Factors affecting downy mildew infection of fenugreek

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ABSTRACT: Temperature regime of 18°C gave maximum infection frequency of Peronospora trigonella on fenugreek. The per cent infection differed significantly under dark and light conditions with higher infection points under dark conditions. The inoculum of 12h age caused maximum infection. The conidial inoculum used after washing at 5000 rpm was found more virulent with higher rates of infection. Highest infection occurred at flowering stage followed by pod formation growth stage of the crop. Downy mildew infection was initiated when host leaves were kept wet for 6 h. A leaf wetness period of 12h was found optimum to get maximum infection. There was 100 per cent infection on the host leaves when they were inoculated soon after wiping of their surface.

Key words: Downy mildew, Peronospora trigonella, infection, fenugreek

Downy mildew (Peronospora trigonella Gaumann) of fenugreek (Trigonella foenum graecum L.) is the most serious disease all over the country (Thind, 1942). There are number of host, pathogen and environmental factors which affect infection and subsequent development of disease under field conditions. The present paper reports results of some factors affecting downy mildew infection of fenugreek.

MATERIALS AND METHODS

The healthy plants of fenugreek cv. Hisar Sonali grown in pots were drop inoculated with conidia of Peronospora trigonella collected from diseased leaves and incubated at 17, 18 and 19°C temperature in growth chamber for 24 h.

For artificial light, the light of incubator was kept on and for darkness the light of incubator was kept off. After 24 hours of incubation the pots were shifted to field.

To find out the effect of age of Peronospora trigonella inoculum on infection of fenugreek, the conidia of 6, 12 and 24 hours age were collected. The healthy susceptible plants were drop inoculated with this conidial inoculum at congenial temperature and relative humidity for infection.

To measure the effect of host age on infection by Peronospora trigonella, the crop was sown on different dates in such a way that all the four (seedling, branching, flowering and pod formation) growth stages of the crop coincided on the same date. The different growth stages taken into account were soon after germination, branching stage, flowering stage and pod formation stage. The inoculation was made on 31.1.95 and percentage of infection was recorded after 10 days.

The conidia (50,000 conidia/ml of water) were washed by centrifugation at 1500, 5000 and 10000 rpm for four minutes to find out the effect of washing on infection. Unwashed conidia were treated as control. Healthy plants of susceptible cv. Hisar Sonali were inoculated with washed and unwashed inoculum. Such plants were covered with Polythene bags to maintain appropriate humidity for 24 h.

To study the effect of leaf wetness (free moisture) duration on downy mildew infection by Peronospora trigonella, the plants of fenugreek cv. Hisar Sonali were grown in pots maintaining five plants per pot. The pots containing healthy plants were selected and drop inoculated with conidial suspension of downy mildew. Inoculated pots were incubated at 18°C temperature in BOD incubator for 24 hours. Three pots of each treatment were taken out from incubator and leaves were dried between the folds of blotting paper after 6, 12 and 18 hours. The pots were shifted to field for disease development. Appropriate control was also maintained. The observations on infection and disease development were recorded regularly after 24 hours of inoculation till 10 days.

To see the effect of wiping of host leaves on subsequent infection the inoculations with Peronospora trigonella were made after 0, 1, 2 and 3 days of wiping
of cv. Hisar Sonali. Unwiped leaves of separate plants were used as controls. For each experiment per cent infection was calculated after 10 day of inoculation.

RESULTS

Effect of temperature

The effect of temperature on infection of fenugreek by *P. trigonella* was studied at 17°, 18° and 19°C temperature. At 18°C temperature relatively higher percentage of infection was observed as compared to other treatments. At 17°C there was 39.6 per cent infection which increased by 8.4 per cent at 18°C temperature. However, the infection percentage increased with the increase in temperature up to 18°C only, after which it declined. It was observed that 10.1, 18.5 and 14.7 per cent more infection was recorded at 17°C, 18°C and 19°C temperature than control where temperature fluctuated between 4.9 to 15.8°C. There was significant difference in per cent infection by *P. trigonella* at different temperature levels.

Effect of darkness and light

Maximum infection of 52.2 per cent was observed when the inoculated plants were incubated in darkness followed by 49.5 per cent in light. The per cent infection differed significantly under darkness and light conditions.

Effect of age of inoculum

The effect of age of *P. trigonella* conidia on fenugreek infection was studied after inoculating 6, 12 and 24 h old conidia. It is evident from the Fig. 1A that 46.3, 70.7 and 62.4 per cent infection was observed when plants were inoculated with 6, 12 and 24 h old conidia, respectively. Fig. 1 (A) clearly showed that there was sharp increase in infection from 6 to 12 h old conidial inoculum, but when 24 h old inoculum was used the infection percentage decreased considerably. The inoculum of 12 h age showed relatively more infection over 6 h. However, 24 h old conidia resulted in good infection of more than 62 per cent. The plants inoculated with 12 and 24 h old conidial inoculum showed 24.4 and 16.8 per cent more infection than 6 h old conidial inoculum. The per cent infection by 6 h old inoculum was found significantly lower than 12 and 24 h old inoculum.

Effect of washing of conidia

It is clear from Fig. 1 (B) that highest infection was recorded from conidial inoculum washed at 5000 rpm and least from unwashed conidial inoculum. The Fig. 1 (B) clearly indicated that infection increased rapidly with conidial inoculum washed at 5000 rpm but later it decreased sharply when washed at 10000 rpm. The conidial inoculum washed at 1500, 5000 and 10000 rpm caused 50.5, 61.5 and 56.9 per cent infection, whereas, unwashed conidial inoculum infected up to 48.8 per cent leaves. Precisely, washed conidial inoculum showed significantly higher infection over unwashed except at 1500 rpm. However, a non-significant infection difference was observed from washing at 1500 rpm and unwashed conidial inoculum.

Effect of host age

To determine the effect of host age on downy mildew infection and development, fenugreek plants of different ages viz., soon after germination, branch-

![Fig.1. Effect of (A) age of inoculum and (B) washing of conidia of *Peronospora trigonella* on infection](image-url)
ing stage, flowering stage and pod formation stage were inoculated with *P. trigonella*. It is clear from Fig. 2 that the infection and disease development increased with the age of the crop up to flowering stage. At pod formation stage considerable reduction in infection was observed. The per cent infection was 8.6, 32.2, 47.2 and 39.6 per cent when plants were inoculated soon after germination, branching stage, flowering and pod formation stages, respectively. The crop inoculated soon after germination showed relatively less infection. At flowering stage the per cent infection was observed more than 5 times in comparison to soon after germination. Highest infection occurred at flowering stage followed by pod formation stage. The difference in host infection was found significant at all growth stages of crop.

![Fig. 2. Effect of host age on infection by Peronospora trigonella](image)

**Effect of leaf wetness duration**

Leaf wetness duration played very significant role in infection and development of downy mildew. The infection was initiated when inoculated leaves were kept wet for 6 h. The maximum infection of 56.2 per cent was observed when inoculated leaves were kept wet for 12 h. It is evident from Fig. 3 that with increase in leaf wetness up to 12 h there was an increase in infection, whereas, further increase in leaf wetness duration did not improve infection percentage. After 6, 12 and 18 h of leaf wetness duration 49.1, 56.2 and 53.4 per cent infection was obtained while in control it was 32.4 per cent. After 12 h of leaf wetness duration 23.8 per cent more infection was obtained over control, whereas, it was 16.7 and 20.9 per cent more from 6 and 24 h of leaf wetness duration.

![Fig. 3. Effect of leaf wetness duration on infection by Peronospora trigonella](image)

Statistically, the per cent infection at all the leaf wetness duration periods was found significant over control. The leaf wetness duration of 12 h recorded significant difference on per cent infection than 6 h leaf wetness, while, the per cent infection at 12 and 18 h leaf wetness was found non-significant.

**Effect of wiping of host surface**

The wiped leaves were inoculated after 0, 1, 2 and 3 days of wiping. It is evident from Fig 4 that during 1993-94 wiping of fenugreek leaves after 0, 1, 2 and 3 days before inoculation recorded 93.3, 86.6, 70.0 and 60.0 per cent infection, whereas, unwiped plants showed 43.3 per cent infection only. Though maximum infection 93.3 per cent was observed when the leaves were

![Fig. 4. Effect of wiping of host surface on infection of Peronospora trigonella](image)
inoculated with *P. trigonella* conidia soon after wiping, but found non-significant when compared with inoculation after 1 day of wiping. The inoculation made after 0, 1, 2 and 3 days of wiping of leaves showed a significant difference on infection as compared to control or unwiped. Likewise, during 1994-95, 100 per cent infection was observed when the plants were inoculated soon after wiping. Unwiped leaves showed just half times infection than the leaves inoculated soon after wiping.

**DISCUSSION**

In the present investigation it was found that there was maximum infection of *Peronospora trigonella* at 18°C temperature after 24 h of incubation period which was also suitable for conidial germination. These results showed the similarity with the findings of Abd-Elrazik and Lorbeer (1980) who reported maximum infection of *Peronospora destructor* on onion at 18°C temperature.

Darkness and light played an important role in the infection process of downy mildew disease of fenugreek. Light inhibited the per cent infection of downy mildew. Similar results were also reported in case of downy mildew of onion, vine and lettuce (Yarwood, 1937).

The perusal of data in the present investigation showed that per cent infection increased with the age of conidia upto 12 h. The 12 h old conidia of *Peronospora trigonella* showed 70.7 per cent infection, while one and two days old conidia of *Peronospora destructor* caused 70 per cent infection on onion but later infection decreased (Abd-Elrazik and Lorbeer, 1980).

In the present study percentage of infection increased with the use of prior washed conidia of *Peronospora trigonella*. The maximum infection was observed from plants inoculated with prior washed conidia at 5000 rpm followed by 10000 rpm. The fact that conidial washing before inoculation increased infection may be possibly due to the removal of some toxic compounds present on the surface of conidia affecting the conidial germination and subsequent infection (Abd-Elrazik and Lorbeer, 1980).

The inoculation of *Peronospora trigonella* at four different growth stages of the host showed significant differences in percentage of infection. Maximum infection was recorded when the inoculation was done at flowering stage followed by pod formation stage. Inoculation of *Peronospora trigonella* soon after germination and at branching stage caused less infection than at other stages tested. While, in contrast, Cohen and Sackstan (1973) recorded 50 per cent infection from sunflower leaves inoculated with *Peronospora halstedii* at the apical bud in the 8 leaf stage, but none at 12 leaf stage.

Leaf wetness duration play an important role in infection and development of downy mildew of fenugreek. Evidently the leaf wetness duration of 12 h recorded maximum infection by *Peronospora trigonella* followed by a leaf wetness period of 18 h. All the three duration of leaf wetness observed more infection over control. Similarly, Campbell (1935) showed leaf wetness period of two hours as insufficient for germination and sporulation of *Peronospora viciae* conidia in beans.

The wiping of host leaf before inoculation increased infection level to a great extent. The inoculation of fenugreek with *Peronospora trigonella* soon after wiping recorded maximum infection. Inoculation made at 0, 1, 2 and 3 days after wiping the host surface caused more than 60 per cent infection. During 1994-95, inoculation of fenugreek with *Peronospora trigonella* conidia soon after wiping showed 100 per cent infection. Similar results were observed by Abd-Elrazik and Lorbeer (1980) that there was 100 per cent infection when the plants were inoculated after wiping between 0 to 2 days. In the same manner Berry (1959) found that the leaves wiped with cotton before inoculation showed greater disease intensity than the respective treatments without wiping. The increase in infection with the wiping of host surface may be due to removal of wax and other toxic chemical compounds from the surface of leaf which might be providing resistance to the host.

**REFERENCES**


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