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RESEARCH ARTICLE :

Effect of seed treatments and storage containers on seed health and seed discolouration of popular rice (*Oryza sativa* L.) cultivars

■ **HARSHA, B. RAJESWARI, D. KRISHNAVENI AND A. CHIRANJEEVI**

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SUMMARY : Two rice varieties *viz.*, RNR 15048 (Telanganasona) and JGL 18047 (Bathukamma) were treated with three fungicides *viz.*, thiram @ 0.3 %, carbendazim @ 0.2 % and mancozeb @ 0.25 % and three biocontrol agents *viz.*, *T. harzianum*, *T. viride* and *P. flourescence* and stored in gunny bag and polythene bag were assessed for seed health and seed discolourationat biomonthlyintervals.In rice cv. RNR 15048, seeds treated with thiram and stored in polythene bag recorded lesser number of fungal colonies (6.7%) and less seed discolouration (22.5%) at the end of eight months storage period as against the seeds stored in gunny bag which recorded more number of fungal colonies (8.25 %) and high seed discolouration of 26 %, respectively.In rice cv. JGL 18047, seeds treated with thiram and stored in polythene bag recorded lesser number of fungal colonies (6.5%) and less discolouration percentage (23.5 %)at the end of eight months storage period as against the seeds stored in gunny bag which recorded more fungal colonies (9.5 %) and seed discolouration percentage of 24 %, respectively. The other seed treatments *viz.*, carbendazim, *P. fluorescence*, *T. harzianum* and *T. viride* were also found effective in reduction of seed mycoflora and seed discolouration as compared with untreated seeds of two rice cultivars in polythene bag storage.

KEY WORDS :
Seed treatment, Seed discolouration, Polythene bag, Gunny bag, RNR 15048, JGL 18047

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Author for correspondence :
HARSHA
Department of Plant Pathology, College of Agriculture, Rajendranagar, HYDERABAD (TELANGANA) INDIA
See end of the article for authors' affiliations

BACKGROUND AND OBJECTIVES

Rice is the main staple food for more than half of the world's population. The crop is infected by various fungi before and after harvest causing grain discolouration. Seed treatment is an efficient technology replacing wasteful foliar and soil application of chemicals. In recent years, use of *Trichoderma* spp. as a bioagent was found effective in controlling diseases (Cook and Baker, 1983).Seed treatment should be done as a routine practice as it is a cheap insurance against possible disasters at a later stage. Thrimurthy (1986) has reported the efficacy of carbendazim (Bavistin) in reducing disease severity.

RESOURCES AND METHODS

Rice varieties *viz.*, RNR 15048 (fine

grain rice variety) and JGL 18047 (coarse grain rice variety) were inoculated with *Drechsleraoryzae* @ 10^9 conidia/ml and shade dried for 24 h. The seeds were treated with fungicides and biocontrol agents as dry seed treatment along with untreated (control). After seed treatment the seeds of two rice varieties were equally divided into two parts and filled in two containers *viz*., gunny bag (25 × 15 cm) and polythene bag (10 x 12cm) commercially available 700 guage. The seeds thus packed were stored under ambient laboratory conditions of Indian Institute of Rice Research, Rajendranagar, Hyderabad for a period of eight months from August 2015 to April 2016. The laboratory experiments were conducted in four replications adopting Factorial experiment laid out in CRD taking seed treatment as one factor and container as another factor. At biomonthly intervals, seed samples were drawn from different seed treatments and containers and tested for seed mycoflora, and per cent seed discolouration.The data pertaining to percentage values were analyzed after converting them into transformed values (Gomez and Gomez, 1984).

Details of seed treatments and storage containers adopted in the experiment are as follows :

Treatments	
Factor 1: seed treatments	Factor 2: storage container
T_1 : Thiram @ 3g/kg	C_1 : Gunny bag
T_2 : Carbendazim @ 2g/kg	C_2 : Polythene bag
T_3 : Mancozeb @ 2.5g/kg	
T_4 : *T. viride* @ 10g/kg	
T_5 : *P. flourescence* @ 10g/kg	
T_6 : *T. harzianum* @ 2.5g/kg	
T_7 : Untreated seeds (control)	

Fungal colonies (%) :

Sterilized blotter paper discs of 9 cm diameter were placed in sterile Petri plates (9 cm diameter) and moistened with distilled water. The excess water was drained off from the plates. Seeds were transferred to the plates containing the moist blotter paper. Twenty five seeds per plate were placed at equidistance in a circle. Four hundred seeds from each sample were placed in the plates in four replications. The plates were incubated at 25 ± 2^0C for seven days under alternate cycles of 12 h light and 12 h darkness for 7 days in BOD incubator. The plates were examined under stereo binocular microscope on 7th day and total number of fungal colonies were counted and expressed in percentage (%).

Per cent seed discolouration :

Per cent seed discolouration was calculated by using the formulae

$$\text{Per cent seed discolouration } Z \frac{\text{Number of discoloured seeds in a sample}}{\text{Total number of seeds in each sample}} \text{ x } 100$$

OBSERVATIONS AND ANALYSIS

The results obtained from the present study as well as discussions have been summarized under following heads:

Effect of seed treatments and storage containers on total number of fungal colonies (%) in rice cvs. RNR 15048 and JGL 18047 :

Irrespective of the seed treatments and containers in rice cv. RNR 15048, the total number of fungal colonies were gradually increased with increase in the storage period. Seeds packed in polythene bag recorded lesser number of total fungal colonies than the gunny bag storage. The increase in total number of fungal colonies over initial storage period at eight months was high in gunny bag (8.75 %) as compared to polythene bag (6.36 %). Seed treatments especially thiram (T_1) recorded less number of total fungal colonies followed by carbendazim (T_2) as compared to untreated seeds during all the periods of seed storage. The other seed treatments *viz*., mancozeb (T_3), *T. viride* (T_4), *P. flourescence* (T_5), *T. harzianum* (T_6) were also recorded less total number of fungal colonies than untreated seeds. Treated seeds stored in polythene bag had less number of total fungal colonies as compared to untreated seed stored in gunny bag. At the end of eight months storage, seeds treated with thiram and stored in polythene bag showed minimum number of total fungal colonies (6.7 %) and untreated seeds stored in gunny bag showed maximum number of total fungal colonies (12.7 %). Irrespective of containers, seeds treated with thiram (T_1) (7.37 %) exerted a significant influence on total number of fungal colonies in rice cv. RNR 15048 at eight months storage period (Table 1).

In rice cv. JGL 18047 seeds stored in polythene bag showed less total number of fungal colonies than the gunny bag storage. The increase in total number of fungal colonies over initial storage to eight months was high in gunny bag (8.86 %) as compared to polythene bag (7 %). Among all the seed treatments, thiram (T_1) recorded lesser number of fungal colonies followed by carbendazim

(T_2) as compared to untreated seeds during all the period of seed storage. The other seed treatments, mancozeb (T_3), *T. viride* (T_4), *P. flourescence* (T_5), *T. harzianum* (T_6) were also recorded less number of total fungal colonies than untreated seeds. Treated seed stored in polythene bag had less number of fungal colonies as compared to untreated seed stored in gunny bag. At the end of eight months storage, seeds treated with thiram (T_1) and stored in polythene bag showed minimum number of total fungal colonies (6.5 %) and untreated seeds stored in gunny bag showed maximum number of total fungal colonies (14.5 %). Irrespective of containers, seeds treated with thiram (T_1) (8 %) exerted a significant influence on total number of fungal colonies in rice cv. RNR 15048 when stored for a period of eight months. Treatments T_2 (carbendazim) (8.62 %) and T_5 (*P. fluorescence*) (9.25 %) were found at par with each other in recording the total number of fungal colonies.The results are in agreement with Nghiep and Gour (2005) who reported that seed borne fungi were reduced by seed treatment with thiram, mancozeb and vitavax.

Table 1 : Effect of seed treatments and storage containers on total fungal colonies (%) of rice cv. RNR 15048 (Telanganasona)

Treatments	Before storage	2MAS			4MAS			6MAS			8MAS		
		C_1	C_2	Mean	C_1	C_2	Mean	C_1	C_2	Mean	C_1	C_2	Mean
T_1	1.25	4.50	3.50	4.00	6.50	4.50	5.50	7.50	5.50	6.50	8.25	6.70	7.37
T_2	1.25	4.75	3.75	4.25	6.75	5.75	6.25	8.75	5.50	7.12	8.75	6.75	7.75
T_3	1.50	5.75	4.75	5.25	7.50	5.50	6.50	7.75	7.25	7.50	10.5	7.75	9.12
T_4	1.75	5.75	4.75	5.25	8.50	6.75	7.62	9.50	6.25	7.87	11.7	8.25	10.0
T_5	1.50	4.00	4.50	4.25	7.25	5.25	6.25	8.50	6.50	7.50	9.25	7.50	8.37
T_6	1.75	6.50	5.50	6.00	7.75	7.50	7.62	9.25	7.50	8.37	11.5	9.00	10.2
T_7	2.5	8.50	7.50	8.00	10.5	8.50	9.50	11.5	9.00	10.2	12.7	10.2	11.5
Mean	1.64	5.67	4.89		7.82	6.25		8.96	6.78		10.3	8.00	
			2MAS			4MAS			6MAS			8MAS	
		T	C	T× C	T	C	T×C	T	C	T×C	T	C	T×C
S.E.±		0.20	0.10	0.28	0.20	0.11	0.29	0.21	0.11	0.30	0.24	0.13	0.35
C.D. (P=0.05)		0.57	0.30	NS	0.59	0.31	0.83	0.61	0.33	0.87	0.70	0.37	NS

Each value is a mean of four replications

C_1- Gunny bag C_2- Polythene bag MAS: Months after storage T_1- Thiram @ 3g/kg T_2- Carbendazim @ 2g/kg
T_3- Mancozeb @ 2.5g/kg T_4- *Trichodermaviride* @ 10g/kg T_5- *Pseudomonas fluorescence* @ 10g/kg T_6- *Trichoderma harzianum* @ 10g/kg
T_7- Untreated seeds NS=Non-significant

Table 2 : Effect of seed treatments and storage containers on total fungal colonies (%) of rice cv. JGL 18047 (Bathukamma)

Treatments	Before storage	2MAS			4MAS			6MAS			8MAS		
		C_1	C_2	Mean	C_1	C_2	Mean	C_1	C_2	Mean	C_1	C_2	Mean
T_1	1.50	4.75	3.50	4.12	6.50	4.50	5.50	8.50	5.50	7.00	9.50	6.50	8.00
T_2	1.75	5.00	4.50	4.75	7.50	5.25	6.37	8.00	6.50	7.25	9.50	7.75	8.62
T_3	2.00	7.50	6.50	7.00	8.50	7.75	8.12	10.0	7.25	8.62	10.7	8.75	9.75
T_4	2.50	8.00	7.50	7.75	9.75	8.25	9.00	10.2	8.50	9.37	11.2	10.5	10.8
T_5	1.75	6.50	5.00	5.75	6.75	6.50	6.62	9.50	7.50	8.50	10.0	8.50	9.25
T_6	2.25	8.50	5.75	7.12	9.50	7.50	8.50	9.50	9.00	9.25	11.5	9.00	10.2
T_7	3.25	10.0	9.00	9.50	12.0	10.5	11.2	13.5	12.2	12.8	14.5	13.0	13.7
Mean	2.14	7.17	5.96		8.63	7.17		9.89	8.07		11.00	9.14	
			2MAS			4MAS			6MAS			8MAS	
		T	C	T× C	T	C	T×C	T	C	T×C	T	C	T×C
S.E.±		0.25	0.13	0.36	0.22	0.12	0.32	0.25	0.13	0.36	0.23	0.12	0.32
C.D. (P=0.05)		0.73	0.39	NS	0.65	0.35	0.92	0.73	0.39	1.03	0.66	0.35	0.93

Each value is a mean of four replications

C_1- Gunny bag C_2- Polythene bag MAS: Months after storage T_1- Thiram @ 3g/kg T_2- Carbendazim @ 2g/kg
T_3- Mancozeb @ 2.5g/kg T_4- *Trichodermaviride* @ 10g/kg T_5- *Pseudomonas fluorescence* @ 10g/kg T_6- *Trichoderma harzianum* @ 10g/kg
T_7- Untreated seeds NS=Non-significant

Effect of seed treatments and storage containers on seed discolouration (%) in rice cvs. RNR 15048 and JGL 18047 :

Seed discolouration percentage in rice cv. RNR 1504 was gradually increased with increase in storage period irrespective of the seed treatments and containers. The interaction between seed treatments and storage containers was found significant at two months storage period and minimum per cent seed discolouration was observed in the seeds treated with thiram (T_1) (24.2 %) followed by carbendazim (T_2) (25.0 %) and the maximum percentage of seed discolouration was observed in untreated seeds (T_7) (31.5 %). Seeds stored in gunny bag recorded highest per cent seed discolouration during all the storage periods than the polythene bag (Table 3).

In rice cv. JGL 18047, seed discolouration was gradually increased with the advancement of storage period irrespective of the seed treatments and containers. The interaction between seed treatments and storage containers was found non-significant at six months storage period. Minimum percentage of seed discolouration was observed in the seeds treated with

Table 3 : Effect of seed treatments and storage containers on seed discolouration (%) of rice cv. RNR 15048 (Telanganasona)

Treatments	Before storage	2MAS			4MAS			6MAS			8MAS		
		C_1	C_2	Mean	C_1	C_2	Mean	C_1	C_2	Mean	C_1	C_2	Mean
T_1	7.75	19.7	18.0	18.8	24.2	19.5	21.8	25.0	21.0	23.0	26.0	22.5	24.2
T_2	8.50	22.5	17.5	20.0	24.5	20.5	22.5	26.0	22.2	24.1	27.0	23.0	25.0
T_3	9.75	22.5	20.0	21.2	26.0	20.2	23.1	27.5	24.0	25.7	28.0	24.7	26.3
T_4	10.2	23.5	20.5	22.0	27.0	22.0	24.5	28.5	24.5	26.5	29.0	26.0	27.7
T_5	9.50	21.0	19.2	20.1	25.0	20.2	22.6	26.7	22.7	24.7	28.0	24.7	26.3
T_6	11.5	23.5	21.5	22.5	27.5	23.0	25.2	29.5	27.0	28.2	32.0	28.0	30.0
T_7	12.5	23.7	21.7	22.7	28.5	24.5	26.5	30.2	27.5	29.0	33.5	29.5	31.5
Mean	9.96	22.3	19.7		26.1	21.4		27.6	24.1		29.1	25.5	
			2MAS			4MAS			6MAS			8MAS	
		T	C	T× C	T	C	T×C	T	C	T×C	T	C	T×C
S.E.±		0.25	0.13	0.36	0.27	0.14	0.39	0.30	0.16	0.43	0.28	0.15	0.40
C.D. (P=0.05)		0.73	0.39	1.03	0.79	0.42	NS	0.87	0.46	NS	0.81	0.43	NS

Each value is a mean of four replications
C_1- Gunny bag C_2- Polythene bag MAS: Months after storage T_1- Thiram @ 3g/kg T_2- Carbendazim @ 2g/kg
T_3- Mancozeb @ 2.5g/kg T_4- *Trichodermaviride* @ 10g/kg T_5- *Pseudomonas fluorescence* @ 10g/kg T_6- *Trichoderma harzianum* @ 10g/kg
T_7- Untreated seeds NS=Non-significant

Table 4 : Effect of seed treatments and storage containers on seed discolouration (%) of rice cv. JGL 18047 (Bathukamma)

Treatments	Before storage	2MAS			4MAS			6MAS			8MAS		
		C_1	C_2	Mean	C_1	C_2	Mean	C_1	C_2	Mean	C_1	C_2	Mean
T_1	8.50	19.5	17.5	18.5	19.7	19.2	19.5	21.0	20.5	20.7	24.0	23.5	23.7
T_2	9.50	20.7	18.2	19.5	22.0	21.2	21.6	23.5	21.7	22.6	25.0	23.5	24.2
T_3	10.5	20.0	19.2	19.6	24.2	21.5	22.8	25.0	24.2	24.6	27.7	25.5	26.6
T_4	12.5	24.0	22.0	23.0	25.7	23.7	24.7	26.7	25.0	25.8	32.7	27.0	29.8
T_5	9.75	19.7	19.5	19.6	23.0	20.5	21.7	25.2	22.5	23.8	26.5	23.7	25.1
T_6	10.7	22.5	20.5	21.5	23.5	22.5	23.0	26.0	24.7	25.3	28.5	26.7	27.6
T_7	14.5	27.7	24.5	26.1	31.0	27.0	29.0	31.7	29.2	30.5	34.0	30.5	32.2
Mean	10.8	22.0	20.2		24.1	22.2		25.6	24.0		28.3	25.7	
			2MAS			4MAS			6MAS			8MAS	
		T	C	T× C	T	C	T×C	T	C	T×C	T	C	T×C
S.E.±		0.32	0.17	0.46	0.31	0.16	0.43	0.27	0.14	0.39	0.23	0.12	0.33
C.D. (P=0.05)		0.93	0.49	1.31	0.88	0.47	1.25	0.79	0.42	NS	0.67	0.36	0.95

Each value is a mean of four replications
C_1- Gunny bag C_2- Polythene bag MAS: Months after storage T_1- Thiram @ 3g/kg T_2- Carbendazim @ 2g/kg
T_3- Mancozeb @ 2.5g/kg T_4- *Trichodermaviride* @ 10g/kg T_5- *Pseudomonas fluorescence* @ 10g/kg T_6- *Trichoderma harzianum* @ 10g/kg
T_7- Untreated seeds NS=Non-significant

thiram (T_1) (23.7 %) followed by carbendazim (T_2) (24.2 %) and the maximum percentage of seed discolouration was observed in untreated seeds (32.2 %). Seeds stored in gunny bag recorded highest per cent of seed discolouration during all the storage periods than the polythene bag. Seed treatments T_2 (carbendazim) (24.2 %) and T_5 (*P. fluorescence*) (25.1 %) were found at par in recording the seed discolouration (Table 4).

Similar findings were reported by Mettananda *et al*. (1999) and Misra *et al*. (1990). The level of seed discolouration in all the seed treatments increased during storage indicating that most of the seed lots with low level of seed infection with *D. oryzae* pathogen might be responsible for seed discolouration.

Authors' affiliations :

B. RAJESWARI AND A. CHIRANJEEVI, Department of Plant Pathology, College of Agriculture, Rajendranagar, HYDERABAD (TELANGANA) INDIA

D. KRISHNAVENI, Indian Institute of Rice Research, Rajendranagar, HYDERABAD (TELANGANA) INDIA

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