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Epidemiological study of Downey mildew (*Peronospora parasitica*.) on Cucumis Sativus

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Abstract

An experimental investigation was carried out to examine the conidial germination of Peronospora parasitica under different temperature and humidity conditions. Results indicated that the highest germination occurred at 30°C under conditions of high relative humidity, although the overall germination rate remained low. No germination was recorded at temperatures below 20°C, above 30°C, or when humidity dropped below 90%. Field studies on pea plants demonstrated that powdery mildew symptoms first appeared as small, white, powder-like patches on the upper surface of leaves. These spots gradually increased in size, eventually covering entire leaves, petioles, stems, and pods. The earliest leaves did not exhibit symptoms until 7 to 8 weeks after germination, whereas newly formed leaves showed symptoms within 2 weeks. Conidial germination was found to be significantly lower on younger leaves (2 weeks old) compared to older ones (6 weeks old), suggesting greater susceptibility with leaf age. Further field observations revealed that the disease became visible approximately one week following extended periods of leaf surface wetness (around 12 hours) in combination with high humidity (close to 90%). Initial infections typically appeared in small, scattered patches before spreading more extensively across the foliage.

Keywords: *Downey mildew, Peronospora parasitica., Epidemiology Cucumis Sativus*

Introduction

Downey mildew on Cucumis Sativus caused by *Peronospora parasitica*., is a common and serious disease throughout India. According to a survey Jalgaon dist. (Khandesh region). The disease can reduce photosynthetic area of leaves, and in severe cases causes defoliation on plants, effects that are likely to reduce yield and quality of fruit (Mandloi et.al. 1988). Methods for disease control currently available to growers include repeated application of sulphur or calixin and karathane fungicides (Uppel et al. 1935; Perata, 1949; Starker, 1954 and Mishra and Krishna, 1990). Alternative powdery mildew control methods with antagonistic micro-organisms (Heijwegen, 1992) and plant extracts (Singh, 2000; Chavan et al. 2000) have been reported. These can not be effectively applied without a full understanding of the disease. Although powdery mildew is common in pea, the epidemiology and life cycle of fungus are not fully understood (Uppal et al. 1935, Butt, 1978) and have not been studied in Jalgaon dist. This research outlines the early results of epidemiological investigations on powdery mildew occurring in the Khandesh region.

Materials and Methods

Effect of Temperature on Conidial Germination

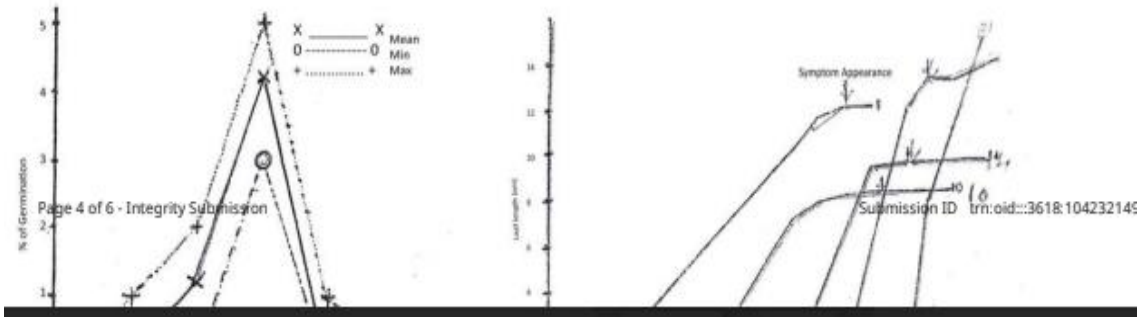
Conidia of *Peronospora parasitica* were collected from infected pea leaves and carefully transferred onto clean glass microscope slides using a fine paintbrush. Two slides were suspended above distilled water in a sealed plastic container (10 × 50 cm) using a rubber stopper. These containers were incubated at different temperatures ranging from 10°C to 35°C. Each temperature treatment was replicated five times. After 72 hours of incubation, the percentage of germinated conidia was determined microscopically.

Effect of Relative Humidity on Conidial Germination

To assess the impact of relative humidity, saturated salt solutions were prepared following the method described by O'Brien (1948) to establish specific humidity levels inside sealed containers. Each container (10 × 50 cm) was filled with 50 mL of the prepared solution and maintained at 25°C in an incubator. Conidia were dusted onto microscope slides and suspended over the solutions inside the containers. The following salts were used to achieve different relative humidity levels: $Mg(NO_3)_2$ (52%), NH_4NO_3 (63%), NaCl (75%), KCl (86%), KNO_3 (94%), and distilled water (100%). After 3 days, germination percentages were recorded under a compound microscope.

Field Observation of Disease Development

The progression of powdery mildew was monitored on five individual Cucurbitaceae plants cultivated in field conditions between Yawal and Bhalod. Each emerging leaf was numbered, and the date of emergence was noted. Leaf length was measured along the central vein at intervals of 3–4 days. Disease development was recorded for each leaf, and observations were conducted over two consecutive growing seasons (2007–08 and 2008–09).



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Effect of Leaf Age on Conidial Germination

Leaf discs (1 cm diameter) were excised from 2-week-old and 6-week-old leaves of Cucumis sativus plants. These discs were positioned on fine gauze with the adaxial (upper) surface facing upward and placed on rubber stoppers inside sealed plastic containers, similar to previous methods. Fresh conidia of *Peronospora parasitica* were lightly dusted onto the leaf discs. The containers were then incubated at 25°C for 72 hours. After incubation, the proportion of conidia that had germinated on each type of leaf disc was assessed using light microscopy.

Field Observations

Development of downy mildew on Cucumis sativus was studied at two field sites approximately 1 km apart in the Yawal–Bhalod region. Observations were recorded every 3 to 4 days, tracking disease progression and symptoms. Simultaneously, weather parameters including temperature, relative humidity, and leaf wetness were monitored throughout the study period.

Results

Temperature Effect on Conidial Germination

Maximum germination of conidia (~5%) was observed at 25°C after four days of incubation. Although a few conidia germinated at 20°C and 30°C, no germination was recorded at extreme temperatures of 10°C or 35°C (Fig. 1). Overall germination rates remained low across all temperatures tested.

Relative Humidity Effect on Conidial Germination

Germination occurred only at relative humidity levels between 95% and 100%. No germination was observed when the relative humidity dropped to 94% or below, indicating a narrow moisture threshold for successful germination.

Disease Progression in Individual Plants

A consistent pattern of disease development was observed in all monitored pea plants (Fig. 2). Initial symptoms were absent from early-formed leaves for the first 7–8 weeks post-emergence. However, later-developing leaves exhibited symptoms much earlier in their growth stages. Notably, the disease was seldom observed on incompletely expanded or rapidly growing leaves.

Impact of Leaf Age on Germination

Only a small fraction (approximately 4–6%) of conidia successfully germinated on leaf discs derived from 2-week-old leaves. In contrast, a significantly higher germination rate was observed on discs from 6-week-old leaves, suggesting increased susceptibility with leaf age (Table 1).

Field Conditions and Disease Initiation

The onset of downy mildew in field-grown pea crops was first detected between December and January, following an extended duration of leaf wetness (approximately 12 hours) and ambient temperatures rising above 22°C. The incubation period of the pathogen ranged from 5 to 7 days. Infections initially appeared as small patches beneath dense foliage, eventually expanding outward to cover large portions of the crop within a week.

Table 1: Conidia germination *Peronospora parasitica*., conidia on leaf discs cut from different age leaves on mean germination.

Leaf age (Weeks)	Mean Germination %	Confidence interval
2	5.7	3.3, 9.7
6	30.3	24.5 , 38.9

To estimate 95% confidence intervals, percentage values were transformed using the logit function, followed by a back-transformation for interpretation.

Discussion

The findings of this study support the widely accepted view that the conidial germination of *Peronospora parasitica* occurs within a temperature range of 20°C to 40°C. This range corresponds with the summer season in the Khandesh region, a period during which downy mildew symptoms are commonly observed on cucurbit crops. Optimal germination was observed around 70% relative humidity, consistent with the findings of Jooty and Munshi (1990). However, germination was not observed below this humidity level, highlighting the necessity of moist air for successful spore development.

These results also align with earlier reports by Butt (1978), who demonstrated that the presence of free water inhibits germination, suggesting that excessive moisture may hinder rather than promote infection. This may help explain our field observations where initial disease symptoms were typically found on leaves growing under dense canopies—areas where humidity tends to be higher than in open sunlight.

Previous studies (Munjal et al., 1963; Parashar and Sindhan, 1986; Wyness and Aryes, 1987) have similarly noted that powdery mildew in peas develops more effectively in shaded conditions than in direct sunlight. It is also recognized that younger leaves are more resistant to powdery mildew compared to mature ones (Sindhan and Parashar, 1986; Singh, 1977). In our field study, however, a direct comparison of conidial germination between later-formed younger leaves and older ones was not possible, as the younger leaves began showing symptoms only after 2–3 weeks of development, typically coinciding with the end of their expansion phase (Fig. 2).

In the Yawal to Bhalod region, field observations confirmed that downy mildew symptoms were first visible during mid-January. This onset closely followed extended periods of leaf wetness (approximately 12 hours) coupled with air temperatures rising above 22°C. The disease was found to spread rapidly under these conditions.

Based on these epidemiological insights, current field trials are being conducted to evaluate the effectiveness of targeted fungicide applications. Sprays containing Calxin, sulfur powder, and Karathane are being applied at the initial appearance of symptoms in an effort to manage and control powdery mildew outbreaks effectively.

Conclusion

The present study highlights the significant influence of environmental factors such as temperature, humidity, and leaf age on the germination of Peronospora parasitica conidia and the development of downy mildew in cucurbit crops. Optimal germination occurred at 25°C and high relative humidity, with older leaves showing greater susceptibility to infection. Field observations confirmed that disease onset coincided with prolonged leaf wetness and moderate temperatures. These findings provide a basis for timely disease prediction and support the need for early, targeted fungicide application to manage downy mildew effectively.

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Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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