

Botanical Leaf Packing as a Green Strategy to Manage Stem End Rot Caused by *Lasiodiplodia theobromae* in Mango cv. Kesar

Abstract

Mango (*Mangifera indica* L.) is one of the most important tropical fruit crops of India; however, its production and market value are severely affected by post-harvest diseases, particularly stem end rot (SER). During storage and ripening, stem end rot caused by latent fungal infections such *Lasiodiplodia theobromae* causes large post-harvest losses. Concerns about fungicide resistance, chemical residues, environmental contamination, and hazards to human health have been brought up by the overuse of synthetic fungicides for disease management. Thus, there is an immediate need for sustainable and eco-friendly alternatives. The current study was conducted to assess the effectiveness of various plant leaf treatments for the management of stem end rot disease in the mango variety Kesar. Fresh leaves of tulsi, karanja, curry leaf, neem, lantana, eucalyptus, and drumstick were packed inside 25 g kg⁻¹ of healthy, homogeneous mango fruits, which were then kept at room temperature using a fully randomized method. Healthy, uniform mango fruits were packed with fresh leaves of tulsi, karanja, curry leaf, neem, lantana, eucalyptus, and drumstick at 25 g kg⁻¹ fruit and stored at room temperature under a completely randomized design. Disease incidence and shelf life observations were noted. In comparison to the control (70.00%), the results showed that fruits packed with karanja leaves had the lowest disease incidence (20.00%), which was at par with neem leaves (23.33%), followed by tulsi and eucalyptus leaves (30.00%). Fruits treated with neem leaves (12.67 days) and karanja leaves (14.67 days) had far longer shelf lives than control fruits (7.00 days). The study showed that plant leaf treatments—specifically, karanja and neem leaves—are safe, efficient, and eco-friendly substitutes for controlling stem end rot disease and extending the shelf life of mango fruits.

Keywords: Mango, Stem end rot, Leaves, Per cent disease incidence, Shelf life

1. Introduction

One of India's most significant tropical fruit crops, the mango (*Mangifera indica* L.) is referred to as the "King of Fruits" because of its superior flavor, abundance of nutrients, and versatility (Mayani *et al.*, 2017). Mango, *Mangifera indica* L., a member of the Anacardiaceae family and order Sapindales (Anusha *et al.*, 2023). Fundamental chromosomal number of mango is 10 ($2n = 4x = 40$) (Hassan Zai, 2024). It is frequently grown in tropical and subtropical regions of Southeast Asia. It is believed that mangoes originated in India,

Burma (Myanmar) and even the Malay region. In the sixteenth century, it started to spread to other continents (Anusha *et al.*, 2023).

"Alphonso" and "Kesar" in western India, "Banganpalli," "Totapuri," and "Neelum" in southern states, "Bombai," "Gulabkhas," "Malda," "Zardalu," and "Fazli" in eastern states, and "Dashehari," "Langra," and "Chausa" in northern states are popular varieties grown throughout the nation (Singh *et al.*, 2017). Kesar, Alphonso, Rajapuri, Totapuri, Dadamiyo, Jamadar, Dashehari, Langra, Karanjiyo, Sardar, and Neelum are among the commercial mango varieties planted in Gujarat (Noorullah, 2018).

Gujarat is one of the top mango-producing states due to its advantageous agro-climatic conditions and India leads the globe in mango production, accounting for a significant portion of worldwide production (Anon., 2013; Bhagwat *et al.*, 2016). Mango production and marketing are significantly hampered by post-harvest diseases, which result in significant qualitative and quantitative losses during storage, transportation and ripening, despite the fruit's economic significance (Dodd *et al.*, 1997; Haggag, 2010)

Stem end rot (SER) is one of the most severe post-harvest diseases that affect mango quality, shelf life, and marketability (Johnson *et al.*, 1992). Latent fungal pathogens such *Lasiodiplodia theobromae*, *Dothiorella* spp., *Phomopsis mangiferae*, and *Pestalotiopsis* spp., which infect fruit throughout flowering and fruit development stages and remain dormant until ripening, are the primary cause of the disease (Johnson *et al.*, 1992; Galsurker, 2018). Mango fruit undergoes physiological and biochemical changes during ripening, including ethylene generation, increased sugar content, cell wall disintegration, and decreased defense chemicals, which encourage the activation of these pathogens and cause severe decay at stem end (Galsurker, 2018).

Microbial degradation is responsible for 17.0–26.9% of fresh mango post-harvest losses in Asian nations, which are estimated to be between 25 and 40% in India (Diedhiou *et al.*, 2007; Vahia, 2021). Synthetic fungicides are traditionally used to control stem end rot before or after harvest; however, their irresponsible application has led to fungicide resistance, chemical residues, environmental contamination, and possible health risks (Bally, 2006; Zhan *et al.*, 2023). These restrictions have made it necessary to create safe, environmentally acceptable, and sustainable options for the control of mango post-harvest diseases.

Because of their innate antifungal qualities, non-toxicity, and safety for both people and the environment, plant extracts have drawn interest as a potential solution for postharvest disease management (Obagwu & Korsten, 2003).

By serving as an antifungal include flavonoids, phenolic acids, alkaloids, isothiocyanates, tannins, saponins, aliphatic aldehydes, and terpenoids, are responsible for their antimicrobial effectiveness. It has been discovered that using plant extracts can decrease the severity of diseases, postpone fruit ripening, and increase fruit shelf life without producing hazardous residues.

By lowering dependence on chemical fungicides and protecting human health and the environment, eco-friendly management techniques not only reduce post-harvest losses but also support sustainable agriculture (Perrenoud, 1994; Vahia, 2021). However, systematic studies on the use of different plant leaves for the management of mango stem end rot disease are limited, particularly under Indian conditions.

With the goal of reducing post-harvest losses while establishing grower-friendly, sustainable disease management techniques, the current study was conducted to assess the effectiveness of various plant leaf extracts as environmentally sound treatments for the management of mango stem end rot disease.

2. Materials and methods

Ten healthy, uniform in size and shape, free from any bruising and mechanical injured fruits of mango of Kesar variety were collected from farm and each was cleaned by washing under cold tap water then wiped with muslin cloth. Fruits were packed in cardboard boxes by making a layer of leaves (25g Kg⁻¹ fruits) of each treatment along with the control and kept at room temperature. Each fruit amongst the different treatments were thoroughly scrutinized for any visible symptoms of stem end rot disease and end of shelf life was considered when 30 per cent fruits were show over ripen.

3. Observations recorded

- Shelf life
- Number of infected fruits were recorded and per cent disease incidence was calculated by using following standard formulae (Mamatha and Rai, 2000):

$$DI(\%) = \frac{Do}{D} \times 100$$

Where, DI = Disease incidence

Do = Number of infected fruit

D = Total number of fruit

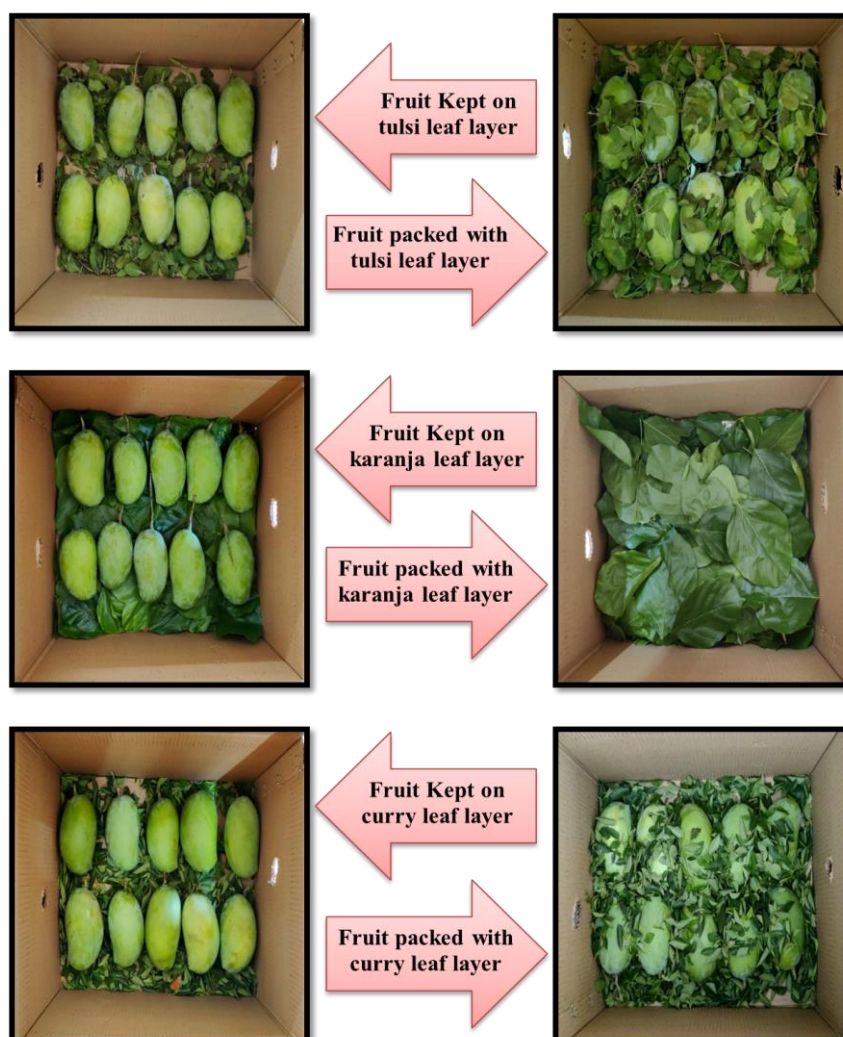
4. Statistical analysis

For the experiment CRD (Completely Randomized Design) design was done through statistical packages. The replicate fruits were used to assess disease incidence and shelf life. Data were subjected to analysis of variance (ANOVA) and disease incidence were arc sine transformed before analysis.

Table 1. Different botanicals used in experiment

Tr. No.	Name	Scientific name	Family	Chemical Compounds
T ₁	Tulsi	<i>Ocimum tenuiflorum</i> L.	Lamiaceae	Eugenol
T ₂	Karanja	<i>Millettia pinnata</i> L.	Febaceae	Karanjin
T ₃	Curry tree	<i>Murraya koenigii</i> (L.) Sprengel	Rutaceae	Murrayacine, Murrayanine
T ₄	Neem	<i>Azadirachta indica</i> A. Juss	Meliaceae	Nimbicidin, Azadirachtin
T ₅	Lantana	<i>Lantana camera</i> L.	Verbenaceae	Sesquiterpenes
T ₆	Eucalyptus	<i>Eucalyptus camaldulensis</i> L.	Myrtaceae	Eucalyptol

T ₇	Drumstick	<i>Moringa oleifera</i> L.	Moringaceae	Niazirin
T ₈	Control			



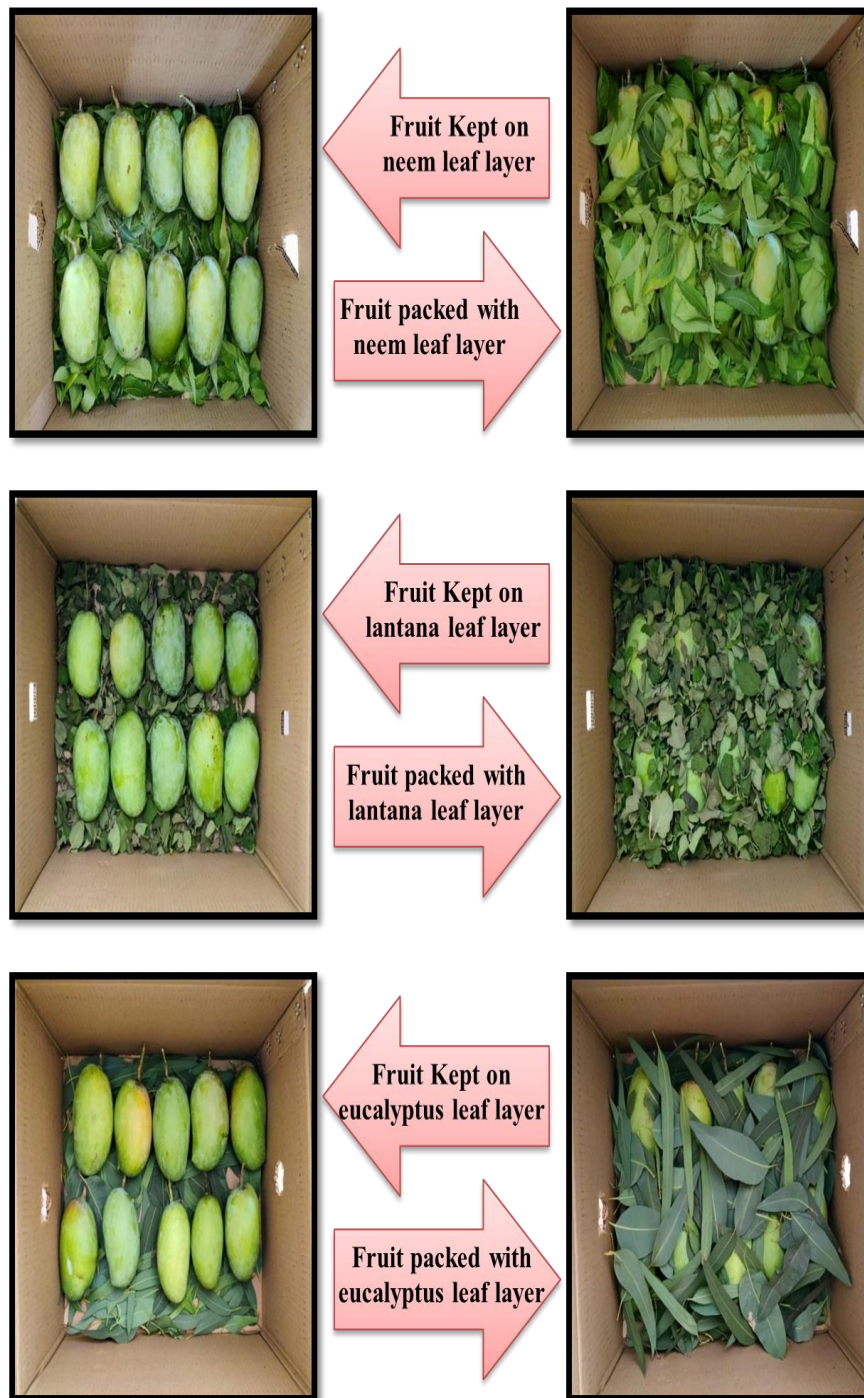




Photo 1 : Mango fruits packed with different botanical leaves in cardboard box (10 kg) with making layer of leave on fruit

5. Results and Discussion

The data presented in table 1 showed that fruit packed karanja leaves show minimum disease incidence (20.00%) which is at par with neem leaves (23.00%) followed by tulsi leaves (30.00%), eucalyptus leaves (30.00%), curry leaves (50.00%), lantana leaves (50.00%), drumstick leaves (53.00%) as compared to control (70.00%). Shelf life of fruit found to be higher in fruits covered by karanja leaves (14.67 days) followed by neem leaves (12.67 days) as compared to control (7 days) (Table 2 and Photo 1).

This, result was in accordance with, Tandel (2017) discovered that mango fruits treated with a 10 per cent solution of neem leaf extract exhibited a notable decrease (88.30%) in the occurrence of stem end rot disease. Additionally, these treated fruits demonstrated an extended shelf life of 11.17 days which was comparable to the shelf life achieved 7.00 days in control fruits.

Suresh and Sagar (2016) who reported that fruit treated with neem and karanj leaf extract (10%) showed significant percent inhibition 8.15 per cent and 5.93 per cent respectively in disease incidence of mango stem end rot disease. The fruits treated with neem leaf extract showed higher shelf life (11.17 days).

Phytochemical profiling studies confirm that karanjin in a karanj plant is prominent with antibacterial, antifungal and antioxidant properties, making it a key compound in the plant's defense mechanism. These studies support the use of *P. pinnata* extracts as natural antimicrobial agents with potential applications in plant and human disease management. Azadirachtin is considered the most active substance in neem, which has growth-regulating, fungicidal and insecticidal properties (Khan *et al.*, 2021). The aroma and volatile compound of different leaves form a thin film around the fruit that works as an anti-repellent and antifungal. Therefore, it prevents the entry, penetration and attack of pathogens.

Table 2. Eco-friendly management of stem end rot disease of mango cv. Kesar

Tr. no	Treatment	Plant part used	PDI (%)	Reduction in incidence (%)	Shelf life (days)
1	Tulsi	Leaves	(30.00) 33.21	57.14	10.67
2	Karanja	Leaves	(20.00) 26.57	71.42	14.67
3	Curry tree	Leaves	(40.00) 39.23	42.85	9.00
4	Neem	Leaves	(23.33) 28.78	66.67	12.67
5	Lantana	Leaves	(40.00) 39.23	42.85	9.00
6	Eucalyptus	Leaves	(30.00) 33.21	57.14	9.67
7	Drumstick	Leaves	(53.33) 46.92	23.81	7.67
8	Control	-	(70.00) 56.79	00.00	7.00
	SEm±		1.04	-	0.31
	CD (%)		3.11	-	0.93
	CV (0.05%)		4.73	-	2.92

*Figures in parenthesis are original value and those outside are arcsine transformation value

6. Conclusion

Mango fruits were pecked in various types of fresh plant leaves when they were at the green ripe stage in order to evaluate the effect of different leaf treatments on the development of stem end rot disease. Our results revealed that fruit packed with karanj leaves showed the lowest incidence (20.00%), which was at par to neem leaves (23.33%), followed by tulsi leaves (30.00%) and eucalyptus leaves (30.00%) in comparison to the control (70.00%). Fruits covered with karanja leaves (14.67 days) and neem leaves (12.67 days) had longer shelf lives than the control (7.00 days).

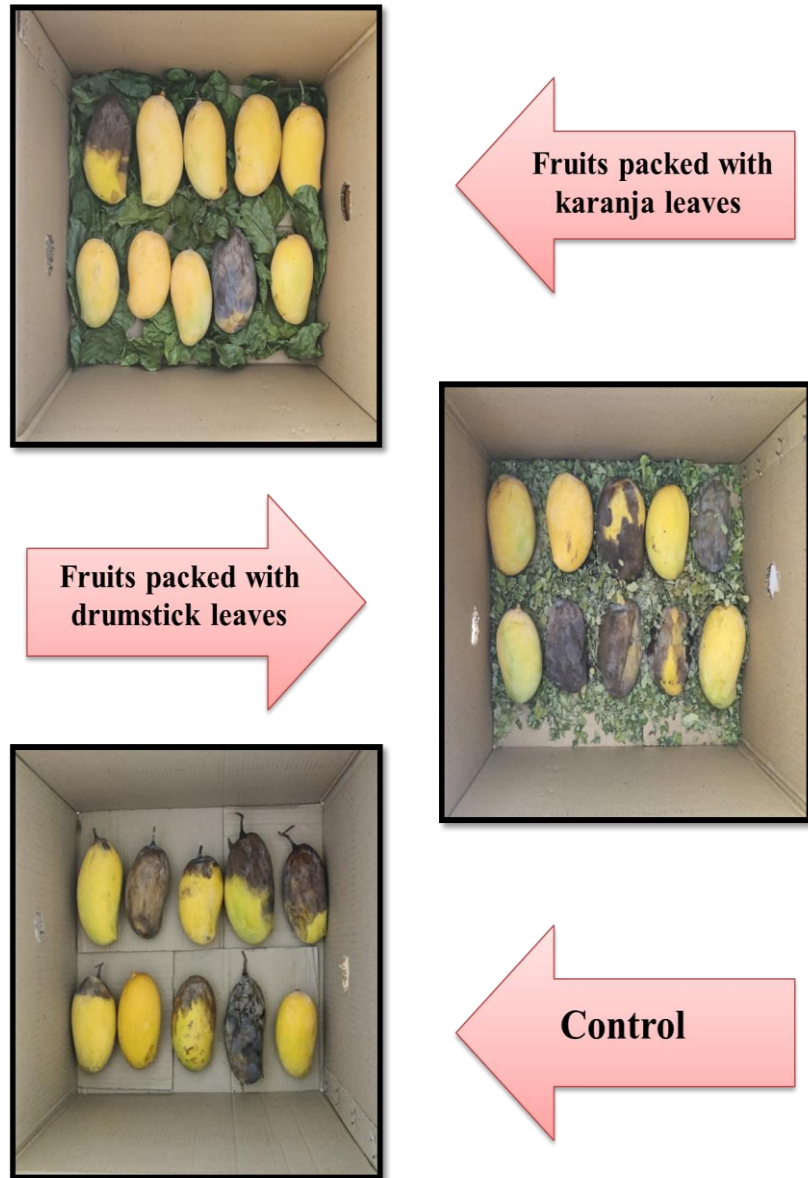


Photo 4 : Most superior and inferior botanicals against mango stem end rot disease

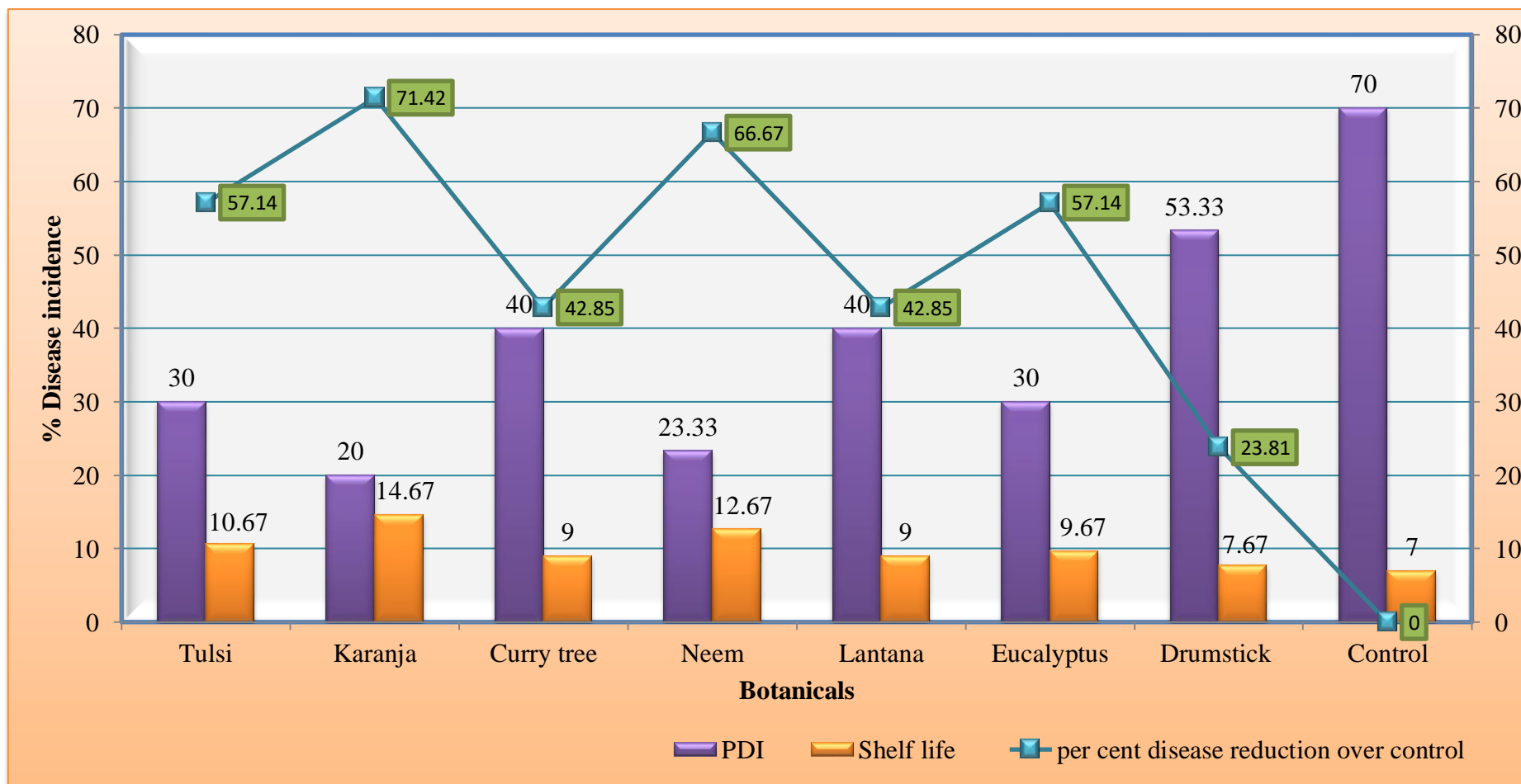


Fig. 1: Eco friendly management of stem end rot disease of mango cv. Kesar

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