STUDIES ON EFFECT OF THE SEED COATING SUBSTANCES AGAINST PADDY SEED BORNE FUNGI AND THEIR SHELF-LIFE DURING STORAGE

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Abstract: A laboratory experiment was conducted to evaluate the effect of different seed coating materials and storage containers on germination, seedling vigour and suitability of packaging material for Paddy seed. Alternative methods for seed quality enhancement through various seed coating techniques were carried out in Paddy up to six months storage period at SRTC, Rajendranagar for two years 2012 and 13 to minimize the seed borne pathogens which causes enzyme degradation and nutritive loss in seed germination during storage period. The experiment was conducted with six treatments in four replications with different seed coating techniques. Seed coating with polymer (polykote @ 4 ml/kg seed + Vitavax 200 (Thiram 37.5% + Carboxin 37.5%), 2g kg-1 seed (T5) induced maximum suppression of the fungal mycoflora followed by polymer coating across the storage period up to six months in both gunny bags and HDPE bags. Maximum germination percent (94%) and seedling vigour index (2241) was recorded with polykote + Vitavax 200 compared to control and other treatments. The fungicide seed treatments are the most used traditional application to protect the seeds and young seedlings from many seed-and soil-borne pathogens, Polycoat seed treatment was the next best in maintaining seed quality which induced maximum suppression of fungi but the response was relatively lower compared to polykote + Vitavax 200 treatment. Coated seed with Polykote and Vitavax 200 was proved to be the best even with gunny bag and HDPE bag up to nine months storage period.

Key words: Seed quality, polymer, polycoat, Vitavax 200, Gunnybag and High density polythene bag (HDPE), storage, Paddy.

Introduction: Paddy is the staple food of over half the world's population. The qualitative loss in stored seed for seed purpose is attributed to change in bio-chemical components such as carbohydrates, proteins. Insect pests and seed born disease incidence is of paramount importance are the constraints influencing the storability of rice seed,. nMost of the field crops grown in the world are propagated via the seed and all of them are attacked by devasting seed borne pathogens. The rice crop (Oryza sativa) is known to be attacked by many pathogenic seed borne fungi; e.g. *Bipolaris* sp (brown spot), *Rhizoctonia* sp. (stackburn), *Fusarium* sp (Kernel smut), *Curvularia* sp, *Magnapartha* (blast). Important storage fungi are *Aspergillus flavus* and *Aspergillus niger*. Fungi contamination is a major cause leading to seed deterioration of rice grain qualities (Hewett, 1987). Moreover the fungal pathogens normally attached to the seed, so it is difficult to find out the chemical substances that will destroy the fungus without harming the seeds, since the toxicity of fungicides has been ascribed to produce phytotoxic compounds which induces sometimes seed deterioration (Han, 2000). Therefore, it is essential to assess rice seed quality parameters during extended period of ambient storage by using polymer coating and minimum quantity of fungicides. Seed coating is a process of applying useful material to form a continuous layer of thin coating over the seed without altering the shape or size, by employing water as the solvent. Seed coating polymers along with active ingredients such as insecticides and fungicides are invogue. This helps in improving the resistance of seeds towards insect pest and diseases in the plant growth period besides improving the seedling vigour (Shakuntala *et al.*, 2010). The polymer coat provides protection from the stress imposed by accelerated ageing, which includes fungal invasion (Baig *et al.*, 2005). The coat is thin (8 µm), simple to apply, diffuse and provides protection against ageing which includes fungal invasion. The polymer film reported to reduce the leaching of inhibitors from the seed coat and may restrict oxygen diffusion to the embryo (Duan and Burris, 1997). Through the present investigation an attempt was made to study the effect of seed polymer coating on seed quality of sunflower during storage.

Materials and Methods: The experiment was conducted at Seed Research and Technology Centre, Rajendranagar (National Seed Project) ANGRAU during 2012-13 to know the effect of seed coating with polymer, fungicide and container on seed quality of sunflower during storage. The freshly harvested seeds were taken cleaned and dried to seven per cent moisture content and then imposed with the seed treatments. The treatment combinations include

T1-polymer seed coating @ 4 ml/kg of seeds (T1),

T2-Polymer seed coating @ 4 ml/kg of seeds + fungicide thiram 75% WP @ 2.5 g kg-1 seed

T3- Polymer @ 5 ml/kg of seeds + flowable thiram (Royal flow 40 SC)

T4-Vitavax 200 fungicide treatment

T5-Polymer seed coating + Vitavax 200 (Thiram 37.5% + Carboxin 37.5%), 2g kg-1 seed (T5)

T6- untreated control (T6).

The liquid polymer used for seed coating was polykote manufactured by Witle's oriental Balm and PHS limited, Chennai. One hundred grams of seeds was taken in a polythene bag and added a polymer coating @ 4 ml per kg of seeds (T1). The bag was closed tightly trapping air in it to form a ballon then polybag was vigorously shaken till the seeds are uniformly coated. Later the treated seeds were spread on a sheet under the shade and dried completely. The dried seeds were used for the experiment. One hundred grams of seeds were taken in a polythene bag initially they are treated with fungicides thiram WP @ 2.5 g kg^{-1}, and followed by polymer coating (T2), One hundred grams of seeds were taken in a polythene bag initially they are treated with fungicides flowable thiram 2.4 ml kg-1 (T3), One hundred grams of seeds were taken in a polythene bag treated with fungicides vitavax @ 2g kg-1 (T4), One hundred grams of seeds were taken in a polythene bag initially coated with polymer coating and they are treated with fungicides Vitavax @ 2g kg-1 (T5). Respective treated seed in were uniformly spread on a sheet under the shade for drying. The dried seeds were used for experiment. One hundred grams of seeds were untreated and kept as control (T6).

Germination assay: The treatmental effect on germination seed health was recorded by rolled paper towel method Blotter method (Annon, 1996) as per ISTA rules.

Seedling vigour: One hundred seeds in each treatment were tested for germination petridishes with filterpaper placed in them. The number of normal seedling were counted at two days interval and cumulative germination obtained on the 8^{th} day was recorded. Percent seed germination was then expressed as number of seeds germinated over total number of seeds plated. Seedling vigour index was calculated using the formula (Abdulbaki and Anderson, 1973).

Enumeration of total fungal colonies by Blotter method: Discs of blotter paper were kept in 90 mm petri plates. Blotter discs were wiped in beaker containing sterile distilled water with the help of forceps and placed at the bottom of each sterilized petriplate. Two hundred seeds from each treatment were tested in 20 plates of 10 seeds each. Petriplates were labeled and incubated at 25+2^{o}C under alternating cycles of 12 hr light and 12 hr day for nine days in BOD incubator. The plates were examined under stereo binocular microscope on 9^{th} day of incubation in standard blotter method. Infestation levels were recorded as percentage of infested seeds in each sample. Percent seed rot and seedling decay were recorded for the treated seeds in blotter method

Statistical analysis: Statistical analysis was done using Duncan's multiple range test at 5% Significance according to **Snedecor and Cochran (1980)**

Results and Discussion: Data pertaining to germination (%),vigour index , and seed borne infection (%) as influenced by seed coating treatments and storage containers are presented in the Table 1, 2 and 3. The results showed significant differences with respect to germination and vigour due to seed coating treatments. Treatment with results were obtained due to polymer coating differed significantly for the seed quality parameters. All the treatments recorded significantly higher germination up to six months of storage compared to control. Irrespective of containers, among the different treatment combinations, seed coating with polymer polykote @ 4 ml/kg seed + Vitavax 200 recorded maximum germination (94%) and vigour index (2241) followed by polymer coating (Table 1& 3). Omar and Rahhal (1993) recorded that seed coating with thiram increased the percentage of seedling survival in soybean compared to untreated control. Wilson and Geneve (2004) also reported that corn seed coated with polymer and fungicide resulted higher germination (98.5%), less number of abnormal seedlings compared to control (89.0%), During initial months of storage, seedling vigour index of all the seed coating treatments was superior to that of control.

Among the containers, storage of seed in HDPE bag recorded higher germination and vigour. Seeds stored in HDPE bag results in maximum germination than seeds stored in Gunny bag. Germination was above 80 per cent in the polymer coating + fungicide treatment over a period of six months even in gunny bag in both years which was above certification standards. In the initial stage of storage there was no significant difference among the containers, but with the increase in the storage period the decline in germination was significant between the two containers. The decline in germination may be attributed to accelerated ageing leading to depletion of food reserves and polymer prevention of damage from the death of seed due to fungal invasion (Manjunatha *et al*. 2008). It was observed that up to sixth months of storage germination per cent was above MSCS Level in both the containers but with the increase in storage period it was decreased. Higher germination percentage can be seen in polymer coated seeds stored either in gunny bag or HDPE bag due to increase in the rate of imbibition. These results are in agreement with the findings of (Sherien *et al*. 2005). where in they proved the effectivity of pink polykote @ 3g/kg of seed + fungicide + insecticide in maize. Maximum mean percent germination and vigour index (92%) and (90%) by polykote +Vitavax treated seed even after

six months storage. In uncoated seeds at the end of six months of storage germination was drastically reduced in control. It may be due to age induced decline in germination, decrease in dry matter accumulation in seedling and decrease in seedling dry weight. Similar findings were reported by Savitri et al. (1994) in Sorghum. The fungi observed during storage period are *Curvularia, Aspergillus, Penicillium, Rhizopus, Colletotrichum* and *fusarium* spp. During six months storage period maximum infection was observed in gunny bag compared to HDPE bag. Among the seed treatments (Table 2) seeds coated with polymer + Vitavax 200 significantly reduced seed infection (3.13 and 3.91%) followed by T1 (5.30 and 5.91%) and it was low compared to control (24.6 and 24.8%). Basavaraj *et al*. (2008) also reported similar results of higher germination and low seed infection and electrical conductivity compared to control in onion seeds coated with polymer @ 12 ml + thiram @ 2g/kg seeds. Per cent infection was less in treated seed stored in gunny bag as compared to untreated seed stored in gunny bag. This may be attributed to profound growth and development of seeds with maximum enzyme activity promoted by polymer coating and vitavax 200 which resulted in higher vigour index and high quality seed development and maintenance of membrane integrity and minimum fungal invasion. The treated seeds regained better enzyme activity compared to untreated seeds during storage. These results are in conformity with the results of Manojkumar and Agarwal (1998). Minimal pathogen infection in seeds coated with polymer + fungicide had been reported by many researchers like in Soybean (Baig *et al.*, 2005) and Tomato (Manjunatha *et al.* (2008). From the present investigation it can be concluded the Paddy seeds can be stored for six months in Gunny bag without affecting the seed quality by treating the seed with Polymer seed coating @ 5 g/kg of seed +Vitavax 200 or alone Polymer coating @ 4ml /kg seed.

Conclusion: Polymer coating enables accurate and reduces chemical wastage. It also provides resistance against mechanical damage in the seed drill. Thus improves the appearance and quality of treated seeds.Storage with polymer coating in gunny bag was found suitable and sustainable.

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Table 1. Effect of Polymer coating and fungicide on Germination (%) of Paddy during storage period (Pooled analysis)

Treatments	2 months			4 months			6 months		
	Gunny bag	HDPE bag		Gunny bag	HDPE bag		Gunny bag	HDPE bag	
T1- Polymer coating (polykote @ 3 ml/kg of seed	86.67 (68.73)	90.67 (72.47)	88.67 (70.60)	83.33 (65.96)	88.60 (70.44)	85.95 (68.34)	78.00 (62.14)	82.33 (65.18)	80.16 (63.66)
T2 - T1 + Fungicide (Thiram 75% WP @ 2.5g / kg);	87.33 (69.24)	88.67 (70.44)	88.0 (69.84)	30.6 (33.6)	26.6 (31.06)	28.60 (32.33)	30.00 (33.15)	38.67 (38.31)	34.33 (35.73)
T3 T1 + FlowableThiram (Royal flow 40 SC) @2.4 ml/kg seed	86.33 (68.32)	86.00 (68.24)	86.16 (68.28)	62.60 (52.42)	68.61 (58.91)	65.60 (54.20)	46.67 (43.07)	77.67 (61.82)	62.17 (52.44)
T4 Vitavax 200 (Thiram 37.5% and Carboxil 37.5%) @ 2g kg Seed	88.00 (69.77)	87.33 (70.76)	87.65 (70.26)	42.0 (40.37)	59.3 (50.38)	50.65 (45.37)	46.67 (43.00)	47.33 (43.46)	47.00 (43.23)
T5 T1 + Vitavax 200 (Thiram 37.5% and carboxyn @ 37.5% @ 2g/kg of seed)	92.67 (74.53)	96.00 (78.72)	94.33 (76.62)	88.67 (70.76)	92.62 (74.53)	90.64 (72.40)	88.67 (70.67)	92.33 (74.62)	90.50 (72.58)
T6 Untreated control	29.33 (32.78)	40.67 (39.56)	35.00 (36.17)	15.4 (23.08)	32.3 38.42)	30.70 (33.60)	13.33 (21.26)	18.00 (25.08)	15.66 (23.17)
Gunny bag	78.39 (63.89)			53.76 (47.20)			50.55 (40.44)		
HDPE bag	81.56 (67.42)			61.33 (51.86)			59.38 (50.06)		
CV %	5.15			6.29			8.62		
CD at 5% Container.	2.32	0.81		2.25	0.72		2.87	0.97	
Treatments.	4.01	1.28		3.28	1.08		4.98	1.69	
TXC	5.68	1.91		5.51	1.88		7.04	2.35	

Table 2 . Effect of Polymer coating and fungicide on seed infection (%) of Paddy during storage (Pooled analysis)

Treatments	2 months			4 months			6 months		
	Gunny bag	HDPE bag		Gunny bag	HDPE bag		Gunny bag	HDPE bag	
T1- Polymer ating (polykote @ 3 ml/kg of seed	2.00 (8.014)	1.38 (6.66)	1.69 (7.33)	7.08 (15.43)	3.70 (11.08)	5.39 (13.25)	6.69 (14.90)	5.30 (13.31))	5.99 (14.10)
2 - T1 + Fungicide Thiram 75% WP @ 2.5g / kg);	10.06 (18.4)	12.19 (20.3)	11.13 (19.4)	9.99 (18.30)	10.06 (18.41)	10.02 (18.35)	22.19 (28.09)	22.0 (27.9)	22.09 (28.0)
T3 T1 + FlowableThiram Royal flow 40 SC) @2.4 ml/kg seed	8.31 (16.6)	5.00 (12.8)	6.66 (14.7)	8.81 (16.55)	4.38 (11.9)	6.59 (14.22)	14.5 (22.3)	10.31 (18.6)	12.41 (20.4)
T4 Vitavax 200 Thiram 37.5% and arboxil 37.5%) @ 2g/kg Seed	7.56 (15.8)	7.00 (15.3)	7.28 (15.6)	7.78 (16.19)	9.19 (17.6)	8.48 (16.89)	17.06 (24.39)	17.13 (24.4)	17.09 (24.4)
5 T1 + Vitavax 200 Thiram 37.5% and arboxyn @ 37.5% @ 2g/kg of seed)	0.25 (4.47)	0.25 (4.47)	0.25 (4.47)	5.81 (13.31)	2.25 (8.13)	4.03 (10.72)	4.69 (12.3)	3.13 (10.15)	3.91 (11.2)
T6	22.25 28.13)	17.56 (24.7)	19.12 (26.4)	20.69 (27.03)	18.13 (25.18)	19.41 (26.10)	25.00 (30.00)	24.63 (29.75)	24.81 (29.8)
Gunny bag	22.25 (15.26)	17.56 (14.06)		9.60 (17.82)	7.95 (15.36)		15.02 (22.01)	13.75 (20.77)	
HDPE bag									
CV(%)	10.2			11.4			6.91		
CD at 5%									
Container.	0.52	0.17		1.26	0.43		0.86	0.28	
Treatments.	1.07	0.36		1.19	0.39		1.50	0.51	
TXC	2.25	0.78		3.10	1.03		2.12	0.71	

Table 3 . Effect of Polymer coating and fungicide on seedling vigour index of Paddy during storage (Pooled analysis)

Treatments	2 months			4 months			6 months		
	Gunny bag	HDPE bag		Gunny bag	HDPE bag		Gunny bag	HDPE bag	
T1- Polymer coating (polykote @ 3 ml/kg of seed	2042	2192	2117	1907	1965	1936	1745	1996	1871
T2 - T1 + Fungicide (Thiram 75% WP @ 2.5g / kg);	1984	2022	2003	1641	1722	1682	1453	1500	1477
T3 T1 + FlowableThiram (Royal flow 40 SC) @2.4 ml/kg seed	1891	1989	1940	1906	1985	1946	1324	1728	1526
T4 Vitavax 200 (Thiram 37.5% and Carboxil 37.5%) @ 2g/kg Seed	1924	1997	1960	1841	1930	1886	1034	1390	1212
T5 T1 + Vitavax 200 (Thiram 37.5% and carboxyn @ 37.5% @ 2g/kg of seed)	2146	2336	2241	1989	2146	2067	1896	2140	2018
T6 Untreated control	1625	1614	1619	1556	1621	1589	519	718	619
Gunny bag	1935	1992		1807			1329		
HDPE bag				1878			1579		
CV (%)	2.95			3.56			5.15		
CD at 5% Container	37.27	12.2		45.3	15.1		36.9	12.1	
Treatment	164	21.5		58.5	20.2		71.3	23.8	
TXC	91.3	30.4		111.0	37.1		115.0	38.3	

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