ISSN: 2319-5584
Global Journal of Biology, Agriculture & Health Sciences

OPEN ACCESS Freely available online

Research Article

Evaluation of Taro Genotypes against the Most Virulent Isolate of *Phytophthora colocasiae* in Wolaita and Kembata Tembaro Zones of Southern Ethiopia

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ABSTRACT

Taro leaf blight disease, caused by *Phytophthora colocasiae* is a major limiting factor in Taro production worldwide. Knowledge of resistance of Taro genotypes against the pathogen is very important for effective management of Taro leaf blight disease. Taro leaf blight disease was surveyed in 27 Taro growing farmers' fields of Wolaita and Kembata Tembaro Zones of Southern Ethiopia during 2017. A total of 15 representative *Phytophthora colocasiae* isolates were isolated at Areka Pathology Laboratory. This isolates virulence test was carried out by using detached leaf disc method. From the 15 *P. colocasiae*, isolate A, collected from Sodo Zuria produced extensive necrotic lesions on the leaf and the pathogen was found to be most virulent when compared with the other fourteen isolates. Then after most aggressive *P. colocasiae* isolate (A) identified by virulent test was adjusted at the concentration of 3×10^4 sporangia/ml and inoculated at green house on five Taro cultivars. Finally three days after inoculation mean lesion diameter was measured at 24 hr interval for six consecutive days. The result of the study indicated that more or less all the cultivars tested were infected by the pathogen and none of them were found to be immune to *P. colocasiae*. Bolloso-I was resistant with MLD of 22 mm, whereas two cultivars, Yeda (MLD of 35 mm) and Dolka (MLD of 30 mm) showed moderately resistant (MR) reaction. Cultivars Molia (MLD of 50 mm) and Yiteria (MLD of 65 mm) showed susceptible and highly susceptible reactions, respectively. The result of the present study demonstrates the role host resistance may play in integrated management of the disease. Future research should be directed towards evaluating additional taro genotypes against *P. colocasiae*.

Keywords: Green house; Taro cultivars; Genotypes; *Phytophtora colocasiae*

INTRODUCTION

Taro (*Colocasia esculenta*) is a perennial tropical starchy root crop which belongs to the Araceae family [1]. It originated from South East Asia and later spread into other parts of the continent and Africa of tropical climatic settings [2]. It mostly growth where the annual rainfall exceeds 2000 mm and it grows best under hot and wet conditions with temperatures above 21°C. It is sensitive to frost and it is therefore a lowland crop [3]. Taro has both medicinal and nutritional uses as it is used as food for man and animal feed [4]. The crop is a good source of income to its producers to the extent that some subsistence farmers generate enough revenue from taro production to take care of basic family needs [5]. Despite the importance of taro, the major constraint to its production is Taro leaf blight. It is one of the major important economic diseases of taro because it reduces corm yield of up to 50% [6] and leaf yield of up to 95% in susceptible genotypes [3]. *Phytophthora colocasiae* causes corms to rot both in the field and in storage, and this has led to heavy storage lost [7]. Taro Leaf Blight Disease (TLBD) is characterized by large necrotic zonates spot on the leaves often coalescing to destroy large areas of leaf [8]. The margin of the lesion is marked by a white powdery band of sporangia and numerous droplets of orange or reddish exudates [9]. *Phytophthora colocasiae* originated in South East Asia [8] and is widely distributed throughout the tropical regions of the world [10]. This study was conducted to investigate test for virulence and pathogenicity of *P. colocasiae* under greenhouse conditions.

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Received: 04-Sep-2022, Manuscript No. GJBAHS-22-17925; **Editor assigned:** 07-Sep-2022, PreQC No. GJBAHS-22-17925(PQ); **Reviewed:** 21-Sep-2022, QC No. GJBAHS-22-17925; **Revised:** 28-Sep-2022, Manuscript No. GJBAHS-22-17925 (R); **Published:** 05-Oct-2022 DOI: 10.35248/2319-5584.22.11.147

Citation: Tomas Z, Shikur E, Said A (2022) Evaluation of Taro Genotypes against the Most Virulent Isolate of *Phytophthora colocasiae* in Wolaita and Kembata Tembaro Zones of Southern Ethiopia. Glob J Agric Health Sci.11: 147.

MATERIALS AND METHODS

Description of experimental sites

The laboratory and green house experiments were done at Areka Agricultural Research Center Plant Pathology Laboratory. It is located 300 km South West of Addis Abeba at an altitude of 1833 meters above sea level with latitude and longitude of 703'25''N and 37040'52''E, respectively.

Collection, isolation and identification of fungi isolates

Survey was carried out at 27 Taro growing farmer's fields at 5 km-10 km interval in 2017 cropping season. From them 15 representative taro leaf blight samples collected were surface-sterilized with 0.5% sodium hypochlorite solution for 60 sec 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 labelled and placed in an incubator at temperature of 22°C-26°C [3]. After 2-3 days, the culture was sub cultured in to new Petri dishes to obtain pure culture of isolates and the isolated fungi were 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].

Virulence test of fungi isolates

Virulence tests of 15 *P. colocasiae* isolates were done by using detached leaf disc method. One 60 mm diameter leaf disc was taken from youngest, fully expanded and disease free, local taro cultivar (Molia) and placed into 90 mm diameter Petri dishes containing water amended with 150 µg/litre kinetin. Each leaf disc was inoculated in the center with each isolate of 6 mm diameter agar plug taken from 2 day old cultures of *P. colocasiae*. The inoculated leaf discs were incubated for 4 days at 25°C in the dark. Then mean lesion diameter was measured to identify virulent isolate [13]. From the 15 *P.colocasiae* isolates inoculated on the detached leaf disk of taro plant, isolate A, collected from Sodo Zuria produced extensive necrotic lesions on the leaf and the pathogen was found to be most virulent when compared with the other fourteen isolates, followed by isolates from Damot Gale (C) and Bolosso Sore (J) with mean lesion diameter of 46 mm, 37 mm and 35 mm, respectively.

Inoculums preparation

Sporangia suspension was prepared from 21 days old culture of different *P. colocasiae* isolates, by flooding the surface of the growing colonies in each Petri dish with 5 ml of sterile distilled water and dislodging the sporangia with a small sterile brush. The suspension was then centrifuged for 3 minutes and the supernatant filtered through a 2 layered sterile muslin cheesed cloth. A sporangia suspension (inoculums) of each isolate was adjusted with the aid of haemocytometer to concentration of 3×10^4 sporangia/ml of sterilized water. The inoculums were put in a refrigerator at a temperature of 4°C for 30 minutes to stimulate liberation of zoospores and a drop of Tween 80 (25 µl) was added to each sporangia suspension as a surface wetting agent [14].

Evaluation of taro genotypes against virulent *Phytophthora colocasiae* isolate

One improved cultivar of taro, Bolloso-I and four local cultivars, Yeda, Dolka, Molia and Yiteria, which are commonly grown in the study area were obtained from taro accessions maintained at AARC were tested for their reaction against a virulent *P. colocasiae* isolate. For this purpose plants were raised in plastic pots (one seedling per pot) and kept in greenhouse condition. Forty nine days after planting youngest fully expanded taro leaves were inoculated with the most aggressive *P. colocasiae* isolate identified by virulent test at the concentration of 3×10^4 sporangia/ml of sterilized water (adjusted with the aid of haemocytometer). Inoculation was done by injecting 3 ml of sporangia suspension into three spots on the leaves of taro plant using sterile hypodermic syringe (control plants were also inoculated with 3 ml of sterile distilled water). After inoculation plants were kept in greenhouse and watered and sterilized as needed to maintain normal growth. Treatments were replicated three times and arranged in CRD. Then three days after inoculation mean lesion diameter was measured at 24 hr interval for six consecutive days by using ruler.

Data analysis

Data collected were subjected to Analysis of Variance (ANOVA) using SAS computer software program and significant means were compared using Duncan Multiple Range Test (DMRT) at 99% level of probability.

RESULTS AND DISCUSSION

Evaluation of taro genotypes against virulent *P. colocasiae* isolate

The reactions of taro cultivars tested against *P. colocasiae* (isolate A) are presented in Table 1. Five cultivars were evaluated against one virulent isolates of *P. colocasiae* (isolate A) under greenhouse conditions. The result of the study indicated that all the cultivars tested were affected by the *P. colocasiae*. There was highly significant difference in Mean Lesion Diameter (MLD) among cultivars tested. Bolloso-I had resistant reaction with MLD of 22 mm, whereas two cultivars, Yeda (MLD of 35 mm) and Dolka (MLD of 30 mm) showed moderately resistant (MR) reaction. Cultivars Molia (MLD of 50 mm) and Yiteria (MLD of 65 mm) showed susceptible and highly susceptible reactions, respectively. Similar research evaluated six taro cultivars against *P. colocasiae* isolate [15]. His result revealed that out of six cultivars evaluated none of them were found to be immune to the isolate, while only one cultivar had resistant reaction to the disease with MLD of 20.5 mm, and three cultivars with MLD of 32.5 mm, 32 mm and 30 mm, respectively showed moderately resistant reaction. The remaining two cultivars showed susceptible reaction. In another study 38 promising taro lines were evaluated against *P. colocasiae* and their result revealed that 11 isolates were found to be immune [16]. Others isolate 4, 7, 7 and 9 showed resistant, moderately resistant, moderately susceptible and susceptible reaction to leaf blight, respectively. Identification of resistant sources is considered as an important factor in determining the breeding methodology to be adopted for incorporating resistance. The findings of the present research will serve as source of information for resistance breeding of taro against Phytophthora leaf blight.

Table 1: Cultivars responses to the virulent isolate of *P. colocasiae* based on mean lesion diameter (mm).

Name of the cultivar	MLD (mm)	Disease reaction
Bolloso-I	22	Resistant
Yeda	35	Moderately resistant

Yiteria	65	Highly susceptible
Molia	50	Susceptible
Dolka	30	Moderately resistant
CV (%)	10.68	

Note: MLD=Mean Lesion Diameter.

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

Disease severity scale: 0%=immune, 0.01%-10%=highly resistant, 10.01%-25%=resistant, 25.01%-40%=moderately resistant, 40.01%-60% =susceptible and >60.01%=highly susceptible disease reaction.

CONCLUSION AND RECOMMENDATION

Five Taro cultivars were screened against one virulent isolates of *P. colocasiae* (isolate A) under greenhouse conditions. The isolate caused lesions, on inoculated leaves. The result of the study indicated that more or less all the cultivars tested were infected by the pathogen and none of them were found to be immune to *P. colocasiae*. Bolloso-I was resistant with MLD of 22 mm, whereas two cultivars, Yeda (MLD of 35 mm) and Dolka (MLD of 30 mm) showed moderately resistant (MR) reaction. Cultivars Molia (MLD of 50 mm) and Yiteria (MLD of 65 mm) showed susceptible and highly susceptible reactions, respectively. The result of the present study revealed that importance of Phytophthora leaf blight of taro in Southern Ethiopia. It also demonstrates the role host resistance may play in integrated management of the disease. Future research should be directed towards evaluating additional taro genotypes against *P. colocasiae*. Since, this is the first study on the taro leaf blight pathogen in Ethiopia, will provide base line information for future research on pathogen characterization, yield loss assessment and management study.

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