Research Article

In Vitro Evaluation of Antifungal Properties of Essential Oil against Seed Borne Fungal Pathogens of Basmati Rice

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Abstract

Rice seed sample varieties of PB-1121, PB-6 and VB 22 were collected from Chirodi farm of SardarVallabhbhia Patel University of Agriculture & Technology, Meerut, Uttar Pradesh, India. From these three Rice varieties, six seed borne fungus were detected. The identified fungus were *Fusariumoxysporum*, *F. moniliforme*, *Alternaria, padwickii*, *Aspergillusflavus*, *Aspergillusnigar*and *penicillium* sp. Efficacy of essential oils were evaluated in different concentration *viz*. Neem (4%), Lemongrass (2%), Thruja (1.5%) and Citrus (1.5%) for seed treatment. In these essential oils, Lemongrass (2%) concentration was found best for three rice varieties which successfully increase root and shoot length of rice plant (5.19cm,6.18cm)) and reduce seed infection 82.8% in varieties PB-1121, (5.8 cm, 6.86 cm) (87.5%) in VB -22 and (5.9 cm, 6.5cm) (86.25%) in PB-6 respectively seed borne infection and also increase seed germination up to (37.45%) in PB-1121 (39.77%) in VB-6 and (46.03%) in PB -22 over control. Other treatment like Citrus oil, Thruja oil and Neem oil also increase the seed germination up to (36.33%), (33.45 %) and (33.33%) respectively. Based on the present study, it may be concluded that among the all other essential oils, Lemongrass essential oil with the concentration of (2%) was most effective in controlling seed borne fungal flora of rice.

Keywords: Varieties, Neem oil, Thruja oil, Root length, Shoot length, Rice

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Introduction

Rice (*Oryza sativa* L.) a member of the Oryzoid group is one of the most important staple food for humans throughout the world. Among various Asian countries, China and India are the major producers of this crop (IRRI, 2011). In India, it is cultivated in nearly all states. The major producer viz: Punjab, Haryana, Uttar Pradesh, Bihar, and West Bengal. The main varieties cultivated are Jaya, Pusa Sugandh, Unnatt Pusa, Basmati-1, Pusa R. H. 10. Due to increase in population, the demand for rice is growing every year. As per estimates by [1, 2] the current demand of rice is approximately 145 million tons and it is estimated that it will reach up to 169 million ton in 2025. So in order to sustain present food self-sufficiency and future food requirements, India has to increase its rice productivity by 3 percent per annum. However, the productivity of rice is severely affected by seed borne pathogens [3]. Most of the diseases of rice are carried though seed and cause enormous losses to the crop. Fungi including *Alternaria padwickii, Aspergillus niger, Curvularia oryzae*, *Drchslera oryzae*,*Fusarium miniliforme* f.sp. *oxysporum*, and *Pyricularia oryzae*, have been isolated from seeds of different varieties of rice [4-7]. These fungi may decrease seed germination, cause seed discoloration, produce toxins that may be injurious to human and may reduce seed weight also [8] the present study was carried out to identify the fungi associated with seeds of different rice varieties and their control.

Materials and Methods

The experiment was carried out at Centre of Excellence (SPS) laboratory in the Department of Plant Pathology, SVPUA&T, Meerut. Rice varieties selected for the study were Panjab Basmati,-6, PB 1121 and Vallabh Basmati,-22. The experiment was conducted following Completely Randomized Design (CRD) with three replications. Seed sample were collected from Chirodi farm of SardarVallabhbhai Patel University of Agriculture Meerut and sample enclosed in the paper bags with proper labeling and were kept at room temperature until used for subsequent studies. Four different plants namely Lemongrass, Citrus, Thruja, and Neem plant parts were collected from HRC of university to test their antifungal activity against seed borne pathogens of rice.

Extraction of essential oil

The essential oils from the fresh leave of Lemongrass, Citrus, Thruja and Neem were extracted by using the Clevenger apparatus as recommend by [8] The recovered essential oil from each extraction was stored in darkness at 4 ^{0}C temperature. The plant species were selected on the basis of the previous knowledge of antifungal activity.

Seed treatment

The seed were treated with an essential oil and 0.1% water Agar solution [9]. The following EOs were diluted with distilled water at the ratio of Citrus oil 1.5%V/V, Thruja oil,1.5%V/V, Neem oil 4%V/V, and Lemongrass oil 2%V/V. Initially the rice seeds were treated with One hundred (100) µl of 0.1% water Agar solution followed by treat with diluted Eos at the rate of one hundred (100) µl of oil solution. The mixture was applied per gram of rice seeds according to [10]. These concentrations were selected based on preliminary study.

Results and Discussion

Effect of essential oil on root, shoot length and seed Germination of three Rice varieties

In this experiment four essential oils were used in controlling seed borne fungi. In case of variety Punjab Basmati, 1121 the highest root, shoot length (5.19 cm, 6.18 cm) and seed germination (93.75%) were recorded when the seed treated with lemongrass @ 2.00% and it increase the germination by (37.45%) over control. Among the other essential oil Citrus 1.5%, Neem 4.00%, Thruja 1.5%, also increase the root and shoot length of rice plant (4.88 cm, 5.24 cm) (4.96 cm, 5.32cm) (4.40 cm, 5.13 cm) and it increase seed germination by (30.51%), (31.38%), (33.45%) respectively over control. Minimum root length (4.40cm) shoot length (5.51cm) and (68.75%) seed germination was recorded by control [11].

Table 1 Effect of essential oil on root, Shoot length seed germination and reduction% seed borne infecting of PB- 1121 rice variety

S.No	Treatment	Concentration	Root length (cm)	Shoot length (cm)	Seed germination %	Seed germination % over control	Reducing % seed borne infection
1	Leamongrass	2.00%	5.19	6.18	93.75	37.45	82.8
2	Citrus	1.5%	4.88	5.24	89.73	30.51	82.5
3	Neem	4.00%	4.965	5.32	90.33	31.38	77.61
4	Thruja	1.5%	5.175	5.13	91.75	33.45	80.00
5	Control		4.405	5.3625	68.75		
	S. Ed. (±)		0.24	0.33			
	C. D. (P = 0.05)		0.52	0.71			

Table 2 Effect of essential oil on root, Shoot length seed germination and reduction% seed borne infecting of PB-6 rice variety

S.N	Treatment	Concentration	Root length (cm)	Shoot length (cm)	Seed germination %	Seed germination % over control	Reducing% seed borne infection
1	Leamongrass	2.00%	5.59	6.57	92.25	39.77	86.25
2	Citrus	1.5%	5.75	6.38	90	36.33	80.00
3	Neem	4.00%	5.7	6.025	88.75	34.46	78.5
4	Thruja	1.5%	5.8	5.86	90.65	37.34	80.00
5	Control		4.465	6.47	66		
	S. Ed. (±)		0.35	0. 20			
	C. D. (P = 0.05)		0.75	0.44			

Table 2 data indicate that in case of varieties PB-6 the highest root, shoot length and seed germination were recorded (5.5cm, 6.5cm) (92.25%)when the seed treated with lemongrass @ 2.00% and it increase the germination by (39.77%) over control. Among the other essential oil Citrus1.5% Neem,4.00% Thruja,1.5% also increase the root and

shoot length of rice plant (5.7cm,6.3cm) (5.7cm,6.0cm) (5.8,cm5.8cm) and it increase seed germination by (37.33%), (34.46%), (37.35%) respectively over control. Minimum root length (4.4cm) shoot length (6.4cm) and (66%) seed germination was recorded by control.

Table 3 Indicate that in case of varieties VB-22 the highest root, shoot length and seed germination were recorded (5.8cm, 6.8cm) (93.1%)when the seed treated with lemongrass @ 2.00% and it increase the germination by (46.03%) over control. The other essential oil Citrus1.5% Neem,4.00% Thruja,1.5% also increase the root and shoot length of rice plant (5.6cm, 6.3cm) (5.5cm, 6.4cm) (5.5cm, 6.2cm) and it increase seed germination by (33.33%), (43.45%) (33.33%) respectively over control. Similar result found by [12] they were tested essential oils (EOS) extracted from *Cymbopogoncitratus*, *Ocimumsgratissimum* and *Thymus vulgaris*, for their ability to control seed-borne infection and seed to seedling transmission of Alternariapadwickii, Bipolarisoryzae and Fusariummoniliforme in naturally infected seeds. These EOs applied as slurry controlled the seed infection at a range of 48% to 100% and these Eos also increased the germination capacity of the treated rice seeds with 5 to 13%.

Table 3 Effect of essential oil on root, Shoot length seed germination and reduction% seed borne infecting of VB-22 rice variety

S.No.	Treatment	Concentration	Root length (cm)	Shoot length (cm)	Seed germination %	Seed germination % over control	Reducing% seed borne infection
1	Lemon grass	2.00%	5.805	6.865	93.1	46.03	87.5
2	Citrus	1.5%	5.6125	6.375	85	33.33	86.25
3	Neem	4.00%	5.57	6.49	91.25	43.45	77.5
4	Thruja	1.5%	5.53	6.295	85	33.33	78.75
5	Control		5.0325	5.485	63.75		
	S. Ed. (±)		0.20	0.24			
	C. D. (P = 0.05)		0.43	0.51			

Among the plant EO best performance in term of reducing percent seed borne infection was obtain treating the seed of variety Punjab Basmati1121 lemongrass @ 2.00% which reduce 82.8% seed borne infection and also increase the seed germination by 37.45% over control and other EO Ctrus,1.5% Neem 4.00% Thruja1.5% also reduce (82.5%) (77.61%) (80.00%) reduce seed borne infection and also increase the germination by 30.51%, 31.38%, 33.45% respectively over control. Table 2 in case of variety PB-6 best performance in term of reducing percent seed borne infection was obtain through treating the seed with lemongrass @ 2.00% which reduced 86.25% seed borne infection respectively and also increase seed germination by 39.77% respectively over control and other EO Citrus,1.5% Neem 4.00% Thruja1.5% also reduce (80.00%) (78.5%) (77.5%) reduce seed borne infection and also increase the germination by (36.33%), (34.48%), (37.34%) respectively over control. Table 3 in case of varietyVB-22 best performance in term of reducing percent seed borne infection was obtained through treating the seed with lemongrass @ 2.00% with reduced 87.5% seed borne infection and also increase the seed germination by 46.03 over control and other EO Citrus 1.5%, Neem 4.00%, Thruja1.5% also reduce (86.25%) (77.5%) (78.75%) reduce seed borne infection and also increase the germination by (33.45 %,) (43.45 %,) (33.34%) respectively over control. Similar result was found by [13].The efficacy of the essential oil from Cymbopogonnardus as antifungal agent of Pestalotia sp. which causes leaf spot disease of narra (Pterocarpusindicuswild) was tested *in vitro*. Mycelial growth was recorded in different concentrations of essential oils (0.02%, 0. 1%, 1%, 2%, and 5% v/v). Fungal growth inhibition was significantly observed in all concentrations. However, in the absence of the essential oil, the pathogenic fungi had a normal development in 10 days of incubation. The present study revealed that essential oil of C. nardus is a promising natural means of controlling the development of the pathogenic fungi of P. indicus. Similar result was found by [14]. The effect of essential oil control of *F. moniliforme*in seeds of maize was achieved at 90% in all the 4 cultivars tested using the essential oils extracted from and *C. citratus.* and *O. gratissimum.* Improvement of the germination was recorded from the treatment with the essential oils. The control of seed to seedling transmission of *F. moniliforme*was achieved at 47% for the essential oils *O. gratissimum*and 31% for *C. citratus*. These control effects of the essential oils from *O. gratissimum*and *C. citratus*on *F. moniliforme*in maize seeds as well as the improvement in the germination disclosed the potential use of the 2 essential oils studied as seed treatment against fungi in maize.

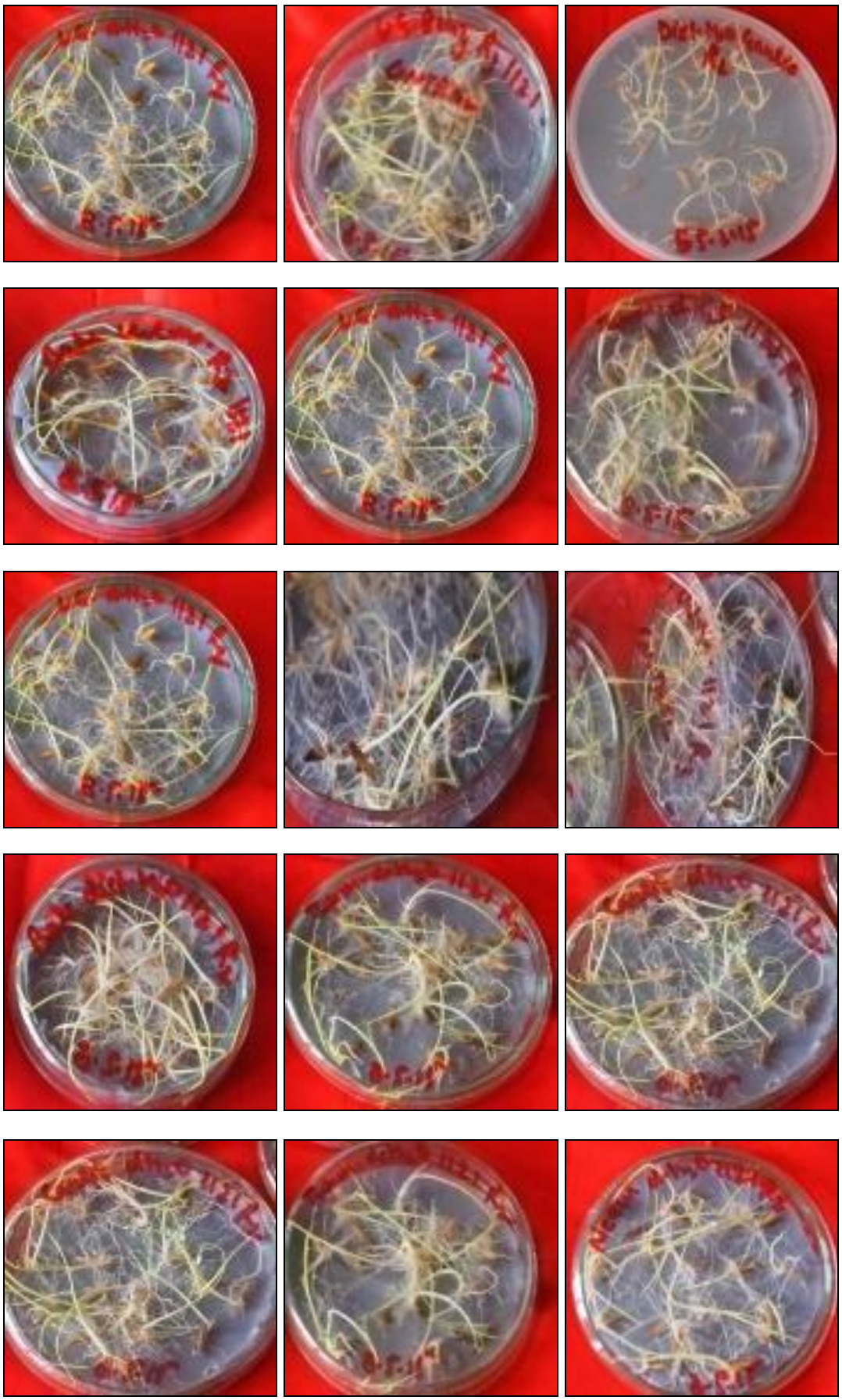

Plate 1 Effect of essential oil on root, Shoot length, seed germination and reduction% seed borne infecting of PB-1121 rice variety

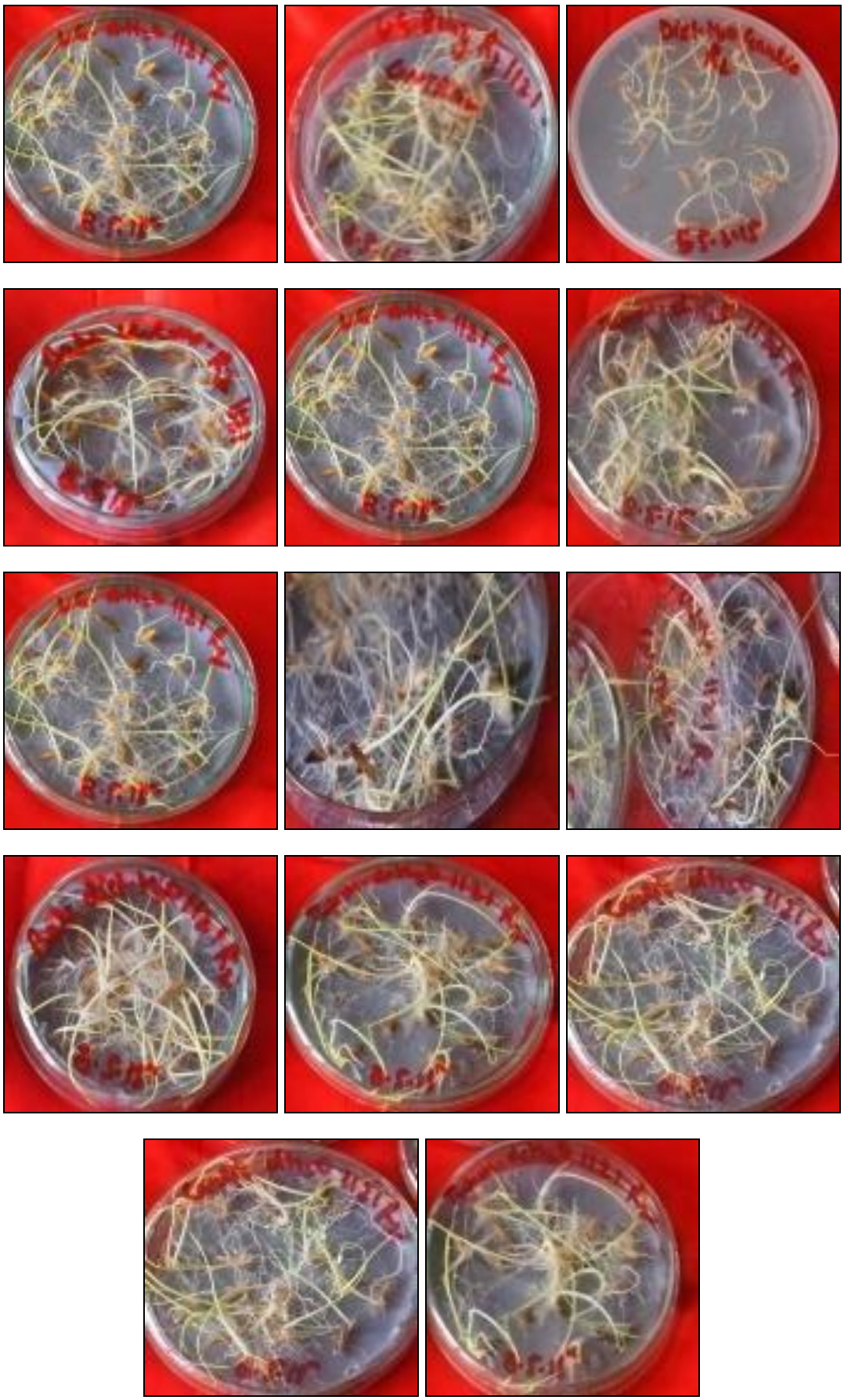

Plate 2 Effect of essential oil on root, Shoot length, seed germination and reduction% seed borne infecting of PB-6 rice variety

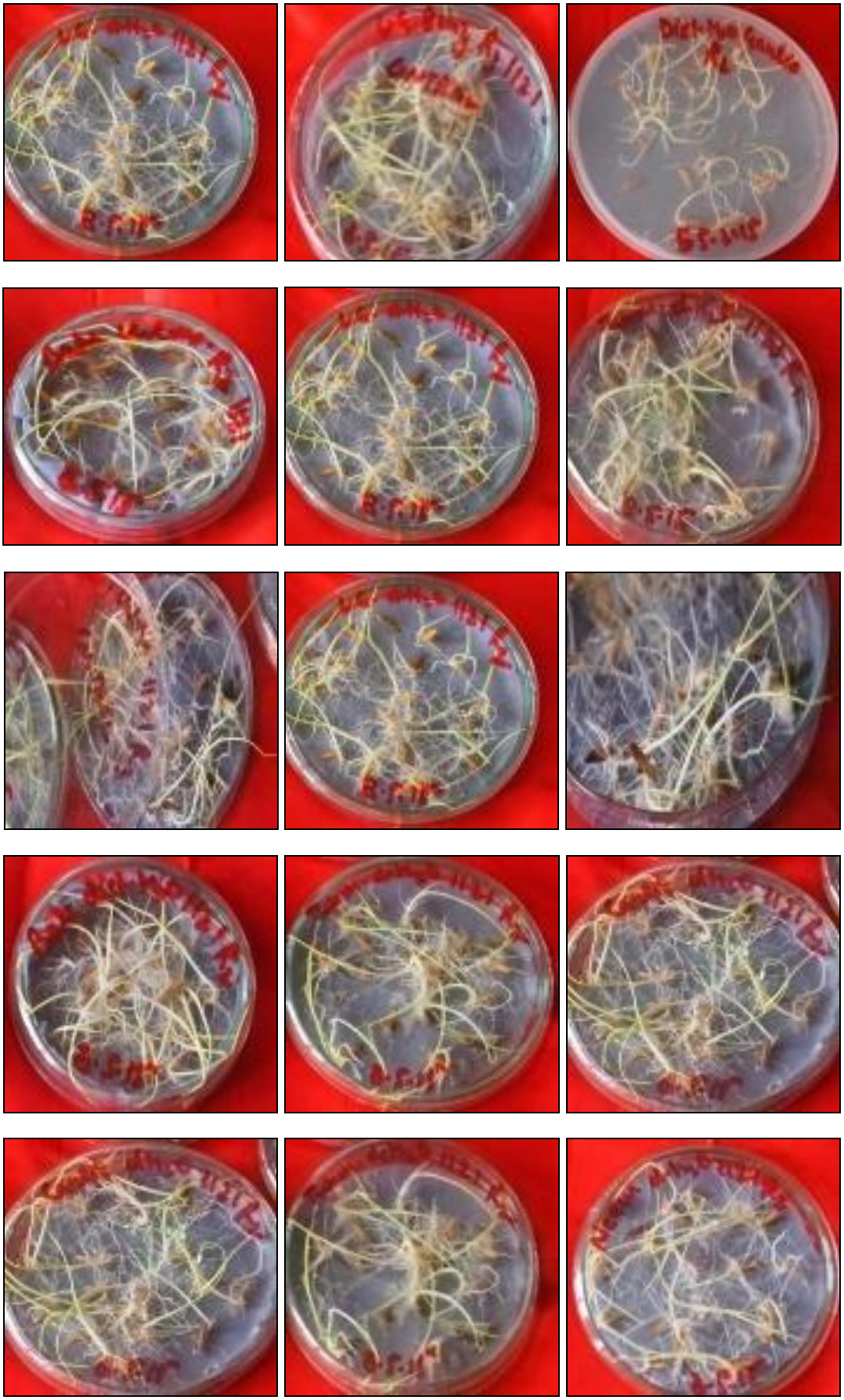

Plate 3 Effect of essential oil on root, Shoot length, seed germination and reduction% seed borne infecting of VB-22 rice variety

Conclusion

From the present study it is clear that seed borne fungi are threat to health of rice seed. Seed treatment may be quick technique in this regard as it reduced or elimination seed borne fungi and also increase seed germination. Seed treatments with the lemongrass @ 2.00% significantly increase root, shoot length, seed germination % and also reduce seed borne infection of three rice varieties and effectively control the seed borne fungi of rice.

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