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Current Scenario of Production, Area and some Important Post Harvest Disease of Mango and their Management in India: An Overview

[1]Bijendra Kumar Singh, [2]Saurabh Singh and [3]S.M. Yadav
[1]Department of Mycology and Plant Pathology,
[2]Department of Horticulture and Vegetable Science,
[3]Institute of Agricultural Science, Banaras Hindu University, Varanasi, 2210105, India

Abstract: Mangoes account for approximately half of all tropical fruits produced worldwide. India is the largest mango producer accounting for about half of the global mango production. This research attempts to study about the production, area, productivity, disease associated with mango, management and factor which are responsible for the low production of Mango. Mango, a tropical fruit of great economic importance is generally harvested green and then commercialised after a period of storage. Unfortunately, the final quality of mango batches is highly heterogeneous in fruit size as well as in gustatory quality and postharvest behaviour. A large amount of knowledge has been gathered on the effects of the maturity stage at harvest and postharvest conditions on the final quality of mango. Considerably, less attention has been paid to the influence of environmental factors on mango growth, quality traits and postharvest behaviour. The preharvest factors presented here are light, temperature, carbon and water availabilities which can be controlled by various cultural practices such as tree pruning, fruit thinning and irrigation management. Recent advances are also discussed in modelling mango function on the tree according to environmental conditions that combined with experimental studies, can improve our understanding of how these preharvest conditions affect mango growth and quality.

Key words: Mango, preharvest, disease, area, production

INTRODUCTION

Mango is a fleshy fruit containing more than 80% water (Lakshminarayana *et al*., 1970). Its size depends on the accumulation of water and dry matter in the various compartments during fruit growth. The skin, the flesh and the stone have specific compositions that appear to accumulate water and dry matter at different rates depending on environmental conditions (Lechaudel *et al*., 2002). Fruit growth after cell division consists in the enlargement of fruit cells characterised by a large accumulation of water that results from the balance between incoming fluxes such as phloem and xylem and outgoing fluxes such as transpiration (Ho *et al*., 1987). Changing the balance between these various fluxes which have elastic and plastic components, leads to large variations in fruit volume. Mango dry matter mainly consists of carbohydrates, 60% of which are sugars and acids (Ueda *et al*., 2000), the main compounds contributing to fruit sweetness and acidity (Malundo *et al*., 2001). The amount of carbohydrates supplied to tree fruits depends on the amount produced by leaf photosynthesis on sink demand and on the availability of the reserve pool. Also, from the point of view of fruit quality, it is essential to understand how preharvest factors influence source-sink relationships involved in fruit growth. Fruit flesh taste is highly dependent on the balance between organic acids and soluble sugars which are predominantly represented in mango by citric and malic acids and sucrose, fructose and glucose, respectively (Medlicott and Thompson, 1985). The patterns of these compounds during mango development and maturation are well described, even if many studies deal with the evolution of fruit flesh composition during ripening according to harvest date. To our knowledge, only a few results of preharvest factor effects on mango taste have been reported. Studies on mango dealing with the factors that determine the final quality of fruit at the consumer level have generally focused on maturity at harvest (Jacobi *et al*., 1995; Lalel *et al*., 2003) and on postharvest management (Hoa *et al*., 2002; Nunes *et al*., 2007). However, as is the case with other stone fruits, pre-harvest cultural practices which affect the environmental conditions of fruit development, profoundly influence postharvest performance and final quality (Crisosto *et al*., 1995; Hewett, 2006). Few studies related to the effects of environmental factors on mango quality before harvest

Corresponding Author: Saurabh Singh, Department of Horticulture and Vegetable Science, Banaras Hindu University, Varanasi, 2210105, India

have been carried out and even less have focused on the interaction between preharvest and postharvest factors, whereas it is necessary to take these factors into account in order to propose technical solutions to improve final mango quality.

AREA

Area, production and productivity of important mango producing countries are given in Table 1. India is the major mango growing country contributing nearly 46.74% of world's area and 40.48% of world's production, respectively. The share of China in world's area and production is 9.4 and 11.72% while the share of Thailand in world's area and production is 6.29% and 6.87, respectively. These three important countries contribute more than 56% of world area and production. In case of productivity, Brazil ranks first i.e., 15.83 tonnes/hact., followed by Pakistan and Indonesia i.e., 10.6 and 9.78 tonnes/hact. Though, India is the major mango producing country but its productivity is only six tonnes/hact.

Table 1: Area and production of mango (2012-2013)

States	Area	Production
Andaman nicobar	0.30	2.80
Andhra pradesh	489.66	4406.92
Arunachal pradesh		
Assam	5.39	55.27
Bihar	147.74	1363.80
Chhatisgarh	60.15	291.83
D and N haveli	-	-
Daman and diu	-	-
Delhi	-	-
Goa	4.77	9.04
Gujarat	141.26	1003.71
Haryana	9.01	79.55
Himachal pradesh	39.81	50.00
Jammu and kashmir	12.50	23.09
Jharkhand	51.33	517.92
Karnataka	178.80	1795.10
Kerala	74.44	441.03
Lakshadweep	-	-
Madhya pradesh	25.18	376.00
Maharashtra	482.00	633.00
Manipur	-	-
Meghalaya	-	-
Mizoram	0.75	3.47
Nagaland	0.42	3.00
Odisha	197.46	753.79
Puducherry	0.20	3.41
Punjab	6.66	105.92
Rajasthan*	5.00	70.17
Sikkim	-	-
Tamil nadu	152.43	714.08
Tripura	8.38	28.85
Uttar pradesh	274.03	4386.99
Uttarakhand	39.85	148.64
West bengal	92.50	735.00
Total	2500.02	18002.38

Indian horticulture database, 2012-2013

Area under cultivation and production trends of mangoes: Major producing States are Andhra Pradesh, Bihar, Gujarat, Karnataka, Maharashtra, Orissa, Tamil Nadu, Uttar Pradesh and West Bengal. Other States, where mangoes are grown include Madhya Pradesh, Kerala, Haryana and Punjab etc.

PRODUCTIVITY

Average productivity of mangoes is 7.2 mt ha^{-1}. Productivity of mango depends mainly upon three factors; (1) Selection of cultivar, (2) Age of the tree and (3) Adoption of pre-harvest technology. Uttar Pradesh ranked second in case of area coverage of mangoes but stood first in production and productivity having production and productivity 3823.22 thousand tones and 14.56 tonnes per hectares, respectively during 2012-13. Andhra pradesh was having highest area but productivity is only 9.60 tonnes per hectares.

ENVIRONMENTAL FACTORS

Preharvest factor affecting the low production of mango

Light environment: Light exposure is a factor that varies with the position within the canopy of the fruit-bearing branch and of the fruit itself. The effect of light on photosynthesis includes both a direct effect of the photosynthetic photon flux on the rate of electron flow (Farquhar *et al*., 1980) and an indirect effect of light on leaf photosynthetic capacity, since plants allocate nitrogen resources within the canopy to enhance photosynthetic capacity in portions of the tree receiving high irradiances (Hollinger, 1996).

Temperature: Simulations have shown that temperature influences processes involved in fruit growth at the sink level, i.e., fruit demand and growth rate. The contribution of temperature to fruit demand can be associated with the daily variation in degree-days used to compute fruit demand in the model of mango growth in dry mass (Lechaudel *et al*., 2005).

Carbon availability: It is a recognised fact that fruit growth is mainly affected by the availability of carbohydrates. For mango, it would be useful to determine the leaf-to-fruit ratio of a girdled branch or the crop load of a tree required to obtain optimum fruit size, since biennial bearing which can be due to depletion of carbohydrates occurs in many mango cultivars (Chacko *et al*., 1982; Reddy and Singh, 1991). The shortage of assimilate supply appeared to increase glucose and fructose content per unit of structural dry

mass in mango flesh. This result indicates a possible role of these hexoses during fruit development in osmotic adjustment, even if this strategy to sustain growth during stress conditions was only reported for water stress (Wang and Stutte, 1992).

Water availability: The main effect of water stress on fruit growth according to the quantity of water shortage and the period when stress occurred was to alter the final mango size. Simmons *et al.* (1995) observed that if irrigation was cut off between flowering and the first half of the growing period, water stress occurred and affected fruit growth rate and final fruit size. However, for a water shortage close to harvest (1.5 weeks before harvest, for example), no effect on fruit size was observed. Early water stress influenced final fruit size through an effect on the cell number.

SOME IMPORTANT DISEASE OF MANGO AND THEIR MANAGEMENT

Powdery mildew (*Oidium mangiferae*): Powdery mildew is one of the most serious diseases of mango affecting almost all the varieties. The characteristic symptom of the disease is the white superficial powdery fungal growth on leaves, stalk of panicles, flowers and young fruits. The affected flowers and fruits drop pre-maturely reducing the crop load considerably or might even prevent the fruit set. Rains or mists accompanied by cooler nights during flowering are congenial for the disease spread.

Management: Alternate spraying of Wettable sulphur 0.2% (2 g Sulfex/litre), Tridemorph 0.1% (1 mL Calixin/litre) and Bavistin at 0.1% at 15 days interval are recommended for effective control of the disease. The first spray is to be given at panicle emergence stage.

Anthracnose (*Colletotrichum gloeosporioides*): It is of widespread occurrence in the field and in storage. The disease causes serious losses to young shoots, flowers and fruits under favorable climatic conditions (high humidity, frequent rains and the temperature range of 24-32°C). The disease produces leaf spot, blossom blight, withered tip, twig blight and fruit rot symptoms. Tender shoots and foliage are easily affected which ultimately cause die back of young branches. Older twigs may also be infected through wounds which in severe cases may be fatal. Black spots develop on panicles. Severe infection destroys the entire inflorescence resulting in failure of fruit setting. Young infected fruits develop black spots, shrivel and drop off. Fruits infected at mature stage carry the fungus into storage and cause considerable loss during storage, transit and marketing.

Management: The diseased twigs should be pruned and burnt along with fallen leaves. Spraying twice with Carbendazim (Bavistin 0.1%) at 15 days interval during flowering controls blossom infection. Spraying of copper fungicides (0.3%) is recommended for the control of foliar infection. Postharvest disease of mango caused by anthracnose could be controlled by dip treatment of fruits in Carbendazim (0.1%) in hot water at 52°C for 15 min.

Die back (*Botryodiplodia* (*Lasiodiplodia*) theobromae): Die back is one of the serious diseases of mango. The disease on the tree may be noticed at any time of the year but it is most conspicuous during October-November. The disease is characterized by drying of twigs and branches followed by complete defoliation which gives the tree an appearance of scorching by fire. Initially, it is evident by discoloration and darkening of the bark. The dark area advances and extends outward along the veins of leaves. The affected leaf turns brown and its margins roll upwards. At this stage, the twig or branch dies, shrivels and leaf falls. This may be accompanied by exudation of yellowish brown gum.

Management: Pruning of the diseased twigs 2-3 inches below the affected portion and spraying Copper Oxychloride (0.3%) on infected trees controls the disease. The cut ends of the pruned twigs are pasted with Copper Oxychloride (0.3%).

Phoma blight (*Phoma glomerata*): The symptoms of the disease are observed only on old leaves. Initially, the lesions are angular, minute, irregular, yellow to light brown, scattered over leaf lamina. As the lesions enlarge their colour changes from brown to cinnamon and they become almost irregular. In case of severe infection such spots coalesce forming patches resulting in complete withering and defoliation of infected leaves.

Management: The disease is controlled by spraying Benomyl (0.2%) just after the appearance of the disease followed by 0.3% Miltox (Copper Oxychloride + Zineb) at 20 day interval.

Bacterial canker (*Xanthomonas campestris* pv. *mangiferaeindicae*): Canker is a serious disease in India. The disease causes fruit drop (10-70%), yield loss (10-85%) and storage rot (5-100%). Many commercial cultivars of mango including Langra, Dashehari, Arnrapali, Mallika and Totapuri are susceptible to this disease. The disease is found on leaves, petioles, twigs, branches and fruits. The disease first appears as minute water soaked irregular lesions on any part of leaf or leaf

lamina. Several lesions coalesce to form irregular necrotic cankerous patches. In severe infections, the leaves turn yellow and drop off. Cankerous lesions also appear on petioles, twigs and young fruits. The water soaked lesions also develop on fruits which later turn dark brown to black. They often burst open, releasing highly contagious gummy ooze containing bacterial cells.

Management: Three sprays of Streptocycline (0.01%) or Agrimycin-100 (0.01%) after first visual symptom at 10 day intervals and monthly sprays of Carbendazim (Bavistin 0.1%) or Copper oxychloride (0.3%) are effective in controlling the disease.

Red rust (*Cephaleuros virescens*): The disease attack causes reduction in photosynthetic activity and defoliation of leaves thereby reducing the vitality of the host plant. The disease is evident by the rusty red spots mainly on leaves and sometimes on petioles and bark of young twigs. The spots are greenish grey in colour and velvety in texture. Later, they turn reddish brown. The circular and slightly elevated spots sometimes coalesce to form larger and irregular spots. The affected portion of stem cracks. In case of severe infection, the bark becomes thick, twigs get enlarged but remain stunted and the foliage finally dries up.

Management: Two to three sprays of Copper Oxychloride (0.3%) is effective in controlling the disease.

Sooty mould (*Meliola mangiferae*): The disease is common in the orchards where mealy bug, scale insects and hoppers are not controlled efficiently. The disease in the field is recognized by the presence of a black sooty mould on the leaf surface. In severe cases, the trees turn completely black due to the presence of mould over the entire surface of twigs and leaves. The severity of infection depends on the honey dew secretion of the above insects. Honey dews secretions from insects stick to the leaf surface and provide necessary medium for fungal growth. Although, the fungus causes no direct damage, the photosynthetic activity of the leaf is adversely affected.

Management: Pruning of affected branches and their prompt destruction followed by spraying of Wettasulf (0.2%) + Metacid (0.1%) + gum acacia (0.3%) helps to control the disease.

Diplodia stem-end rot (*Lasiodiplodia theobromae*): The fungus enters through mechanically injured areas on the stem or skin. The fungus grows from the pedicel into a circular black lesion around the pedicel.

Management: Careful handling to minimize mechanical injuries. Postharvest dip of fruits in Carbendazim (0.1%) in hot water at 52±1°C for 15 min controls the disease in storage and transit.

POST-HARVEST MANAGEMENT

Post-harvest management means the handling of an agricultural product after harvest to prolong storage life, freshness and an attractive appearance. In order to deliver a quality product to the market and ultimately to the consumer to command buyer attention and gives the grower a competitive edge, proper post-harvest management is the need of the hour. Nearly, 20-25% of fruits are wasted due to faulty post-harvest practices during harvesting packaging, storage and grading etc. This wastage can be reduced to some extent through proper and scientific methods post-harvest management can be considered as second production operation to add values to the products and the basic means for effective marketing. Post-harvest management operations are quite diversified consisting of collection, curing, pre-treatment, grading, packaging, pre-cooling, low temperature storage, pallet loading, transporting and depending upon various crops. Like post-harvest management, the pre-harvest and subsequent harvesting of the fruits also plays an important role in enhancing the shelf life and quality of the fruits.

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