

PHYSIOLOGICAL DISORDERS IN FRUIT CROPS

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The productivity as well as the quality of fruit crops is affected to a greater extent due to the physiological and nutritional disorders. Disturbance in the plant metabolic activities resulting from an excess or deficit of environmental variables like temperature, light, aeration and nutritional imbalances result in crop disorders. In fruit crops, the deficiency of micronutrients causes many more disorders than that of macronutrients. Nutritional disorders have become widespread with diminishing use of organic manures, adoption of high density planting, use of root stocks for dwarfing, disease and salt tolerance, unbalanced NPK fertiliser application and extension of horticulture to marginal lands. To get high quality fruit and yields, micronutrient deficiencies have to be detected before visual symptoms are expressed.

The deficiencies of Zn, Mn and B are common in sweet orange, acid lime, banana, guava and papaya in India. To correct both visual and hidden micronutrient deficiencies, appropriate foliar and soil applications are necessary. The description of physiological and nutritional disorders in crops include a number of technical terms and it is essential to understand the terms for better identification of symptoms. Some common terms are, *bronzing* (development of bronze or copper colour on the tissue), *chlorosis* (loss of chlorophyll resulting in loss of green colour leading to pale yellow tissues), *decline* (onset of general weakness as indicated by loss of vigour, poor growth and low productivity), *die-back* (collapse of the growing tip affecting the younger leaves), *firing* (burning of tissue accompanied with dark brown or reddish brown colour), *lesion* (a localised wound of the leaf/stem tissue accompanied with loss of normal colour), necrosis (death of tissue), scorching (burning of the tissue accompanied with light brown colour resulting from faulty spray, salt injury etc.)

BANANA

Choke throat

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. 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.

Chilling injury

Chilling occurs when pre-harvest or post-harvest temperatures fall below 14°C for various time periods. The peel of banana become dark and the fruit exhibit uneven ripening. Ripening fingers show dull yellow to smoky yellow colour and watery dark patches are observed on the skin. Brittleness of the fruit and fungal invasion is also observed. The vascular bundles of the sub epidermal layer show brown streaks. The discoloration is ascribed to the enzymatic oxidation of dihydroxy phenylalanine.

Kottaivazhai

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, gibberellin and cell dividing factors at sub epidermal levels affect the development of parthenocarpic fruits. Application of 2,4- D 25ppm and GA 100ppm after the opening of last hand favours development of parthenocarpic fruit.

Potassium deficiency

Chlorosis: The most characteristic of the K deficiency symptoms is the yellowing of older leaf tips followed by inward leaf curling and death.

Stunted growth : 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.

MANGO

Black tip

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. It is characterised 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. 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 or 0.6% borax is recommended as control measure.

Spongy tissue in fruit

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 in mature fruit at pre-and post-harvest stages. Single and double pre-harvest dip of fruits in calcium solution significantly increased the calcium content in the ripe fruits, whereas there was no significant increase in calcium content by post harvest Ca dip treatment. 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.

Malformation

Among all the known diseases and insect pests of mango, malformation is undoubtedly the most serious. Depending on the plant part affected, two categories of the malformation, vegetative and floral, have been recognized. 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. 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. 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.

Fruit drop

In mango, there is a heavy drop of hermaphrodite flowers and young fruits amounting to 99% or more. In general, in mango 0.1% or less hermaphrodite flowers develop fruits to maturity. The maximum drop of fruits in 'Langra' and 'Dashehari' takes place in the first three weeks of April and differs significantly from the drops in the following weeks. Fruit drop is to some extent associated with the variety, as the variety 'Langra' is more prone to fruit drop than 'Dashehari'. Deficient nutrition of many developing embryos may be the most important internal factor leading to post-fertilization drop in mango. This results due to competition among overcrowded fruitlets on panicle. Degeneration of the embryo in the initial stages of its development may yet be another cause of drop. This occurs invariably, if the flowers are self-pollinated. 2,4-D produced better results at concentrations below 20ppm, because at higher concentrations fruit and seed development is retarded. Single spray of NAA or 2,4-D each at 20ppm or Alar 100ppm at pea stage of fruit gives promising results.

Zinc deficiency

The major nutritional disorder in mango is *little leaf* caused by the deficiency of zinc. This leads to stunted growth of roots, shoots and leaves. The lamina of leaves turn pale yellow while midrib remain green. Leaves become very small, little with interveinal chlorosis. Yellowing, necrotic patches develop on old leaves with drying of leaves. Subsequently necrotic patches turn grey and cover the entire surface. Two sprays of 1-2% Zinc sulphate, one at the time of flowering and the other at one month after the first spray correct the disorder.

CITRUS

Fruit drop

The most pronounced stages of fruit drop are, (i) immediately after fruitset at marble stage which lasts for a month after full bloom, referred as post-set drop, (ii) the second wave of intense fruit drop occurs at the onset of hot summer weather during May-June, known as June drop, and (iii) preharvest drop or premature drop occurring during ripening period, which lasts from August to December-January. Higher summer temperature, excess or deficiency of soil moisture, lack of nutrients like zinc, phosphorus and potash and attack of fungal diseases like anthracnose, styler-end rot and stem-end rot are some of the primary factors responsible for fruit drop. Application of 2,4-D 10ppm combined with aureofungin 20ppm in the first week of September provides excellent check against physiological and pathological pre-harvest fruit drop in citrus.

Granulation

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. Singh and Singh (1980) reported that in the areas with high incidence of granulation, the plant tissues contain high Ca and Mn, and low P and B.

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. 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.

Boron deficiency

The deficiency causes yellowish translucent spots accompanied by leaf distortion or deformation. Mature and old leaves may show corky veins. They may be somewhat twisted or totted. Immature fruits become hard and somewhat misshaped. To control various leaf deficiencies, a combined spray of different microelements at a concentration of 25-50 ppm depending on the intensity of deficiency is generally applied. It is very likely that some of the components of such a spray would be a waste, if the trees are really not deficient in those elements. Copper and zinc are antagonistic when sprayed together. It is also observed that combined spray may cause tip burning of leaves in the absence of continuous stirring of spray fluid. It is, therefore, best to spray different micronutrients which are deficient individually rather than in combination based on leaf analysis.

GRAPES

Flower-bud, flower and berry-drop

This problem has been reported from the states of Punjab, Haryana and Rajasthan in North India. The malady has been investigated and the association of a number of factors such as, improper nitrogen application, improper fertilization, ambient temperature, heavy crop load, uneven ripening and endogenous auxin deficiency at a particular stage of berry development are reported to cause the malady. To control bud, flower and berry drop, the following measures are suggested; making 0.5 cm wide girdle from the trunk about 10 days before full bloom which results in better berry set; judicious application of fertilizers under a given set of conditions, particularly N fertilizers, for 'even' ripening; 500 ppm ethrel at veraison stage should be applied; dipping of bunches in NAA 100ppm 10 days before ripening reduces berry drop, heavy irrigation at bloom should be avoided.

Blossom-end rot

A black sunken spot develops at the blossom-end of the berry which later on spreads with water-soaked region around it. Defective calcium nutrition and assimilation appear to be the cause for it. Spray of 1.0 per cent calcium nitrate may correct it.

Boron deficiency

The presence of small sized fruits and large sized fruits in the same bunch is known as *hen and chicken* disorder. The fruits are sour in taste. The symptoms include death of growing tips, leaf fall and brittleness of young shoots. The leaves may be deformed with interveinal chlorosis spreading from margins to inwards and this is particularly evident after the fruiting. Spraying of 0.2% boric acid a week before bloom and another at full bloom control the disorder effectively.

Iron deficiency

The leaves turn yellow (*chlorosis*) during iron deficiency and the entire shoot become yellow to yellowish green under extreme conditions. Iron deficiency may occur due to the presence of excess calcium in the soil (*lime induced chlorosis*). The corrective measure is two sprays of 0.2% ferrous sulphate, one before bloom and the second after fruitset.

GUAVA

Die-back

The disease infects young as well as the old bearing trees. Some trees are more prone to attack. The typical symptoms include withering of lowermost branch of the tree from top downwards. The growing tip turns dark brown and necrotic areas extend backwards. A typical lesion develops at the junction of the diseased and healthy areas which advances down the

healthy areas. The infected branches defoliate giving them a barren appearance. Application of 1.8 kg lime or gypsum reduce the mortality of trees by maintaining soil pH.

Bronzing

Bronzing in guava is a complex nutritional disorder. When fruiting starts in a soil marginal in P and K, the nutrients are mobilised from older leaves to the fruits, causing bronze coloured leaves which results in reduced photosynthate transfer to the roots and reduced uptake. In mild symptoms, mixture of 20 kg of FYM, 1 kg of SSP, 0.5kg MOP and 100g ZnSO₄ /tree should be applied in soil. In severe cases, the dose may be doubled except FYM and foliar spraying of DAP 0.3% and SOP 0.5% is to be given 45 days after the emergence of leaves.

Boron deficiency

The disorder is identified with appearance of red spots on the newly emerged leaves. Leaves become dry and brittle. Spraying of 0.3% boric acid 10-15 days before flowering correct the deficiency. In general, foliar application of 0.5 per cent zinc sulphate and 0.4 per cent boric acid 10 to 14 days before flowering effectively eliminate the zinc and boron deficiencies.

PAPAYA

Boron deficiency

Boron deficiency is one of the serious disorders limiting yield in papaya. It results in malformed fruits. Spraying of boric acid 0.1% at 3 months interval from sixth month after planting onwards correct the deficiency.

SAPOTA

Fruit drop

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. Increase in fruitset and retention are possible by spraying NAA and GA₃ at 25 to 100 ppm during flowering and at 15-day interval (Rathod and Amin, 1981).

POMEGRANATE

Fruit cracking

Fruit cracking is a serious problem of pomegranate. The malady is thought to be due to boron deficiency in young fruits while in developed fruits it may be caused due to variations in soil moisture content and atmospheric humidity. At the time of fruit ripening, if the soils become too dry and then irrigated heavily or there is some rains, cracking may occur. Some cultivars, like Guleshan, Khog, Kazaki are reported to be resistant to fruit cracking. Regular irrigation to maintain soil moisture at desired level, spraying of calcium compounds or GA₃ at 120 ppm on young fruits are reported to minimize the fruit cracking.

