

## Conidial size and germination of *Erysiphe cichoracearum* DC causing powdery mildew of sunflower

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The pathogen causing powdery mildew of sunflower was identified as the oidium state of *Erysiphe cichoracearum* DC. The hypha was tubular and septate in nature and at frequent interval, the multiseptate conidiophores were produced. Conidiophores were unbranched, septate and the conidia are hyaline, single celled, ellipsoid borne in long chains on short conidiophores. Fibrosin bodies in the conidia were well developed and recognizable. The conidia were barrel shaped and measured 23.04 -32.16 x 13.92 -18.00  $\mu$ m with an average size 26 x 17  $\mu$ m and conidia germinated by producing simple germ tube. The temperature range for germination of conidia of *Erysiphe cichoracearum* was found to be 20°C-30°C, with the optimum temperature being 25°C. Whereas the relative humidity ranged from 70 -100 per cent (61.67 to 74.00 %) under laboratory conditions. The germination of conidia of *Erysiphe cichoracearum* was enhanced in 1 to 2 per cent concentration of sucrose solution. The conidia of powdery mildew pathogen were short lived on the host debris under natural conditions.

**Key words:** Powdery mildew, conidial size, germination, storage conditions

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### INTRODUCTION

Powdery mildew caused by *Erysiphe cichoracearum* DC. has been considered as economically important disease among the 80 pathogens occurring on sunflower listed by Gulya and Masirevic (1991). It affects most of the commercial varieties under present cultivation and it has been reported from different parts of the world. In India, the disease has been first reported from Bombay province (Patel *et al.*, 1949), later from Rajasthan (Prasada *et al.*, 1968), West Bengal (Goswami and Dasgupta, 1981) and Punjab (Bains *et al.*, 1996) causing considerable reduction in yield. Two different genera of powdery mildew fungi

*Sphaerotheca fuliginea* (Schlecht. Ex. Ft.) Pollacci and *Erysiphe cichoracearum* DC. f. sp. *helianthi* Jacz. (Patel *et al.*, 1949; Prasada *et al.*, 1968; Goswami and Dasgupta, 1981) are reported on sunflower in India. In the present study efforts are made to identify the genus and to know the effect of temperature, relative humidity and storage conditions on the germination of conidia.

### MATERIALS AND METHODS

#### *Collection of pathogen*

The fungus was collected from the affected sunflower plants in field, Conidia from clear, separate



and isolated colonies were picked up through the bristles of a brush and dusted onto glasshouse raised KBSH 44 plants which is highly susceptible to powdery mildew. Isolated colonies developing on these plants was further transferred to large number of KBSH 44 plants and a pure culture originating from a single, well developed, isolated colony was established. The culture, thereafter, was maintained in the glasshouse to avoid contamination. The culture was transferred to new plants as and when required. This culture was sent to Herbarium Cryptogame Indiae Orientalis (HCIO), Division of Plant Pathology, Indian Agricultural Research Institute, New Delhi, India for identification and the same was used in all further studies.

#### **Maintenance of inoculum**

The inoculum required for glasshouse and laboratory studies was maintained and multiplied on KBSH-44, a powdery mildew susceptible sunflower hybrid under glass house condition by dusting the conidia on the leaf surface using camel hair brush.

#### **Morphological studies**

Diseased samples were collected freshly from the pots maintained in the glasshouse. Aerial parts of the plant, mainly the leaves composed the disease samples. The samples were thoroughly examined and anamorph of powdery mildew was studied microscopically. The following anamorphic characters were studied and dimensions were measured. (1). morphology of conidiophore in relation to branching. (2). arrangement of conidia on conidiophores (3). shape of conidia and (4). dimensions of conidia (length and breadth)

#### **Influence of temperature on conidial germination**

Temperature is an important environmental factor which influences the germination of conidia. Conidial germination was studied at different temperatures viz., 4°C to 40°C. Powdery mildew conidia was dusted on a dry clean slide and the slide was placed in moist chambers and incubated at different temperatures viz., 4°C, 10°C, 15°C, 20°C, 25°C, 30°C, 35°C and 40°C in thermostatically controlled incubators for 24 hrs. The per cent germination was calculated by counting the number of spores germinated to total number of spores observed under each microscopic field.

#### **Influence of relative humidity on conidial germination**

Effect of different levels of relative humidity on conidial germination was studied. Different levels of relative humidity were maintained in desiccators containing various proportions of potassium hydroxide with distilled water (Soloman, 1951). The Petri dishes containing conidia on clean dry glass slide were then placed in desiccators containing solution of potassium hydroxide and distilled water. The different levels of relative humidity percentages maintained were 10, 20, 30, 40, 50, 60, 70, 80, 90 and 100 per cent. The desiccators were then incubated in an incubator at 22°C for 24 hrs. The per cent germination was calculated by counting the number of spores germinated to total number of spores observed under each microscopic field.

#### **Influence of sucrose solution on conidial germination**

The 0.5, 1, 1.5, 2, 2.5 and 3 per cent sucrose solution was prepared by dissolving different quantities of sucrose in 100 ml distilled water. The distilled water served as control. Two drops of the different concentrations of sugar solution were placed in a cavity slide and conidia were dusted on the slide. The slide was placed in moist chambers and incubated at room temperature for 24 hrs. The per cent germination was calculated by counting the number of spores germinated to total number of spores observed under each microscopic field.

#### **Effect of storage conditions on viability of conidia of *Erysiphe cichoracearum***

The investigation on viability and survival of *Erysiphe cichoracearum* was undertaken at Zonal Agricultural Research Station, GKVK to obtain information about the perpetuation of the pathogen during the off-season. The freshly harvested powdery mildew infected leaves of sunflower were collected and stored in polythene bags under different storage conditions, viz., freeze (4-5°C), under tree shade (15-20°C), room temperature (21-28°C) and field condition (28-30°C) in separate lots

Per cent germination of conidia on each type of leaf was recorded before preserving samples. The



viability of conidia of each type of leaf under different storage conditions were regularly examined by checking germination under microscope.

## RESULTS AND DISCUSSION

### Causal organism

The culture was sent to the Herbarium Cryptogame Indiae Orientalis (HCIO), Division of Plant Pathology, Indian Agricultural Research Institute, New Delhi, India and identified as the oidium state of *Erysiphe cichoracearum* with the accession /identification number HCIO 50056.

**Table 1 :** Effect of temperature on conidial germination of *Erysiphe cichoracearum*

Temperature (°C)	Conidia germination (%)
5	0.0 (4.82)
10	9.0 (10.10)
15	15.0 (11.44)
20	42.67 (14.84)
25	81.33 (17.50)
30	40.33 (14.64)
35	4.00 (8.35)
40	0.0 (4.82)
SEM ±	0.134
CD @ 1 %	0.403

(Figures in parenthesis indicate angular transformed values)

**Table 2 :** Effect of relative humidity on conidial germination of *Erysiphe cichoracearum*

Relative humidity (%)	Conidia germination (%)
10	11.33
20	15.33
30	25.33
40	33.00
50	43.67
60	52.33
70	61.67
80	66.00
90	74.00
100	70.00
SEM ±	0.92
CD @ 1%	3.53

### Morphological studies

The morphology of the fungus was studied in the laboratory. The observation revealed that the hypha was tubular and septate in nature (Fig. 1a).

**Table 3 :** Effect of sucrose on conidial germination of *Erysiphe cichoracearum*

Sucrose Conc. (%)	Conidial germination (%)
0.5	62.66 (52.34)
1.0	72.00 (58.07)
1.5	81.00 (64.16)
2.0	78.00 (62.05)
2.5	73.33 (58.93)
Distilled water	42.33 (40.59)
SEM ±	0.897
CD @ 1 %	5.06

(Figures in parenthesis indicate angular transformed values)

At frequent interval, the multiseptate conidiophores were produced (Fig.1b). Conidiophores were unbranched, septate and the conidia are hyaline, single celled, ellipsoid, borne in long chains on short conidiophores (Fig. 2a). Fibrosin bodies in the conidia were well developed and recognizable. The conidia are barrel shaped and measured 23.04 -32.16 x 13.92 -18.00 µm with an average size 26 x 17 µm (Fig. 2b). Conidia germinated by simple germ tube (Fig. 3).

### Effect of temperature on conidial germination of *Erysiphe cichoracearum*

The perusal of the data as presented in Table 1 show that the per cent conidial germination ranged from 0.0 to 81.33 per cent at the different temperature levels. Maximum germination was observed at 25°C (81.33 %), followed by 20°C (42.67 %) and 30°C (40.33 %). While it was minimum (4.0%) at 35°C. None of the conidia germinated at 5°C and 40°C.

This showed that the temperature range of 20-30°C is favourable for the germination of conidia with the optimum being 25°C. The results agree with Paulech (1969) who reported minimum temperature for conidial germination of *E. polygoni* as 7°C and higher germination percentage was noted at 25°C as against, no germination of conidia at 35°C.

### Effect of relative humidity on conidial germination of *Erysiphe cichoracearum*

The conidial germination ranged from 11.33 per cent to 74 per cent at the different relative humidity levels tested (Table 2). The highest germination of 74 per cent was observed at 90 per cent relative humidity and lowest of 11.33 at a relative humidity of 10 per cent. It was observed that the





Fig. 1a : Branched and septate mycelium of *Erysiphe cichoracearu*



Fig. 2a : Chains of conidia on the host leaf surface



Fig. 1b : Conidiophore and conidia of *Erysiphe cichoracearum*

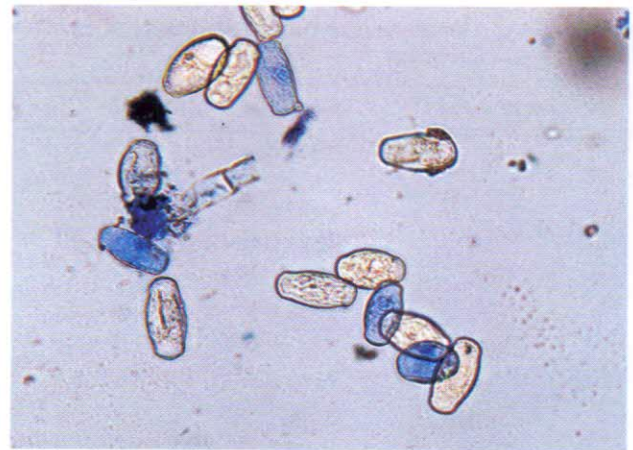


Fig. 2b : Barrel shaped conidia of *Erysiphe cichoracearum*

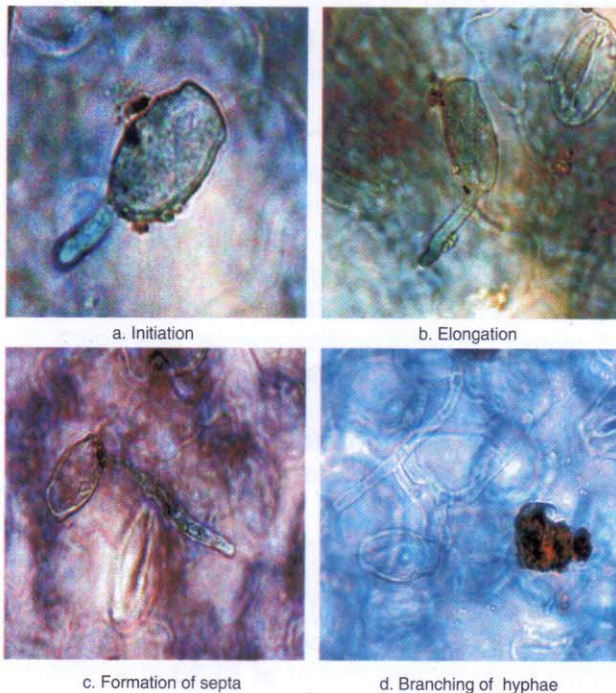


Fig. 3 Stages of conidial germination of *Erysiphe cichoracearum*

optimum relative humidity range of 70 -100 per cent is required for good germination of conidia (61.67 to 74.00 %) under laboratory conditions. Conidial germination increased with an increase in relative humidity.

The results agree with Mandhare and Suryawanshi (2007) who reported that in *E. polygoni* causing powdery mildew of mung bean conidial germination increased with an increase in relative humidity from 60 per cent onwards.

#### **Effect of sucrose concentrations on conidial germination of *Erysiphe cichoracearum***

Conidial germination of 62.66 to 81.00 per cent was favoured by the different sucrose concentrations tested (Table 3) . Maximum conidial germination of 81 per cent was recorded in 1.5 per cent sucrose solution followed by 2 per cent (78%), 2.5 per cent (73.33%), 1 per cent (72%) and 0.5 per cent (62.66%). The lowest conidial germination was in distilled water (42.33). Thus, the germination of



**Table 4:** Effect of different storage conditions on the viability of conidia of *Erysiphe cichoracearum* causing powdery mildew of sunflower

Storage Conditions	Conidial Germination																			
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Field	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-
Room	+	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-	-	-	-	-
Freeze	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-	-
Tree shade	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-	-	-

conidia of *Erysiphe cichoracearum* was enhanced by using 1 to 2 per cent concentration of sucrose solution. The difference in conidial germination is in agreement with Aswathanarayana (2003) who explained that conidia of *Uncinula necator* do require some nutrients for germination and poor germination in distilled water may be due to lack of essential nutrients. The results agree with Raghavendra (2005) who found that maximum germination of conidia of *Leveillula taurica* was observed in two per cent dextrose solution (59.53%) at 24 hrs after incubation.

#### Effect of storage conditions on viability of conidia of *Erysiphe cichoracearum*

The powdery mildew infected leaves of sunflower were collected and stored under different study conditions to study the viability of conidia of *Erysiphe cichoracearum*. The conidial germination at different weekly intervals was recorded and presented in Table 4. The results revealed that the conidia remained viable up to 10 weeks when stored under field conditions. Whereas, they remained viable up to 11 weeks at room temperature (21°C – 28°C). The conidia remained viable up to 13 weeks when the infected leaves were kept under tree shade. However, under freeze conditions, the conidia were viable upto 17 weeks. This indicated that the conidia of powdery mildew pathogen were short lived on the host debris under natural conditions.

The method employed for testing the survival of the fungus permits only the conidia and not the dormant mycelium. It is possible that while conidia

have a shorter longevity, the fungus may be persisting as dormant mycelium for longer periods. Further, investigations are required to verify the hypothesis. This is in agreement with Caesar and Clark (1985) who determined that, on water stressed chilli plants in addition to the fungus having smaller conidia, the germinability of conidia and elongation of the germ tubes were reduced appreciably.

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