Current status and symptomatology of neem dieback in Raichur and Yadgir districts of Karnataka, India

ABSTRACT

Neem is an evergreen tree, native to Indian subcontinent and it is renowned for its medicinal properties and versatile uses in agriculture. Among various diseases that attack neem, dieback is one of the most devastating disease that has been spreading in an alarming rate. A roving survey was conducted in all taluks of Yadgir and Raichur districts of Karnataka, India to know the status of neem dieback and to understand the progressive symptomatology of the disease by considering an average of 20 trees from each place in a taluk. The results revealed that, Yadgir district showed maximum disease incidence (70.00%) whereas, maximum disease severity was observed in Raichur district (43.28%). And among the surveyed taluks Lingasugur taluk recorded maximum disease incidence (100.00%) and severity (88.91%), in contrast, Maski and Gurmatkal recorded minimum disease incidence (40.00%) and severity (13.10%), respectively. The symptoms of dieback observed during the survey were yellowing and drying of leaves, twig blight, fruit rot and death of the infected trees. However, every surveyed taluk showed neem dieback disease irrespective of the age or size of the neem trees.

Keywords: *Neem, dieback, survey, incidence, severity, symptoms, twig blight*

1. INTRODUCTION

Neem (*Azadirachta indica* Adr. Juss.) is an evergreen deciduous tree which is commonly called as “Indian lilac”, “Margosa” or “village pharmacy”. It is native to Indian sub-continent (Roxburgh 1874) and found growing wild all over India, Pakistan, Bangladesh, Sri Lanka, Burma, Thailand, Malaysia and Indonesia. Neem is one of the most versatile, multifarious trees of the tropics, with immense potential to protect the environment while developing sustainable agriculture. Billions of neem trees exist all over India, Karnataka stands third with a 5.5 per cent trees after Uttar Pradesh (55.7%) and Tamil Nadu (17.8%) (Bahuguna 1997).

Neem is a versatile medicinal plant used since 2000 years in India, contains over 135 bioactive compounds, including isoprenoids (e.g., azadirachtin, nimbin) and non-isoprenoids (e.g., proteins, polyphenolics). Neem oil, rich in fatty acids like oleic and linoleic acids, is beneficial for treating skin diseases and rheumatism (Maithani et al. 2011).

Beyond medicine, neem is vital for pest control, environmental protection, and reforestation. Its insecticidal compound azadirachtin is effective against over 300 insect species and is safe for humans (Nigam et al. 1994). Neem-based formulations also have antifungal properties (Bhonde et al. 1999). The durable, termite-resistant wood is used in construction, and its high photosynthesis rate

helps to purify air (Randhawa and Parmar 1993). Neem's health and environmental benefits are celebrated during Ugadi festival that marks the cultural and religious significance of neem.

Despite of its well-known antifungal and antibacterial properties, it is still susceptible to various microbial diseases (Radwanski and Wickens 1981). Among them, dieback disease has caused major threat to neem trees in different parts of Karnataka and other states of India. Die back is caused by *Phomopsis azadirachtae* and other fungal species. This destructive disease affects leaves, twigs, flowers and even cause low or no fruit production leading to 100 per cent fruit yield loss in severely infected trees (Bhat et al. 1998). This study reveals the status of neem dieback in Raichur and Yadgir districts of Karnataka with the possible symptoms observed due to the disease.

2. METHODOLOGY

An extensive random roving survey was conducted during 2023-24 to assess the severity and incidence of neem dieback disease in different locations of Raichur and Yadgir districts of Karnataka, India. Each taluk within these districts was surveyed for the presence of dieback disease. In each area, an average of 20 neem trees were randomly selected and each tree was assigned a disease scale (Table 1) based on the extent of visible symptoms of the disease. The severity (PDI) and incidence rates were calculated for each taluk.

Table 1. Disease scale rating for dieback disease of neem (Korra 1989)

Scale	Description (Area infected)
0	No disease
1	1-10 %
2	11-25 %
3	26-50 %
4	51-75 %
5	76-100 %

Disease incidence was calculated as per the formula (Wheeler 1969).

$$\text{Disease Incidence } (\%) = \frac{\text{Number of trees infected}}{\text{Total number of trees observed}} \times 100$$

Per cent disease index (PDI) was calculated as per the formula (Wheeler 1969).

$$\text{Per cent disease index (PDI)} = \frac{\text{Sum of numerical ratings}}{\text{Total number of plants scored}} \times \frac{100}{\text{Maximum scale}}$$

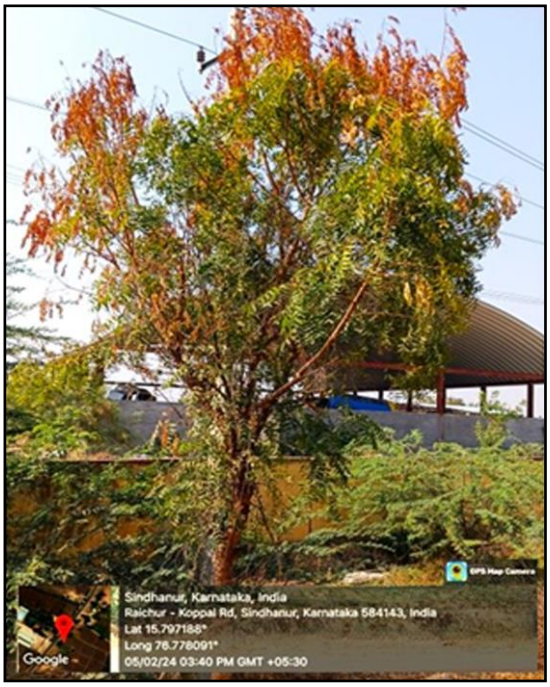
The diversified symptoms of dieback of neem were documented by visible symptoms, photographed and assessed the severity by using disease scale.

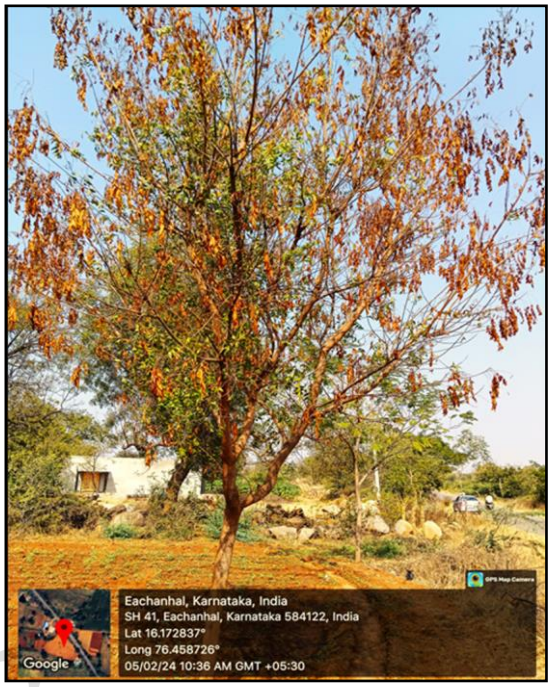
3. RESULTS AND DISCUSSION

3.1 Survey to assess neem dieback disease incidence and severity in Raichur and Yadgir districts of Karnataka

The results of the current study reveal that, the disease incidence more or less uniform in all the surveyed taluks of Raichur and Yadgir districts exhibiting a range of symptoms (Fig 1). Among the two districts surveyed, the mean disease incidence was found to be highest in Yadgir district (70%) and moderate in Raichur (65.71%). However, the maximum mean disease severity of 43.28 per cent was noticed in Raichur district and minimum severity of 37.02 per cent in Yadgir district. In Yadgir district, disease incidence ranged from 60 to 90 per cent, with the highest incidence recorded in Shahapur taluk and the lowest in three taluks viz., Surpur, Wadgera and Gurumitkal. Similarly, disease severity varied between 13.10 and 76.40 per cent, with the maximum severity observed in Shahapur and the minimum in Gurumitkal taluk. In Raichur district, the disease incidence ranged from 40 to 100 per cent, reached its peak in Lingasugur taluk and its lowest in Maski taluk. Likewise, disease severity ranged from 19.16 to 88.91 per cent, with the highest severity in Lingasugur and the lowest in Sirwara taluk (Table 2).

The study revealed significant differences in disease dynamics between Yadgir and Raichur districts of Karnataka, attributed to varying neem tree populations, genetic diversity and local climatic conditions. The higher incidence of disease in Yadgir was likely driven by the higher number of neem





trees observed during the survey and the favourable conditions of higher humidity (51-93%) and slightly warmer temperatures (24-33°C), which might have promoted pathogen The study revealed significant differences in disease dynamics between Yadgir and Raichur districts of Karnataka, attributed to varying neem tree populations, genetic diversity and local climatic conditions. Conversely, Raichur experienced maximum disease severity, possibly due to moderate humidity (27-76%) and higher temperatures (27-35°C), which may have weakened trees due to physiological stress, making them more susceptible to severe infections. This highlights the interplay between host density and environmental factors in influencing disease outcomes.

Fig. 1. Dieback affected neem trees observed during the survey in Raichur and Yadgir districts

3.2 Symptomatology of neem dieback

This study has provided a comprehensive description of the symptoms associated with neem dieback (Fig 2), focused on the observable stages of the disease and the impact on the overall health of the tree. The early signs of dieback in neem trees are subtle and often begin with the yellowing, followed by the drying of the leaves at the tips of the branches. These initial symptoms can be mistaken for simple water stress or nutrient deficiencies. However, unlike temporary stress conditions, the leaves do not recover and instead begin to show further signs of distress. The drying of the leaf tips gradually spreads, causing the entire leaf to become desiccated and sometimes gum exudation was also observed. As the condition progresses, the affected leaves undergo a change in colour, turning from

healthy green to a yellowish hue and eventually to brown. This discoloration is often accompanied by wilting, where the leaves lose their turgidity and appear droopy sometimes, secretion of gum also occurs. The wilting is not restricted to a single branch but can affect multiple branches simultaneously, especially those branches located on the same side of the tree.

Following the leaf symptoms, the disease advances to the branches. The affected branches start dying back from the tips, with a kind of blight- like symptoms. This dieback is usually first observed in

the smaller, outermost branches and gradually moves inward towards the larger branches and the trunk. As the disease progresses, the branches exhibit signs of wilting and defoliation, with leaves falling prematurely and fruit rotting. In severe cases, the dieback is not confined to the smaller branches but extends to the larger, more structurally important branches and even the main trunk of the tree.

During the survey, it was obvious to find that, neem dieback is most commonly observed after the monsoon season, during the period when residual moisture as well as dew deposition are still present but before the onset of the summer heat. This post-rainfall period creates conditions conducive to pathogen activity, as the trees are stressed by fluctuating humidity and temperature. The timing aligns with the transition from wet to dry conditions, which may weaken the trees and increase their susceptibility to dieback. Consequently, the disease tends to manifest more prominently during this specific climatic window. Towards the winter season (November), an increased population of tea mosquito bugs and infestation were also noted as pre-disposing factors for aggravation of disease.

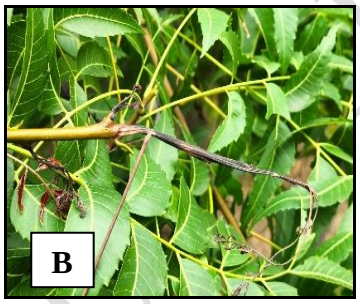
Table 2. Status of neem dieback in Raichur and Yadgir districts of Karnataka during 2023-24

Sl. No.	Districts	Taluks	Latitude	Longitude	Disease incidence (%)	Disease severity (PDI %)	District mean disease incidence (%)	District mean disease severity (%)
1	Raichur	Raichur	16.2047° N	77.3540° E	80.00	23.46	**65.71**	**43.28**
2		Lingasugur	16.1553° N	76.5223° E	100.00	88.91		
3		Sindhanur	15.7693° N	76.7556° E	70.00	69.83		
4		Maski	16.1777° N	76.6539° E	40.00	34.57		
5		Manvi	15.9906° N	77.0507° E	60.00	26.84		
6		Devadurga	16.4031° N	77.4841° E	60.00	40.23		
7		Sirwara	16.3615° N	77.1128° E	50.00	19.16		
8	Yadgir	Yadgir	16.7702° N	77.1376° E	70.00	39.23	**70.00**	**37.02**
9		Surpur	16.5157° N	76.7531° E	60.00	19.07		
10		Shahapur	16.6957° N	76.8424° E	90.00	76.40		
11		Hunsigi	16.5423° N	77.5196° E	80.00	53.34		
12		Wadgera	16.4230° N	77.1403° E	60.00	21.02		
13		Gurumitkal	17.1680° N	77.1162° E	60.00	13.10		

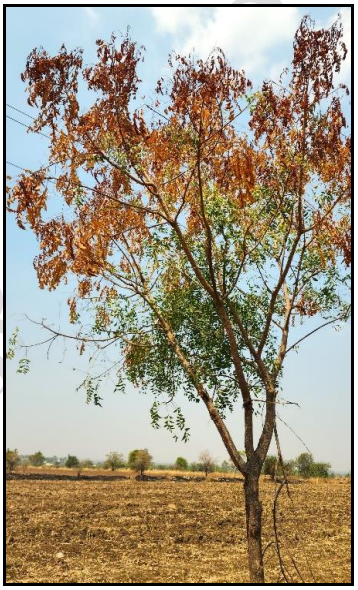
Initial dieback of twigs

Yellowing of infected twigs

Gum exudation



A. Fruit rot B. Twig blight



Spread of the disease to main branches

Death of the infected neem tree

Fig. 2. Symptoms of neem dieback observed during the survey

Moreover, the feeding activity of the tea mosquito bug (*Helopeltis* spp.) on neem trees can create wounds that serve as entry points for various fungal pathogens such as, *Phomopsis azadirachtae*, *Fusarium* sp., *Pseudofusicoccum* sp., *Colletotrichum* sp., *Curvularia* sp., *Alternaria* sp., *etc*. These secondary infections exacerbate the symptoms of dieback and can accelerate the decline of the tree.

Comparable findings were reported by Sateesh (1998) as well as Girish and Shankara Bhat (2008), who noted that the terminal branches were primarily affected. These observations were also made by Nagendra Prasad 2010 who revealed that the widespread occurence of neem dieback disease across Karnataka, with nearly 100 per cent incidence in most areas, except Tumkur (93.4%) and Dharwad (86.7%). Similarly, a high incidence of neem dieback disease was reported in Tamil Nadu (Nagendra Prasad 2011), with an incidence of 100 per cent in Madurai and Ramanathapuram. Tirunelveli had the lowest incidence of 27.7 per cent, indicating varying severity across the surveyed regions. A disease survey of the neem dieback was conducted in the Narayanpet district of Telangana (Singh and Shrishail 2023). The severe disease damage was recorded from Narva followed by Kondapur and Kosgi.

4. CONCLUSION

Neem dieback is a serious disease impacting neem trees, causing damage to leaves, twigs and inflorescence, leading to reduced growth and fruit production. A systematic survey conducted during 2023-24 in Raichur and Yadgir districts of Karnataka revealed varying levels of neem dieback incidence and severity. Yadgir recorded the highest disease incidence (up to 90%), while Raichur showed greater severity (up to 88.91%). Local climatic conditions and susceptible nature of neem plants were key factors influencing the disease development and spread. Early symptoms of neem dieback include drying and discoloration of leaf tips, which gradually spread, causing wilting, desiccation, and gum exudation. The disease progresses from the smaller outer branches to larger ones and can eventually affect the trunk. As per the observation, the post-monsoon period and *Rabi* season is most conducive for disease development. Understanding the status of neem dieback is crucial for developing effective strategies to mitigate the impact of this disease on neem populations in these districts.

Disclaimer (Artificial intelligence)

Author(s) hereby declares that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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