



Physiological Disorders: A Big Barrier to Mango Growers in India

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Mango orchards in India are facing declining growth in recent time leading to decrease in yield and productivity. Although a number of factors are responsible for mango yield decline, yet physiological disorders play more devastating and vital role. As a result, mango growers are losing their faith and interest in mango orchards and trying to shift their cultivation practices from mango to other crops. In this article we discussed the problems associated with mango especially physiological disorders in details along with their possible management strategies which will certainly help the farmers in timely overcoming this malady for getting satisfactory remunerative prices from mango cultivation.

Introduction

Mango (*Mangifera indica* L.) is the choicest fruit of India in terms of not only production but also economic importance and acceptability by the consumers. It is grown in around 87 countries in the world but no where it is as greatly valued as in India where it covers around 36 per cent of total fruits growing area. Owing to delicious taste, succulence type and exotic flavour it enjoys the same popularity in the tropics as apple in the temperate region. India is the largest producer of choice table varieties of mango in the world. More than 1000 mango varieties are under cultivation in India, each differing in shape, size and taste. But the production share of mango in India is quite low (20.3%) with total annual production of only 15.19 million tons due to low productivity (6.6 tonnes/ha). Despite India has got excellent export mango varieties (Dashehari, grown in northern India, Alphonso and Kesar in western India and Krishnabhog, Gulabkhas and Himsagar in

eastern India) it occupies just fourth position in mango export market of the world with Philippines being the first. Among the different factors responsible for low productivity and low export potentiality, physiological disorders associated with mango is one of the main factor which affects mango cultivation at all stages, right from the plants in the nursery to the fruits in storage or transit. These physiological disorders not only reduce the production efficiency of the tree but also hamper the fruit quality which is the key factor for export, resulting huge economic losses to the growers every year. Therefore, to obtain higher mango production with better quality, utmost attention must be given to solve the problems of physiological disorders. Details of different physiological disorders along with their management strategies are as follows:

1. Alternate Bearing: This is one of the most burning problems of mango cultivation

as it renders mango cultivation less remunerative to growers. It 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 alternate bearers, while south Indian varieties like Totapuri Red Small, Bangalora, and Neelum are regular in nature but they are unable to produce quality fruits under north Indian condition. Generally mango trees when laden with fruits, they do not produce new shoots. Even after harvesting, if new shoots are produced, they are negligible in number and do not flower in the coming year because new vegetative flush of mango required a certain amount of maturity (8-10 months) for flower bud differentiation. Normally if this year it flowers and fruits, next year new shoots will be produced in the months of March-April which flower again in the next year resulting flowering and fruiting in alternate year. Moreover, when a tree produces heavy crop in one season, it gets nutritionally exhausted failing to yield in following season. Besides climatic factors, C/N (carbohydrate/nitrogen) ratio and hormonal imbalance also play vital role to cause alteration in bearing in mango.

Management Strategies

- a. Paclobutrazol (PP₃₃₃) @ 4 g/tree as soil and foliar spray in September results early maturation of vegetative flush and commencement of flowering in the following year.
- b. Deblossoming of some 'on year' flowers and pruning of the tree just after harvesting will maintain proper physiological balance between vegetative and reproductive growth

and permit ample amount of sunlight to reach the inner area of the orchard resulting in better performance of the tree every year. Moreover pruning also helps to produce some new shoots just after harvesting which may mature in the next flowering season.

c. Flowering in 'off' year' can also be induced by smudging. Smudging in mango is carried out by building slow fires, emitting smoke under mango tree. Similarly, application of Ethrel can also induce flowering.

d. Growers who are in primitive stage of mango cultivation can select cultivars like Amrapali, Mallika, Ratna, Dashehari-51, Pusa Arunima, Pusa Shrestha, Pusa Pitambar, Pusa Lalima, Pusa Pratibha, Arka Anmol, Arka Aruna, Arka Puneet, Arka Neelkiran for commercial cultivation as they are regular bearing in nature. Rejuvenation of old mango tree by grafting or budding with regular bearing varieties are also recommended to convert the alternate bearing habit into regular one.

2. Mango Malformation: During last few decades farmers particularly in northern India facing huge problem due to this disorder. Although, it was first observed in 1891 in Bihar but now it is an alarming threat in Punjab, Delhi and Uttar Pradesh with to some extent in Gujarat, Maharashtra, Bihar, West Bengal and Orissa. Southern India is virtually free from this threat. It is mainly of two types: vegetative and floral. Vegetative malformation is more common in nursery seedling and in young plants. Malformed vegetative shoots assume the appearance of bunchy top with narrow scaly leaves. Vegetative buds growing in cluster, swells and losses the apical dominance.



Fig. Vegetative Malformation

But the most destructive one is the floral malformation which appears on the trees at the bearing stage and produce short, thicker and hypertrophied panicles as condensed clusters. Ratio of sterile male to hermaphrodite flower increased in the malformed panicles, resulting no fruit set in those branches.



Fig. Floral Malformation of Mango

Almost all the commercial mango cultivars like Bombay Green, Dashehari, Lucknow Safeda and Chausa show huge susceptibility to this malady, however the cultivar Baramasi is less affected. Cultivars like Ellaichi, Alib and Bhadauran are totally free from this disorder but their fruit quality being not superior; their use is limited to only for resistant breeding not for commercial cultivation. Scientist from different part of the country reported that a

fungi- *Fusarium moniliformae* var. *subglutinans* is highly associated with this disorder. Temperature range of 21-27⁰C (max.) and 8⁰C (min.) along with relative humidity of 85% during late winter or early spring is conducive for the growth of the fungi, resulting severe incidence of malformation on newly emerged panicles.

Management Strategies:

a. Application of NAA/ Planofix (200ppm) during October, prior to fruit bud differentiation followed by debloosming of newly emerged panicles or bud during January- February is beneficial to control the disorder.

b. Spraying of different phenolic compounds like catechol, cynamic acid, tannic acid during 1st week of October at 2000 ppm is equally effective in reducing floral malformation.

c. Several anti-malformins have been suggested for beneficial results when sprayed on panicles just after emergence (4-6 cm). Sprays of glutathione at 2250 ppm, ascorbic acid at 2110 ppm, AgNO₃ at 600 ppm have also been found effective to control the malformation.

d. Application of nutrients likes P & K and micronutrients especially Zn & B just after harvesting are quite effective in reducing the incidence of malformation. Application of moderate amount of N helped to minimize the vegetative malformation while Zn and B helped in biosynthesis of auxins which ultimately helps to reduce the incidence of mango malformation.

e. Removal of just emerged malformed panicles or vegetative shoots at a distance of 15-20 cm below the point of occurrence is beneficial to minimize the spread of disorder further.

3. Black Tip: This malady is widely prevalent in Punjab, Uttar Pradesh, Bihar and West Bengal. It causes considerable economic losses to the growers. Among the commercial cultivars, Dashehari is the highly susceptible one, while Lucknow Safeda is the least. This disorder has mainly detected in orchards located in the vicinity of brick kilns. Gases like carbon dioxide, sulphur dioxide and ethylene constituting the fumes of brick kiln, damage growing tip of fruits and give rise to the symptoms of black tip. Etiolation of distal end of the fruit leaving mesocarp and seed unaffected followed by appearance of grey spots of indefinite outline, turns brown in colour, coalesces and the entire fruit tip turns brown black. In severe cases, the affected tissues of the fruit with a thin layer of collapsed tissues left over it. The necrotic area is always restricted to the tip of the fruit because of high stomatal density, high catalase and peroxidase activity.

Management Strategies

- a. Establishment of the orchards away from brick kiln by at least 1.6 km in east to west and 0.8 km in north to south direction and increasing the chimney height to at least 15-18 metres can be preventive measures for this malady.
- b. Spray 1 per cent borax (10g/lit) thrice-first before flowering, second during flowering and third at fruit set stage is very effective. Moreover, spraying of other alkaline solutions like caustic soda (0.8%) or washing soda (0.5%) at pea stage followed by two more sprays at 15 days interval may neutralize the acidic fumes of brick kilns, precipitating on the tip of the fruits.

4. Spongy Tissue: Cheema and Dhani was first to observe spongy tissues in mango in 1934. It is a major hindrance for Alphonso growers. This is caused because ripening enzymes during fruit maturation stage become inactive due to high temperature, convective heat and post harvest exposure of fruit to sunlight which results in the development of non-edible, sour, yellowish and sponge like patch with or without air pocket in the mesocarp of the fruit during ripening. In extreme cases, the whole fleshy portion becomes too soft resembling bacterial rot.



Fig. Spongy Tissue of Mango

Management Strategies

- a. Harvesting of fruits at 3/4th maturity stage and post harvest exposure to low temperatures between 10-15^oC for 10-18 hrs has been beneficial in reducing the disorder.
- b. Sod culture with *Eragrostis* (*Spartina*) *cynosuroides*, cover cropping etc. should be used in the orchard to reduce direct heat radiation from soil which ultimately minimizes the raise of convective heat from the ground.
- c. Use of black poly-ethylene mulch is recommended for spongy tissue prone orchards.
- d. Resistant varieties like Ratna, Arka Puneet, Arka Aruna which have Alphonso

like character should be planted in the orchard.

5. Fruit Drop: Despite initial high fruit set, the ultimate retention is quite low in mango (only 0.1% perfect flowers develop fruit to maturity). The intensity of fruit drop varies from variety to variety. Among the commercially grown varieties, Langra is more susceptible to drop while Dashehari is the least. Fruit drop in mango is classified into three groups: (i) Pinhead drop, (ii) Post-setting drop and (iii) pre-harvest drop (May drop). The first two drops causes less economic losses to the growers but the third group is most destructive and cause huge economic losses to the growers as the fruits totally drop down at pre-harvesting stage. A good deal of fruit drop is attributed to disintegration of embryos and ovular abnormalities. Other factors like climatic conditions, disturbed water relations, lack of nutrition, competition among fruits and pests and diseases also play important role in fruit drop.

Management Strategies

- a. The extent of fruit drop in mango can be significantly reduced by regular and frequent irrigations during the entire fruit developmental period.
- b. Orchards should be protected from desiccating winds by planting wind breaks.
- c. Timely and effective control measures against major pests and diseases should be adopted.
- d. Growth regulators like NAA and 2,4-D in varying concentration depending upon the variety and time of application can be sprayed. The optimum concentration lies

between 10- 15 ppm during the month of April-May.

6. Clustering (Jhumka): It implies the development of fruits in clusters at the tip of the panicles. Such fruits do not grow beyond pea or marble stage and drop down after a month of fruit set. Mainly it is due to lack of pollination / fertilization which may be attributed to many reasons such as the absence of sufficient population of pollinators in the orchards, indiscriminate spray of pesticides during flowering, spraying of synthetic pyrethroids, monoculture and bad weather during flowering.

Management Strategies:

- a. Spraying of pesticides during flowering should be avoided. Apart from this, monoculture in the orchard should be avoided by planting at least 5-6 per cent of other cultivars in new plantations. In old orchards, a few branches should be top worked with pollinizing varieties.
- b. Introduction of beehives in the orchards during flowering season for increasing the number of pollinators.

7. Internal Fruit Necrosis: It is characterized by the appearance of dark green colour in lower half of the fruit followed by browning of the seed and mesocarp which ultimately turned into brown black necrotic lesion. At advanced stage complete lower half of the fruits turns necrotic and results into longitudinal cracking of the fruit through the necrotic region exposing the seed. It is mainly due to boron deficiency.

Management Strategies

This disorder can be corrected by soil or foliar application of boron. For soil application, Borax @ 500 g per tree should be incorporated at the time of October fertilization. Foliar application of 1 % borax is recommended at the time of fruit set (pea size stage) followed by two more sprays at 10-15 days interval which will minimize the disorder to a great extent.

8. Leaf scorching in mango: The characteristic symptom is akin to that of potash deficiency i.e. scorching of old leaves at the tips or margins. The leaves fall down and consequently, the tree vigour and yield is reduced. It is mainly due to excess of chloride ions which render potash unavailability. This disorder is more common in saline soils or where brackish water is available for irrigation or where muriate of potash is used as a fertilizer to meet the potash requirement of the plants.



Fig. Leaf Scorching of Mango

Management Strategies

a. It can be checked effectively by collecting and burning the fallen leaves and using potassium sulphate instead of muriate of potash.

b. Acute condition can be cured by 4-5 foliar applications of potassium sulphate on newly emerged flushes at fortnightly intervals.

Conclusion: Among all the physiological disorders associated with mango, none is due to a single factor but all are due to the amalgamation of several factors like genetic factors, environmental factors, nutritional imbalance, poor cultural practices in the orchard, etc. So, it is very difficult bring a affected orchard into a healthy orchard in a single step within one or two years. But proper cultural and management practices like application of required fertilizers at proper stage, pruning of some old branches just after harvesting, deblooming of some flower buds during February-March, application of recommended plant growth regulators at proper stage etc. can prevent the disorders to a large extent. Hence, mango farmers should follow all the recommended cultural and management practices in a proper manner in time so as to prevent from any disorder. Some varieties like Pusa Shrestha, Pusa Pitambar, Pusa Lalima, Pusa Pratibha are regular bearing developed from IARI, New Delhi and Arka Puneet, Arka Aruna are free from spongy tissue developed from IIHR, Bangalore. Farmers should adopt these new cultivars either by top working on older cultivars or by replacing with older one. For recent updates to overcome these problems, farmers can also consult with horticultural specialists, agricultural pathologists and state and central government's agriculture officers, extension officers at village level to gather valuable ideas for profitable mango cultivation.