Assessment of yield loss of cumin (Cuminum cyminum) caused by Alternaria leaf blight and pathogen recovery from infected seeds

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Cumin, also known as ‘Jeera’ in India, is a widely used ingredient in Indian cuisines. It is referred to as the dried seed of Cuminum cyminum that belongs to the parsley family. In India, it ranks first among the spices in area with 5.94 M ha, with total production of 3.94 MT and productivity of 0.7 MT/ha (1). Rajasthan is the main cumin producing state, followed by Gujarat and Maharashtra. In Rajasthan cumin is mainly grown in Jalore, Nagaur, Bikaner, Jodhpur, Barmer, Pali, Jaisalmer, Sirohi and Ajmer districts. Cumin production in Rajasthan was 1.76 MT and area was 4.96 M ha and productivity was 356 kg/ha during 2012-13 (2). Cumin cultivation is often challenged by diseases that cause quantitative and qualitative losses in yield. The major diseases are blight (Alternaria brunsii Uppal, Patel and Kamat), wilt (Fusarium oxysporum f.sp. cumini Patel, Prasad, Mathur and Mathur) and powdery mildew (Erysiphe polygoni DC ex. St.-Am.) (5). Alternaria blight is considered as the most devastating disease of cumin in sub-tropical countries. This disease is quite prevalent and destructive as it affects all above ground plant parts including seed, thus, causing direct yield loss up to 70% (5). In India blight of cumin caused by A. burnsii was first reported by Uppal et al. (1938). Later on, it was reported from Rajasthan by Joshi (8). The losses caused by a disease vary with the host-pathogen combination and disease severity. Since limited information is available on the yield losses caused by A. burnsii and A. alternata in cumin an experiment was performed to assess the yield loss.

Field trials were conducted in two consecutive seasons (rabi 2012-13 and 2013-14) to assess the reduction in yield under different disease severity generated by application of different inoculum densities of A. burnsii (Ab) (l x 10^6 conidia ml^-1), A. alternata (Aa) (l x 10^6 conidia ml^-1), A. burnsii + A. alternata (l x 10^6 conidia ml^-1) and A. burnsii + A. alternata (1 x 10^6 conidia ml^-1). Fungicide (mancozeb) un-inoculated but protected and unprotected plots served as control (3). The experiment was conducted taking local susceptible land race of cumin and the most virulent isolates of Jaalore A. burnsii and A. alternata were used. The seeds of local land races of cumin were sown in 3 x 2 m plots, keeping ten rows (30 cm) and 40 plants in each row, with 5 cm plant distance. Recommended agronomical practices for fertilizers (N-80, P-40 and K-40 kg ha^-1) and weeding (mechanical removal) were followed. Fungicide was applied only in protected uninoculated. Four replications of each inoculum density, and protected and unprotected uninoculated checks for local genotype were maintained. The treatments were laid out in a randomized block design. Spore (conidia) suspension was prepared by flooding the 7 days old culture with distilled water (1: 1) in a warring blender and then filtered through muslin cloth. The desired inoculum densities were prepared with the help of a haemocytometer. The inocula were prepared fresh just before inoculation. Inoculations were done late in evening by spraying 45-days-old plants with the help of hand sprayer to the run off level. The per cent disease index (PDI) was calculated by standard method.

To know any possible relation between disease intensity on foliage and seed infection of A. burnsii and A. alternata and also to recover the fungi, seed samples were collected from both inoculated and the uninoculated plots and tested by standard-blotter method. Blotter papers were cut in 9 cm diameter discs and sterilized at 1.045 kg cm^-2 for 30 min. Three layers of blotter papers were placed at the bottom of each sterilized Petri-plates aseptically and moistened with sterile distilled water. Ten seeds of each treatment having different levels of disease severity were placed at equal distance in each Petri-plate. The seeds were washed three times with sterilized distilled water before placement in Petri plates. These plates were incubated at 28±2°C for 12 hrs of light, alternating with 12 hrs of dark period. The seeds were examined on eighth day of incubation for the presence of A. burnsii and A. alternata. The lab experiment was conducted in CRD during both the years.

Two year average data presented in table 1 revealed that minimum disease index 17.5 per cent was recorded after 30 days of inoculation in uninoculated protected control plots. This was followed by uninoculated control plots with percent disease index 31.1. Plots inoculated with A. burnsii and A. alternata alone @ 1 x 10^6 conidia ml^-1 exhibited per cent disease index (PDI) 68.0 and 63.5,
respectively. Mixed inoculum with lower inoculum density (Ab + Aa 1×10³ conidia ml⁻¹), exhibited 61.3 per cent disease index which was significantly lower as compared to their individual applications at higher concentrations (1×10⁶ conidia ml⁻¹), but mixed inoculum of both the pathogens at higher concentration (Ab + Aa 1×10⁶ conidia ml⁻¹) exhibit significantly higher PDI of 77.6 over rest of the treatments.

Maximum grain yield 998.3 kg/ha was recorded in uninoculated protected control plots, followed by 836.7 kg/ha in uninoculated unprotected plots. Among the inoculated plots, plots inoculated with individual pathogen at 1×10⁶ conidia ml⁻¹ exhibited 520.0 kg/ha and 611.7 kg/ha grain yield, respectively, while their mixed inoculum 1×10⁶ conidia ml⁻¹ exhibited 680.0 kg/ha grain yield. Mixed inoculum of both the pathogens at higher concentration (1×10⁶ conidia ml⁻¹) was found to have significantly higher yield of 77.6 over rest of the treatments.

<table>
<thead>
<tr>
<th>Inoculums density (conidia ml⁻¹)</th>
<th>Per cent disease index (PDI) 15 days after inoculation*</th>
<th>Per cent disease index (PDI) 30 days after inoculation*</th>
<th>Grain yield* (kg/ha)</th>
<th>Per cent loss of grain yield over un-inoculated protected control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ab (1×10⁶)</td>
<td>60.1</td>
<td>63.0</td>
<td>61.5</td>
<td>65.9</td>
</tr>
<tr>
<td>Aa (1×10⁶)</td>
<td>55.0</td>
<td>59.5</td>
<td>62.3</td>
<td>62.0</td>
</tr>
<tr>
<td>Aa + Ab (1×10³)</td>
<td>49.0</td>
<td>51.2</td>
<td>50.1</td>
<td>60.5</td>
</tr>
<tr>
<td>Aa + Ab (1×10⁶)</td>
<td>72.1</td>
<td>75.6</td>
<td>73.8</td>
<td>76.1</td>
</tr>
<tr>
<td>Un-inoculated protected (Mancozeb) control</td>
<td>12.1</td>
<td>15.1</td>
<td>13.6</td>
<td>16.0</td>
</tr>
<tr>
<td>Un-inoculated unprotected control</td>
<td>26.1</td>
<td>30.0</td>
<td>28.1</td>
<td>29.0</td>
</tr>
<tr>
<td>CD (5%)</td>
<td>2.47</td>
<td>2.80</td>
<td>1.74</td>
<td>2.80</td>
</tr>
</tbody>
</table>

*Average of three replications; Figures in parentheses are arc sine or angular transformed values
Ab = Alternaria burnsii; Aa = Alternaria alternata

Table 1. Yield losses in cumin due to inoculation of Alternaria burnsii and A. alternata at different inoculum levels in field during rabi 2012-13 and 2013-14

These observations suggested that the Alternaria blight is quite damaging to the crop, and may become a major limiting factor in realization of potential yields and also may cause complete failure of the crop. These findings are in agreement with the results of Huq et al. (7) and Hossain and Hossain (6). Similar results were also reported on Alternaria blight of cauliflower cultivars Pant Gobi (PG) 2, PG-3, PGA and Pant Shubhra by Prasad and Vishunavat (9). The highest seed yield loss (55.93%) was found in Pant Shubhra under severe disease situation. As mentioned earlier, the extent of losses depend on timing of infection, and may vary with maturity period of the host genotype. The study indicates that seed borne inoculum had a significant role in the development of blight disease in the field. Average on data recovery of A. burnsii and A. alternata from seeds of both the years i.e. 2012-13 and 2013-14 revealed that 23.0% seeds collected from uninoculated protected control plots yielded colonies of Alternaria spp., followed by 36.0% from uninoculated unprotected plots. A recovery of 75.0 and 71.0 per cent recovery from seeds of the plots, inoculated with mixed inoculum of both Alternaria spp. On the other hand higher concentration (Ab + Aa 1×10⁶ conidia ml⁻¹) showed 84.0 per cent recovery of Alternaria colonies from the infected seeds. The per cent Alternaria recovery from the samples of variously inoculated plots were statistically (P ≤ 0.05) significant.

REFERENCES


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