***Original Research Article***

# *In vitro* evaluation of Botanicals, Bio-agents and Fungicides against *Rhizoctonia solani* causing Web blight disease of Mungbean


**Abstract**

Mungbean [*Vigna radiata* (L.) Wilczek] is the important source of proteins, minerals, and vitamins of the predominantly vegetarian Indian diet. It belongs to the family Leguminaceae. Web blight caused by *Rhizoctonia solani* (Kuhn) is one of the most important fungal diseases which come every year with different intensity and causes huge losses in yield. The losses in grain yield is more when the plants get infected earlier *i.e.* 25 days after sowing (DAS) than 35 and 40 DAS. It causes losses in yield and weight 33.40 to 37.80 per cent and 23.12 to 28.60 per cent in different varieties. The present investigations were carried out in the laboratory, department of Plant Pathology A.N.D.U.A. & T., Kumarganj, Ayodhya to test the efficacy of different treatments against *Rhizoctonia solani* Kühn under lab conditions (*In vitro*). Botanicals and Fungicides were tested through Poisoned food technique and Bio-agents were tested through dual culture technique. Fungus were isolated from diseased mungbean plant and further tested against different treatments. Radial growth and percent inhibition were recorded at 24, 36 and 48 hours of intervals. Minimum radial growth and maximum percent inhibition were recorded in Propiconazole 1.45 mm, 1.85 mm and 2.16 mm at 24, 36 and 48 hours of intervals respectively.


Comment [u1]: Please, write the abstract in systematic manner
Background, aims, methods, results, conclusion


**Keywords:** Efficacy, Botanicals, Bio-agents, *Vigna radiata, Rhizoctonia solani*, *In vitro*




## Introduction

Mungbean [*Vigna radiata* (L.) Wilczek] is the important source of protein, vitamins and minerals. It belongs to the family Leguminaceae. Among the pulses mungbean also called as green gram or golden gram. It is mainly grown in Rajasthan, Maharashtra, Karnataka, Andhra Pradesh, Orissa, Bihar, Tamil Nadu, Madhya Pradesh, and Uttar Pradesh (Anonymous, 2019). In Uttar Pradesh, it is cultivated on 93000 ha, with a production of 9480 tonnes. Compared, the productivity of mung bean in India and the U.P. is 567 kg/ha and 536 kg/ha, respectively, which

is very low compared to the genetic potential of 1500–2000 kg/ha (Anonymous, 2019). The major limiting factors for its poor yield are the attacks of various biotic and abiotic stresses. Among them, diseases caused by fungi, bacteria, and viruses are major potential threats that adversely affect the productivity of mung bean. In 1924, web blight was reported for the first time on mung bean from the Philippines (Nacien, 1924). While in India, Dwivedi and Saksena (1974) first reported it on mung beans from Kanpur, Uttar Pradesh. Further, it has also been reported from Assam (Saikia, 1976), Punjab (Bains *et al.*, 1988), Madhya Pradesh (Tiwari and Khare, 1998), Bihar, Rajasthan, Haryana, Himachal Pradesh, and Jammu & Kashmir (Anonymous, 2004). Web blight caused by *Rhizoctonia solani* (Kuhn) is one of the most important fungal diseases which appear every year in varying intensity and causes heavy reduction in yield. The losses in grain yield is more when the plants get infected earlier i.e. after 25 days after sowing (DAS) than 35 and 40 DAS. Gupta *et al.* (2010) reported losses in yield and lost weight were 33.40 to 37.80 per cent and 23.12 to 28.60 per cent respectively. Though, the web blight could be managed by the use of fungicide but due to the emergence of several problems like environmental pollution, residual effect in grains, killing non targeted organisms its use should be discouraged. Hence, for minimizing the losses caused by web blight need in-expensive and environmentally safe management practices. Many botanicals and bio-agent have been found effective against *Rhizoctonia solani* in different crops, therefore keeping in view the importance of the crop and seriousness of diseases present research work carried.

**Materials and Methods**

The present investigations were carried out in the laboratory, department of Plant Pathology A.N.D.U.A. & T., Kumarganj, Ayodhya to test the efficacy of different treatments against *Rhizoctonia solani* Kühn under lab conditions (*In vitro*). Botanicals and Fungicides were tested through Poisoned food technique and Bio-agents were tested through dual culture technique. Fungus were isolated from diseased mungbean plant and further tested against different treatments. In order of find out the efficacy of various plants extracts against *R. solani*, five plants extract viz., Neem, Garlic, Tulsi, onion and Ginger, were used. By adding the necessary quantity of sterilized PDA medium, the concentrations of 10.0 percent were created. Two fungicides were tested *in vitro* against *R. solani* i.e., Propiconazole and Hexaconazole. Prior to pouring, both fungicides Propiconazole and Hexaconazole were added at a concentration of 20

ppm to PDA. The flasks were thoroughly shaken to ensure an even mix of the extract under aseptic conditions. Twenty ml of sterilized melted PDA was aseptically poured in sterilized Petri dishes and allowed to solidify. The efficacy of *T. asperellum* and *T. harzianum* against Rhizoctonia solani were assessed by using dual culture technique by measuring the radial growth of *R. solani* as well as that of Trichoderma spp. Three-day-old *R. solani* culture discs were cut into five mm pieces with a sterilized cork borer and positioned in the centre of Petri dishes with plant extracts and fungicides added. Five mm disc of each antagonist and *R. solani* cut with the help of sterilized cork borer from the age of three days old culture and were placed in Petri dishes having solidified PDA in such a manner that they lie opposite to each other 60 mm apart. Control (Check) Petri dishes were inoculated only with *R. solani* bits. Each treatment and control was repeated four times to make four replications. These Petri dishes were kept in BOD incubator at $28^0$ C. The observations on radial growth were made at 24, 36, and 48 hours of incubation in Petri dishes amended with different treatments as well as in control. Per cent growth inhibition was calculated by using formula (Vincent, 1947).

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

Where,

I = Per cent inhibition of fungal growth.

C = Radial growth of control.

T = Radial growth in treated Petri dish.



**Results and Discussion**

**A. Botanicals**

**1. Effect of botanicals against *R. solani* on mycelial growth at 24, 36 and 48 hours.**

At 24 hours of incubation, the minimum mycelial growth was obtained in Garlic (10.18 mm) followed by Ginger (11.43 mm), Neem (12.90 mm), Onion (15.42 mm), Tulsi (17.63 mm) as

compared to control (45.47 mm). Each treatment was significantly different to each other (Table 1, Fig 1). At 36 hours of incubation, the minimum mycelial growth was obtained in Garlic (14.04 mm) followed by Ginger (16.07 mm), Neem (18.63 mm), Onion (20.00 mm), Tulsi (22.00 mm) as compared to control (71.86 mm). Garlic and Ginger, Neem and Onion, Onion and Tulsi were found at par to each other (Table 1, Fig 1). At 48 hours of incubation, the minimum mycelial growth was observed in Garlic (15.49 mm) followed by Ginger (18.00 mm), Neem (19.95 mm), Onion (22.33 mm) and Tulsi (24.66 mm) as compared to control (85.42 mm) which were significantly differed to each other (Table 1, Fig 1)

**2. Efficacy of botanicals against *R. solani* on per cent inhibition at 24, 36 and 48 hours**

At 24 hours of incubation, the maximum per cent inhibition was recorded in Garlic (77.45%) followed by Ginger (74.67%), Neem (71.43%), Onion (65.79 %) and Tulsi (60.95%). However, each treatment was significantly differed to each other (Table 2, Fig 2). At 36 hours of incubation, the maximum per cent inhibition was recorded in Garlic (80.42%) followed by Ginger (77.63%), Neem (74.09%), Onion (72.20%) and Tulsi (69.39%). However, Ginger and Garlic were at par to each other (Table 2, Fig 2). At 48 hours of incubation, the maximum per cent inhibition was recorded in Garlic (81.89 %) followed by Ginger (78.98 %), Neem (76.52 %), Onion (73.81 %) and Tulsi (71.08%). However, each treatment was statistically differed to each other (Table 2, Fig 2,) Plate 1.The present findings are supported by Shinde and Patel (2004) discovered that bulb gather of garlic gave 100% inhibition of mycelial growth of *R solani* causing black scurf of potato, followedbyGinger,Tulsi,Eucalyptus,andNeem. Meena*et al*.(2002)also discoveredthat extract of garlic at 5.0 per cent concentration (w/v) completely inhibited the mycelial growth of *R. solani*causing sheath blight of rice.

**B. Bio-agents**

**1. Effect of bio-agents against *R. solani* on mycelial growth at 24, 36 and 48 hours.**

The efficacy of bio-agents *T. asperellum* and *T. harzianum* were tested for mycelial growth and per cent inhibition of *R. solani* by using dual culture technique.At 24 hours of incubation results clearly indicated that mycelial growth was minimum in *T. asperellum* (18.58 mm) followed by *T. harzianum* (23.14 mm) as compared to control (44.99 mm). Each treatment was significantly differed to each other (Table 3 Fig 3). Similar results were also obtained at 36 hours of

incubation. However, the mycelial growth was 23.24 mm, 31.58 mm and 71.83 mm in *T. asperellum*, *T. harzianum* and control respectively. Each treatment was significantly differed to each other (Table 3 Fig 3).At 48 hours of incubation the mycelial growth was 25.60 mm, 39.55 mm and 82.00 mm in *T. asperellum*, *T. harzianum* and control respectively. Each treatment was statistically differed to each other (Table 3 Fig 3).

**2. Efficacy of bio-agents against *R. solani* on per cent inhibition at 24, 36 and 48 hours.**

*T. asperellum* and *T. harzianum* significantly inhibit the growth of *R. solani* as compared to control at 24, 36 and 48 hours of incubation. *T. asperellum* showed higher per cent inhibition as compared to *T. harzianum* (Plate 2). The per cent inhibition in *T. asperellum* and *T. harzianum* were 58.71% and 48.53% at 24 hours, 67.64% and 56.02% at 36 hours and 68.77% and 58.32% at 48 hours, respectively. Each treatment was significantly differed to each other (Table 4, Fig. 4). The present findings are supported by Dubey and Patel (2001) and Dubey (2002) reports that *T. asperellum* was more effective than *T. harzianum* at inhibiting the mycelial growth of *R. solaniin vitro*. *T. harzianum*, as opposed to *T. asperellum*, was found to be more effective at preventing the mycelial growth of *R. solani* by Meena *et al*. (2002) and Khan and Sinha (2007).

**C. Fungicide**

**1. Effect of fungicides against *R. solani* on mycelial growth at 24, 36 and 48 hrs.**

The efficacy of Propiconazole and Hexaconazole were tested for mycelial growth and per cent inhibition of *R. solani* by using poison food technique.At 24 hours of incubation, the minimum mycelial growth was recorded in Propiconazole the mycelial growth 1.45 mm followed by Hexaconazole3.65 mm and control 45.17 mm, respectively. Each treatment was statistically differed to each other (Table 5, Fig. 5).At 36 hours of incubation,the mycelial growth was recorded 1.85 mm, 4.85 mm and 71.86 mm in Propiconazole, Hexaconazole and Control respectively. Each treatment was statistically differed to each other (Table 5, Fig. 5). At 48 hours of incubation, the results clearly indicated that mycelial growth was minimum in Propiconazole

(2.16 mm) followed by Hexaconazole (5.93 mm) as compared to control (85.42 mm). Each treatment was significantly differed to each other (Table 5, Fig. 5).

**2. Efficacy of fungicides against *R. solani* on per cent inhibition at 24, 36 and 48 hours.**

At 24 hours of incubation, results clearly indicated that maximum percent inhibition in Propiconazole (96.80%) followed by Hexaconazole (91.92%) as compared to control (0.00%). Each treatment was significantly differed to each other (Table 6, Fig. 6). At 36 hours of incubation, maximum percent inhibition was recorded in Propiconazole (97.41%) followed by Hexaconazole (93.25%) as compared to control (0.00%). Each treatment was significantly differed to each other (Table 6, Fig. 6).At 48 hours of incubation,maximum percent inhibition was recorded in Propiconazole (97.47%) followed by Hexaconazole (93.05%) as compared to control (0.00%). Each treatment was significantly differed to each other (Table 6, Fig. 6 Plate 3). Propiconazole and Hexaconazole significantly inhibit the growth of *R. solani* as compared to control. Propiconazole showed higher per cent inhibition as compared to Hexaconazole. (Table 6,Fig. 6). The present findings are supported by VipinKumar*et al.* (2001) reports that Propiconazole was more effective than Hexaconazole at inhibiting the mycelial growth *in vitro*.

**Comment [u2]:** Please included in references section



**Table 1: Effect of Plant extracts against *R. solani*on mycelial growth at 24, 36 and 48 hours.**

| Treatment | MycelialGrowth(mm) | | |
|---|---|---|---|
| | Duration in Hours | | |
| | 24 Hours | 36 Hours | 48 Hours |
| **Neem** | 12.90 | 18.63 | 19.95 |
| **Garlic** | 10.18 | 14.04 | 15.49 |
| **Tulsi** | 17.63 | 22.00 | 24.66 |

| | | | |
|---|---|---|---|
| **Onion** | 15.42 | 20.00 | 22.33 |
| **Ginger** | 11.43 | 16.07 | 18.00 |
| **Control** | 45.17 | 71.86 | 85.42 |
| **CD at5%** | 1.18 | 2.27 | 1.30 |
| **SE(m)** | 0.39 | 0.76 | 0.44 |

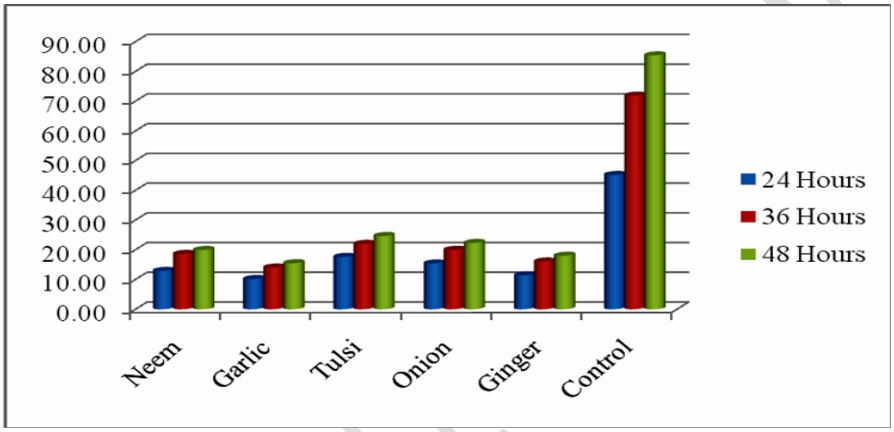



**Fig. 1: Effectof Plantextractsagainst*R. solani*onmycelial growthat24, 36 and48hours**.

**Table2:EfficacyofPlantextractsagainst*R. solani*onpercentinhibitionat24,36 and 48 hours.**

| **Treatment** | **Percentinhibition** | | |
|---|---|---|---|
| | **Duration in Hours** | | |
| | **24 Hours** | **36 Hours** | **48 Hours** |
| **Neem** | 71.43 (57.67) | 74.09 (59.40) | 76.52 (61.07) |
| **Garlic** | 77.45 (61.62) | 80.42 (63.76) | 81.89 (64.79) |

| | | | |
|---|---|---|---|
| **Tulsi** | 60.95<br>(51.31) | 69.39<br>(56.40) | 71.08<br>(57.48) |
| **Onion** | 65.79<br>(54.20) | 72.20<br>(58.20) | 73.81<br>(59.23) |
| **Ginger** | 74.67<br>(59.77) | 77.63<br>(61.75) | 78.98<br>(62.64) |
| **Control** | 0.00<br>(0.00) | 0.00<br>(0.00) | 0.00<br>(0.00) |
| **CD at5%** | 2.34 | 2.88 | 1.47 |
| **SE(m)** | 0.78 | 0.96 | 0.49 |

**Figuregiveninparenthesisaretransformed value**

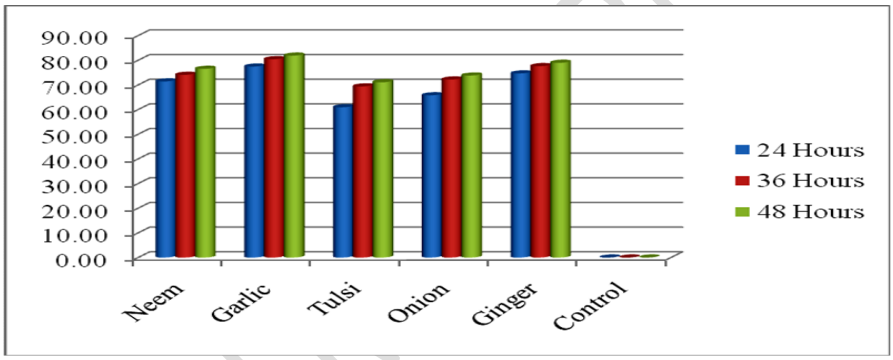



**Fig. 2: Efficacy of Plant extracts against*R. solani*onpercent inhibition at 24, 36 and48hours.**

**Table 3:Effectofbio-agentsagainst*R. solani*on mycelialgrowth at24,36and48 hours.**

| **Fungalantagonist** | **MycelialGrowth(mm)** | | |
|---|---|---|---|
| | **24 Hours** | **36 Hours** | **48 Hours** |
| ***T. asperellum*** | 18.58 | 23.24 | 25.60 |
| ***T. harzianum*** | 23.14 | 31.58 | 39.55 |
| **Control** | 45.17 | 71.86 | 85.42 |
| **CD at 5 %** | 1.58 | 1.56 | 1.17 |
| **SE(m)** | 0.49 | 0.48 | 0.36 |

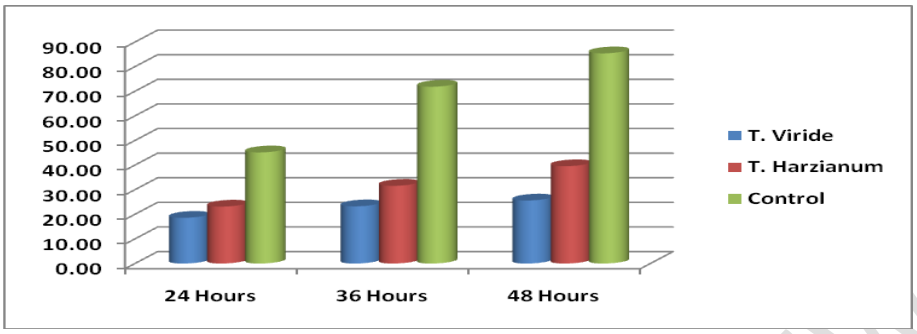



**Fig. 3: Effectof bio-agents against*R. solani*on mycelial growthat 24, 36 and48hours**

**Table 4. Efficacy of bio-agents against *R. solani*on per cent inhibition at 24, 36 and 48 hours.**

| Fungalantagonist | Percentinhibition | | |
|---|---|---|---|
| | 24 Hours | 36 Hours | 48 Hours |
| | 58.87 | 67.65 | 70.82 |
| | | | .28) |
| | | | .30 |
| | | | .45) |
| | | | 00 |
| | | | 00) |
| | | | 09 |
| SE(m) | 0.48 | 0.48 | 0.64 |

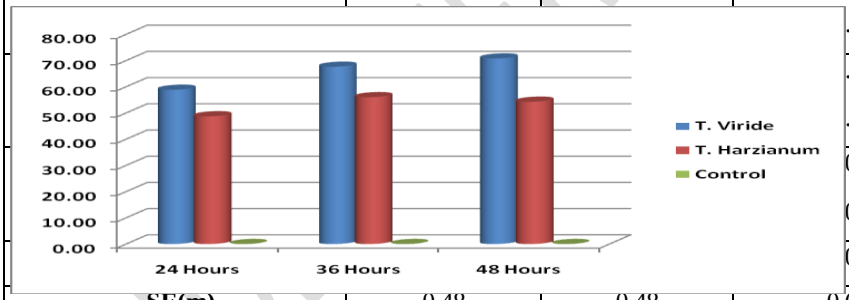



**Figure given in parenthesis are transformed value**

**Fig. 4: Efficacy of bio-agents against*R. solani*onpercent inhibitionat24, 36 and48hours.**

**Table 5: Effect of Fungicides against *R. solani*on mycelial growth at 24, 36 and48hours.**

| Treatment | MycelialGrowth(mm) | | |
|---|---|---|---|
| | Duration In hours | | |
| | 24 Hours | 36 Hours | 48 Hours |

| | | | |
|---|---|---|---|
| **Propiconazole** | 1.45 | 1.85 | 2.16 |
| **Hexaconazole** | 3.65 | 4.85 | 5.93 |
| **Control** | 45.17 | 71.86 | 85.42 |
| **CD at 5%** | 1.43 | 1.37 | 1.01 |
| **SE(m)** | 0.44 | 0.42 | 0.31 |

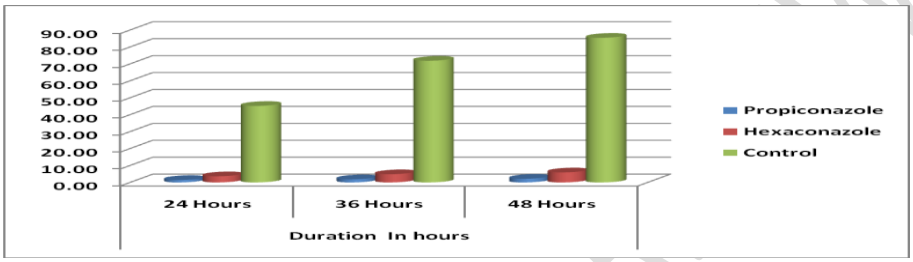



**Fig. 5: Effectof fungicides against*R. solani*onmycelialgrowth at 24, 36 and48hours.**

**Table 6: Efficacy of Fungicides against *R. solani*on percent inhibition at 24, 36 and 48hours.**

| **Treatment** | **Percentinhibition** | | |
|---|---|---|---|
| | **Duration In hours** | | |
| | **24 Hours** | **36 Hours** | **48 Hours** |
| Propiconazole | 96.80 (79.67) | 97.42 (80.74) | 97.47 (80.81) |
| Hexaconazole | 91.92 (73.46) | 93.25 (74.91) | 93.05 (74.70) |
| Control | 0.00 (0.00) | 0.00 (0.00) | 0.00 (0.00) |
| CD at 5% | 0.66 | 0.23 | 0.76 |
| SE(m) | 0.20 | 0.07 | 0.23 |

**Figuregiveninparenthesisaretransformed value**

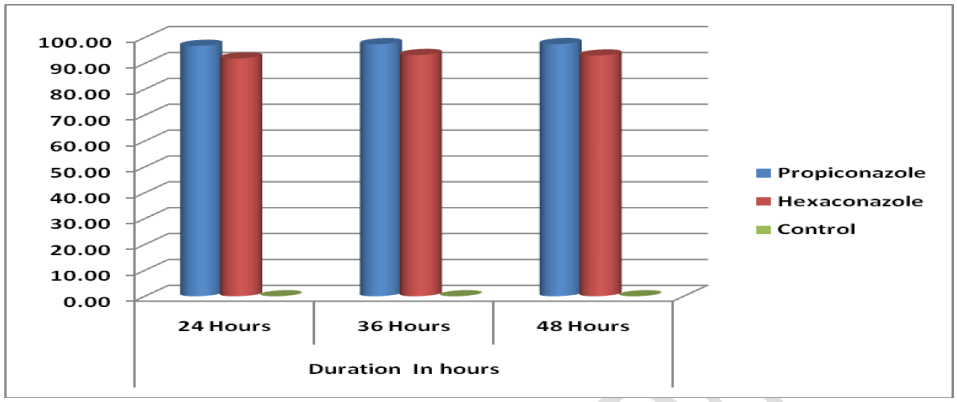
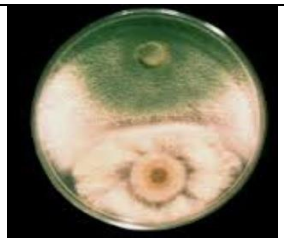


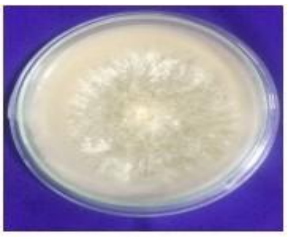

**Fig. 6:Efficacy offungicides against*R. solani*on inhibition percent at24, 36 and48hours.**

**NeemGarlicTulsi**

**OnionGinger control**

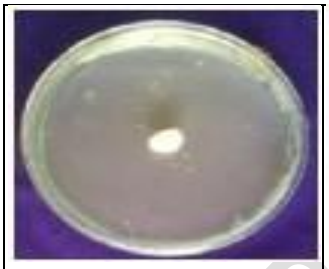
**Plate:1. Response ofbotanicals against *R. solani*on mycelialgrowth.**

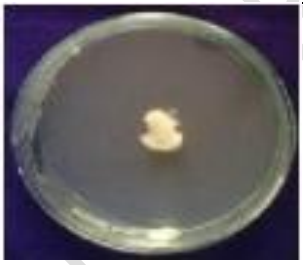




| *Trichoderma asperellum* | *Trichoderma harzianum* | Control |
|---|---|---|

**Plate:2.Responseofbio-agents against*R. solani*onmycelialgrowth.**





| Propiconazole | Hexaconazole | Control |
|---|---|---|

**Plate:3. Response offungicides against*R. solani*on mycelialgrowth.**



## Conclusions

Comment [u3]: Please write conclusions of the manuscript

## References

Comment [u4]: Add more references and must include advanced references

Anonymous (2019). *All India Coordinate Research Project on MullaRP, IIPR. Kanpur*, 108 pp.

Nacien, C.C. (1924). Studies on *Rhizoctonia blight* of beans. *Philippine Agriculturist*, 8:315-321.

Dwivedi, R.P. and Saksena, H.K. (1974). Occurance of web blight disease caused by *Thanatephorus cucumeris* on mungbean. *Indian J. Farm Sci.* 2:100.

Saikia, U.N. 1976. Blight of mung caused by *Corticiumsasakii* a new disease recorded from Assam. *Indian Phytopath*. 29: 61-62.

Bains, S.S., Dhaliwal, H.S. and Basandrai, A.K. 1988. A new blight of Mung and Mash in Punjab. *Ann. Biol. Ludhiana*. 4: 113–114.

Tiwari, A. and Khare, M.N. (1998). Variability among isolates of *Rhizoctonia solani* infecting mungbean. *Indian phytopath.*, 51:334-337.

Anonymous (2004). *Annual Report (kharif).* All India Co-ordinated Research Project on MullaRP (ICAR), IIPR, Kanpur, 112 pp.

Gupta, R.P. Singh, S.K. and Singh, R.V. (2010). Assessment of losses due to web blight and weather effects on disease development in mungbean. *Indian Phytopath.* 63 (1) : 108-109.

Vincent, J.M. (1947). Distortion of fungal hyphae in the presence of certain inhibitors. Nature 159:850-853.

Dubey, S.C. and Patel, B. (2001). Evaluation of fungal antagonists against *Thanatephorus Cucumeris* causing web blight of urd and mungbean. *IndlianPhytopath.* 54(2) : 206- 209.

Dubey, S.C. (2002). Evaluation of *Glioclodiumvirens*and *Trichoderma viride* as foliar spray against web blight of urd and mungbean. *J. Mycol. Pl. Pathol*. 32 (2):236-237

Meena, R.L., Rathore and Mathur, K. (2002). Evaluation of fungicides and plant extracts against banded leaf and sheath blight of maize (*Zea mays). J.Mycol. PL. Pathol*. 32 (3):397.

Khan,A.A.andSinha,A.P.(2007).Screeningof*Trichodermaspp*.against*Rhizoctonia solani* the causal agent of rice sheath blight*. Indian Phytopath*. 60 (4):450-456

Kumar, Vipin., Chaudhary, V.P., Kumar, Dharmendra., Kumar, Ajay., Sagar, Sushma and Chaudhary, Sorabh. (2017) Efficacy of botanicalsand fungicides against *Rhizoctonia solani*

inciting sheath blight disease on Rice *(Oryza sativa* L.) *Journal of Applied and Natural Science* 9 (4): 1916 -1920(2017)

Shinde, G.R. and Patel, R.L. (2004). Evaluation of plant extract against *R. solani*incitant of black scurf Disease in Potato. *J. Mycol. Pl. Pathol*. 34 (2) 28:4- 285