Advances in Bioresearch
Adv. Biores., Vol 10 (4) July 2019: 63-68
©2019 Society of Education, India
Print ISSN 0976-4585; Online ISSN 2277-1573
Journal's URL:http://www.soeagra.com/abr.html
CODEN: ABRDC3
DOI: 10.15515/abr.0976-4585.10.4.6368

Advances in Bioresearch

ORIGINAL ARTICLE

Effect of Weather factors on Conidial germination of *Erysiphe cichorocearum* causing Powdery mildew on sesame

Sijo Joseph[1]., Kiran Kumar, N.[2] and Sanath Kumar, V.B.[3*] and Padmaja, A.S.[2]
[1]Research Scholar, College of Agriculture, UAS (B), V.C. Farm, Mandya-571405, Karnataka
[2]Assistant Professor of Plant Pathology, College of Agriculture, UAS (B), V.C. Farm, Mandya-571405, Karnataka
[3]Associate Professor of Plant Pathology, College of Agriculture, UAS (B), V.C. Farm, Mandya-571405, Karnataka
*Corresponding author:- email: sanath.kumar7@gmail.com

ABSTRACT
The study on epidemiological factors on conidial germination of Erysiphe cichoracearum revealed that, the germination of conidia was maximum at 20˚C (76.82%) followed by at 15˚C and 25˚C. The temperature range of 15 to 25˚C was the most congenial for conidial germination of E. cichoracearum. The optimum temperature required for conidial germination was 20˚C. The relative humidity of 85 per cent was found to be optimum for conidial germination (75.63%). Maximum germination of conidia was observed at 2.0 per cent dextrose solution (77.50%) at 24h after incubation. Very poor germination was recorded in sterile water compared to tap water. Maximum 58.80 per cent conidial germination was recorded in 10 : 14 hrs of darkness and light which was significantly higher than other treatments. This was followed by 12 : 12 hours of darkness and light where 46.96 per cent germination of conidia was obtained. The minimum conidial germination of 38.74 per cent was obtained in 16:08 hours of darkness and light showing that light is important for conidial germination. It was observed that the conidia harvested in the noon time (2.00 PM) had higher germination percentage followed by those harvested at 12.00 PM. The conidia harvested in the forenoon (early morning) and late in the evening showed lower germination percentage of E. cichoracearum.
Key words: *Dextrose; Epidemiology; Erysiphe cichorocearum; conidial germination*

Received 04.02.2019 Revised 18.04.2019 Accepted 01.06.2019

How to cite this article:
S Joseph., Kiran Kumar, N. and Sanath Kumar, V.B. and Padmaja, A.S.. Effect of Weather factors on Conidial germination of *Erysiphe cichorocearum* causing Powdery mildew on sesame. Adv. Biores., Vol 10 [4] July 2019.63-68.

INTRODUCTION

Sesame (*Sesamum indicum*) is the sixth most important oilseed crop and the crop has early origins in East Africa and India [2]. In India, sesamum is cultivated in an area of 1.74 million hectares, with a production of 0.83 million tonnes. It is grown in marginal and sub marginal lands as rain fed crop mainly in the states of West Bengal, Madhya Pradesh, Rajasthan, Gujarat, Uttar Pradesh, Tamilnadu, Andhra Pradesh and Karnataka which accounts for more than 93 % of the total area and production. In Karnataka, it is grown in an area of 0.44 lakh hectares, with a production of 0.22 lakh tonnes and 500 Kg/ha productivity [1].

The sesame production is below expectation and has not contributed its best to the current bright oilseed scenario. The low production is due to a number of reasons such as low inputs and poor management, occurrence of biotic and abiotic stresses. However, major factors that limit its productivity besides narrow genetic base are extreme susceptibility to biotic and abiotic stresses.

Sesame is susceptible to several diseases and pests of which powdery mildew and phyllody among diseases and capsule borer among insect pests contribute for significant losses. Powdery mildew caused by *Erysiphe cichoracearum,* has shown considerable economic damage throughout the sesame growing areas in post rainy/ severe winter season. Shambarkar *et al.,* [13] reported that powdery mildew alone could cause yield loss upto 45 per cent. Further, powdery mildew is common in all the sesame growing

areas, especially in Karnataka and Andhra Pradesh which is problem where climate is relatively cool and moist. The fungus causing powdery mildew disease is an obligate pathogen and it hardly kills its host, however, by using their nutrients, decreased photosynthesis, increased respiration and transpiration, reduces the yield of sesamum. Management of the disease before it gets severe is very important to achieve a good yield. Realizing the importance of powdery mildew on sesamum and need for prophylactic measures in managing the same, the present investigation was undertaken to know the effect of epidemiological factors on conidial germination of the *E. cichoracearum*, which influences the severity of the powdery mildew disease on sesame.

MATERIAL AND METHODS

The experiment was conducted during 2017 at College of Agriculture V.C. Farm, Mandya to study the weather factors affecting conidial germination of *Erysiphe cichorocearum* causing powdery mildew on sesame under laboratory conditions.

Effect of different sugars on conidial germination

The germination of conidia was tested in different medium viz., tap water, distilled water, dextrose (0.5, 1.0, 1.5 and 2%) and sucrose (0.5, 1.0, 1.5 and 2.0%) by cavity slide method. The required quantity of dextrose and sucrose (0.5, 1.0, 1.5 and 2.0) were weighed and dissolved in 100 ml sterile distilled water separately to get desired concentrations and used for the study.

Powdery mildew infected sesamum leaves with maximum sporulation were collected and brought to the laboratory. Spores from the leaf surface were transferred with the help of camel hair brush to the test tube containing different medium.

The two drops of the suspension from each medium was transferred on to the cavity slide and placed in the incubator for 24 hours at 20±10C temperature. Later cavity slides were removed from the incubator and observed under low power (10X) of the compound microscope. The total number of conidia and number of conidia germinated were recorded in each microscopic field and the per cent germination was calculated by using the formula:

$$PG = \frac{A}{B} \times 100$$

Where,

PG = Per cent germination

A = Number of conidia germinated

B = Total number of conidia examined.

Effect of temperature on conidial germination

Temperature is an important environmental factor which influences the germination of conidia. Conidial germination was studied by cavity slide technique at different temperatures ranging from 5 to 40^{o} C. Two drops of conidial suspensions were mixed with two drops of four per cent dextrose solution in cavity slides to achieve required concentrations of 2 per cent. The experiment was replicated thrice. The cavity slides were placed in moist chambers and incubated at different temperatures *viz.,* 5, 10, 15, 20, 25, 30, 35 and 40 ^{o} C in thermostatically controlled incubators for 24 hours. The per cent germination was calculated by counting the number of spores germinated to total number of spores observed.

Influence of relative humidity on conidial germination

Effect of different percentages of relative humidity on conidial germination was studied. Different levels of relative humidity were maintained in desiccators containing various proportion of sulphuric acid with distilled water as described by Solomon, 1951. The Petri dishes containing spore suspension on cavity slide were then placed in desiccators containing solution of sulphuric acid and distilled water. Different relative humidity percentages maintained were 65, 70, 75, 80, 85, 90, 95 and 100 per cent. The desiccators were then incubated in an incubator at 20±1ºC for 24 hrs and the per cent germination was recorded.

Effect of Darkness and light on conidial germination

To know the effect of darkness and light on conidial germination, the experiment was carried out for dark : light for 12: 12, 16: 8, 14: 8 and 10: 14 hrs. The conidia were picked up as per as per procedure described earlier. For observing the effect of different light and dark periods on conidial germination, the Petri plates containing conidial suspension were incubated at 15, 20 and 25°C and after 24 hrs of incubation the conidial germination was recorded.

Effect of different harvesting time on conidial germination

The conidia were harvested from the powdery mildew infected sesame leaf at an interval of two hours from 8.00 AM to 8.00 PM and inoculated on two per cent dextrose solution and incubated at 20 ± 1°C and

85 per cent relative humidity. The conidial germination percentage was recorded after 24 hours of incubation.

The research data of different experiments were analysed by using randomized complete block design and completely randomized design as given by Panse and Sukhatme [8]. The 'r' value has been worked out and per cent values were transformed to arc sine values for analysis.

RESULTS AND DISCUSSION

The spore germination of *E. cichoracearum* was studied in different sugar solutions. The per cent germination was recorded after 24 hours of incubation and the data are presented in Table 1 and Fig.1. Supplementation of nutrients artificially is important to enhance the growth and development of the pathogens. In the present study different concentrations of sugars, distilled water, sterile water and tap water were tested under laboratory conditions on germination of conidia. The effect of different sugar on the conidial germination of *E. cichoracearum* was found significant. The maximum conidial germination of 77.50 per cent was recorded in two per cent dextrose solution, which was found significantly superior over the other media tested. However, this was followed by sucrose at 1.5 per cent (71.17%) and dextrose at 1.5 per cent (70.27%). The per cent conidial germination using tap water, sterile water and distilled water was 58.83, 53.86 and 55.31 respectively. Among the sugar solutions, least conidial germination (51.12%) was observed with sucrose at 0.5 per cent. The maximum conidial germination was observed in 2.0 per cent dextrose followed by 1.5 per cent dextrose and 1.5 per cent sucrose and least conidial germination in sterile water as compared to distilled water and tap water. These findings are in agreement with Divyajyothi [5] who reported that the maximum conidial germination of 75.50 per cent was recorded in two per cent dextrose solution. The maximum germination (59.53%) of conidia was observed in 2.0 per cent dextrose solution at 24 h after incubation [10]. The uredospores required some nutrients for germination and poor germination of spores in distilled water could be due to lack of essential nutrients [6].

Effect of temperature on conidial germination of *E. cichoracearum*

The effect of different temperature levels on spore germination of *E. cichoracearum* was studied and data presented in Table 2. The conidia of *E. cichoracearum* are airborne and are thus the obvious source of secondary infection. Temperature is an important factor governing distribution, growth, reproduction and survival of the fungus. The present study revealed that, the fungus showed variation in its conidial germination at different temperatures. The maximum conidial germination (76.82%) was observed at 20ºC, which varied significantly from the other temperature levels tested. This was followed by 15ºC and 25ºC at which the conidial germination was 63.42 and 45.32 per cent respectively. At 35ºC and 5ºC, germination percentage was significantly decreased to 11.32 and 7.32 per cent respectively. There was no conidial germination at 40ºC. The wide range of temperature adaptability of *E. cichoracearum* to cause infection, both under hot and cold season, resulted in severe disease incidence. Similar results were noticed in case of *E. polygoni* [16]. The conidia of chilli and green gram powdery mildew pathogen germinated at 5ºC [10 & 5].

Effect of different relative humidity on conidial germination of *E. cichoracearum*

The effect of different relative humidity regimes on the conidial germination of *E. cichoracearum* was significant. Maximum conidial germination (75.63%) was observed at 85 per cent relative humidity, which was significantly superior to other treatments. Relative humidity of 80 percent was next best treatment for conidial germination (69.36%). The conidial germination was 61.75% and 60.14% at 90 per cent and 75 per cent relative humidity, respectively which varied significantly among the treatments. The conidial germination was least (49.31%) at 65 per cent relative humidity and was maximum when the relative humidity was 85 per cent. However, even from 65per cent to 100per cent humidity, the conidia germinated indicating the ability of the fungus to infect both under dry and humid conditions. Carroll and Wilcox (2003) observed at 85 per cent RH the germination of grapevine powdery mildew conidia was maximum. Sanjivareddi [14] reported that maximum conidial germination (85.63%) of *E. cichoracearum* was observed at 85 per cent relative humidity, which was significantly superior to other treatments (Table 3 and Fig 2).

Effect of darkness and light on conidial germination

The effect of combination of different duration of darkness and light on the conidial germination of *E. cichoracearum* was studied at 15^0, 20^0 and 25°C temperature. The data is presented in Table 4. The pooled data revealed that maximum 58.80 per cent conidial germination was recorded in 10 : 14 hrs of darkness and light which was significantly higher than other treatments. This was followed by 12 : 12 hours of darkness and light where 46.96 per cent germination of conidia was obtained. The minimum conidial germination of 38.74 was obtained in 16:08 hours of darkness and light. Whereas, with the

increased exposure of conidia to dark hours, the conidial germination was reduced. It can be concluded that exposure of conidia to dark showed inhibitory effects. Cherewick [14] observed 95 per cent conidial germination if the *Erysiphe graminis* f. sp. *tritici* in light. The conidial germination of *Erysiphe polygoni* on fenugreek stimulated in light and inhibited in darkness [9]. Rekhonde *et al.* (2011) [11] also reported that light of 24 hours was found to be most favourable for conidial germination of *E. polygoni* in green gram. The maximum conidial germination (64.44 per cent) occurred when 10 : 14 hours of darkness and light was used [12].

Table 1: Effect of different concentrations of sugars solutions on conidial germination of *Erysiphe cichoracearum*

Sugar	Concentration (%)	Conidial germination (%)
Dextrose	0.5	63.51 (52.82)
Dextrose	1	66.50 (54.61)
Dextrose	1.5	70.27 (56.94)
Dextrose	2	77.50 (61.66)
Sucrose	0.5	61.12 (51.40)
Sucrose	1	64.16 (53.20)
Sucrose	1.5	71.17 (57.50)
Sucrose	2	67.50 (55.22)
Distilled water	-	55.31 (48.03)
Tap water	-	58.83 (50.07)
Sterile water	-	53.86 (47.19)
S. Em±		0.46
CD		1.37

* Figures in parenthesis are Arc sine values.

Table 2: Effect of temperature on conidial germination of *Erysiphe cichoracearum*

Temperature (^{0}C)	Conidial germination (%)
5	7.32 (15.69)
10	13.62 (21.65)
15	63.42 (52.76)
20	76.82 (61.19)
25	45.32 (42.30)
30	23.36 (28.89)
35	11.32 (19.65)
40	0.00 (0.00)
S. Em±	0.46
CD	1.45

*Figures in parenthesis are arc sine values.

Table 3: Effect of relative humidity on conidial germination of *Erysiphe cichoracearum*

Relative humidity (%)	Conidial germination (%)
100	55.35 (48.05)
95	58.32 (49.77)
90	61.75 (51.77)
85	75.63 (60.39)
80	69.36 (56.37)
75	60.14 (50.83)
70	55.15 (47.94)
65	49.31 (44.59)
S. Em±	0.39
CD	1.22

*Figures in parenthesis are arc sine values.

Effect of different conidial harvesting time on their germination

The per cent germination of *E. cichoracearum* conidia depends on the time at which they are harvested, because of influence of light. Effect of different harvesting time on per cent conidial germination was observed to know whether particular time of the day has any effect on per cent conidial germination under identical (artificial) conditions in the laboratory, the data of which are presented in Table 5. It was observed that, the conidia which were harvested early in the morning and late in evening has less germination percentage as compared to those harvested in noon hours. The highest germination

percentage (55.32 %) was observed in the conidia harvested at 2.00 PM which was followed by 12.00 PM (70.45 %). The least conidial germination was observed in conidia harvested at 8.00 PM. The results are in line with Yarwood [17] observed the importance of light to increase conidial germination of powdery mildew pathogens harvested during noon hours. Drandarevaski [6] found that light stimulated conidial germination of *Erysiphe betae* (Vanha) Weltzein.

Table 4: Effect of darkness and light on conidial germination of *Erysiphe cichoracearum* at different temperatures.

Dark : Light (In hours)	Temperature (°C)			
	15	20	25	Pooled
	Per cent conidial germination			
12:12	53.77 (47.14)	57.11 (49.07)	30.00 (33.20)	46.96 (43.24)
16:08	46.00 (42.69)	48.22 (43.96)	20.00 (26.55)	38.07 (38.08)
14:10	48.44 (44.09)	51.67 (45.94)	23.33 (28.87)	41.15 (39.88)
10:14	61.42 (51.58)	70.55 (57.11)	44.44 (41.79)	58.80 (50.05)
SEm±	0.48	0.55	0.26	0.45
CD	1.48	1.69	0.81	1.38

*Figures in parenthesis are arc sine values.

Table 5: Effect of different conidial harvesting time on conidial germination of *Erysiphe cichoracearum*.

Conidia harvesting times	Per cent germination
8.00 AM	46.89 (43.20)
10.00 AM	61.01 (51.34)
12.00 PM	70.45 (57.05)
2.00 PM	75.12 (60.06)
4.00 PM	67.85 (55.44)
6.00 PM	61.47 (51.61)
8.00 PM	44.06 (41.57)
SEm±	0.67
CD	2.03

*Figures in parenthesis are arc sine values.

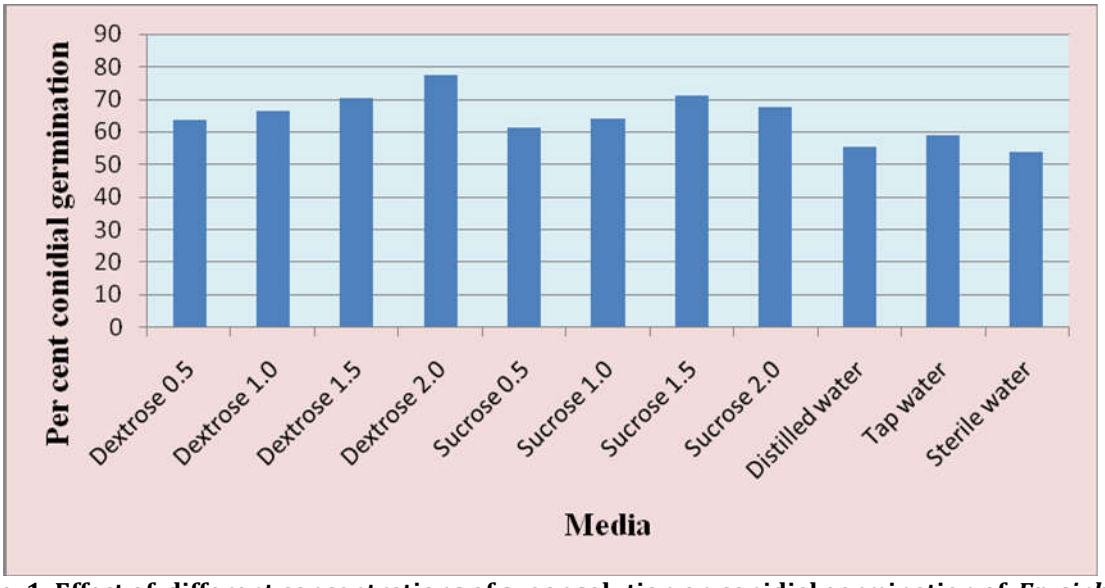

Fig. 1: Effect of different concentrations of sugar solution on conidial germination of *Erysiphe cichoracearum*

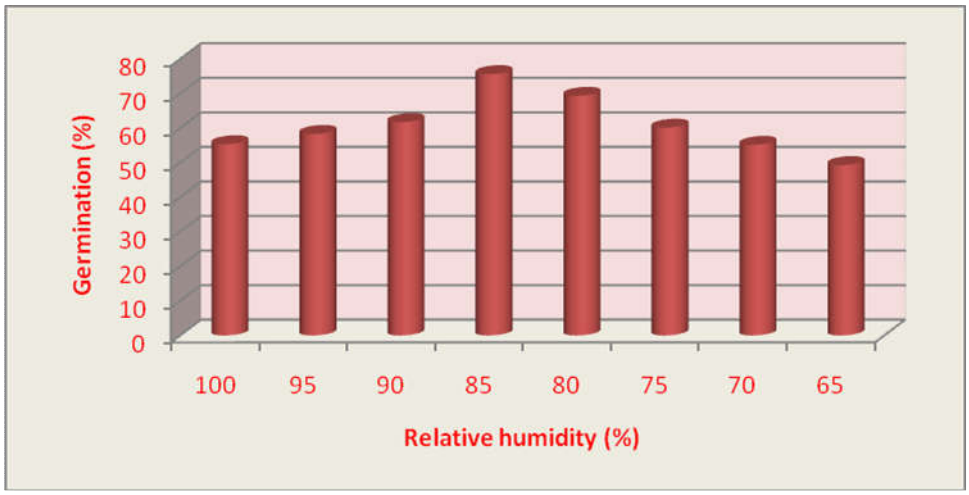

Fig. 2: Effect of relative humidity on conidial germination of *Erysiphe cichoracearum*

REFERENCES

1. Anonymous (2015). *Annu. Rep.,* Directorate of statistics and economics, Government of India.
2. Bedigian D. (2003). Evolution of sesame revisited, domestication, diversity and prospects. *Genetic resources and crop evolution,* **50**: 779-787.
3. Carroll JE, Wilcox NF. (2003). Effects of humidity on the development of grapevine powdery mildew. *Pl. Dis.,* **93**:1137-1144.
4. Cherewick WJ. (1944). Studies on the biology of *Erysiphe graminis* DC. *Canadian J. of Res.,* **22:** 52- 86.
5. Divya Jyothi (2012). Epidemiology and management of powdery mildew of greengram caused by *Erysiphe polygoni* DC. *M. Sc. (Agri) thesis*, Univ. Agric. Sci., Dharwad (India).
6. Drandarevski (1969). *The powdery mildew* (Ed),Spencer DM., Academic Press London. p. 565.
7. Navi SS. (1986). Studies on leaf rust of wheat caused by *Puccinia recondita* f. sp. *tritici* Rob. Ex. Desm. *M.Sc. (Agri.) Thesis*, Univ. Agril. Sci., Dharwad.
8. Panse VG., Sukhatme PV. (1985). Statistical methods for agricultural workers, Indian council of agricultural research, New Delhi, 359 pp.
9. Prakash S., Saharan GS. (2000). Conidial germination of *Erysiphe polygoni* causing powdery mildew of fenugreek. *Indian Phytopathol.,* **53** (3): 318-320.
10. Raghavendra BK. (2005). Epidemiology and management of chilli powdery mildew caused by *Leveillula taurica* (Lev.) ARN. *M. Sc. (Agri) Thesis*, University of Agricultural Sciences Dharwad.
11. Rakhonde P N., Wadaskar RM., Koche M D., Anvikar D G. (2011). Influence of weather parameters on powdery mildew (*Erysiphe polygoni*) in green gram. *Crop Res.,* **42** (1): 344-347.
12. Rekha K. (2015). Epidemiology and management of powdery mildew of fenugreek, *Phd thesis,* Srikaran Narendra Agriculture University, Jobner.
13. Shambarkar DA., Shinde Y M., Baviskar, (1997). Genetic resource evaluation against major diseases of sesame. *Sesame and Safflower News letter*, **12:** 6-10.
14. Sanjivareddi Y.B. (2012). Investigations on powdery mildew (*Erysiphe cichoracearum dc. F.sp. Helianthi jacz.*) of sunflower in northern dry zone of Karnataka. *M. Sc. (Agri) Thesis*, University of Agricultural Sciences, Dharwad..
15. Solomon ME. (1951). Control of humidity with potassium hydroxide, sulphuric acid or other solutions. *Bulletin Entomol. Res.*, **42**: 543-554.
16. Venkatrao (1997). Studies on powdery mildew of green gram (*Vigna radiata* (L.) Wilczek) caused by *Erysiphe polygoni* DC. *M.Sc. (Agri.) Thesis*, Univ. Agric. Sci., Dharwad.
17. Yarwood CE., Sidky S., Cohen M., Santilli V. (1954). Temperature relations of powdery mildews. *Hilgardia*, **22**: 603-622.