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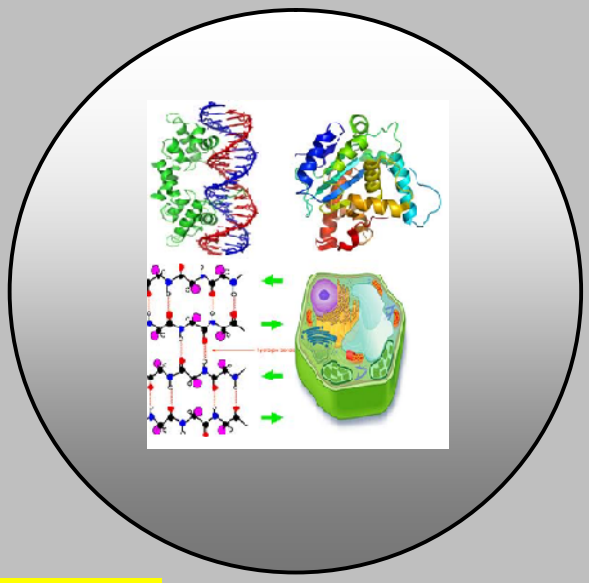

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RESEARCH PAPER

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Role of Polymer Coating on Seed Quality Status of Hybrid Rice (*Oryza sativa* L.) During Storage under Coastal Ecosystem

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ABSTRACT

Seeds of hybrid rice have a specific problem of split husk due to improper closing of glumes during pollination resulted in poor planting value and storability. Seed coating with synthetic polymer (polykote) in combination with fungicides may be a potent tool for quality rice seed storage and effective disease management against seed and soil-borne pathogens. Hence, a study on seed coating with synthetic polymer (polykote) alone, in combination with flowable Thiram and Vitavax 200 (powder formulated polykote containing Carboxin, Thiram, dye and filler) was undertaken to evaluate the storability of polymer coated hybrid rice seeds (KRH 2). Observations on percentage seed germination, seed moisture and seed infection of coated rice seeds stored in 700 gauge polythene bags and cloth bags were recorded at bimonthly intervals upto four months. The results indicated that seed germination declined with the progress of storage period. Among the treatments, seeds coated with Vitavax 200 recorded maximum germination followed by seeds coated with flowable Thiram whereas reduced germination was found in seeds coated with polymer alone. Over four months of storage, the seed moisture content was found to increase in both uncoated and coated seeds irrespective of containers. The pathogen infection was found to be increased with increase in storage period. Among the treatments, seeds coated with Vitavax 200 effectively suppressed the pathogen infection. Between storage containers, seeds stored in polythene bags registered lesser pathogen infection than the cloth bags.

Key words: Polymer coating, Hybrid rice, Seed quality, Seed storage, Seed germination, seed moisture, seed infection and Coastal environment

INTRODUCTION

Rice is a major dietary staple food for higher percentage of the world's population particularly in Asia, where more than 90 per cent of rice is grown. India has emerged as the second largest hybrid rice growing country in the world (Yuan, 1997). However, the success in hybrid rice in India could be visualized only if adequate quantities of quality hybrid seeds are made available to the farming community (Ponnuswamy *et al.,* 2000). Seeds of hybrid rice have a specific problem of split husk due to improper closing of glumes during pollination resulted in poor planting value and storability (Ramanadane and Ponnuswamy 2006). Owing to the prevailing sub-tropical climate in India, seeds of hybrid rice show rapid deterioration of seed vigour and viability during storage. Film coating technology is a sophisticated process of applying precise amount of active ingredients along with a liquid material directly on to the seed surface without obscuring its shape and the total seed weight may increase up to 1 to 2 per cent (Vijayakumar Kunkur *et al* .,2007 and Shakuntala *et al.,* 2010). The film formulations consist of a mixture of polymer, plasticizer and colourants (Robani, 1994) that are commercially available as ready to use liquids or as dry powders (Ni., 1997). Seed coating provides an opportunity to package effective quantities of materials so that they can improve the germination and seedling growth. The polymer film coating may act as physical barrier, which has been reported to reduce the leaching of inhibitors from the seed coverings and may restrict oxygen diffusion to the embryo (Vanangamudi *et al.,* 2003). Seed coating with synthetic polymer (polykote) in combination with fungicides may be a potent tool for quality hybrid rice seed storage and effective disease management against seed and soil-borne pathogens (Pham Long Giang and Rame Gouda, 2007). It is a need of the day to develop polymer based seed coats that can prevent moisture entry, fungus penetration and insect attack during storage (Jitendra Kumar *et al*., 2007). Hence, in the present investigation, efforts have been made to study the seed quality status of polymer coated hybrid rice during storage under coastal environment.

MATERIAL AND METHODS

A laboratory experiment was conducted under National Seed Project (Crops), at Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal, Puducherry (UT) during 2010 to evaluate the seed health status and storability of polymer coated seeds of hybrid rice KRH 2 with various seed treatment combinations. The seeds were coated with synthetic polymer alone (Polykote @ 4ml kg^{-1} seed) (T1), fungicide alone (Flowable Thiram (Royal Flow 40SC) @ 2.4ml kg^{-1} seed) (T2), Polymer coating alongwith flowable thiram (T3), Vitavax 200 @ 2g kg^{-1} seed treatment alone (T4), polymer coating in combination with vitavax 200 (T5) and untreated control (T0). The experiment was designed as Completely Randomised Block Design with three replications. The various treated seeds were packed in cloth bags and polythene bags and stored in ambient conditions of Karaikal district. Observations on percentage seed moisture content (ISTA, 1999), seed germination per cent (Anon., 1996) and percentage of seed infection (ISTA, 1999) were recorded at bimonthly intervals upto four months. The statistical analysis was done as described by Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

Seed senescence or deterioration is an irreversible and inexorable/ unavoidable process. However, the rate of seed deterioration could be slowed down either by storing the seeds under controlled conditions or by imposing certain treatments with either chemicals or any other protectants. Seed coating with polymer is one such pre-storage treatment that can be used either singly or in combination with other pesticides to protect the seeds against pest and diseases. (Duan and Burris, 1997) explained the possibilities of using polymers along with other chemicals to maintain the keeping quality of the seeds. The rapid deterioration of stored seed is a serious problem, particularly in the coastal environment where high temperature and relative humidity prevail and associated with accelerated ageing phenomenon. Since, the controlled condition involves huge cost; the polymer seed coating could be one of the best alternative approaches to maintain seed quality during storage.

Effect of polymer coating on seed longevity

Seed germination The results on seed germination indicated that the percentage seed germination was found to decline with the progress of storage period irrespective of storage containers (Table 1). Among the treatments, polymer coated seeds alongwith fungicide Flowable Thiram (T3) recorded the maximum germination in both the containers of storage followed by seeds coated with Vitavax 200 alone (T4) whereas reduced germination was found in seeds coated with polymer alone (T1). The decline in germination per cent might be attributed to ageing effect, leading to depletion of food reserves and decline in synthetic activity of embryo apart from death of seed because of fungal invasion, insect damage and storage conditions (Vijaykumar Kunkur *et al*., 2007 and Manjunatha *et al*., 2008). Similarly, decrease in germination with increase in storage period was reported in cotton (Vijaykumar Kunkur *et al*., 2007); in soyabean (Kurdikeri *et al*., 1996): in hybrid rice (Pham Long Giang and Rame Gowda , 2007) and also in sorgum due to dye treatment (Tonapi, 1989). Thiram acts as a protective agent against seed deterioration due to fungal invasion and physiological ageing as a result of which the seed viability was maintained for a comparatively longer period of time (Savitri *et al*., 1994). Among the two types of containers, polythene bag with 80 per cent germination exerted better storability than cloth bag registering a mean germination of 72 per cent. The reduction in germination in cloth bag could be due to more fluctuation in seed moisture even in moisture impervious containers especially at the end of the storage period. Similarly, Agarwal (1976), Dharam Singh (1999) Pham Long Giang and Rame Gouda (2007) and Rettinassababady and Ramanadane (2012) also observed increase in seed moisture content and its negative association with percentage germination of polykote treated hybrid rice during storage.

Seed moisture: Amount of moisture in seeds is probably the most important factor influencing seed viability during storage (Table 2). Over four months of storage, the seed moisture content was found to increase in both uncoated and coated seeds irrespective of containers. An initial mean seed moisture content of 9.31 per cent was increased to 10.02 per cent after a period of four months of storage under ambient condition.

Table 1. Effect of polykote seed coating on per cent seed germination during storage in Hybrid paddy KRH 2.

Treatments	Cloth bag (C_1)				Polythene bag (C_2)			
	P_0	P_1	P_2	Mean	P_0	P_1	P_2	Mean
T_0 - Untreated control	88	77	41	**69**	88	80	70	**79**
T_1 - Polymer coating (Polykote @ 4 ml/kg of seed)	89	68	57	**71**	89	72	68	**76**
T_2 - Fungicide (Flowable Thiram – Royal flow 40SC) @2.4 ml/kg)	91	77	54	**74**	91	83	82	**85**
T_3 - T_1+ Flowable thiram – Royal flow 40SC) @2.4 ml/kg	92	82	68	**81**	92	85	70	**82**
T_4 - Vitavax 200 @ 2g/kg	91	85	53	**76**	91	89	85	**88**
T_5 -T_1 + Vitavax 200	90	59	42	**64**	90	73	47	**70**
Mean	**90**	**75**	**53**		**90**	**80**	**70**	
	C	P	T	CxP	**PxT**	CxT	CxPxT	
SEd.	1	1.22	1.73	1.73	2.99	2.44	4.23	
CD (P=0.05)	1.99	2.43	3.44	3.44	5.96	4.89	8.43	

P_0: Initial P_1: 2 months after storage P_2: 4 months after storage

Mean Table

Treatments (T)				Period of		Containers	
T	7	T	8	P	9	C	7
T	7	T	8	P	7	C	8
T	7	T	6	P	6		

Table 2. Effect of polykote seed coating on per cent seed moisture during storage in Hybrid paddy KRH 2.

Treatments	Cloth bag (C_1)				Polythene bag (C_2)			
	P_0	P_1	P_2	Mean	P_0	P_1	P_2	Mean
T_0 - Untreated control	8.99	9.42	10.29	**9.57**	8.95	9.02	9.67	**9.21**
T_1 - Polymer coating (Polykote @ 4 ml/kg of seed)	9.39	9.66	10.42	**9.82**	9.18	9.28	9.58	**9.35**
T_2 - Fungicide (Flowable Thiram – Royal flow 40SC) @2.4 ml/kg)	9.4	9.54	9.85	**9.6**	9.28	9.32	9.65	**9.42**
T_3 - T_1+ Flowable thiram – Royal flow 40SC) @2.4 ml/kg	10.1	10.6	11.32	**10.66**	9.89	9.98	10.53	**10.1**
T_4 - Vitavax 200 @ 2g/kg	9.02	9.12	9.49	**9.21**	9	9.04	9.12	**9.05**
T_5 -T_1 + Vitavax 200	9.44	9.86	10.35	**9.88**	9.05	9.22	10.13	**9.47**
Mean	**9.39**	**9.69**	**10.29**		**9.22**	**9.31**	**9.78**	
	C	P	T	CxP	PxT	CxT	CxPxT	
SEd.	0.03	0.03	0.05	0.05	0.09	0.07	0.12	
CD (P=0.05)	0.06	0.07	0.1	0.1	0.17	0.14	0.24	

P_0: Initial P_1: 2 months after storage P_2: 4 months after storage

Mean Table

Treatments (T)				Period of		Containers	
T	9	T	1	P	9	C	9
T	9	T	9	P	9	C	9
T	9	T	9	P	1		

The increase was gradual in the case of polythene bag stored seeds when compared to cloth bag stored seeds. The fluctuation in the seed moisture content was higher in cloth bag than polythene bag storage. Moisture content in polythene bag stored seeds recorded the lower moisture content (9.44%) when compared to cloth bag (9.79%) at the end of storage. Among the treatments, seeds coated with vitavax 200 (T4) registered the mean minimum moisture content of 9.13 per cent during storage. Therefore the viability of seeds in cloth bag declined rapidly than the seeds stored in polythene bag. This underlines the suitability of seed coatings as a barrier to the entry of moisture strengthening them against the fungal infection as experimentally demonstrated by West ***et al***.(1985), Pham Long Giang and Rame Gowda (2007) in hybrid rice, Jitendra Kumar ***et al*** (2007) in soyabean and Vijaykumar Kunkur ***et al*** (2007) in cotton.

Seed infection: During seed storage, the fungi accelerated the deterioration which was reflected in reduced seed germination and increased seed moisture per cent. The inoculums of fungi are universally present and their proliferation during storage is governed by factors such as seed moisture, seed temperature, relative humidity and chemicals used for treating seeds etc. The results on seed health status indicated that about five fold increase in seed infection was noticed after four months of storage period (Table 3). The percentage seed infection was found to be increased with increase in storage period in both containers. Among the treatments, seeds coated with Vitavax 200 (T4) and Vitavax alongwith polykote (T5) effectively suppressed the seed infection. Between containers, seeds stored in 700 gauge polythene bags (3.9%) excelled cloth bag (5.6%) by maintaining higher germination and lesser seed infection during storage. Storage fungi produces spores in large numbers under favourable conditions and their appearance on stored seed is a sign of deterioration in seed quality (Williams and McDonald, 1983; Jitendra Kumar *et al.,* 2007; Manjunatha *et al*., 2008 and Rettinassababady and Ramanadane, 2012). Hence, it is concluded that, hybrid rice seeds coated with Vitavax 200 maintained better storability besides lesser pathogen infection.

Table 3. Effect of polykote seed coating on per cent seed infection during storage in Hybrid paddy KRH 2.

Treatments	Cloth bag (C_1)				Polythene bag (C_2)			
	P_0	P_1	P_2	Mean	P_0	P_1	P_2	Mean
T_0 - Untreated control	3.9	8	26.7	**12.9**	3.9	4.4	13.3	**7.2**
T_1 - Polymer coating (Polykote @ 4 ml/kg of seed)	3.9	11.1	24.4	**13.1**	3.9	6.6	15.6	**8.7**
T_2 - Fungicide (Flowable Thiram – Royal flow 40SC) @2.4 ml/kg)	2.2	2.2	4.4	**2.9**	2.2	2.2	4.4	**2.9**
T_3 - T_1+ Flowable thiram – Royal flow 40SC) @2.4 ml/kg	2.8	4.4	6.7	**4.6**	2.8	4.4	6.7	**4.6**
T_4 - Vitavax 200 @ 2g/kg	0	0	0	**0**	0	0	0	**0**
T_5 -T_1 + Vitavax 200	0	0	0	**0**	0	0	0	**0**
Mean	**2.1**	**4.3**	**10.4**		**2.1**	**2.9**	**6.7**	
	C	P	T	CxP	PxT	CxT	CxPxT	
SEd.	0.14	0.17	0.24	0.24	0.42	0.34	0.6	
CD (P=0.05)	0.28	0.34	0.49	0.49	0.84	0.69	1.19	

P_0: Initial P_1: 2 months after storage P_2: 4 months after storage

Mean Table

Treatments (T)				Period of		Cont	
T	1	T	4	P	2	C	5
T	1	T	0	P	3	C	3
T	2	T	0	P	8		

In the present study an effort was made to identify the suitable polykote combination treatment that could reduce the seed deterioration during storage. From the observations it is clear that seeds coated with different combinations of polykote treatments in general deteriorate at slower pace as manifested with higher percentage germination with less or no seed infection over the control.

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