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Eco-Friendly Management of Post-Harvest Anthracnose of Mango

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ABSTRACT

Traditional approaches for the management of various post-harvest diseases involving synthetic or chemical preservatives have raised concerns regarding their impact on human health and the environment. In this study, we propose novel and sustainable management practices using a leaf layer as a natural barrier to manage post-harvest anthracnose and extend the shelf life of mango fruits, which offer a promising alternative to the conventional use of chemical fungicides. Therefore, this study was conducted at the Department of Plant Pathology, N. M. College of Agriculture, NAU, Navsari during the year 2022 to find out the effect of different botanicals on the suppression of anthracnose disease and its effect on the shelf life of mango cv. Kesar. Among the evaluated different treatments, fruits covered with neem leaves showed the lowest disease incidence (30.00%) which was at par with fruit covered with lantana leaves (33.33%) followed by fruit covered with marigold leaves (40.00%) as compared to control (80.00%). The shelf life was significantly found higher (13.33 days) in fruit covered with neem leaves followed by fruit covered with lantana leaves (12.00 days) as compared to the control (7.00 days). The aroma and volatile compounds emitted by various leaves create a thin film and delicate layer around the fruit, acting as a natural repellent and antifungal agent. This protective film serves to deter pathogens from entering, penetrating, and attacking the fruit. The utilization of botanicals or plant-based materials for fruit preservation is considered safer for both humans and the environment compared to synthetic or chemical preservatives. Consequently, botanicals could serve as a substantial alternative to chemical pesticides for the management of post-harvest diseases. They are not only eco-friendly and efficient but also cost-effective, ensuring the safety of consumers and the environment.

Keywords: *Mango, anthracnose, botanicals, leaf layer, neem, post-harvest, Eco-Friendly, Colletotrichum gloeosporioides*

INTRODUCTION

Mango (*Mangifera indica* L.) is one of the oldest and choicest tropical fruits of the world and is commonly called as "King" of all fruits. They are a member of the family *Ancardiaceae* and are grown throughout India, in almost all states. Mangoes originated in northeast India, Burma and the Andaman Islands and bordering the Bay of Bengal. Due to their delicious taste and numerous health benefits, mangoes have become one of the most popular tropical fruits consumed worldwide [12]. Mangoes are vulnerable to several diseases throughout their growth stages, from seedling to harvesting. These diseases can have a significant impact on the quality and yield of the mango crop. Post-harvest diseases such as anthracnose, stem end rot, rhizopus rot, aspergillus rot *etc.* pose a significant challenge to the storage and marketing of mango fruits. Among them, anthracnose can affect all parts of the mango tree including the leaves, twigs, flowers, and fruits. It can occur throughout the year and can cause significant damage during the grading, packing, transportation, storage, and marketing of mangoes [2]. In recent times, there has been extensive research conducted on a diverse range of extracts and essential oils, exploring their antimicrobial, antioxidant, insecticidal, and herbicidal properties. The films and coatings developed using these substances have proven to be environmentally friendly, as they are typically non-toxic and biodegradable [8]. Keeping in view the importance of mango and the severity of the disease, the present work was carried out to know the effect of different botanicals on the suppression of anthracnose disease and its effect on the shelf life of mango cv. Kesar. The results obtained were documented here under.

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METHODOLOGY

This experiment was conducted at the Department of Plant Pathology, N. M. College of Agriculture, NAU, Navsari during the year 2022. The effect of different botanicals was tested in the Laboratory condition using a Completely Randomized Design with three repetitions. Ten healthy, uniform in size and shape, free from any bruising and mechanical injury fruits of mango of Kesar variety were collected from NAU farm and each fruit was cleaned by washing under cold tap water and then wiped with muslin cloth. Fruits were packed in cardboard boxes by making a layer of leaves (10 g kg^{-1} fruits) of each treatment along with the control and kept at room temperature (Photo 1). Each fruit amongst the different treatments was thoroughly scrutinized for any visible symptoms of anthracnose disease and the end of shelf life was considered when 30 per cent of fruits were show over ripen.

Assessment of Disease Incidence: The number of infected fruits were recorded and per cent disease incidence was calculated by using the formula given by Mamatha *et al*. (2000) [9]

$$DI(\%) = \frac{D_0}{D} \times 100$$

Where,	DI = Disease incidence
	D_0 = Number of infected fruit
	D = Total number of fruit

RESULTS AND DISCUSSION

The experiment was carried out to study the effect of different leaf layers to manage post-harvest anthracnose in mangoes. Its effect on anthracnose disease development and the shelf life of mango fruit was recorded. Among different treatments, the fruits packed with neem leaves show the lowest disease incidence (30.00%) which was at par with lantana leaves (33.26%) followed by marigold leaves (40.00%), castor leaves (46.65%), drumstick leaves (50.00%), eucalyptus leaves (60.00%), drumstick leaves (70.00%) as compared to control (80.00%). The shelf life of fruit was found to be higher in fruits covered by neem leaves (13.33 days) followed by lantana leaves (12.00 days) as compared to control (7 days) (Table 1 and Photo 2).

The efficacy of different botanicals against anthracnose disease was studied here in line with the efficacy of botanicals against different post-harvest diseases studied by Tandel (2017) who reported that fruit treated with neem leaf extract (10%) showed a significant reduction (91.09%) in disease incidence of mango anthracnose disease. The fruits treated with neem leaf extract showed higher shelf life (11.17 days) at par with lantana leaf extract (10.33 days) as compared to control (7.00 days) [11]. Kolase *et al*. (2014), Khan *et al*. (2021) and Kumar *et al*. (2016) also reported that neem plant extract more effectively inhibited the mycelial growth of *C. gloeosporioides* [5] [6] [7]. Shrestha *et al*. (2018) observed that neem leaf extract gives promising result followed by lantana with minimum physiological weight loss, maximum ascorbic acid content, shelf life, total soluble solids, freshness, and firmness [10]. Dissanayake *et al*. (2019), Bashir *et al*. (2019) and Deressa et al. (2015) observed that leaf extract of *L. camara* inhibited radial mycelium growth and conidia formation of *C. gloeosporioides* [1] [3] [4].

Table 1: Effect of different leaf layer on anthracnose disease and Shelf life of mango cv. Kesar

Tr. No.	Treatments	Plant part used	PDI (%)	Reduction in incidence over control (%)	Shelf life (days)
T_1	Neem	Leaves	33.21 (30.00)*	62.50	13.33
T_2	Lantana	Leaves	35.22 (33.26)	58.42	12.00
T_3	Marigold	Leaves	39.23 (40.00)	50.00	11.00
T_4	Castor	Leaves	43.08 (46.65)	41.69	10.00
T_5	Datura	Leaves	56.79 (70.00)	12.50	7.67
T_6	Drumstick	Leaves	45.00 (50.00)	37.50	9.00
T_7	Eucalyptus	Leaves	50.77 (60.00)	25.00	8.67
T_8	Control	-	63.43 (80.00)	00.00	7.00
SEm±			0.98		0.20
CD at 5%			2.95		0.61
CV (%)			3.71		3.60

**Figures in parenthesis are re transformation value (original value) and those outside are arcsine transformation value.*

The neem plant (*A. indica*) is a valuable resource that contains over 300 primary and secondary metabolites. It is known for its potent natural biopesticide properties and various bioactive compounds have been extracted from neem that exhibited significant antifungal, antibacterial, antioxidant, and anti-repellent properties. Among these compounds, Azadirachtin and Propyl disulfide are the most important. Azadirachtin is considered to be the most active substance in neem, and it possesses growth-regulating, fungicidal and insecticidal properties. It has been shown to inhibit conidial germination and radial mycelial growth of *C. gloeosporioides*. Propyl disulfide is another important compound extracted from neem that has been found to be effective in inhibiting the mycelial growth of *C. gloeosporioides* because they possess strong antifungal and antibacterial properties [5].

In addition to the azadirachtin compound, neem leaves contain several other active ingredients that play a crucial role in disease management. These include nimbidin, gedunin, salannin, meliantriol, nimbidin, mahmoodin, nimbolinin, sodium nimbinate, 22,23-dihydronimocinol, gallic acid and quercetin. The diverse bioactive components present in neem contribute to its remarkable biopesticidal and biofungicidal properties. The utilization of neem leaves as a natural fungicidal treatment not only ensures effective disease control but also promotes a healthier and more environmentally conscious approach to crop protection.

Currently, the leaf layer method used because leaf is easily available, cheap and considered as the best alternative for ecofriendly management of post-harvest diseases. Firstly, it provides a safe and non-toxic alternative that ensures consumer safety. Secondly, it is environmentally friendly, as it reduces the reliance on harmful chemicals and minimizes their impact on ecosystems. Furthermore, the leaf layer method offers a cost-effective solution, utilizing readily available plant materials that are relatively inexpensive. Moreover, the leaf layer help to extend the shelf life of mango fruits by reducing disease incidence and maintaining their overall quality. Thus, leaf layer technique represents a promising approach for managing post-harvest anthracnose in mango fruits and extending their shelf life.

CONCLUSION

Based on present investigations, it is concluded that fruit packed with neem leaves exhibited the lowest incidence (30.00%) which was at par with lantana leaves (33.26%) followed by marigold leaves (40.00%) as compared to control. Maximum incidence was observed in control that is (80.00%). Additionally, the shelf was significantly found higher (13.33 days) in fruit treated with neem leaves followed by lantana leaves (12.00 days) as compared to control (7.00 days). The natural aroma and volatile compounds emitted by various leaves create a protective shield around fruits, acting as a repellent and antifungal agent. This leaf layer serves as a barrier, deterring pathogens and extending the shelf life of mangoes.

Therefore, utilization of botanicals or plant-based materials for fruit preservation as an eco-friendly approach offers a promising alternative to conventional chemical fungicides, providing a safer solution for both humans and the environment. Botanicals emerge as a substantial and eco-friendly alternative to chemical pesticides in managing post-harvest diseases.

FUTURE SCOPE

The future holds exciting prospects for the eco-friendly management of post-harvest anthracnose of mango, coupled with extending shelf life using diverse botanical leaf layers. Anticipated developments include optimizing botanical combinations, exploring bioactive compounds and conducting extensive field trials. Scaling up these eco-friendly solutions, assessing economic viability, and fostering community engagement will shape a sustainable and attractive path toward mango preservation. The future promises not only effective disease management but also a greener and safer approach to mango cultivation.

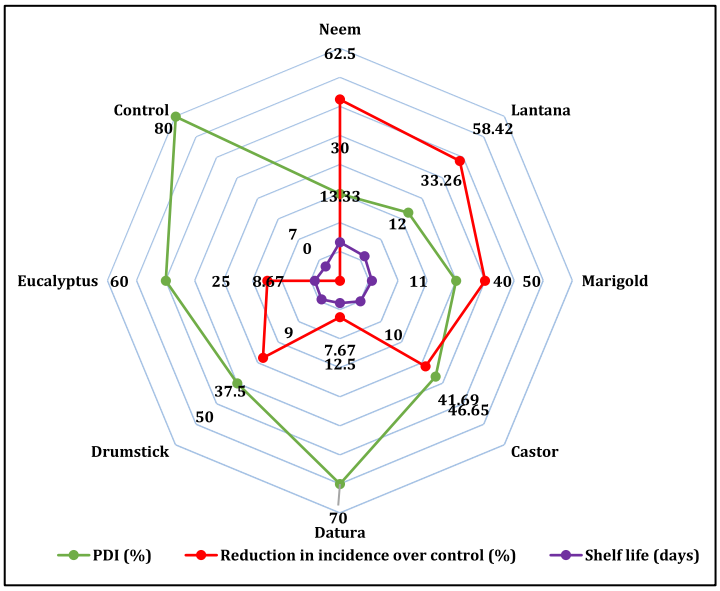

Figure 1: Effect of different leaf layer on anthracnose disease and Shelf life of mango

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Conflict of interest: The authors declare that they have no conflicts of interest.

Photo 1: Mango fruit packed with different botanical leaves in cardboard box (10kg) and cover by making layer of leaves on fruit and control.

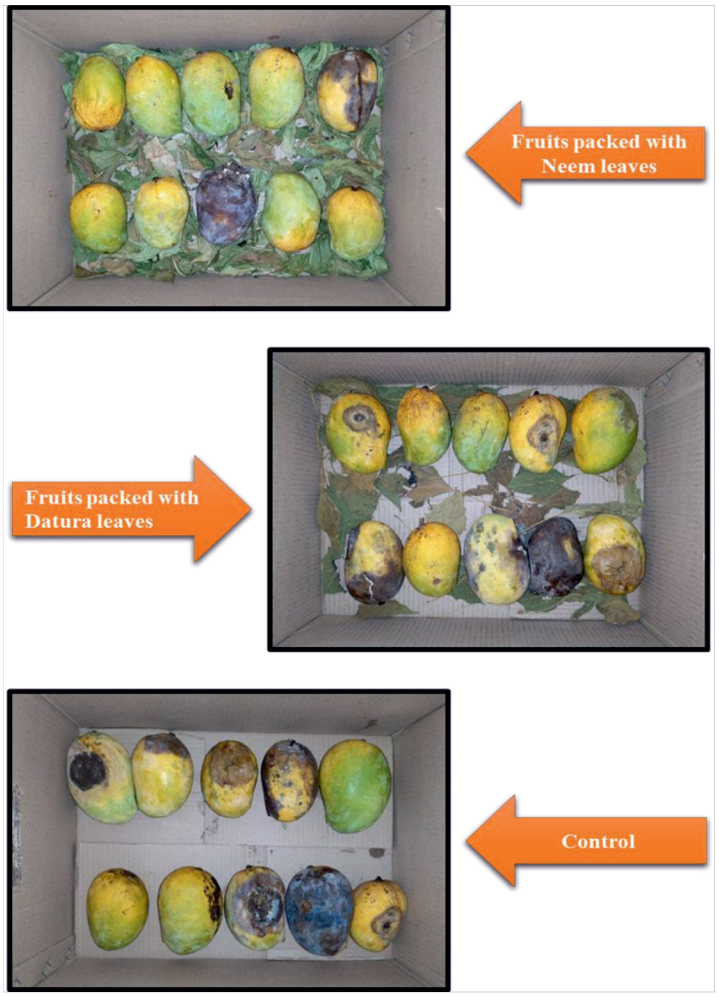

Photo 2: Most superior and inferior botanicals against mango anthracnose disease

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