*Himachal Journal of Agricultural Research 34 (1):62-64, 2008*

# Effect of environmental factors on the development of Colocasia blight in Himachal Pradesh

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**Abstract**

**Effect of different climatic variables was studied on the development of Colocasia blight. Twelve hour leaf wetness period was found essential to initiate the disease. With an increase in the length of leaf wetness period, a corresponding increase in disease severity and decrease in incubation as well as latent periods were noticed. Maximum sporangial and zoospore germination was observed at 25°C and 15°C temperature, respectively and zoospores failed to germinate at 28°C. Temperature and relative humidity played a significant and vital role in the disease severity. The progress of disease in relation to weather variables exhibited sigmoidal curve during 2003 and 2004 cropping seasons.**

**Key words :** Colocasia blight, leaf wetness, temperature, RH.

## Introduction

Colocasia [*Colocasia esculenta* (L.) Schott.] leaf blight (*Phytophthora colocasiae* Rac.) is the most destructive and globally distributed disease (Gollifer and Brown, 1974; Hunter *et al.*, 1998). The disease spreads through sporangia and zoospores which are abundantly produced and are easily carried by rain splashes and wind (Misra and Roy Chowdhury, 1996). In Himachal Pradesh, the appearance of disease coincides with the onset of monsoon making the conditions adverse for successful cultivation of the crop. The disease assumes severe form in areas with high relative humidity and frequent rainfall and reported to cause 25-50 per cent losses in crop yield (Misra *et al.*, 1996; Gurung, 2001) which may exceed 60 per cent under epiphytotic conditions.

## Material and Methods

***Preparation of sporangial and zoospore suspension***

The sporangia were harvested from ten fresh sporulating lesions by washing with distilled water in a beaker and filtered through double layered muslin cloth. The suspension containing at least ten sporangia per microscopic field was used in different experiments. To get zoospore suspension, 1 ml of sporangial suspension was put in 5ml of chilled distilled water. Zoospores were released within 10 min. and this suspension was used in different experiments.

***Effect of leaf wetness***

To study the duration of leaf wetness period required for successful infection, the plants with 4-5 leaves were inoculated in triplicate with sporangial suspension containing at least ten sporangia per microscopic field. After inoculation these seedlings were kept in humidity chamber (90-100% RH) for 6, 12, 24, 36, 48 and 60 hours at 22 ± 1°C temperature.

***Effect of temperature on sporangial and zoospore germination***

Effect of seven temperature regimes *viz.*, 15, 18, 20, 22, 25, 28 and 30°C was studied on the germination of sporangia and zoospores of the pathogen through slide germination tests. The slides were fixed in lactophenol in cotton blue and data on per cent germination were recorded as below:

$$\text{Germination \%} = \frac{\text{Number of germinated spores}}{\text{Total spores}} \times 100$$

***Effect of environmental factors***

To study the relationship between climatic variables viz., mean temperature, mean RH and mean rainfall and disease development, field trials were laid out during Kharif 2003 and 2004 crop seasons and disease was scored on 1-9 scale (Vasquez, 1990) at weekly intervals starting with the appearance of disease. The disease severity was correlated with the

prevailing weather variables like temperature (°C), relative humidity (%) and rainfall (mm).

## Results and Discussion

### *Effect of leaf wetness period*

With an increase in the length of leaf wetness period corresponding decrease occurred in incubation and latent periods with consequently increase in the disease severity (Table 1). There was no development of disease with six hours of leaf wetness. Twelve hours of leaf wetness period was found essential for the development of disease and its symptoms appeared after 62 hours of incubation while sporulating lesions appeared after 89 hours of inoculation. With an increase in leaf wetness period from 24-60 hours, the incubation and latent periods decreased and ranged between 56-50 and 83-69 hours, respectively. The severity of disease ranged between 33-58.6 per cent and differed significantly between different periods of leaf wetness.

**Table 1. Effect of leaf wetness period (h) on the development of Colocasia blight**

| Leaf wetness period (h) | Incubation period (h) | Latent period (h) | Disease severity (%) |
|---|---|---|---|
| 6 | 0 | 0 | 0 |
| 12 | 62 | 89 | 33.0 (35.3) |
| 24 | 56 | 83 | 41.4 (40.1) |
| 36 | 54 | 76 | 45.8 (42.7) |
| 48 | 51 | 74 | 52.4 (46.4) |
| 60 | 50 | 69 | 58.6 (50.1) |
| CD(P=0.05) | 2.6 | 2.3 | (2.3) |

Arc sine transformed values in parentheses

Huber and Gillespie (1992) reported that availability of free moisture is responsible for low crop transpiration and water potential near zero, hence a higher availability of internal water for pathogen. Peronosporales like *Pseudoperenospora cubensis*, *Phytophthora tabacina* and *Phytophthora infestans* produce considerable amount of sporangia within a wetting period of one night (Rotem *et al.*, 1978) which accounts for explosive development of the pathogen and consequently the disease.

### *Effect of temperature*

There was maximum (24.5%) germination of sporangia at 25°C and minimum (9.7%) at 15°C (Table 2). At other temperature regimes, the direct germination ranged between 12.5-22.9 per cent. Also, with an increase in temperature upto 25°C corresponding increase in direct germination was noticed and thereafter it decreased significantly. Thus 25°C was found optimum for sporangial germination of *P. colocasiae*. The zoospores showed maximum (82.6%) germination at 15°C and thereafter with an increase in temperature, a corresponding decrease in their germination was noticed which differed significantly among the temperature regimes tested. Zoospores failed to germinate at 28 and 30°C. The results of present study are in accordance with the observations of Ghosh and Das (1996) who reported very less direct germination at 30°C temperature.

**Table 2. Effect of temperature on the germination of sporangia and zoospores of *Phytophthora colocasiae***

| Temperature (°C) | Germination (%) | |
|---|---|---|
| | Sporangium | Zoospore |
| 15 | 9.7 (3.2)* | 82.6(65.4)# |
| 18 | 12.5(3.6) | 77.4(61.7) |
| 20 | 17.3(4.2) | 76.8(61.2) |
| 22 | 21.9(4.7) | 63.7(52.9) |
| 25 | 24.5(5.0) | 39.8(39.1) |
| 28 | 22.9(4.8) | 0.0 (0.81) |
| 30 | 14.8(3.9) | 0.0 (0.81) |
| CD (P=0.05) | (0.08) | (2.7) |

#Arc sine transformed values in parentheses
*Square Root transformed values in parentheses

### *Effect of weather variables*

Multiple correlation coefficients between disease severity and a group of independent variables (Table 3) were 0.65 and 0.68 during 2003 and 2004, respectively, indicated that these parameters contributed more than 65 per cent variation in disease. The multiple regression equation revealed that a unit change in mean temperature and mean RH influenced the disease severity upto 12.04 and 0.41 units respectively during 2003 whereas during 2004, a unit change in temperature and RH influenced disease severity upto the extent of 5.85 and 0.21 units respectively. Both these factors were significant during both the years thereby indicated that these played a vital role in variation in disease severity.

**Table 3. Multiple correlation coefficients between epidemiological parameters of Colocasia blight during 2003 and 2004**

| Year | Regression equation $Y = b_0+b_1X_1 + b_2 X_2 + \text{-------} b_nX_n$ | Multiple correlation coefficient (R) | Coefficient of multiple determination ($R^2$) |
|---|---|---|---|
| 2003 | $Y = 292.69 - 12.04 X_1 + 0.41X_2 - 0.07X_3$ | 0.65 | 0.42 |
| 2004 | $Y = 169.50 - 5.85X_1 + 0.21X_2 - 0.11X_3$ | 0.68 | 0.47 |

$X_1$ = Mean temperature $X_2$ = Mean relative humidity
$X_3$ = Rainfall

The progress of disease in relation to weather variables exhibited sigmoidal pattern of curve during both the years (Fig.1).Trujillo (1965) advocated the importance of day and night temperatures and relative humidity on the occurrence of Colocasia blight epidemics. The results of present study corroborate the findings of Pan and Ghosh (1997), who found positive relationship between blight severity and maximum and minimum RH and mean temperature-humidity index. Gadre and Joshi (2003) found that sunshine, soil temperature and crop age had significant influence on the development of Colocasia blight.

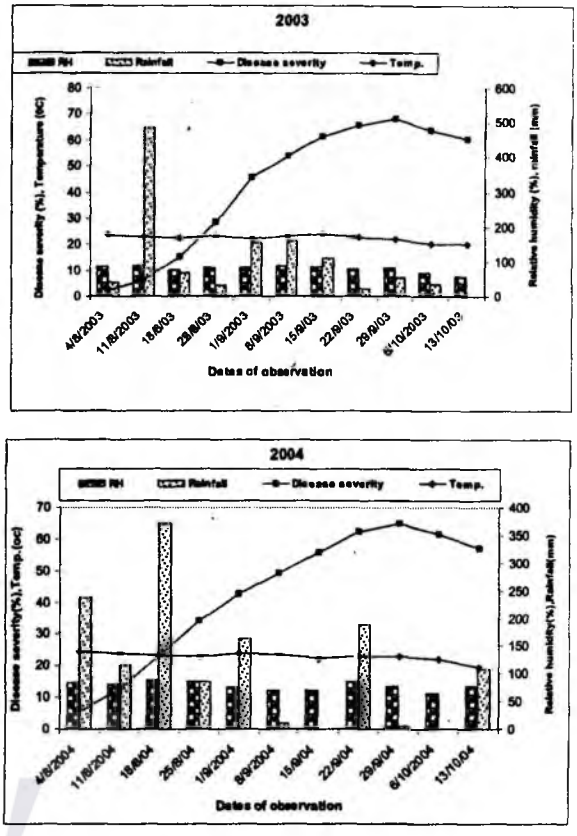



**Fig. 1. Progress of leaf blight of Colocasia during 2003 and 2004**

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