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# Effect of Selected Essential Oils and Botanicals on Alternaria Blight (*Alternaria brassicae* (Berk) Sacc) of Mustard (*Brassica juncea* (Linn) Czern and Coss

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***Authors' contributions***

*This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.*

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## ABSTRACT

Indian mustard (*Brassica juncea* (L.) Czern.coss) is also known as sarson, rai or raya, toria or Lahi.it is a herbaceous annual plant. Mustard is the second important oilseed crop in the world after sunflower, soybean and palm oil. Alternaria blight disease caused by *Alternaria brassicae* (Berk.) Sacc. It has been reported from all the continents of the world. Average yield losses occur due to various pest and diseases among which Alternaria blight is an important disease. Field experiment was conducted at the research plot of the Department of Plant Pathology, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh during the *rabi* season of 2020-2021 to test, Effect of selected essential oils and botanicals against Alternaria blight (*Alternaria brassicae* (Berk.) Sacc) of mustard (*Brassica juncea* (Linn.) Czern and Coss), by foliar spray of certain essential oil, plant extracts and fungicide. The treatments were Neem oil @2%, Eucalyptus oil @2%, Pongamia oil @2%, *Lawsonia inermis* extract @15%, *Chenopodium album* extract @15% Mancozeb (treated check) @ 0.2% and control (untreated check). The percent disease intensity on leaves at 45, 60 and 75 DAS, number of siliquae per plant, number of

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seeds per siliquae, length of siliquae (cm), test weight of seed (1000 number), biological yield (gm) and seed yield were recorded. Among the treatments, maximum number of number of siliquaes (243.13), maximum number of seeds per siliquae (12.27), length of siliquae (5.16 cm), minimum disease intensity (%) (29.01 %), maximum test weight (3.57 gm), maximum yield (9.43 qt) and biological yield (24.70 gm) were recorded in the treatment $T_2$ Eucalyptus oil @2% followed by $T_1$ Neem oil @2%, $T_4$ *Lawsonia inermis* extract @15%, $T_3$ Pongamia oil @2%, $T_5$ *Chenopodium* extract @15%, when compared to treated check $T_6$ Mancozeb @ 0.2% and untreated check $T_0$. Higher gross return value (Rs. 66295), net return value (Rs. 29295), and B: C ratio (1.7:1) was found in the treatment $T_2$ – Eucalyptus oil @2% as compared to $T_5$–mancozeb and $T_0$–control.

*Keywords: Alternaria brassicae; essential oils; mustard; fungicides; plant extracts.*

## 1. INTRODUCTION

Indian mustard (*Brassica juncea* (L.) Czern.coss) is also known as sarson, rai or raya, toria or Lahi. It belongs to family Brassicaceae and its centre of origin Mediterranean. Indian mustard has 36 chromosomes (2n) and it is amphidiploid in nature. 'Rape' is a Latin word means turnip, 'Mustard' also a Latin term 'must'/'mustum' denoted expressed juice of grapes and 'ardens' means hot and burning. The earliest written records of mustard are found in ancient Sanskrit writings from 2000 to 1500 BC. Sarson finds mention in all the Ayurvedic Samhitas with the multiplicity of forms that are grown, it is quite probable that there are several areas of origin. Mustard is cultivated in mostly under temperate climate. It is also grown in certain tropical and subtropical regions as cold weather crop. Indian mustard is reported to tolerate annual precipitation of 500 to 4200mm, annual temperature of 6 to 27°C, and pH of 4.3 to 8.3 [1]. The aroma and pungent flavor of mustards comes from the sulphur containing glucosinolates. The oil content of the seeds ranges from 38-46%. The conventional varieties of *B. juncea* are high in Erucic acid (40-50%) as well as in glucosinolates (180-200 micro moles). Mustard is considered to be of high economic importance in local and international trade as it yields the most important edible oil ranging from 30-38 per cent. From nutritional point of view it contains 38-57% eruric acid, 4.7-13% linolenic acid, 27% oleic and linoleic acids, which are highly nutritive value required for the human body [2]. They constitute the second largest agricultural commodity in India after cereals accounting for nearly 6% of gross national product and 10% of the value of all total agricultural oilseeds production in the country during 2019-2020. It is estimated at 33.42 million tonnes which is higher by 1.90 million tones than the production of 31.52 million tonnes during 2018-2019 [3]. Among the oilseeds, rapeseed/mustard crop occupies prominent position globally contributing nearly 17.19% (36.59 m ha) cropped area, 8.54% (72.37 mt) of production [4]. Indian is the fourth producer of mustard contributing to around 11% of world's production [5]. Indian mustard occupy an area of 6.70 million hectare with a production of 7.96 million tonnes and productivity of 1188kg/ha during 2013-14 [6]. Wide gap exists between the potential yield and the yield realized at the farmer's field which is largely because of number of biotic and abiotic stresses to which rapeseed mustard crop was exposed. Among the biotic stress, Alternaria blight disease caused by *Alternaria brassicae* (Berk.) Sacc. And *Alternaria brassicicola* (Schw). It is one of the important disease of Indian mustard which has been reported from all continents of the world, causing 10-70% yield losses depending on the crop species [7]. Alternaria blight reduced 5-15% seed yield at harvest and it can reach up to 47% under high disease severity [8]. This diseases is caused by necrotrophic fungal species of Alternaria. The disease causes yield losses of 40-70% in India and 30-60% in Bangladesh. In addition to direct yield losses, the disease adversely affects the seed quality by reducing seed size and causing seed discoloration and reduction in oil [9]. Up to 50% yield losses due to Alternaria blight have been reported in mustard from various parts of India [10,11].

## 2. MATERIALS AND METHODS

### 2.1 Experimental Site

The experiment was conducted at the Department of Plant Pathology in the Central Research Farm, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj during *Rabi* season 2020-2021. The trail was laid out in Randomized Block Design with three replications. The site selected was uniform, cultivable with typical sandy loam soil having good drainage. The various treatments included under study were as follows:

## 2.2 Methodology

### 2.2.1 Collection of disease samples

Plants showing typical symptoms, in the field of standing crop i.e., the infected plant part of mustard leaves was selected. These disease plant materials were brought to the lab for further investigation.

### 2.2.2 Isolation of the pathogen

The pathogen was isolated from the disease infected plants and it was identified as the identified as the *Alternaria brassicae.* Alternaria blight of mustard infected leaves were collected. The concentric brown to black portions of infected leaves were used for isolation. Selected infected portions of diseased leaves were cut into small pieces of about 4 to 6 mm and were washed with fresh, running tap water simultaneously, approximately 20 ml of sterilized molten warm PDA, amended with streptomycin sulphate @50ppm, was poured into sterilized petriplates aseptically. Pieces were surface sterilized by keeping into 0.1 per cent mercuric chloride solution for 30 seconds followed by washing the pieces in sterilized distilled water thrice. Such treated 5 pieces were placed on solidified PDA surface at equal distance in each of the petriplates. Inoculated petriplates were incubated at 27±1°C for five days. Fungal growths obtained in petriplates were examined microscopically. Then hyphal bits of such growth were transferred to PDA slants for further growth and purification of fungus.

### 2.2.3 Purification of the pathogen

The Hyphal tip method is used to purify the Fungus. The Pure culture was be maintained by sub culturing it every fifteenth day on PDA medium and then will be preserved it in refrigerator at 10 degree Celsius.

### 2.2.4 Evaluation of various treatments *In vivo*

The efficacy of essential oils, botanicals and non-systemic fungicide against *Alternaria brassicae* was carried out in field condition. The treatments were sprayed and observations were taken at 15 days interval after initiation of disease. Observations of the characters were recorded at 45, 60 and 75 DAS.

### 2.2.5 Disease severity scale of Alternaria leaf blight

Disease intensity was recorded as grades in five randomly selected plants in each plot at different time that is before spraying, 15 days after the first spray and 15 days after the second spray as per the scale. (Ahmed and Ashraf 2016).

### 2.2.6 Severity scale grade leaf area covered reaction

| Disease rating | Leaf and pod area covered | Reaction |
|---|---|---|
| 0 | No symptoms on leaf | Immune |
| 1 | Small light brown spots scattered covering <5% leaf area | Highly resistant |
| 2 | Spots small, brown, with concentric rings, covering 5.1 to 10% leaf area | Resistant |
| 3 | Spots large, brown, irregular, with concentric rings 10.1 to 25% leaf area | Moderately resistant |
| 4 | Large, brown, irregular lesions withtypical blight symptoms, covering 25.1 to 50% leaf area | Moderately susceptible |
| 5 | Large, brown, irregular lesions withtypical blight symptoms, coveringmore than 50% leaf area | Highly susceptible |

Disease intensity (%) is calculated by using the formula was given by [12]

$$\text{Disease intensity} = (Sum\ of\ all\ numericals\ ratings\ /\ Total\ no.of\ leaves\ observed \times Max\ Disease\ rating) \times 100$$

### 2.2.7 Benefit cost ratio

Cost benefit ratio is the ratio of gross return to cost of cultivation, which can also be expressed as return per rupees invested. This index provides an estimate of the benefit a farmer derives from the expenditure he incurs in adopting a particular cropping system. Any value above 2.0 is considered safe as the farmer gets Rs. b2 for every rupee invested. The benefit cost ratio was calculated using the following formula (Reddy and Reddi, 2004).

**Table 1. Effect of treatments on disease intensity of mustard at 45, 60 and 75 DAS**

| S. No | Treatment | Average disease intensity (%) | | |
|---|---|---|---|---|
| | | 45 DAS | 60 DAS | 75 DAS |
| $T_0$ | Control (Untreated check) | 19.61 | 38.99 | 57.58 |
| $T_1$ | Neem oil @2% | 18.03 | 24.00 | 30.21 |
| $T_2$ | Eucalyptus oil @2% | 17.05 | 23.04 | 29.01 |
| $T_3$ | Pongamia oil @2% | 18.35 | 30.64 | 42.07 |
| $T_4$ | *Lawsonia inermis* extract @15% | 17.86 | 28.55 | 38.84 |
| $T_5$ | *Chenopodium album* extract @15% | 18.79 | 36.94 | 54.63 |
| $T_6$ | Mancozeb @0.2% (treated check) | 16.76 | 22.84 | 28.30 |
| F-test | | S | S | S |
| S.Ed. (±) | | 0.308 | 0.738 | 0.598 |
| C.D. (P = 0.05) | | 0.679 | 1.627 | 1.317 |

B:C ratio = (($Net\ returns(Rs/ha)$ / $Total\ cost\ of\ cultivation(Rs/ha)$)

## 3. ESULTS AND DISCUSSION

### 3.1 Effect of Treatments on Disease Intensity (%) of Mustard

(Table 1) Disease intensity (%) at 75 DAS was recorded minimum in $T_2$ Eucalyptus oil @2% (29.01 %)followed by $T_1$ Neem oil @2% (30.21 %), $T_4$ *Lawsonia inermis* extract @15% (17.86 %), $T_3$ Pongamia oil @2% (42.07 %), $T_5$ *Chenopodium album* extract @15% (18.79 %), when compared to treated check $T_6$ mancozeb @ 0.2% (28.30 %) and untreated check $T_0$ (57.58 %). Among the treatments ($T_6$ and $T_2$), ($T_1$ and $T_2$) were found to be non-significant to one another and all treatments were found to be significant over untreated control $T_0$.As per the findings from this study, it was observed that the minimum disease intensity of the Alternaria blight of mustard was recorded in $T_2$ Eucalyptus oil (29.01 %). Among the two different essential oils applied to the crop, both Eucalyptus oil (29.01 %) and Neem oil (30.21 %) showed promising results. These results are at par with Mancozeb. This is in agreement with the results obtained from another study by Yadav *et al*. [13] who reported that minimum disease intensity of leaf spot of cabbage was achieved by Eucalyptus leaf extract. Similar results were obtained by Khalse *et al*. [14] who reported that the maximum inhibition of the *Alternaria brassicae in-vitro* was recorded in Eucalyptus leaf extract. The minimum disease intensity was recorded in Eucalyptus leaf extract. The probable reason for such findings could be the presence of β-fenchol and α-eudesmol in eucalyptus essential oil. These components possess fungicidal properties which obviously inhibits the fungi.

#### 3.1.1 Effect of treatments on No of siliquae per plant, No of seeds per siliquae, Test weight of seeds (1000 number) (gm), Length of siliquae (cm), Biological yield (cm) and Seed Yield per plot q/ha

Table 2. all the parameters were recorded maximum in $T_2$ Eucalyptus oil @2% followed by $T_1$ Neem oil @2%, $T_4$ *Lawsonia inermis* extract @15%, $T_3$ Pongamia oil @2%, $T_5$ *Chenopodium album* extract @15%, when compared to treated check $T_6$ Mancozeb @ 0.2% and untreated check $T_0$.The average seed yield per plot is presented in table 2 the data reveals that the yield was recorded maximum in $T_2$ Eucalyptus oil @2% (9.43 q), followed by $T_1$ Neem oil @2% (9.23q), $T_4$ *Lawsonia inermis* extract @15% (8.07 q), $T_3$ Pongamia oil @2% (7.90 q), $T_5$ *Chenopodium album* extract @15% (7.78 q), when compared to treated check $T_6$ Mancozeb @ 0.2% (9.52q) and untreated check $T_0$ (7.73 q). Among the treatments ($T_6$, $T_2$ and $T_1$), ($T_4$, $T_3$, $T_5$, and $T_0$) were found to be non-significant to one another and treatments $T_6$, $T_2$ and $T_1$ were found to be significant over untreated control $T_0$.The average yield per plot is presented in table 2 as per the findings from this study, the maximum number of siliquae per plant were produced in $T_2$ Eucalyptus oil (9.43 q). Among the different essential oils and botanical extracts tried, Eucalyptus oil (9.43 q) and Neem oil (9.23 q) were proved to be the best and are at par with the Mancozeb. Similar results were obtained by the Patni *et al.* [15] who reported that the maximum yield was obtained in Eucalyptus leaf extract (12.02 q). The probable reason for such findings could be the chemical composition of the Eucalyptus oil and Neem oil which suppressed the disease and supported the growth of mustard crop.

**Table 2. Effect of treatments on a. No of siliquae per plant, b. No of seeds per siliquae, c. Test weight of seeds (1000 number) (gm), d. Length of siliquae (cm), e. Biological yield (cm) and f. Seed Yield per plot q/ha**

| S.No | Treatment | No of siliquae per plant | No of seeds per siliquae | Test weight of seeds(1000 number)(gm) | Length of siliquae (cm) | Biological yield (cm) | Seed Yield per plot q/ha |
|---|---|---|---|---|---|---|---|
| $T_0$ | Control (untreated check) | 161.53 | 9.07 | 3.06 | 4.42 | 20.48 | 7.73 |
| $T_1$ | Neem oil @2% | 233.87 | 11.87 | 3.54 | 5.09 | 23.77 | 9.23 |
| $T_2$ | Eucalyptus oil @2% | 243.13 | 12.27 | 3.57 | 5.16 | 24.70 | 9.43 |
| $T_3$ | Pongamia oil @2% | 183.47 | 9.93 | 3.15 | 4.58 | 21.42 | 7.90 |
| $T_4$ | *Lawsonia inermis* extract @15% | 191.53 | 10.87 | 3.38 | 4.73 | 22.45 | 8.07 |
| $T_5$ | *Chenopodium album* extract @15% | 173.67 | 9.47 | 3.11 | 4.47 | 21.72 | 7.78 |
| $T_6$ | Mancozeb @0.2%(treated check) | 252.33 | 12.60 | 3.58 | 5.31 | 25.30 | 9.52 |
| F-test | | S | S | S | S | S | S |
| S. Ed. (±) | | 3.86 | 0.22 | 0.09 | 0.05 | 0.41 | 0.38 |
| C.D. (P = 0.05) | | 8.50 | 0.48 | 0.20 | 0.12 | 0.90 | 0.82 |

**Table 3. Effect of treatments on economics of mustard**

| Tr. No | Treatment | Total cost of cultivation (Rs) | Gross return (Rs) | Net return (Rs) | B:C ratio |
|---|---|---|---|---|---|
| $T_0$ | Control | 27700 | 43650 | 15950 | 1.5:1 |
| $T_1$ | Neem oil | 38800 | 64995 | 26195 | 1.6:1 |
| $T_2$ | Eucalyptus oil | 37000 | 66295 | 29295 | 1.7:1 |
| $T_3$ | Pongamia oil | 35200 | 44500 | 9300 | 1.2:1 |
| $T_4$ | *Lawsonia inermis* | 31200 | 45350 | 14150 | 1.4:1 |
| $T_5$ | *Chenopodium album* | 29800 | 43900 | 14100 | 1.4:1 |
| $T_6$ | Mancozeb | 30496 | 57360 | 26864 | 1.8:1 |

### 3.1.2 Effect of treatments on economics of mustard

The economics of mustard are shown in the table 3 Higher B:C ratio was found in $T_2$ Eucalyptus oil @2% (1.7:1), followed by $T_1$ Neem oil @2% (1.6:1), $T_4$ *Lawsonia inermis* extract @15% (1.4:1), $T_3$ Pongamia oil @2% (1.2:1), $T_5$ *Chenopodium album* extract @15% (1.4:1), when compared to treated check $T_6$ Mancozeb @ 0.2% (1.8:1) and untreated check $T_0$ (1.5:1).

## 4. CONCLUSION

It is concluded that Eucalyptus oil @ 2% and Neem oil @ 2% was found the most effective treatments showing minimum disease intensity and produced maximum no of siliquae, no of seeds per siliquae, test weight of seeds, length of siliquae, biological yield, seed yield per plot (q/ha) and recorded highest cost benefit ratio as compare to other treatments.

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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