EFFECT OF CERTAIN FUNGICIDES AND BOTANICALS AGAINST EARLY BLIGHT OF TOMATO CAUSED BY ALTERNARIA SOLANI (ELLIS AND MARTIN) UNDER ALLAHABAD UTTAR PRADESH, INDIA CONDITIONS

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ABSTRACT
The effect of fungicides, namely mancozeb (0.2%), zineb (0.2%) and carbendazim(0.05%), botanicals i.e. Azadirachta indica (neem) leaf extract (20%), Eucalyptus chamadulonsis (eucalyptus) leaf extract (5%) and Allium sativum (garlic) extract (5%) was evaluated in a field experiment conducted at the research plot of the Department of Plant Protection, SHIATS, Allahabad, Uttar Pradesh, India, during the 2012-13 rabi seasons for the management of early blight of tomato caused by Alternaria solani. The lowest percent disease incidence (PDI) was observed in mancozeb (18.36) followed by carbendazim (25.62) and zineb (27.84) treatments. Similarly, the highest yield of tomato fruits was recorded with mancozeb (246.40 q/ha) followed by carbendazim (221.50 q/ha), zineb (208.85q/ha) when sprayed three times at an interval of 15 days starting from the initiation of the disease. The botanicals, namely neem leaf extract (30.66 PDI), garlic bulb extract (32.44 PDI) and Eucalyptus leaf extract (34.07 PDI) were also effective in reducing disease incidence and increasing fruit yield by 170.60, 154.40 and 164.40 q/ha, respectively. The highest cost benefit ratio was obtained with mancozeb treatment (1:4.15) followed by carbendazim(1:3.73), however, zineb (1:3.49), neem leaf extract(1:2.88), garlic bulb extract and eucalyptus leaf extract were promising in obtaining higher returns up to 1:2.79 and 1:2.61, respectively.

KEYWORDS: Early Blight, Alternaria solani, Fungicides and Botanicals, Mancozeb, Azadirachta indica

INTRODUCTION
Tomato (Lycopersicon esculentum Mill.) is the second most important remunerable solanaceous vegetable crop after potato. It is native to South America and is widely cultivated in 140 countries of the world with an annual production of 16826000 mt. [1]. Tomato ranks next to the potato crop and ranks first among the processing crops in the world acreage. Tomato is commonly consumed in our daily life and it is a good source of antioxidants [2]. Tomato contains 95.3% of water, 0.07% calcium and niacin, all of which have great importance in metabolic activities of humans. With high nutritional value, it provides a balance source of Vitamin A, C and E needed to maintain good human health [3]. Varied climatic adaptability and high nutritive value made the tomato cultivation more popular in the recent years. Tomato crop is vulnerable to infect by bacterial, viral, nematode and fungal diseases. Among the fungal diseases, Alternaria leaf blight of tomato caused by Alternaria solani is the worst damaging one [4,5] and cause reduction in quantity and quality of the tomato crop. Alternaria solani (Ellis and Martin) is a soil inhabiting air-borne pathogen responsible for leaf blight, collar and fruit rot of tomato disseminated by fungal spores [6]. It is an important disease of tropical and sub-tropical areas. Distinctive bulls-eye pattern of leaf spots with concentric rings of spores surrounded by a halo of chlorotic leaf area are common. Leaves turn yellow and dry up when only a few spots are present [7]. The pathogen causes infection on leaves, stem, petiole, twig and fruits as well as leads to the defoliation, drying of twigs and premature fruit drop which ultimately reduce the yield. The disease, if favoured by high temperature and humidity (crowded plantation, high rainfall and
extended period of leaf wetness from dew) and plants are more susceptible to the blight infection during fruiting period [8]. Fungicides and botanicals application can increase the genetic potential and yield reduction due to disease can be minimized. Preventive fungicides and botanicals inhibit the spore germination and penetration but pathogen can derive resistance against fungicide application so repeated application of fungicides at proper dose and interval of time is mandatory [9, 10]. Application of fungicides and botanicals against early blight has been reported in India [11, 12]. Unplanned and wide use of fungicides often leads to serious environmental problems besides affecting the health of users and consumers. So, it is necessary to minimize the use of chemicals for controlling disease. Present study was aimed to determine the efficacies of different doses of fungicides and botanicals against Alternaria leaf blight of tomato under Allahabad Agro climatic condition as this disease causes enormous losses.

**MATERIALS AND METHODS**

The experiment was carried out during 2012-13 at the field of Department of Plant Protection, Sam Higginbottom Institute of Agriculture, Technology & Sciences (deemed-to-be university) Allahabad, Uttar Pradesh, India. The soil of the experimental field was sandy loam with pH 5.6. The experiment was laid out in a randomized complete block design with three replications. The unit plot size was 2 m × 1 m which was separated by 1.0 m wide drains. Row to row and plant-to-plant distances were 60 cm and 45 cm, respectively. The soil was raised and drains were made to remove excess water. The symptoms appeared after 55 days of sowing.

On the basis of symptoms and conidial characteristics (figure 1) of the fungus was identified as *Alternaria solani* causative agent of Early blight of tomato (Ellis, 1976). The treatments comprised of application of carbendazim@ 0.05%, zineb@ 0.2%, mancozeb@ 0.2%, eucalyptus extract@ 5%, neem leaf extract@ 20%, garlic extract@ 5%, and Untreated (control). The crop was sprayed three times at 65, 80, and 95 DAS. The disease intensity of early leaf blight was recorded after ten days of spray. The disease intensity was recorded on 0 - 9 scale. Five infected plants were selected randomly from each plot and five leaves were selected from each selected plant for scoring the disease intensity data. Each disease was identified on the basis of following symptoms (Table 1).

**Table 1: Score of Disease Intensity of Tomato**

<table>
<thead>
<tr>
<th>Disease Score</th>
<th>Disease Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No infection</td>
</tr>
<tr>
<td>1</td>
<td>0.1-1.0 per cent leaf area affected</td>
</tr>
<tr>
<td>3</td>
<td>1.1-10.0 per cent leaf area affected</td>
</tr>
<tr>
<td>5</td>
<td>10.1-25.0 per cent leaf area affected</td>
</tr>
<tr>
<td>7</td>
<td>25.1-50.0% per cent leaf area affected</td>
</tr>
<tr>
<td>9</td>
<td>&lt;50.1 per cent leaf area affected</td>
</tr>
</tbody>
</table>

Figure 1: Symptoms of Early Blight on (A) Stem, (B) Leaves of Tomato and (C) Conidia of *Alternaria solani*(40x)
Effect of Certain Fungicides and Botanicals against Early Blight of Tomato Caused by *Alternaria solani* (Ellis and Martin) under Allahabad Uttar Pradesh, India Conditions

Per cent disease incidence (PDI) was calculated based on the following formula [13].

\[ PDI = \frac{\text{Sum of all numerical grades}}{\text{Total number of leaves counted} \times \text{Maximum Grade}} \times 100 \]

RESULTS AND DISCUSSIONS

The results obtained during the present investigation are presented under appropriate headings with the observation concerning various aspects of disease intensity and yield attributes of tomato.

Effect of Fungicides on the Disease Intensity of Early Blight of Tomato

Fungicides and botanicals differed in respect of early blight disease intensity (%) at different growth stages (Table 1). At 75 DAS, the lowest (10.81%) disease intensity was recorded with mancozeb@ 0.2% followed by carbendazim@ 0.05% (12.29%). The highest disease incidence was recorded in control (30.51%) followed by zineb@ 0.2% (13.32%), neem leaf extract@ 20% (16.44%), eucalyptus extract@ 5% (18.21) and garlic extract@ 5% (19.10%). At 90 DAS, the lowest (14.51%) disease intensity was recorded in mancozeb@ 0.2%, while the highest (42.36%) was recorded in control plot. At 105 DAS, the lowest (18.26%) disease intensity was recorded in mancozeb@ 0.2% followed by zineb@ 0.2% (23.10%). On the other hand, the highest (60.58%) disease intensity was recorded in control plot. Among the fungicides and botanicals mancozeb@ 0.2% performed better than other fungicides and botanicals to reduce Percent disease intensity of the early blight disease (Table 1).

<table>
<thead>
<tr>
<th>Treatment (%)</th>
<th>75 DAS PDI</th>
<th>90 DAS PDI</th>
<th>105 DAS PDI</th>
<th>Yield (q/ha)</th>
<th>C:B Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>30.51</td>
<td>42.36</td>
<td>60.58</td>
<td>80.00</td>
<td>1:1.39</td>
</tr>
<tr>
<td>Carbazoline@ 0.05%</td>
<td>12.29</td>
<td>16.44</td>
<td>27.84</td>
<td>220.83</td>
<td>1:3.73</td>
</tr>
<tr>
<td>Zineb@ 0.2%</td>
<td>13.32</td>
<td>21.29</td>
<td>23.10</td>
<td>208.81</td>
<td>1:3.49</td>
</tr>
<tr>
<td>Mancozeb@ 0.2%</td>
<td>10.81</td>
<td>14.51</td>
<td>18.26</td>
<td>246.30</td>
<td>1:4.15</td>
</tr>
<tr>
<td>Neem leaf extract@ 20%</td>
<td>16.44</td>
<td>25.65</td>
<td>30.66</td>
<td>168.91</td>
<td>1:2.88</td>
</tr>
<tr>
<td>Garlic bulb extract@ 5%</td>
<td>19.10</td>
<td>29.33</td>
<td>32.44</td>
<td>154.41</td>
<td>1:2.61</td>
</tr>
<tr>
<td>Eucalyptus leaf extract@ 5%</td>
<td>18.21</td>
<td>28.44</td>
<td>34.07</td>
<td>164.41</td>
<td>1:2.79</td>
</tr>
<tr>
<td>S. Ed. (+)</td>
<td>0.831</td>
<td>1.531</td>
<td>2.312</td>
<td>4.795</td>
<td>----</td>
</tr>
<tr>
<td>C. D. (P = 0.05)</td>
<td>1.762</td>
<td>3.246</td>
<td>4.901</td>
<td>10.448</td>
<td>----</td>
</tr>
</tbody>
</table>

PDI= Per cent disease intensity  
DAS= Date after sowing  
C: B= Cost Benefit ratio

Effect of Fungicides on the Yield of Early Blight of Tomato

The investigation on effect of fungicides and botanicals on disease intensity and fruit yield indicated that fruit yield obtained from all fungicidal and botanicals treated plants significantly differed from untreated control. Maximum yield of 246.30 q/ha was recorded from mancozeb at 0.02 per cent treated plot which was on par with carbendazim at 0.05 per cent (220.83 q/ha), as against the yield in control plots of just 80 q/ha. When, the economic analysis of different fungicidal and botanicals spray schedules was worked out, three sprays of mancozeb not only reduced the disease intensity but also gave the higher cost benefit ratio (4.15) followed by 0.05 per cent carbendazim (3.73) treated plots.

In the present study, the minimum disease intensity of early blight and maximum yield was found when Mancozeb@ 0.02 was used as foliar spray. The probable reason for such finding may be that, mancozeb would have
affected the spore germination and mycelial development, which may have resulted in the inhibition of disease producing activity of pathogen in the plant and induced resistance in plant. This resulted in better overall growth and good health of tomato plants. This may be the reason for minimum disease intensity and maximum yield as compared to other treatments. Similar trends were reported by [14, 15]. They also reported that mancozeb was the most effective fungicide recorded minimum disease intensity against early blight of tomato. This was also supported by the findings of [16, 17] against early blight of Potato.

Mancozeb @ 0.2 was the most effective fungicides in managing the disease intensity of early blight on tomato caused by *Alternaria solani*. This fungicide also gave higher yield (q/ha) and was the most economical with 1:4.15. Amongst the botanicals neem leaf extract was the most effective where as garlic bulb extract and eucalyptus leaf extracts are also found to be significantly effective in comparison to control as such botanicals lasted in the present experiment have proved their potential and can be used in future for the management of early blight of tomato and thus can reduce the indiscriminate use of fungicides by the tomato growers.

REFERENCES


