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Preliminary study on the effect of temperature in uredospore germination of wheat leaf rust (*Puccinia triticina* Eriks.)

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Abstract

Leaf rust, caused by the fungus *Puccinia triticina*, has been one of the major foliar diseases of wheat. Temperature and moisture are the key climatic factors which interact with leaf rust infection and the rate of disease development. To know the effect of different temperature on rust uredospore germination; various temperature *i.e.* 5, 10, 15, 20, 25, 30 and 35°C were set in a B.O.D. incubator. The studies on effect of temperature on germination of uredospores revealed that maximum per cent spore germination with 6 hours of incubation, was recorded in case of temperature range of 20-25°C. The mean maximum spore germination was recorded at 20°C (92.95%) which was followed by at 25°C (87.65%).

Keywords: *Puccinia triticina*, leaf rust, temperature, uredospore germination and wheat

Introduction

Wheat (*Triticum aestivum* L.) is one of the most important food crops and is a staple food for over one third of the world's population. More of the earth's surface is covered by wheat than with any other food crop. Wheat is a widely grown cereal in climates varying from temperate, irrigated to dry, high rainfall, warm humid to dry and cold. As a C₃ plant, wheat is capable of thriving in cool environments (Acevedo *et al.*, 2006) [1]. One of the major constraints of production in the country is occurrence of different diseases. Out of various diseases of wheat rust diseases *i.e.* Black rust, Brown rust and Yellow rust are the most significant which have continued to ravage this crop since ancient times. Among the three wheat rusts, brown rust (*Puccinia triticina* Eriks.) is the most widely distributed and prevalent all over the country (Bhardwaj *et al.*, 2006) [4]. All rusts are obligate pathogens of living tissue and thus require a host as a "green bridge" in order to survive until the next growing season (Staples, 2003) [8]. Temperature is the most recognized environmental factor that is able to affect spore germination. Infection at temperatures between 16-27°C causes significant yield losses, by reducing kernels number, quality, and weight (Agrios, 2004) [2]. As the temperature moves outside this range, development is either slowed or becomes dormant until the temperature moves back within the required range. At optimum temperature range urediospores germinate and infect leaves within 6 to 8 hours after landing on the plant surface. Environmental impact on plant disease is difficult to determine in the field due to complicating factors such as multiple climatic variables, varying disease levels and perhaps most importantly pathogen-environment interactions so that in present investigation, effect of different temperature on uredospore germination was carried out in laboratory condition.

Mythology

The experiment was carried out for studying the effect of temperature on germination of uredospore. A drop of distilled water was applied on a clean microscopic slide and kept in moistened Petri dishes. The uredospores were collected from fresh uredosori from infected plants of wheat. The uredospores were put with the help of sterilized fine brush in the drop of water on microscopic slide and three microscopic slides were prepared for each treatment. The slides were incubated at each of the temperature point *viz.*, 5, 10, 15, 20, 25, 30 and 35°C for 6 hours in B.O.D. incubators. Spores with germ tubes longer than the spore diameter were considered as germinated and the levels of germination were represented in per cent from each of the slide in microscopic filed. A light microscope at 40x objective lens was used to examine

germination of uredospore. The statistical analysis was carried out using standard method. Per cent uredospore germination was calculated by following formula (Anusha *et al.*, 2018)^[3].

$$\text{Per cent spore germination} = \frac{A}{B} \times 100$$

Where,

A = No. of uredospores germinated;

B = No. of uredospores observed.

Results and Discussion

The results (Table 1) of studies on the effect of temperature on germination of uredospores of *P. tritricina* after 6 hours indicated that germination varies in percentage depending on temperature. Uredospore germination was maximum with 6 hours of incubation, in the temperature range of 20-25°C. The mean maximum spore germination was recorded at 20°C (92.95%) which was followed by at 25°C (87.65%). It was statistically superior over all the tested temperatures. The lowest germination was recorded at 5°C (10.36%) and 35°C (6.93%). Thus, studies indicated that the optimum temperature for uredospore germination was 20- 25°C. The minimum temperature for germination under the conditions used was between 0 and 5°C, the optimum between 20 and 25°C, and the maximum between 30 and 35°C and these similar values were reported by Roelfs *et al.* 1992^[7]. There is evidence that low and high temperatures affect plant disease. The maximum number of *P. striiformis* urediniospores germinated between 8-12°C was recorded by Vallavieille-Pope *et al.* (1995)^[10]. According to Kadvani (2012)^[5] the highest urediniospore germination of pear millet rust was observed at 20 °C temperatures after 12 hours of incubation and also spore germination was maximum within 24hr of incubation, in temperature range of 20-30°C while the mean maximum spore germination was recorded at 25°C that was studied by Utpal *et al.* (2015)^[9]. According to Mederick (1972)^[6] minimum temperature for germination of urediospores of *P. sorghi* on water agar was between 2 and 5°C, optimum between 10 and 25°C, and maximum between 30 and 35°C.

Table 1: Effect of different temperature on spore germination of uredospores of *P. tritricina* *in vitro*

Temperature °C	Per cent mean germination of urediospore
5	18.78** (10.36)*
10	35.08 (33.03)
15	51.04 (60.47)
20	74.60 (92.95)
25	69.42 (87.65)
30	31.55 (27.37)
35	15.26 (6.93)
S.Em. ±	0.75
C.D. at 5 %	2.27
C.V. %	3.07

**Data were transformed (Arcsine) prior to analysis

*Data given in parentheses are retransformed values

Conclusion

On basis of ongoing discussion, it can be concluded that uredospore germination of *Puccinia tritricina* causing rust in wheat was maximum with 6 hours of incubation, in the temperature range of 20-25°C. This is most favourable condition for infection and diseases development. As temperature moves outside this range, development of disease either slowed or becomes dormant until the temperature

moves back within the required range. This information will be helpful in formulating management strategy under climate change.

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