

## Assessment of Colletotrichum Leaf Spot Disease of Turmeric in Major Growing Area of Southwestern Ethiopia

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### ABSTRACT

Turmeric (*Curcuma longa* L.), a herbaceous monocot plant is one of the most valuable and important spices of the world. It occupies an important place in the socio-cultural, spiritual and health care aspects in Ethiopia. However, leaf spot diseases caused by *Colletotrichum capsici* is a major limiting factor for the cultivation and production of turmeric in southwestern parts of the country. Therefore, the aim of this study was to identify leaf spot diseases of turmeric in different agro-ecologies of southwestern Ethiopia. The study was conducted at 10 locations from 2017 to 2018. Infected leaf of turmeric were randomly collected from Sheka, Bench Majia and Mejang zone of South Nations Nationality and Peoples Regional State for laboratory evaluations. Tissue segments of each leaf were agitated in 10% sodium hypochlorite for 2 minutes and then rinsed three to four times in sterile distilled water. Five pieces of each plant tissues were cultured on PDA media with five replications and then incubated at room temperature for 7 to 10 days. Vegetative hyphae and shape of conidia of pure cultures of fungal colony were identified under microscope. Based on morphological and cultural characteristics the pathogen is confirmed as *Colletotrichum capsici*. Future research should be undertaken in search of resistance variety to *Colletotrichum capsici* and integrated disease management should be tried to manage the disease.

**Keywords:** *Colletotrichum capsici*, Turmeric, Survey

### INTRODUCTION

Turmeric (*Curcuma longa* L.), a herbaceous monocot plant is one of the most valuable and important spices of the world. It belongs to the family Zingiberaceae in order Scitamineae, and is native of South East Asia especially India. Turmeric is cultivated for its underground rhizomes, which are used in many ways, such as condiment in culinary preparation, colouring agent in textiles, as food and confectionaries (Jansen, 1981). Medicinally, it acts as carminative and antiseptic, antiparasitic for many skin infections, cure the sore throat, inflammation and common cold. It is used as an appetizer and helps in digestion and used in preparation of cosmetics and soaps.

The turmeric rhizome contains a variety of pigments in which curcumin is the major one responsible for colour. Apart from curcumin and volatile oil, it also contains appreciable quantities of proteins (6.30%), lipids (5.10%), carbohydrate (69.40%) and fibre (2.60%). It is also rich in minerals like phosphorous, calcium, iron and vitamin A with calorific value of 349 per 100 g of rhizomes.

Besides, India turmeric is also cultivated to a smaller extent in Sri Lanka, China, Indonesia, Peru, Jamaica, Bangladesh and Ethiopia. India is the largest producer and exporter of cured turmeric (Girma *et al.*, 2008). The great demand for Indian turmeric in International market is because of its high curcumin content of > 8.7 percent (Edison and Johny, 1991).

In Ethiopia turmeric is grown in southwestern parts of the country. In Ethiopia, the figures for the area and production of turmeric stand as 657 ha and 22750 tonnes respectively, with the productivity of 3.2 to 4.2 tonnes per ha during 2015/16 (MoANR, 2016).

Turmeric suffers badly with *Colletotrichum* leaf spot in rainy season under humid condition in southwestern Ethiopia. Survey conducted in major producing areas of southwestern Ethiopia have found that the crop suffers from this disease. Leaf spot of turmeric caused by *Colletotrichum capsici* is one of the worst pathogens causing quantitative and qualitative losses all over the turmeric production of India. Maximum losses were found in severely

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diseased plants (>50 %) i.e. 25.83 and 62.12 per cent in mother and finger respectively (Mali, 2012). The disease is known to cause damage to a greater extent by reducing rhizome size and weight up to 52 per cent (Ramakrishnan, 1954 ).

The information available on incidence and losses due to this disease is very scanty. Therefore studies on assessment of Colletotrichum leaf spot of turmeric were conducted with following objectives:

- Survey of farmers fields for the occurrence of the disease and Isolation and purification of the pathogen, its characterization and proving pathogenicity.

### MATERIAL AND METHODS

#### Survey for Occurrence of the Disease

The survey was under taken in the turmeric growing areas of southwestern Ethiopia during 2017-2018. During the survey one turmeric field was sampled approximately every 10 km along the road side, depending up on the cropping intensity. Disease were recorded in each field in each of five quadrates by following X shape. one quadrate was situated in each of four corners and one in the centre of the field. Disease samples were collected for isolation and identification of pathogen and the fields were assessed for incidence and severity of leaf spot of turmeric. Diseased leaf samples were collected from cultivators fields, which were then properly marked, packed in polythene bags and brought to the laboratory for further studies. Different locations visited during 2017/18 for assessing the occurrence of disease have been given in table 1.

Disease incidence =

$$\frac{\text{No. of plants exhibiting disease symptoms}}{\text{Total no. of plants observed in the quadrant}} \times 100$$

**Table1.** Different locations and fields visited for assessing the Incidence of disease

S. No	Zone	Location
1	Sheka	Bachi
2		Addis Alem
3		Selamber
4		Shosha
5		Korcha
6	Benchi maji	Sheko
7		Gizmaret
8		Babaka
9	Mejang	Akash
10		Toki Tokali

#### Isolation of the Pathogen

The standard tissue isolation procedure was followed to isolate the pathogen. The infected leaf bits along with adjoining healthy portions were surface sterilized with 1:100 sodium hypochlorite solution for one minute and washed thrice with sterilized water to remove the traces of chemicals if any. The diseased pieces were then dried by placing between two sterile papers, which were then transferred to sterilized petriplates containing solidified PDA-S medium. The inoculated petri plates were incubated at a temperature of 25±1°C and observed periodically for the growth of emerging fungus developed from diseased tissues. The growth was transferred to PDA slants and incubated at 25°C ±1°C for 15 days. The pure cultures of the Colletotrichum were obtained

by single spore isolation method using the procedure described by Choi et al. (1999) with modifications. The pathogen were identified based on morphological and cultural characteristics of (Than *et al.*, 2008). Based colony characteristics and observing acervulus, setae, conidiophores and conidia of the isolated pathogen under compound microscope Colletotrichum *capsici* the causal agent of turmeric leaf spot.

#### Proving - Koch's Postulates (Pathogenicity)

Turmeric seedlings raised in earthen pots were sprayed first with distilled water. They were then covered with polythene bags for 24 hours. Seven days old sporulating culture of *C. capsici* grown on PDA was used for pathogenicity tests. The spore suspension (10<sup>5</sup> c fu/ml) was sprayed by an spray can on foliage. Similarly, control plants were sprayed with sterilized water for comparison.

The seedlings were covered with polythene bags and were kept for 5 days to ensure successful penetration of the pathogen into host tissue. Thereafter polythene bags were removed and the seedlings were kept under green house conditions. Regular observations were made for the appearance and development of symptoms. The symptoms appeared after thirteen days and re-isolations were made from the advancing leaf spots for confirmation.

### RESULT AND DISCUSSIONS

Experiments were carried out on Colletotrichum leaf spot of turmeric with emphasis on the causal organism associated and assessment of disease incidence.

### Assessment of Disease Incidence

Surveys of farmers fields were undertaken in major turmeric producing areas of southwestern Ethiopia to assess the incidence of Colletotrichum leaf spot on turmeric.

**Table 2.** Survey of incidence (%) of Colletotrichum leaf spot on turmeric in southwestern Ethiopia

S/N	Zone	Location	Disease incidence (%)
1	Sheka	Bachi	61.8
2		Addis Alem	59.5
3		Selamber	54.2
4		Shosha	51.0
5		Korcha	49.0
6	Benchi Maji	Sheko	45.4
7		Gizmaret	43.0
8		Babaka	41.5
9	Mejang	Akash	40.2
10		Toki Tokali	39.1

The data presented in table two indicated that Colletotrichum leaf spot was wide spread disease making its appearance in all surveyed areas in varying degree. The maximum percent disease incidence was recorded in Bachi village (61.8%), followed by Addis Alem (59.5%), Selambar (54.2%) and the minimum disease incidence was recorded from Toki Tokali (39.1%). It has been observed in different areas surveyed in varying severity. Ramakrishnan (1954) reported the disease causing heavy losses in rhizome production in India. Much later, Joshi and Sharma (1980) reported Colletotrichum leaf spot on turmeric from Tamil Nadu. Since, then

it has been observed in different areas of the world in varying severity, causing low to moderate losses to the crop. Present study is thus an indication of up to 61% incidence of this disease in certain areas, which certainly may result in yield losses in isolated pockets. As such, the scientists should be vigilant for the occurrence of different diseases in changing scenario of weather so that the diseases with negligible incidence may not assume serious proportions. Leaf spots in turmeric like taphrina leaf spot, Helminthosporium leaf spot and Colletotrichum leaf spot appear during different periods of crop growth but, erratic rainfall patterns may cause a change in the disease scenario in future.

### Disease Symptom

Symptoms on leaves appeared as elliptical to oblong spots, measuring 2.5 to 4 cm in length and 1.5 to 2.5 cm in width. Two or more spots coalesced to develop irregular patches, which eventually dry up. In the initial stages the spots had greyish white centre having numerous

Black dot like structures i.e. the acervuli in concentric rings and such spots were surrounded by a yellow halo, which later coalesced giving blighted appearance. Such leaves become papery, easily tom off and drop. The severely infected plant exhibited a burnt appearance, which can be noticed easily from a distance. This symptoms are in agreement with those described by Ramakrishnan (1954) and Sarma *et al.* (1994)



**Fig1.** Symptom of turmeric leaf spot under field condition

### Isolation of the Pathogen

Diseased leaves of turmeric showing typical leaf spot symptoms of Colletotrichum leaf spot were collected. Isolations were made from infected portion of leaves on potato dextrose agar (PDA-S) medium to obtain pure culture of the pathogen.

The pathogen was identified as *Colletotrichum capsici* on the basis of the morphological characteristics of mycelium, acervuli, setae, conidia and conidiophores observed. Which were identical to those described in the literature (Ramakrishnan, 1954; Rangaswami, 1972)

### Pathogenicity Test

Typical symptoms of the disease appeared on the leaves after thirteen days of incubation, upon inoculation with a pure and virulent culture of *C. capsici*. The pathogen was re-isolated from the infected spots and Koch postulates were proved.

### SUMMARY AND CONCLUSION

Studies were conducted to assess the disease incidence, isolation and characterization of the pathogen. The field survey indicated that maximum disease incidence observed in Baschi (61.8%) and the minimum in Toki Tokali (39.1%). The pathogen was identified as *colletotrichum capsici* on the basis of cultural characters observed and those described in the literature and pathogenicity. *Colletotrichum* leaf spot had been found to be a disease of wide spread occurrence on turmeric in southwestern Ethiopia. The disease symptoms appeared as elliptical to oblong brown spots with black concentric rings i.e. acervuli, with yellow halo, *colletotrichum* leaf spot shown to be incited by *colletotrichum capsici*.

Future research should be undertaken in search of resistance variety to *colletotrichum capsici* and integrated disease management should be tried to manage the disease.

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