

EFFECT OF CERTAIN ENVIRONMENTAL FACTORS ON GERMINATION OF CONIDIA OF *PERONOSPORA ARBORESCENS* (BERK) DE BARY

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Conidia of the Opium poppy downy mildew pathogen germinated maximum between temperature range 15 to 19°C while Conidia required high humidity as well as thin film of water. Blue light and pH 9.1 to 10.3 favoured the best germination. When conidia were exposed to UV-rays for 30 minutes, conidial germination was maximum (65.9%) and length of germ tube was also found to be very long.

Keywords : Conidia; Downy mildew; Germination.

Introduction

Conidia of the downy mildew pathogen (*Peronospora arborescens*) of opium poppy (*Papaver somniferum L*) are responsible for the secondary spread of the disease and cause heavy losses^{1, 2}. The environmental factors influence the conidial germination and infection. Hence, investigations were done to study the effect of temperature, relative humidity, light, source of water, pH and UV-radiation on conidial germination.

Materials and Methods

Effect of different sources of water was investigated by placing conidia in water taken from different sources i.e. well, stream, rain, tap, distilled, double distilled water. To study the effect of pH, different pH levels were obtained by 1N NaOH and 1N HCl buffers. Method developed by Manners and Hossains³ was used to maintain humidity in desiccators and fresh conidia collected from infected leaves were dusted on moisture free clean glass slides and incubated at

different RH levels to find out the effect of RH on germination. Cellophane papers of different colours were used to receive different kinds of light. Temperature from 5 to 27°C was maintained in different incubators to find out the effect of temperature on conidial germination. Effect of near UV-radiation was seen according to De Weille⁴. Conidial suspension in tap water was exposed to UV-radiation for different periods i.e. 10 to 240 minutes and then transferred to room temperature for germination.

"Hanging drop method" was followed for germination of conidia in every experiment unless mentioned otherwise and 2 drops of conidial suspension were kept on each slide. Approximately 300 conidia were observed in each drop for all the germination studies.

Results and Discussion

A. *Mode of Germination* : Conidia of *P. arborescens* germinated within 14 hrs in

thin film of water, however, initiation of germination started after an hour. Mostly germ tubes were long and slender; short and stout germ tubes were also found but germination through zoospores was never observed. The protoplasm gradually moved into the germ tube with elongation. Each conidium produced single germ tube which was at times bifurcated. The diameter of the germ tube was throughout uniform and sometimes pyriform swelling was also found which may be an indication of appressorium formation. The length of germ tube varied from 16.4 μ to 328.0 μ and the average being 125 μ .

B. Different sources of water : Maximum germination (88.5%) was obtained in tap water out of all sources used. There was least germination in distilled water and conidia did not germinate in

Table 1. Effect of different sources of water on germination of conidia

Source of water	Germination (%)
Well water	35.0
Stream water	15.0
Rain water	20.0
Distilled water	2.0
Tap water	88.5
Double distilled water	0.0
Host-leaf-exudates	70.0

double distilled water indicating the importance of pH of the medium. The pH of water from different sources indicated that high pH favoured the germination. Therefore, an experiment was

laid out to find out the effect of pH on germination of conidia.

C. Effect of pH : The best germination was found to be in pH 9.1 and 10.3

Table 2. Germination of conidia of *P.arborescens* as influenced by different pH

Adjusted pH	pH after addition of conidia	Germination (%)
2.0	2.1	2.8
4.0	4.3	11.2
6.0	6.1	50.8
7.0	6.9	58.4
8.0	8.2	65.2
9.0	9.1	75.0
10.5	10.3	75.5

while least was at 2.1. However, it is apparent from the results that germination reduced with reduction in pH level and *vice versa*.

Table 3. Effect of different temperatures on conidial germination of *P.arborescense*

Temperature (°C)	Germination (%)
5 \pm 13	7.0
10 \pm 1	47.5
15 \pm 1	70.2
19 \pm 1	84.8
24 \pm 2	23.5
27 \pm 1	9.2

D. Effect of temperature : Temperature range from 15 to 19 \pm 1°C was found to be conducive for germination whereas high or low temperatures reduced the germination of conidia.

E. Humidity : The highest germination was recorded when 100% relative

humidity was provided to conidia. The germination of conidia reduced with reduction in RH indicating that high RH is necessary for germination. Germination was at par with the conidia placed

Table 4. Effect of different relative humidity on the conidial germination of *P.arborescens*

Relative Humidity (%)	Germination (%)
20 ± 2	3.0
35 ± 2	20.2
40 ± 2	32.5
50 ± 2	51.4
70 ± 2	60.0
80 ± 2	68.5
98 ± 2	100.0

in thin film of water. However, it was observed that the germ tube of conidia germinated without water was short as compared to the conidia which were placed in thin film of water.

Therefore, it is evident that conidia of *P.arborescens* may not require free film of water for germination but it may

Table 5. Effect of different kinds of light on conidial germination of *P.arborescens*

Light	Germination (%)
Blue	80.5
White	62.6
Yellow	51.5
Green	45.0
Red	39.5
Diffuse	25.2
Total dark	10.0

be necessary for elongation of germ tube and infection.

F. *Light*: Maximum germination (80.5) occurred when blue light was supplied followed by white (62.5%) and yellow light (51.5%) and least germination was found in absence of light (10%). These results indicate that conidia of opium poppy downy mildew fungus also need light for their germination.

G. *Effect of near UV-radiation* : It is clear from Table 6 that when conidia were exposed for 30 minutes to UV-rays, conidial germination was maximum (65.9%) and length of the germ tube was also found to be very long. Longer exposures were found to be lethal for conidial germination and conidia germinated, if any, possessed short germ tubes.

The asexual spores of the downy mildews germinate either by germ tubes or by zoospores. *Peronospora arborescens* germinated by germ tubes as also observed by Behr⁵ and Kothari and Prasad⁶. However, importance of environmental factors have been realised as conidia could only be germinated in presence of moisture/or high humidity as well as light. Exposure to light was found necessary for conidial germination of *P. arborescens* which have also been reported in *P. manshurica* and *P. trifoliorum*⁷. Blue light enhanced the germination which have also been recorded in other fungus⁸. However, light had no marked effect on germination of many other species of *Peronospora*. Longer exposure to UV-

Table 6. Effect of near UV-radiation on the germination of conidia of *P. arborescens*.

Exposer period in minutes	Germination (%)	Length of germ tube
10.	40.10	Moderate
20.0	40.20	Moderate
30.0	69.90	Very long
60.0	51.90	Very long
90.0	50.00	Moderate
120.0	40.80	Short
150.0	30.25	Very short
180.0	5.60	Very short
24.00	4.00	Very short

rays was found lethal whereas 30 minutes was found best for germination, similar results were also obtained by Deweilla⁴.

Growth, germination and infection of all plant pathogens are highly influenced by temperature, humidity, and pH⁹. Similarly, it was observed that temperatures ranging 15-19°C along with high pH (9.1 to 10.3) were best for germination. While working with this fungus regarding temperature requirement other workers also found similar results^{5,6}.

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