RESEARCH ARTICLE

IMPACT OF ABIOTIC FACTORS AND AGE OF HOST PLANT ON PURPLE BLOTCH OF ONION CAUSED BY ALTERNARIA PORRI (ELLIS) AND ESTIMATION OF YIELD LOSSES

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Abstract: An experiment was conducted on “Impact of abiotic factors and age of host plant on purple blotch of onion (Allium cepa L.) caused by Alternaria porri (Ellis)” and estimation of yield losses “was carried out in Department of Plant Pathology, cage house and experimental field of Horticulture farm, Rajasthan College of Agriculture, Udaipur during 2014-2015. Sixty-days-old plants were more susceptible for infection of A. porri. However, susceptibility increased with increased age and after 60-days age decreased in susceptibility was recorded. In field trial conducted for yield loss estimation revealed that maximum yield loss (50.11%) was obtained in control plots followed by one, two and three spray of Mancozeb @ 0.2 per cent concentration. In relation to environmental factors study, temperature ranged from 13 to 32°C, relative humidity more than 75 per cent, wind velocity 2.4 Kmph, sunshine 8.4 hrs and optimum rainfall was found favourable for purple blotch disease development.

Keywords: Purple blotch, Onion, Abiotic, Age of host, Yield loss

INTRODUCTION

Onion (Allium cepa L.) belongs to family Amaryllidaceae, is a bulbous, biennial herb, rightly called as “Queen of kitchen”. It is one of the most important vegetable cum condiment crop grown throughout the world. In India onion is cultivated in three seasons mainly – Kharif, late Kharif and Rabi. Rabi accounts for 60 per cent production and other two season’s accounts for 20 per cent each. India occupies second rank in productivity next to China with an area of 12.04 lakh hectares with an annual total production of 194.02 lakh tons and an average productivity of 16.1 mt/ha. In Rajasthan, it is cultivated in 5.75 lakh hectares with a total production of 7.05 lakh tons and productivity of 12.3 mt/ha. (1)Anonymous, 2013-14). Onion crop suffers from number of disease among them purple blotch of onion caused by A. porri (Ellis) is the most destructive disease, prevalent in almost all onion growing areas of the world causing heavy losses under field conditions and is the major constraints to the onion production and due to this disease yield loss ranging from 2.5 to 87.8 per cent during Kharif season (2)Srivastava et al., 1994). The fungus attacks both leaves and flower stalk (3)Bock, 1964), reducing foliar production by 62-92% (4)Suheri and Prince, 2001). The disease can cause a yield loss of 30% (5)Everts and Lacy, 1990) and 100% of the seed crop, when the weather is favourable (6)Daljeet et al., 1992 and Schwartz, 2004). The yield loss of onion in India due to this disease under favorable conditions varies from 5.0 to 96.5 per cent (7)Gupta and Pathak, 1988) and 97 per cent (8)Lakra, 1999).

Keeping in view, economic importance and yield losses caused by purple blotch present investigation were undertaken.

MATERIAL AND METHOD

Effect of plant age on disease development

A pot experiment was laid out in completely randomized design with five replications. Each pot had four plants. The susceptible onion cultivars Nasik red seedlings were transplanted in pots. After 15 days of transplanting (i.e. 15 day plant age) five pots were taken and inoculated with culture of A. porri by spray inoculation technique. Inoculated plants were kept in humid chamber for 20 hrs and then transferred to cage house and high humidity was maintained throughout the disease development period by regular spraying with water. Observations for disease severity were recorded periodically after 10 days of inoculation on 0-5 disease rating scale given by (9)Sharma (1986). The process was repeated similarly for 30, 45, 60, 75 and 90 day plant age.

The details of 0-5 rating scales is listed below:

<table>
<thead>
<tr>
<th>Per cent area covered</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>No disease symptom</td>
<td>0</td>
</tr>
<tr>
<td>A few spots towards tip covering 10 per cent leaf area</td>
<td>1</td>
</tr>
<tr>
<td>Several purplish brown patches covering upto 20 per cent of leaf area</td>
<td>2</td>
</tr>
</tbody>
</table>

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Several patches with paler outer zone covering upto 40 per cent leaf area
Leaf streaks covering upto 75 per cent leaf area or breaking of the leaves from center and
Complete drying of the leaves or breaking of leaves from center

The per cent disease index (PDI) was calculated using following formula given by [10] Wheeler 1969:

\[ \text{Percent disease index (PDI)} = \frac{\text{Sum of all individual disease rating}}{\text{Total No. of plant assessed}} \times 100 \]

\[ \text{PDI} = \frac{n \times 1 + n \times 2 + n \times 3 + n \times 4 + n \times 5}{N} \times \frac{100}{\text{Maximum diseasescore (5)}} \]

Where,
- \( n \) = Number of plants in each score, 0-5 = disease score
- \( N \) = Total number of plant under observation

At maturity, plants from each plot were harvested and bulb yield/plot were determined. The per cent losses in bulb yield were calculated by using formula given by [11] Klem (1940) as:

\[ a - b \times 100 \]

Where,
- \( a \) = Mean yield per plot from healthy plant
- \( b \) = Mean yield per plot from diseased plant
- \( Q \) = Per cent loss in yield

**Epidemiological studies**

Epidemiology of the disease, aerobiological studies such as appearance of spores and development of disease were carried out. Study on air borne conidia of *A. porri* was carried out in cage house throughout the cropping season after 30 days of inoculation under different environmental conditions to understand the development of the disease. The pathogen released the inoculum continuously in the form of conidia throughout the crop season. Later on intensity of purple blotch were correlated in relation to weather parameters. The weather data *i.e.* maximum and minimum temperature, morning and evening relative humidity, total rainfall per week, total rainy days per week, wind velocity (Km/h) and sunshine hrs per day were collected from agronomy farm observatory at RCA, Udaipur.

**RESULT AND DISCUSSION**

**Effect of plant age on disease development**

As the age of plants of cv. Nasik red increased, the percentage of leaf area showing symptoms and the percentage of defoliation increased. The most susceptible age of onion plants was found to be 60-days with 52.48 PDI. Inoculation at 30, 45-days-old plants resulted in 18.60 and 33.86, PDI respectively. At the later stage (75 and 90-days-old) onion cultivar showed decline in PDI 50.40 and 43.72 while no disease occurred at 15-days-old plant age. Increased susceptibility to infection with increasing host age has been reported in many *Alternaria*-host systems, such as *A. brassicicola* and *A. brassicicola* on brassica crops ([12] Babadoost & Gabrielson, 1979), *A. porri* on onions ([13]Gupta & Pathak, 1986) and *A. macrospora* on cotton ([14] Rotem et al., 1990). [15]
Kareem et al. (2012) studied the onion plants at different age viz., 15, 30, 45, 60 and 75 days were inoculated separately with conidial suspension of *A. porri*. With the increased host age there was a significant increased in disease development. Highest PDI (54.43) recorded at 60 days age followed by 75 days (51.75), 45 days (36.25) and 30 days (28.83 PDI) whereas 15 days age plant showed less PDI (21.08). (Table 1)

**Estimation of losses of onion bulb under field conditions**
All the treatments resulted in higher yield ranging from (12.02-16.04 kg/plot) over the untreated control (8.98 kg/plot). In the inoculated control plots, onion yield was 8.98 kg/plot. The maximum yield loss (50.11%) was obtained in control plots followed by one spray (33.22%), two spray (22.38%) and three spray (10.89%). Purple blotch of onion has been reported to cause heavy losses in yield and as per reports it causes 20-25 per cent yield loss ([16] Thind and Jhooty, 1982). In present investigation Mancozeb @ 0.2 per cent concentration was used as protective spray and untreated control was also maintained, taking three treatments of one, two and three sprays. PDI was also recorded and based on PDI it was found that three sprays of Mancozeb @ 0.2 per cent concentration at 10 days interval was best to control the disease with least PDI i.e. 26.04 with maximum yield of 16.04 kg/plot and yield loss 10.89 per cent respectively. Loss increased with the decreased in number of sprays viz., two sprays with PDI 30.14 per cent and losses in yield 22.38 per cent followed by one spray with 33.22 per cent over healthy plots. Spray schedule and frequency is decisive in the disease management. Huq et al. (1999) showed average yield reduction in garlic cv. GC-018 with 21.54 per cent when yield was taken in different disease severity levels. [17] Upmanyu and Sharma (2007) observed extent of seed yield losses due to purple blotch of onion and reported that as the PDI increased yield of seed decreased. [18] Singh et al (2014) reported yield losses upto 58.44 per cent due to *A. lini* and *A. linicola*. (Table 2)

**Epidemiological study**
The PDI were recorded from December third week (standard week 51) to April fourth week (standard week 17) and February weeks were found favourable for initiation of purple blotch disease development in onion, whereas December third week was found least favourable. Maximum disease index was observed during February second, third, fourth and first week of March, there was increase in mean PDI 28.5 to 39.2, 39.2 to 47.8, 47.8 to 56.9 and then 56.9 to 64.7, respectively. Subsequently in later weeks disease declined with mean PDI 64.9 to 60.2, 60.2 to 51.3, 51.3 to 46.5 and 46.5 to 36.7 in second, third, fourth and fifth week of March, respectively and finally disease declined with mean PDI 17.4 in third week of April.

**Table 1. Effect of plant age on purple blotch development on onion cultivar Nasik red**

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Plant age ( days )</th>
<th>Per cent disease index (PDI)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>15</td>
<td>0.00 (0.00)</td>
</tr>
<tr>
<td>2.</td>
<td>30</td>
<td>18.60 (25.54)</td>
</tr>
<tr>
<td>3.</td>
<td>45</td>
<td>33.86 (35.58)</td>
</tr>
<tr>
<td>4.</td>
<td>60</td>
<td>52.48 (46.42)</td>
</tr>
<tr>
<td>5.</td>
<td>75</td>
<td>50.40 (45.23)</td>
</tr>
<tr>
<td>6.</td>
<td>90</td>
<td>43.72 (41.39)</td>
</tr>
</tbody>
</table>

SEm± 0.78  
CD (P = 0.05) 2.29  
CV (%) 5.28  

*Mean of five replications  
Figures in parentheses are arcsine √ per cent angular transformed values

**Table 2. Yield losses in onion due to *Alternaria porri* in field during Rabi 2014-15**

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Treatments</th>
<th>Per cent disease Index (PDI)*</th>
<th>Bulb yield* (kg/plot)</th>
<th>Per cent loss in bulb yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Healthy plot</td>
<td>0.00</td>
<td>18.00</td>
<td>0.00</td>
</tr>
<tr>
<td>2.</td>
<td>Three spray</td>
<td>26.04 (30.68)</td>
<td>16.04</td>
<td>10.89 (19.27)</td>
</tr>
</tbody>
</table>
Temperature from 13 to 32°C was found most favourable however, maximum temperature showed positive correlation ($r = +0.99$) while minimum temperature showed negative correlation ($r = -2.19$) more than 40°C and less than 12°C was found not favourable. Relative humidity more than 75 per cent was found more favourable, however morning and evening relative humidity showed positive correlation ($r = +2.38$ and +1.12). Optimum rainfall was favourable for purple blotch of onion, however, rainfall showed positive correlation with spread while rainy days showed negative correlation. Wind velocity and sunshine hrs showed positive correlation. However, [19] Bassey and Gabrielson (1983) studied plants inoculated with A. brassicicola developed symptoms most quickly at 25°C, while seedlings raised from infected seeds developed symptoms most quickly at 30°C. [15] Kareem et al. (2012) reported infection of A. porri on onion over a temperature range of 15 to 35°C, with maximum infection at 25°C. The optimum RH for the infection of onion by A. porri was found to be 95 per cent, though disease development occurred over the range of 75 to 100 per cent relative humidity. [20] Mohammad and Dabbas (2012) studied the influence of environmental factors on the development of purple blotch of onion under field conditions; temperature and RH play an important role in the disease development. Range of temperature 25.50-28.00 and 26.50-27.20, relative humidity 88-76 per cent and 80-78 per cent favoured highest disease incidence during 2008 and 2009 seasons, respectively. (Table 3)

The present data of experiment are again confirmed and strongly supported the results obtained by earlier workers on this disease.

**REFERENCES**


