

## Physiological Disorders in Fruit Crops

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**Abstract**— Physiological disorders mainly affect deciduous tree fruits, such as apples, pears and most citrus fruits. Most of these disorders affect discrete areas of tissue, whether the produce be fruits. Thus, physiological disorder may be defined as the abnormal growth pattern or abnormal external or internal conditions of fruits caused by adverse environmental conditions (such as deviation from normal state of temperature, light, moisture, nutrient, harmful gases and inadequate supply of growth regulators).

**Key words:** Fruit Crop, Physiological Disorder

### I. PAPAYA



Fig. 1: Papaya

#### A. Skin Freckles

##### 1) Causes

The cause and factors that influence this disorder are unknown. Freckle-like blemishes occurred on ripe papaya fruits (cv. Sunset). Young fruits (less than 40 days old) were free from freckle. The freckle diameter increase during the last phase of fruit growth as the fruits approached the maturity. More freckle were seen on the exposed side of the fruit away from the stem.

##### 2) Treatment

Wrapping young fruits in white paper bags significantly reduced freckle incidence.

#### B. Malformed Fruits

##### 1) Causes

This melody is due to boron deficiency and it is one of the serious disorders limiting yield in papaya. It results in malformed fruits.

##### 2) Treatment

-Spraying of boric acid 0.1% at 3 months interval from sixth month after planting onwards correct the deficiency.

### II. GUAVA



Fig. 2: Guava

#### A. Bronzing

##### 1) Causes

Bronzing of guava has been observed in places having low soil fertility and low pH. Affected plants show purple to red specks scattered all over the leaves. Under aggravated condition, total defoliation and fruits characterized with brown coloured patterns on the skin, with reduced yield are noticed.

##### 2) Treatment

- Foliar application 0.5 % diammonium phosphate and zinc sulphate in combination at weekly intervals for two months reduced the bronzing in guava.
- Pre-flowering spray with 0.4 % boric acid and 0.3 % zinc sulphate increase the yield and fruit size.
- Spraying of copper sulphate at 0.2 to 0.4 % also increase the growth and yield of guava.

### III. PINEAPPLE



Fig. 3: Pineapple

#### A. Multiple Crowns

##### 1) Causes

Ordinarily fruit bears a single crown but in some cases fruit bears more than one. Consequently the top of the fruit will be flat and broad and fruit will be unfit for canning. Such fruits taste insipid and are corky. It is supposed to be a heritable character, found mostly in Cayenne group to which the variety Kew belongs.

#### B. Fruit & Crown Fasciation

##### 1) Causes

Fasciated fruits are deformed to such an extent that they are totally useless. In certain cases, proliferation is so extreme that fruit is highly flattened and twisted with innumerable crowns. Fruits and crowns fasciation is associated with high vigour of plants, which take longer time to flower. High fertility of soil, warm weather and calcium r zinc deficiency may favour fasciation.

#### C. Collar of Slips

##### 1) Causes

The collar of slips is typified by the presence of a large number of slips arising from stem close to the base of the fruit, or even

directly from the fruits itself. The excessive slip growth is at the expense of the fruit, resulting in small, tapered fruits, often with knobs at the base. High nitrogen fertilization and high rainfall along with relatively low temperature are supposed to be congenial for such an abnormality.

#### D. Dry Fruit & Bottle Neck

##### 1) Causes

The dry fruit and bottle neck fruit types are very similar and may be derived from the same parent. In dry fruit type, fruit is small, flowers are absent and fruitlets do not develop. In bottle neck, lower fruitlets develop normally and upper ones do not develop and give the same appearance as dry fruits. Suckers are freely produced from both the types.

#### E. Sun-Scald

##### 1) Causes

This results when plant leans or falls over to one side, thus exposing one side of the fruit to direct sunlight. The cells of the exposed surface get damaged. Later shell surface assumes a brownish to black colour and cracks may appear between fruitlets. Affected fruits soon rot and become infested with pests. They must be cut as soon as noticed and safely disposed of where they will not contaminate other fruits. In high-density planting, intensity of sun-scald is very much minimised. Under favourable climates where leaf growth is luxuriant, leaves can be tied around the fruits to protect them from sun-scald. The other method is to cover sun-exposed portion of the fruit with dry straw or grass or with any other locally available materials.

#### IV. MANGO



Fig. 4: Mango

#### A. Spongy Tissue

##### 1) Causes

A non-edible sour patch developed in the mesocarp of mango fruit is broadly termed spongy tissue. The malady has been reported only in Alphonso. The peculiarity of this malady is that external symptoms of the fruit affected by spongy tissue are not apparent at the time of picking or at the ripe stage. These can be detected only on cutting the ripe fruit. This malady renders the fruit unfit for human consumption. It is a physiological disorder in which fruit pulp remains unripe because of unhydrolyzed starch due to physiological and biochemical disturbances caused by heat convection in mature fruit at pre-and post-harvest stages.

##### 2) Treatment

- Single and double preharvest dip of fruits in calcium solution significantly increased the calcium content in the ripe fruits.
- The pre harvest dip significantly reduced the occurrence of spongy tissue in the ripe Alphonso' fruits.
- The use of wind-breaks for protecting the orchard from warm air during May, and use of proper precautions at post-harvest stage checks the disorder.

#### B. Black tip

##### 1) Causes

Coal fumes of brick kilns containing sulphur dioxide, ethylene and carbon monoxide are observed to be responsible for black tip. The damage has been noticed in the mango orchards located up to 200metres of distance from brick kiln and also due to boron deficiency. It is characterized by depressed spots of yellowing tissues at the distal end of the fruit, which gradually increase in size, become brown and finally black. The necrotic area is always restricted to the tip of the fruit. The growth of the fruit is almost at stand still and the fruit becomes soft after premature ripening. Such fruits never reach full maturity and drop earlier.

##### 2) Treatment

- The preventive measure is to have orchards 1.5km to the east and west and 0.75km to the north and south away from the kilns.
- Spraying of 2% sodium carbonate.
- Spraying of 0.6% borax is recommended as control measure.

#### C. Malformation

##### 1) Causes

Among all the known diseases and insect pests of mango, malformation is undoubtedly the most serious cause due to low temperature. Depending on the plant part affected, two categories of the malformation, 1. Vegetative and 2. Floral malformation, have been recognized.

- a) In vegetative malformation, the vegetative buds in the leaf axils or at the apical meristem of the younger plants, on activation, develop abnormally as compact rosette-like shootlets, bearing tiny leaf rudiments. Many such shoots may arise to form a bunch, hence it is also sometimes known as bunchy top. The problem is not serious in the grown-up trees. The affected new shoots on the old trees, however, become thick, stunted, and develop a whorl of small leaves.
- b) Floral malformation, in contrast, is very virulent and can cause the loss of the entire crop. It affects the fruit production directly by converting the panicle to a barren one. Floral malformation exhibits all sorts of symptoms, but any deviation of a part of the panicle, or all the parts of a panicle, from the normal to abnormal should be considered as a symptom of this malady. In severe form, the affected panicle, appears like a compact mass, being more green and sturdy. It bends down due to its own weight.

## 2) Treatment

- It is found that the application of 200ppm NAA during the first week of October as spray resulted in considerable reduction of floral malformation.
- Early deblossoming, combined with NAA spray during October, may reduce the extent of malformation considerably.

## D. Leaf scorch

### 1) Causes

The characteristic symptom is akin to that of potash deficiency, i.e. scorching of old leaves at the tip and margins. This condition is quite common during the winter months when the entire old foliage in some regions appears to be affected by this symptom. The leaves fall down and the tree vigour and yield are reduced. This disorder is common in saline soils or where brackish water is available for irrigation or where muriate of potash is used as a fertilizer.

### 2) Treatment

- This disorder can be checked effectively by collecting and burning the fallen leaves.
- Using potassium sulphate instead of muriate of potash.
- 4-5 foliar applications of potassium sulphate (5%) on newly emerged flushes at fortnightly can cure this disorder.

## E. Soft nose

### 1) Causes

This disorder also known as tip pulp, insidious fruit rot and yeasty fruit rot. The typical symptom is breakdown of the flesh towards the apex of the fruit before ripening. Meso-carp cells in fruits of the cultivars Kent and Beverly showed marked cell separation and cell wall disintegration. The characteristic symptom is that of excess of calcium and nitrogen deficiency.

### 2) Treatment

- Harvest fruits at ¾ maturity stage.
- Apply calcium containing fertilizers like calcium ammonium nitrate.
- Use of sod culture.
- Varieties susceptible: Alphonso, Olour, Totapuri
- Varieties resistant: Arka Puneet

## F. Biennial Bearing

### 1) Causes

The term biennial, alternate or irregular bearing generally signifies the tendency of mango trees to bear a heavy crop in one year (On year) and very little or no crop in the succeeding year (Off year). Most of the commercial varieties of north India, namely, Dashehari, Langra and Chausa are biennial bearers, while south Indian varieties like Totapuri Red Small, Bangalora, and Neelum are known to be regular bearers. When a tree produces heavy crop in one season, it gets exhausted nutritionally and is unable to put forth new flush thereby failing to yield in the following season.

The problem has been attributed to the causes like genetical, physiological, environmental and nutritional factors.

## 2) Treatment

- For overcoming biennial bearing, deblossoming is recommended to reduce the crop load in the 'On' year so that it is balanced in the 'Off' year.
- Proper maintenance of orchard by way of effective control of pests and diseases and regular cultural operations may also result in better performance of the tree every year.
- Soil application of Paclobutrazol (PP333) or Cultar @ 4 g/tree in the month of September resulted in early flowering with higher fruit set and yield.
- It may be applied every year for regular fruiting, particularly in young trees. Ringing of branches is recommended as means of inducing flowering in the 'Off' year.
- However, Weak, stunted, unhealthy trees should not be ringed to force flowering. It involves removal of 1 cm wide ring of bark on a branch of about 15 cm thickness.
- Ringing stops vegetative growth and results in accumulation of carbohydrates and other metabolites in the portion of the branch above the ring, thereby creating physiological condition for flowering.
- Ringing should be done in August or early September, well before the time of fruit-bud differentiation.

## G. Fruit Drop

### 1) Causes

The intensity of fruit drop varies from variety to variety. Among the commercially grown varieties, Langra is more susceptible to drop, while Dasherri is the least. The fruit drop is more or less a continuous process and can be classified into three phases, viz. (i) pinhead drop, (ii) post-setting drop and (iii) May-month drop.

The fruit drop in first two phases are insignificant compared to the third phase which affects the final yield significantly and needs more attention. Embryo abortion, climatic factors, disturbed water relation, lack of nutrition, attack of disease and pest and hormonal imbalances are the major factors that lead to fruit drop.

### 2) Treatment

- The foliar application of Alar (B-nine) @ 100 ppm or NAA 20 ppm at pea stage of fruit was found effective in controlling fruit drop in mango.

## H. Clustering in Mango ('Jhumka')

### 1) Causes

A fruiting disorder, locally known as 'Jhumka', is characterised by the development of fruitlets in clusters at the tip of panicles. Such fruits cease to grow beyond pea or marble stage and drop down after a month of fruit set. Absence of sufficient population of pollinators in the orchards is the major reason. The other reasons causing the disorder are old and overcrowding of trees, indiscriminate spraying against pests and diseases, use of synthetic pyrethroids, monoculture of Dashehari and bad weather during flowering.

### 2) Treatment

- Introduction of beehives in the orchards during flowering season for increasing the number of

- pollinators and restrict insecticidal sprays at full bloom to avoid killing of pollinators.
- Pests and diseases should be controlled in time by spraying the recommended pesticides and concentrations.
  - Spraying of NAA (300 ppm) during October-November is recommended.
  - The practice of monoculture of a particular variety may be avoided.
  - Particularly in case of Dashehari, 5-6% of other varieties should be planted in new plantations.

## V. BANANA

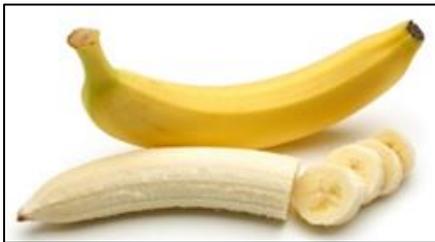


Fig. 5: Banana

### A. Choke throat

#### 1) Causes

It is due to low temperature affecting active growth of the plant. Leaves become yellow and in severe cases, the tissue gets killed. In case of normally flowering plants, the stalk carrying bunches elongates freely so that the entire inflorescence comes out of the pseudostem and hangs down. Bunch development is normal, but when the time of flowering synchronizes with low temperature, the bunch is unable to emerge from the pseudostem properly. The distal part of the inflorescence comes out and the basal part gets stuck up at the throat. Hence, it is called Choke throat. Maturity of the bunch is delayed by taking 5-6 months instead of 3.5-4 months for harvest.

#### 2) Treatment

- Provision of shelter belts using Casuarina or Eucalyptus to prevent the effect of cold wind blowing into the orchard and planting low temperature tolerant varieties like Kullan check the disorder.

### B. Kottaivazhai

#### 1) Causes

It is a serious malady in Poovan variety of banana, reducing the production by 10-25%. The symptoms are distinctly conical and illfilled fruits with a prominent central core having many underdeveloped seedy structures making the fruit inedible. The pseudostem exhibits streaks, striations and blotches on the surface. Bunches are held at an angle above the horizontal position. Pollen grains are infertile, shriveled, shrunken and broken while the pericarp is smaller and the locular cavity is bigger than normal. The absence or the occurrence of auxin, gibberellins and cell dividing factors at sub epidermal levels affect the development of parthenocarpic fruits.

#### 2) Treatment

- Application of 2,4- D 25ppm and GA 100ppm after the opening of last hand favours development of parthenocarpic fruit.

### C. Neer Vazhai

#### 1) Causes

This is a malady of unknown etiology. It affects Nendran banana in Tamil Nadu. Infested plants show poor plant growth, delayed shooting, lanky bunch with few hands and immature unfilled fingers. Fruits ooze out watery fluid when cut, hence the name 'Neer' meaning 'water' and 'vazhai' 'banana'. In infested plants, severe root damage is noted. Cause of this disorder is not known but is of serious concern causing considerable loss. There are stray reports of this malady affecting 'Poovan' around Trichy in Tamil Nadu. It is transmitted through suckers. Thus it can be suspected to be caused by virus or mycoplasma.

#### 2) Treatment

- Application of growth hormone NAA improves the finger filling.

### D. Improper Bunch Filling

#### 1) Causes

The most characteristic of the K deficiency symptoms is the yellowing of older leaf tips followed by inward leaf curling and death. Usually, a K deficient banana plant will grow slowly and have a sturdy appearance due to the shortening of internodes. Bunch deformation: The banana bunches in K deficient plants are short, slim and deformed as a consequence of poor fruit filling caused by reduced photosynthesis and sugar transportation.

## VI. CITRUS



Fig. 6: Citrus

### A. Granulation

#### 1) Causes

Granulation is a serious problem of citrus, especially under North Indian conditions. This abnormality is initiated at the stem end of the fruit which gradually extends towards the stylar end.

The affected juice sacs become hard and dry, fruits become grey in colour, enlarged in size, have flat and insipid taste and assume a granular texture. Granulated fruits contain less extractable juice as most of it turns into gelatinous mass. This results in more quantity of rag and thus low pulp/rag ratio. The terms granulation, crystallization and dry end are used to describe this trouble. It is much more prevalent in larger sized fruits than in small fruit, in young than in old trees and in humid than in dry areas. Several factors

like luxuriant growth, rootstock and the variety, frequent irrigation, mineral constituents in plant tissue, time of harvest, exposure to sunlight, etc., are found to be associated with this malady. The incidence is relatively high in the fruits of younger plants as compared to those in older plants. The vigorous rootstocks like rough lemon increase the incidence of granulation as compared to less vigorous rootstocks. Late maturity and persistent cold weather throughout the period of maturity have been found to increase the incidence of granulation.

#### 2) Treatment

- The incidence of granulation could be reduced to 50 per cent by applying two to three sprays of NAA (300 ppm) in the months of August, September and October.
- Spraying of GA 15 ppm followed by NAA 300 ppm in October and November also reduce granulation.

### B. Rind pitting

#### 1) Causes

Superficial rind pitting (SRP) of Shamouti orange causes serious damage to fruits and tremendous losses to growers. While SRP developed on the tree and could be identified in the packaging house, the majority of SRP symptoms developed 3-5 weeks after harvest, during shipment and marketing. Ethylene increased the incidence of SRP. Fruits with SRP had lower rind K contents than healthy fruits.

#### 2) Treatment

- Spraying trees with 9% bonus 13-2-44, a K fertilizer increased leaf K concentration and reduce the incidence of SRP significantly.
- Storage at 5<sup>o</sup> C also restricted the development of SRP.
- A combination of preharvest Bonus spray with postharvest low temperature storage gave good results.

### C. Leaf mottling

#### 1) Causes

Leaf mottling is characterized by yellow and green patterns on old leaves, similar to deficiencies of zinc, manganese, iron and boron which makes field diagnosis difficult. Leaf mottling of citrus was first noted in 1957 in Batangas, Phillippines. The affected tree showed yellowing, dieback of leaves and fruits. The emerging leaves are small also fruits are small in size.

#### 2) Treatment

- Used resistant varieties for planting the orchard.
- Used disease free planting material for establishment of orchard.

### D. Exanthema/ Ammoniation/ Dieback

#### 1) Causes

Mild copper deficiency is usually associated with large, dark green leaves on long soft angular shoots. Young shoots may develop into branches which appear curved or "S-shaped," referred to as "ammoniation" usually resulting from excessive nitrogen fertilization. Twigs can develop blister-like pockets of clear gum at nodes. As twigs mature, reddish brown eruptions may occur in the outer portion of the wood. Severely affected twigs commonly die back from the tip with new growth appearing as multiple buds or "witches broom". Necrotic-corky areas on the fruit surface may sometimes occur in extreme situations. Copper deficiency

is more likely to occur in new plantings on previously uncropped soils, which are usually deficient or totally lacking in copper.

### E. Yellow Leaf of Citrus

#### 1) Causes

Rarely observed, it can occur under acidic soil conditions. The most characteristic field symptoms are large yellow spots on the leaves that appear first as less defined water-soaked areas in spring, later developing into distinct larger interveinal yellow spots.

## VII. AVOCADO



Fig. 7:

### A. Pulp Spot Causes

The first symptoms of pulp spot are noticed soon after the fruit is cut. The spots are initially smooth and glassy of 1.0 mm in diameter and occur along the vascular bundle. The spots discolor after being exposed to the atmosphere and are generally brown to dark brown within 30 minutes. The severity of pulp spot varies from season to season and the incidence drops rapidly as the season advances.

#### 1) Treatment

- The fruits avocados are stored at lower temperatures as the season advances.
- Spray the calcium which reduced the incidence of pulp spot.

## VIII. SAPOTA



Fig. 8:

### A. Fruit drop

#### 1) Causes

Sapota has the problem of low fruit setting and shedding. Only about 10-12 per cent of the total fruits set, develop and retained until maturity. Most of the fruit-drop occurs immediately after fruit setting.

## 2) Treatment

- Increase in fruitset and retention are possible by spraying NAA and GA3 at 25 to 100 ppm during flowering and at 15-day interval.

### IX. CUSTARD APPLE

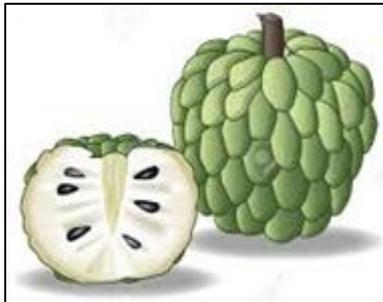


Fig. 9: Custard Apple

#### A. Stone Fruits

##### 1) Causes

Custard apple fruits which are set late in the season remain small and hard like stone and never ripen no matter how long they are left on the tree. Such fruits are known as stone fruit. The occurrence of stone fruit is very common during November and December. The competition between the developing fruits and maturation are the cause of stone formation.

##### 2) Treatment

- Irrigation, manuring and good cultivation considerably reduced stone formation in fruits.

### X. AONLA



Fig. 10: Aonla

#### A. Internal Necrosis

##### 1) Causes

The symptom starts with the browning of the innermost part of mesocarpic tissue at the time of endocarp hardening and extends towards the epicarp resulting into brownish black appearance of the flesh. In case of severe incidence, these black spots become corky and gummy pockets develop.

##### 2) Treatment

- 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 cvs like Chakaiya, NA6 & NA 7 should be planted.

### XI. POMEGRANATE



Fig. 11: Pomegranate

#### A. Fruit Cracking

##### 1) Causes

The soil type and soil moisture condition of the fruit orchard responsible for fruit cracking in pomegranate. Lack of orchard management and the quality (volume) of rainfall at one time. The full quantity and distribution of rainfall during the mature and ripening time and long spell of irrigation or uneven irrigation also affect the pomegranate fruit. Also boron deficiency responsible for fruit cracking in pomegranate fruits.

##### 2) Treatment

- Conservation of moisture during hot dry month of May and June is very necessary because during high temperature the rate of transpiration rate become high due to rapid evaporation.
- Regular application of water through drip in the orchard is the main factor which maintains moisture percent in fruit. These are very sensitive to high and stress water condition.
- Suitable wind break should be planted around the orchard boundary and it should be at a right angle to the direction of prevailing wind. A row of tall growing trees, such as seedling mango and jamun are suitable wind breaks.
- An organic mulch such as leaves, straw are good source of conserving moisture by reducing evaporation, preventing emergence of weed, and on decaying adds humus to the soil. Maintenance of soil moisture reduce the cracking percentage of fruit trees.
- Spray borax @ 1gm per litre of water.

#### B. Internal Break Down

##### 1) Causes

The pulp bearing seeds (arils) do not develop the typical colour and are somewhat flattened rather than plump. Flavor of the arils is abnormal, and many have a streaked appearance due to fine white lines radiating from the seed. There are no external symptoms. The cause of the disorder is not known; it is originated during growth in some seasons, usually only in limited areas.

##### 2) Treatment

- Give proper irrigation to maintain proper humidity.
- The fruits should be harvested as soon as they mature.
- Management strategies used for other disorders may also help in reducing the problem.

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