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# Survey of Taro Leaf Blight and Identification of the Causative Agent in Southern Ethiopia Region

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## Abstract

In Southern Ethiopia, taro is grown extensively and used to fill seasonal food gaps when other crops are not in the field. However, this important crop has been severely affected by leaf blight disease. Therefore, the current study was designed with the objectives of assessing the intensity of the disease in Southern Ethiopia and to identify the causative agent of taro leaf blight. For this purpose, total of 27 farm fields were surveyed across 9 Woredas of two zones, Wolaita and Kembata Tembaro Zone, during 2017 cropping season. Among fields surveyed 15 representative taro leaf bight samples were collected for the identification of the causative agent. All the 15 isolates had fluffy or slightly fluffy colony texture and whitish or dull white colony color. Mycelium was aseptate and Sporangia types were ranged from semipapillate to papillate, Sporangia shape were ovoid or lemon shaped. Based on colony character and sporangial nature the pathogen isolated was identified as *Phytophthora colocasiae*. The mean *P. colocasiae* leaf blight incidence varied from 10 to 100% while mean disease severity ranged from 16.67 to 50%. This indicates the disease occurred in moderate to severe form in all taro surveyed fields. The present study revealed the importance of *Phytophthora* leaf blight of taro in Southern Ethiopia. Future research should be directed towards surveying more agro ecologies and to know effect of the disease on taro production in Ethiopia.

**Keywords:** Disease intensity; *Phytophthora colocasiae*; Sporangia; Taro leaf blight; Taro

## Introduction

Taro (*Colocasiae esculenta* L. Schott.) commonly known as *colocasiae*, cocoyam and dasheen is a flowering plant belonging to the family *Araceae*, native to tropical Polynesia and South Eastern Asia [1]. Taro is an important food crop in tropical areas of Africa, Asia and Latin America since many tropical areas often experience unfavorable environmental conditions [2]. Taro is also social and food security crop for millions of people in sub-Saharan Africa [3].

In Southern Ethiopia, taro grow extensively, due to the acute problems caused by enset bacterial wilt and sweet potato butter fly [3]. However, this important food crop has been affected by a number of infectious diseases caused by fungi, bacteria, nematodes, and viruses as well as noninfectious or a biotic factor. Among the biotic factors leaf blight of taro caused by *Phytophthora colocasiae* has been responsible for the serious decline in yield of taro in Solomon Islands, Papua New Guinea, Hawaii, Taiwan, American Samoa, Nigeria, Ghana and Cameroon [4-6]. According to Ooka (1994), fungal diseases of taro are the most significant ones. Because, diseases caused by fungi are aided by climatic conditions which favor the growth of taro. Leaf blight of taro also poses a serious threat to the production and biodiversity of this important food crop [5]. CABI (2014) also indicated that presence taro leaf blight in Cameroon, Equatorial Guinea, Ethiopia, Ghana and Seychelles [7].

In Ethiopia, Stewart and Dagnachew (1967) reported occurrence of taro blight-like disease attributed to *P. colocasiae* but comprehensive details on pathogen or disease is not available [8]. Taro leaf blight has contributed to the decline in taro production but still farmers have not recognized taro leaf blight as a disease associating its symptom with a maturity stage of the crop and impact of heavy rain fall. While the disease is present in many taro growing regions of Ethiopia and causing severe crop loss, there is no information on disease intensity and its real causal agent is not been identified in Ethiopia.

## Materials and Methods

### Description of experimental sites

The survey was carried out in 2017 cropping season in 20 ha lands of two taro growing zones of Southern Ethiopia. Six woredas of Wolaita and three woredas of Kembata Tembaro Zones vs Sodo Zuria, Damot Gale, Damot Woyde, Damot Sore, Bolosso Sore, Humbo, Mudula, kachabira and Hadaro were surveyed (Table 1). Totally 27 farmer fields were surveyed at 5-10kms interval. Identification of the causative agent was carried out at Areka Plant Pathology laboratory.

| Zone | Woreda | Location | | Altitude | No of kebeles visited |
|---|---|---|---|---|---|
| | | Latitude | Longitude | | |
| Wolaita | Sodo Zuria | 6°53'33"N | 37°48'37"E | 2200 | 4 |
| | Damot Gale | 6°58'01"N | 37°46'18"E | 1994 | 5 |
| | Damot Woyde | 6°53'36"N | 37°50'48"E | 2116 | 3 |
| | Damot Sore | 6°54'47"N | 37°41'03"E | 1981 | 2 |
| | Bolloso Sore | 6°57'27"N | 37°44'22"E | 1974 | 3 |

| | | | | | |
|---|---|---|---|---|---|
| | Humbo | 6°44'22''N | 37°46'29''E | 1747 | 1 |
| Kembata Tembaro | Mudula | 7°16'50''N | 37°31'49''E | 2081 | 3 |
| | Kachabira | 7°12'17''N | 37°49'03''E | 2001 | 2 |
| | Hadaro | 7°12'05''N | 37°38'42''E | 1614 | 2 |

**Table 1:** Description of the study sites.

### Disease prevalence, incidence and severity

Disease prevalence was calculated as the proportion of fields with taro leaf blight in relation to the total fields assessed per zone. For calculating diseases incidence and severity, 10 taro plants were randomly picked from each field diagonally at 2 meter interval. Disease incidence was calculated as the percentage of plants showing symptoms of the taro leaf blight. While disease severity was estimated based on visual estimation of percentage of leaf area affected by the disease by using the 0 to 6 scale as follows: 0=0% (or) No disease; 1=1-7%; 2=8-25%; 3=26-50%; 4=51-74%; 5=75-93%; 6=94-100% leaf area affected [9].

### Isolation and identification of fungi

From 27 farmer fields surveyed 15 representative taro leaf blight symptoms collected were surface-sterilized with 0.5% sodium hypochlorite solution for 60sec and rinsed three times in sterile distilled water. Surface-sterilized leaf fragments were dried on sterile filter paper in a laminar flow hood and for each sample four leaf fragments were transferred into sterilized Petri dishes containing solidified cool potato dextrose agar (PDA) medium amended with antibiotics (penicillin, rifampicin and nystatin). Then, the Petri dishes were labeled and placed in an incubator at temperature of 22-26°C [10]. After 2-3 days, the culture was sub cultured in to new Petri dishes to obtain pure culture of isolates and designated as A-O. Then isolated fungi were identified as *Phytophthora colocasiae* based on its mycelia and sporangial characters using standard mycological keys [11,12].

### Data collection and analysis

Data related to colony texture, colony color, mycelium type, sporangia shape and type and whether sporangia is stalked or sessile were collected and analyzed by using SAS computer software program and significant means were compared using Duncan multiple range test (DMRT) at 99% level of probability.

## Results and Discussion

### Disease prevalence

Taro leaf blight was found wide spread in all areas surveyed. 27 taro fields surveyed were infected with the *Phytophthora* leaf blight, implying 100% disease prevalence (Table 2). The reason could be due presence of continuous rain during survey period. In addition, farmers does not manage the disease early because they do not recognized taro leaf blight as a disease associating its symptom with a maturity stage of the crop and the impact of heavy rain falls. Misra and Chowdhury (1997) reported that during continues rainy period almost all taro fields in Northern and Eastern India were infected with taro leaf blight disease [13].

### Disease incidence and severity

Disease incidence and severity in the surveyed woredas ranged between 10% and 100%, 16.66 and 50% respectively (Table 2). The lowest (10%) and highest (100%) mean incidence was recorded from Humbo and Kachabira, respectively. The lowest mean severity (16.66%) was recorded from Humbo while in Damot Sore and Mudula the highest mean severity (50%) was recorded. There were significant differences in disease incidence and severity across the various woredas surveyed (Table 2). Similar reports were made by Adomako et al. (2016) in Ghana indicating that there were significant differences in disease incidence and severity in surveyed districts with values ranging between 30% and 92.5%, 6.5% and 86.5% respectively [14]. The low incidence and severity rate recorded for Humbo could be due the area is warmer and receive little rainfall when compared with other surveyed woredas. The warmer areas having little rainfall and relative humidity are comparatively free from taro leaf blight diseases [15]. The other reason could be the use of diseases resistant variety (Bolosso-I) and good agricultural practices like mixed cropping in the area. Asraku (2010) reported that *Phytophthora* leaf blight of taro symptoms were more pronounced in mono cropping than in mixed cropping system [16]. In another study Ayogu et al. (2015) and Amosa&Wati (1997) also indicated that taro leaf blight disease severity was found to be consistently higher in taro mono cropping than in a taro mixed cropping system [17,18]. In contrary to this high mean incidence recorded from Kachabira while high mean severity recorded from Damot Sore and mudula could be due the area receives high relative humidity and frequent rainfall which favors diseases development. Aggarwal and Mehrotra (1987) confirmed that high relative humidity and frequent rainfall are an important factor that favors the development of *Phytophthora* leaf blight [19]. The other reason could be most of the farmers in the area prefer local varieties, which is susceptible to the disease and practices mono cropping when compared with mixed cropping system, which also creates conducive environment for disease development.

| Woreda | Number of fields visited | Altitude (m) | Prevalence (%) | Incidence (%) | Severity (%) |
|---|---|---|---|---|---|
| Sodo Zuria | 4 | 2200 | 100 | $60^{abc}$ | $42.85^{a}$ |
| Damot Gale | 5 | 1994 | 100 | $52^{abc}$ | $39.99^{ab}$ |
| Damot Woyde | 4 | 2116 | 100 | $30^{bc}$ | $37.50^{ab}$ |
| Damot Sore | 2 | 1981 | 100 | $80^{ab}$ | $50^{a}$ |
| Bolosso Sore | 3 | 1974 | 100 | $93.3^{a}$ | $41.67^{ab}$ |
| Humbo | 1 | 1747 | 100 | $10^{c}$ | $16.66^{b}$ |
| Mudula | 3 | 2081 | 100 | $56.6^{abc}$ | $50^{a}$ |
| Kachabira | 2 | 2001 | 100 | $100^{a}$ | $42.85^{a}$ |
| Hadaro | 3 | 1614 | 100 | $40^{abc}$ | $38.89^{ab}$ |
| CV (%) | - | - | - | 47 | 28.4 |

Means followed by the same letters in a column are not significantly different according to Duncan multiple range test (DMRT) at (p<0.01).

**Table 2:** Mean disease prevalence, incidence and severity of *Phytophthora* leaf blight of taro in the surveyed woredas.

## Isolation and identification of fungi

All the 15 isolates had fluffy or slightly fluffy colony texture and whitish or dull white colony color. Mycelium was aseptate and Sporangia types were semipapillate or papillate, Sporangia shape were ovoid or lemon shaped (Figure 1 and Table 3). The characteristics of the pathogen observed were similar with the descriptions and keys for the identification of species of the genus *Phytophthora* [11,12]. Based on colony character and sporangial nature the pathogen isolated was identified as *Phytophthora colocasiae*.

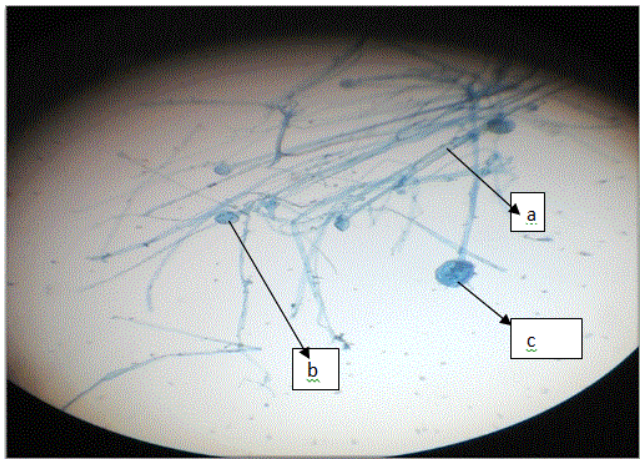


**Figure 1:** Aspetate mycelium (a), semipapillate (b) and ovoid sporangia (c) observed under simple light microscope (40X).

| Isolate | Mycelium type | Sporangia type | Sporangia shape | Stalked/ sessil esporangia | Colony color | Colony texture |
|---|---|---|---|---|---|---|
| A | Aseptate | Semi papillate | Lemon shaped | Stalked | White | Cottony |
| B | Aseptate | Semi papillate | Globose | Stalked | White | Cottony |
| C | Aseptate | Papillate | Globose | Stalked | White | Cottony |
| D | Aseptate | Semi papillate | Ovoid | Stalked | White | Cottony |
| E | Aseptate | Semi papillate | Ovoid | Stalked | White | Cottony |
| F | Aseptate | Papillate | Globose | Stalked | White | Cottony |
| G | Aseptate | Semi papillate | Lemon shaped | Stalked | Dull white | Moderately cottony |
| H | Aseptate | Papillate | Lemon shaped | Stalked | White | Cottony |
| I | Aseptate | Semi papillate | Ovoid | Stalked | Dull white | Moderately cottony |
| J | Aseptate | Papillate | Lemon shaped | Stalked | White | Cottony |
| K | Aseptate | Papillate | Ovoid | Stalked | Dull white | Moderately cottony |
| L | Aseptate | Semi papillate | Lemon shaped | Stalked | White | Cottony |
| M | Aseptate | Semi papillate | Lemon shaped | Stalked | Dull white | Moderately cottony |
| N | Aseptate | Papillate | Lemon shaped | Stalked | Dull white | Moderately cottony |
| O | Aseptate | Papillate | Globose | Stalked | White | Cottony |

**Table 3:** Morphological characteristics of *P. colocasiae* isolates on PDA medium.

## Conclusion

Results from this current survey suggest that leaf blight of taro has become an epidemic in the study areas; hence the urgent need to develop strategies to manage the disease. Management strategies should however be aimed at developing resistant varieties and low cost integrated management packages which can easily be adopted by farmers interested in taro production in Ethiopia. Finally, an impact study should be conducted to determine the effect of the disease on taro production in Ethiopia. Since, this is the first study on the taro leaf blight pathogen in Ethiopia, will provide base line information towards surveying more agro ecologies to know the disease coverage and its impact in Ethiopia.

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