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# Evaluation of Fungicide, Bio-agent and Plant Extract against Altenaria Leaf Spot of Turnip

ALKA YADAV, RAMESH SINGH, A K PRAJAPATI, GAURAV AND DIKSHA SINGH

## ABSTRACT

*Alternaria brassicicola* causes dark leaf spot disease on turnip crop. The pathogen was tested with 6 fungicide, 2 bio-agent and 4 plant extract under *In-Vitro*. *In-Vivo* condition 6 fungicides were tested the year of 2021-22 and 2022-23. Among the tested fungicide Hexaconazole 5% SC and Carbendazim 12%+ Mancozeb 63% WP was found most effective with fungal colony growth (00.00 mm) and per cent inhibition over control 100%. The maximum fungal colony growth (63.25mm) was recorded on onion extract with per cent inhibition over control (28.13). The next treatment was found significantly superior over control. *In-Vivo* condition the tested fungicide Hexaconazole was found most effective with (9.55) mean minimum disease incidence and maximum mean yield (24.36 ton/ha) followed by Carbendazim+Mancozeb which showed (13.34) mean disease incidence and (21.37 ton/ha) mean yield. Among the tested fungicides Sulphur was showed maximum (28.56) mean disease incidence with minimum mean yield (8.84 ton/ha).

**Keywords:** *Alternaria brassicicola*, Fungicide, Bio-agent, Plant extract, Turnip

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## INTRODUCTION

Turnip (*Brassica rapa* L., 2n = 2x = 20, formerly *Brassica compestris* subsp. *rapifera*) belongs to the large family Brassicaceae and bear similar yellow flowers. It is herbaceous and starchy annual root crop, used for its edible roots and leaves. They are one of the world's most important vegetable crops, as they are used to feed both humans and cattle. It is highly nutritious forage crop that has a short growing season and is grown in temperate climates worldwide (Barari *et al.*, 2005). In India turnip is cultivated in approximately 2,500 ha with annual production of 50,000 tons (2013).

Agriculture plays an important role in the development and income of developing countries. It is the main source of livelihood for rural people and nearly 86% of the rural people dependent on agricultural production (Dethier and Effenberger 2011). Vegetable crop are important due to their nutritional values and contribution to food security as they provide nutrients, vitamins and proteins (Kamga *et al.*, 2013). About 18% of agricultural crop losses occur due to animal pests while microbial diseases caused 16% and weeds caused 34% losses. Fungal pathogens make 70–80% count of losses caused by microbial pathogens (Moore *et al.*, 2011). Turnip is rich source of minerals, fiber and vitamin C and A.100gm of turnip bulb contains 34 calories, 3% calcium, 1% iron, 0.7% ash, 7.84% carbohydrates, 2.2% dietary fiber, 0.2% fats, 1.11% protein, no cholesterol and 92.3% water. Turnip suffer from many diseases caused by fungus, bacterias and viruses such as Alternaria leaf spot (*Alternaria brassicicola*), Anthracnose (*Colletotrichum higginisianum*), Black root (*Aphanomyces raphari*), Black rot (*Xanthomonas campestris*), Frogeye leaf spot (*Cercospora brassicicola*), Clubroot (*Plasmdiophora brassicae*), Downy mildew (*Peronospora parasitica*), Sclerotinia rot (*Sclerotinia sclerotiorum*), White spot (*Pseudocercosporella capsellae*), Wirestem or Damping off *(Rhizoctonia solani*) and Turnip mosaic (TuMV).

Alternaria leaf spot is a fungal disease that causes big problem of turnip crop and other plant of Brassica family. Due to Alternaria leaf spot, there is a reduce in the yield up to 40% and decreased quality of turnip. Symptoms of disease firstly appear on leaves and then stem, grown-up plants and in siliquaea at maturing stage. Leaf spot signs on turnip (*B. rapa subsp. rapa*) appear as dark brown spots enveloped by yellow halos (Bassimba *et al.*, 2013).

## MATERIALS AND METHODS

### Screening of fungicides, bioagents and botanicals under *In-Vitro* condition

Relative efficacy of available six selected fungicides, two bio-agents and four plant extracts against the pathogen *In-Vitro* was tested by "Poison Food Technique" as suggested by Schmitz (1930) using PDA medium. The six fungicides namely viz., Hexaconazole 5%SC, Carbendazim 12%+Mancozeb 63%WP, Mycobutanil 10%WP, Mancozeb 75%WP, Tebuconazole 18.3%SC and Sulphur 80%WP was tested at 2%. The bio-agents *Trichoderma harzianum*, and *Pseudomonas fluorescens* was tested at 250 ppm and leaf extracts Neem leaf, Garlic pest, Madar leaf and Onion bulb was studies *In-Vitro* by judging the extent of their inhibitory effect on the growth of the pathogen on 2 percent potato dextrose agar medium.

Deptt. of Plant Pathology, T.D.P.G. College, Jaunpur, Uttar Pradesh, India
*Corresponding Author E-mail: alkayadav5256@gmail.com

Each treatment was replicated 3 times with CRD design with suitable control.

Plant extracts of the botanicals, *Neem* (*Azadirachta indica*), *Madar* (*Calotropis gigantea*), Garlic (*Allium sativum*) and Onion (*Allium cepa*) were prepared by selected their leaves and bulb and air dried under shade with 10 days. The dried leaves and bulb were grinded into powder. The extracts were then filtered through a muslin cloth to obtain a very fine powder. A concentration i.e 10% were prepared 100 gm. fine powder dissolved with 100 ml distilled water. The extract was sterilized by passing them through a Millipore filter (0.22 um pore size) using a swimmy filter adopter. The per cent inhibition over control calculating by following formula:

$$\text{Percent inhibition over control} = \frac{C-T}{C} \times 100$$

Where,

C= Growth of fungus in control

T= Growth of fungus in treatment

**Evaluation of fungicides under *In-Vivo* condition**

In order to find out the best effective fungicide *In-Vivo* condition. The field experiment was conducted on variety of turnip during Rabi season 2021-22 and 2022-23 at the student research farm Pili Kothi of T.D.P.G. Collage, Jaunpur. This experiment was performed in Randomized Complete Block Design with 3 replication and an untreated plot were mention control. After germination, the seleceted plants were artificially incubated by spraying of pure culture of *Alternaria brassicicola*. Treatments were applied after regular interval and data was recorded on weekly basis. The six fungicides namely *viz*., Hexaconazole 5%SC, Carbendazim 12%+Mancozeb 63%WP, Mycobutanil 10%WP, Mancozeb 75%WP, Tebuconazole 18.3%SC and Sulphur 80%WP were used as foliar spray.

**Statistical Analysis**

The data obtained from field observation and orderly subjected to regression, correlation and analysis of variance (ANOVA) at 5% level of significance was applied. For all the statistical tests, SAS/SAT software used.

**Fig. 1a:** Infected field of Turnip

## RESULTS AND DISCUSSION

**Major symptoms of the Alternaria leaf spot of Turnip**

Alternaria leaf spot of turnip, caused by *Alternaria brassicicola*, which shows a wide range of symptoms, appears on all green parts of the plant, especially leaves. It forms irregular spots with concentric rings, which darker towards the center (Fig. 1 a & b).

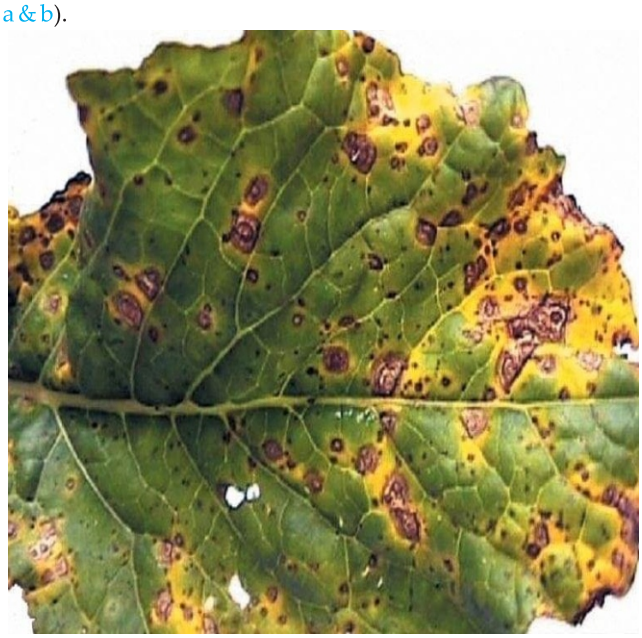


**Fig. 1b:** Infected leaf

The leaf spot regularly appears as grey colored wounds (Meena *et al.*, 2010). The hyphae of Alternaria are flattened, waterless and branched (Fig. 2a) and club-shaped, septate conidia are produced in chain at the tip of condiophore (Fig. 2b). Alternaria is a facultative parasite and found on dead plant parts and in soil and mode of dispersal are many such of infected plant debries, water splash, wind and as culture (Fig. 2c).

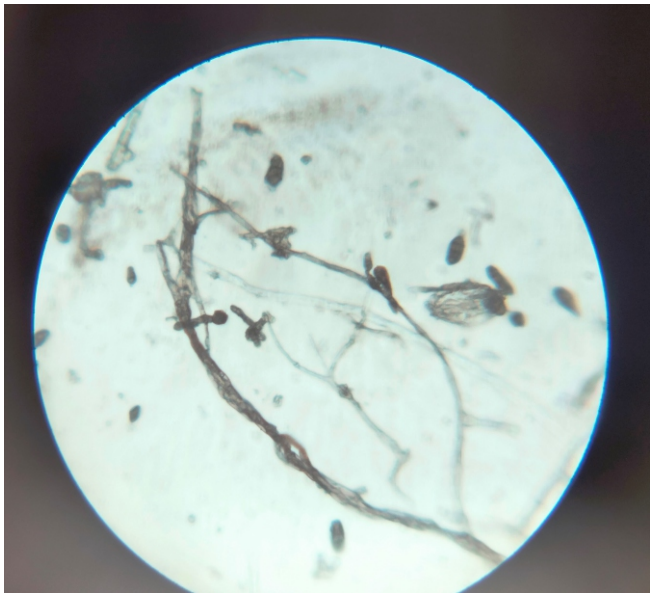


**Fig. 2a:** Mycelium

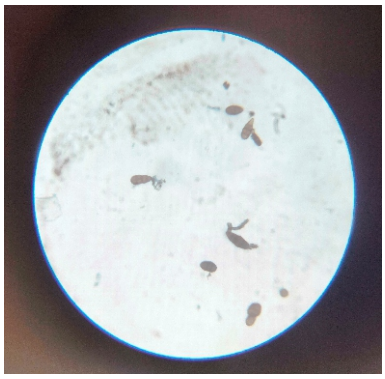
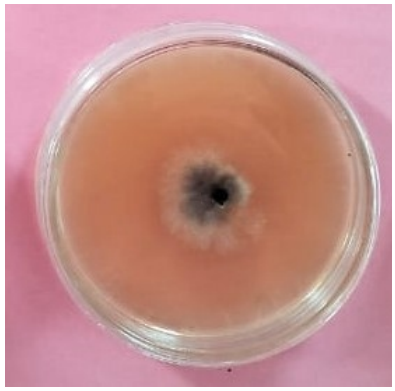


**Fig. 2b:** Conidia of A. bressicicola

**Fig. 2c:** Culture of A. bressicicola

Hexaconazole

Carbendazim+Mancozeb



Myclobutanil

Mancozeb

Tubaconazole

Sulphur

T. harzianum

P. flourosences

Neem Extract

Garlic Extract

Madar Extract Onion Extract Control

**In-vitro evaluation of fungicides, bio-agents and plant extracts**

**Fig. 3:** Effect of fungicides on colony growth of A. brassicicola on P.D.A. medium after 7 days.

The result indicated in Table 1, Fig. 3 and its Corresponding histogram Fig. 4 showed that the fungicide, bio-agents and plant extracts tested were significantly superior over the control and inhibiting the growth of the pathogen. The Hexaconazole (00.00mm) and Carbendazim+Mancozeb (00.00mm) proved to be most effective fungicide as they inhibition the growth of the pathogen 100.00% these were statistically at par with each other. The remaining fungicides in order of their decreasing inhibitory effect against the pathogen were Mycobutanil (18.75mm), Mancozeb (26.25mm) and Tebuconazole (38.25mm) were found to be the next best effective fungicide in inhibiting the growth of pathogen. These were statistically at different which showing (78.69, 70.17 and 56.53) per cent inhibition over control respectively. Among the tested fungicide Sulphur showed maximum fungal growth (41.50mm) was least effective and showed the (52.84%) inhibition over control. The bio-agent *Trichoderma harzianum* was recorded (42.75mm) radial growth and its inhibition over growth (51.42%) followed by *Pseudomonas fluorescens* (45.50mm) radial growth and 48.29% inhibition over control. Both the treatments are statically at par with each other. Among the tested *Neem* leaf extracts (49.00mm) showed the fungal growth with (44.31%) inhibition control against the pathogen. The next effective plant extract Garlic (54.00mm) and *Madar* (55.75mm) showed the per cent inhibition over control (38.73 and 36.54%). The least effective plant extract was Onion (63.25mm) and 28.13 per cent inhibition over control. The observation are similar to the finding of Ved *et al*., 2003; Khan *et al*., 2007 and Kumar *et al*., 1998 an different crop plant caused by *Alternaria brassicicola* and *A. brassicae*.

***In-Vivo* evaluation of different fungicides**

The result presented in Table 2 and Corresponding histogram Fig. 5 of field test with six fungicides showing their effectiveness in managing the disease. In the year 2021-22 spraying of Hexaconazole (8.34%) at the interval of 10 days was proved to be most effective fungicides as they minimizing the disease incidence and increasing the yield (25.60 ton/ha). The next best effective fungicide was Carbendazim+Mancozeb and Myclobutanil which showed (12.02 and 17.69) percent disease incidence and its corresponding yield at (22.17 and 18.27 ton/ha) respectivaly, and these were statistically at par each other. The next order of tested fungicides Mancozeb (21.61%) and Tebuconazole (24.70) per cent disease incidence and yield was (15 and 12.46 ton/ha) respectively. The least effective fungicide was Sulphur which showed maximum (28.14) per cent disease incidence and minimum the yield (9.39 ton/ha).

In 2022-23, Hexaconazole was most effective fungicide which show their (10.76) per cent disease incidence and increasing the yield (23.12 ton/ha). The next best effective fungicide was Carbendazim+Mancozeb and Myclobutanil which showed

**Table 1:** Effect of fungicides on colony growth of A. brassicicola on P.D.A. medium after 7 days

| Name of Treatments | Dose | Average fungal growth (mm) | Per cent inhibition over control |
|---|---|---|---|
| Hexaconazole | 2.0% | 00.00 | 100.00 |
| Carbendazim+Mancozeb | 2.0% | 00.00 | 100.00 |
| Myclobutanil | 2.0% | 18.75 | 78.69 |
| Mancozeb | 2.0% | 26.25 | 70.17 |
| Tubaconazole | 2.0% | 38.25 | 56.53 |
| Sulphur | 2.0% | 41.50 | 52.84 |
| *Trichoderma harzianum* | 250ppm | 42.75 | 51.42 |
| *Pseudomonas fluorescens* | 250ppm | 45.50 | 48.29 |
| *Neem* extracts | 0.5% | 49.00 | 44.31 |
| Garlic extracts | 0.5% | 54.00 | 38.73 |
| *Madar* extracts | 0.5% | 55.75 | 36.54 |
| Onion extracts | 0.5% | 63.25 | 28.13 |
| Control | — | 88.00 | — |
| C.D. | | 3.51 | |

**Table 2:** Efficacy of different fungicides against Alternaria leaf spot of turnip under field condition

| Name of Fungicide | Dose (%) | Disease incidence (%) | | | Yield (ton/ha) | | |
|---|---|---|---|---|---|---|---|
| | | Year | | | Year | | |
| | | 2021-22 | 2022-23 | Mean | 2021-22 | 2022-23 | Mean |
| Hexaconazole | 2.0 | 8.34 (16.74) | 10.76 (19.09) | 9.55 (12.95) | 25.60 (30.40) | 23.12 (28.73) | 24.36 (29.53) |
| Carbendazim + Mancozeb | 2.0 | 12.02 (20.27) | 14.67 (22.46) | 13.34 (21.39) | 22.17 (28.04) | 20.58 (26.92) | 21.37 (27.49) |
| Myclobutanil | 2.0 | 17.69 (24.80) | 18.00 (25.10) | 17.84 (24.95) | 18.27 (25.25) | 16.89 (24.20) | 17.58 (24.73) |
| Mancozeb | 2.0 | 21.61 (27.69) | 21.87 (27.83) | 21.74 (27.76) | 15.00 (22.79) | 14.49 (22.30) | 14.74 (22.55) |
| Tebuconazole | 2.0 | 24.70 (29.80) | 25.96 (30.59) | 25.33 (30.20) | 12.46 (20.62) | 11.63 (19.91) | 12.04 (20.27) |
| Sulphur | 2.0 | 28.14 (32.01) | 28.99 (32.52) | 28.56 (32.27) | 9.39 (17.76) | 8.29 (16.64) | 8.84 (17.26) |
| Control | — | 31.58 (34.14) | 33.61 (35.43) | 32.59 (34.76) | 7.86 (16.22) | 6.38 (14.54) | 7.12 (15.45) |
| C. D. | | 3.40 | 2.39 | | 2.51 | 3.51 | |

*Figure in parenthesis are angular transformed value.

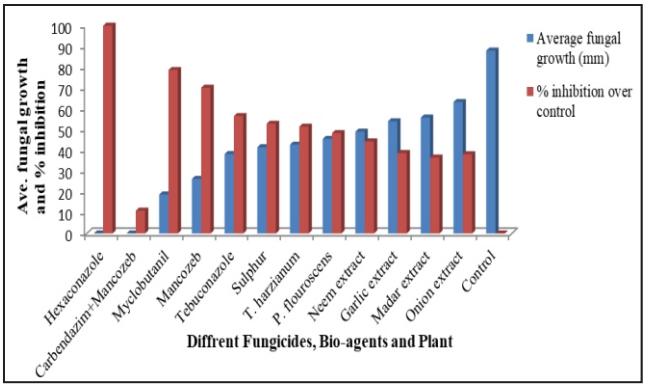



**Fig. 4:** Effect of fungicides on colony growth of A. brassicicola on P.D.A medium

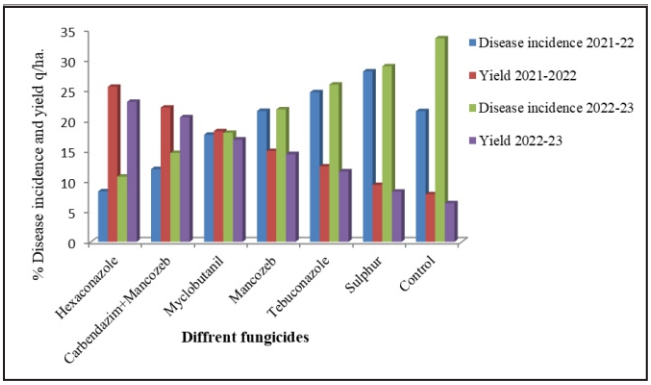



**Fig. 5:** Efficacy of different fungicides against Alternaria leaf spot of turnip under field condition

(14.67 and 18.00) percent disease incidence and (20.58 and 16.89 ton/ha) yield and both the fungicide were statistically at par each other. Next effective fungicide was Mancozeb and Tebuconazole which showed (21.87 and 25.96) percent disease incidence and is corresponding yield (14.49 and 11.63 ton/ha). The least effective fungicide was Sulphur which showed maximum (28.99) percent disease incidence and minimum the yield (8.29 ton/ha). All the fungicides were also control the disease incidence and increasing the yield.

## CONCLUSION

Based on the results of recent studies, it is clear that *In-Vivo* condition is the safest fungicide to use for the management of the Alternaria leaf spot of Turnip. Hexaconazole, proved to be the most effective fungicide for reducing average disease incidence (9.55) with highest average yield (24.36 ton/ha) followed by Carbendazim+Mancozeb and Myclobutanil, which showed (13.34 and 17.84) average disease incidence and corresponding yield was (21.37 and 17.58 ton/ha). Among the tested fungicide Sulphur was also effective which showed the (28.56) mean average disease incidence with minimum average yield (8.84 ton/ha) was recorded. It is also recomanded to farmers for application of Hexaconazole in management of Alternaria leaf spot of turnip in recent scenario.

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