by increasing the number and size of cells in both the outer and inner shells. Subsequently,(Zofolli *et al*., 2009) reported that Forchlorfenuron (CPPU) was effective in increasing stem thickness and epidermal content in table grapes. Furthermore, application of Forchlorfenuron (CPPU) enlarged the cell layer and increased the number of cells in the outer shell, regardless of whether Murcott fruit was dehiscent. This supports the finding that Hongyang kiwifruit treated with Forchlorfenuron (CPPU) had more subepidermal cells and cell layers (Wu *et al*,., 2020)

5. Physiological factors:

vulnerability of fruits to cracking is due to the weakness of anatomical structure of ovary wall, epidermis and cuticle area, the physiological age of fruit, and its sugar content. Paull (1996) Suggested that cracking commonly occurs during postharvest because of changes in osmotic and subsequent turgor, which are related to the production of neutral sugars during ripening, which leads to the movement of water from the skin and receptacle to the Flesh. Previous studies have revealed that starch degradation induces changes in fruit turgor, and fruit softening and cracking are closely related; however, these were mainly observed at the physiological level. Level, the transformation of starch to soluble Sugars may be one of the most important processes in fruit softening and cracking. It has been observed that cracking in flattened citrus fruits is greater than in regular fruits, as a result of lack of thickness of peel in the center of fruit, which makes it more susceptible to cracking.



Factors responsible for fruit cracking

Komal.P.K. & Monika (2023)

Also, the water stress of fruits is one of reasons that results in fruits cracking, so cell wall and structure of fruit must withstand this pressure (Lichter *et al*,., 2002; Jubeir *et al*,., 2023; Khalil, 2023). Biomechanical properties of the skin play a crucial role in preserving fruits from internal pressure and resisting fruit cracking (Saei *et al*, 2014). Knoche (2015) stated that one of the important causes of cracking is rapid absorption of water by trees, which can be generated through direct absorption from the fruit peel or absorption through plant's vascular system. As happens in berries and Alkekeng fruits, the high water

content and high concentration of dissolved substances lead to high pressure on the fruit's skin. This is what the fruit peel cannot resist, and thus fruits crack (Fischer and Melgarejo, 2020; Peet, 2009), and this condition increases if there are few fruits on the plant (Gordillo *et al*. 2004). This problem also arises in the post-harvest stage when treating Alkekeng fruits, for example, by immersing them in water to cool and disinfect fruits, which limits use of these techniques after harvest.

6. Genetic factors:

The susceptibility of fruits to cracking may be due to several genetic factors, as it shows the extent of resistance of many fruit crops to this phenomenon, and the susceptibility varies according to varieties. It was found that late-maturing genotypes are more susceptible to infection compared to early-maturing or medium-maturing varieties, Genes are directly responsible for cracking in fruits, which is why studies have indicated conducting genetic engineering experiments to develop crack-resistant varieties (Yong et al., 2006). Were able to identify two related genes responsible for fruit cracking, as they have been identified in sweet cherry fruits and many other fruit crops (Alkio et al,., 2012). It was also shown that the cell wall-related genes in litchi, analysis of XET1, XET2, and in the envelope while the accumulation of XET2 transcripts was enhanced and XET3 in litchi aryl tissues, suggesting that they may play different roles in litchi aryl and pericarp growth, thus, XET1 is more likely to play a role in reducing litchi fruit cracking compared with XET2 and XET3 (Lu et al,., 2006). Ali (2013) explained that the factor of the period after complete flowering is the increase in the number of cells per mm2 is due to the occurrence of rapid cell divisions immediately after contraction, but the number of cells decreases in The unit of area as the fruits advance towards the maturity stage due to their increasing size and elongation as a result of their continuous access to manufactured nutrients and water. As well as early selection of fruits, as early picking of fruits is a remedial measure to overcome cracking. This does not allow for over ripeness that causes cracking of the fruit, which is one of Measures taken to control fruit cracking (alfalfa, 2022).

Patterns and physiological cracking of some types of fruit:

Cracking or splitting may be described in several ways, but it is clear that the word cracking is common in most types of fruit. An example of this is pomegranate. Once ripe fruits crack, they can be exposed to some fungal and bacterial infections and thus lose their marketing value (Singh, 1995 and Panwar *et al*,., 1994). As it is known, cracking pomegranate fruits is a general problem in all growing areas, and extent of the problem depends on climatic conditions, genetic factors, and diversity. The cracking of pomegranate fruits is due to an imbalance in moisture, as it is considered one of the fruits that is very sensitive to changes in soil moisture, relative humidity, and transpiration rate (Mir *et al*,., 2012). The change in soil moisture negatively affects the growth of fruits and thus leads to cracking of the fruits, in addition to the rapid absorption of water when irrigating stressed fruits, as this leads to cracking and thus the skin of the fruit is exposed to great pressure. This is actually attributed to an increase in the growth of kernels above rate of growth of the peel, which resulted in Extreme pressure leads to splitting. Thin-skinned varieties are more susceptible to this phenomenon, cracking occurs as a result of a lack of water and some nutrients such as calcium and boron in the cell walls, which leads to collapse of the basic tissue of peel and thus cracking of fruits (Lichter *et al*,., 2002). We also notice the phenomenon of cracking in citrus fruits, as recent studies have indicated that wrinkling or cracking of citrus fruits is not due to genetic factors only, but rather to environmental factors, the variety, the nature of the roots, the thickness and hardness of the peel, as well as growth regulators (Agusit *et al*,., 2003; Majeed and Al-Dahan, 2021; Al-Muhanna, 2023). Cracking occurs in fruits of citrus varieties during cell enlargement or ripening period, and it can appear throughout the period of the fruit's growth and development. Cracking varies according to the varieties and stages of fruit growth. There are three patterns of cracking that can be observed in citrus fruits, which are the division of Flavedo layer, division of inner layer, and division of Albedo layer. An example of this is Flavedo layer cleavage in navel orange (Jincheng) fruits Flavedo cuticle begins to split, followed gradual deformation and collapse from the

outside inward, reaching Albedo layer (Wang and Qin, 1987). The other type of cracking is an internal crack that starts from the central axis of fruit all way to top (Wu *et al*,., 1987), while the third type is the wrinkling of the fruit, as the fruit begins to wrinkle, as in sweet oranges (Zou, 2008). Phenomenon of cracking has also been observed in fig fruits, which are soft fruits with a thin skin and are highly susceptible to lateral cracking of peel during growth and development stage, and these damages are related to genotype and pregnancy conditions (Condit, 1947; Crisosto *et al*,., 2011). Cracking in fig fruits is described as split or cracking in epidermis or skin and usually does not penetrate flesh, meaning that split is in an extreme form that penetrates the skin (Opera *et al*,., 1997). It has been noted that figs harvested between two stages of maturity are more susceptible to deterioration than other crops because they contain easily damaged skin and a high sugar content (Turk, 1989 and Kaynak *et al*,., 1998). This explains that fruit cracking is not an explosion, but rather a gradual process that can be divided into the period natural growth of the fruit, the critical period for cracking, initial period, intermediate stage, and subsequent stage.

Varieties vary in their resistance to cracking:

The resistance of varieties to cracking was linked to a decrease in stress factors in the outer cell layers, according to measurements conducted by (Yamamoto *et al*,., 1990 and 1996) when studying resistance of 82 varieties to phenomenon of cracking over a period of four years. This phenomenon was reviewed by Opara *et al*. (1997) and Christensea (1972b) also showed that varieties with a high level of sugar are more susceptible to cracking than varieties with a low content, but effect of sugar was not found in resistant varieties. This was interpreted in 1976 to indicate that the ability of varieties to resist phenomenon of cracking may be affected only slightly. By osmotic concentration of the fruits, size of the fruits, as well as size of the stomata, and the quantity and quality of colloids in the cells. It may also explain the reason why varieties differ in their resistance to the phenomenon of cracking and water absorption, and this is a partial explanation for resistance of varieties, as the possible explanation is the variety's differences in the size of the air-filled spaces between the cells, which allows water to be absorbed without increasing size of the fruits. This can be determined by measuring the percentage Water absorption leads to an increase in fruit size for resistant and susceptible varieties. Fruits of varieties with weakly attach to each other cells may crack at lower pressure than those with strongly adherent cells without cell adhesion, which is determined by the covalent attachment of non-cellulosic sugars to cellulosic microfibrils, pectin, and related bonds that include cin-namicacials (Herdia *et al*,., 1995; Carpita and Gibeaut, 1993; Ralph *et al*,., 1995). Decrease in cracking can also be explained by a direct decrease in the rate of water absorption resulting from an increase in osmotic concentration of water in contact with the treated fruits (Christensea, 1976).

Horticultural practices:

There are many field practices used to reduce phenomenon of cracking, including yield thinning and treatment with growth regulators such as gibberellins, Sharma and Balsare (2011). In addition to use potassium and calcium, as no single practice can reduce this phenomenon. One of the most important practices followed to control the phenomenon of fruit cracking is spraying with potassium nitrate and 2.4-D at the end full flowering stage or spraying with 0.4% borax twice and at intervals during the fruit development stage. While maintaining air humidity at 70-75% and soil moisture level at 60-70%. In addition to treatment with 0.2% boron, all of these are practices and procedures through which phenomenon of fruit cracking can be controlled and reduced. Manjuia and Sheikh (2012). The relative humidity rises during the night in the winter months when temperatures drop below 10°C, and given the ability of the fruit peel to absorb water falling or condensing on it, especially dew drops, and the high concentration of juice in the fruit, this allows water to penetrate into the fruit as well. Moreover, continuous irrigation is required during the winter period due to the scarcity of rain in the region and the low night temperature Also, this leads to a decrease in the rate of transpiration of the leaf and an increase in the flow of water to the fruit. This results in

a noticeable increase in the rate of swelling pressure of the fruit and an increase in the tension on the peel. Consequently, swelling occurs in the cells filled with very large amounts of cell juice, which presses on the peel of the fruit, pushing it to outside, causing fruits crack (ali, 2013).
Regular irrigation, improving drainage in heavy lands, and planting crack-resistant varieties, as well as taking care of service operations to give good vegetative growth, help to shade fruits and thus reduce cracking, especially at high temperatures. The phenomenon of cracking can also be reduced by maintaining water balance of the trees, especially in the Fruits stage , in addition to spraying trees with anti-transpiration materials to maintain their moisture content (El-Rhman, 2010 and Samra and Khalil, 2014). And also, organizing fertilization processes, providing nutrients, especially calcium and boron, and spraying with growth regulators such as gibberellin and auxin are all ways to reduce and limit phenomenon of cracking (Yamamoto, 1991).

Conclusion:
The phenomenon of cracking in fruits is a very complex phenomenon because mechanisms and influencing factors related to this phenomenon are still uncertain, as studies and research results have shown relationship between cell wall metabolism and biochemical modification of peel occurrence of cracking in fruits provides a stronger theoretical basis for preventing occurrence phenomenon of cracking by encouraging study mechanical properties of the peel and study cellular metabolism at the molecular level and changes in the infrastructure between natural peel and wrinkled fruit peel of various types of fruit taking into account food treatments and plant growth regulators, as well as clarifying the mechanisms of fruit wrinkling and cracking.

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