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Black Tip Disorder of Mango in Jharkhand: Causes and Management Strategies

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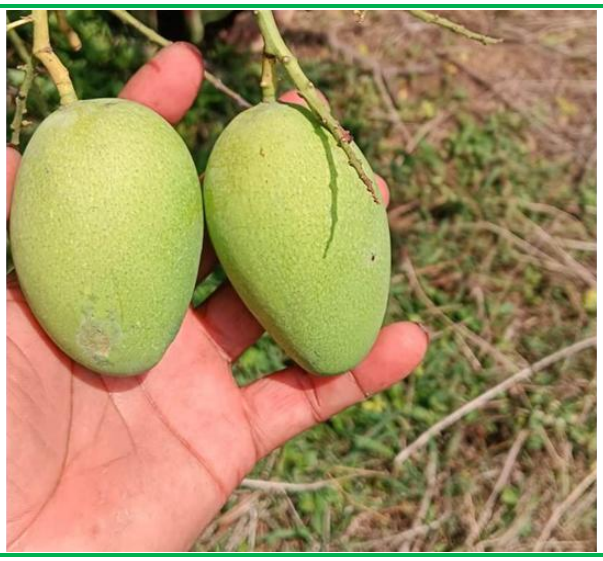
Mango (*Mangifera indica* L.) belonging to the family Anacardiaceae with chromosome number 2n = 40, is one of the most important tropical fruit crops cultivated in Jharkhand and plays a vital role in the horticultural economy of the state. However, mango production and fruit quality are adversely affected by several physiological disorders, among which black tip is considered a serious problem in orchards located near brick kilns and industrial emission zones. Black tip is a non-pathogenic disorder characterized by browning, necrosis, and blackening at the stylar end of developing fruits, leading to reduced fruit size, poor appearance, premature fruit drop, and low market acceptability. The disorder is mainly caused by toxic gases such as sulphur dioxide (SO_2), carbon monoxide (CO), carbon dioxide (CO_2), ethylene, and soot particles released from brick kilns, which injure the tender tissues of developing fruits (Nauriyal et al., 1968). In Jharkhand, increasing brick manufacturing activities near mango-growing regions may enhance the incidence of this disorder. Management strategies such as maintaining adequate distance between orchards and kilns, increasing chimney height, adopting cleaner kiln technologies, and foliar spraying of borax (1%), sodium carbonate (0.5%), or caustic soda (0.8%) at regular intervals have been found effective in reducing the severity of black tip (Chadha and Pal, 1986). Therefore, integrated orchard management, environmental regulation, and farmer awareness are essential for minimizing economic losses and improving mango fruit quality in Jharkhand.

Introduction

Mango (*Mangifera indica* L.) is one of the most important and widely cultivated tropical fruit crops in the world and belongs to the family Anacardiaceae. The crop possesses a chromosome number of 2n = 40 (Darlington and Wylie, 1955; Pierozzi and Rossetto, 2011). Mango is popularly known as the "King of Fruits" because of its excellent taste, attractive flavor, pleasant aroma, and high nutritive value (Singh, 1960). India is recognized as the largest producer of mango in the world and contributes a major share to global mango production (Litz, 2009). The fruit is consumed both in fresh and processed forms and is utilized for preparation of juice, pulp, squash, pickles, chutney, nectar, jam, and several other value-added products. Mango fruits are rich sources of carbohydrates, vitamins A and C, minerals, antioxidants, and dietary fiber, making them highly beneficial for human nutrition and health (Salunkhe and Desai, 1984). Jharkhand possesses favorable agro-climatic conditions for cultivation of mango, and the crop is widely grown in districts such as Ranchi, Dumka, Deoghar, Godda Pakur and some area of Khunti. Despite good production potential, fruit quality is often reduced by physiological disorders. Black tip of mango is one such

disorder associated with air pollution from nearby brick kilns. The problem is more severe when orchards are situated close to smoke-emitting units during fruit development. This disorder causes blackening of the distal end of fruits, resulting in poor appearance, reduced growth, and economic loss to growers. Black tip disorder is primarily associated with toxic gases such as sulphur dioxide, carbon monoxide, and ethylene released from the smoke of brick kilns (Singh, 1988). These pollutants adversely affect the developing fruits, especially during the active stages of fruit growth and development. The disorder generally appears on fruits situated on the side of the tree exposed to kiln smoke and becomes more severe when orchards are located within close proximity to brick-manufacturing units (Rymbai et al., 2016). Initially, yellowing develops near the distal or stylar end of the fruit, which gradually turns brown and finally black as the disorder advances. In severe cases, the affected tissues become necrotic, hard, and cracked, resulting in reduced fruit size, poor fruit appearance, inferior quality, and diminished market value.

The severity of black tip disorder is influenced by several environmental and management factors such as distance of orchard from brick kilns, direction of prevailing winds, concentration of toxic gases, climatic conditions, and varietal susceptibility. Fruits affected by black tip fail to attain normal growth and ripening, thereby causing considerable economic losses to mango growers (Rajan and Singh, 2002). Since fruit appearance and quality are major determinants of consumer acceptance and export potential, the occurrence of black tip poses a serious challenge for profitable mango cultivation in affected areas.



Symptom at initial stage

Symptom at advance stage

Importance of Mango in Jharkhand

Mango is grown both in homestead orchards and commercial plantations in Jharkhand. Common cultivars include local seedling types and improved varieties such as Dashehari, Langra, Amrapali, Mallika, Bombay Green and regional selections. Mango provides:

- Seasonal income to small and marginal farmers
- Employment in harvesting, grading, and transport
- Raw material for pickle, pulp, and processing units
- Nutritional fruits rich in vitamins A and C
- Any reduction in marketable fruit quality therefore directly affects rural livelihoods.

Historical Background

The earliest published report of black tip in mango dates back to 1909, when Woodhouse observed mango fruits damaged by smoke from brick kilns at Sabour Farm in Bihar. Since the historical Bihar region was geographically adjacent to present-day Jharkhand, these findings are highly relevant to eastern Indian mango ecosystems. Later studies confirmed that the disorder was physiological rather than infectious and strongly associated with kiln fumes.

Etiology of Black Tip

Black tip is a non-pathogenic physiological disorder caused mainly by toxic gases released from brick kilns. The principal gases reported are:

- Sulphur dioxide (SO_2)
- Carbon monoxide (CO)
- Carbon dioxide (CO_2)
- Ethylene / acetylene gases
- Soot and smoke particles

These pollutants injure the tender tissues of young fruits, especially at the stylar end, leading to necrosis and discoloration. Severity depends on wind direction, proximity of kiln, and local climatic conditions.

Relevance in Jharkhand

In many parts of Jharkhand, seasonal brick kilns operate near agricultural land. Many districts have temporary or permanent brick manufacturing units near villages and farmland. Mango orchards located around peri-urban and rural production belts may therefore be exposed to smoke and acidic fumes during flowering and fruit development. Such conditions can increase the risk of black tip incidence, especially under stagnant air and dry summer weather. Growers may confuse black tip with fungal disease or sunburn, delaying preventive action. While district-wise published incidence data are limited, the disorder remains agriculturally relevant wherever orchards and kilns coexist.

Symptoms

- Small yellowish or brown spots first appear at the fruit tip.
- Spots enlarge and turn dark brown to black.
- The affected tissue becomes hard, sunken, and necrotic.
- Fruit growth is restricted, resulting in undersized fruits.
- Cracking may occur in severe cases.
- Premature fruit drop reduces yield.

Economic Importance

Black tip significantly lowers fruit appearance, consumer acceptance, and market price. Severely affected fruits become unsuitable for table use and premium markets. For mango growers in Jharkhand, this can reduce profitability, especially where orchards supply local mandis and urban markets.

Management Strategies

1. Orchard Planning

- Avoid establishing mango orchards near brick kilns. Mango orchards should preferably be located **more than 1–2 km away** from brick kilns.

 Traditional low-height kilns are more harmful because smoke remains near the orchard canopy. Maintain adequate distance between kilns and orchards.

- Prefer open sites with better air circulation.

2. Industrial Measures

Increase chimney height to disperse gases upward. Brick kiln chimneys should be at least **15–18 meters (50–60 feet) high** to reduce the concentration of harmful gases near mango orchards.

- Promote cleaner fuel use and pollution control in kilns.

3. Chemical Control

- Sprays of alkaline solutions help reduce injury:
- Borax (1.0%)
- Sodium carbonate (0.5%)
- Caustic soda (0.8%)

- Apply 2–3 sprays after fruit set at 10–15 day intervals.

4. Orchard Care

- Balanced nutrition and irrigation
- Timely pruning
- Regular orchard monitoring during fruit development

Suggested Research Priorities for Jharkhand

- District-wise survey of black tip incidence
- Mapping orchards near kiln clusters
- Screening local mango genotypes for tolerance
- Air pollutant analysis around orchards
- Economic loss estimation
- Standardized spray schedule for Jharkhand climate

Conclusion

Black tip of mango is an important pollution-induced physiological disorder that can affect fruit quality in Jharkhand, particularly where brick kilns are located near orchards. Preventive orchard planning, environmental regulation, and timely chemical sprays are effective tools for management. Integrated management through better orchard siting, kiln regulation, alkaline protective sprays, and grower awareness can substantially reduce losses. Future district-level studies are needed to quantify incidence and develop region-specific recommendations. With growing demand for quality mango fruits, attention to black tip control is essential for sustainable mango production in Jharkhand.

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