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Managing physiological disorders in arid fruits

Physiological disorders are mainly caused by changing environmental conditions such as temperature, moisture, unbalanced soil nutrients, inadequate or excess of certain soil minerals, extremes of soil pH and poor drainage. At present, the climatic scenario of arid region is also changing and the problems like frost, temperature and moisture fluctuation, high evaporation and low precipitation as well as nutrient imbalances are becoming a challenge for cultivation of many arid fruit crops. In this article we have discussed the problems associated with ber, pomegranate, aonla, date palm and bael especially physiological disorders which will certainly help the farmers in timely overcoming these maladies for getting satisfactory remunerative prices from arid fruit crops under hot ecosystem of western Rajasthan.

Physiological disorder of fruit crops mainly occurs in western Rajasthan condition due to unfavourable environmental conditions as well as improper cultural practices, which affect the plant growth and development; this mechanism is called physiological disorders. The physiological disorders are most important non-pathological problems faced by present day fruit growers which are the results of dysfunction or malfunction of the physiological processes of the fruit tissues due to abiotic stresses like temperature, relative humidity, moisture/water stress, chemicals, nutrient excesses and deficiencies. The productivity as well as the quality of fruits is affected to a greater extent due to the physiological and nutritional disorders.

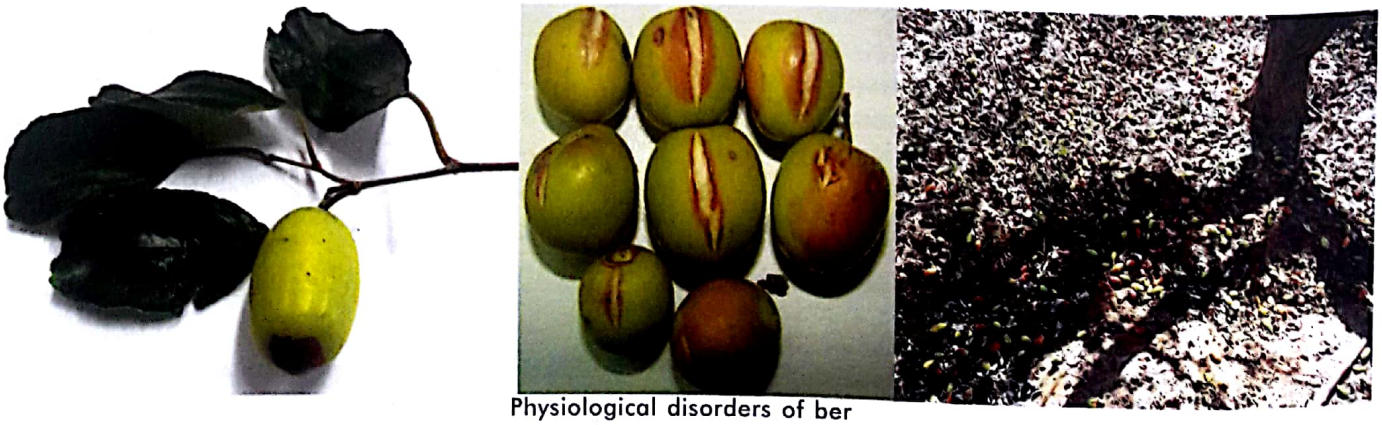
BER

Stylar-end Browning

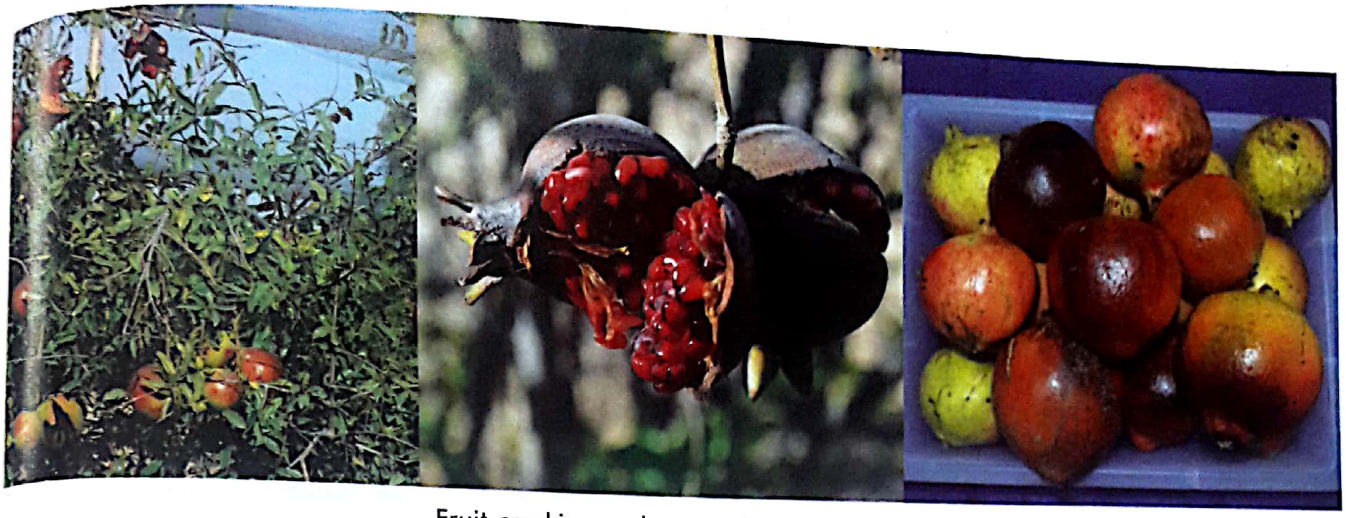
It was identified in ber (*Ziziphus mauritiana* Lamk.) cv. Chhuhara, wherein tip (stylar end) of the ber fruits turned brown. It was found to aggravate with the progress in maturity. The affected fruits contain less soluble solids, reducing, total sugars and ascorbic acid; besides higher content of secondary metabolites and enzymes responsible for oxidative browning. This disorder was found to occur under high boron accumulation conditions, which was triggered by high temperature, coupled with high illumination and evapo-transpiration.

Fruit Cracking

The causes of fruit cracking in arid condition may be due to soil moisture imbalance, low relative humidity and fluctuation in day and night temperature as well as nutrient deficiency at the time of fruit development and ripening stage. This disorder is characterized by cracks developed after a rain on the skin of the fruits, sometimes deep into the flesh, affecting the stem end area, the calyx end and the cheeks of the fruit (side cracks). Cracking in ber can be minimized by spray of Gibberellins @ 20 ppm, 2, 4-D, NAA at concentrations 20 ppm or 20 mg per litre and Boric acid @ 2g/l at the initial stage of flesh development reduces the activity of cellulose and reduced cracking. Use of organic manures and irrigated regularly during the entire fruit development stage by conserving soil moisture through mulching, straw, black polythene sheet etc.



Physiological disorders of ber



Fruit cracking and sun scald in pomegrante

Fruit Drop

Heavy fruit drop occurs at early stage of fruit development i.e. during second fortnight of December. Many reasons such as hormonal imbalance, abortion of embryo and inclement weather have been ascribed to immature drop of fruits in ber. The highest fruit drop is in cv. Banarasi Pewandi as compared to Thornless and Banarasi Karaka. Single spray of 10-20 ppm Naphthalene acetic acid (NAA) in mid- October shall be sufficient to control fruit drop.

POMEGRANATE

Fruit Cracking

It is a most serious physiological disorder which hinders its cultivation to a great extent. In young fruits it may be due to boron deficiency but fully grown fruit crack due to moisture imbalances or due to extreme variations in day and night temperature. Prolonged drought causes hardening of peel and if this is followed by heavy irrigation then the pulp grows and the peel cracks and if harvesting of the mature fruit is delayed for long time or there is attack of insect pests it leads to cracking. This problem can be overcome by maintaining soil moisture and cultivation of tolerant varieties. The water retention capacity of the plants should be increased by the use of organic manures. The plants should be irrigated regularly during the entire fruit development stage. Early harvesting and spray of calcium hydroxide on leaves and on fruit set reduces the incidence of fruit cracking. Foliar application of boron reduced the extent of fruit cracking in pomegranate. GA is used for improving fruit set and also to control cracking in various fruits including pomegranate. Application of GA_3 @ 40 ppm in pomegranate reduced fruit cracking. Some varieties like Sur-Anar, Francis, Shirvan, Krasnyl etc., were reported to be tolerant to cracking.

Sun Scald

Surface skin of fruits facing afternoon sun turns brownish black due to scorching while underneath skin is normal. To avoid this disorder proper canopy architecture should be developed which prevent the direct exposure of fruits to sunlight. Spraying of kaolin during the hot summer months is useful in reducing sunscald. First spray of 5% and subsequently 1 or 2 additional spray with kaolin @ 2.5% at 15 days interval reduce sunscald. Bagging the fruits with butter paper covers is useful in minimizing fruit spoilage due to sunscald. White colour bags are more effective in reflecting sunlight and protecting the growing fruits.

Internal Breakdown

It is another serious disorder in pomegranate which leads to 50-60% loss. This disorder mostly occurs in ambe bahar. Softening of fruits occur 90 days after anthesis and fruits become creamy-browny to dark blackish-brown from outerside and became severe, if matured fruits retain on the plants for 140 days onwards. So, to avoid this disorder 130-135 days old fruits should be harvested.

Aril Browning

Aril browning or internal breakdown of arils in pomegranate critically affect fruit quality in some commonly grown cultivars such as Ganesh and Bhagwa. Aril breakdown or browning is

Aril browning and internal breakdown

Internal necrosis

characterized by soft, light creamy, brown, dark blackish or brown and slightly flattened arils which are deformed and possess an unpleasant odour when the fruit is cut open. This disorder is accompanied by desiccation, wrinkling and development of internal spaces in the arils. Experimental studies indicated that the juice and seed content of affected fruits have reduced level of TSS, acidity, ascorbic acid, reducing sugars, calcium, phosphorus and enzyme catalase, and increased level of non-reducing sugars, starch, tannins, nitrogen, potassium, magnesium, boron and enzyme polyphenol oxidase compared to healthy fruits. Studies have shown that the malady is influenced by diverse factors such as genetic background, pruning, growing season, fruit size, harvested date and variety. It can be managed by harvesting at proper maturity period.

AONLA

Internal Necrosis

This is the main disorder of aonla in sodic soil which is deficient in micro nutrients (mostly 'B'). It is mainly nutrient related disorder however some newly developed cultivars are comparatively free from this disorder. Francis cultivar is severely affected with this malady. Evaluation of aonla cultivars (NA-6, NA-7, NA-10, Kanchan and Chakaiya) at NDUAT, Faizabad found to exhibit higher productivity and fruits are free from necrosis indicating their suitability for fruit processing. Cultivar 'Francis' and 'NA-9' are most affected by necrosis. Necrosis is a micro nutrient deficiency related disorder. Combined spray of zinc sulphate (0.4%) + copper sulphate (0.4%) and borax (0.4%) during September-October has been found effective. Spray of 0.5 to 0.6% borax in the month of September-October. Resistant Cv. 'Chakaiya', 'NA-6' & 'NA-7' should be planted in the orchard for avoidance of this disorder.

Off-season Flowering

Off season flowering is also a serious problem in aonla production. An economical loss of 30 to 40% due to off season flowering in aonla was estimated. The main reason of this disorder may be global warming or due to some alteration in the tree physiology due to externally governed internal mechanism which leads to absence of distinct phase of dormancy after fruit harvest. Plant comes in partial flowering with predominance of male flower which do not set fruit, exhaust the plant and disturb the physiology and forcing the plant to enter in dormancy by spraying 10% urea after fruit harvest. Restricting soil moisture build up near root zone can lead plant to enter into dormancy.

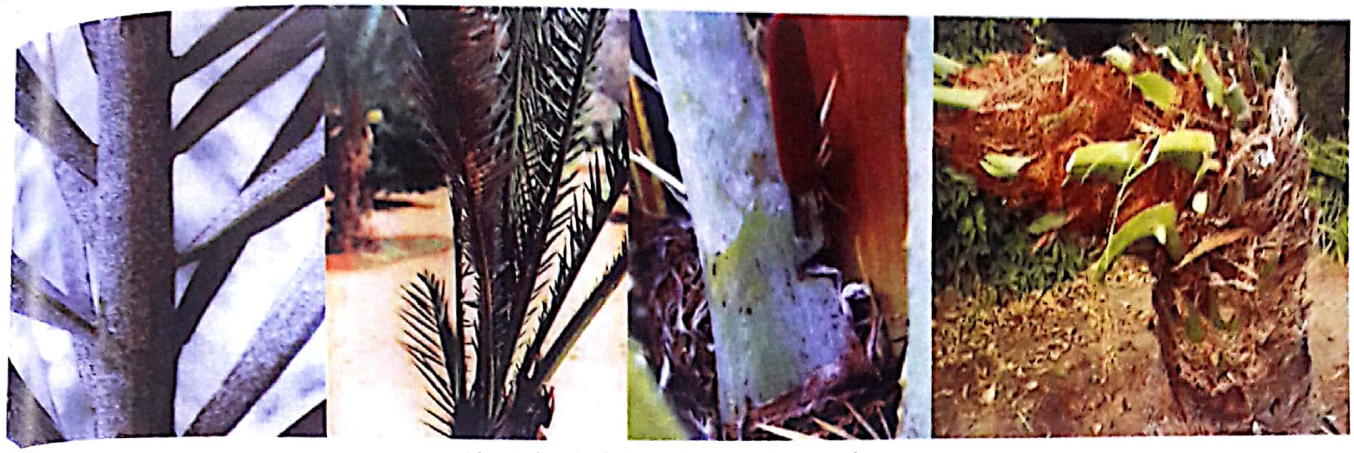
DATE PALM

Black Nose

Black nose refers to abnormally shriveled and darkened tip of a date palm fruits. Deglet Nour and Hayani seem to be the most susceptible varieties to this physiological disorder. Black nose results from excessive checking of the epidermis, especially in the form of numerous small, transverse checks or breaks at the stylar end of the fruit. Pronounced shriveling and darkening occur in proportion to the abundance of the checks and are related to humid weather at the Khalaal stage. The checking is induced by high humidity and rainfall, it can be measured to avoid conditions that increase environment humidity. The conditions to be avoided include excessive soil moisture and the presence of intercrops and weeds, especially at the susceptible stage of fruit development. This problem can be managed by bagging of fruits in brown paper. Over thinning can also increase the incidence of checking and subsequent development of black nose.

Crosscuts (V-Cuts)

Crosscuts are a physiological disorder of fruit stalks and fronds. It consists of a slight to deep notch, similar to a cut artificially done by a knife. Fruits borne on strands in line with the break wither and fail to mature properly. Crosscuts result from an anatomical defect in the fruit stalks and fronds involving internal, sterile cavities leading to mechanical breaks during elongation of the stalk or



Physiological disorders in date palm

the fronds. Crosscuts are commonly found in varieties having crowded leaf bases like Sayer and Khadrawy. Control measures is not to use such plants for propagation.

White Nose

White nose disease is commonly found in Iraq. Dry and prolonged wind in the early Rutab stage causes rapid maturation and desiccation of the fruit resulting in whitish drying at the calyx end of the fruit. The affected fruit becomes very dry, hard and has high sugar content. Hydration may correct this condition in harvested fruits.

Barhee Disorder

Barhee disorder is characterized by an unusual bending of the crown of Barhee and Dayri date palm varieties. The disease was first reported in California (USA) and later in Al Basra (Iraq). Affected palms were found to bend mostly to the south and sometimes to the south-west. This phenomenon is severe and bending could reach an angle of about 90. The growers are correcting this situation by fixing a heavy iron bar to the opposite side of the bending; fruit bunches from the opposite side are tied to this bar in order to move the actual weight against the bending side. It seems that within 2 to 3 years, the bending is corrected. Bunch handling is also proposed to correct such an abnormality.

Black Scald

Black scald, different from black nose, is a minor disorder of unknown cause occurring in the United States. It consists of a blackened and sunken area with a definite line of demarcation. The disease usually appears on the tip or the sides of the fruit, and affected tissues have a bitter taste. The appearance of the disorder suggests exposure to high temperature, but the exact cause is not definitely known.

Bastard Offshoot

This is a deformed growth of date palm vegetative buds especially of offshoots fronds. The bastard condition is due to infestation by the date palm bud mite *Makiella phoenicis* K. It may also be due to reduction in growth caused by an inequilibrium of growth regulators.

Frost Damage

The date palm resists large temperature variations (-5 to 50°C) with a growth optimum between 32 and 38°C and a zero of vegetation of about 7°C. The vegetative activity will also decrease above 40°C and ceases around 45°C. When temperature falls below 0°C, it causes serious metabolic disorders with some injury to date palm leaves characterized by a partial or total desiccation. Water of protoplasma freezes after coming out from the cells during defrost, water invaded inter-cellular spaces and affected leaves turn brown and desiccated.

The most practical and available protection for the date growers is to turn on the water and keep the date plantation wet when the temperature begins to get low enough (-5°C and below). A date plantation just irrigated or being irrigated when the temperature falls, has some heat stored, which gives protection.

Lack or Excess of Water

The growth of the date palm is highly affected by variations in water availability and the water content of the soil. A decrease in yield or complete failure in fruit production could result from these water variations. To compensate for high evapotranspiration, the date palm requires a quantity of water from 1,500 to 2,800 mm/year. Prolonged water stress will significantly decrease growth and yield, and if the drought continues for several years, date palm can dry up and die.

On the other hand, when the water table is high and drainage is inadequate and/or the leaching and transport of soluble salts is not complete, high evaporation rates tend to increase the concentration of salts in soil and in surface water. However, there are limits of salt tolerance and the date palm will not grow when soluble salt of the soil is above 6%. Although date palms are resistant to flooding, healthy growth of palms requires a well-drained soil, and it is clear that irrigation must always go hand in hand with drainage.

Cracking and fruit drop in bael

BAEL

Fruit Cracking

Fruit cracking is an important physiological disorder found in some commercial cultivars throughout the growth and development period of fruit. Spray of growth regulators also help to reduce the ill effect of hormonal imbalances. From the review, it is clear that physiological disorders have become menace in many fruit crops resulting in huge losses to growers. There is a need for long-term quantitative documentation of tree phonological patterns in diverse climatic zones of India. Recent advances in physiology and genetics may help solve problems of perennial fruit tree production. Though molecular biology have greatly improved our understanding of plant responses to stresses in many important commercial horticultural crops, a lack of transcriptomic and genomic information hinders our understanding of the molecular mechanisms underlying fruit-set and fruit development. There is need for exhaustive studies to know the precise physiological significance of radiation effect in climatic fastidious fruit crops. Intelligent anticipatory management strategies and adaptation will be the critical components for successful and sustainable quality fruit production. Management aspects may include biophysical treatments including reclamation of deficiency and excess of nutrient elements by proper fertility status maintenance, timely agronomical operations and input application. Location specific management strategies for important perennial fruit crops will require focused attention through multidisciplinary approach including adaptation and management.

Fruit Drop

Fruit drop in Bael occurs due to embryo abortion, physiological imbalances, fruit borer attack, fruit rotting and fruit cracking. Fruit drop was recorded high in month of July in all varieties which continued till harvest and again showed the peak in the month February. Although, the crossing between Pant Shivani × Pant Sujata and spray of NAA 20 ppm reduced the fruit drop percentage but the spray of Borax @ 1.0% was found most effective in reducing the fruit drop and increasing the physicochemical characters of fruits.

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– Editor