Biological Forum – An International Journal **16(7): 29-32(2024)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

First Report of *Fusarium pallidoroseum* (Cooke) Sacc. causing Wilt Disease in Coriander (*Coriandrum sativum* L.)

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(Received: 13 April 2024; Revised: 27 April 2024; Accepted: 02 June 2024; Published: 15 July 2024)

(Published by Research Trend)

ABSTRACT: Coriander (*Coriandrum sativum* L.) is a significant annual spice crop affected by several diseases. To date, no documentation exists regarding the presence of *Fusarium pallidoroseum* (Cooke) Sacc. on coriander. However, a wilted coriander plant was observed due to *F. pallidoroseum* at the Jambuvadi Farm of Junagadh Agricultural University, Junagadh during the year 2022-23. The pathogen was identified by the Indian Type Culture Collection (ITCC), IARI, New Delhi (ID No. 11,782.22). Studies regarding pathogenicity, symptomatology and cultural and morphological characteristics were carried out. The pathogenicity test of the fungus was established by following Koch's postulates using soil inoculation method. The disease occurs at any crop growth stage. Symptoms at the seedling stage show drooping of the petiole and leaves followed by collapse of the seedlings, which lodge over the surface of the soil. While at flowering stage, the initially affected plant showed yellowing and drooping of the lower leaves which extended upward followed by withering and outright mortality of plant. The vertically split open affected plant's root shows brown vascular discoloration. The fungal colony grown on PDA medium initially exhibited profuse cottony white aerial mycelium, transitioning to creamy white over ten days of incubation at 28 ± 1°C, reaching a diameter of 90 mm. A reddish-brown pigmentation was observed on the back side of the Petri plate containing grown up culture. Microscopic examination revealed the presence of macroconidia, which were sickle-shaped and 3-4 septate. Microconidia were small and single or bi-celled. Chlamydospores were observed in twenty-day-old culture, appearing rough to smooth-walled, nearly spherical in shape.

Keywords: Coriander, *Fusarium pallidoroseum*, wilt, pathogenicity, symptomatology, cultural and morphological character.

INTRODUCTION

Coriander (*Coriandrum sativum* L., 2n=22) is a significant annual herbaceous spice crop belonging to the family Apiaceae. Known as Dhaniya in Hindi, Dhanya in Sanskrit and Kotthamalli in Tamil. It holds historical significance dating back over 5000 years, often referred to as the "Spice of Happiness" by the Egyptians. This slender, soft, hairless plant grows up to 25-50 cm in height, branches extensively and is widely cultivated throughout India (Chahal *et al*., 2017). The characteristic pleasant aroma of coriander is attributed to its essential oil called "coriandrol," found in dry seeds at concentrations ranging from 0.1 to 1.3% (Krishna De, 1999). It is primarily grown as a *Rabi* or winter crop, although it can be cultivated year-round for its green leaves. However, the germination of coriander seeds is adversely affected by temperatures exceeding 30°C or falling below 10°C (Vijay and Malhotra 2001). Coriander is susceptible to various fungal diseases like stem gall (*Protomyces macrosporus* Unger), powdery mildew (*Erysiphe polygoni* DC.), wilt [*Fusarium solani* (Mart.) Sacc. or *F. oxysporum* f. sp. *coriandrii*], root rot (*Rhizoctonia solani* Kuhn); bacterial diseases such as bacterial leaf blight (*Xanthomonas compestris* pv. *coriandrii*), bacterial umbel blight and seed decay [*Pseudomonas syringae* pv. *coriandricola* (Psc.)] and viral disease such as *chlorotic lesion virus* (Lakra, 2001). However, the investigation of coriander wilt incited by *Fusarium pallidoroseum* (Cooke) Sacc. marks the first reported instance, with no existing literature documenting this occurrence up to the present date. It is a soil-borne *Fusarium* species that too has quit less evidence of causing disease in crops, though previously it has been reported in bael causing leaf spot and dieback disease in Uttar Pradesh (Kumar *et al*., 2021), wilt disease of *Chlorophytum nepalense* in West Bengal (Bose *et al*., 2010), leaf blight disease of castor in Nigeria (Mamza *et al*., 2008), fruit rot disease of citrus in Gujarat (Baria *et al*., 2015) and wilt disease of chilli in Kashmir (Wani, 2007).

MATERIALS AND METHODS

The experiment was carried out in the PG laboratory and Net House at the Department of Plant Pathology, College of Agriculture, Junagadh Agricultural University, Junagadh, Gujarat during the year 2023-24. This center is situated at an altitude of 93.18 m above mean sea level, between 21.50°N latitude and 70.44°E longitude. The location falls under the South Saurashtra agroclimatic zone VII of Gujarat.

Collection of samples. The infected coriander plant showing typical wilt symptoms were collected from the Jambuvadi Farm of the Department of Horticulture, Junagadh Agricultural University, Junagadh, Gujarat during the year 2022-23.

Isolation and purification. The fungus was isolated by standard tissue isolation methods. An infected root section of coriander was selected along with some healthy tissues and cut into small pieces using a sterilized scalpel. The small pieces were surface sterilized by dipping in 1 per cent sodium hypochlorite solution for one minute and finally washed well with three changes of sterilized distilled water, which was then kept on the surface of sterile tissue paper to remove excess water. The small pieces were transferred directly to Petri plates containing Potato Dextrose Agar (PDA) medium with the help of inoculating forceps and Petri plates were placed in an inverted position and incubated at 28 ± 1 ºC. The resulting fungal culture was purified by using the hyphal tip isolation technique. The fragments of hyphal growth from the actively growing tips were transferred to fresh PDA containing slants and observed at regular interval for the growth of the pathogen.

Maintenance. The fungus was subcultured on PDA containing slants and kept at 28 ± 1 ºC. Subsequently, subculturing of the pathogen was done at an interval of 20 to 25 days and stored in a refrigerator at 4ºC for further laboratory studies.

Pathogenicity and symptomatology. A pathogenicity test was carried out under Net House conditions in plastic pots (15 cm in diameter) by employing the soil inoculation method to prove Koch's postulates for a given pathogen.

The inoculum of the pathogen was prepared on half cooked healthy sorghum grain. One hundred grams of the medium (sterilized sorghum grain) were filled in plastic bags and sterilized at 121.6 °C and 1.055 kg/cm^2 (15 psi) steam pressure for 15 minutes. After cooling, the polyethylene bags containing the sterilized media were inoculated with a 4 mm diameter mycelial disc of actively growing isolated fungus using a sterilized cork borer from a ten-day-old culture on a PDA containing Petri plate and incubated at 28 ± 1ºC for ten days. These inoculums prepared in polyethylene bags were mixed uniformly with sterilized soil @40 g/kg soil and filled in surface sterilized 15 cm diameter plastic pots. After watering, these pots were kept for the establishment of pathogens upto four days in Net House conditions. On the fifth day, ten coriander seeds of susceptible variety GC-2, surface sterilized with 1 per cent sodium hypochlorite solution followed by three changes of sterilized distilled water were sown after drying in each pot. The pots without inoculums served as control. Watering was done as and when required.

The symptoms of wilt disease in coriander were studied and the expression of the characteristic symptoms and variations were recorded. After the development of disease, the pathogen was re-isolated on the PDA medium from the inoculated plants for confirmation of Koch's postulates.

Cultural and morphological studies. Cultural characteristics such as colony colour, colony diameter and growth patterns were recorded from the initiation of mycelial growth up to ten days. The morphological characters of the fungus were studied with the help of a compound microscope (40X) from a ten-day-old culture. Slides of the fungus were prepared by staining an actively growing fungus with cotton blue. Measurements and photomicrographs of hyphae and spores were taken with the help of ZEISS ZEN microscopy software at the Department of Biotechnology, College of Agriculture, Junagadh Agricultural University, Junagadh, Gujarat.

RESULTS AND DISCUSSION

Isolation and identification of the causal organism. After three days of incubation on PDA medium, the fungal mycelium was emerging from infected root portions. This was further purified by the hyphal tip isolation technique and sent to the Indian Type Culture Collection (ITCC), Division of Plant Pathology, IARI, New Delhi for further identification of the causal organism, which was identified as *Fusarium pallidoroseum* (ID No. 11,782.22).

Isolation of *F. pallidoroseum* by tissue isolation technique was also done by Bose *et al*. (2010) from *Chlorophytum* leaf blade, Ram (2013) from tomato fruit and Muzaffar (2018) from infected roots of a chilli plant on PDA medium.

Pathogenicity. The initial disease symptoms in artificially inoculated plants were observed at 30-40 days after sowing. In the beginning, the sudden drooping of leaves followed by the withering and drying of whole plants within 10 to 15 days in the inoculated pot. While in an uninoculated pot, the plants were free from disease (Plate I).

The symptoms produced on the artificially inoculated plant were similar to those observed under natural conditions in the field. Re-isolation of the pathogen from an artificially inoculated plant was done and compared with the original one, which exhibited almost identical characteristic symptoms as well as cultural and morphological characters in all respects and confirmed the pathogenicity test of *F. pallidoroseum.*

Similarly, the pathogenicity test of *F. pallidoroseum* in chilli plants through the soil inoculation method was also confirmed by Muzaffar (2018) which support the present finding.

Symptomatology. The disease occurs at any crop growth stage. At the seedling stage, drooping of the petiole and leaves followed by the collapse of the seedlings, which lodge over the surface of the soil. The

seedlings of highly susceptible plants die within ten days after emergence. At the flowering stage, the initially affected plant showed yellowing and drooping of the lower leaves, which extended upward followed by withering and outright mortality of the plant. The affected plant's root did not show any external symptoms; however, a longitudinally dissected plant root shows brown vascular discoloration (Plate II).

Similar types of symptoms were also recorded by Muzaffar (2018); Wani (2007) in chilli plants while working with *F. pallidoroseum* as yellowish discolouration of the lower leaves followed by shrivelling, drooping, wilting and ultimately death of the whole plant. The dried leaves remained attached to the wilted chilli plants. When the collar region of the plant dissected vertically, the vascular bundles showed brownish discolouration which corroborate the present findings.

Cultural and morphological studies. The grown-up fungal colony shows initially profuse cottony white aerial mycelium, which gradually turns creamy white and attained a growth of 90 mm in 10 days of incubation at 28 ± 1°C. On the back side of the Petri plate, reddish-brown pigmentation was observed (Plate III).

Observations under a compound microscope showed hyaline, thin, branched mycelium with a width of 2.37 to 2.53 µm. Mycelium produces macroconidia, microconidia and chlamydospores. Macroconidia were sickle-shaped, slightly curved at the apex, mostly with 3 or rarely 4 septa measuring 12.95 to 34.88 µm in length and 2.35 to 3.26 µm in width. Microconidia were small, single or bi-celled, ovoid or ellipsoid or reniform with dimensions of 5.42 to 7.41 µm and 1.75 to 2.27 µm in length and width, respectively. In twenty-day-old culture, chlamydospores were produced; they were rough to smooth walled, nearly spherical, intercalary or terminal and may be formed singly or in chains or pairs and measuring 5.83 to 6.34 µm in diameter (Plate IV).

Similar types of cultural and morphological characteristics were also observed by Muzaffar (2018) and Kumar *et al.* (2021) while working with *F. pallidoroseum* isolated from chilli and bael plant, respectively.

Plate I: Pathogenicity test of *F. pallidoroseum* on coriander plant.

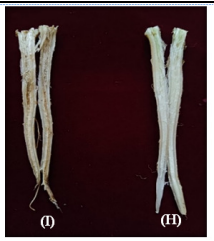
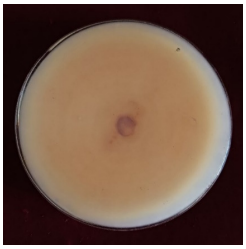


Plate II: Vertical section of infected (I) and healthy (H) roots of coriander.

Fungal colony showing profuse cottony white growth on front side of Petri plate.



Fungal colony showing reddish-brown pigmentation on back side of Petri plate.

Plate III: Cultural characteristics of *F. pallidoroseum.*

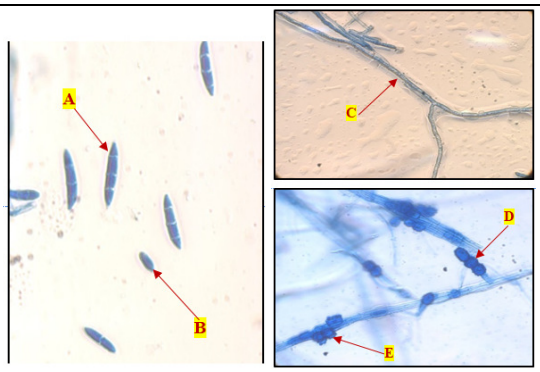


Plate IV: Photomicrograph (40X) of macroconidia (A), microconidia (B), mycelium (C), chlamydospores terminal (D) and intercalary (E)

CONCLUSIONS

Based on the current investigation, it can be concluded that coriander (*Coriandrum sativum* L.) is also a host of *Fusarium pallidoroseum* (Cooke) Sacc., which causes wilt disease under natural conditions.The review of the literature showed that it is a new record on coriander from India.The disease occurs at any stage of crop growth, resulting in the outright mortality of the plant. The longitudinally split open affected plant's root shows brown vascular discoloration. The pathogen is soil-borne in nature and produces chlamydospores, macroconidia and microconidia.

FUTURE SCOPE

In the present study, *F. pallidoroseum* has been identified in limited areas, causing wilt disease in coriander. However, there is potential for its widespread escalation, posing significant future challenges. Therefore, there is a critical need to develop effective management strategies and expand research efforts to anticipate its broader geographical impact and the development of sustainable control measures.

Acknowledgement. The authors are highly thankful to the Director of Research and Dean, Faculty of P.G. Studies, Junagadh Agricultural University, Junagadh, Gujarat, India for providing the necessary facilities to conduct the research work and they are also grateful to the Indian Type Culture Collection (ITCC), Division of Plant Pathology, IARI, New Delhi for the identification of the pathogen with ID No. 11,782.22.

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How to cite this article: D.G. Pithiya and K.K. Kanzaria (2024). First Report of *Fusarium pallidoroseum* (Cooke) Sacc. causing Wilt Disease in Coriander (*Coriandrum sativum* L.)**.** *Biological Forum – An International Journal, 16*(7): 29-32.