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POWDERY MILDEW INFECTION IN WILD POINSETTIA (*EUPHORBIA HETEROPHYLLA* LINN.)

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ABSTRACT

Euphorbia heterophylla Linn. (Wild poinsettia), commonly considered an important weed in soybean, bean and corn crops. It is also believed to have some beneficial effects on human health and in other aspects. Powdery mildew, caused by various fungal pathogens, is a prevalent and economically significant disease affecting a wide range of plant species, including the wild poinsettia (*Euphorbia heterophylla*). On November 2023, typical symptoms of powdery mildew were observed on *E. heterophylla* plants from the crop cafeteria of Agricultural College and Research Institute, Vazhavachanur. This study investigates the occurrence, severity, and ecological implications of powdery mildew infection in wild poinsettia populations. For identifying the pathogen, mass of conidia was scraped from the leaf surface and observed under a compound microscope. Conidia were dimorphic, and were recorded to be 14-17 × 63-89 µm in size. Miao W. *et al,* (2019) reported conidial size as 47 to 70 × 14 to 24 µm. Morphological and molecular analyses were employed to identify the specific fungal species responsible for the observed infections. Additionally, environmental factors influencing disease development, such as temperature, humidity, and plant density, were investigated to elucidate the ecological context of powdery mildew in wild poinsettia. Disease severity varied across different habitats, suggesting a complex interplay between environmental factors and pathogen-host interactions. Furthermore, the disease management approaches, including cultural practices and fungicidal treatments, were

explored for their efficacy in controlling powdery mildew in wild poinsettia.

KEYWORDS

Wild poinsettia, Powdery mildew, weed, *Euphorbia heterophylla*, *Leveillula clavata,* infections and management

INTRODUCTION

The persistent invasion of wild poinsettia (*Euphorbia heterophylla* L.) presents a serious problem in global agriculture and pasture lands, marking it as a notorious weed within the Euphorbiaceae family. Thriving in tropical and subtropical regions, this invasive species has infiltrated itself into diverse ecosystems, often finding utility in ornamental landscaping and traditional herbal medicine practices. However, the subtle nature of this plant becomes particularly evident when considering its role as a host for a formidable pathogenic invader.

A comprehensive investigation conducted by Wu *et al.* in 2019 uncovered further details about the pathogen in wild poinsettia plants. The symptoms were conspicuous white masses, comprised of

mycelia and conidia that intricately enveloped both the upper and lower leaf surfaces. The consequence of this aggressive colonization was a visual deterioration of the plant, marked by discoloration, necrosis, and a transformative impact on the coloured bracts. The mycelial intrusion exhibited a dual nature, partly internal and partly external, with emergent conidiophores arising from the internal mycelium.

The conidiophores, characterized by their hyaline nature, appeared singular and exhibited cylindrical foot cells, followed by two to three shorter cells. The resulting conidia, formed individually, displayed a spathulate or clavate shape, devoid of fibrosin bodies, and exhibited an angular/rectangular wrinkling appearance on their outer walls. Notably, germ tubes were produced at the terminal position of these conidia, while indistinct appressoria arose from these germ tubes.

A remarkable observation was the resemblance of the morphological characteristics of this pathogen to *Leveillula clavata*. Despite the comprehensive study, the elusive teleomorph, or sexual reproductive stage, remained unknown.

This pathogenic interaction is more than just a plant curiosity; it poses a significant threat to the commercial cultivation of poinsettias. It is important to develop specific plans to manage this problem because understanding the details of the pathogen's appearance is crucial for creating effective solutions. By figuring out how the plant and pathogen interact, researchers and farmers can come up with informed measures to protect agricultural areas from this invasive weed and its harmful effects.

HOST DESCRIPTION

Euphorbia heterophylla is an herbaceous plant that can grow erect, reaching heights of 20-200 cm, depending on prevailing environmental conditions, with the most common size being 40-60 cm tall. The plant produces milky latex when its various parts are broken. Its branched and cylindrical stem features nodes at regular intervals, exhibiting a smooth, reddish-green surface. Along the stem, Obovate to lanceolate leaves develop, with secondary branches sprouting from axillary buds. Basal leaves are long-petiolate and alternate. Upper leaves are sessile and arranged in an opposite or verticillate fashion, forming a cluster of bracts often accompanied by a pale patch at the base, subtending the terminal inflorescence (Euphorbia Heterophylla, Wild Poinsettia, PlantwisePlus Knowledge Bank, n.d.).

BIOLOGY AND ECOLOGY

Euphorbia heterophylla is a monoecious C4 annual species characterized by a taproot. Its seeds exhibit a prolonged germination period, covering a broad spectrum of environmental conditions. Remarkably, each individual plant has the capacity to yield more than 4500 seeds throughout a single growing year. This species proves to be a problematic weed, causing challenges both in its native habitat and within non-native regions.

HABITATS

Euphorbia heterophylla is frequently observed thriving in diverse habitats, including agricultural surroundings such as crops and orchards, as well as along roadsides, in gardens, waste areas, and troubled sites. Its adaptability extends to tropical, sub-tropical, semi-arid, and occasionally temperate regions. This adaptable species can flourish in a broad

spectrum of soil conditions, with a preference for shaded environment.

IMPACTS

Euphorbia heterophylla founds itself as a widespread weed affecting numerous crops globally. Notably, it serves as a significant weed in various agricultural fields, including cocoa, coffee, cotton, cowpeas, maize, papaya, groundnut, sorghum, soybean, sugarcane, tea, and upland rice. Its rapid growth allows it to compete for essential resources early in the crop's life cycle, leading to the formation of dense monocultures. Moreover, *Euphorbia heterophylla* acts as a host for several crop fungi and viruses, including *Leveillula* (powdery mildew of cotton), Euphorbia mosaic virus (Begomovirus), tomato yellow leaf curl virus (Begomovirus), and mungbean yellow mosaic virus (Begomovirus). Additionally, it possesses the potential to be toxic to livestock.

TRADITIONAL MEDICINE

People have used *Euphorbia heterophylla* in traditional medicine around the world. They have used different parts, like leaves and stems, to treat things like skin infections, fever, and stomach problems. But it is important to know that the plant has toxic substances. As such, its use in medicinal applications should be approached with caution and under proper guidance to avoid potential health risks.

ORNAMENTAL PLANT

Euphorbia heterophylla, known for its vibrant and colourful bracts, is often cultivated as an ornamental plant in gardens and landscapes.

This unique plant not only adds a splash of colour but also provides visual interest to flower beds and containers, enhancing the overall aesthetic appeal of outdoor spaces.

DISEASE SYMPTOMS

In a poinsettia infected with powdery mildew caused by *Oidiopsis sp*., distinct symptoms manifest across various parts of the plant. Initially, yellow to brown blotches were identified emerging on the upper surfaces of leaves and bracts.

Subsequently, the classic sign of the fungus appears as white, powdery, dust-like structures, primarily on the undersides of leaves (Wagh*et al.,* 2023).

Fig. 1 Entire lower surface is covered by hyphal growth

Fig. 2 Blotchy appearance on the upper surface of the leaves

As the infection progresses, fungal growth extends to the upper leaf surfaces under favourable conditions which resulted as

blotchy appearance. These unsightly structures are the result of the pathogen's thread-like hyphae and conidia, infectious spores forming discrete white colonies, some reaching up to 1 cm in diameter.

While colonies may start patchy, they can eventually cover large portions of the leaf.

Conspicuous white mycelium, formed by the aggregation of all the hyphae, becomes apparent on both mature and immature leaves, stems, and petioles.

Severely affected leaves show twisting, bending, and premature aging.

PATHOGEN

The fungus *Leveillula clavata* undergoes anamorphous stages in its life cycle and teleomorph was not found.

Its morphological structures include initially white, later turning gray or light brown, septate endophytic or exophytic mycelium, along with hyaline conidiophores bearing monocellular single conidia of the Oidiopsis type.

The conidia exhibit dimorphism, with recorded size 14-17 × 63-89 µm, with primary conidia being spathulate and rounded at the base.

Secondary conidia are cylindrical to sub cylindrical, with rounded ends, aseptate, hyaline, and smooth.

A single germ tube emerges from the end of each conidium, accompanied by an indistinct appressorium.

The hyphae emerging through stomata only occasionally grow directly into conidiophores (Wu *et al*., 2019).

Fig. 3 Microscopic view of primary conidia

EPIDEMIOLOGY

Cool days and warm nights create favourable conditions for infection and disease development. The spores produced by the pathogen are easily dispersed by the wind. While a high relative humidity of 65–75% (Recorded in the Meteorology Department of AC and RI, Vazhavachanur) favours the pathogen, wet leaves inhibit infection, as their spores typically require a thin film of water for germination. Powdery mildew symptoms are less common in summer, as temperatures exceeding 25°C cause spores to shrivel, thereby preventing the spread of the disease. Disease development was notably slower at 15°C compared to 20°C. Despite the establishment of the fungus within leaves, the disease may remain latent until cooler autumn conditions enable the manifestation of symptoms.

DISEASE CYCLE

The polycyclic disease cycle of *Leveillula clavata* resembles that of other powdery mildew species. It overwinters in crop residues above the soil surface as chasmothecia. When climatic conditions are favourable, the chasmothecia open, releasing wind-dispersed

ascospores. These ascospores penetrate the host through stomata, germinate, and establish mycelial colonization in the host's tissues. Subsequently, the pathogen generates asexual conidia, either singly or on branched conidiophores. These conidia exit through the host stomata, acting as a secondary inoculum to propagate the disease following the initial infection. In the fall, the pathogen undergoes sexual reproduction, producing chasmothecia as its dormant, overwintering structures.

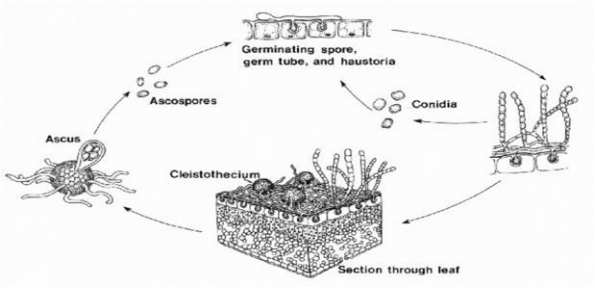

Fig. 4 Generalized Life Cycle of Powdery Mildew

MATERIALS AND METHODS

The plant specimens were collected from both symptomatic and asymptomatic for comparison. The samples were individually packed in sterilized polythene bags, labelled with details including collection locality, date, and time, and then transported to the laboratory for further examination. Identification of powdery mildew fungi involved both macroscopic and microscopic analysis of the infected plant material. Leaf scrapings and sections were utilized for slide preparation and were mounted with lactophenol. Subsequently, slides were examined under a light microscope, and micro-photography was conducted. Identification of powdery mildew fungal genera relied on morphological characteristics of conidia and conidiophores, guided by established literature sources (Garibaldi et al., 2006 and Wagh et al., 2023)

RESULTS AND DISCUSSION

The diseased plant leaf when visually observed exhibited dense mass of powdery white patches on the abaxial side (Fig 1.) and irregular white blotches on the adaxial side (Fig 5.). Microscopic examination revealed mass of conidia. Conidiophores were erect, bearing a single conidium or occasionally with short chains of 2–3 conidia. The fungus produces both primary conidia being spathulate and rounded at the base and secondary conidium cylindrical to sub cylindrical, with germ tubes often arising near end of conidia.

Fig. 5 Microscopic view at 40X scope

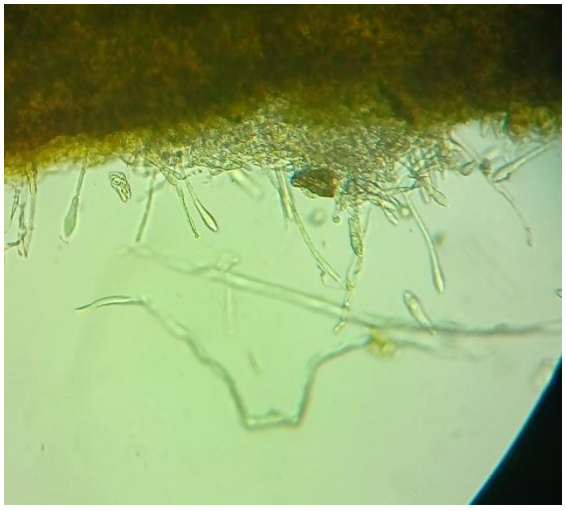

Fig. 6 Microscopic view at 10X scope

MANAGEMENT

To effectively manage powdery mildew in poinsettia crops, implement the following measures:

1. Remove any undesired poinsettia plants from the locality of the farm, as they can serve as potential reservoirs for the pathogen.

2. Employ overhead irrigation to moisten poinsettia leaf surfaces. While this practice inhibits mildew development, it is essential to be aware that it may create conditions favourable to the growth of other pathogens.

3. Conduct regular inspection of the poinsettia crop to promptly identify symptoms of powdery mildew. Thoroughly inspect both sides of numerous mature and young leaves and bracts during these assessments.

4. Upon detecting infected leaves or bracts, take immediate action by removing them. Bag the affected material and ensure its removal from the production site, either through disposal or destruction.

5. Recognize that temperatures exceeding 30°C (86°F) delay the pathogen's activity. Therefore, when cultivating poinsettias, opt for a warm location to discourage powdery mildew development.

FUNGICIDES

Product Name	Active Ingredient	Formulation
Terraguard SC	Triflumizole 42.14 %	Systemic fungicide
Compass 50 WDG	Trifloxystrobin 50.0%	Mesostemic fungicide
Nimrod	Bupirimate 26.7% w/w EC	Emulsifiable concentrate
Insignia 20WG	20% WG Pyraclostrobin	Water-Dispersible Granule

CONCLUSION

This study unveils the ecological principles of powdery mildew in wild poinsettia (Euphorbia heterophylla), a problematic weed in soybean, bean, and corn crops. The research attributes the infection to the fungal pathogen Leveillula clavata and explores its dynamics, considering environmental factors. Results reveal a widespread presence of powdery mildew emphasizing the intricate interplay between environmental factors and pathogen-host interactions. The study gives effective disease management strategies, including cultural practices and fungicidal treatments. Additionally, it highlights the diverse nature of Euphorbia heterophylla, acting as both an agricultural weed and a plant with potential health benefits. The study's findings give us useful information about powdery mildew and how it affects crops. This can help us find better ways to protect crops and handle economic challenges.

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