Efficacy of essential oils against purple blotch of garlic (*Allium sativum* L.) caused by *Alternaria porri*(Ellis)Cif.

ABSTRACT

A research trial was carried out during *Rabi* season, 2023-24 at the Central Research Field, Department of Plant Pathology, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology And Sciences, Prayagraj, Uttar Pradesh. The experiment was conducted to evaluate the effect of different essential oils on purple blotch of garlic caused by *Alternaria porri*and other growth parameters. The trial was conducted using seven treatments *viz*. T_1- neem oil (5%), T_2- eucalyptus oil (5%), T_3- clove oil (5%), T_4- castor oil (5%), T_5- mustard oil (5%), T_6- mancozeb 75 WP (0.2%) and T_0- control with each treatment replicating three times to manage the disease and also to evaluate the effect of treatments on the growth parameters. . It was observed that all treatments significantly increased growth parameters of garlic and reduced the intensity of disease. From the study of results, it was concluded that among all the treatments, the most effective in managing the disease was T_6- Mancozeb (27.85%) followed by T_1- Neem oil (34.76%), T_3- Clove oil (37.66%), T_2- Eucalyptus oil (37.83%), T_4- Castor oil (39.49%) and T_5- Mustard oil (40.25%) as compared to T_0- Control (49.24%) and for influencing the yield was yield (t/ha.) was T_6- Mancozeb (5.41) followed by T_1- Neem oil (4.05), T_3- Clove oil (3.83), T_2- Eucalyptus oil (3.73), T_4- Castor oil (3.56) and T_5- Mustard oil (3.31) as compared to T_0- Control (2.61).

Keywords:*Alternaria porri*, essential oils, purple blotch, yield.

INTRODUCTION

Garlic (*Allium sativum* L.) (2n=16) is the second most important allium crop after onion grown throughout the plains of India, of family Alliaceae amongst the spices and condiments. It is commonly termed as "Lasan" **(Singh *et al.*, 2021)**.Garlic has higher nutritive value as compared to other bulbous crops. It is a rich source of carbohydrates (29%), proteins (7%), fibres (0.8%), minerals (0.3%), fat (0.2%), essential oils (0.1-0.4 %) and also contains vitamin C and sulphur **(Memane*et al.*, 2008)**.In addition to this, garlic has a wide spectrum of actions. It has antibacterial, antiviral, antifungal and antiprotozoal properties. It is also beneficial to the cardiovascular and immune systems and has antioxidant and anticancer properties **(Harris *et al.*, 2001)**.

Garlic comes from Central Asia, but it's grown all over the world, including in Brazil, Mexico, Spain, India, Egypt, Bulgaria, and Hungary. One of the major bulb crops cultivated and utilized as a spice or condiment all over India is garlic. It contributes significantly to India's foreign exchange earnings.The world's largest producer of garlic is the Chinese mainland. India is the second-largest producer of garlic in the world, with a yield of roughly 81378 kg/ha from 392000 hectares of land, yielding approximately 3190000 tonnes of garlic **(FAO, 2021)**. India's top states for garlic production are Gujarat (3.29%), Uttar Pradesh (6.57%), Madhya Pradesh (62.85%), Rajasthan (16.81%), and Punjab (2.66%) **(NHB, 2021-22)(Tripathi and Lawande, 2006)**.

The major diseases of this crop are purple blotch, botrytis rot, botrytis leaf blight, cercospora leaf spot, downy mildew, fusarium basal rot, damping-off, white rot, stem and bulb nematode, mosaic virus etc. *Alternaria* sp. decay is one of the major factors responsible for economic losses in garlic **(Prajapati *et al.*, 2020)**.

The name purple blotch for this disease was proposed by **Nolla (1927)**. The pathogen of Allium was first designated as *Macrosporiumporri***(Cooke and Ellis, 1879)** and *Alternaria allii***(Nolla, 1927)**. Later both species were called *Alternaria porri***(Ciferri, 1930)**. According to **Simmons (2007)**, the conidia of *Alternaria allii* were different than those of *Alternaria porri* based on their multiple branches and beaks.Purple blotch caused by *Alternaria porri*, is the most destructive disease of *Allium* sp. (onions, garlic, shallots, leeks, scallions and chives). The pathogenicity of *Alternaria* sp. is due to production of host specific or nonspecific toxins that may induce disease. These toxins are mainly secondary metabolites that destroy susceptible cultivars by leaf necrosis. The disease usually affects the leaves and bulbs of a plant, and reducing their yield up to 97% **(Kareem *et al.*, 2012)**.

MATERIALS AND METHODS

The field investigations were carried out at the Central Research Field of the Department of Plant Pathology, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.) during *rabi* 2023-24. The seeds were sown in December, 2023 maintaining a distance of 15 cm row to row and 10 cm plant to plant.

Isolation of pathogen

Diseased leaves were first collected from infected plants and thoroughly washed under running tap water. The diseased portion of the leaves were then cut into small bits and surface sterilized with 1% NaOCl solution for 1 minute followed by washing three times with sterile distilled water and placed on media. The petri plates were wrapped and incubated at 27±2°C in an incubator. To avoid bacterial contamination streptomycin @100 ppm, was added to the media at lukewarm stage before pouring PDA into petri plates. Hyphal tip method was used for sub-culturing the fungus in media slants/petri-plates. To obtain pure culture of fungus, single spore technique was used.

Identification of pathogen

On the basis of morphological characteristics of the colony, mycelium, conidiophores and conidia and their comparison with the available literature, the organism was identified as *Alternaria porri*. The pathogen (*Alternaria porri*) isolated produced septate mycelium. Later it produced conidiophores arising singly or in small groups. The conidiophores were straight or flexuous, sometime geniculate, septate, pale or mid brown in colour and measured up to 120 µm long and 6-10 µm thick, with one or several conidial scars. A mature conidiophore usually produced solitary conidium but occasionally it also produced conidia with very short chains, straight or curved, rostrate, beak generally equal to the length of the body of the conidium, pale brown to mid golden brown in colour. Overall length of conidia ranged from 100-300 µm, 15-20µm thick in the broadest part with 7-12 transverse and zero to several longitudinal septa, beak flexuous, pale, 2-4 µm thick and tapering **(Priya *et al.,* 2016)**.

Symptomps

The initial symptoms on host leaves and floral stalks are white flecks which enlarge and produce sunken purple lesions sometimes surrounded by a yellow to pale brown border. The disease manifests itself on leaves and seed stalks. Later, the spots enlarge rapidly into purplish areas, further coalescing to form large dead patches covering several square centimetres of the leaf or shoot area. Their length may go up to 4-6 inches or even more. The purplish area of the spot is separated from the healthy green tissues by a narrow, light-coloured zone. Within a period of 15-21 days alternating light and dark zones become clearly differentiated over the whole purple surface of the leaf and seed stalk. A distinct yellowish discoloration usually extends from the spots to the tips and bases of the leaves. The leaves shrivel, usually from the tip **(Nolla, 1927)**.

The most characteristic symptom of this disease as observed is the appearance of dark purple colour on the spots, the dark shade being due to the dark brown colour of the fruiting mycelium. The purple colour has often been seen to fade away in the case of very old lesions, the centre of the spots, however, retain a mild purple colour **(Pandotra, 1964)**.

In order to assess the effect of various treatment, seven treatments applied*viz*. T_1- neem oil (5%), T_2- eucalyptus oil (5%), T_3- clove oil (5%), T_4- castor oil (5%), T_5- mustard oil (5%), T_6- mancozeb 75 WP (0.2%) and T_0- control with each treatment replicating three times to manage the disease and also to evaluate the yield of crop.

Observations were recorded under field conditioni.e., disease intensity (%) at 30, 60 and 90 days after incidence of purple blotch and yield.

Percent disease index was calculated by using the following formula **(Wheeler, 1969).**

$$\text{Percent Disease Index (PDI)} = \frac{\text{Sum of individual ratings}}{\text{Total number of ratings} \times \text{Maximum disease grade}} \times 100$$

Table 1. Disease scale

Grade	Description
0	No disease symptoms.
1	A few spots towards tip covering 10% leaf area.
2	Several dark purplish brown patches covering up to 20% leaf area.
3	Several patches with paler outer zone covering up to 40% leaf area.
4	Leaf streaks covering up to 75% leaf area or breaking of the leaves from centre.
5	Complete drying of the leaves or breaking of the leaves from centre.

RESULTS AND DISCUSSION

Effects of essential oils were assessed on plant disease intensity and yield of garlic.

Effects of essential oils were assessed on plant disease intensity of garlic. The data presented in **Table2.** and depicted in **Figure2.** revealed that at 30 DAS the disease intensity of purple blotch of garlic significantly decreased in the treatment T_1- Neem oil (5.75%), followed by T_6- Mancozeb (5.98%), T_2- Eucalyptus oil (7.83%), T_3- Clove oil (7.94%), T_4- Castor oil (9.25%) and T_5- Mustard oil (9.85%) as compared to non-treated check, T_0- Control (9.98%).

At 60 DAS the disease intensity of purple blotch of garlic significantly decreased in the treatment T_6- Mancozeb (20.49%) followed by T_1- Neem oil (26.31%), T_3- Clove oil (30.93%), T_2- Eucalyptus oil (31.34%), T_4- Castor oil (32.03%) and T_5- Mustard oil (33.34%) as compared to non-treated check, T_0- Control (37.37%).

At 90 DAS the disease intensity of purple blotch of garlic significantly decreased in the treatment T_6- Mancozeb (27.85%) followed by T_1- Neem oil (34.76%), T_3- Clove oil (37.66%), T_2- Eucalyptus oil (37.83%), T_4- Castor oil (39.49%) and T_5- Mustard oil (40.25%) as compared to non-treated check, T_0- Control (49.24%).

Among the treatments, disease intensity (%) recorded in treatments T_1- Neem oil @5% (22.27) followed by T_3- Clove oil @5% (25.51), T_4- Castor oil @5% (26.92) and T_0- Control (32.19) showed similar findings (21.35, 25.13, 24.76 and 32.00) respectively supported by **Singh *et al*. (2021)**. T_2- Eucalyptus oil @5% (25.66) and T_5- Mustard oil @5% (27.81) showed similar finding as 25.44 and 26.10 respectively supported by **Rahmatzai*et al*. (2017)**. T_6- Mancozeb (18.10) showed similar finding (19.00) supported by **Chaurasia *et al.***

(2007).The most active component of neem oil is azadirachtin, followed by nimbidol, nimbin, sodium nimbinate, nimbidin, salannin and quercetin. Azadirachtin is a terpene limonoid present in seeds that has properties, which are both antifeedant and toxic to pathogens. Through antimicrobial activity, it inhibits microbial growth or potential to break the cell wall of pathogen **(Vijaykumar *et al.*, 2022)**.

Table 2. Effect of treatments on disease intensity(%) of purple blotch of garlic at 30, 60 and 90 DAS

Treatments		Disease intensity (%)		
		30 DAS*	60 DAS*	90 DAS*
T_0	Control	9.98[a]	37.37[a]	49.24[a]
T_1	Neem oil (5%)	5.75[d]	26.31[d]	34.76[d]
T_2	Eucalyptus oil (5%)	7.83[c]	31.34[c]	37.83[c]
T_3	Clove oil (5%)	7.94[c]	30.93[c]	37.66[c]
T_4	Castor oil (5%)	9.25[b]	32.03[c]	39.49[b]
T_5	Mustard oil (5%)	9.85[ab]	33.34[b]	40.25[b]
T_6	Mancozeb (0.2%)	5.98[d]	20.49[e]	27.85[e]
C.D. (0.05)		0.65	1.18	1.23
S.Ed. (±)		0.30	0.54	0.57

***Mean of three replications**

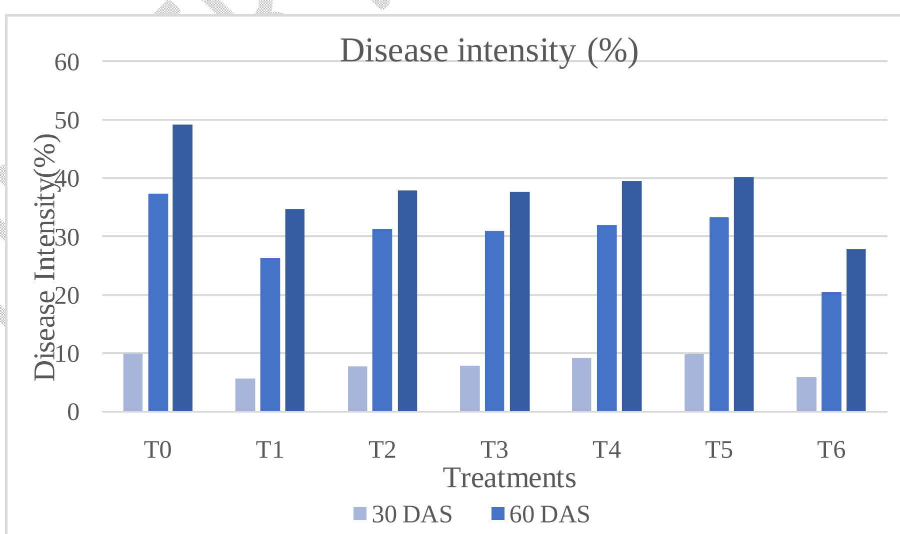

Figure 2.Effect of treatments on disease intensity of garlic at 30, 60 and 90 DAS

Study of data on yield of garlic is presented in **Table 3.** and illustrated in **Figure 3.** reveals that the yield (t/ha.) significantly increased in the treatment T_6- Mancozeb (5.41) followed by T_1- Neem oil (4.05), T_3- Clove oil (3.83), T_2- Eucalyptus oil (3.73), T_4- Castor oil (3.56) and T_5- Mustard oil (3.31) as compared to non-treated check, T_0- Control (2.61).

Among the treatments, yield recorded by the treatments T_1- Neem oil @5% (4.05) and T_0- Control (2.61) showed similar findings (4.06 and 2.60) respectively supported by **Singh *et al.* (2021)**. T_6- Mancozeb (5.41) showed similar finding (5.20) supported by **Akter *et al.* (2022)**.

Table 3. Effect of treatments on yield (t/ha.) of garlic

Treatments	Treatment details	Yield (t/ha.)*
T_0	Control	2.61
T_1	Neem Oil (5%)	4.05
T_2	Eucalyptus Oil (5%)	3.73
T_3	Clove Oil (5%)	3.83
T_4	Castor Oil (5%)	3.56
T_5	Mustard Oil (5%)	3.31
T_6	Mancozeb 75 WP (0.2%)	5.41
C.D. (0.05)		0.27
S.Ed. (±)		0.12

***Mean of three replications**

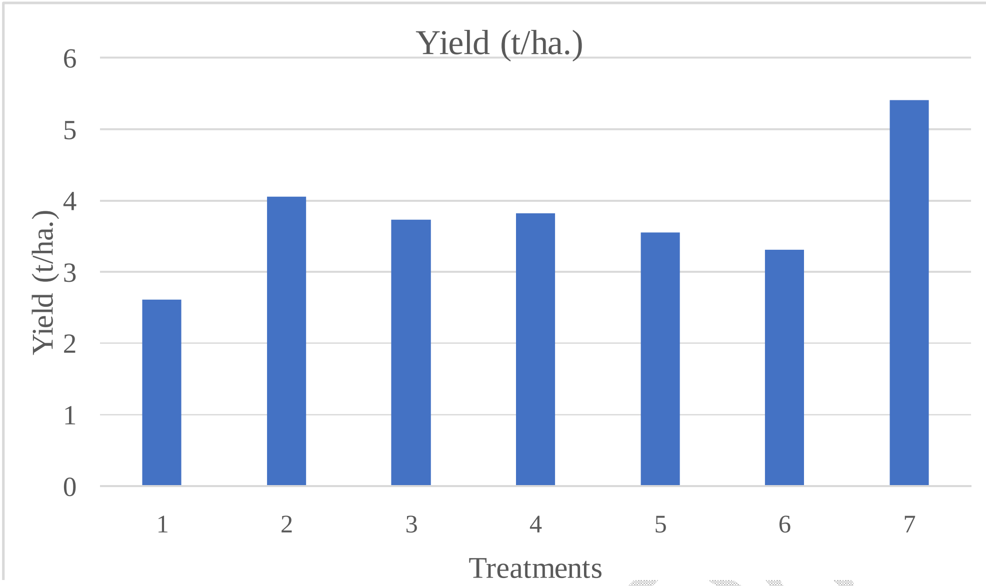

Figure 3. Effect of treatments on yield (t/ha.) of garlic

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