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Avinash
Govind Ballabh Pant University of Agriculture and Technology (G.B.P.U.A&T), Pantnagar, Udham Singh Nagar, Uttarakhand, India

K Bijendra
Govind Ballabh Pant University of Agriculture and Technology (G.B.P.U.A&T), Pantnagar, Udham Singh Nagar, Uttarakhand, India

Shivani
Govind Ballabh Pant University of Agriculture and Technology (G.B.P.U.A&T), Pantnagar, Udham Singh Nagar, Uttarakhand, India

Correspondence
Avinash
Govind Ballabh Pant University of Agriculture and Technology (G.B.P.U.A&T), Pantnagar, Udham Singh Nagar, Uttarakhand, India

First report of *Fusarium acuminatum* on *Zingiber officinale* Rosc. from India

Avinash, K Bijendra and Shivani

Abstract
Ginger (*Zingiber officinale* Rosc.) is a high value cash crop being cultivated all across the world including India. India is the highest producer and exporter of ginger. In India it is cultivated in all states including Uttarakhand. In Uttarakhand, it is mainly grown by small and marginal farmers on which their livelihood depends and cultivated in almost all the districts of Uttarakhand. Although it is a high value cash crop but its productivity is very low and the reason seems to be continuous use of degenerated seed rhizomes which are prone to various diseases, insect-pests and nematodes. Among these, rhizome rot caused by multitude of pathogens is a complex and one of the major limiting factors in successful cultivation of ginger.

During present investigation, in order to establish the etiology of disease, infected rhizomes showing symptoms of rhizome rot were collected from the ginger growing areas of Kumaon during crop season 2015 and brought to laboratory for isolation of pathogens. Fifteen isolates of *Fusarium*were isolated on PDA, isolate no. 6 of *Fusarium* sp. (Kotabagh isolate) were proved to be pathogenic under glasshouse conditions. This isolate was sent to Indian Type Culture Collection, Division of Plant Pathology, Indian Agriculture Research Institute, New Delhi for further confirmation and identification up to species level which was identified as *Fusarium acuminatum* (Ellis and Everh.,). *F. acuminatum* has earlier been isolated from the ginger rhizome by Ingle *et al.* (2008) [2] but they have not proved the pathogenicity so it should be considered as first report from India.

Keywords: *Fusarium acuminatum*, *Zingiber officinale* Rosc.

Introduction
Ginger (*Zingiber officinale* Rosc.) is a perennial monocotyledonous herb belonging to the *Zingiberaceae*, a family comprised of 47 genera and 1400 species (Hogarth, 2000) [1]. The crop is native to either Asia in general (Singletary, 2010) [6] or specifically to India; however, its exact origin is still unclear (Zachariah, 2008) [7]. Today ginger is cultivated worldwide throughout the subtropics and tropics where it plays an important role in agricultural economic systems in these regions (Kavitha and Thomas, 2008) [3]. Ginger is an important commercial crop cultivated for its aromatic rhizomes which are used both as spice and medicine (Nath *et al.*, 2014) [5].

Plants with yellow or dead shoots, rhizome and pseudostem were collected (Figure- A, B and C) from major ginger growing areas of Kumaon region for isolation of pathogens on Potato Dextrose Agar media during 2015 crop season, 15 isolates had cultural and microscopic characteristics considered typical of *Fusarium* (hyaline, septate, cottony white mycelium (Fig. D and E), rounded micro-conidia (Fig. F) with septate, sickle-shaped macro-conidia (Fig. G) and chain of terminal and intercalary chlamydospores (Fig. H).

To determine whether these isolates are pathogenic or not? pathogenicity tests were set up separately for each isolate under glass house conditions. Plants were inoculated 60 days after the rhizomes had been planted (Fig. I). Symptoms of the disease were noticed only in the plants inoculated with isolate 6 of *Fusarium* (isolated from samples collected from Kotabagh, Nainital). The pathogens were re-isolated from infected rhizomes/pseudostems of plants inoculated with *Fusarium.* Similar, cultural and morphological characteristics have been observed as recorded earlier.

The identities of the pathogens were confirmed based on spore morphology and colony characteristics of the fungus under microscope with the help of standard monograph or literature. The identification of *Fusarium acuminatum* was done on the basis of conidial characters by reffering "The *Fusarium* Laboratory Manual" (Leslie and Summerelle, 2006) [4] and further confirmed by Indian Type Culture Collection, Division of Plant Pathology, IARI, New Delhi. *F. acuminatum* has earlier been isolated from the ginger rhizome by Ingle *et al.* (2008) [2] but they have not proved the pathogenecity. Thus, whether it was pathogenic or saprophytic not clearly reported in literature. It seems that this is the first report of *F. acuminatum* causing rhizome rot of ginger in India.

Fig A. Rhizome rot infected ginger field, **B** and **C.** Rotted rhizome and pseudostem

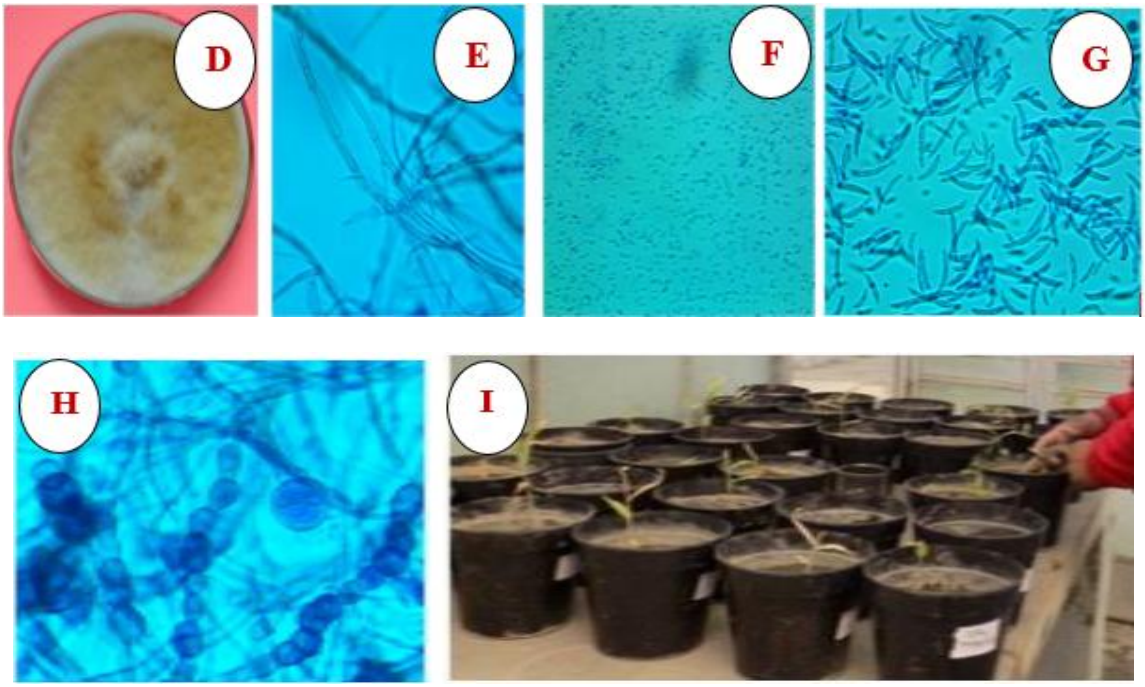

Fig D. Colony character of *Fusrium acuminatum*, **E.** Septate mycelium **F.** Rounded micro-conidia of *F. acuminatum*, **G.** Sickle shaped, septate macro-conidia of *F. acuminatum*, **H.** Chlamydospores in chains, **I.** Proving pathogenicity in glasshouse

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