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PATHOGENICITY OF *PHYTOPHTHORA CAPSICI* AND POSSIBILITIES OF ITS BIOLOGICAL AND CHEMICAL CONTROL

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Abstract: An experiment was conducted at the laboratory of the Department of Plant Pathology, Bangladesh Agricultural University, Mymensingh during the period of January to April 2006 on the pathogenicity of Phytophthora capsici, collar and root rot pathogen of chilli and its in vitro control using fungicides and plant extracts. P. capsici was found to be pathogenic in seedlings of brinjal, tomato, cucumber, white gourd, water melon, ribbed gourd, snake gourd, dhundol, khira and bangi except dhundol. The efficacy of four fungicides i.e. Ridomil, Acrobat MZ, Macuprax and Dithane M 45 each with 2 different concentrations (0.1% and 0.2%) and plant extracts viz. Alamanda and Garlic with 3 different dilutions of 1:2, 1:3 and 1:4 were evaluated for control of mycelial growth of the organism Phytophthora capsici in vitro condition. All the different concentrations of fungicides and all the dilutions of plant extracts significantly controlled the mycelial growth of P. capsici.
Key words: Phytophthora, Collar rot, Root rot, Pathogenicity, Biological, Chemical control.

Introduction

Collar and root rot diseases are very common diseases in chilli (*Capsicum annum*) throughout the world including Bangladesh. *Phytophthora capsici* infection commonly occurs in temperate, sub-tropical and tropical environments in the world (Erwin *et al.*, 1995 and Zitter *et al.*, 1996). *P. capsici* was first described by Leonian (1922) as the causal agent of a blight of chilli pepper in New Mexico. In South Korea, Lee *et al.*(1999) studied aggressiveness of *P. capsici* from pepper and pumpkin on pumpkin cultivers and reported significant pathogen host infection. In Italy, Tamietti and Valentino (2001) grouped *P. capsici* isolates into 13 depending on their ability to infect different plant species (tomato, brinjal, cucumber, snake gourd, white gourd, sweet gourd, watermelon, ridge gourd, dhundol, khira and bangi). They evaluated the relative virulence of isolates of *P. capsici* from cucumber and squash on pepper and found difference in virulence among the isolates. The disease caused by this soil borne fungus is widespread in furrow-irrigated fields. The disease generally occurs under excessively wet conditions, usually in heavy soils or low spots in a field. The disease exhibits patches in a field, or follow rows, and is spread in water. Infected plants exhibit severe wilting, die and turn straw-colored. Plants may defoliate. Roots become dead and the root barks sluff off easily. Traditional disease control strategy involves avoiding excess water to prevent the root and collar rot disease. Generally, water should not be allowed standing in the field and proper draining of the field quickly can avoid infection. But quick drainage of the entire field is difficult in terms of sudden heavy and prolonged shower and ridge-furrow cultivation requires improved implements; extra time, money and labour. In these conditions, fungicides and plant extracts may work against root and collar rot disease. Although root and collar rot like symptom on chilli plant are common in Bangladesh, unfortunately no detailed study was conducted on collar and root rot associated with *P. capsici.* So, it is our growing interest to study on collar and root rot disease on chilli plants and its control *in vitro*. The purpose of this study was determination of host range or pathogenicity of *P. capsici* and evaluating its control by using different chemicals and plant extracts *in vitro*.

Materials and methods

Pathogenicity study of *P. capsici* and its possibility of biological and chemical control was conducted in the laboratory of plant pathology during the month of January to April, 2006. Four fungicides (Acrobat MZ, Ridomil, Macuprax and Dithane M-45) each with 2 different concentrations were used in this study (Table 1). Concentrations of 0.2% and 0.1% of Acrobat MZ and Ridomil were used while for Macuprax and Dithane M-45, 0.5% and 0.25% concentration were used. A total of 8 fungicidal treatments with above mentioned concentrations were prepared with 3 replicates on the basis of active ingredients they contained. To prepare each fungicidal suspension of specific concentration, the required amount of fungicides were kept in the conical flask prior to mixing with sterilized water.The pathogenicity of the isolated *P. capsici* was tested on tomato, brinjal, cucumber, snake gourd, white gourd, sweet gourd, watermelon, ribbed gourd, dhundol, khira and bangi fruits and their seedlings, respectively. These fruits were collected from the local market. Seedlings of tomato, brinjal, cucumber, snake gourd, white gourd, sweet gourd, watermelon, ribbed gourd, dhundol, khira and bangi were grown on small plastic pots filled with sterile soil in green house. Ten healthy seedlings of each fruit type were kept to grow on. Watering and necessary care after germination were taken through out the experimental period. At the age of 1 month, the seedlings of each fruit type were inoculated with fungal block of *P. capsici* (4 mm diameters) at the base of the each seedling and observation was made for 7 days post inoculation. Control seedlings were kept non-inoculated with fungal block. Wilted and collar rotted seedlings were counted from each pot. In case of fruit, collected fruits were pricked with a sterile cork borer and fungicidal solutions were injected in the pricked point of the fruits. Then inocula blocks of mycelia of *P. capsici* (4 mm diameter prepared from 7 days culture) were placed on the pricked skin of the fruits. The inocula treated fruits were kept wrapping with brown paper for the incubation of the pathogen and appearance of the disease symptoms. Observation was made for about 5 days.Fruits,whichwereinoculated but administered no chemicals served as control.

Table 1. Details of fungicides used against *P. capsici.*

Name of the fungicides	Chemical name	Concentration
Acrobat MZ	Morpholide (C21 H22 ClNO4 C36 H54 N18 S36 ZnMn9)	0.2%, 0.1%
Ridomil	Methyl N- (2,6-dimethylphenyl)-N- (methoxyacetyl)-DL-alaninate	0.2%, 0.1%
Dithane M-45	Mauganous ethyline bishdi thiocarbamate + Zinc ions	0.5%, 0.25%
Macuprax	Basic copper sulfate	0.5%, 0.25%

Different plant extracts were tested against *Phytophthora capsici* pathogen. Details of plant extracts used in this experiment are given below-

Sl. No.	Name of the extracts	Concentrations
1	Garlic extract	1:2, 1:3, 1:4
2	Alamanda extract	1:2, 1:3, 1:4

The whole garlic or alamanda were crashed separately for mashing and sterile distilled water was added to make them 10% solution. Then the solution was sieved with fine sterile cloth. Clean extract was collected and dilutions (1:2, 1:3, 1:4) were made. Thirty mililitre extract was poured per plate and allowed for solidification at room temperature. After solidification fungal block of 4 mm diameter was placed on the centre of the petri plate. Observation was made daily for 3 days. At the same time, effectiveness of chemical fungicides were tested seperately by treating the fungal blocks with the prepared fungicidal solutions. Two different concentrations of each fungicides and 3 different concentrations of each plant extract zere used along with 3 non-treated control replications. The experiment was conducted in the laboratory in a Completely Randomized Design (CRD). Data were subjected to statistical analysis to find out the level of significance of the experimental result. The mean values of all treatments were compared and Analysis of Variance (ANOVA) was performed. The difference among the treatments was evaluated with Duncan's Multiple Range Test (DMRT).

Results and Discussion

Phytophthora capsici can strike chilli plant at any stage of growth. The infection usually appears first in low areas of the fields where the soil remains wet for longer periods of time. The pathogen infects seedlings, leaves, stem and fruit.

In the present study pathogenicity test of *P. capsici* carried out on fruits and seedling of brinjal, tomato, cucumber, white gourd, water melon, ribbed gourd, snake gourd, dhundol, khira and bangi (Plate 1a-4b).

In terms of pathogenecity, all fruits and their seedlings except dhundal were susceptible to *P. capsici* infection and developed clear fruit rot, root rot and wilting symptoms on artificially inoculated seedlins (Plate3a – 4b). Erwin and Ribeiro (1996) reported more than 40 plant species to be infected with *P. capsici*. Among the major host of *P. capsici* red and green pepper, cucumber, pumkin, watermelon, tomato and black pepper were reported. Later on, Tian and Babadoast (2004) reported 5 crop plants, namely beet, swish chard, lima bean, turnip, spinach and the weed species, valvet leaf, as host of *P. capsici*.

For the present study 4 commercially available fungicides namely Ridomil, Acrobat MZ, Macuprax and Dithane M 45 were used for the determination of their effectiveness against *P. capsici*. Two different concentrations (0.1% and 0.2%) of each fungicide were used with 3 replications providing 3 non-treated control replications (Table 2). All fungicides using both concentrations inhibited total growth of mycelia (Table 2). But non-treated control replications showed continuous growth of 1.14, 2.36 and 4.033 cm, respectively on day 1, day 2 and day 3 in 0.2% concentration group while in 0.1% concentration group it was 1.14, 2.30 and 4.20 cm, respectively on the respective days of observation (Table 1).

Effect of Alamanda extract and Garlic extract against *P. capsici* showed in Table 3. Three different concentrations (1: 2, 1: 3 and 1: 4) of each extract were used with three replication providing 3 non-treated control replications. Both extracts using 3 concentrations inhibited total growth of mycelia (Table 3). But non-treated control replications showed continuous mycelial growth which in case of 1:2 concentration group size was 1.8, 3.4 and 4.9 cm, respectively at day 1, day 2 and day 3 and in 1:3 concentration group that was 1.9, 3.4 and 5.0 cm, respectively and in 1:4 concentration group that was 1.6, 3.4 and 5.0 cm, respectively (Table 3).

In the present study, the infectivity of *P. capsici* on brinjal, tomato, cucumber, whitegourd, watermelon, ribbed gourd, snake gourd, dhundol, khira and bangi fruits was inhibited by fungicidal treatment (Ridomil, Acrobat MZ, Macuprax and Dithane M-45). This result agreed with the findings of Papavizas *et al.*, (1991) who found that Ridomil 2E (metalaxyl) was an effective fungicide for control of *P. capsici*. According to Hausbeck *et al.* (2002) Acrobat MZ can be an effective fungicide used to control the same disease.

This is the first time investigation on *P. capsici* associated with root and collar rot in chilli plant in Bangladesh. Due to the lack of adequate facilities genetic analysis of *P. capsici* isolates was not performed in the present study. So, further studies on genetic analysis of *P. capsici* for determination of strains of field isolates are needed.

Plate 1a *P. capsici* inoculated Ribbed gourd with fungicide

Plate 1b *P. capsici* inoculated Ribbed gourd without fungicide

Plate 2a. *P. capsici* inoculated sponge gourd with fungicide

Plate 2b. *P. capsici* inoculated sponge gourd without fungicide

Plate 3a. Healthy water melon seedling

Plate 3b *P. capsici* inoculated water melon seedling

Plate 4a. Healthy melon seedlings

Plate 4b *P. capsici* inoculated water melon seedlings

Table 2. Effect of fungicide on mycelial growth of *P. capsici*

Name of fungicide	Concentration used (%)	Radial mycelial growth (cm)		
		Day 1 (24 hours)	Day 2 (48 hours)	Day 3 (72 hours)
Ridomil Gold	0.2	0.0	0.0	0.0
	0.1	0.0	0.0	0.0
Macuprax	0.2	0.0	0.0	0.0
	0.1	0.0	0.0	0.0
Acrobat MZ	0.2	0.0	0.0	0.0
	0.1	0.0	0.0	0.0
Dithane M45	0.2	0.0	0.0	0.0
	0.1	0.0	0.0	0.0
Control	Non treated	1.14	2.36	4.03
	Non treated	1.14	2.3	4.20

Table 3. Effect plant extract on mycelial growth of *P. capsici*

Plant extract	Concentration used	Radial mycelial growth (cm)		
		Day 1 (24 hours)	Day 2 (48 hours)	Day 3 (72 hours)
Allamanda Extract	1:2	0.0	0.0	0.0
	1:3	0.0	0.0	0.0
	1:4	0.0	0.0	0.0
Garlic Extract	1:2	0.0	0.0	0.0
	1:3	0.0	0.0	0.0
	1:4	0.0	0.0	0.0
Control	Non treated	1.8	3.4	4.9
	Non treated	1.9	3.4	5.0
	Non treated	1.6	3.4	5.0

All seedlings and fruits except Dhundal seedlings were susceptible for *P. capsici* infection and developed clear fruit rot, root rot and wilting symptoms on artificially inoculated seedlings.

The current study showed that, all the 4 fungicides (Ridomil, Acrobat MZ, Macuprax and Dithane M 45) are highly effective in complete inhibition of mycelial growth of isolated *P. capsici* at a concentration of 0.1- 0.2%. Garlic and Alamanda extracts are also equally effective against the mycelial growth of *P. capsici* at different concentrations like 1:2, 1:3 and 1:4. Therefore, considering the envirionmental consequences and cost involvement, plant extracts could be preferred over chemical fungicides. Among the cucurbit vegetables, dhundal can be a better option to cultivateas it showed non-susceptability for *P.capsici*

References

Erwin, D. C. and Ribeiro, O. K. 1996**.** Phytophthora Diseases Worldwide. American Phytopathological Society, St. Paul, MN.

Erwin, D.C., Bartnicki, G. S. and Tsao, P.H. 1995. *Phytophthora its biology* taxonomy and pathology. American Phytopathological Society, St. Paul, MN. (Source: Internet).

Hausbeck, M., Goldy, R., Fulbright, D. and Hammerschmidt, R. 2002. An integrated Approach to Manage Phytophthora Blight on Michigan's Vine Crops. Phytophthora Workshop, lecture

Lee, J. Y., Kim, B., Lim, S. W., Lee, B. K, Kim, C. H., Hwang, B. K., Lee, J. Y., Kim, B. S., Lim, S. W., Lee, B. K., Kim, C. H. and Hwang, B. K**.** 1999. Field control of Phytophathora blight of pepper plants with antagonistic rhizobacteria and DL-beta-amino-n-butyric acid. Plant Pathology Journal 15(4**):** 217-222.

Leonian, L. H. 1922. Stem and fruit blight of pepper caused by *Phytophthora capsici*. Phytopathology 12: 401-408.

Papavizas, G. S, Bowers, J. H. and Johnston, S. A. 1991. Selective isolation of *phytophthora capsici* from soils. Phytopathology 71: 129-133.

Tamietti, G. and Valentino, D. 2001. Physiological characterisation of a population of *Phytophthora capsici Leon.* from northern Italy. Journal of Plant Pathology 83: 199-205.

Tian, D. and Babadoost, M. 2004**.** Host range of *Phytophthora capsici* from pumpkin and Pathogenicity of isolates. Plant Disease 88: 485-489.

Zitter, T. A.; Hopkins, D. and Thomas, C. 1996. Compendium of Cucurbit Diseases. The American Phytopathological Society. APS Press, St. Paul, MN. 86.