Report on *Phytophthora* sp.causing corm rot of colocasia (*Colocasia esculenta* L.) from Prayagraj (Uttar Pradesh)

ABSTRACT

Taro [(*Colocasia esculenta* L.) Schott] also known as old cocoyam or true cocoyam is a water-loving herbaceous plant. Taro is affected by major diseases and pests in different parts of the world but among them taro blight and corm rot caused by a fungus-like oomycete *Phytophthora colocasiae*Racib is most important disease. The infected corm samples were collected from markets in two districts of Andhra Pradesh and the experiment was carried out based on Koch's postulates in the Department of Plant Pathology, SHUATS, Prayagraj during *Rabi* season (2022-23). Isolation was done from collected corm samples (infected corms) for identification of the pathogen. Based on the cultural and morphological characters under microscopic examination, the pathogen was identified as *Phytophthora* sp. which causes corm rot and leaf blight of Colocasia.The isolated pathogen was inoculated into the healthy corms of Colocasia. At the time of corm germination, thetypical symptomswere observed like downy whitish growth on the surface of the corms and on the leaf surface as small grey to brown discoloured water-soaked spots which later enlarged, became dark brown and coalesced, finally destroyed entire leaf lamina. After the examination of the symptoms, reisolation was done and pathogenecity of the fungus was proved by Koch's postulates. Perusal of the literature revealed that *Phytophthora* sp. causes post and pre harvest corm rot and leaf blight in colocasia and it seems to be the first report from Prayagraj, Uttar Pradesh.

1. INTRODUCTION

Taro [(*Colocasia esculenta* (L.) Schott], is a tropical aroid with nearly 1000 cultivars and it is an important staple or subsistence crop for millions of people in developing countries [4].Taro is also known as old cocoyam, true cocoyam is a water-loving herbaceous plant. Taro is ranked the 14th most consumed tuber vegetable in the world, with production capacity of 12 million tonnes generated from approximately 2 million hectares of land with a corresponding average yield of 6.5 tonnes/ ha [1]. It is the most important edible species of the monocotyledonous family Araceae.In India, two taro types viz., *C. esculenta* var. *esculenta* and *C. esculenta* var. *antiquorum* are commonly cultivated throughout the country.The plant helps in achieving food security because it is a multipurpose crop in which both the corms and leaves are used in different forms as different food products [8].

Despite the numerous socioeconomic benefits of taro plants, the yield of this crop continues to decline yearly due to a number of constraints like diseases and pests in different parts of the world and among them

taro blight disease and corm rot caused by a fungus-like oomycete *Phytophthora colocasiae*Racib is most important disease" [6].

The disease was first reported and described by Raciborski on taro plants in Java in 1900**(Adomako *et al.*, 2017)**. The disease has severely constrained taro production in American Samoa.American Samoa were devastated by an epidemic of taro leaf blight from 1993-1994 [4]. Taro blight epidemics have the potential to reduce food availability and posing a serious threat to the rural dwellers and regional food security[1]. *Phytophthora colocasiae*Raciborski is of prime importance because it can reduce corm yield by up to 50% and leaf yield by 95% in susceptible varieties. Corm rots usually develop after harvest and entire corms can decay in 7–10 days and causes heavy loss during storage [9].

2. MATERIALS AND METHODS

2.1 Collection of Disease Samples

Sixteen infected corm samples of Colocasia are shown in Plate 1. were collected from different markets in two districts (West Godavari and East Godavari) of Andhra Pradesh (Table 1) and pot experiment was carried out (October- March) in the Department of Plant Pathology, SHUATS, Prayagraj during *Rabi* season (2022-23).

Table 1. Collection of disease samples from markets

S. No.	Name of the sample	Name of the market	Mandal	District	State
1	A1	Ganesh Chowk Rythu Bazar	Rajamahendravaram Rural Mandal	East Godavari	Andhra Pradesh
2	A2	AmalapuramRythu Bazar	Amalapuram Mandal	East Godavari	Andhra Pradesh
3	A3	GopalapuramRythu Bazar	Gopalapuram Mandal	West Godavari	Andhra Pradesh
4	A4	KovvuruRythu Bazar	Kovvur Mandal	West Godavari	Andhra Pradesh

Plate 1. Collected colocasia corms from different markets in Andhra Pradesh

2.2 Symptoms of colocasia corm rot

Infection can occur on any part of the corm and develop rapidly after harvest. In early stages, the diseased tissue is light-brown, firm and often has a distinct margin and also it is difficult to recognize [8]. Downy whitish growth developed on the surface of the corms. When infected corm sliced, tan colored, rubber-like and soft appearance can be observed. Later an expanding, brown discolored area with a diffuse, indistinct border develops (Plate 2) [5].

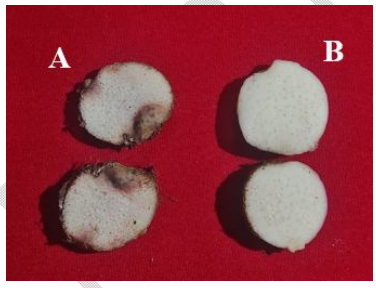


Plate 2. A) Infected and B) healthy corms of Colocasia

2.3 MediaPreparation

Two hundred grams of peeled carrots were cut into small pieces and boiled in one litre of distilled water till they became soft. Then it was blended and the extract obtained was filtered through doublelayered muslin cloth for twice and all the liquid was squeezed in a beaker. Then 20 g of agar was addedbit by bit and let it boiled. Volume of the solution made up to 1000 ml byadding more distilled water. Then 250 ml of this solution was dispensed to each of four conicalflasks and sterilized at 1.1 kg /cm2(121.6 °C) pressure for 20 minutes in an autoclave.

2.4 Isolation of the Pathogen

The infected corm showing characteristic symptoms was cut with healthy portion into small pieces (2-5 mm), firstly surface sterilized with sterile distilled water and then sterilized with sodium hypochlorite (0.1%) for 15-30 seconds and again sterilized with sterile distilled water to

remove the disinfectant and blotted dry. The sterilized pieces were plated (4 pieces/dish) on carrot agar medium in Petri-dishes under aseptic conditions. Incubated at 25°C for five to ten days for obtaining sufficient quantity of inoculums. Pure culture of *Phytophthora* sp. (Plate 3) was obtained by sub-culturing.

Plate 3. Pure culture of *Phytophthora* sp.

2.5 Koch's Postulate

Koch's postulates serve as a basic tool to test, relation betweenpathogen and the disease. The following work has been done on the basis ofKoch's postulates. The infected corms showing typical symptoms was collected (Plate 1) for isolation and identification of the pathogen. The Koch's postulate was verified by inoculating the pathogen thoroughly mixed with the soil. In treated check three rhizomes were sown in each pot and it was inoculated with 10 days old culture of the fungal isolate. In control, three rhizomes were sown in uninoculated pots. The symptoms were observed after 30 days of inoculation in treated pots (Plate 4), whereas uninoculated pots remained symptom-free.

At the end of each test, corms were taken out from inoculated pots, washed with water. Corms were cut into small pieces and surface sterilized with distilled water and with sodium hypochlorite then dried with sterile filter paper for reisolation. Sterilized pieces were plated on carrot agar poured petri plates and incubated for four to seven days at 25 °C in the dark.

2.6 Symptomsafter Inoculation of Pathogen

In the early stages of corm rot, the symptoms are subtle. Diseased tissue has a light tan colour, rubber-like and soft.Downy whitish growth on the surface of the leaflets and corms.After the germination of corm, the symptoms appeared on the leaf surface as small grey tobrown discoloured water-soaked spots which later enlarged, became dark brown andcoalesced, finally destroyed the entire leaf lamina (Plate 4)[5].

Plate 4. Phytophthora blight and corm rot symptoms of Colocasia (after corm germination)

3. RESULTS AND DISCUSSION

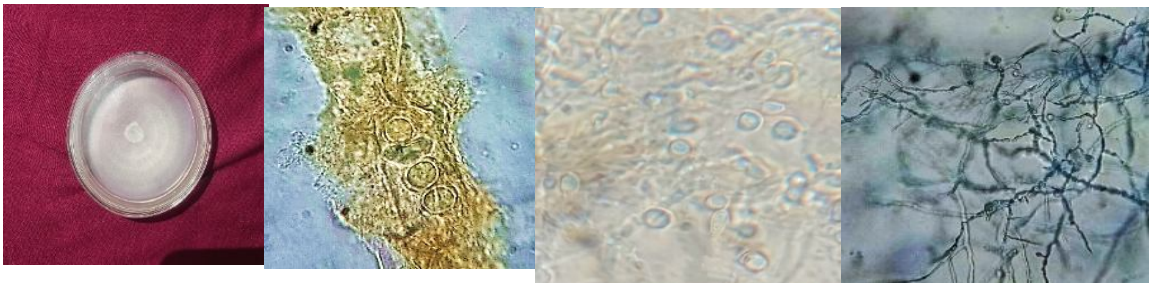
The pathogen causing disease on the Colocasia plants and corms was identified as *Phytophthora* sp. on the basis of morphological (Plate 5) and cultural characters (Plate 3).

3.1 Morphological Characteristics of Pathogen

The morphological characteristics of pathogens are represented inPlate 5. The mycelium was hyaline, coenocytic and inter or intra-cellular. The pathogen is a heterogeneous species that asexually produces sporangia (Plate 5e), sporangiospores and zoospores (Plate 6f & g). In contrast, as a result of sexual reproduction, it produces oospores [7].

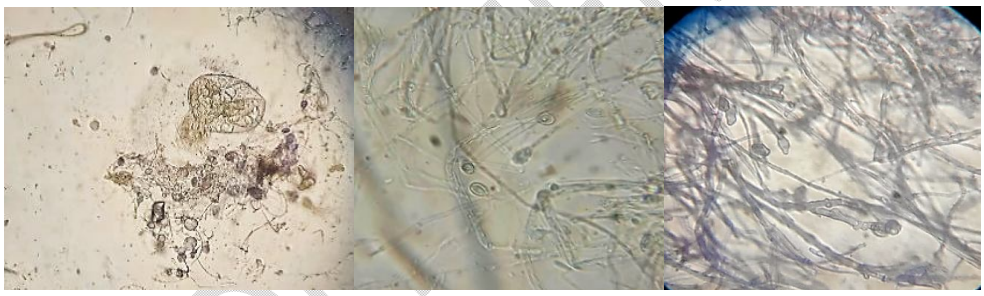
The sporangiophores are very slender and narrow at the tip. The shape of the sporangia varied from globose to ovoid,ellipsoid, elongated or pyriform(Plate 6e, f& j) [3].The sporangia are the primary reproductive unit of *Phytophthora* sp.During wet and humid conditions, the sporangiophores and sporangia can be seen as adowny whitish growth on the surface of the leaflets and corms.The sporangiophores are of indeterminate growth and form a sympodium with somewhatzigzag growth and characteristic nodal swellings.Sporangia are separated from sporangiophore by thickening of wall which forms a basalplug [3].

The oogonium is spherical and yellowish and the amphigynous antheridium persists at the base of the oogonium for a considerable period after the oospores are formed [4].Flagellated zoospores are released from zoosporangia (Plate 6h), which convert to cysts and germinate. The chlamydospores (Plate 6b, c, d&i) are globose or spherical in shape. The abundant production of zoosporangia (Plate 6g), zoospores and cysts make *Phytophthora* sp. a devastating pathogen [3].



(a) (b) (c) (d)

(e) (f) (g)



(h) (i) (j)

Plate5. (a) Pure culture andmicroscopic view of *Phytophthora* sp. (b) thick walledchlamydospores in rotted corm tissue, (c) chlamydospores of *Phytophthora* sp. (40X), (d) chlamydospores with hyphal swelling (10X), (e) sporangia of *Phytophthora* sp. (40X), (f) Sporangium of *Phytophthora* sp. (40X), (g) zoosporangia (40X), (h) ruptured zoosporangia releasing zoospores (40X), (i) chlamydospore and sporangia with hyphal swelling, (j) internal nested sporangia (40X)

4. CONCLUSION

Infected corm samples were collected from two districts (West Godavari and East Godavari) of Andhra Pradesh and pot experiment was carried out in the Department of Plant Pathology, SHUATS, Prayagraj during *Rabi* season (2022-23). After the examination of the symptoms, isolation was done by using carrot agar media.Based on the koch's postulates, after the isolation the pathogen was inoculated into the pots

which contain healthy corms of Colocasia.The symptoms were observed after 30 days of inoculation in treated pots, whereas uninoculated pots remained symptom-free.At the end of each test, reisolation was done to fulfil the Koch's postulates. Based on the cultural and morphological characters under microscopic examination, the pathogen was identified as *Phytophthora* sp. which cause colocasia corm rot and leaf blight. Pathogenecity of the fungus was proved by Koch's postulates. Perusal of the literature revealed that *Phytophthora* sp. causes post and pre harvest corm rot and leaf blight in colocasia and it seems to be the first report from Prayagraj, Uttar Pradesh.

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