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Effect of Different Temperature and Relative Humidity Regimes on the Germination of Blastospores of *Taphrina deformans* (Berk.) Tul.

Vinay Kumar Kardam*, A.K. Gupta, Arti Shukla and S.K. Sharma
Department of Plant Pathology, Dr Yashwant Singh Parmar University of Horticulture and Forestry, Nauni, Solan (Himachal Pradesh), India.

(Corresponding author: Vinay Kumar Kardam)*
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ABSTRACT: Peach (*Prunus persica* L. Batsch.) is one of the most important stone fruit crops grown extensively in the temperate, sub-temperate and subtropical regions of the world. The leaf curl caused by *Taphrina deformans* (Berk.) Tul. is the most serious disease of peaches which counts for loss in quantitative and qualitative yield. Cool wet weather with intermittent rains favours the development of the disease especially during bud swell to bud opening stage. The effect of different temperature (0-30°C) and relative humidity levels (80.5 -100 per cent) were studied on the germination of blast spores of peach leaf curl fungus *Taphrina deformans*. It was observed that the per cent germination increased up to 20°C after which a decline in germination per cent was recorded. Maximum germination per cent of 70.73 was observed at 20°C. The germination per cent decreased with decreasing relative humidity maximum (69.05 %) being at 100 per cent relative humidity.

Keywords: *Taphrina deformans*, temperature, relative humidity, blastospores germination.

INTRODUCTION

Peach (*Prunus persica* L. Batsch.) is one of the most important stone fruit crops grown extensively in the temperate, sub-temperate and subtropical regions of the world. It is a favourite table fruit and rich source of protein, sugars, minerals, vitamins. In India, peach is grown on commercial scale in mid hills of Himachal Pradesh, Jammu & Kashmir, Uttrakhand, subtropical plains and to a limited scale in North Eastern states. The production of peach and nectarine per unit area is very low in India as compared to other countries like China, Italy, Spain and USA. The production of peach and nectarine per unit area is very low in India as compared to other countries like China, Italy, Spain and USA. Peach has area in India in 2018-19 is 19,000 ha and annual production is 118,000 MT and productivity is 6.21 MT per hectare (Anonymous, 2019a). Peach has area in Himachal Pradesh in 2018-19 is 5042 ha and production is 7292 tonnes and productivity is 1.44 kg/ha (Anonymous, 2019b).

Low average yield is due to different cultivation constraints including both biotic and abiotic factors. Among biotic factors, diseases caused by fungi, bacteria, viruses and phytoplasmas are of prime importance. Leaf curl caused by *Taphrina deformans* (Berk.) Tul. is the most serious disease of peaches which counts for loss in quantitative and qualitative yield. *T. deformans* is the most troublesome disease in peach orchards grown in the world. It affects peaches and nectarines in most regions of the world where these fruits are grown (Anderson 1956). Peach cultivation faces the threat of intensive development of leaf curl (Randal, 2016) caused by *Taphrina deformans* (Berk.) Tul and it also infect on apricot trees in Syria (Khalil *et al*., 2020), Japanese plums in South Korea (Oh *et al*., 2020).

Leaves infected with *Taphrina deformans* (Berk.) Tul. are thickened, curled and red to yellow coloured instead of normal green. Severely affected shoots die. Irregular and reddish lesions are sometimes seen on fruits also. Badly diseased leaves fall by early summer and repeated infections debilitate trees and kill branches (Kumar *et al.* 2005). The fungus reduces fruit quality, fruit-set, fruit yield and weaken trees. In affected orchards, it occurs every year and causes epidemics that frequently affect 60-90% of the shoots, however, infection on fruits are usually less severe (Rossi *et al.,* 2006). Primary infection is caused by ascospores while, secondary infection is caused by blastospores of the fungus. Leaf curl is most serious in years when cool, wet weather with intermittent rains occur especially during bud swell to bud opening stage (Mix 1935)

which helps in dispersal of spores. Thus, temperature and relative humidity has a definite role in development of this disease. In order to study the effect of these edaphic factors on disease development, there was need to isolate the fungus in pure form first which was otherwise very difficult to isolate. Hence, the pathogen i.e. *Taphrina deformans* was isolated in pure form (Kardam, 2018) and thereafter, present studies were undertaken to find out the effect of different temperature and moisture regimes on disease development in terms of germination of blastospores of the fungus.

METARIALS AND METHODS

Preparation of inoculums. The pathogen was isolated in pure form on PDA enriched with 2 % yeast extract (Fig. 1). For the preparation of blastospore suspension, a loop full of pure culture was added into 100 ml of sterilized distilled water with the help of inoculating needle. The blastospore concentration was adjusted to $\approx 7 \times 10^8$ spores per ml with the help of haemocytometer. This spore suspension of pure culture of *Taphrina deformans* was used for further studies.

In order to find out the optimum temperature for spore budding of *Taphrina deformans,* 10 µl drop of blastospore suspension ($\approx 7 \times 10^8$ spores per ml) was put in cavity slide and placed on triangle glass rod and finally kept in petri dishes (90mm) containing blotting paper and thin layer of cotton wool and moistened with sterilized distilled water. Petri dishes were covered and sealed with parafilm to maintain 100% relative humidity and were incubated in BOD incubator maintained at different temperature regimes *viz*., 0°C, 4°C, 10°C, 15°C**,** 20°C, 25°C and 30°C for 12 hours. Five replications were maintained for each temperature. Each drop was observed microscopically for spore germination (Fig. 1) and per cent germination of budding spores was calculated by using the following formula:

$$\text{Spore germination (\%)} = \frac{\text{No. of spores germinated}}{\text{Total no. of spores observed}} \times 100$$

Fig. 1. Pure culture of *Taphrina deformans* on PDA+YE medium and microscopic view of blastospores.

To find out the optimum relative humidity for germination of spores, 10 µl drop of blastospore suspension was placed in petri dishes as mentioned above and incubated at most effective temperature and at different humidity levels *viz.,* 100.0, 95.6, 89.9, 85.7 and 80.5 per cent which were regulated with the help of different concentration of sulphuric acid as recommended by Stevens (1960). Thereafter, per cent spore germination was recorded as mentioned above.

RESULTS AND DISCUSSION

A. Effect of temperature on blastospores germination

Perusal of the data (Table 1 and Fig. 2) reveal that spore germination occurred at all the temperatures from 0°C to 30°C. Further, the germination per cent increased up to 20°C after which a decline in germination per cent was recorded. Maximum germination of 70.73 per cent was observed at 20°C followed by 49.11 per cent at 15°C and 47.87 per cent at 25°C, which were statistically at par with each other. Minimum spore germination was recorded at 0°C i.e. 8.09 per cent.

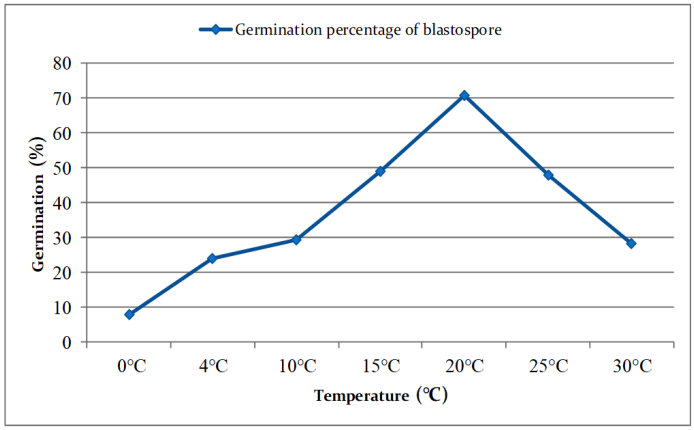

Fig. 2. Graphical representation of germination per cent of blastospores at different temperature regime.

B. Effect of relative humidity on blastospores germination

Perusals of the data (Table 2 and Fig. 3) reveal that there was decline in blastospore germination with decreasing relative humidity. Maximum germination per cent of 69.05 was observed at 100% relative humidity level followed by 49.15 per cent at 95.6% relative humidity. Minimum spore germination was recorded at 80.5 per cent relative humidity level.

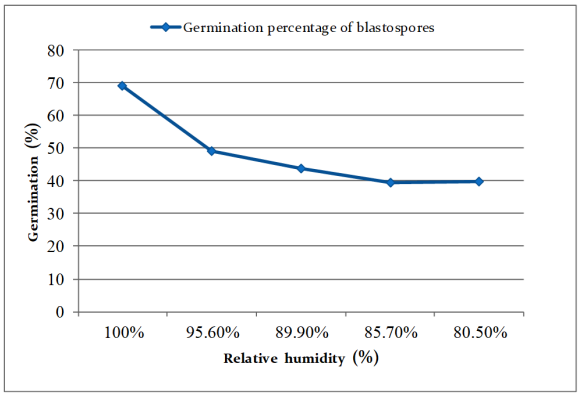

Fig. 3. Graphical representation of germination per cent of blastospores at different relative humidity regimes.

The results obtained in the present study are in conformity with Agarwala *et al.* (1966) who reported that maximum disease occurred when the temperature was oscillating between 15°C to 20°C. Similarly, Rossi *et al.* (2006) in their studies found that infection occurred only when air temperature was <16°C during the wet period and <19°C during incubation. As far as the effect of different relative humidity levels on germination of blastospores is concerned, the results of present study corroborates the findings of Lorenz (1976); Rossi *et al.* (2007) who also reported 100 per cent relative humidity level optimum for germination of blastospores of *T. deformans*.

Table 1: Effect of different temperature regimes on germination (%) of blastospores of *T. deformans*.

Temperature	Blastospores germination (%)
0°C	8.09 (16.51)
4°C	24.06 (29.29)
10°C	29.37 (32.78)
10°C	29.37 (32.78)
20°C	70.73 (57.23)
25°C	47.87 (43.76)
30°C	28.45 (32.20)
$CD_{0.05}$	2.38

*Figures in parentheses are arc sign transformed values

Table 2: Effect of different relative humidity regimes on germination (%) of blastospores of *T. deformans*.

Relative Humidity	Blastospores germination (%)
100%	69.05 (56.23)
95.6%	49.15 (44.50)
89.9%	43.88 (41.50)
85.7%	39.54 (38.90)
80.5%	39.95 (38.00)
$CD_{0.05}$	3.05

*Figures in parentheses are arc sign transformed values

CONCLUSION

For the germination of blastospores optimum temperature and relative humidity was recorded. It was observed that per cent germination increased up to 20ºC after which a decline in germination per cent was recorded. Maximum germination per cent of 70.73% was observed at 20ºC and it was also observed that the germination per cent decreased with decreasing relative humidity. Maximum germination per cent of 69.05% was observed at 100%.

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Conflicts of Interest. None.

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