Management of Cercospora Leaf Spot in Mungbean by use of Botanicals, Fungicides and Bio-agents in *In Vivo*.

ABSTRACT:

~~This study aimed to investigate the Management of Cercospora leaf spot in mungbean by use and efficacy of botanicals, fungicides and bio-agents in *In Vivo*.~~ Mung bean is an important pulses crop worldwide and one of the most important pulses in India. This study aimed to investigate the management of Cercospora leaf spot in mungbean by use and efficacy of botanicals, fungicides and bio-agents in *In Vivo*. The experiment was carried out during kharif 2019 in randomized block design with ten treatments and three replications. Mung bean crop is ~~It is known to~~ suffer from many types of diseases, Cercospora leaf spot is one of them. Cercospora leaf spot causes *Cercospora canescens* much damage to the production of mung bean. To manage the disease an investigation at research laboratory in the Department of Plant Pathology, ANDUA and ~~&~~T Kumarganj, Ayodhya was carried out to evaluate the efficacy of plant extracts *viz*. Neem leaf extract, Onion, Garlic clove extract, Tulsi, and Ginger @ 10% against *Cercospora canescens*. ~~*In situ* (field) experiments~~ ~~The present investigation were carried out during kharif 2019 at students instructional farm of A.N.D. University of Agriculture and Technology Kumarganj, Ayodhya (U.P.) India located at latitude 26.47 0N, longitude 82.12 0E and altitude 113m above the sea level. Were also carried out in randomized block design with ten treatments and three replications.~~ The growth inhibition ~~growth~~ was obtained in Garlic followed by Onion, Tulsi, Ginger, and Neem. The disease incidence was not much reduced at 10% concentration at 60 days after sowing. The same trend was also found in per cent disease control. **The** two fungicides namely, Carbendazim and Thiram were evaluated against *C. canescens* in vitro. Their results ~~results~~ showed that Carbendazim completely inhibited the radial growth at 100 ppm. However, Thiram provided some growth at 500 ppm concentration. *Trichoderma viride* was more effective in reducing radial growth as compared to *T. harzianum* at 4 and 7 days of incubation in dual culture technique and differed significantly to each other. However, the bioagents *viz*., *T. viride and T. harzianum* were ineffective against Cercospora leaf spot when applied as foliar spray. In general, uses of resistant varieties are most economical means of disease management, fungicides (Carbendazim and Thiram) have been found effective for the management of diseased~~.~~

~~*Trichoderma viride* was more effective in reducing radial growth as compared to *T. harzianum* at 4 and 7 days of incubation in dual culture technique and differed significantly to each other. However, the bioagents *viz*., *T. viride and T. harzianum* were ineffective against Cercospora leaf spot when applied as foliar spray.~~

KEY WORDS: *Cercospora canescens*, botanical products, mungbean.

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INTRODUCTION

Mungbean (*Vigna radiate* L.), belongs to the family leguminosae and sub family Papilionaceae. Pulses are major sources of proteins among the vegetarians in India, and complement the staple cereals in the diets with proteins, essential amino acids, vitamins and minerals. They contain 22-24% protein, which is almost twice the protein in wheat and thrice that of rice. Pulses provide significant nutritional and health benefits, and are known to reduce several non-communicable diseases such as colon cancer and cardio- vascular diseases. Production followed by pigeon pea (18-20%), mungbean (11%), urdbean (10-12%), lentil (8-9%) and other legumes (20%) (Laxmipathi *et al.*, 2013). Presently, the per capita share of pulses in nutrition supply in India with respect to energy, protein and fat is 117.4 K cal, 6.9 g and 1.0 g per day respectively. ~~An adult male and female requires 80 and 70 g per capita per day, respectively for balanced diet (Anonymus, 2004).~~ ~~The crop is generally grown during *kharif* as rainfed crop. It has the yield potential of 11 to 12 q ha-1 (Anonymus, 2004), as against the national average of 4.17 q ha-1.~~ Among various factors responsible for low yields, biotic and abiotic stresses take a heavy toll of the crop, out of which diseases cause an estimated yield loss of 21.93 to 68.77% (Sharma *et al.*, 2008). Mung bean crop

Covers a total world area of 5 m ha with a total production of 3 m ton (John, 1991). ~~India's contributing 23% global pulses in world production from an area of about 12.08% (Anonymous, 2012).~~ Mung bean suffers from many diseases caused by fungi, bacteria, viruses, nematodes and also abiotic stresses. In green gram, considerable losses in the production occur as a result of *cercospora* leaf spot (*Cercospora canescens*), anthracnose (*Colletotrichum lindemuthianum*), powdery mildew (*Erysiphe polygoni*), bacterial blight (*Xanthomonas phaseoli*), rust (*Uromyces appendiculatus*), leaf crinkle and yellow mosaic virus. Among these, cercospora leaf spot is a serious problem in all the areas having rice based cropping systems of the country (Abbaiah, 1993). Grain yield losses have been reported up to 23% due to cercospora leaf spot in mung bean (Quebral and Cagampang, 1970). Maximum loss of 61% was observed in case of grain yield (Iqbal et al., 1995). The disease starts appearing about 30 days after sowing (Grewal *et al.*, 1980). The objective/s were

Methods and Material:

1. Dscription of the study area~~Management of *Cercospora canescens in vivo:*~~

The study was~~present investigation were~~ carried out during kharif 2019 at students instructional farm of A.N.D. University of Agriculture and Technology Kumarganj, Ayodhya (U.P.) India located at latitude 26.47 ^{0}N, longitude 82.12 ^{0}E and altitude 113m above the sea level. The experiment was laid out in randomized block design (RBD) with ten treatments with control and three replications. ~~The plan of layout of the experiment is shown in~~

2. Experimental treatments and procedures

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The ~~plan of layout of the~~ experimental treatments arranged~~is~~ as listed~~shown~~ below~~in~~

List 2.1. Treatments Detail

T_1- Neem leaf extract (*Azadirachta indica*)	-@10 ppm/kgseed
T_2- Garlic bulb extract (*Allium sativum*)	- @ 10 ppm/kg seed
T_3- Tulsi extract (*Ocimum sanctum*)	- @ 10 ppm / kg seed
T_4- Onion extract (*Allium cepa*)	- @ 10 ppm / kg seed
T_5- Zinger extract (*Zingiber officinale*)	- @ 10 ppm / kg seed
T_6- *Trichoderma viride*	- @ 4g / kg seed
T_7- *Trichoderma harzianum*	- @ 4g/ kg seed
T_8 - Carbendazim	- @ 2g/ kg seed
T_9- Thiram	- @ 1g / kg seed
T_{10} – Untreated (Check)	

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Efficacy of fungicide against *Cercospora canescens* in *In Vivo*

The effective fungicides were used for seed treatment *in vivo*. Seeds of mungbean variety 'Kopergoan' were moist for 12 hrs. prior to s~~h~~owing and then treated with the Carbendazim @ 2g/kg seed + Thiram @ 1g/kg seed, treated seeds of susceptible variety 'Kopergoan' were sown in each plot. The p~~P~~er~~-~~centage of cercospora incidence was recorded at 30 and 45 days after sowing.

Efficacy of plant extracts against *C. canescens* in *In Vivo*

The effective concentration of plant extracts found effective *in vitro* were further tested *in vivo*. After 7 days plant extracts (10 per cent) @ 100 ml per kg of soil was thoroughly mixed to determine the effect of plant extract *in vivo*. Twelve seeds of a highly susceptible variety of mungbean (Kopergoan) were sown in each plot ~~where finally 15 plants were maintained. The experiment was conducted in RBD with 10 treatment including control.~~

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First appearance of disease, disease incidence and per cent disease control were recorded at 30 and 45 days after sowing. Percent of disease incidence and per cent disease control was calculated by using following formula.

$$\text{Per-cent disease incidence} = \frac{\text{Number of infected plants}}{\text{Total number of plants}} \times 100$$

$$\text{Per cent disease control} = \frac{C - T}{C} \times 100$$

Where,

C = Per cent disease incidence of control plots

T = Per cent disease incidence in treated plots

Efficacy of bio-agents against *C. canescens* in *In Vivo*

The pure culture of antagonists was used for seed treatment. Pure culture of *Trichoderma harzianum* and *Trichoderma viride* was prepared with 15 days old culture multiplied in Potato Dextrose Agar and Nutrient agar medium. Potato Dextrose Agar medium and Nutrient agar medium was filled in the Petri plates, approximately up to 1/3 of their total capacity. The medium of each flask were sterilized at 15 *p.s.i.* for 20 minutes. After sterilization, broth was inoculated with mm disc of actively growing culture of most effective isolate of *Trichoderma harzianum* and *Trichoderma viride*. Flasks were incubated at 25 ± 2^0C for 14-15 days till the whole surface was completely covered by mycelial mat. The liquid cultures of the bio-agents were filtered through Whatman filter paper No.44. Mycelial mat was desiccated at room temperature for three days. Dried mycelial mats were grinded by pestle and mortar to get pure powder of these bio-agents.

This preparation was used for the seed treatment @ of 4 gm per kKg seed of mungbean. The seed was treated with bio-agents separately and sown in plots as described earlier in three replications. The sowing of untreated seeds served as check. Per cent wilt incidence was recorded at 30 and 45 days after sowing.

Results ~~Experimental Findings:~~

1. Efficacy of botanicals, chemicals and bio-agents against *Cercospora canescens in vivo*.

1.1 Effect of botanicals against *Cercospora canescens* on disease incidence and disease reduction *in vivo*

Ten per cent concentration was found most effective *in vitro* was further tested *in vivo* at 30 days and 45 days after sowing.

(i) At 30 days after sowing:

The minimum disease incidence was found in Garlic (22.70 %), followed by Tulsi (30.90 %), Onion (32.00 %), Ginger (32.80 %), Neem (33.80 %). The per cent disease incidence in between however Neem, Tulsi, Onion, and Ginger were significantly at par to each other while the ~~manimum~~minimum disease incidence was found in Garlic (Table 1 and fig. 1).

The maximum disease reduction was found in Garlic (71.63 %) followed by Tulsi (61.38 %), Onion (60.00 %), Ginger (59.00 %), Neem (57.75 %). The per-cent of disease reduction ~~in~~ between Neem, Garlic, Tulsi, Onion and Ginger were significantly differed from each other with respect to ~~per cent disease~~ contol treatments (Table 1 and fig. 1).

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Table 1. Effect of plant extracts on disease incidence and disease reduction against *Cercospora canescens* mungbean *in vivo* at 30 days after sowing

Plant extract	Concentration (%)	Disease incidence (%)	Disease Reduction (%)
Neem (leaf)	10	33.80 (35.5[illegible])	57.75 (49.46)
Garlic (bulb)	10	22.70 (28.4[illegible])	71.63 (57.82)
Tulsi (leaf)	10	30.90 (33.7[illegible])	61.38 (51.58)
Onion (bulb)	10	32.00 (34.4[illegible])	60.00 (50.77)
Ginger (rhizome)	10	32.80 (34.9[illegible])	59.00

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			(50.19)
Control	-	80.0 (63.43)	0.00 (0.00)
SEm±	-	1.90	0.63
CD at 5%	-	5.98	0.00

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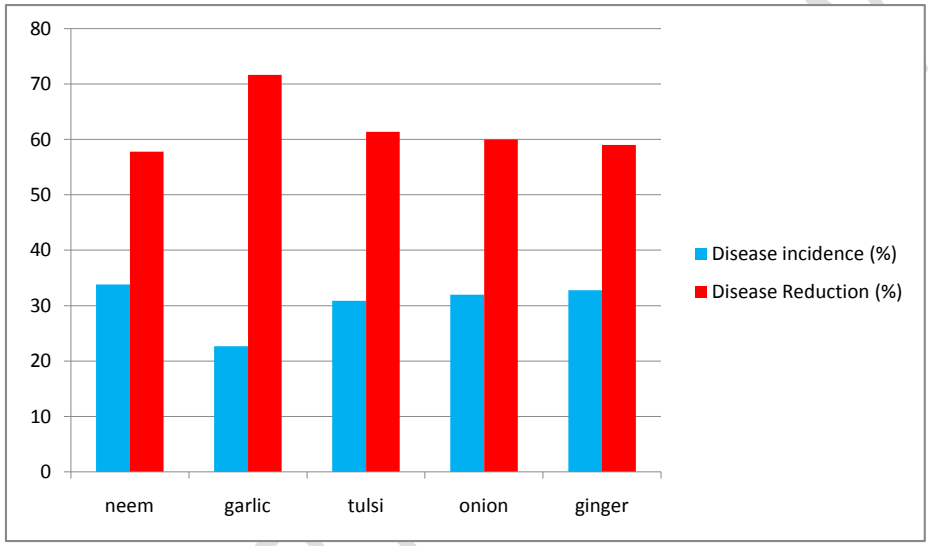

Fig. 1: Effect of plant extracts on disease incidence and disease reduction against *Cercospora canescens* mungbean in vivo at 30 days after sowing.

(ii) At 45 days after sowing

The minimum disease incidence was obtain in Garlic (31.56~~27.40~~ %), followed by Tulsi (33.00 %), Onion (36.20 %), Ginger (37.40 %), Neem (40.20 %) and control (90.00 %) was recorded at 10 per cent concentration of 45 days after ~~-~~sowing. The per cent disease incidence in Neem, Tulsi, Onion, and Ginger were significantly at par to each other while thus, the minimum disease incidence was observed in Garlic and maximum in control followed by Neem.

The disease incidence in between Tulsi, Onion and Ginger were at par to each other (Table 2 and fig. 2). Thus, the minimum and maximum disease incidence was observed in Garlic and ~~maximum in~~ Neem respectivley.

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Table 2. Effect of plant extracts on disease incidence and disease reduction against *Cercospora canescens* mungbean *in vivo* at 45 days after Sowing

Plant extract	Concentration (%)	Disease incidence (%)	Disease Reduction (%)
Neem (leaf)	10	40.20 (39.35)	55.33 (48.10)
Garlic (bulb)	10	27.40 (31.56)	69.56 (56.515)
Tulsi (leaf)	10	33.00 (35.10)	63.33 (52.736)
Onion (bulb)	10	36.20 (36.99)	59.78 (50.64)
Ginger (rhizome)	10	37.40 (37.70)	58.44 (49.86)
Control	-	90.00 (71.57)	0.00
SEm±	-	1.42	1.43
CD at 5%	-	4.46	4.50

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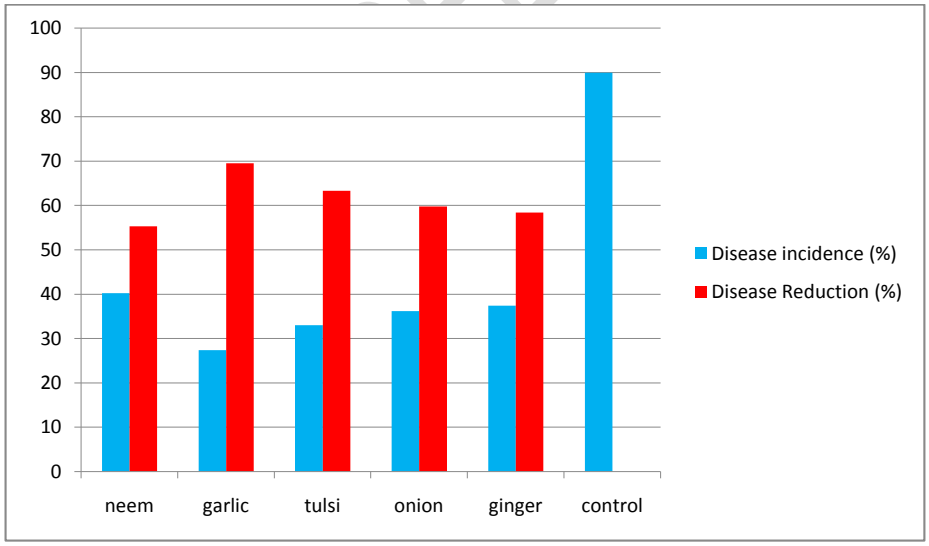

Fig. 2: Effect of plant extracts on disease incidence and disease reduction against *Cercospora canescens* mungbean *in vivo* at 45 days after Sowing.

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The maximum disease reduction was obtained in Garlic (69.56 %), followed by Tulsi (63.73 %), Onion (59.78 %) and Ginger (58.44 %), Neem (55.33) at 10 per cent concentration of 45 days after sowing. The per cent disease reduction in Neem, Onion and Ginger, Onion and Tulsi, Onion and Tulsi, were at par to each other. Thus, the disease reduction was maximum in Garlic and minimum in Neem was recorded at 30 days and 45 days after sowing. Per cent disease reduction in rest of the treatment differed significantly (Table 2 and fig. 2).

2. Efficacy of chemicals against *Cercospora canescens* on disease incidence and disease reduction *in vivo*

(i) At 30 days after sowing

The minimum disease incidence was found in Carbendazim (18.43 ~~10.00~~ %), followed by Thiram (28.39~~22.60~~ %). The per cent disease incidence in between Carbendazim and Thiram were at par to each other and maximum disease incidence was found in control~~Thiram~~ (63.43~~22.60~~ %) (Table 3 and fig. 3).

The maximum disease reduction was found in Carbendazim (87.50 %) followed by Thiram (71.75 %). The per cent disease incidence in between Carbendazim and Thiram were at par to each other and minimum disease reduction was found in Thiram (71.75 %) (Table 3 and fig. 3).

Table 3. Effect of Chemicls against *Cercospora canescens* on disease incidence and disease reduction *in vivo* at 30 days after sowing

Fungal antagonist	gm/kg of seed	Disease incidence (%)	Disease reduction (%)
Carbendazim	2.0	10.00 (18.43)	87.50 (9.38~~69.74~~)
Thiram	1.0	22.60 (28.39)	71.75 (8.55~~8.01~~)
Control	-	80.00 (63.43)	0.00 (0.71~~00~~)
SEm±	-	4.91	3.08

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CD at 5%	-	19.28	12.10

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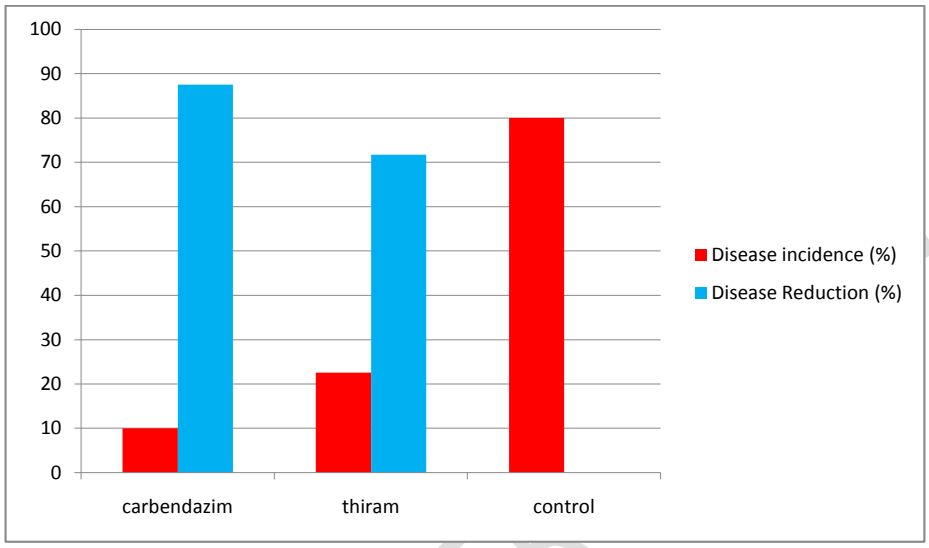

Fig. 3: Effect of Chemicls against *Cercospora canescens* on disease incidence and disease reduction *in vivo* at 30 days after sowing

(ii) At 45 days after sowing

The minimum disease incidence was found in Carbendazim (14.00 %), followed by Thiram (28.60 %) The per cent disease incidence in between Carbendazim and Thiram were at par to each other and maximum disease incidence was found in Thiram (28.60 %) (Table 4 and fig. 4).

The maximum disease reduction was found in Carbendazim (84.44 %) followed by Thiram (68.11 %) The per cent disease incidence in between Carbendazim and Thiram were at par to each other and minimum disease reduction was found in Thiram (68.11%) (Table 4 and fig. 4).

Table 4. Effect of Chemicals against *Cercospora canescens* on disease incidence and disease reduction *in vivo* at 45 days after sowing

Fungal antagonist	gm/kg of seed	Disease incidence (%)	Disease reduction (%)
Carbendazim	2 .0	14.00	84.44 (67.00)
Thiram	1 .0	28.70	68.11 (55.66)
Control	-	90.00	0.00 (0.00)
SEm±	-	5.53	2.24
CD at 5%	-	21.72	8.78

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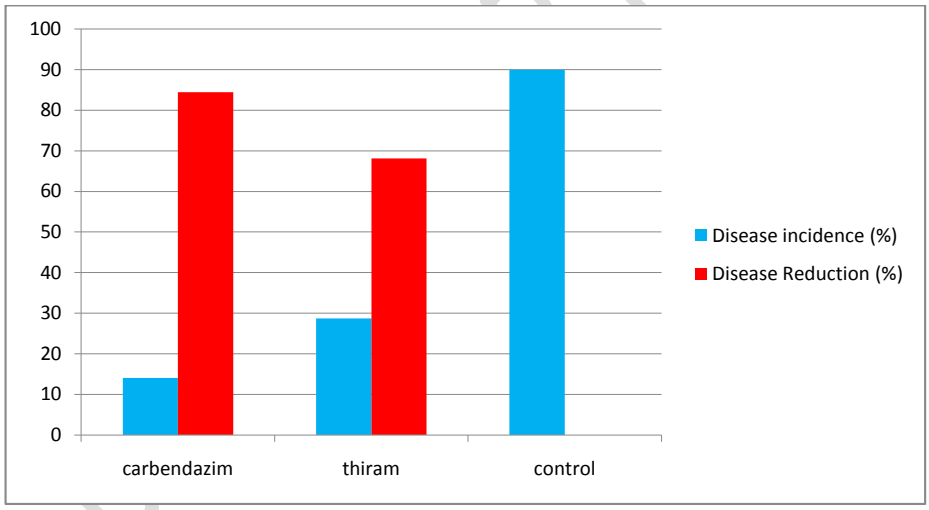

Fig. 4: Effect of Chemicals against *Cercospora canescens* on disease incidence and disease reduction *in vivo* at 45 days after sowing

Results clearly indicated that Carbendazim was better as compare to Thiram in reducing disease and enhancing plant disease reduction.

3. Efficacy of bio-agents against *Cercospora canescens* on disease incidence and disease reduction *in vivo*

The results revealed that *Trichoderma viride*, *Trichoderma harzianum* significantly reduced disease incidence at 30 and 45 days after sowing.

(i) At 30 days after sowing

The disease incidence was minimum in *Trichoderma viride* (16.70 %) followed by *Trichoderma harzianum* (31.40 %). The disease incidence in control was (80.00 %) at 30 days after sowing, respectively which is differed significantly to each other. (Table 5 fig. 5).

Table 5. Effect of bio-agents against *Cercospora canescens* on disease incidence and disease reduction *in vivo* at 30 days after sowing

Fungal antagonist	Concentration (%)	Disease incidence (%)	Disease reduction (%)
Trichoderma viride	10	16.70	79.13 (62.83)
Trichoderma harzianum	10	31.40	0.75 (51.21)
Control	-	80.00	0.00 (0.00)
SEm±	-	1.12	0.79
CD at 5%	-	4.39	3.11

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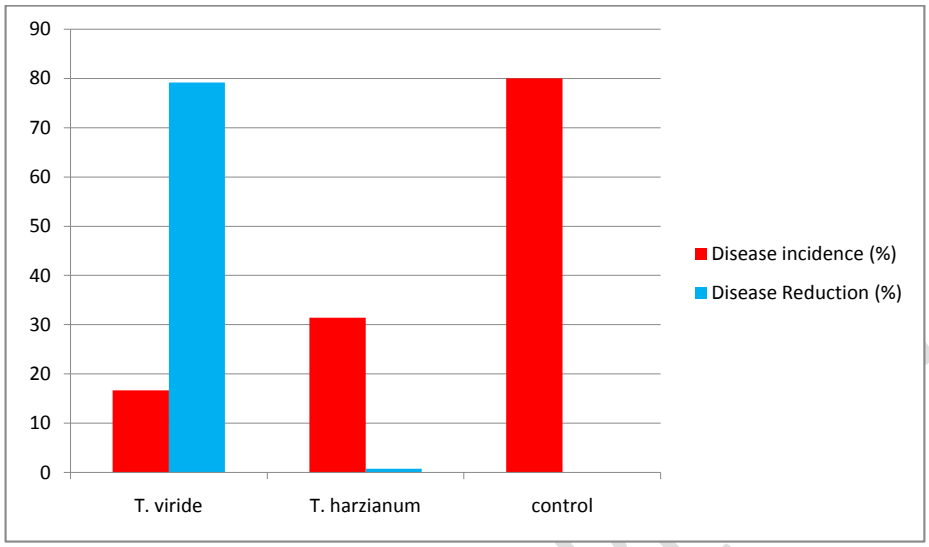

Fig. 5: Effect of bio-agents against *Cercospora canescens* on disease incidence and disease reduction *in vivo* at 30 days after sowing

The maximum disease control was obtained in *Trichoderma viride* (79.13 %) followed by *Trichoderma harzianum* (60.75 %) at 30 days after sowing which is significantly, differed with each other.

(ii) At 45 days after sowing:

The disease incidence was minimum in *Trichoderma viride* (18.30 %) followed by *Trichoderma harzianum* (35.60 %). The disease incidence in control was (90.00 %) at 45 days after sowing, respectively which is differed significantly to each other. (Table 6 and fig. 6).

Table 6. Effect of bio-agents against *Cercospora canescens* on disease incidence and disease reduction *in vivo* at 45 days after sowing

Fungal antagonist	Concentration (%)	Disease incidence (%)	Disease reduction (%)
Trichoderma viride	10	18.30	79.67 (63.29)
Trichoderma harzianum	10	35.60	60.44

			(51.11)
Control	-	90.00	0.00 (0.00)
SEm±	-	1.99	2.65
CD at 5%	-	7.80	10.39

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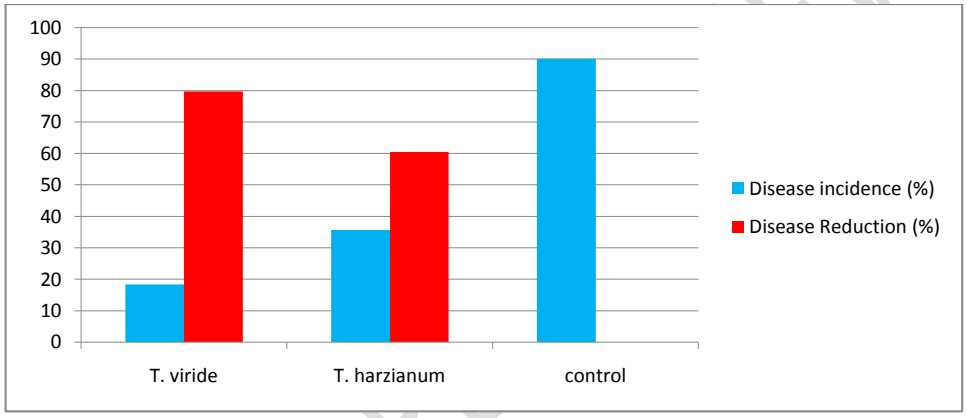

Fig. 6: Efficacy of bio-agents against *Cercospora canescens* on disease incidence and disease reduction *in vivo* at 45 days after sowing

The maximum disease control was obtained in *Trichoderma viride* (79.67 %) followed by *Trichoderma harzianum* (60.44 %) at 45 days after sowing which significantly, differed with each other. (Table 6 and fig. 6).

Results clearly indicated that *Trichoderma viride* was better as compare to *Trichoderma harzianum* in reducing disease and enhancing plant disease reduction.

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Discussion

1. **Effect of botanicals against *Cercospora canescens* on disease incidence and disease reduction in *in vivo***

Ten per cent concentration was found most effective *in vitro* was further tested *in vivo* at 30 days and 45 days after sowing.

(i) At 30 days after sowing:

The minimum disease incidence was found in Garlic (22.70 %), followed by Tulsi (30.90%), Onion (32.00 %), Ginger (32.80 %), Neem (33.80). The per cent disease incidence in between however Neem, Tulsi, Onion, and Ginger were significantly at par to each other while mi~~a~~nimum disease incidence was found in Garlic (Table 1).

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The maximum disease reduction was found in Garlic (71.63) followed by Tulsi (61.38 %), Onion (60.00%), Ginger (59.00), Neem (57.75). The per cent disease reduction in between Neem, Garlic, Tulsi, Onion and Ginger were significantly differed from each other with respect to per cent disease contol (Table 1).

(ii) At 45 days after sowing

The minimum disease incidence was obtain in Garlic (27.40 %), followed by Tulsi (33.00 %), Onion (36.20 %), Ginger (37.40 %), Neem (40.20 %) and control (90.00 %) was recorded at 10 per cent concentration of 45 days after sowing. The per cent disease incidence in Neem, Tulsi, Onion, and Ginger were significantly at par to each other while thus, the minimum disease incidence was observed in Garlic and maximum in Neem.

The disease incidence in between Tulsi, Onion and Ginger were at par to each other (Table 2), thus, the minimum disease incidence was observed in Garlic and maximum in Neem.

The maximum disease reduction was obtained in Garlic (69.56 %), followed by Tulsi (63.73 %), Onion (59.78 %) and Ginger (58.44 %), Neem (55.33) at 10 per cent concentration of 45 days after sowing. The per cent disease reduction in Neem, Onion and Ginger, Onion and Tulsi, Onion and Tulsi, were at par to each other. Thus, the disease reduction was maximum in Garlic and minimum in Neem was recorded at 30 days and 45 days after sowing. Per cent disease reduction in rest of the treatment differed significantly (Table 2).

It is very clear from the present studies that the plant extracts which were better in inhibiting the radial growth *in vitro* also showed reduction in disease incidence and per cent disease control was also higher ~~accordingly. i~~*~~I~~n vivo* condition.

Bdliya and Alkali (2010) evaluated the efficacy of Neem (seed), Garlic (clove), Onion (bulb), Ginger (rhizome) and Pawpaw (leaf extracts) applied as foliar spray in controlling cereospora leaf spot of groundnut in two successive growing seasons. All the plant extracts reduced the incidence and severity of cercospora leaf spot in both seasons compared to the untreated crops. However, Neem (seed) and Garlic (clove) extracts significantly reduced the incidence and severity of the disease compared to the other plant extracts.

Sheshma and Kumar (2017) evaluated the efficacy of plant extracts *viz*. Neem leaf extract, Dhatura leaf extract, Garlic clove extract, Arjun leaf extract, Aswagandha leaf extract and Alovera leaf extract @10% against *Cercospora canescens*. *In-situ* (field) experiments were also carried out in randomized block design with six treatments and three replications. Neem leaf was found to be the most effective treatment and recorded minimum disease intensity (25.69 %), m~~M~~aximum No of pod per plant, maximum weight of pod (g) and yield (q/ha) followed by Arjun leaf extract, Alovera leaf extract, Aswagandha leaf extract, Dhatura leaf extract and Garlic clove extract. ~~Mungbean is an important pulses crop worldwide and one of the most important pulses in India. It is known to suffer from many types of diseases, Cercospora leaf spot is one of them. Cercospora leaf spot causes *Cercospora canescens* much damage to the production of mungbean.~~

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2. Efficacy of chemicals in *in vivo*

~~***In Vivo:***~~ Experimental findings have revealed that Carbendazim ~~(%)~~ was found most effective treatment as compared with Thiram in vivo.

Results indicated that a gradual decrease in disease incidence in all the treatments by fungicides. Most effective treatment was found Carbendazim followed by Thiram.

Dubey and Singh (2006) ~~determinated~~determine the efficacy of integrating insecticides , fungicides (carbendazim and thiram) and biological control agents (*Trichoderma viride*) as seed treatment or foliar sprays in controlling cercospora leaf spots (*Cercospora* canescens and *Pseudocercospora cruenta*) and yellow mosaic (Mungbean yellow mosaic virus) infecting

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urdbean (*Vigna mungo*). The combination of seed soaking in 0.1 per cent imidacloprid for 2 h and dry seed treatment with carbendazim 50 WP + thiram 75WP (1:1) 2 g/kg seed followed by foliar sprays of 0.02 per cent imidacloprid and 0.05 per cent carbendazim at 30 and 45 days after sowing, respectively, was the best treatment to control cercospora leaf Spots (4.3%) and yellow mosaic (MYMV) (9.5%), consequently resulting in the highest grain yield (954.2 kg/ha).

Mian *et al*. (2000) determined the effect of foliar application of Carbendazim (0.05%), Mancozeb (0.2%) and Urea (1.2%) on the incidence and severity of cecospora incidence and Severity of cercospora leaf spot caused by *Cercospora cruenta* and *C. canescens* and yield of mungbean. Both fungicides significantly reduced disease incidence and increase the yield however, Carbendazim was more efficient than Mancozeb.

Khalil and Jalaluddin (2004) evatuated foliar fungicides i.e., Bavistin [carbendazim] 50 WP, Dithane M-45 [mancozeb], Indofil M-45 [mancozeb + thiophanate-methyl], Ridomil MZ [mancozeb + metalaxyl] 72, Knowin 50 WP and Thiovit [sulfur] consistently reduced the incidence and severities of cercospora leaf spot (Cercospora cruenta) and powdery mildew (Erysiphe polygoni) of black gram (Vigna mungo) and increased seed yield. Among these foliar fungicides, Bavistin 50 WP was the best one for the economic management of both the diseases and gave the highest seed yield followed by Knowin. The benefit—cost ratio was highest for Bavistin followed by Knowin.

~~It is clear from the ongoing discussion that the two fungicides, evaluated were found effective in order to manage cercospora leaf spot diseases. But the fungicide (Vitavax) was not much more effective against cercospora leaf spot disease.~~

3. Efficacy of bio-agents *~~in vitro~~ and in vivo~~:~~*

In Vivo: The effect of bio-agents (*T. viride and T. harzianum*) were also studied to find out their role in suppressing the leaf spot of mungbean in plot sown crop as foliar application.

The disease control was 79.67 and 60.44 per cent in *T. viride* and *T. harzianum*, respectively which were at par to each other. Thus, the effect of bio-agents were very less when applied as foliar spray. This might be due to that the condition was not favorable for increasing

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the population of bio-agents on the plants. As the bio-agents is mostly soil inhabitant and grow saprophytically in presence of high organic matter in soil and increase their population very fast.

Upma Singh ~~.,~~ (2015) an extensive survey of Kota district resulted several fungal diseases occurring on Trigonella crop. Leaf spot caused by *Cercospora traversiana* was found to be more prominent and caused a great loss to the crop. To control the disease Trichoderma sps. Viz *Trichoderma viride*, *Trichoderma harzianum* were experimented in vitro.

In present findings the bio-agents were not much effective against *Cercospora canescens* of mungbean when applied as foliar application.

Summary and Conclusion~~:~~

~~1.~~ The efficacy of botanicals of f~~F~~ive plant extracts *viz.*, Neem, Garlic, Tulsi, Onion, Ginger were tested *in vitro* against *Cercospora canescens*. The 10%~~Ten per cent~~ concentration of plant extract was found most effective *in vitro* and was further tested *in vivo* to find out the efficiency of the 5 plant extract at 30 and 45day after sowing.

~~a.~~ The disease incidence was lower in Garlic (27.40 %), Tulsi (33.00%), Onion (36.00 %), Ginger (37.00 %), Neem (40.20 %), was recorded at 10 per cent concentration of 45 days after sowing. ~~The disease incidence in between Tulsi and Onion Ginger, Onion and Ginger, Neem Ginger and Neem were at par to each other thus, the minimum disease incidence was observed in Garlic and it was maximum in Neem.~~

~~b.~~ The maximum disease reduction was obtained in Garlic (69.56 %), followed by Tulsi (63.73 %) and Onion (59.78 %), Ginger (58.44 %), Neem (55.33) at 10 per cent concentration of 45 days after sowing. ~~The per cent disease reduction in between Neem and Tulsi, Onion, Ginger, Ginger and Onion, Tulsi, Onion and Tulsi, Tulsi and Garlic were at par to each other.~~ The similar trend in per cent in disease incidence and disease control in different treatments were similar at 30 days after sowing. ~~However, per cent incidence and disease control were less~~.

The ~~2.~~ ~~t~~~~T~~wo fungicide treatments *viz.*, Carbendazim and Thiram were also tested *in vivo* against *Cercospora canescen.* The ~~All the~~ two treatments Carbendazim and Thiram showed significant reduction in radial growth of test fungus at different concentration 2g/ kg and 1g/ kg seed respectively.

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~~a.~~ The results showed that minimum incidence was obtained in Carbendazim (14.00 %) and Thiram (28.70 %) and in control (90 %) ~~per cent~~ disease incidence were recorded at 45 days.

~~b.~~ Thus,~~c~~ The maximum per cent disease control is obtained in Carbendazim (84.44) followed by Thiram (68.11 %) at 45 days after sowing.~~disease incidence in between Carbendazim and Thiram were at par to each other. Thus minimum leaf spot incidence was observed in Carbendazim fallowed by Thiram. The results were found at 45days after sowing.~~

~~c.~~ ~~The maximum per cent disease control is obtained in Carbendazim (84.44) followed by Thiram (68.11 %) at 45 days after sowing.~~

S~~d. The s~~imilar trend ~~were~~was also found in per cent of~~in~~ disease incidence and disease control in different treatments at 30 days after sowing. However, per cent incidence and disease control were less at 30 days after sowing.

~~3.~~ *Trichoderma~~T.~~ viride and Trichoderma~~T.~~ harzianum* bio-angents were also tested in vivo to see their effects with reference to -biological management against *C. canescens* when applied as foliar spray on plot sown crop.

~~a.~~ The disease incidence in *T. viride* was (18.30 %) followed by *T. harzianum* (35.60 %) which were at par to each other at 45 days after sowing.

~~b.~~ The disease control was 79.67 and 60.44 per cent in *T. viride* and *T. harzianum*, respectively which were at par to each other.

~~c.~~ The effect of *T. viride* and *T. harziamum* were very less in disease management when applied as foliar spray.

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