Pak.J.Bot., 30(1): 39-43, 1998.

EFFECT OF PHYSICAL PARAMETERS ON THE INCIDENCE OF ROOT AND COLLAR ROT DISEASE IN CHILLIES

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Abstract

The effect of physical parameters like temperature, flooding duration and soil type on the incidence of root and collar rot disease of chillies was examined. The disease incidence increased from 0-100% with rise in temperature from 15-30°C producing maximum canker length (4.5 cm) and girdling index (4 cm). Gradual increase of flooding period from 0-48 hours enhanced the disease development from 25-100% with maximum Canker length (3.66 cm) and girdling index at 48 h flooding period. Heavy soils showed 83.3% disease as compared to light medium soil which respectively showed 50 and 66.7% of disease incidence.

Introduction

Out of 34 different diseases reported on chillies (Black *et al.*, 1991), the root and collar rot disease caused by *Phytophthora capsici* L., is of great importance in different parts of the world (Sherf & Macnab, 1986; Stamps, 1985). *P. capsici* is also well established in the Punjab and causes root and collar rot epidemic each year in the main chilli growing areas (Saleem *et al.*, 1989, 1996). The disease like many other diseases caused by *Phytophthora* spp., has been observed to be more serious under high water regimes (Ristaino, 1991). Similarly temperature and soil type also affect the development of diseases caused by *Phytophthora* spp., (Duniway, 1983; Mircetich & Browne, 1987). The present report describes the effect of physical parameters viz., temperature, water flooding duration and soil types on the development of root and collar rot disease in chillies.

Materials and Methods

a) Effect of Temperature: Culture of *Phytophthora capsici* multiplied on sterilized oat seeds in 250 ml conical flasks was used (Papavizaz *et al.*, 1981). Susceptible chilli plants of FD-selection were transplanted in earthen pots containing 1 kg sterilized soil, one plant/pot. After one week 5 g culture of *P. capsici* multiplied on oat seed was added in each pot and mixed in the soil. Uninoculated plants served as control. After inoculation, pots were flooded with sterilized water for 24 hours to establish the pathogen. The experiment was run in quadruplicate in Hotpack growth chambers, where the inoculated and uninoculated plants were exposed to 15, 20, 25, 30, 35 and 40°C temperature condition. Disease incidence was recorded after 15 days of exposure to each temperature and analyzed statistically. Canker length and girdling index(0-4) was also noted as given by Matheron & Mircetich (1985).

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b) **Effect of flooding duration:** Inoculated potted plants were placed for 0, 6, 12, 18, 24 and 48 hours in iron tubs (75x45x35 cm) containing sterile water. The plants were dipped in water upto one inch stem keeping the upper portion of the plants in the air. In healthy control the plants were not inoculated with *P. capsici* but dipped in water for 0 and 48 hours. There were four replicates of each treatment with three plants in each replicate. The pots were incubated in glasshouse at 25± 5°C and plant mortality were recorded after 15 days.

c) **Effect of soil type:** Three types of soils viz, light sandy loam, medium sandy clay loam and heavy clay loam having sand, soil and clay in ratios of 74:12:14, 55:21:24 and 40:24:36, respectively, were used. One kg of sterilized soil of each type was transferred separately in 15 cm diameter pot. One seedling of susceptible FD-selection was transplanted in each pot and after one week the plants were inoculated with *P. capsici* as described earlier. There were 5 replicates of each treatment with 3 plants in each replicate. The pots were incubated in glasshouse at 25± 5°C and mortality percentage was recorded after 30 days of soil infestation.

Results:

a. **Effect of temperature:** Temperature had a direct influence on disease development (Fig.1). No disease was observed at 15°C. The disease incidence increased with the rise of temperature above 20°C and the pathogen produced 100% mortality of plants at 30°C which appeared to be optimum temperature for disease development. The disease declined thereafter and at 40°C the plants exhibited the scorching symptom on leaves due to high temperature with only 25% mortality of plants. Maximum canker length of 4.6 cm and 4.5 cm was recorded at 25 and 30°C, respectively (Fig.1). At 20, 25 and 35°C, the girdling index was 3.5, 3.75 and 3.5, respectively, with maximum (4) at

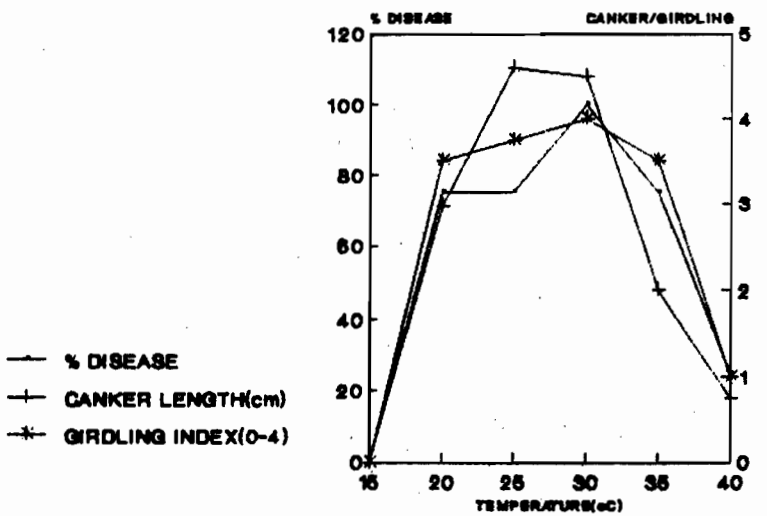

Fig.1. Effect of temperature on disease incidence, canker length and girdling index in pots.

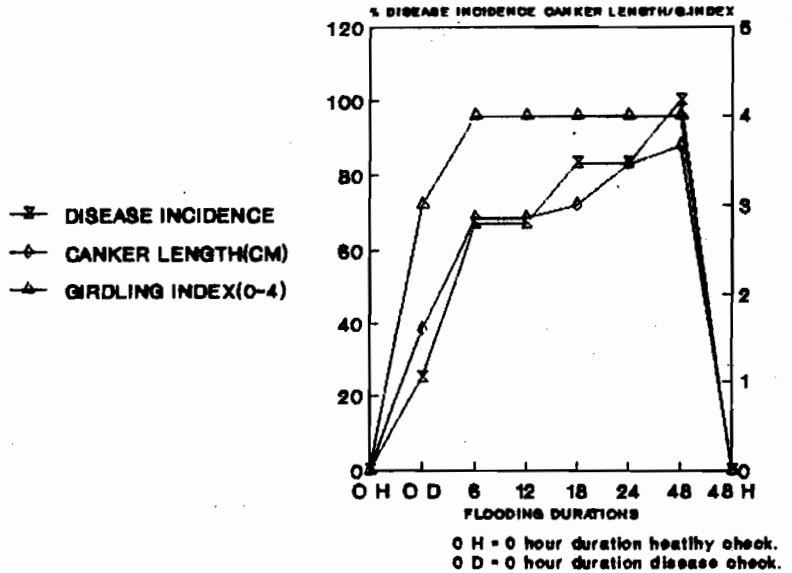

Fig.2. Effect of flooding duration on disease incidence, canker length and girdling index.

30°C. No disease symptoms were produced in uninoculated plants kept at different temperatures.

b. **Effect** of flooding duration: Seedlings grown in sterilized soil infected with *P. capsici* showed that root and collar rot severity increased progressively as flooding period increased from 0-48 hours (Fig.2). The disease incidence in non-flooded soil was 25% which increased to 100% after 48 hours flooding. Similarly, the canker length was maximum (3.66 cm) in 48 hours flooding as compared to 3.47, 2.86 and 2.86 cm at 24, 12 and 6 hours flooding durations, respectively. The girdling index at 6, 12, 18, 24, and 48 hours was 4 as compared to 3 in infested control. No girdling was observed in uninoculated control.

c. Effect of soil types: The disease incidence varied with soil type. It was significantly high in heavy soil 83.3%, as compared to light (50%),or medium soil (66.7%). Disease incidence in medium soil was not significantly different from light or heavy soils.

Discussions

In the present studies, *P. capsici* showed maximum activity at 30°C with 100% mortality of chilli plants. Kim *et al.*, (1989) reported that zoospores were released from sporangia of *P. capsici* at 20°C with germination rate of 80.7% followed by 70% at 25°C and 58.4% at 35°C, whereas, direct germination of sporangia, encysted zoospores and mycelial growth was optimum at 25°C. However, Greenleaf (1986) reported that *P. capsici* grew in culture between 8°C and 37°C with an optimum temperature of 30°C. The optimum temperature for zoospores production from sporangia and for host

penetration is slightly below 30°C which could be the reason for the optimum disease development at 30°C in the present studies.

Field observations strongly suggest that incidence and severity of *Phytophthora* root and collar rot of chillies is closely related to soil moisture conditions. These observations are supported by the result of the present studies where the disease incidence increased with the increase in flooding duration from 0 to 48 hours and at 48 hours of flooding duration maximum canker length and 100% mortality of chilli plants was observed after 5 days. Wilcox & Mircetich (1985) have also reported that prolonged flooding period can dramatically increase the incidence and severity of *Phytophthora* root and crown rot caused by *P. cryptogea* in Mahalab and Mazzard cherry cultivar seedlings grown under controlled conditions. Flooding appears to increase disease severity by promoting the discharge and dispersal of zoospores of *P. cryptogea* and *P. megasperma*. Similarly, Ristaino *et al.*, (1993) also found that in bell pepper the incidence of collar rot disease caused by *P. capsici* was 53.1-67.3% in lower portion of the fields where irrigation water was in contact with the plants for longer time than 15.9-22.6% in upper portions of the field. Flooding period that persist after zoospore release may influence disease severity by affecting the host as well as the fungus. It appears that chilli roots and collar tissues may significantly be more susceptible to colonization by *P. capsici* in the very low soil oxygen supply than well aerated soil. Thus infection initiated within first few hours following zoospore discharge may develop most extensively if oxygen become depleted in the root zone as it often does while the soil remains flooded (Drew & Lynch, 1980; Loannou *et al.*, 1970). Thus proper soil water management i.e. avoidance of soil saturation with water for long period and planting chilli nursery in well drained soil has much potential to minimize losses due to *P. capsici*.

The soil type is another important physical factor which plays an important part in inducing root and collar rot in chillies because most of the life cycle of the pathogen takes place in the soil. In the present study, incidence and severity of root and collar rot of chillies was highest in heavy (clay loam) soil followed by medium (sandy clay loam) and light (sandy loam) soils. The compact structure/fine texture of clay loam generally retain more moisture and low oxygen level which in turn affect inoculum production of *P. capsici*. The adverse effects of fine textured soils on zoospore movement has been reported (Mac-Donald & Duniway, 1978).

Oxygen has a very low solubility and diffusion rate in water and when a soil is flooded or saturated, oxygen may be depleted in sites of high metabolic activity (Drew & Lynch, 1980; Stolzy, 1974). As a result, roots experience varying degrees of 0_2 deficiency in saturated soil and the physiologic damage resulting from both the direct and indirect effects of low oxygen concentrations in soils may predispose roots to infection (Drew & Lynch, 1980; Stolzy, 1974). Thus the impact of soil type on the development of Phytophthora diseases is that it directly affects the multiplication, infection process and movement of the propagules (mainly zoospores) and indirectly it depletes the O_2 of the soil and predispose the plant to infection.

An understanding of the role of physical factors in determining the development of disease is therefore essential and the information generated through such studies could be utilized in devising IPM strategy for the control of the disease.

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(Received for publication 20 December, 1996)