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Effect of temperature and moisture levels on disease development of stem gall of coriander

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ABSTRACT

Stem gall is one of the most important diseases of coriander. The effects of different temperature (15–35°C) and moisture levels (15-75 per cent) was studied on the development of stem gall of coriander caused by *Protomyces macrosporus* plants grown under controlled conditions. Results revealed that disease development was maximum (77.50%) at 25°C soil temperature followed by 30°C temperature giving 52.50 per cent disease incidence and 30.00 per cent disease severity, while very low and high temperature were not favourable for development of disease. In other experiment on different moisture regimes, 45 per cent of soil moisture level was favourable for disease development and resulted in 70.25 per cent disease incidence and 35.25 per cent disease severity. Very low and very high soil moisture levels were not favourable for disease development.

Key words: Coriander, Epidemiological parameters, Moisture, *Protomyces macrosporus*, Stem gall, Temperature.

INTRODUCTION

Coriander (*Coriandrum sativum* L.), a member of family Apiaceae, is one of the major spice crop in India (Raghavan, 2000). Its seeds (fruits) and leaves are extensively used (Bhat *et al*., 2014) as natural additives in cooking, added to food in order to improve its appearance and flavour. All parts of this herb are used as flavoring agent and/or as traditional remedies for the treatment of various diseases and disorders in the folk medicine systems of different civilizations (Sahib *et al*., 2012). The crop yield is reduced by a number of fungal diseases (Bilgrimi and Razivi, 1991) of which stem gall disease caused by *Protomyces macrosporus* Unger, is the most destructive and versatile disease. The disease is prevalent in all coriander growing areas of India and is considered as a limiting factor for successful cultivation of the crop. The symptoms of the disease first appear as gall like appearances on the lower part of stem, which gradually extends upwards to flower and seeds. The diseased seeds are hypertrophied depending upon the stage of infection, ultimately lowering the crop yield and quality.

Interactions of environmental factors are known to influence disease development (Rotem, 1978). An understanding of the role environmental factors on the infection and survival of any root pathogen is necessary to develop cultural disease management practices as well as assays that evaluate host resistance or efficacy of seed treatments (Dorrance *et al*., 2003). Studies undertaken in the past on stem gall disease show clearly that disease appears continuously every year in the field of coriander grown on high pH soil, moisture and adverse ecological and edaphic factors (Saxena, *et al*., 2002). Field observations indicated that progress of stem gall was closely circumscribed by environmental conditions and plant age (Mukhopadhyay and Pavgi, 1971). Temperature is known to influence resistance to bacteria, fungi, virus, and insects; and different host-pathogen interactions respond differently to different temperature ranges (Garrett *et al.*, 2006). A high temperature very often inhibits disease resistance or plant immunity (Dropkin, 1969), although low temperature also leads to reduced plant defense in some cases (Szittya, 2003). Development of soil borne diseases is enhanced by abundant soil moisture. Therefore, in the present study, effect of different temperature and moisture regimes on development of stem gall of coriander was studied under controlled conditions.

MATERIALS AND METHODS

The experiments were conducted in humidity chamber under laboratory conditions in Department of Vegetable Science, UHF, Nauni.

Preparation of inoculum: For the preparation of chlamydopsore inoculum, the diseased stem and seeds of coriander infected plants were collected from the field and were shade dried and powdered in a pestle mortar. This powdered material containing 7.5×10^4 chlamydospores /g of crushed material was used as inoculum.

Effect of soil temperature regimes on disease development: To determine the effect of temperature on disease development, a pot experiment with five different

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temperature regimes i.e. 15, 20, 25, 30 and 35°C was conducted by maintaining different temperature levels under laboratory conditions in humidity chamber by setting at these levels and were regularly monitored. Four replications were kept for each treatment. The healthy coriander seeds of susceptible variety "Rajendra Swati" were sown in small sterilized pots (10 cm) which were filled with sterilized soil (570 g) in laboratory by placing at a depth of 2.5 cm in the soil. The crop was irrigated as per requirements and standard recommendations for crop raising were followed. After germination, ten seedlings were maintained in each pot. The chlamydospores of the fungus in powdered form were added as inoculum. Observations on disease incidence and disease severity were recorded.

Effect of soil moisture on disease development: In order to find out the optimum soil moisture for coriander stem gall disease development, effect of different moisture regimes i.e. 15, 30, 45, 60 and 75 per cent on disease development was studied by maintaining different moisture levels by thermogravimetric method (Mishra and Ahmed, 1987) in pots under laboratory conditions.

The coriander seeds of susceptible variety "Rajendra Swati" were sown as explained earlier above. For maintaining the moisture level, the total weight of each pot along with oven dried soil was noted (Dickson, 1923). Inoculum was mixed with soil and this weight was added to pot weight for moisture calculation. Seeds were sown and weight of seeds was also added. Then with the help of formula given by Mishra and Ahmed (1987) moisture level was checked and the required amount of water was added to the treatment pots and weight of the pots was taken.

$$PW = \frac{WS_1 - WS_2}{WS_2} \times 100$$

Where,

PW = moisture percentage
WS_1 = fresh weight of soil
WS_2 = dry weight of soil

The soil moisture level were maintained till the end of the experiment by adding water equal to loss in weight per pot with the help of measuring cylinder. Observations on disease incidence and disease severity were recorded.

RESULTS AND DISCUSSION

Effect of soil temperature: Data (Fig 1) revealed that the stem gall disease developed at all the tested temperatures except 15°C, however, highest incidence and severity were found at 25°C temperature giving 77.50 (62.62) per cent incidence and 37.50 (37.48) per cent severity, respectively. This was followed by 30°C temperature which resulted in 52.50 (46.43) per cent incidence and 30.00 (32.44) per cent severity, respectively, though statistically at par with each other. Thus, 25°C temperature was the optimum temperature

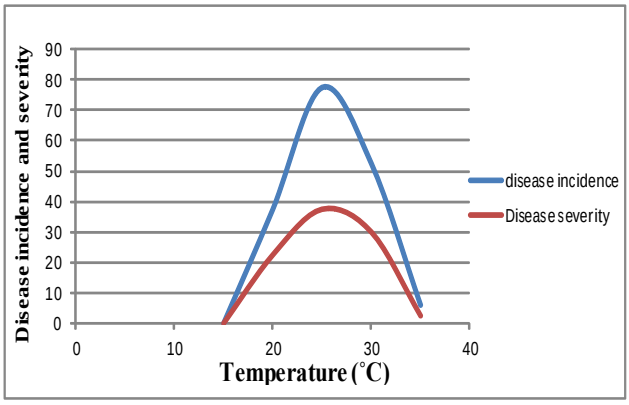


Fig 1: Effect of different temperature regimes on development of stem gall of coriander.

for disease development and there was a gradual decline with the increase and decrease in temperature from 25°C towards upper and lower side with no disease development at 15°C.

The influence of temperature on the stem gall disease development under *in vitro* conditions revealed that the disease was initiated when the temperature start increasing to the 20°C which is achieved in the month of Feburary (Mukhopadhyay and Pavgi, 1971). It attained a maximum disease incidence when temperature goes to the 30°C during March and April. Lakra (1993) observed that disease incidence and symptoms in stem gall of coriander caused by *P. macrosporus* were maximum at 25-30°C. Disease appears continuously in every year in the field of coriander grown on high pH soil, moisture and adverse ecological and edaphic factors (Saxena *et al*., 2002). Tripathi (2003) also reported that range of soil temperature for stem gall disease development was 20-30°C with optimum at 27°C.

Effect of soil moisture: It is evident from the data presented in Fig 2 that all the moisture levels tested were able to support

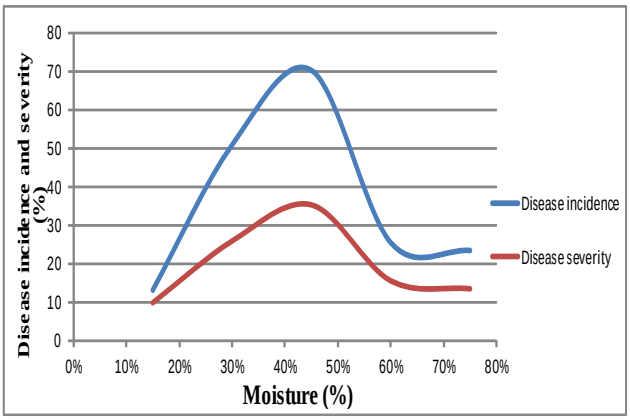


Fig 2: Effect of different soil moisture regimes on development of stem gall of coriander.

the disease, however, 45 per cent soil moisture resulted in maximum disease incidence and severity with 70.25 (57.38) per cent and 35.25 (36.26) per cent, respectively, followed by 30 per cent moisture level giving 50.82 (45.47) and 25.82 (30.48) per cent disease incidence and severity, though statistically different from each other. Minimum disease incidence 13.10 (21.06) per cent and severity 9.80 (18.07) per cent were recorded at 15 per cent moisture level.

With the increase in moisture level above 45 per cent, there was a decrease in disease incidence and severity giving 25.42 (30.24) and 23.37 (28.88) per cent disease incidence and 15.50 (23.11) and 13.42 (21.44) per cent disease severity, respectively, at 60 per cent and 75 per cent moisture level. This decrease in disease incidence and severity could be due to poor establishment of plants at higher moisture levels.

Relatively high percentages of soil moisture were correlated with increased incidence of the disease whereas very low soil moisture and very high soil moisture were not favourable for stem gall development of coriander (Pavgi and Mukhopadyay, 1970; Lakra, 1993). Bacigalova (2004) confirmed the occurrence of *P. macrosporus* fungus mainly on the humid places along the brooks and streams during the whole vegetation season (spring, summer and autumn). Malhotra *et al*. (2016) observed that presence of excess soil moisture, low sunshine hours due to cloudy weather in winter season fuels the spread of stem gall and damages the crop up to 100 per cent.

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