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## Efficacy of *Trichoderma viride* and essential oils against *Alternaria* blight disease (*Alternaria helianthi*) of sunflower (*Helianthus annuus* L.)

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### Abstract

An experiment was conducted to manage *Alternaria* blight of Sunflower in the Departmental field (Department of Plant Pathology) SHUATS, Prayagraj during *Kharif* season of 2022 by using Mentha oil (0.7%), Fennel oil (0.7%), Cumin oil (0.7%), Lemongrass oil (0.7%), Eucalyptus oil (0.7%), *Trichoderma viride* (10 g), treated check Mancozeb (0.2%). Among those treatments Mentha oil (0.7%) was found the most effective treatment and exhibited minimum percent disease incidence (27.3%), maximum plant height (37.6 cm).

**Keywords:** Essential oil, bio agent, *Helianthus annuus*, *Alternaria helianthi*, disease incidence

### Introduction

Sunflower (*Helianthus annuus* L.) is a major oilseed crop all over the world. It belongs to the family Asteraceae which contains 200 genera including *Helianthus* with 65 different species. It is native to North of Eastern America and it is thought to have been domesticated around 3000 B.C. by native Americans. The wild sunflower is native to North America but commercialization of the crop (sunflower) took place in Russia. They are large plant and are grown throughout the world because of their relatively short growing season. Sunflower is an annual herb, with a rough, hairy stem, 3 to 12 feet high, broad, coarsely toothed, rough leaves, 3 to 12 inches long and circular heads of flowers, 3 to 6 inches wide in wild specimens and often a foot or more in cultivation. The flower-heads are composed of many small tubular flowers arranged compactly on a flattish disk: those in the outer row have long strap-shaped corollas, forming the rays of the composite flower. Each sunflower head, or inflorescence, is actually composed of two types of flowers. The face of the head is comprised of hundreds of disk flowers, which each form into a seed (Luqueño *et al.*, 2014) [3]. Important sunflower growing states in the country are Karnataka, Andhra Pradesh, Maharashtra, Tamil Nadu, Bihar, Punjab, Haryana and Uttar Pradesh. Almost 50% of area and production is accounted for by Karnataka followed by Andhra Pradesh and Maharashtra (Waghe *et al.*, 2015) [8]. In India; Karnataka, Andhra Pradesh, Maharashtra and Tamil Nadu are the traditional sunflower growing states with Karnataka ranking first in production. However, recently sunflower has moved to northern parts of the country where the productivity is very high. In India, sunflower production area shows decreasing growth trend. CAGR of sunflower in India was found -5.27 per cent. Maximum area under sunflower was cultivated in 1993-94 i.e. 2.66 million hectares while minimum area in 2016-17 i.e. 0.38 million hectares (Nimbrayan *et al.*, 2020) [6].

Sunflower suffers from many diseases caused by fungi, bacteria, and viruses. Some of the most important fungal diseases of sunflower are *Alternaria* leaf blight (*Alternaria helianthi*), Rust (*Puccinia helianthi*), Powdery mildew (*Erysiphe cichoracearum*), Downy mildew (*Plasmopara halstedii*), Root rot (*Macrophomina phaseoli*), Collar rot (*Sclerotium rolfsii*), Head rot (*Rhizopus* spp.), Verticillium wilt (*Verticillium dahliae*) and Leaf spot (*Helminthosporium helianthi*) (Waghe *et al.*, 2015) [8].

The disease symptoms are characterized by irregular, necrotic greyish brown lesions surrounded by a chlorotic halo on leaves, stem and even on florets resulting in premature defoliation and stem breakage (Saqib *et al.*, 2020) [7].

The biodegradability of the essential oil is one of the attractiveness among the alternative methods for phytopathogen control. They are generally recognized as safe for human and animal consumption by regulatory agencies and easily obtained from natural renewable sources.

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Lemongrass also shows an essential oil yield of 1–2% from dry mass, which is considered an excellent yield among the essential oil sources. Lemongrass essential oil is known for its activity as natural pesticides, which includes antifungal action for several microorganisms (Antonioli *et al.*, 2020) [1].

### Materials and Methods

The field experiment on *Alternaria* blight of sunflower caused by *Alternaria helianthi* was carried out in the Departmental field (Department of Plant Pathology), SHUATS, Prayagraj, during the *kharif* season of 2022. The sunflower variety modern susceptible to *Alternaria* blight was used for investigation. Prayagraj is located at 25.45°N 81.84°E in the southern part of the Uttar Pradesh at an elevation of 98 meters (322 ft) and stands at the confluence of two, the Ganges and Yamuna.

The selected field area was prepared and plot marked as per the lay out plan. The selected field was dug up, weeded, cleaned and the soil was well pulverized, then the total area was divided into sub plots. Surya S3 variety of Sunflower was chosen for the experiment. All the practices were followed as per the general agronomic practices.

Seeds were sown in rows at a distance of 25 cm plant to plant and row to row distance was 60 cm. Light irrigation was done after sowing of seeds. Light irrigation in the field was done before and after sowing. Regular irrigation in the field was given at alternate days in the evening time.

Symptoms of the disease are characterized by the development of dark brown to black, circular to oval spots, varying from 0.2 to 5.0 mm diameter. The spots are surrounded by necrotic chlorotic zone with a gray-white necrotic center marked with concentric rings. Initially the spots are small and they gradually increase in size, making their first appearance on the lower leaves. As the plant grows, the spots subsequently are developed on middle and upper leaves. At the later stages, elongated spots are found on

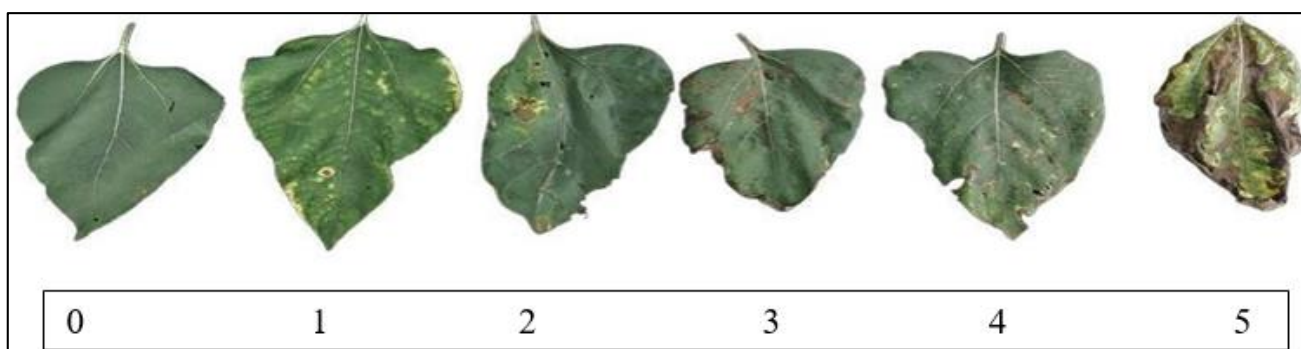
petioles, stem, and ray florets. Under high humidity conditions, the spots enlarge in size and coalesce resulting in blighting of leaves and sometimes rotting of flower heads.

Morphology of the pathogen was observed as the colonies were usually black or olivaceous black and sometimes grey. Conidiophores produced singly or in small groups, simple or branched, straight or flexuous, sometimes geniculate, pale to mid olivaceous or golden brown, smooth, up to 50 µm long, 3–6 µm thick, with one or several conidial scars. *A. helianthi* found to be solitary, non-beaked, born on simple unbranched conidiophores, cylindrical to elongate elliptic, yellowish brown septate with 3–10 transverse or occasionally longitudinal septa, constricted at septa, rounded at both ends and 40 – 120 µm X 15–28µm (average 100.6 X 25.5µm) in size.

Essential oils (Mentha, Fennel, Cumin, Lemongrass and Eucalyptus), and mancozeb were sprayed as foliar spray as per their concentration. 10g of *Trichoderma viride* used for one kg of seed as seed treatment. The essential oils of Mentha, Fennel, Cumin, Lemongrass and Eucalyptus were bought from the market. One litre of distilled water was taken in five plastic bottles. Then 2

% of DMSO was added to each bottle. After adding DMSO, 0.7% of each essential oil was added to respective bottles and mixed well. Mancozeb was used as fungicidal spray, for preparation of its spray solution, one litre of distilled water was taken in a bottle and 0.2% of Mancozeb was added to it and mixed well. Percent disease incidence was recorded at 30, 45 and 60 days after sowing. The disease incidence was calculated using the following formula given by (Jena *et al.*, 2020) [2].

$$\text{Disease incidence} = \frac{\text{Number of infected leaf}}{\text{Total no. of leaves examined}} \times 100$$



Disease severity scale of *Alternaria* blight of sunflower

### Results

The data represented in table 1 and shown in figure 1 reveals that the disease incidence (%) significantly decreased.

The disease incidence at 30 DAS, T1- Mentha oil @ 0.7% (14.5%), followed by T4- Lemongrass oil @ 0.7% (15.2%), T2- Fennel oil @ 0.7% (15.3%), T5- Eucalyptus oil @ 0.7% (15.5%), T3- Cumin oil @ 0.7% (16.3%) and as compared to T6- Mancozeb @ 0.2% (11.9%) and T0- untreated check (17.3%). As compared to CD value (2.3) all the treatments were found non- significant to each other.

The disease incidence at 45 DAS, T1- Mentha oil @ 0.7% (21.6%), followed by T4- Lemongrass oil @ 0.7% (22%), T2-

Fennel oil @ 0.7% (23.8%), T5- Eucalyptus oil @ 0.7% (25.8%), T3- Cumin oil @ 0.7% (26.1%), and as compared to T6- Mancozeb @ 0.2% (17.4%) and T0- untreated check (33.9%). As compared to CD value (4.1) all the treatments were found non- significant to each other.

All the treatments were found significant to the untreated check T0 (Control). Among the treatments (T1, T4, T2), (T4, T2, T5, T3) were found non-significant to each other.

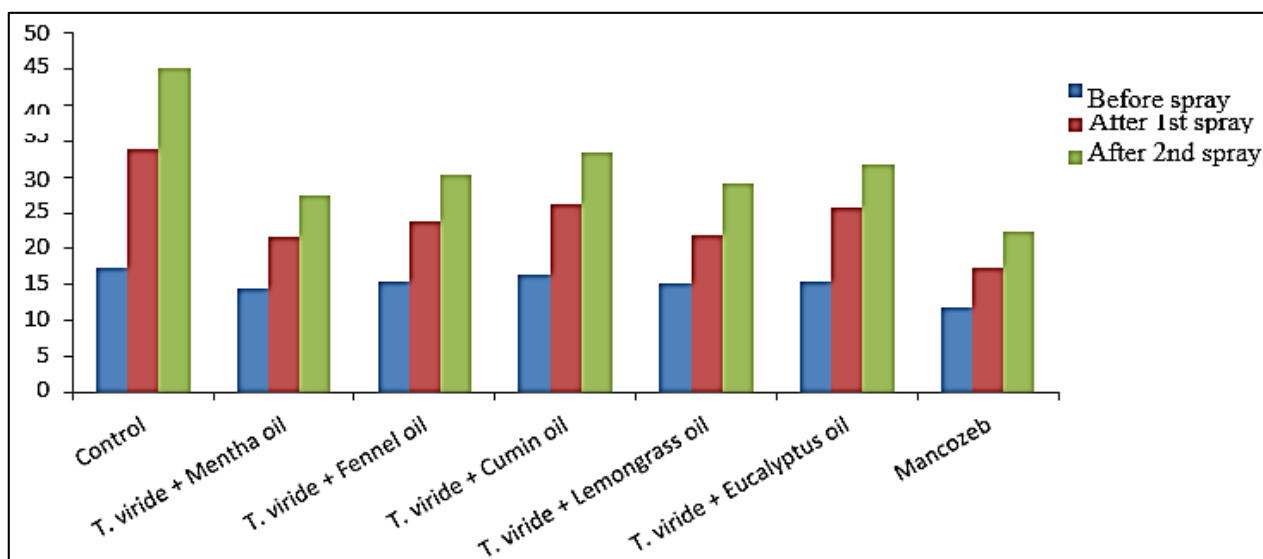
The disease incidence at 60 DAS, The data represented in table 1 and shown in figure 1 reveals that the disease incidence (%) significantly decreased in T1- Mentha oil @ 0.7% (27.3%), followed by T4- Lemongrass oil @ 0.7%

(29%), T2- Fennel oil @ 0.7% (30.2%), T5- Eucalyptus oil @ 0.7% (31.6%), T3- Cumin oil @ 0.7% (33.3%), and as compared to T6- Mancozeb @ 0.2% (22.4%) and T0- untreated check (45.2%). As compared to CD value (2.2) all

the treatments were found non-significant to each other. All the treatments were found significant to the untreated check T0 (Control). Among the treatments (T1, T4), (T4, T2), (T2, T5), (T5, T3) were found non-significant to each other.

**Table 1:** Disease incidence (%) Before spray, After 1st spray and After 2nd spray affected by treatments

S. No	Treatments	Disease incidence (%)		
		Before spray	After 1 <sup>st</sup> spray	After 2 <sup>nd</sup> spray
T0	Control (untreated check)	17.3	33.9	45.2
T1	Seed treatment with <i>Trichoderma viride</i> @ 10 g/kg seed + <i>Mentha piperita</i> @ 0.7% (7 ml)	14.5	21.6	27.3
T2	Seed treatment with <i>Trichoderma viride</i> @ 10 g/kg seed + <i>Foeniculum vulgare</i> @ 0.7% (7 ml)	15.3	23.8	30.2
T3	Seed treatment with <i>Trichoderma viride</i> @ 10 g/kg seed + <i>Cuminum cyminum</i> @ 0.7% (7 ml)	16.3	26.1	33.3
T4	Seed treatment with <i>Trichoderma viride</i> @ 10 g/kg seed + Lemongrass @ 0.7% (7 ml)	15.2	22	29
T5	Seed treatment with <i>Trichoderma viride</i> @ 10 g/kg seed + <i>Eucalyptus globules</i> @ 0.7% (7 ml)	15.5	25.8	31.6
T6	Treated check- Mancozeb @ 0.2%	11.9	17.4	22.4
	F. test	S	S	S
	S.Ed. (±)	1.08	1.92	1.02
	CD (5%)	2.3	4.1	2.2



**Fig 1:** Disease incidence (%) Before spray, after 1st spray and After 2nd spray affected by treatments

The data represented in table 2 and shown in figure 2 reveals that the plant height significantly decreased.

The plant height (cm) of Sunflower at 30 DAS, T3- Cumin oil @ 0.7% (25 cm) followed by T5- Eucalyptus oil @ 0.7% (27.8 cm), T2- Fennel oil @ 0.7% (28.3 cm) T4- Lemongrass oil @ 0.7% (29.11 cm) and T1- Mentha oil @ 0.7% (32.9 cm) as compared to T6- Mancozeb @ 0.2% (35.9 cm) and T0- untreated check (22.3 cm).

All the treatments were found significant over untreated check T0 (Control). Among the treatments (T3, T5), (T5, T2, T4), and (T2, T4) were found non-significant to each other.

The plant height (cm) of Sunflower at 45 DAS, T3- Cumin oil @ 0.7% (27.3 cm) followed by T5- Eucalyptus oil @ 0.7% (29.3 cm), T2- Fennel oil @ 0.7% (29.7 cm) T4- Lemongrass oil @ 0.7% (31.1 cm) and T1- Mentha oil @ 0.7% (34.3 cm) as compared to T6- Mancozeb @ 0.2%

(37.5 cm) and T0- untreated check (23.6 cm).

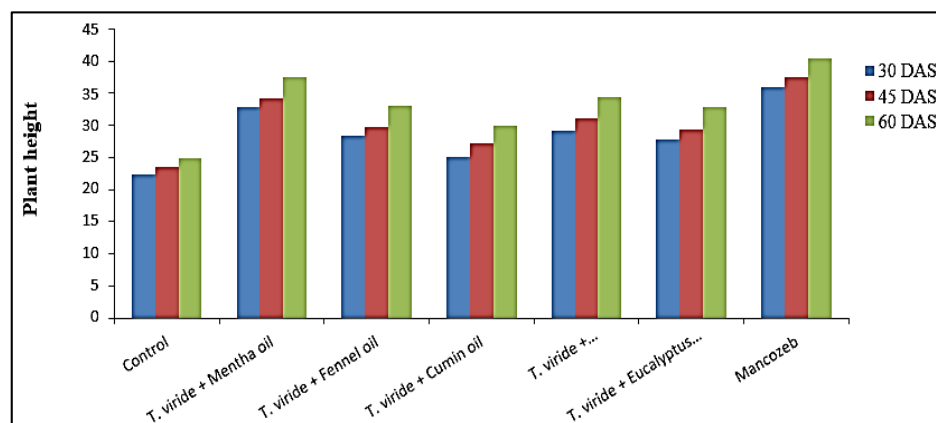
All the treatments were found significant over untreated check T0 (Control). Among the treatments (T3, T5, T2), (T5, T2, T4) and (T2, T4) were found non-significant to each other.

The plant height (cm) of Sunflower at 60 DAS, The data represented in table 2 and shown in figure 2 reveals that the plant height significantly decreased in T3- Cumin oil @ 0.7% (30 cm) followed by T5- Eucalyptus oil @ 0.7% (32.8 cm), T2- Fennel oil @ 0.7% (33 cm) T4- Lemongrass oil @ 0.7% (34.5 cm) and T1- Mentha oil @ 0.7% (37.6 cm) as compared to T6- Mancozeb @ 0.2% (40.4 cm) and T0- untreated check (24.9 cm).

All the treatments were found significant over untreated check T0 (Control). Among the treatments (T3, T5, T2), (T5, T2, T4), and (T2, T4) were found non-significant to each other.

**Table 2.** Effect of treatments on plant height (cm) of sunflower at 30 DAS, 45 DAS and 60 DAS.

S. No	Treatments	Plant Height (cm)		
		30 DAS	45 DAS	60 DAS
T0	Control (untreated check)	22.3	23.6	24.9
T1	Seed treatment with <i>Trichoderma viride</i> @10g/kg seed + <i>Mentha piperita</i> @ 0.7% (7 ml)	32.9	34.3	37.6
T2	Seed treatment with <i>Trichoderma viride</i> @10g/kg seed + <i>Foeniculum vulgare</i> @ 0.7% (7 ml)	28.3	29.7	33
T3	Seed treatment with <i>Trichoderma viride</i> @10g/kg seed + <i>Cuminum cyminum</i> @ 0.7% (7 ml)	25	27.3	30
T4	Seed treatment with <i>Trichoderma viride</i> @10g/kg seed + Lemongrass @ 0.7% (7 ml)	29.1	31.1	34.5
T5	Seed treatment with <i>Trichoderma viride</i> @10g/kg seed + <i>Eucalyptus globules</i> @ 0.7% (7 ml)	27.8	29.3	32.8
T6	Treated check-Mancozeb @ 0.2%	35.9	37.5	40.4
F. test		S	S	S
S.Ed. (±)		1.18	1.32	1.50
CD (5%)		2.5	2.8	3.2

**Fig 2:** Effect of treatments on plant height (cm) of sunflower at 30 DAS, 45 DAS and 60 DAS.

The probable reasons for such findings may be that *Trichoderma* species is a fast growing fungi and may have suppressed pathogen growth through competition, antibiosis, production of cellulose and other hydrolytic enzymes. They are also able to indirectly suppress pathogens by inducing plant resistance and promote plant growth and mentha essential oil which has Menthol is reported to have hydroxyl group around the phenolic ring which acts as effective antimicrobial agent by disruption of the cytoplasmic membrane of the microorganisms. This may have inhibited the growth of *Alternaria helianthi*. This may have also resulted in better growth of plants recording maximum height (cm). Similar findings have reported by Nakkeeran *et al.* (2018) <sup>[5]</sup>; Mafakheri and Mirghazanfari (2018) <sup>[4]</sup>.

### Conclusion

The result of the present study revealed that seed treatment with *Trichoderma viride* @ 10 g and foliar spray of mentha essential oil @ 0.7% recorded minimum per cent disease incidence against *Alternaria* blight of sunflower and recorded maximum plant height (cm). The findings of the present experiment are limited to one crop season (April 2022- June 2022) under Prayagraj agro-climatic conditions, as such to validate the present findings more such trials should be carried out in future.

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