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Sanyam Tripathi
M.Sc. Scholar, Department of Plant Pathology, Naini Agriculture Institute, Faculty of Agriculture, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India

Abhilasha A Lal
Assistant Professor, Department of Plant Pathology, Naini Agriculture Institute, Faculty of Agriculture, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India

Bhavna Sinha
Faculty Associate, Department of Agriculture, Jharkhand Rai University, Ranchi, Jharkhand, India

Corresponding Author:
Sanyam Tripathi
M.Sc. Scholar, Department of Plant Pathology, Naini Agriculture Institute, Faculty of Agriculture, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India

Evaluate the effect of essential oils on disease incidence of Alternaria blight of sunflower *Alternaria helianthi*

Sanyam Tripathi, Abhilasha A Lal and Bhavna Sinha

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Abstract
During the *kharif* season of 2022, the trial on sunflower crop to control of Alternaria blight at Department (Department of Plant Pathology), SHUATS, Prayagraj. The oils used were Mentha oil (0.7%), Fennel oil (0.7%), Cumin oil (0.7%), Lemongrass oil (0.7%), Eucalyptus oil (0.7%), *Trichoderma viride* (10 g), and treated check Mancozeb (0.2%). Out of these treatments, Mentha oil (0.7%) was found utmost functional and had a lowest level of disease incidence (27.3%).

Keywords: Essential oils, bio agent, *Alternaria helianthi*, disease incidence

Introduction
Sunflowers are one of the most important oilseed crop in the world. The relatively short growing season of these plants allows them to be grown throughout the world. The flower heads are circular, and are 3 - 6 inch broad in wild species and up to a foot in cultivation. In the outer row of the flower-heads are long strap-shaped corollas, forming the rays of the composite flower: the smaller tubular flowers on the flattish disk are compactly arranged on the disk. Sunflower heads, or inflorescences, consist of two distinct types of flowers. There are hundreds of disk flowers on the face of the head, which form into seeds. (Luqueño *et al*., 2014) [3].

In the late 1990s, India emerged as one of the world's largest importers of edible oils as one of the largest producers and consumers of oilseeds and their products. As a result of an increase in per capita income and a higher standard of living, the domestic demand for vegetable oils and fats is also increasing rapidly at an increasing rate. Sunflower is an important oilseed crop which belongs to the genus Helianthus of the family Asteraceae. It is widely adopted and accepted for its high-quality edible oil. The achnes of sunflower contain high oil content ranging from 35-50%. Sunflower acquired the status of an important commercial oilseed crop in India after the introduction of Russian varieties such as Peredovick (EC 68414) and Armavirskii (EC 68415) during 1960s and cultivated across a number of climatic and geographical regions due to its day length neutrality, wider adaptability and responsiveness to added inputs. The traditional sunflower-growing states of India are Karnataka, Andhra Pradesh, Maharashtra and Tamil Nadu, where Karnataka is the largest producer. In India, sunflower production area has been decreasing in recent years due to the higher productivity of northern areas of the country (Nimbrayan *et al*., 2020) [6].

On leaves, stems, and even on florets, the disease produces irregular, necrotic brown lesions that lead to early defoliation and break the stem (Saqib *et al*., 2020) [7].

Essential oil of fennel following The best fungicidal and inhibitory effects on *Alternaria sp*. were demonstrated by mentha essential oil. Plant diseases may be managed with the help of the promising natural fungicidal properties of mentha and fennel essential oil. Certain human diseases could be prevented and treated with the essential oil in place of synthetic fungicides, if it is used responsibly. Mentha essential oil is non-toxic to humans and possesses a number of significant qualities, including antibacterial, insecticidal, and antifungal effects. The primary constituents found in fennel essential oils were α-phellandrene (4.6%), α-Thujone (4.3%), fenchone (7.2%), and (E)-anethole (75.8%). Significant biological qualities, including antibacterial and antifungal activity, are present in cumin essential oil (Mafakheri *et al*. 2018) [4].

One of the reasons why essential oils are attractive for controlling phytopathogens is their biodegradability. Regulation agencies generally recognize them as safe for human and animal consumption and they can be easily obtained from natural renewable sources. As well as providing 1–2% of essential oil from dry mass, lemongrass also exhibits excellent essential oil yields (Antonioli *et al*., 2020) [1].

Sesquiterpenes and monoterpenes are two examples of the complex mixes of volatile organic molecules that make up essential oils. These mixtures also contain oxygenated chemicals. The mechanism behind these compounds' antibacterial activity in essential oils is linked to their lipophilic character, which interacts with microbial membranes to cause cell chemical leakage and microbial cell energy losses. It has been demonstrated that the essential oils of Eucalyptus globulus have antifungal properties against a variety of fungus (Tomazoni *et al*., 2017) [8].

Materials and Methods

As part of the field experiment at the Department of Plant Pathology at SHUATS, Prayagraj, conducted during the *kharif* season of 2022, a field experiment was conducted to determine the cause and extent of Alternaria blight of sunflower. It has been examined using a contemporary sunflower variety sensitive to Alternaria blight. In southern Uttar Pradesh at coordinates 25.45°N 81.84°E, Prayagraj is located at the confluence of the Ganga and Yamuna rivers, 98 meters (322 feet) above sea level. Plotting was done in the chosen field area in accordance with the layout plan. The chosen field was cleared of all vegetation, thoroughly cleaned, and the soil ground into fine particles before being split up into smaller plots. The sunflower variety used in the experiment was the Surya S3. Every procedure was carried out in accordance with standard agronomic procedures.

Plants were spaced 25 cm apart from one another, and rows were separated by 60 cm. After the seeds were sown, a light irrigation was carried out. Prior to and following seeding, the field received light irrigation. On alternate days, the field received regular evening irrigation.

The appearance of circular to oval, dark brown to black spots with a diameter ranging from 0.2 to 5.0 mm is a hallmark of the disease's symptoms. Necrotic chlorotic zone encircles the spots, and a gray-white necrotic core with concentric rings delineates its center. First appearing on the lower leaves, the spots are tiny at first and then get bigger over time. Later stages have elongated spots on the stem, ray florets, and petioles. High humidity causes the spots to grow larger and coalesce, blighting leaves and occasionally rotting flower heads.

The colonies were typically black or olivaceous black, occasionally greyish, indicating the pathogen's morphology. Conidiophores are produced singly or in small groups, smooth, 50 micrometer lengthy, 3-6 micrometer wide in size, simple or branched, straight or flexuous, and occasionally geniculate. They may also have one or more conidial scars. Upon closer inspection, *A. helianthi* was discovered to be solitary, no beak and born on simple conidiophores with no branched. Its size ranged from 40 to 120 micrometer × 15-28 micrometer (average 100.6 × 25.5 micrometer), and it was septate, cylindrical to elongate elliptic, yellow brown in color, with 3–10 transverse or sporadically long septa.

Mancozeb and essential oils were sprayed as a foliar spray based on their concentration. As a seed treatment, 10 gram of *Trichoderma viride* was mixed with the one kg of seed. We purchased the eucalyptus, mentha, fennel, cumin and lemongrass from the market. Five plastic bottles containing one litre of distilled water were taken. Next, each bottle received a 2 percent DMSO addition. The DMSO was added, and then 0.7 per cent of each essential oil was added to the corresponding bottle and mixed. In order to prepare the fungicidal spray solution, one liter of distilled water was filled in a bottle, 0.2% of mancozeb was added, and the mixture was thoroughly mixed. The disease incidence was calculated using the following formula given by (Jena *et al*., 2020) [2].

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

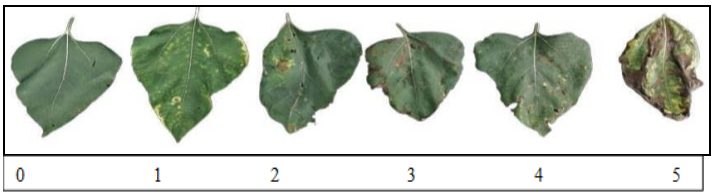

Fig 1: The severity of Alternaria blight in sunflowers was measured on a scale of 0 to 5

Results

The data pertaining to disease incidence, as presented in Table 1 and Figure 2, indicates a significant decrease in disease incidence (%).

It was determined that the disease incidence at 30 DAS was 0.7% (14.5%) with (Treatment – 1) Mentha oil, followed by 0.7% (15.2%) for (Treatment – 4) lemongrass oil, 0.7% (15.3%) for (Treatment – 2) fennel oil, 0.7% (15.5%) for (Treatment – 5) Eucalyptus oil and 0.7% (16.3%) (Treatment – 3) for cumin oil, as compared with 0.2% (11.9%) for (Treatment – 6) Mancozeb and 17.3% for the (Treatment – 0) untreated control. The CD value (2.3) indicates that all treatments are not statistically significant.

It was determined that the disease incidence at 45 DAS was 0.7% (21.6%) with (Treatment – 1) Mentha oil, followed by 0.7% (22%) for (Treatment – 4) Lemongrass oil, 0.7% (23.8%) for (Treatment – 2) Fennel oil, 0.7% (25.8%) for (Treatment – 5) Eucalyptus oil, 0.7% (26.1%) for (Treatment – 3) Cumin oil, as compared with 0.2% (17.4%) for (Treatment – 6) Mancozeb and (33.9%) for the (Treatment – 0) untreated control. The CD value (4.1) indicates that all treatments are not statically significant.

It was observed that all of the treatments were significant to the control check (T_0). However, the treatments (T_1, T_4, T_2), (T_4, T_2, T_5, T_3) were showed no significance between one another.

It was determined that the disease incidence at 60 DAS was 0.7% (27.3%) with (Treatment – 1) Mentha oil, followed by 0.7% (29%) for (Treatment – 4) Lemongrass oil, 0.7% (30.2%) for (Treatment – 2) Fennel oil, 0.7% (31.6%) for (Treatment – 5) Eucalyptus oil, 0.7% (33.3%) for (Treatment – 3) Cumin oil, as compared with 0.2% (22.4%) for (Treatment – 6) Mancozeb and (45.2%) for the (Treatment – 0) untreated control. The CD value (2.2) indicates that all the treatments are not statically significant.

It was observed that all the treatments were significant to the control check (T_0). However, the treatments (T_1, T_4), (T_4, T_2), (T_2, T_5), (T_5, T_3) showed no significance between one another.

Table 1: Data showing Incidence of disease (%) before spray, after I spray and after II spray

S. No	Treatments	Disease incidence (%)		
		Before spray	After I spray	After II spray
T_0	Control check	17.3	33.9	45.2
T_1	Seeds were treated with *Trichoderma viride* @ 10 g/kg + 0.% of *Mentha piperita* (7 ml)	14.5	21.6	27.3
T_2	Seeds were treated with *Trichoderma viride* @ 10 g/kg + 0.7% of *Foeniculum vulgare* (7 ml)	15.3	23.8	30.2
T_3	Seeds were treated with *Trichoderma viride* @10 g/kg + 0.7% of *Cuminum cyminum* (7 ml)	16.3	26.1	33.3
T_4	Seeds were treated with *Trichoderma viride* @ 10 g/kg + 0.7% of Lemongrass (7 ml)	15.2	22	29
T_5	Seeds were treated with *Trichoderma viride* @10g/kg + 0.7% of *Eucalyptus globules* (7 ml)	15.5	25.8	31.6
T_6	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

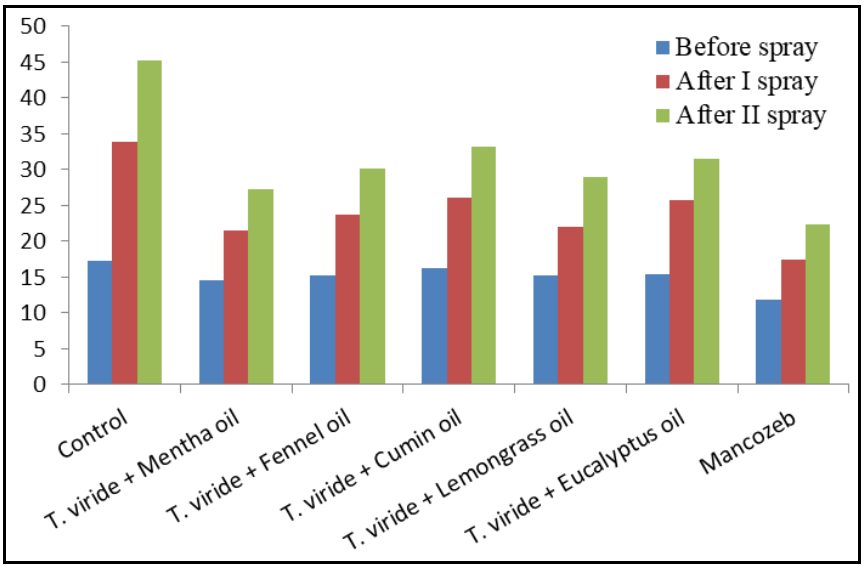

Fig 2: Graph representing the Incidence of disease (%) before spray, after I spray and after II spray

These results could be explained by the fact that Trichoderma species is a fast-growing fungus that suppresses pathogen growth through cellulose synthesis, antibiosis, competition, and other hydrolytic enzyme production. Additionally, by fostering plant resistance and encouraging plant growth, they can indirectly reduce infections. According to reports, menthol contains a hydroxyl group surrounding the phenolic ring, which disrupts the cytoplasmic membrane of microorganisms to operate as an effective antimicrobial agent. *Alternaria helianthi* growth might have been hampered by this Nakkeeran *et al*. (2018) [5]; Mafakheri and Mirghazanfari (2018) [4].

Conclusion

This study found that treating seeds with *Trichoderma viride* at 10 grams and spraying mentha essential oil at 0.7 percent resulted in the lowest disease incidence of 10% against Alternaria blight. The present findings need to be validated by conducting more trials under Prayagraj's agro-climatic conditions in the future. It is necessary to conduct more trials in the future to validate the findings of this current experiment, which was limited to one crop season April - June 2022).

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