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A new report of rhizome rot of Sweet flag (*Acorus calamus* L.) caused by *Sclerotium rolfsii* from West Bengal, India

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Abstract

Acorus calamus L. is an important medicinal plant commonly known as 'Sweet flag' or 'Bach' and generally distributed in temperate countries like, North America, Canada and Europe. The plant is found throughout in India, predominantly in Himalayan and sub Himalayan regions. The rhizome rot of Sweet flag was observed in a field experiment conducted with five cultivars, viz., Aihagaripalli, Gaddipalli, Munipalli, Nagireddigudem and Symbolia in the year of 2015 in the medicinal garden, Kalyani, Nadia, West Bengal, India. The disease caused by *Sclerotium rolfsii* Sacc. was recorded for the first time in India. Symptoms of the disease, morphology of the pathogen and incidence were studied in details. The disease incidence was observed on all the cultivars and the maximum was on Aihagaripalli (10.12%) followed by Symbolia (8.49%) and Nagireddigudem (6.19%) and the minimum was on Munipalli (3.99%).

Keywords: *Acorus calamus*, *Sclerotium rolfsii*, Rhizome rot.

Introduction

Sweet flag (*Acorus calamus* L.), commonly known in different parts in India as *Bach* (Hindi), *Vashampu* (Tamil), *Baje* (Kannada) and *Vasa* (Telugu), belongs to family Acoraceae (Raja *et al.*, 2009) [4]. It is a native of Central Asia and Eastern Europe (Shetty and Shruthi, 2015) [6]. The word 'acorus' is originated from the Greek word 'acoron' used by Dioscorids which in turn derived from the 'coreon' word means 'pupil' because it is used in the treatment of eyes diseases and its inflammation (Reddy *et al.*, 2018) [5]. The Latin word *calamus* (meaning "cane") are found in both Greek [*kalamos*, meaning "reed"] and Sanskrit (*kalama*, meaning "reed" and "pen" as well as a sort of rice). Sweet flag used in Asia since last 2000 years for a number of beneficial and medicinal effects (Singh *et al.*, 2011) [7]. Roots, rhizomes and leaves have been used in the Indian systems of traditional medicine for hundreds of years. In India, the rhizomes have been used to cure several diseases like fever, asthma and bronchitis (Reddy *et al.*, 2018) [5].

This plant is available both under wild and under cultivated conditions. It has been estimated that 77 per cent of the sweet flag is cultivated with an area of 80 ha and 23 per cent is gathered from the wild in India. About 70 per cent of total cultivated area is in Karnataka. The total production of sweet flag in the country is 5725qt/annum (Lokesh, 2004) [2].

Plant and pathogen are co-evaluated. Medicinal plants are not the exception and are vulnerable to be attacked by several pathogens resulting crop loss in terms of both quantity as well as quality. Therefore, plant diseases create challenging problems in commercial agriculture and pose real economic threats and the "health of these healthy plants" should be our main concerned. In this context, early detection and identification of plant pathogens with proper understanding of demographic and ecological factors that lead to the evolution of plant-pathogen species are an integral part towards formulation of successful disease management strategies and it is also important in the context of globalization. Without proper identification of the disease and the disease causing agent, disease control measures can be a waste of time and money and can lead to further plant losses.

Sclerotiu rolfsii Sacc. is an important destructive soil plant pathogen having an extensive host range and world-wide distribution and affects about 500 plant species of 100 families (Punja, 2005) [3]. The pathogen primarily attacks at basal or collar region of hosts including roots, under warm and humid conditions. It commonly occurs in the tropics, subtropics and other warm temperate regions of the world. On a global perspective, estimated losses of 10- 20 million dollars associated with *S. rolfsii* have been recorded with yield depletion ranging from 1- 60% in fields (Kator *et al.*, 2015) [1]. Sclerotia serve as primary inoculum for the pathogen and are spread to uninfected areas by wind, water and soil (Kator *et al.*, 2015) [1].

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Material and Methods

Field experimental

The field experiment was conducted with five varieties of sweet flag (*Acorus calamus* L.) viz., Aihagaripalli, Gaddipalli, Munipalli, Nagireddigudem and Symbolia in upland and irrigated condition of the year 2015-16 in the experimental field of the Medicinal and Aromatic Plants Garden, Directorate of Research, Bidhan Chandra Krishi Viswavidyalaya, Kalyani, West Bengal, India. The geographical location of the field is 23.5° N latitude and 89.0° E longitude with an altitude of 9.75 m above the mean sea level.

Single node rhizome cuttings were planted on 25.06.2015 in the first year and on 01.07.2016 in the second year with 60cm × 30cm spacing with four replications in RCBD design. The disease was recorded on 20.09.2015.

Survey

Disease symptoms were studied visually on the standing plants and also with the help of Zeiss stereo microscope. The percentage of incidence of the disease from initiation to final development was recorded at 15 days interval and the incidence of rhizome rot was recorded in percentage value over the total plant populations with formula as follows:

$$\text{Disease incidence (\%)} = \frac{\text{Number of infected plants or leaves of plant} \times 100}{\text{Total number of plants / leaves per plants}}$$

Isolation and Purification

The entire work of isolation and purification was done in laminar air flow chamber, which was sterilized by UV light and also with ethyl alcohol (99%) prior to use. The causal organism was isolated from infected rhizomes, infected leaves containing mycelial mat and sclerotia at the base of the plant at soil region from the experimental plot. The infected parts were cut into small bits of 3-5mm. Both bits and sclerotia

were surface sterilized in 0.1% mercuric chloride (HgCl₂) for 45 - 60 seconds, rinsed three times in sterile distilled water, plated on potato dextrose agar (PDA) media and then incubated at ±28°C. Hyphal tips from the margin of developing colony were picked up and transferred to PDA medium for pure culture. The pathogenicity was tested through Koch's postulate after purification of the pathogen. The pure culture was maintained on PDA medium at ±28°C for further study.

Morphological observation and pathogenicity test

Zeiss light microscope (Axio Scope. A1) was used for study of the morphology and asexual structure of the pathogen and the measurements were taken by using Carl Zeiss Vision (Axio Vision LE Rel.4.3) software.

Results and Discussion

The rhizome rot caused by *Sclerotium rolfsii* attacked mainly at the basal region of the plant resulting gradual drying of total leaves (Figure 1). In severe infection, white mat of mycelia and occasionally sclerotia of the pathogen were observed to cover the base of leaves and on the adjacent soil. The rhizomes of the infected plants were rotted. The decay starts from the base of the stem and progresses towards rhizomes. On PDA medium, the mycelia were fan-like growth pattern and silky white in colour (Figure 1). Sclerotia were observed 5-7 days after inoculation. Hyphae were hyaline and septated. The sclerotia were round, smooth and dark brown in colour. The size of the sclerotia on PDA was ranges from 883.46 µm to 1650.21 µm (Mean: 1202.28 µm ±190.5). Therefore, on the basis of morphology, the pathogen was identified as *Sclerotium rolfsii* Sacc. The pathogen belongs to the Kingdom- Fungi, Division- Basidiomycota, Class- Agaricomycetes, Order- Atheliales, Family- Atheliaceae. The Telio-morph stage of *Sclerotium rolfsii* Sacc. is *Athelia rolfsii* (Curzi) C.C. Tu & Kimbr.

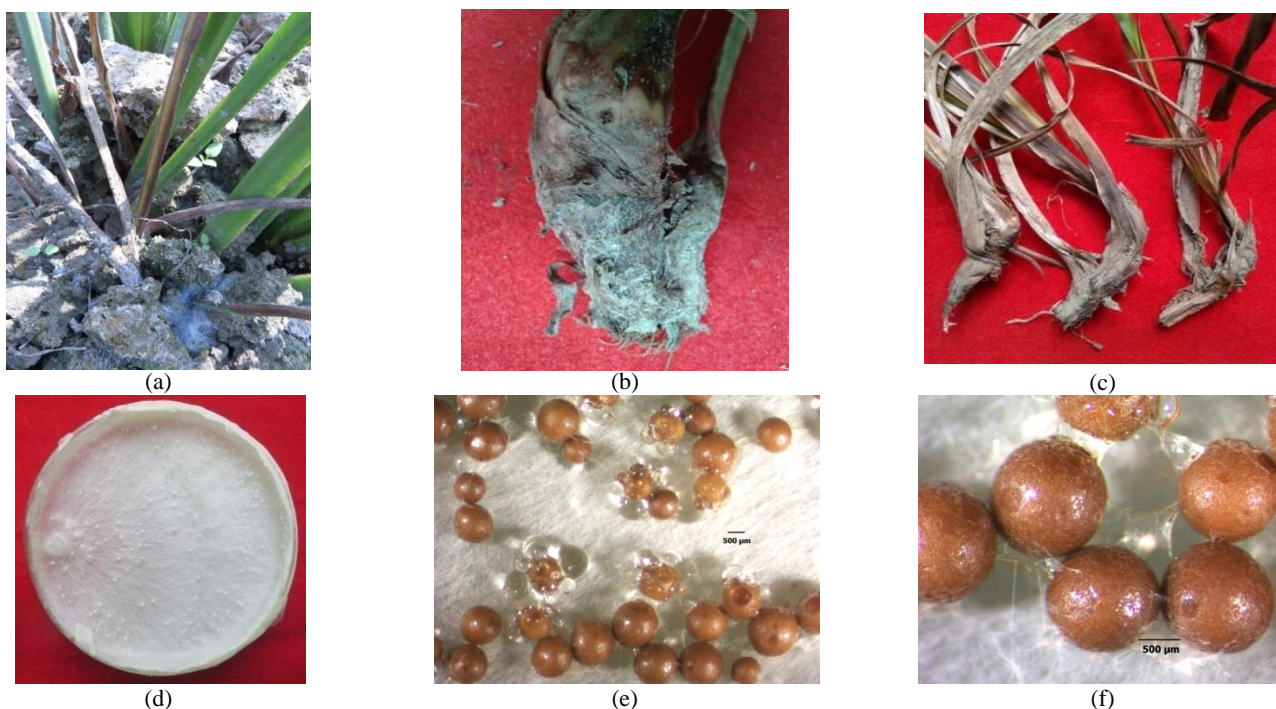


Fig 1: Symptoms of rhizome rot on sweet flag and sclerotia of *Sclerotium rolfsii*. [(a) Infected plant with white mycelium colonization on soil, (b) Infected rhizome, (c) Dead plants, (d) *Sclerotium rolfsii* colony on PDA and (e & f) Sclerotia of pathogen]

The pathogen occurs primarily in warm and humid climates, especially at high moisture and high temperature. The pathogen generally causes damping-off of seedlings, stem canker, crown blight, root rot, crown rot, bulb rot, tuber rot, fruit rot and affects wide varieties of plants, including most of the vegetables, flowers, legumes, cereals, forage plants and weeds (Kator *et al.*, 2015) ^[1]. The rhizome rot disease appeared during moist and humid weather in the experimental plot. Incidence of the disease was recorded on 20th September, 2015 (Table 1). The maximum incidence of the disease was recorded on Aihagaripalli (10.12%) followed by Symbolia (8.49%) and Nagireddigudem (6.19%) whereas, the minimum disease incidence was observed on Munipalli (3.99%). Therefore, among the five varieties, Aihagaripalli was found most susceptible one and Munipalli was comparatively tolerant.

Table 1: Incidence of basal rot disease on different cultivars of sweet flag

Treatment	Basal rot Incidence (%)*
Gaddipalli	5.61 (13.56)
Munipalli	3.99 (11.51)
Symbolia	8.49 (16.85)
Nagireddigudem	6.19 (14.38)
Aihagaripalli	10.12 (18.47)
CD at 5 (%)	3.02
CV (%)	13.09

* Average of 4 replications. Values in the parentheses indicate the angular transformed values

This disease is observed first time in the experimental field of the Medicinal and Aromatic Plants Garden, Directorate of Research, Bidhan Chandra Krishi Viswavidyalaya, Kalyani, West Bengal, India. So far, there is no report of *Sclerotium rolfsii* causing disease in sweet flag. All the cultivars are found to be susceptible to the pathogen. A special attention is needed regarding management of the pathogen for commercial cultivation of Sweet flag in disease prone zone.

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