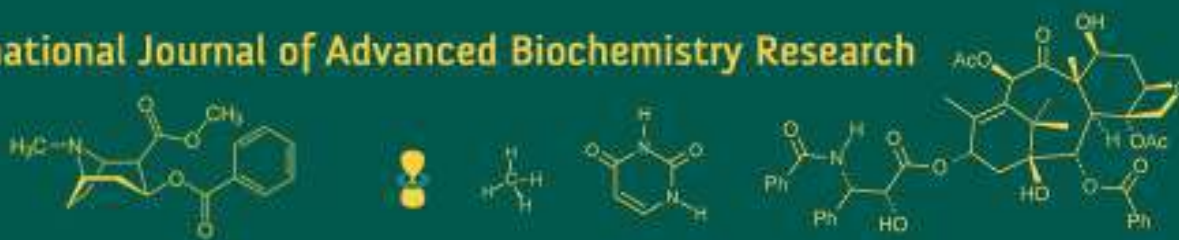


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Evaluation of certain fungicides against *Alternaria sesame* causing leaf spot disease in Sesame, (*Sesamum indicum* L.) under *In-Vitro* and *In-Vivo* conditions

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Abstract

Sesame, (*Sesamum indicum* L.), is one of the world's ancient important oilseed crop cultivated in more than 55 countries of the world, belonging to the family *Pedaliaceae* and native of India. A test was conducted two consecutive year 2023-24 and 2024-25 for the test was conducted in laboratory department of Plant Pathology and at Student Research Farm Pili Kothi, Jaunpur. Seven fungicide were tested under *In-vitro* and *In-Vivo*. Viz., Carbendazim+Mancozeb, Mancozeb, Thiophanate methyl, Chlorothalonil, Captan+Hexaconazole, Propineb and Metalaxyl @0.25%. Under *In-Vitro* among the tested fungicide the best effective fungicide was found with Carbendazim+Mancozeb and Mancozeb with (0.00 cm) radial growth having hundred percent inhibition over control recorded same in both year 2023-24 and 2024-25 and least effective was found with Metalaxyl with radial growth of 4.20 cm and 4.32 cm with 6.66% and 28.00% respectively inhibition over control. In both the year 2023-24 and 2024-25 under *In-Vivo* minimum average disease incidence found with Carbendazim+Mancozeb 10.40% and 10.50% during 2023-24 and 2024-25 whereas Percentage disease control recorded was 73.86% and 73.75% recorded with average yield of 1200 kg./ha. And 1150 kg. /ha. Respectively. The least effective fungicide was found with Captan+Hexaconazole with average disease incidence of 35.25% and 34.155 having Percentage disease control 11.43% and 14.62% recorded with average yield of 700 kg./ha. And 600 kg. /ha. Respectively found in both the year 2023-24 and 2024-25.

Keywords: Sesame, fungicides, *Alternaria sesame*, *In-Vitro* and *In-Vivo*

Introduction

Sesame, (*Sesamum indicum* L.), is one of the world's ancient important oilseed crop cultivated in more than 55 countries of the world belonging to the family *Pedaliaceae* and native of India. It is an herbaceous, annual, self-pollinated (considerable insect cross pollination) crop with $2n=26$ chromosomes and which is mentioned in *Atharva Veda*, *Ashtadavaiji*, *Manusmriti* and *Puranas* as tila indicating the presence of sesame in India since the pre-christian era.

The mesopotamian ellu seems to be connected with the Dravidian word and crop ellu from the Indian sub-continent. Genetic, morphological and phytochemical evidences support the hypothesis that domesticated sesame had originated on the Indian subcontinent (Bedigian and Harlan, 1986) ^[1]. The Portuguese introduced sesame to Brazil where it is known as gangelim, a name is as directly comparable with the Indian name gingelly as to suggest that it was from their Indian colonies.

About 78 percent of sesame produced in India is used for oil extraction. India export sizeable quantity of sesame seeds to different countries. Sesame oil is used for edible purpose besides; it is widely used in the manufacture of soaps, scented hair oils, cosmetics, insecticides, perfumes, paints and in pharmaceutical products. Seeds are directly used in different foods and also as a flavouring agent. In certain parts of India, such as Andhra Pradesh, Ghani press cake from dehulled seed is used as an ingredient for curry preparations. The hull accounts for 15-20% of the whole seed and contains 2-3% oxalic acid and 1-2% calcium and is high in fibre. A hundred gram of seeds provides 502 calories. Sesame oil is important cooking oil in the south India. It is really the poor man's substitute for ghee. Powdered sesame seeds with rice and honey are used to prepare funeral cakes called Pindas. The oilcake is an edible cake. It is eaten mixed with sugar by poor people. It is also used as a livestock feed especially for

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Milch animals and poultry because of rich in protein, vitamin (Niacin), minerals (Ca and P) and methionine content. Sesame cake is also used as soil amendment for control of various diseases (Maiti *et al.*, 1985) [8].

In India, sesame crop is commonly grown in *Kharif* season, also grown as pre-*Kharif* and summer crop. Sesame is basically a quantitative short day plant and with a 10 hour day period normally flowers in 40-50 days. Temperature range for optimum from seedling emergence to flowering and fruiting has been found to be in the range 27-33^o C. A temperature of 40^o C or above at flowering can seriously affect fertilization and number of capsule set. A frost free growing period is required for sesame; hard frost at maturity will not only kill plants but will also reduce seed and oil quality. It can also adversely affect minor seed oil constituents such as *sesamol* and *sesamin*.

The area, production and productivity of sesame has been reported to be 13.05 and 15.31 lakh hectares, 6.8 million tonnes and 8.74 lakh tonnes, 520 kg/ha. And 571 kg/ha. During 2023 respectively, in the World and India. Major sesame growing states in India are: West Bangal (33%), Gujarat (17%), Madhya Pradesh (14%), Uttar Pradesh (14%), Rajsthan (9%). However, crop is grown in all the states of country. The total area in Uttar Pradesh under sesame was 3.03 lakh hectares area, with production 0.08 metric tons and productivity of 239 kg/ha (Department of Agriculture and Farmers Welfare 2023-24). Sesame is called as —Queen of oilseeds in view of its high quality edible oil (38 to 54%) and proteins 18 to 25%.

Among the major factors responsible for lower yields, diseases play an important role. Sesame is also affected by many biotic and abiotic stresses. Among the biotic agents, fungi cause major diseases, followed by Bacteria, Viruses and Nematodes. Major Sesame diseases caused by fungi *Viz.* Leaf spot / blight (*Alternaria sesami*), *Cercospora* leaf spot (*Cercospora sesami*), Wilt (*Fusarium oxysporum* f. sp. *sesami*), Root rot (*Rhizoctonia bataticola*), Powdery mildew (*Sphaerotheca fuliginia*), stem blight (*Phytophthora parasitica*) and Anthracnose (*Colletotrichum capsici*); bacterial Leaf blight / spot (*Pseudomonas sesami*); Mycoplasmal such as phyllody (*Mycoplasma*); viral diseases such as Leaf curl (*Nicotina virus* 10), Mosaic (*Cucumber mosaic virus*), Necrosis (Tobacco streak virus) and root knot (*Meloidogyne hapla*) nematode (Bhale *et al.*, 1998) [3]. Among these diseases, at present leaf spot/blight caused by *Alternaria sesami* (Kawamura) is widespread and have continued to be the major constraints in the production and productivity of sesame all over the country in general as well as in the state of Uttar Pradesh particularly.

The *Alternaria* leaf blight disease was first reported by Dey (1948) [6] from Uttar Pradesh, which later spread in sesame growing region of the country (Dolle, 1981; Kolte, 1985; Narute and Utikar, 1994) [4, 11, 12]. The disease has been reported to cause 20 to 40 per cent yield losses all over India. The pathogen being seed borne, initially dark necrotic lesions (2-5 mm) appear on the hypocotyls as well as cotyledons. The initial symptoms of leaf blight of sesame incited by *A. sesami* appears right from seedling stage (30 days old) as small isolated light brown to dark brown circular spots (1-2 mm) on leaves mostly marginal and apical. As the infection progress, these spots enlarge and become irregular. In the centre of the spots, there appears a brown dot surrounded by a number of alternating dark concentric rings, later lesions coalesce to form large patches

covering greater area of leaves, resulting in defoliation in severe cases. The symptoms also appear on stem, petiole and pods. Infection on stem covered majority area and produced browning and blighting of stem, while on pods deep seated spots damage the seed quality and caused heavy loss of seed yield.

Materials and Methods

Efficacy of fungicides against Pathogen under *In-Vitro* condition during 2023-2024 and 2024-2025

The relative efficiency of seven fungicides *Viz.*, Carbendazim+Mancozeb, Mancozeb, Thiophanate methyl, Chlorothalonil, Captan+Hexaconazole, Propineb and Metalaxyl @0.20% belonging to different group was tested against the pathogen *In-Vitro* condition in laboratory of Plant Pathology, TDPG, College, Jaunpur. To find out percent inhibition on growth of the pathogen in culture by Poison Food Technique. Request quantity of each fungicide was incorporated in sterilized 2.0% Potato Dextrose Ager medium, thoroughly mixed by shaking prior to proving in sterilized plate and were allowed to solidify. These petri plate were inoculated with 5mm disc. The inoculum cut by the sterilized corn borer from 10 days old culture of the pathogen and inoculum was transfer to in the centre of plate and incubated at 25±1°C. Each treatment was replicated thrice with C.R.D. design. The petri plate without fungicide to serve as control. The efficacy of fungicide in each treatment and average of three replication were calculated. Per cent mycelium growth inhibition was calculated by following formula as given below

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

Where,

C = Fungus in control

T = Growth of fungus in treatment

Experimental Details: (*In-Vitro*)

Replication: 3

Treatment: 8

Experimental design: C.R.D.

Efficacy of fungicides against *Alternaria sesami* under *In-Vivo* condition during 2023-2024 and 2024-2025.

In order to find out the suitable five fungicides was the found infective *In-Vivo* condition. A field trial was conducted at Student Research Farm, Pili Kothi, T.D.P.G College, and Jaunpur. The effective fungicide was assessed in find trail during *Kharif* season 2024-25. A highly sick field with known history of *Alternaria* blight of sesame variety "T-78" was sowing in (3×1) meter Plot size in Randomized Block Design with three replication. The five fungicide *Viz.*, Carbendazim+Mancozeb, Mancozeb, Thiophanate methyl, Chlorothalonil and Captan+Hexaconazole were used as spray for recording the disease incidence in percentage was transfer into angles and analysed statistically. Yield was estimated a plot basis without the border row in the q/ha. Disease incidence was calculated using following formula

$$\text{Disease incidence (\%)} = \frac{\text{Total number of infected}}{\text{Total plant population}} \times 100$$

The experimental details was as for given below:-

Experimental details: (In-Vivo)

- Replication: 3
- Treatment: 5
- Experimental design: R.B.D.
- Crop: Sesame
- Variety: T-78
- Location: Student Research Farm (Pili Kothi)

•Plot size: 3x1 Meter

Treatment details:

- T1: Foliar application with Carbendazim+Mancozeb.
- T2: Foliar application with Mancozeb.
- T3: Foliar application with Thiophanate methyl.
- T4: Foliar application with Chlorothalonil.
- T5: Foliar application with Captan+Hexaconazole.

Table 1: Effect of fungicides on colony growth of *A. sesami* on P.D.A. medium after 7 days during 2023-2025

S.No.	Name of fungicide	Dose (%)	Average fungal growth (cm) Year 2023-2024	Average fungal growth (cm)Year2024-2025	Percent inhibition over control (%)Year 2023-2024	Percent inhibition over control (%)Year2024-2025
1.	Carbendazim+mancozeb	0.2	0.00	0.00	100.00	100.00
2.	Mancozeb	0.2	0.00	0.00	100.00	100.00
3.	Thiophanate methyl	0.2	2.53	2.50	43.77	58.33
4.	Chlorothalonil	0.2	2.83	2.70	37.11	55.00
5.	Captan+ Hexaconazole	0.2	3.43	3.32	23.77	44.66
6.	Propineb	0.2	4.10	4.25	08.88	29.16
7.	Metalaxyl	0.2	4.20	4.32	06.66	28.00
Control		0.0	4.50	6.00	0.00	0.00
C.D. at 5% level			(0.428)		(0.417)	

Table 2: Efficacy of different fungicides against Alternaria blight of *Sesamum* under field condition during (2023-25)

S.No.	Fungicides	Dose (%)	Average disease Incidence (%) Year 2023-2024	Average disease incidence (%)Year 2024-2025	Percentage disease control Year 2023-2024	Percentage disease control Year 2023-2024	Average Yield during 2023-2024 (Kg./ha.)	Average Yield during 2024-2025 (Kg./ha.)
1.	Carbendazim+Mancozeb	0.2	10.40	10.50	73.86	73.75	1200	1150
2.	Mancozeb	0.2	14.30	14.10	64.07	64.75	1180	1000
3.	Thiophanate methyl	0.2	20.50	20.20	48.49	49.50	800	700
4.	Chlorothalonil	0.2	28.40	28.30	28.64	29.25	750	650
5.	Captan+Hexaconazole	0.2	35.25	34.15	11.43	14.62	700	600
6.	Control		39.80	40.00			300	350
C.D. at 5%			(2.30)	(2.10)				

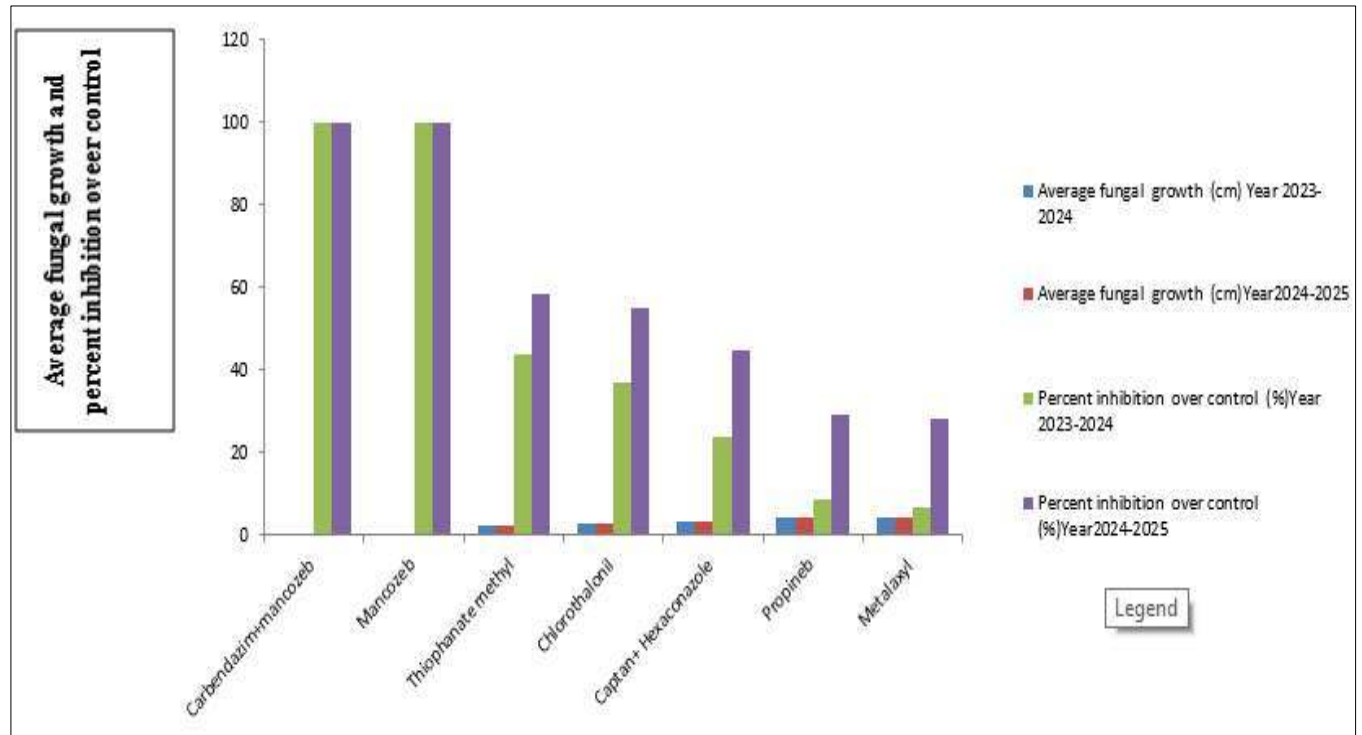


Fig.2: Effect of fungicides on colony growth of *A. sesami* on P.D.A. medium after 7 days during 2023-24 and 2024-2025

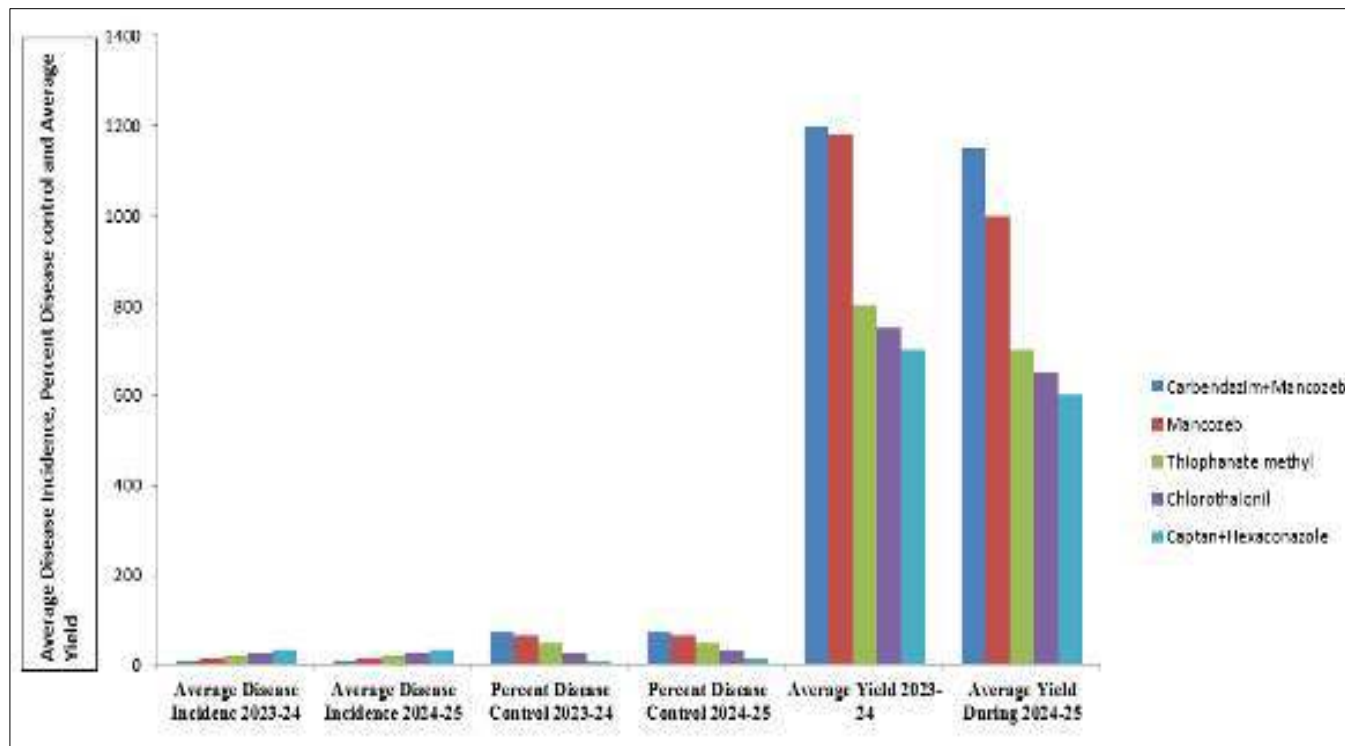


Fig.2: Effect of Different Fungicides on Average Disease Incidence and Percent Disease Control and Average Yield During 2023-24 and 2024-25



Fig 1: Symptom of Alternaria blight of Sesame

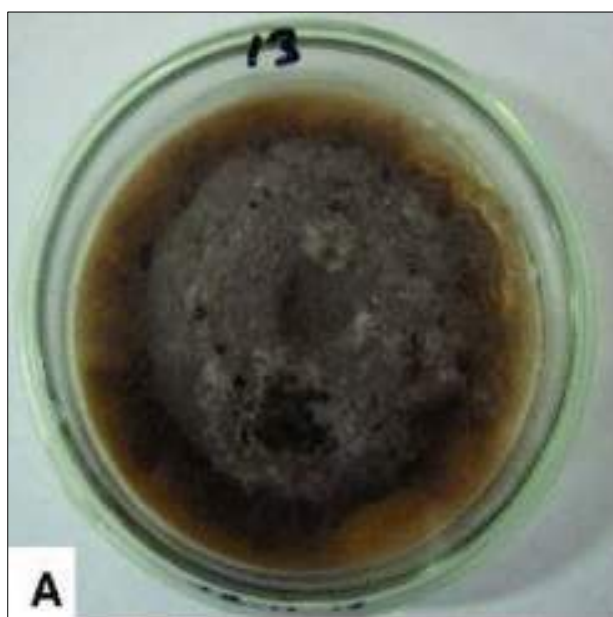


Fig 2: Mycelial colony of *Alternaria sesame*



Fig 3: Conidia of *Alternaria sesami*



Fig 4: Mycelium of *Alternaria sesame*

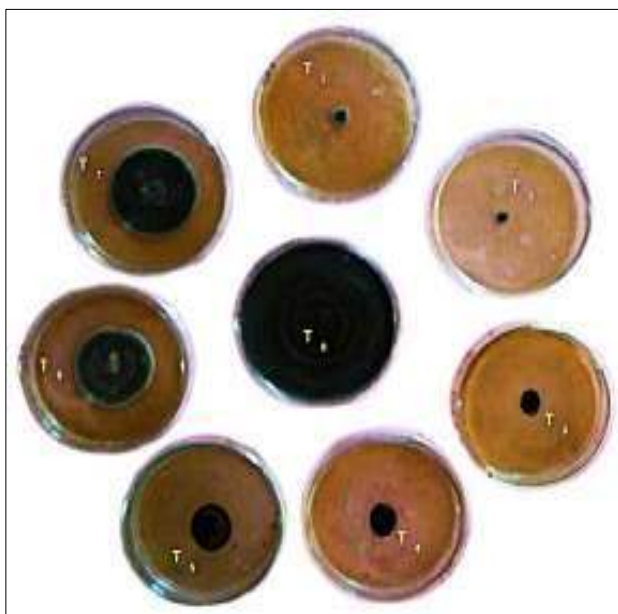


Fig 5: Effect of Different Fungicide on Radial Growth of the Pathogen during 2023-24



Fig 6: Effect of Different Fungicide on Radial Growth of the Pathogen during 2024-25

Result and Discussion

Efficacy of fungicides against *Alternaria sesami* under *In-Vitro* condition

Seven fungicide were tested according to the procedure mentioned under "Materials and Method" Growth of the pathogen was observed and average diameter of colony in each Petri dish was recorded. Percent over inhibition over control was calculated separately for each treatment and presented in Table 1.

The result presented in Table 1. Plate.1 and corresponding histogram Fig.1 during year 2023-2024 showed that all the fungicide tested were significantly superior to the control in inhibiting the growth of the pathogen. The tested fungicide Carbendazim+Mancozeb and Mancozeb proved to be the most effective fungicide as they showed (0.00cm) fungal growth and complete inhibition of the fungal growth (100%). Thiophanate methyl and Chlorothalonil were the next best effective fungicide which recorded the growth of 2.53cm and 2.83cm, respectively, and their percent inhibition of the fungal growth compared to our control were 43.77% and 37.11%, respectively. Both were statistically at par with each-other. Captan+Hexaconazole and Propineb were the next good effective fungicide which recorded the growth of 3.43cm and 4.10cm, respectively, and their percent inhibition over control were 23.77% and 8.88%. The least effective fungicide was Metalaxyl, which showed the maximum average fungal growth (4.20cm) and minimum inhibition (6.66%) over control. The similar result was also observed by Meena *et. al.*, (2013) ^[9].

The result presented in Table 1. Plate 2. And corresponding histogram Fig.1 during year 2024-2025 showed that all the fungicide tested were significantly superior to the control in inhibiting the growth of the pathogen. The tested fungicide Carbendazim+Mancozeb and Mancozeb proved to be the most effective fungicide as they showed (0.00cm) fungal growth and complete inhibition of the fungal growth (100%). Thiophanate methyl and Chlorothalonil were the next best effective fungicide which recorded the growth of 2.50cm and 2.70cm, respectively, and their percent inhibition of the fungal growth compared to our control were 58.33% and 55.00%, respectively. Both were statistically at par with each-other. Captan+Hexaconazole and Propineb were the next good effective fungicide which

recorded the growth of 3.32cm and 4.25cm, respectively, and their percent inhibition over control were 44.66% and 29.16%. The least effective fungicide was Metalaxyl, which showed the maximum average fungal growth (4.32cm) and minimum inhibition (28.00%) over control. Similar result was also recorded by Jewaliya *et.al.* (2021) ^[10].

Efficacy of fungicides against *Alternaria sesami* under *In-Vivo* condition

The five fungicide viz., Carbendazim+Mancozeb, Mancozeb, Thiophanate methyl, Chlorothalonil and Captan+Hexaconazole were used as foliar spray. For recording the disease incidence, four randomly selected plant per plot were examined and the disease incidence in percent and yield under field condition during the crop season (2023-2024 and 2024-25). The disease incidence recorded were summarized in Table 2.

The result of Table 2. And its corresponding histogram (Fig.2) of field trial with five fungicides that indicate their effectiveness in minimizing the disease. In the year 2023-24, spraying of fungicide Carbendazim+Mancozeb (0.2%) at the interval of 15 days was found most effective in minimizing disease the minimum disease incidence (10.40%) and reducing the percentage disease control (73.86%) with average yield of 1200 kg./ha. The next best effective fungicide was Mancozeb and Thiophanate methyl which showed 14.30% and 20.50% disease incidence and its corresponding percent disease control 64.07% and 48.49%, with average yield of 1180 kg./ ha. And 800 kg. /ha. Respectively. These were statistically different from each other. The next effective fungicide was Chlorothalonil which showed 28.40% disease incidence and 28.64% disease control having yield of 750 kg. /ha. The least effective fungicide was Captan+Hexaconazole which showed the maximum disease incidence (35.25%) and minimum percent disease control (11.43%) with average yield of 700 kg. /ha.

The result of Table 2. And its corresponding histogram (Fig.2) of field trial with five fungicides that indicate their effectiveness in minimizing the disease. In the year 2024-25, spraying of fungicide Carbendazim+Mancozeb (0.2%) at the interval of 15 days was found most effective in minimizing disease the minimum disease incidence (10.50%) and reducing the percentage disease control (73.75%) with average yield of 1150 kg./ha. The next best effective fungicide was Mancozeb and Thiophanate methyl which showed 14.10% and 20.20% disease incidence and its corresponding percent disease control 64.75% and 49.50%, having average yield of 1000 kg./ha. And 700 kg. /ha. Respectively. These were statistically different from each other. The next effective fungicide was Chlorothalonil which showed 28.30% disease incidence and 29.25% disease control with average yield of 650 kg. /ha. The least effective fungicide was Captan+Hexaconazole which showed the maximum disease incidence (34.15%) and minimum percent disease control (14.62%) with average yield of 600 kg. /ha.

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