

Eco-Friendly Disease Management of *Alternaria* Blight (*Alternaria brassicae*) of Rapeseed and Mustard

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Abstract

The investigation was carried out for eco-friendly disease management of *alternaria* blight (*Alternaria brassicae*) of rapeseed and mustard using non-toxic chemical salts (calcium sulfate and micro-nutrients), fungal and bacterial biocontrol agents (*Trichoderma viride*, *Pseudomonas fluorescens*) and botanicals (*Eucalyptus globosus* and garlic extracts). The field experiment was conducted in two consecutive years. Observation on disease index on leaf, number of spots and spot size were recorded at 75 and 90 DAS and on pod at one week before maturity. Seed weight and yield were also recorded. All the treatments showed significantly better results as compared to check. Among various treatments, minimum disease index on leaf and pods was observed in recommended check mancozeb followed by *Eucalyptus*. Similar results were also observed at 90 DAS. Mancozeb spray showed minimum no. of spot while smallest size of spot was observed in *Eucalyptus*. Maximum seed weight was recorded in mancozeb followed by *E. globosus*. Two spray of *Eucalyptus* at 2% wt/vol at 75 and 90 DAS could be applied for eco-friendly disease management of *alternaria* blight of rapeseed and mustard.

Key words : Disease management, *Alternaria* blight, Rapeseed, Mustard.

Indian mustard *Brassica juncea* (Leann.) Czern and Coss is a major crop of oilseed brassicas. *Alternaria* blight caused by *Alternaria brassicae* (Berk.) Sacc. is one of the most severe yield destabilizing factors. The disease can cause yield reduction upto 35—45% in mustard (1—5) compared to severe losses (70%) in yield of rapeseed crops of yellow and brown sarson. Control of this disease through chemicals is quite expensive and also not eco-friendly. Thus one of the major challenges for minimizing the losses caused by *Alternaria brassicae* are to screen the antifungal activity of plant extract and field evaluation of botanicals and biocontrol agents on disease component. The investigation was carried out for eco-friendly disease management of *alternaria* blight (*Alternaria brassicae*) of rapeseed and mustard using non-toxic chemical salts (calcium sulfate and micro-nutrients), fungal and bacterial biocontrol agents (*Trichoderma viride*, *Pseudomonas fluorescens*) and botanicals (*Eucalyptus globosus* and garlic extracts).

Methods

Field Layout. During two consecutive years

crop season the field experiment was laid out using mustard variety Varuna in a randomized block design with 13 treatments and three replications. The plot size was 5 × 3m with three replications. A distance of 1.25 m was maintained between plots and the replications.

Sowing and Spraying. The sowing was done on 11 November and 7 November in 2006-07 and 2007-08 crop season respectively. Sowing was done manually by keeping a row distance 30 cm. In 2006-07 first spray was done on 11 January 2007 and thereafter two subsequent sprays were given at 15-day intervals while in 2007-08 first spray was done on 15 January 2008 and thereafter two subsequent sprays were given at 15-day intervals.

Preparation of Plant Extract. For the preparation of garlic extract, fresh garlic bulbs were collected, washed in tap water and 10 g was crushed in warring blender by adding small quantity of distilled water, sieved through muslin cloth several times and the extract was made upto 1 liter to obtain 1% (wt/vol). Fresh extract was used for application. *Eucalyptus* extracts were prepared with the help of Soxhlet assembly using methanol as a solvent. The plant extracts were collected in methanol. Extra methanol of

Table 1. Effect of eco-friendly non-toxic chemical salts and bioagents on the alternaria blight severity on leaf and pods of mustard (2006-07 and 2007-08). Figures in parentheses are angular transformed values. DAS-Days after sowing, WBM-Weak before maturity.

| Treatments | Disease Severity (%) | | | | | | | | | | | |
|---|----------------------|---------|---------|---------|---------|---------|---------|-------|---------|-------|---------|-------|
| | On Leaf | | 90 DAS | | On Pod | | | | | | | |
| | 2006-07 | 2007-08 | 2006-07 | 2007-08 | 2006-07 | 2007-08 | | | | | | |
| ZnSO ₄ 0.2% | (34.40) | 35.89 | (36.33) | 35.1 | (38.93) | 38.59 | (43.87) | 48.03 | (47.20) | 43.39 | (46.30) | 52.27 |
| Borax 0.5% | (36.53) | 37.18 | (36.52) | 35.43 | (37.60) | 37.78 | (36.73) | 35.77 | (49.06) | 44.45 | (43.43) | 47.27 |
| MOP+S (40 kg/ha+20kg/ha) | (38.40) | 38.28 | (37.08) | 36.36 | (45.86) | 42.62 | (41.32) | 43.6 | (53.86) | 47.22 | (45.64) | 51.13 |
| Sulfur (20kg/ha) | (37.06) | 37.49 | (38.15) | 38.16 | (49.33) | 44.61 | (41.67) | 44.20 | (54.13) | 47.38 | (45.36) | 50.63 |
| CaSO ₄ 0.5% | (40.00) | 39.22 | (35.66) | 34.0 | (46.13) | 42.77 | (37.07) | 36.35 | (52.00) | 46.14 | (42.28) | 45.26 |
| <i>Trichoderma viridae</i> 0.5% | (32.80) | 34.92 | (32.59) | 29.03 | (39.80) | 39.09 | (37.94) | 37.81 | (40.53) | 39.54 | (38.84) | 39.33 |
| <i>Pseudomonas fluorescens</i> 0.5% | (32.26) | 34.59 | (32.59) | 29.03 | (35.73) | 36.70 | (35.32) | 33.44 | (36.26) | 37.02 | (35.96) | 34.5 |
| <i>Eucalyptus globosus</i> 0.5% | (28.80) | 32.40 | (31.32) | 27.03 | (34.40) | 35.89 | (35.32) | 30.55 | (29.86) | 33.11 | (31.51) | 27.33 |
| <i>Allium sativum</i> 0.2% | (28.00) | 31.93 | (31.38) | 27.13 | (32.00) | 34.40 | (35.32) | 30.73 | (32.80) | 34.93 | (33.58) | 30.66 |
| <i>Allium sativum</i> + cow urine (5% + 2%) | (30.40) | 33.45 | (32.26) | 28.5 | (32.53) | 34.71 | (34.90) | 32.74 | (34.93) | 36.21 | (34.65) | 32.33 |
| Cow urine 0.5% | (35.46) | 36.53 | (35.44) | 33.63 | (34.13) | 35.72 | (34.78) | 32.55 | (41.60) | 40.15 | (37.66) | 37.33 |
| Mancozeb (standard check) 0.5% | (20.26) | 26.65 | (24.95) | 17.8 | (25.80) | 30.49 | (28.85) | 23.29 | (25.86) | 30.55 | (28.79) | 23.2 |
| Check | (48.26) | 43.99 | (42.76) | 46.1 | (52.26) | 46.30 | (44.98) | 49.96 | (61.06) | 51.42 | (50.47) | 59.5 |
| CD at 5% | (5.10) | 3.15 | | 1.31 | (9.58) | 5.64 | | 0.84 | (5.36) | 3.11 | | 0.90 |

plant extract was evaporated by keeping the plant extract in the oven at 35 C. After methanol was evaporated, paste of plant extract was obtained. The extract was prepared fresh on the day of its foliar application. Cow urine 5% prepared by taking 50 ml of cow urine and added to 950 ml of water to get 5% solution and garlic bulb (2%) + cow urine (5%) was obtained by adding 2% garlic bulb extracts and 5% cow urine at 1 : 1.

Fertilizer Application. Recommended doses of fertilizer of NPK (100 : 40 : 40) kg/ha were given in the form of urea, single super phosphate and muriate of potash, respectively. Fertilizers were broadcasted and mixed thoroughly by light harrowing. MOP + S (40 kg/ha potash and 20 kg/ha sulfur) and sulfur (20 kg/ha) were incorporated to the soil at the time of sowing.

Intercultural Operations. Plants were thinned out keeping 10 cm distance among the plants after one week of germination. Irrigation and weeding were done, time to time when required necessary.

Observations Recorded. Disease development on leaves of *B. juncea* variety Varuna was recorded in different ways as given below. Total foliage infection : Leaves infected with *Alternaria brassicae*, were counted individually on the randomly selected plants and the percentage leaves infected per plants was calculated. Numbers of spots/leaf were counted at weekly interval on 20 leaves each from randomly selected 25 plants and average number of spots per leaf was calculated. Number of spots/6.25 cm² leaf area was recorded at weekly intervals.

Size of Leaf Spot. Size of the spot on leaves was also recorded at weekly intervals. For this purpose 20 spots were randomly selected from the tagged plants and their diameter was measured in mm with the help of a thin plastic scale. Average size of spot was then calculated.

Average Disease Index. Average disease index on leaf due to *Alternaria brassicae* was taken at weekly intervals by use of the 0—6 rating scale given by Conn et al. (6). Twenty five leaves col-

Table 2. Effect of eco-friendly non-toxic chemical salts and bioagents on the number of alternaria spot on leaf of mustard (2006-07 and 2007-08).

| Treatments | Number of Alternaria spots/6.25 cm ² leaf area | | | |
|---|---|---------|---------|---------|
| | 75 DAS | | 90 DAS | |
| | 2006-07 | 2007-08 | 2006-07 | 2007-08 |
| ZnSO ₄ 0.2% | 10.13 | 8.21 | 14.66 | 12.63 |
| Borax 0.5% | 10.33 | 8.18 | 13.20 | 11.73 |
| MOP + S (40kg/ha + 20 kg/ha) | 12.63 | 10.94 | 15.70 | 13.76 |
| Sulfur (20 kg/ha) | 10.16 | 8.07 | 13.53 | 12.10 |
| CaSO ₄ 0.5% | 12.33 | 11.13 | 15.43 | 13.90 |
| <i>Trichoderma viridae</i> 0.5% | 9.30 | 7.30 | 12.10 | 11.16 |
| <i>Pseudomonas fluorescens</i> 0.5% | 10.00 | 8.40 | 13.03 | 12.20 |
| <i>Eucalyptus globosus</i> 0.5% | 7.00 | 6.06 | 11.93 | 10.70 |
| <i>Allium sativum</i> 0.2% | 9.00 | 7.60 | 12.20 | 11.30 |
| <i>Allium sativum</i> + cow urine (5% + 2%) | 6.66 | 5.90 | 11.10 | 10.33 |
| Cow urine 0.5% | 7.70 | 6.06 | 12.50 | 11.66 |
| Mancozeb (standard check) 0.5% | 4.36 | 3.23 | 8.59 | 7.72 |
| Check | 14.26 | 13.30 | 19.86 | 18.13 |
| CD at 5% | 2.40 | 0.77 | 2.99 | 0.71 |
| CV | 14.96 | 5.72 | 13.28 | 3.49 |

lected from middle portion of the plants were rated based on the scale and the disease index was calculated by using the formula

$$\text{Disease index (\%)} = \frac{\text{Sum of all numerical rating}}{\text{Number of leaves examined} \times \text{Maximum grade}} \times 100$$

Recording of Observation of Disease Intensity on Pods. Disease development on pods of *B. juncea*

variety Varuna was recorded in respect to the average disease index at 1 WBM.

Results and Discussion

Disease Index on Leaves and Pods

During 2006-07 crop season, at 75 DAS maximum disease index on leaf was recorded in check

Table 3. Effect of eco-friendly non-toxic chemical salts and bioagents on the size of alternaria spot on leaf of mustard (2006-07 and 2007-08).

| Treatments | Size of alternaria spots (mm) | | | |
|---|-------------------------------|---------|---------|---------|
| | 75 DAS | | 90 DAS | |
| | 2006-07 | 2007-08 | 2006-07 | 2007-08 |
| ZnSO ₄ 0.2% | 4.76 | 3.83 | 5.50 | 4.93 |
| Borax 0.5% | 4.93 | 4.20 | 5.06 | 4.73 |
| MOP + S (40 kg/ha + 20 kg/ha) | 5.53 | 4.86 | 5.70 | 5.23 |
| Sulfur (20 kg/ha) | 5.36 | 4.96 | 5.23 | 5.10 |
| CaSO ₄ 0.5% | 4.76 | 4.02 | 5.33 | 5.13 |
| <i>Trichoderma viridae</i> 0.5% | 3.73 | 3.13 | 4.10 | 3.76 |
| <i>Pseudomonas fluorescens</i> 0.5% | 4.26 | 3.83 | 4.86 | 4.63 |
| <i>Eucalyptus globosus</i> 0.5% | 3.53 | 2.70 | 3.76 | 3.50 |
| <i>Allium sativum</i> 0.2% | 3.70 | 2.93 | 3.90 | 3.53 |
| <i>Allium sativum</i> + cow urine (5% + 2%) | 3.50 | 2.96 | 3.70 | 3.56 |
| Cow urine 0.5% | 3.63 | 2.86 | 3.93 | 3.73 |
| Mancozeb (standard check) 0.5% | 2.20 | 2.13 | 2.26 | 2.96 |
| Check | 7.16 | 5.93 | 7.53 | 5.63 |
| CD at 5% | 1.21 | 0.72 | 1.36 | 0.41 |
| CV | 17.12 | 11.58 | 17.29 | 5.71 |

Table 4. Effect of eco-friendly non-toxic chemical salts and bioagents on yield component of mustard (2006-07 and 2007-08).

| Treatments | Yield/plot (gm) | | Yield/ha (kg) | | 1000 seed weight (gm) | |
|---|-----------------|---------|---------------|---------|-----------------------|---------|
| | 2006-07 | 2007-08 | 2006-07 | 2007-08 | 2006-07 | 2007-08 |
| ZnSO ₄ 0.2% | 908.33 | 1783.33 | 608.58 | 1194.83 | 3.73 | 3.50 |
| Borax 0.5% | 766.66 | 1800.00 | 513.66 | 1206.00 | 3.28 | 3.10 |
| MOP + S (40 kg/ha + 20 kg/ha) | 791.66 | 1816.66 | 530.41 | 1217.16 | 3.46 | 3.30 |
| Sulfur (20 kg/ha) | 816.66 | 1783.33 | 547.16 | 1194.83 | 3.30 | 3.30 |
| CaSO ₄ 0.5% | 866.66 | 1833.33 | 580.66 | 1228.33 | 3.58 | 3.36 |
| <i>Trichoderma viridae</i> 0.5% | 916.66 | 1700.00 | 614.16 | 1139.00 | 3.67 | 3.50 |
| <i>Pseudomonas fluorescens</i> 0.5% | 991.66 | 1866.66 | 664.41 | 1250.67 | 3.68 | 3.33 |
| <i>Eucalyptus globosus</i> 0.5% | 1008.33 | 1916.66 | 675.58 | 1284.16 | 3.91 | 3.83 |
| <i>Allium sativum</i> 0.2% | 1000.00 | 1883.33 | 670.00 | 1261.83 | 3.80 | 3.60 |
| <i>Allium sativum</i> + cow urine (5% + 2%) | 900.00 | 1866.66 | 603.00 | 1250.67 | 3.96 | 3.60 |
| Cow urine 0.5% | 816.66 | 1800 | 547.16 | 1206.00 | 3.72 | 3.50 |
| Mancozeb (standard check) 0.5% | 1008.33 | 1933.33 | 675.58 | 1295.33 | 4.30 | 4.36 |
| Check | 675.00 | 1516.66 | 452.25 | 1016.16 | 3.13 | 3.60 |
| CD at 5% | 124.66 | 324.17 | 83.52 | 217.19 | 0.24 | 0.33 |

(43.99%) followed by CaSO₄ (39.22%), MOP + S (38.28%), sulfur (37.49%) and borax (37.18%) respectively. All the treatments were significantly different to check. Minimum disease index on leaf was observed in mancozeb (26.65%) followed by *A. sativum* (31.93%), *Eucalyptus* (32.40%) and *A. sativum* + cow urine (33.45%) respectively. However these treatments were found significantly different from recommended check mancozeb. Almost similar results were recorded at 90 DAS. Maximum disease index on pod was observed in check (51.42%) followed by sulfur (47.38%), CaSO₄ (46.14%) and MOP + S (47.22%), respectively. Mancozeb (30.55%) gave minimum diseases index on pods followed by *Eucalyptus* (33.11%), *A. sativum* (34.93%) and *A. sativum* + cow urine (36.21%) respectively. All the treatments were significantly different to check (Table 1).

During 2007-08 crop season at 90 DAS maximum disease index on leaf was recorded in check (49.96%) followed by sulfur (44.20%), MOP + S (43.6%) and borax (35.77%) respectively. All the treatments were significantly different to check (Table 1). Minimum disease index on leaf was observed in standard check mancozeb (23.29%) followed by *Eucalyptus globosus* (30.55%), *A. sativum* (30.73%), cow urine (32.55%), *A. sativum* + cow urine (32.74%), *Pseudomonas floescence* (33.44%). However, these treatments were found to be significantly different from recommended check mancozeb. Maximum disease index on pod was observed in check (59.5%)

followed by ZnSO₄ (52.27%), MOP + S (51.13%) and sulfur (50.63%) respectively. All the treatments were significantly different from the check. Minimum disease index on pod was observed in standard check mancozeb (23.2%) followed by *Eucalyptus globosus* (27.33%), *A. sativum* (30.66%), *A. sativum* + cow urine (32.33%) and cow urine (37.33%).

Numbers of Spots

During 2006-07 crop season at 75 DAS maximum no. of spot was observed in check (14.26) followed by MOP + S (12.63) and CaSO₄ (12.33) respectively. Mancozeb (4.36) spray showed minimum no. of spots followed by *A. sativum* + cow urine (6.66), *Eucalyptus* (7.00) and cow urine (7.70). At 90 DAS also similar results were obtained (Table 2).

During 2007-08 crop seasons at 75 DAS maximum no. of spots (13.30) were observed in check followed by CaSO₄ (11.13) and MOP + S (10.94) respectively. Mancozeb spray showed minimum no of spots (3.23) which is significantly different from all the treatments. At 90 DAS also similar results were obtained.

Size of Spots

During 2006-07 crop seasons at 75 DAS largest size of spot was observed in check (7.16) which was

significantly higher than all the other treatments. Mancozeb spray showed smallest size of spot (2.20) followed by *A. sativum* + cow urine (3.50) and *Eucalyptus* (3.53). Similar results were found at 90 DAS, and mancozeb spray showed smallest size (2.26) (Table 3).

During 2007-08 at 75 DAS largest size of spot (5.93 mm) was observed in check followed by sulfur (4.96 mm), MOP + S (4.86 mm) and borax (4.20 mm) respectively. Mancozeb spray showed smallest size of spot (2.13 mm) and was at par with *Eucalyptus globosus* (2.70 mm). Similar results were found at 90 DAS, and mancozeb spray showed smallest size (2.96) (Table 3).

Yield Hectare

During 2006-07 crop season, maximum yield was recorded in mancozeb and *E. globosus* (675.58 kg/ha) and significantly differed from check. In 2007-08 same trend was observed and maximum yield was recorded in Mancozeb (1,295.33 kg/ha) and *E. globosus* (1,284.16 kg/ha) (Table 4).

Seed Weight

In 2006-07 crop season maximum 1,000-seed

weight was recorded in mancozeb (4.30 g) followed by *A. sativum* + cow urine (3.96 g) and *E. globosus* (3.91 g) and *Allium* (3.80 g).

In 2007-08, maximum seed weight was recorded in mancozeb (4.36 g) which was followed by *E. globosus* (3.83 g) per 1,000 seed weight (Table 4).

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