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Short Communication

Efficacy of fungicides seed treatment in improving seed quality and health in Paddy (*Oryza sativa* L.)

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Paddy (*Oryza sativa* L.) belongs to family Poaceae is one of the three most important crops in the world, forms the staple diet of half the worlds' population. Its cultivation is of immense importance to food security of Asia, where more than 90% of global rice is produced and consumed. India is the largest paddy growing country, while China is the largest producer of paddy. Rice is healthful as it does not contain fat, cholesterol and is sodium free. Rice is an excellent food to include in a balanced diet. A good source of protein, vitamins and minerals such as thiamine, niacin, iron, riboflavin, vitamin D, calcium, and fiber. It is low sugar. All rice is gluten free, making rice the essential choice for people with gluten free dietary requirements. Rice does not contain all of the essential amino acids in sufficient amounts for good health, and should be combined with other sources of protein, such as nuts, seeds, beans, fish, or meat. Colored rice strains such as the purple rice derives its color from anthocyanins and tocols. Scientific studies suggest that these color pigments have antioxidant properties that may be useful to human health. The major rice producing countries in the world are China, India, Indonesia, Bangladesh, Vietnam, Thailand and Philippines (Fukagawa and Ziska 2019). Total production of *Kharif* rice during 2020-21 in India is estimated at 102.36 million tones. It is higher by 6.70 million tones than the previous five years' average production of 95.66 million tones. (Anonymous, 2021). Seed deterioration is a continuous and irrevocable process which cannot be stopped but it can be slow down by using suitable seed treatment. The health of seed is important, not only about direct yield losses caused by seed-borne disease, but also for the perpetuation of epidemics, transboundary spread of diseases, food and feed safety (absence of toxins) and storability. Seed is one of the main vehicles for the dissemination of plant diseases. Seed-borne pathogens, such as fungi, bacteria and viruses are serious constraints to crop productivity. The storage fungi deteriorate the seed quality during storage. Seed treatment with fungicides prior to planting provides effective protection against many seed and soil-borne pathogens (Lamichhane *et al.,* 2020). Most seed borne diseases such as brown leaf spot, rice blast, stem rot and bacterial leaf blight are caused by the pathogens like *Drechslera oryzae, Fusarium moniliforme, Pyricularia oryzae, Rhizoctonia solani, Sarocladium oryzae, Sclerotium oryzae, Trichoconiella padwickii and Xanthomonas campestris pv. oryzae* (Bhutta and Hussain 1999; Khan *et al*., 1990; Wahid *et al*., 2001, Gill *et al*., 1999) are the main causes of rice yield reduction in our country. Mycoflora associated with seed results in greater loss in seed quality and in yield. Seed treatment is one of the best methods to manage seed borne diseases. Several fungicides have been employed to control of fungal diseases of the crop. Seed treatment by chemicals is the best, environmentally safe and economical way to keep good seed health condition, because in this management practice mostly a very low dose (1-1.5 g/kg) of chemicals were used as compared to foliar application (Ayesha Mulla *et al*., 2021). Keeping in view, the above mentioned facts, the present study was carried out to assess the efficacy of various fungicides on seed quality and health of paddy. Present study was conducted using seeds of Paddy variety PB1509 in the Department of Seed Science and Technology, CCS HAU, Hisar during 2021.

The seed was treated with single and double dose of various fungicides and examined at various time interval such as after 24 hours, one week and two weeks for seed quality parameters such as germination percent, seedling length, vigour index-I, seed infection percent and frequencies of various fungus *viz*., *Fusarium*, *Curvularia*, *Aspergillus.* Germination test was conducted on 400 seeds *i.e.* four replications of 100 seeds which were placed on sufficiently moistened germination papers (BP) at 25°C temperature with 90-95% relative humidity in the seed germinator. At the time of final seedling evaluation *i.e.* on 14th day (ISTA, 2019), seedling length of 10 randomly selected seedling was measured and average seedling length was expressed in cm. Vigour index-I was estimated as per following formula suggested by Abdul Baki and Anderson (1973):

Vigour Index–I = Germination (%) x Average seedling length (mm)

Seed infection percent and frequencies of *Fusarium*, *Curvularia*, *Aspergillus* was assessed by blotter method by using 400 seeds in having 25 seeds in each 9 cm petriplates replicated thrice (ISTA, 2019). Blotters were maintained wet with sufficient sterilized distilled water. The seeds were incubated in an incubator at 25°±1°C temperature for seven days, with alternate cycles of 12 hours light and 12 hours dark. Seeds were examined under a low power stereo binocular microscope after seven days and different fungi were noticed on the seeds and expressed in percentage. The type of mycoflora growing on each seed was identified and their percentage frequency of occurrence was calculated by applying the following formula:

Percentage Frequency =

No. of seeds on which fungus appear x100

Total no. of seeds

The experiment was conducted in factorial completely randomized design as per standard method suggested by Panse and Sukhatme (1985) and data observed was analyzed by using the online statistical tool (OPSTAT) developed by Sheoran (2010).

Maximum germination (91.11%) was recorded in the seeds treated with Pyraclostrobin 10% CS with single dose followed by the seeds treated with Picoxystrobin 6.78%+Tricyclazole 20.33% SC (90.67%). With double dose, maximum and significantly high germination was recorded in seeds treated with Pyraclostrobin 10% CS (88.44%) followed by the seeds treated with Picoxystrobin 6.78% + Tricyclazole 20.33% SC (88.33%) as comparison to control (84.67%) (Table 2). In single dose, poor vigour index-I (1749) was observed in Picoxystrobin 12% + Propiconazole 7% SC treated paddy seeds followed by Propiconazole 13.9% + Difenoconazole 13.9% EC (1789) treated seeds in comparison to control (2254). In double dose, detrimental effect on vigour index-I was recorded in majority of fungicidal treatments in comparison to control (2254).

Maximum infection (25.00%) was observed in untreated seeds. No infection was recorded in the seeds treated with double dose of Azoxystrobin18.2%+Difenoconazole 11.4% SC, Trifloxystrobin 25%+Tebuconazole 50% WG, Picoxystrobin 6.78%+Tricyclazole 20.33% SC and Fluxapyroxad 33.3% FS. The seed infection reduced significantly after two weeks in both single and double dose. Double dose significantly reduced the infection from 9.05 to 5.95%. The fungus found on rotten and ungerminated paddy seeds could not be identified. The frequency of unidentified fungus was maximum (0.23) in untreated seeds followed by Pyraclostrobin 5% + Metiram 55% WG (0.11) and minimum (0.03) was found in seeds treated with Trifloxystrobin 25%+Tebuconazole 50% WG, Picoxystrobin 6.78%+Tricyclazole 20.33% SC and Fluxapyroxad 33.3% FS. Doubling the dose reduced the frequency of infection significantly from 0.09 to 0.07. The infection of fungus reduced significantly after two weeks from the time of fungicidal application. The above results are in confirmation with study of Lobo 2008, who reported that seeds treatment of paddy with pyroquilon and azoxystrobin resulted in the greatest reduction in rice blast disease, whereas carboxin+thiram and tricyclazole significantly reduced fungi in seeds. The fungicides inhibit the growth of fungi which might be due to the fungicidal effect on production of pectolytic and cellulolytic enzymes by the fungi and thereby reducing the incidence of

Table 1: Effect of fungicides seed treatment on seed health and quality parameters of paddy variety PB1509

Fungicide		Dosages (ml or g/ kg seed)		Germination (%)		Seedling length (cm)		Seedling dry weight (mg)		Vigour index-I		Seed infection (%)	
Technical name	Trade name	Single dose	Double dose	Single Dose	Double Dose	Single dose	Double Dose	Single dose	Double Dose	Single dose	Double Dose	Single dose	Double Dose
Azoxystrobin18.2%+Difeno conazole 11.4% SC	Amistar top	0.50	1.00	85.78 (68.03)	88.17 (70.17)	23.39	21.99	0.08	0.00	2006	1990	8.33 (15.51)	0.00 (0.00)
Propiconazole 13.9% + Difenoconazole 13.9% EC	Taspa	0.50	1.00	85.56 (67.82)	83.44 (66.15)	20.91	21.88	0.05	0.12	1789	1778	5.00 (9.50)	11.67 (18.54)
Picoxystrobin 12% + Propiconazole 7% SC	Galileo way	1.00	2.00	79.78 (63.39)	81.78 (64.89)	21.88	21.26	0.12	0.08	1749	1777	11.67 (19.88)	8.33 (13.44)
Pyraclostrobin 5% + Metiram 55% WG	Cabriotop	1.00	2.00	89.78 (71.87)	87.17 (69.42)	23.08	20.63	0.15	0.07	2073	1741	15.00 (22.59)	6.67 (12.98)
Trifloxystrobin 25% + Tebuconazole 50% WG	Nativo	0.25	0.50	84.89 (67.36)	88.00 (70.17)	24.77	22.58	0.05	0.00	2109	2061	5.00 (10.32)	0.00 (0.00)
Azoxystrobin 16.7% + Tricyclazole 33.3% SC	Azotrix	0.75	1.50	85.11 (67.89)	87.11 (69.36)	21.78	19.75	0.07	0.05	1858	1757	6.67 (13.93)	5.00 (10.32)
Picoxystrobin 6.78% + Tricyclazole 20.33% SC	Galileo Sensa	1.00	2.00	90.67 (72.22)	88.33 (70.22)	22.79	21.04	0.05	0.00	2066	1805	5.00 (9.50)	0.00 (0.00)
Difenoconazole 25% EC	Score	1.00	2.00	87.33 (69.26)	87.89 (69.87)	27.97	24.31	0.05	0.03	2441	2155	5.00 (9.50)	3.33 (6.97)
Propiconazole 25% EC	Tilt	0.50	1.00	88.44 (70.23)	87.11 (69.14)	24.14	20.79	0.08	0.05	2141	1786	8.33 (15.38)	5.00 (10.32)
Pyraclostrobin 10% CS	Header	0.50	1.00	91.11 (72.90)	88.44 (70.41)	27.41	23.85	0.12	0.07	2491	2048	11.67 (19.81)	6.67 (13.80)
Tebuconazole 2% DS	Raxil	0.50	1.00	83.56 (66.17)	85.67 (68.07)	27.30	21.54	0.10	0.07	2281	1890	10.00 (17.65)	6.67 (11.08)
Tricyclazole 75% WP	Beam	0.50	1.00	89.33 (71.38)	87.89 (69.99)	26.00	22.55	0.05	0.05	2336	1952	5.00 (12.09)	5.00 (8.67)
Fluxapyroxad 33.3% FS	Systiva	0.75	1.50	88.89 (70.62)	87.44 (69.45)	26.21	21.79	0.05	0.00	2334	1876	5.00 (9.50)	0.00 (0.00)
Control		-	-	84.67 (67.00)	84.67 (67.00)	26.65	26.65	0.23	0.23	2254	2254	25.00 (29.91)	25.00 (29.91)

*Figures in the parenthesis are the arc-sine transformed values fungal growth (Mehta *et al.,*1990). Improvement in seed quality and reduction in seed mycoflora by Tebuconazole may be due to its plant growth-regulating properties (Fletcher *et al.,* 2000). Contact fungicides prevent only spore germination, while systemic fungicides inhibit the development of fungi probably may be due to interfering with spindle formation at mitosis (cell division) prevent fungal growth (Wachowska *et al.,* 2013). Aroosa *et al.* (2012) found tebuconazole significantly effective by suppressing radial growth and with reduction of fungal biomass from 20 to 90 per over control of *Fusarium oxysporum* f. sp. *Lycopersici.* It is concluded from the study that seed treatment with Pyraclostrobin 10% CS or Picoxystrobin 6.78%+Tricyclazole 20.33% SC with single dose is beneficial for seed quality enhancement while seed treatment with Trifloxystrobin 25%+Tebuconazole 50% WG or Picoxystrobin 6.78%+Tricyclazole 20.33% SC or Fluxapyroxad 33.3% FS are beneficial for controlling the seed borne fungi which is considered as effective disease management strategy.

Conclusion

It is concluded from the study that seed treatment with Pyraclostrobin 10% CS or Picoxystrobin 6.78% + Tricylcazole 20.33% SC with single dose is beneficial for seed quality enhancement while seed treatment with Trifloxystrobin 25% + Tebuconazole 50% WG or Picoxystrobin 6.78% + Tricylcazole 20.33% SC or Fluxapyroxad 33.3% FS is effective for controlling the seed borne fungi which is considered as effective disease management strategy.

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Compliance with ethical standards: NA

Declaration of interest statement

The authors declare no conflict of interest.

Author's Contribution

S.S. Jakhar: Designing and Execution of experiments

Axay Bhuker: Analysis of data and interpretation

Hemender: Data Collection

Pradeep Dalal and Sunil Kumar: Preparation of the manuscript

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