INTERNATIONAL JOURNAL OF RESEARCHES IN BIOSCIENCES, AGRICULTURE AND TECHNOLOGY
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www.vmsindia.org

EFFICACY OF FUNGICIDES, BIO-AGENTS AND PLANT EXTRACT AGAINST SEED BORNE MYCOFLORA OF PADDY IN EASTERN VIDARBHA ZONE

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Abstract
Twenty four rice seed samples were collected from Bhandara, Gadchiroli, Chandrapur and Gondia district of Maharashtra and fourteen seed-borne fungi were detected from these seed samples. Three fungicides carbendazim 1g kg^{-1}, carbendazim + thiram 1g kg^{-1} carbendazim + mancozeb 1g $kg,^{-1}$ two bio agents *Trichoderma viride* 4g kg^{-1} , *Pseudomonas flourscens* 4g $kg^{-1}$and two plant extracts neem seed powder extract and pongamia extract 5ml $kg^{-1,}$ were applied to seed to test the efficacy. It may be concluded that, among the three fungicides carbendazim + thiram (1: 2) was most effective in controlling seed-borne fungal flora of rice and increased germination percentage followed by carbendazim + mancozeb (1:1) and bio agents *Trichoderma viride* was superior. Neem seed powder extract was superior than pongamia extract.
Keywords: Fungicides, Bio agents and plant Extracts, Varieties

Introduction

Rice (*Oryza sativa*) is one of the most important food crops of India in terms of area, production and consumer preference. It is important staple food grain crop of the world constitute 60 per cent of the world human population. Rice not only performs main diet of the majority of the people but also bears a large influence on their life and economic condition. India is the second largest producer and consumer of the rice in the world. Rice production in India crossed the mark of 100 million metric tons in 2013-14 (Anonymous, 2014) accounting for 22.81 per cent of global production. The productivity of rice has increased from 1948 kg ha^{-1} to 2372 kg ha^{-1} in 2011-12 The average world yield of rice is 3.84 tons/ha (Fakir, 2000). Major diseases of rice are seed-borne and suffers from more than 60 different diseases (Danquah *et al.,1976).* Seed serves as an important microcosm for saprotrophic and pathogenic microorganisms and paddy seeds are no exception to this (Agrios, 1997 and Domijan *et al.,* 2005). Fungi are the principal organisms associated with seed in storage. Among all the seed-borne diseases of rice, 22 are caused by fungi. The most destructive seed-borne fungal diseases of rice are brown spot (*Bipolaris oryzae*), blast (*Pyricularia oryzae*), sheath rot (*Sarocladium oryzae*), sheath blight (*Rhizoctonia solani*), leaf scald (*Microdochium oryzae*), seed rot and seedling blight (*Bipolaris oryzae, Sclerotium rolfsii and Fusarium spp.*), grain spot (*Curvularia lunata, Nigrospora oryzae, Phoma glumarum, and Cladosporium sp.*) Ora *et al.* (2011) carried out an experiment to assess seeds of cultivated hybrid rice varieties as check for seed borne pathogens. Blotter method, paper towel method and agar plate method were used to identify seed borne pathogen and a total of 12 pathogens *(Xanthomonas oryzae, Rhizopus stolonifer, Aspergillus* sp. *Fusarium moniliforme, Phoma* sp,, *Bipolaris oryzae, Curvularia lunata, Penicillium* sp, *Alternaria tenuissima, Nigrospora oryzae, Chaetomium globosum,* and *Tilletia barclyana.)* were identified. Among this pathogen, *Xanthomonas* sp., *Rhizopus stolonifer, Aspergillus niger, Bipolaris oryzae* and *Fusarium moniliforme* are pre-dominant on all tested hybrid rice varieties. There are many constraints responsible for low yield of rice in India. most common associates in paddy all over the world, causing pre- and post-infections and considerable quality losses viz., seed abortion, seed rot, seed necrosis, reduction or elimination of germination capacity, seedling damage and their nutritive value have been reported (Miller, 1995; Janardhana *et al.* 1998; Kavitha *et al.*, 2005). In India farmer use own seed for rice cultivation and not maintain the seed health properly that resulting heavy infestation by the fungi, particularly during hot and humid seasons and cause deterioration of quality and viability of seeds. These seeds results in reduced germination rate and transmit pathogens from seed to seed bed and ultimately cause field diseases. Seed treatment is the safest and the cheapest way of control of seed-borne fungal diseases and to prevent bio deterioration of grains (Chandler, 2005 and Bagga and Sharma, 2006).

Materials and Methods:

Collection of paddy seeds samples

The present studies were carried out at Plant Pathology Laboratory, College of Agriculture, Nagpur during the year 2014-15. A total of 24 seed samples of different cultivars of paddy (Suvarna, Hira, Shivam, Kranti, Jayshree ram, Ukara, and Akshay, Madhusudan, Jayram, Puja, R.P, Prajwal, Ruchi, D.R.K, Virshi and Dhanalakshmi, 1010, Shivam, Nirmalmaji, Y.S.R, Shubam, Hanuman, Sonamcultivar) (approximately 1 kg) were collected from farmers fields (immediately after the harvest) of different agro-climatic regions of area viz., Bhandara, Gadchiroli, Chandrapur and Gondia during the harvest seasons of 2014. Samples were brought to the laboratory in sterile plastic bags and kept at 4°C. All the samples were subjected to mycological analysis.

Detection of seed-borne fungi

Seed–borne fungi were detected by employing different incubation tests. (Comparative seed health testing).

A. Standard Blotter paper method

Standard blotter method (ISTA, 1966) is widely used for the detection of seed borne fungi of most kinds of seed and hence the same method was employed. For this test 400 seeds of each sample were sown on three layers of moist blotters in surface disinfected transparent plastic petriplates of 100 mm diameter. In each plate 10 seeds were arranged, 9 seeds in the outer ring and one in the centre. The plated seeds were then incubated at 27±2°C, under alternate cycle of 12 hours light and 12 hrs. darkness for five days by using two 40 W white fluorescent tubes. After seven days of incubation, seeds are observed and examined under stereoscopic microscope by using a magnification of 6X to 50X. Research microscope was also used to confirm the identification of fungi based on morphological characters given in standard mycological text book, Seed Pathology (Neerguard, 1977).

B. Agar plate method

In agar plate method, potato dextrose agar which was sterilized was poured into petri plates and allowed to cool. 25 seeds were placed on each petri plate under aseptic conditions, using laminar air flow. Then the seeds were incubated under the same conditions as mentioned in blotter paper method and after seven days examined for fungi. The fungi were identified based on the colony characters as above.

C. Deep freezer blotter method

In this method seeds were placed on the moist blotters as followed in blotter test. The plated seeds were incubated under normal room temperature (28±2°C) for 24 hrs. After 24 hrs plated seeds were incubated at 20°C in deep freeze for 24 hrs. For the remaining five days seeds were again incubated at room temperature. After seven days seeds were examined for fungi under stereoscopic microscope and identified.

Efficacy of fungicides, bioagents and plant extract

Efficacy of three fungicides/combination fungicides *viz.*, carbendazim (2-methoxyl-carbonyl benzimidazole) (bavistin 50 % WP) @ 1 g kg^{-1}, carbendazim (50% W.P).+ thiram (75%) (1+2) 1g kg^{-1}, carbendazim + mancozeb (75% W.P.) (tetra methyl di-sulphide) 1 g kg^{-1} and two bioagents, *Trichoderma viride* @ 4 g kg^{-1} and *Pseudomonas sp* @ 4 g kg^{-1}, neem seed powder extract 5 per cent as well as pongamia leaf extract 5 per cent were tested against seed-borne fungi by blotter paper method and germination and seedling vigour index by paper towel method.

Seeds with calculated amount of fungicide, bioagent and plant extracts were shaken in a conical flask for 15-20 min to achieve uniform coating of fungicides, bioagents and plant extract on 400 seeds of each variety. Seeds were tested for fungi by blotter method and examined after seven days of incubation

Results and Discussion:

Total fourteen fungi belonging to nine genera were observed in all the twenty four verities. The identified fungi were *Fusarium oxysporum, F. moniliforme, Rhizoctonia solani, Alternaria alternata, Curvularia lunata, Colletotricum falcatum, Aspergillus flavus, Aspergillus niger, Aspergillus nidulans, Aspergillus `oryzae, Pyricularia oryzae, Penicillium sp, Chaetomium globosum,* and *Rhizopus stolonifer*. Three methods were employed for the identification of seed borne fungi. Through blotter paper method results were as follows, highest per cent of mycoflora was recorded in Suvarna variety i.e., 98.7 per cent and it was followed by H.M.T (76) and Jayshriram varieties (63).

Fungicidal efficacy:

The efficacy of different fungicides, bioagents and plant extracts viz., carbendazim, carbendazim + thiram, carbendazim + mancozeb, *Trichoderma viride* and *Psuedomonas fluorescens*, neem seed powder extract and

pongamia extract on the seed borne fungi *viz.*, *Fusarium moniliforme, Aspergillus flavus, Curvularia lunata, Pyricularia oryzae, Penicillium crysogenum*, *A. niger, R. Stolonifer* and *Alternaria alternata* were assessed by blotter paper method. The association percentage was calculated over control after 7th day. The results are presented in Table No.1 .

The data presented in table 1 showed that the carbendazim + thiram was significantly superior recorded 2.0 per cent association of fungi and 93.42 per cent reduction over control followed by carbendazim + mancozeb and carbendazim with 3.5 and 4.0 per cent association and 90.78 and 89.47 per cent reduction over control respectively. Carbendazim showed 100 per cent control of *Pyricularia oryzae* and *Rhizoctonia solani*, carbendazim + thiram showed 100 per cent control of *Curvularia lunata, Fusarium moniliformae, Penicillium sp, Rhizoctonia solani* and *Alternaria alternata, Trichoderma viride* resulted 7.0 per cent association and 81.52 per cent reduction over the control compared to *Pseudomonas fluorescens* which recorded 8.5 per cent fungal association and 76.57 per cent reduction over the control. Fungicides and bio agents were superior to plant extracts which recorded 10.5 and 12.0 per cent association in both neem seed powder extract and pongamia extract respectively and 71.57 and 68.42 per cent reduction over the control.

Fungicides, bioagents and plant extracts viz., carbendazim, carbendazim + thiram, carbendazim + mancozeb, *Trichoderma viride* and *P. fluorescens,* neem seed powder extract , pongamia extract were used to determined their efficacy on seed germination, shoot and root length and seedling vigour index of paddy seed by employing paper towel method and data are presented in table 2.

The data presented in table 2 resulted all the treatments were statistically significant over the control. Highest seed germination, shoot and root length and seedling vigour index was recorded in the treatment carbendazim + thiram recorded with 95.50 per cent germination, 11 cm shoot length, 10.5 cm root length and 2053.25 seedling vigour index which was statistically significant to all over the treatments, followed by treatment carbendazim + mancozeb @ 1 g kg^{-1} found that 93.25 per cent germination and followed by carbendazim 90.75 per cent but carbendazim was superior to carbendazim + mancozeb in seedling vigour index i.e.,1769.6 with 9.5 cm shoot and 10 cm root length and 1725.12 SVI for carbendazim + mancozeb. All the fungicides were superior over the control 70.32 per cent germination, shoot length 6.5 cm and root length 7 cm and seedling vigour index 949.32 . The bioagent *T. viride* showed germination per cent, shoot and root length 92 per cent, 9 cm and 11 cm respectively with 1754 seedling vigour index. *P. fluorescens* showed germination per cent 82.65 shoot length of 6.5 cm and root length of 9.5 cm with vigour index 1322.4.

The less effective treatments were neem seed powder extract and pongamia extract @ 5 ml kg^{-1} recorded germination percentage 78.45 per cent and 72.50 respectively, in shoot and root length, 8.0 cm and 11 cm shoot length and root length 6.5 cm and 8.0 cm with seedling vigour index 1490 and 1051 respectively over the control.

Table 1- Efficacy of different fungicides, bioagents and plant extracts on seed–borne fungi of suvarna variety (Blotter paper method)

Tr. No.	Fungicides, bioagents &plant extracts	Per cent fungi association with seed								Total Fungi %	% reduction Over control
		A.n	*A.f*	*C.l*	*F.m*	*P.o*	*P.c*	*R.s*	*A.a*		
T1	carbendazim	0.5 (0.91)	0.5 (0.91)	0.5 (0.91)	1.0 (1.12)	0.0 (0.70)	0.5 (0.91)	0.0 (0.70)	1.0 (1.12)	4.0	89.47
T2	carbendazim + thiram	0.5 (0.91)*	1.0 (1.12)	0.0 (0.70)	0.0 (0.70)	0.5 (0.91)	0.0 (0.70)	0.0 (0.70)	0.0 (0.70)	2.0	93.42
T3	Carbendazim + mancozeb	0.0 (0.70)	1.0 (1.12)	0.0 (0.70)	0.0 (0.70)	1.0 (1.12)	0.0 (0.70)	1.5 (1.29)	0.0 (0.70)	3.5	90.78
T4	*Trichoderma viride*	1.0 (1.12)	1.0 (1.12)	0.5 (0.91)	0.5 (0.91)	2.0 (1.43)	0.0 (0.70)	1.5 (1.29)	0.5 (0.91)	7.0	81.52
T5	*Pseudomonas fluorescens*	1.5 (1.29)	1.0 (1.12)	1.0 (1.12)	0.5 (0.91)	1.5 (1.29)	1.0 (1.12)	1.5 (1.29)	0.5 (0.91)	8.5	76.57
T6	neem seed powder extract	1.5 (1.29)	2.5 (1.58)	1.5 (1.29)	0.5 (0.91)	1.0 (1.12)	1.5 (1.29)	1.0 (1.12)	1.0 (1.12)	10.5	71.57
T7	pongamia extract	2.0 (1.43)	1.0 (1.12)	1.0 (1.12)	2.5 (1.58)	1.5 (1.29)	1.5 (1.29)	1.0 (1.12)	1.5 (1.29)	12.0	68.42
T8	Control	8.5 (2.32)	6.5 (2.38)	4.5 (1.29)	3.5 (2.20)	4.5 (2.00)	3.0 (1.58)	4.0 (2.20)	3.5 (1.29)	38.0	-
	S.E. ± (m)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	-	-
	CD (P= 0.01%)	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	-	-

Table no. 2:- Efficacy of fungicides bioagents and plant extracts on seed germination, shoot, root length and seedling vigour index of paddy

Treatment	Fungicides/ Bioagents	Germination (%)	Shoot Length (cm)	Root Length (cm)	Seedling Vigour Index
T1	carbendazim	90.75 (72.27) *	9.5	10	1769.6
T2	carbendazim+ thiram	95.50 (77.31)	11	10.5	2053.25
T3	carbendazim+ mancozeb	93.25 (74.86)	7.5	11	1725.12
T4	*Trichoderma Viride*	92.32 (73.60)	9	11	1754.08
T5	*Pseudomonas fluorescens*	82.65 (65.37)	6.5	9.5	1322.4
T6	neem seed powder extract	78.45 (63.04)	8	11	1490.55
T7	pongamia extract	72.50 (58.60)	6.5	8	1051.25
T8	control	70.32 (56.86)	6.5	7	949.3
	S.E. (m) ±	0.261			22.5
	CD (P=0.01)	1.213			68.24

*** Values are arc sign transformation.**

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