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Evaluation of different seed treatments on seed germination and viability of sclerotia admixtured with moongbean seeds

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Abstract
Different fungicides and botanicals were evaluated for their effect on seed germination, seed vigour and viability of sclerotia admixtured with moongbean seeds. Among various fungicides tested *in vitro* condition, Vitavax power (Carboxin 37.5% + Thiram 37.5% WS) 3gm/Kg seed, Azoxystrobin 23% SC 2ml/Kg seed and Adexar (fluxapyroxad 62.5 g/l + epoxiconazole 62.5 g/l) 2ml/Kg seed gave 100 per cent suppression of mycelial growth from sclerotia of *R. solani* even after 72 hours of incubation. Like wise different botanical extracts were tested at 10% concentration. Thuja gave best results as compared to others. In case of both *in vitro* and *in vivo* evaluation of fungicidal and botanical seed treatment on seedling germination and plant vigour of moongbean Vitavax power (Carboxin 37.5% + Thiram 37.5% WS) and Carbendazim respectively gave highest germination per cent and vigour index among all the fungicides while in case of botanicals Neem was found most effective under *in vitro* condition with 100 per cent germination and highest vigour index (1643.3) and Thuja was found significantly superior in order to germination per cent (93.33%) and vigour index (1353.29) under *in vivo* condition.

Keywords: Web blight, moongbean, *Rhizoctonia solani*, sclerotial viability, seed treatment

Introduction
Pulses in India have been popularly known as “Poor man’s meat” and “Rich man’s vegetable”, contribute significantly to the nutritional security of the country. Pulses are known to be an outstanding vegetarian source of proteins which are necessary part of a healthy and balanced diet. These crops also have ability to fix nitrogen into the soil thus, improve the soil fertility. India is one of the largest producers as well as consumers of pulses. Among pulses moongbean (*Vigna radiata* L. Wilczek) is the third most important pulse crop among the thirteen food legumes grown in India. During 2016-17 area under moongbean production was 4.30 million ha with 2.17 million tones production and 481 kg/ha productivity (Anonymous, 2017b) [1]. Web/aerial blight caused by *Rhizoctonia solani* Kühn is a destructive fungal disease of moongbean and it is one of the important causes for decreasing productivity of the crop in India especially in *tarai* region of Uttarakhand. All the above ground parts of the plant are affected by the disease. The pathogen is seed-borne, soil-borne as well as wind borne in nature and depending upon environmental conditions the fungus produce brown coloured sclerotia (Ou, 1985) [4] Sclerotia of the pathogen *R. solani* is small (1 to 3 mm diameter), irregularly shaped, brown to black structures through which the fungus gets perpetuated and disseminated and can survive for many years in soil and on plant tissue. The pathogen can be transported in uninfected area through movement of infected bean pods or seeds and sometimes these sclerotia can get admixtured with seeds and serve as primary inoculum of the disease. Sclerotia in soil and on plant tissue germinate and produce vegetative threads or hyphae of the fungus that attack the crop. Keeping in view the above said factors and visualizing the seriousness of the disease, the present investigation was carried out to find out the effective seed treatment which are effective on fungal sclerotia as well.

Materials and Methods
The present experiments were carried out in the Department of Plant Pathology, College of Agriculture, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, Udham Singh Nagar, Uttarakhand. Web blight susceptible variety of moongbean *i.e.*, Kopergaon was used in present study. The test pathogen *Rhizoctonia. solani* was isolated from infected moongbean fields from pulse pathology block of Norman E. Borlaug Crop Research Centre (CRC), Pantnagar.
Sclerotia of *R. solani* were grown in culture in the laboratory and were mixed with 100 g per lot of moongbean seeds @ 10 sclerotia per seed lot.

The fungicides and botanicals were used for seed dressing of the seeds in seed lots. The seed admixtured sclerotia were retrieved 24 h after seed dressing. The viability of the sclerotia was tested on PDA medium. Germination per cent of sclerotia, mycelial regeneration from the sclerotia as well as the per cent reduction of the mycelial regeneration from sclerotia over control was measured by the formula given by Vincent (1947) [6] as follows:

$$I = \frac{C - T}{C} \times 100$$

Where;
I = Per cent inhibition of mycelial growth
C = Growth of pathogen in control
T = Growth of pathogen in treatment

After retrieval of sclerotia, the seed in the particular lot were kept for germination by following rolled paper towel method (Agarwal, 1994) [2] and pot culture method. Observations was recorded on germination per cent, root length and shoot length in cm after 7 days.

Results and Discussion

Evaluation of different seed treatments on seed germination and viability of sclerotia admixtured with moongbean seeds

Effect of fungicidal seed treatment on viability of sclerotia

Among all the fungicides evaluated for their effect on viability of sclerotia Captan, Carbendazim, Tebuconazole, Vitavax power, Azoxystrobin and Adexar gave 100 per cent reduction of mycelial regeneration from sclerotia after 48 hours of incubation while after 72 hours of incubation Vitavax power, Azoxystrobin and Adexar were found most effective and gave 100 per cent reduction of mycelial regeneration from sclerotia and Tebuconazole was found least effective among all the fungicides tested after 72 hours of incubation and gave 80 per cent reduction of mycelial regeneration from sclerotia. Result is depicted in Table 1, Figure 1 and Plate 1. These results are in accordance with the findings of Sandhya *et al.* (2018) [5] who tested efficacy of different fungicides *i.e.*, Carbendazim, propiconazole, validamycin, hexaconazole, Tebuconazole, azoxysrtrobin, thifluzamide, difenoconazole, Tebuconazole 50% + Trifloxystrobin 25% on the viability of sclerotia admixtured with rice seeds. Among these all the fungicides showed 100 per cent inhibition of sclerotial germination in case of both wet and dry seed treatments.

Effect of botanical seed treatment on viability of sclerotia

In case of botanicals as shown in Table 2, Figure 2 and Plate 2 Thuja was found most effective in inhibiting viability of sclerotia and showed 38.46 per cent and 48.89 per cent reduction in mycelial regeneration from sclerotia after 48 hours and 72 hours of incubation respectively.

Table 1: Effect of fungicidal seed treatment on viability of sclerotia of *R. solani* admixture with moongbean seeds

Sl No.	Treatments	hours after incubation			
		48 hrs MRS (cm)	48 hrs S%	72 hrs MRS (cm)	72 hrs S%
1.	Captan	0	100	1.6	82.22
2.	Carbendazim	0	100	1.0	88.89
3.	Tebuconazole	0	100	1.8	80.00
4.	Vitavax power (Carboxin 37.5% + Thiram 37.5% WS)	0	100	0	100
5.	Azoxystrobin	0	100	0	100
6.	Adexar (Fluxapyroxad 62.5 g/l + epoxiconazole 62.5 g/l)	0	100	0	100
7.	Check	5.4	-	9.0	-
	S.Em±	-	-	0.05	0.01
	CD at 5%	-	-	0.14	0.03
	CV	-	-	4.1	0.02

MRS- Mycelial regeneration from sclerotia
S% - Reduction per cent in mycelial regeneration from sclerotia

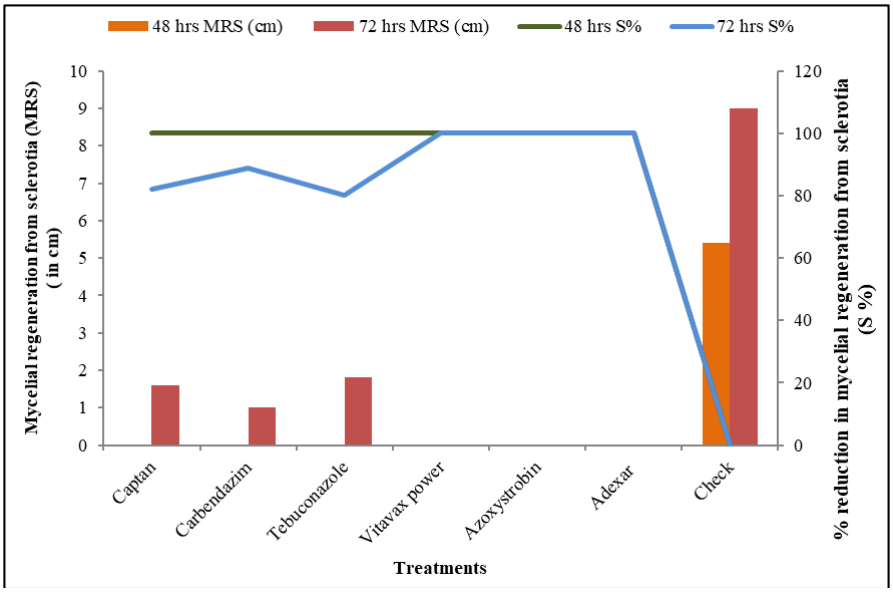

Fig 1: Effect of fungicidal seed treatment on viability of sclerotia of *R. solani* admixtured with moongbean seeds

Lanatana and tulsi were found least effective and showed 0 per cent reduction in mycelial regeneration from sclerotia after 72 hours of incubation. Similar results were observed by Karthika *et al.* (2017) [3].

Table 2: Effect of botanical seed treatment on viability of sclerotia of *R. solani* admixtured with moongbean seeds

Sl No.	Treatments	Hours after incubation			
		48 hrs MRS (cm)	48 hrs S%	72 hrs MRS (cm)	72 hrs S%
1.	Cannabis	4.67	11.54	8.00	11.11
2.	Thuja	3.20	38.46	4.60	48.89
3.	Neem	4.41	15.19	7.70	14.44
4.	Garlic	4.77	8.27	8.53	5.22
5.	Lanatana	4.23	19.23	9.00	0
6.	Tulsi	3.47	33.27	9.00	0
7.	Check	5.20	-	9.00	-
	S.Em±	0.11	0.002	0.11	0.01
	CD at 5%	0.34	0.01	0.35	0.02
	CV	4.54	0.02	2.48	0.08

MRS- Mycelial regeneration from sclerotia, S% - Reduction in mycelial regeneration from sclerotia

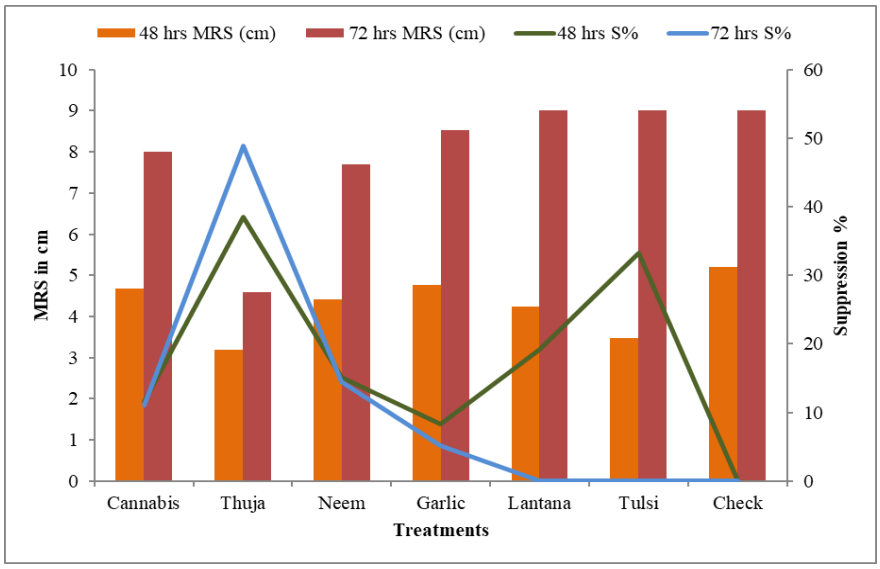

Fig 2: Effect of botanical seed treatment on viability of sclerotia of *R. solani* admixtured with moongbean seeds

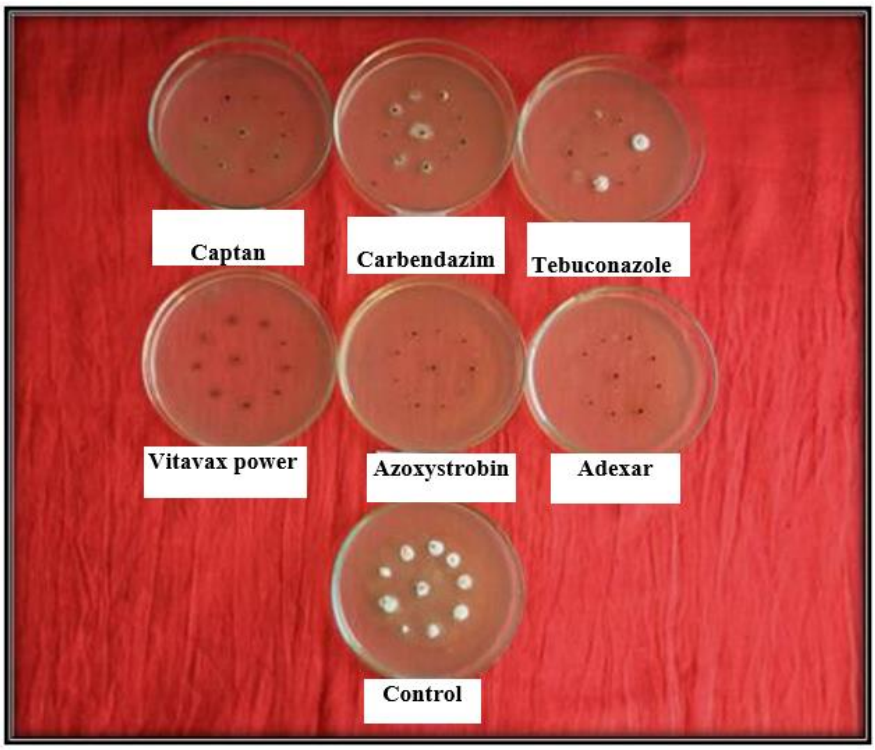

Plate 1: Effect of fungicidal seed treatment on viability of sclerotia admixtured with moongbean seeds

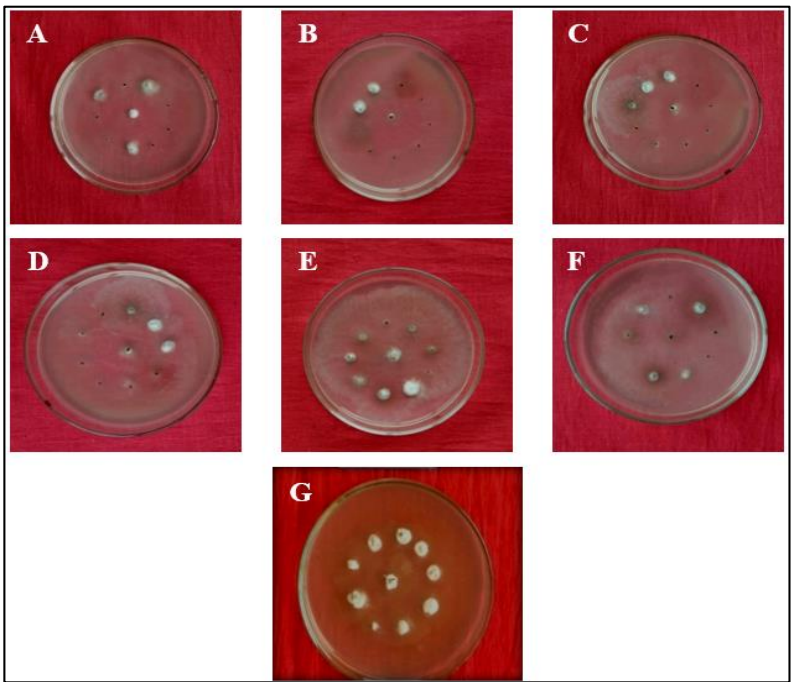

Plate 2: Effect of botanical seed treatment on viability of sclerotia admixtured with moongbean seeds

A- Cannabis, B- Thuja, C- Neem, D- Garlic, E- Lanatana, F- Tulsi, G- Control

***In vitro* and *in vivo* evaluation of fungicidal seed treatment on seedling vigour of moongbean**

Different fungicides were evaluated for their effect on germination and seedling vigour of moongbean under *in vitro* and glass house conditions. According to the results presented in Table 3 and Figure 3 it was observed that under *in vitro* condition highest radicle length was observed in case of Vitavax power (5.67 cm) which was statistically at par with Carbendazim (5.5 cm) but significantly higher than other treatments followed by Captan (5.0 cm) and Azoxystrobin (4.1 cm). Highest plumule length was recorded in case of Vitavax power (11.73 cm) which was statistically at par with Carbendazim (11.13 cm) but significantly higher than other treatments. Adexar was found statistically at par with control in order to both radicle and plumule length. Under glasshouse condition also Vitavax power was found best with root length of 6.3 cm which was significantly higher than other treatments. Carbendazim showed root length of 5.17 cm which was statistically at par with Captan, Azoxystrobin and Tebuconazole with root length of 5.1 cm, 5.07 cm and 5.07 cm respectively, but significantly higher than control. Highest shoot length of 10.47 cm was observed in case of Vitavax power which was significantly higher than other treatments followed by Carbendazim (8.47) cm which was statistically at par with Captan (8.07 cm). Adexar was found least effective in case of both root length and shoot length but was significantly higher than the control.

***In vitro* and *in vivo* evaluation of botanicals as seed treatment on seedling vigour of moongbean**

Different plant extracts were evaluated for their effect on germination and seedling vigour of moongbean under *in vitro* and glass house conditions. According to the results presented in Table 4 and Figure 4 it was observed that under *in vitro* condition highest radicle length was observed in case of Neem (6.0 cm) which was statistically at par with Thuja (5.6 cm) and Cannabis (5.567 cm) but significantly higher than other treatments followed by Garlic (5.13 cm) which was statistically at par with Lanatana (5.1 cm). However, in case of plumule length Neem gave best results (10.43 cm) which was statistically at par with Garlic (10.37 cm) but significantly higher than other treatments followed by Cannabis (9.57 cm) which was statistically at par with Thuja (9.47 cm).

Table 3: Efficacy of different fungicides on seedling vigour of moongbean under *in vitro* and *in vivo* conditions

Sl No.	Treatments	*In vitro*				*In vivo* (glass house)			
		Germination (%)	Radicle length* (cm)	Plumule length* (cm)	Vigour index	Germination (%)	Root length* (cm)	Shoot length* (cm)	Vigour index
1.	Captan	100	5.00	10.97	1596.7	86.67	5.10	8.07	1316.7
2.	Carbendazim	100	5.50	11.13	1663.3	93.33	5.17	8.47	1363.4
3.	Tebuconazole	100	3.77	9.23	1300	80.00	5.07	7.73	1280
4.	Vitavax power(Carboxin 37.5% + Thiram 37.5% WS)	100	5.67	11.73	1740	93.40	6.30	10.47	1676.7
5.	Azoxystrobin	100	4.10	10.07	1416.7	80.00	5.07	6.50	1156.7
6.	Adexar(Fluxapyroxad 62.5 g/l + epoxiconazole 62.5 g/l)	100	3.26	9.17	1236.7	73.33	4.73	6.00	1073.3
7.	Check	100	3.43	9.03	1246.6	73.33	3.50	5.47	896.7
	S.Em±	-	0.14	0.27	-	-	0.13	0.15	-
	CD at 5%	-	0.43	0.84	-	-	0.39	0.46	-
	CV	-	5.54	4.65	-	-	4.57	3.50	-

*Mean of ten seedlings

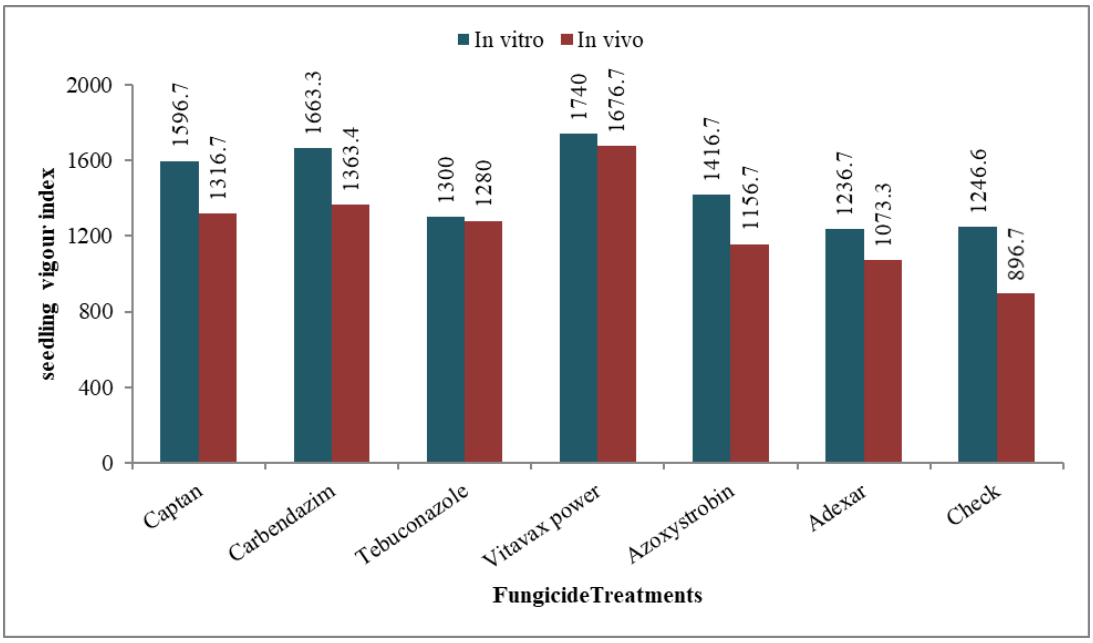

Fig 3: Efficacy of different fungicides on seedling vigour of moongbean under *in vitro* and *in vivo* condition

Lanatana was found least effective but significantly higher than control in both radicle and plumule length.

Under glasshouse condition Neem was found best with root length of 5.77 cm which was significantly higher than other treatments followed by Cannabis (5.27 cm), Thuja (4.9 cm) and Garlic (4.37 cm). Lanatana and Tulsi showed root length of 3.67 cm and 3.57cm respectively which was statistically at par with control (3.5 cm). Highest shoot length of 10.7 cm was observed in case of Garlic which was significantly higher than other treatments followed by Cannabis (9.9 cm) and Thuja (9.6 cm). Plant extract of Tulsi was found least effective in case of both root length and shoot length.

Table 4: Efficacy of different botanicals on seedling vigour of moongbean under *in vitro* and *in vivo* conditions

Sl No.	Treatments	*In vitro*				*In vivo* (glass house)			
		Germination%	Radicle length* (cm)	Plumule length* (cm)	Vigour index	Germination%	Root length* (cm)	Shoot length* (cm)	Vigour index
1.	Cannabis	100	5.57	9.57	1513.4	73.33	5.27	9.90	1112.20
2.	Thuja	100	5.60	9.47	1506.7	93.33	4.90	9.60	1353.29
3.	Neem	100	6.00	10.43	1643.3	73.33	5.77	8.70	1055.95
4.	Garlic	100	5.13	10.37	1550	80	4.37	10.70	1205.36
5.	Lanatana	100	5.10	7.07	1216.7	93.33	3.67	8.23	1110.63
6.	Tulsi	100	4.83	8.57	1340	86.67	3.57	8.03	1005.37
7.	Check	100	3.67	5.43	910	80	3.50	4.93	674.64
	S.Em±	-	0.17	0.14	-	-	0.12	0.09	-
	CD at 5%	-	0.51	0.43	-	-	0.37	0.28	-
	CV	-	5.72	2.79	-	-	4.72	1.82	-

*Mean of 10 seedlings

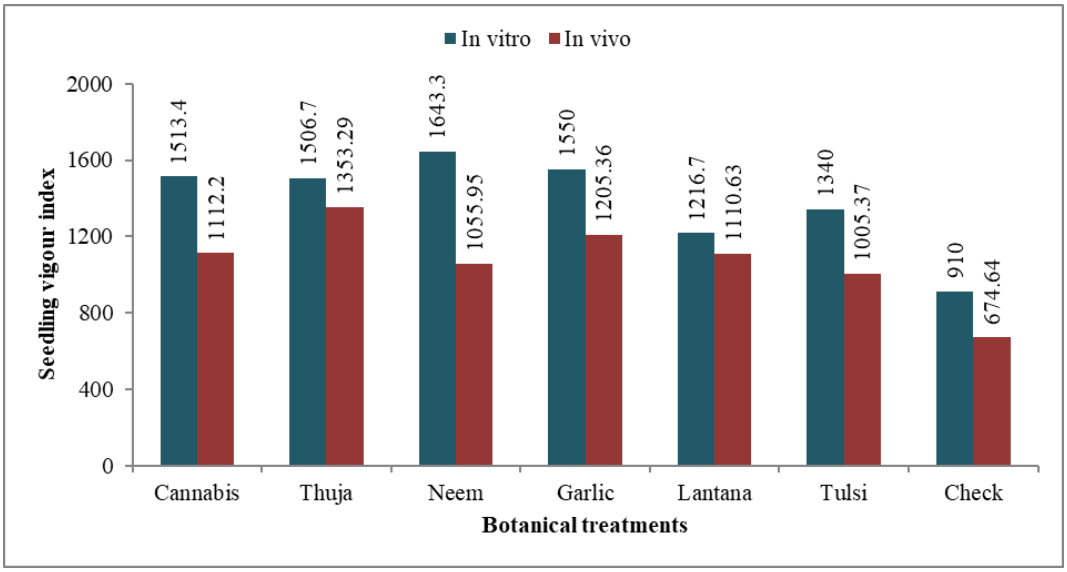

Fig 4: Efficacy of different botanicals on seedling vigour of moongbean under *in vitro* and *in vivo* conditions

Conclusion

Different fungicides was evaluated as seed treatments for their effect on seedling vigour and viability of sclerotia admixtured with moongbean seeds. Among various fungicides tested under *in vitro* condition Vitavax power (Carboxin 37.5% + Thiram 7.5% WS), Azoxystrobin and Adexar (fluxapyroxad 62.5 g/l + epoxiconazole 62.5 g/l) gave 100 per cent suppression of mycelial growth from sclerotia of *R. solani* even after 72 hours of incubation while, Vitavax power (Carboxin 37.5% + Thiram 37.5% WS) and Carbendazim respectively was responsible for highest germination per cent and vigour index under both *in vitro* and *in vivo* conditions.

Among all the plant extracts Thuja gave best results in suppressing mycelial growth from sclerotia. Neem was found most effective under *in vitro* condition and showed 100 per cent germination and 1643.3 vigour index while under *in vivo* condition Thuja gave highest germination per cent (93.33%) and vigour index (1353.29) as compared to check.

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