

CONTROL OF PHYSIOLOGICAL AND PATHOLOGICAL DETERIORATION OF STORED WHEAT SEED

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Hydration-dehydration treatment of stored wheat seed very effectively reduced physiological deterioration of seeds in storage. Dry-dressing of hydrated-dehydrated seed with the fungicides captan, ceresan and dithane M-45 showed only minor improvement in storability over hydration-dehydration. Surface sterilization of the seed with mercuric chloride before placing for germination improved the germinability of stored seeds by reducing fungal attack. When the treated and stored seeds were soaked in water for 2 hr, with or without surface sterilization with mercuric chloride solution before the germination test, there was no difference between water soaking-drying treatment and soaking-drying employing solutions of different fungicides. In dry placement (no pre-soaking before germination test), however, soaking-drying with solutions of fungicides (treatment given prior to storage) proved better than water-soaking-drying. Pre-germination soaking in water, besides physiologically improving germinability, reduced fungal invasion during germination by washing off the fungal spores from seed surface.

INTRODUCTION

Under warm-humid storage conditions, deterioration of stored seed would be physiological as well as pathological. Midstorage hydration-dehydration treatment of stored wheat seed would greatly slow down the physiological deterioration of stored seeds (Basu, 1976). During hydration, a possible repair of damage to bioorganelles or a counteraction of free radical and lipid peroxidation reactions might extend seed longevity (Basu and Rudrapal, 1982). Washing out of fungal spores on seeds during soaking would reduce subsequent damage by storage fungi. Fungal damage has been attributed to the direct invasion of the embryonic tissues by the fungi as well as inhibition of germination by mycotoxins (Harman and Pflieger, 1974 ; Christensen, 1955 ; Misra and Tripathi, 1980).

Physiological and pathological deterioration of seeds can be minimized by adequate seed drying and storage under low humidity and low temperature conditions. To minimize the storage loss by fungi, seed treatment with different fungicides has been recommended by several investigators (Grewal and Kapoor, 1966 ; Kumar *et al.*, 1977 ; Agarwal, 1976).

The present study was taken up to examine the compatibility of hydration-dehydration treatment with fungicides for the maintenance of vigour and viability of wheat seeds in storage.

MATERIALS AND METHODS

The experiments were conducted with seeds of wheat (*Triticum aestivum* Linn. emend. Thell.) cv. Sonalika. Dry and wet fungicidal treatments were given to the stored seeds as briefly mentioned below :

Dry-dressing with fungicides

In this experiment dry fungicides were applied to soaked-dried and control seeds to study the effect of the treatments on storability. Midstorage soaking-drying treatments were given to wheat seeds which were stored in rubber-stoppered glass bottles for 5 months under ambient conditions. The seeds were soaked in double the volume of water for 2 hr at room temperature followed by drying back to the original weight at $35 \pm 1^\circ\text{C}$ in a current of air in a drying cabinet (Mandal and Basu, 1983). The control seeds were not soaked but dried along with the other treatments. After moisture stabilization over fused calcium chloride, seeds were dry-dressed with captan, ceresan and dithane M-45 (each at 2.5 g per kg), the seeds were then subjected to accelerated ageing at 100% RH and $40^\circ\text{C} \pm 1^\circ\text{C}$. Germination tests were carried out by the glass plate method (Punjabi and Basu, 1982) before and after ageing in the following manner: (i) dry-placement—dry seeds placed for germination test without presoaking in water or mercuric solution and (ii) wet placement—seeds were placed for germination test with 2 hr presoaking in water with or without sterilization of the seeds by mercuric chloride (0.05%) solution.

Use of fungicides for soaking-drying treatment

Five-month-old seeds of Sonalika were soaked in double the volume of water and dilute solutions of different compounds viz. mercuric chloride (0.005 and 0.01 per cent), bavistin (0.05 and 0.1 per cent), captan, thiram and dithane M-45 (each at 0.1 and 0.2 per cent). After treatment, seeds were dried back to the original weight following the same technique as described earlier. Control seeds were not soaked but dried along with the treated seeds. After moisture stabilization over fused calcium chloride for 3 days, the seeds were subjected to accelerated ageing. Germination tests were done following the glass plate method using either dry seeds or giving 2 hr presoaking after surface-sterilization with mercuric chloride (0.05%) solution, or without sterilization.

RESULTS

Hydration-dehydration treatment was very effective in preventing seed deterioration, but the use of captan, ceresan, dithane M-45, as dry dressings did not show any major effect on germinability. After accelerated ageing for 6 days when hydrated-dehydrated and fungicide-dressed seeds were placed for germination without soaking (placed dry), some improvement in germinability was observed in water-soaked seed treated with captan and ceresan (WS-D+Captan and WS-D+Ceresan). After 2 hr presoaking of the treated seeds in water (without sterilization with mercuric chloride) before germination test, some improvement was observed but after sterilization of the seed in 0.05% mercuric chloride and 2 hr presoaking there was significant improvement in germinability of all treatments. However, between fungicide dressed and

TABLE 1. Effect of hydration-dehydration and dry-dressing with fungicides on the post-ageing^(a) germinability of wheat seeds placed for germination with or without presoaking

Treatments	Dry Placement (No presoaking with water)			Wet Placement (2 hr presoaking with water)					
	Seeds not sterilized ^(b)			Seeds not sterilized ^(b)			Seeds sterilized ^(c)		
	G (%)	MRL (mm)	MSL (mm)	G (%)	MRL (mm)	MSL (mm)	G (%)	MRL (mm)	MSL (mm)
Control	18	206	28	37	210	24	46	218	24
W-SD	54	236	33	68	275	34	84	306	33
Control+Captan	30	185	34	39	197	29	47	226	29
W-SD+Captan	74	313	34	82	315	35	87	315	35
Control+Ceresan	34	283	29	44	233	28	49	238	29
W-SD+Ceresan	68	330	35	78	293	36	86	312	33
Control+Dithane M-45	38	129	27	39	200	26	46	228	31
W-SD+Dithane M-45	55	215	28	73	299	34	86	320	34
L.S.D. at 0.05 P	9	41	6	7	34	4	6	21	3
L.S.D. at 0.01 P	12	56	NS	10	47	5	9	29	4

Abbreviations: W-SD—2 hr water-soaking and drying back; G—germination; MRL—mean root length; MSL—mean shoot length.

(a) Accelerated ageing was done at 100% RH and 40°C for 6 days.

(b) Before placing for germination test, seeds were not sterilized with 0.05% mercuric chloride solution.

(c) Before placing for germination test, seeds were sterilized with 0.05% mercuric chloride solution.

Treatments were given to 5-month-old Sonalika seed, data were recorded after germination for 5 days.

undressed hydrated-dehydrated (H-D without fungicide dressing and H-D with fungicide dressing) seed there was no significant difference in germinability (Table 1).

Seeds soaked in different concentrations (0.005, 0.01, 0.05, 0.1 and 0.2 per cent) of fungicide solutions and dried back, when placed dry after accelerated ageing, showed greater germinability than untreated control and water-soaking-drying. However, when fungicide treated and untreated seeds were placed for germination test after 2 hr presoaking in water, with or without sterilizing the seeds with mercuric solution (0.05%), none of the fungicide treatments showed significantly greater germination percentage than water alone. Nevertheless, with wet placement (2 hr presoaking) some improvement in the germinability of control seeds was noticed over that in the dry germination placement (no presoaking in water before germination test) (Table 2).

TABLE 2. Effect of soaking-drying treatments of stored seeds with water and different concentrations of fungicides on vigour and viability after accelerated ageing^(a) 100%RH and 40°C for 6 days

Treatments	Dry Placement (No presoaking with water)			Wet Placement (2 hr presoaking with water)					
	Seeds not sterilized ^(b)			Seeds not sterilized ^(b)			Seeds sterilized ^(c)		
	G (%)	MRL (mm)	MSL (mm)	G (%)	MRL (mm)	MSL (mm)	G (%)	MRL (mm)	MSL (mm)
Control	22	116	21	45	199	28	65	244	27
Water	45	130	19	94	275	33	96	292	29
<i>Fungicide soaking-drying</i> (%) per cent fungicide (w/v.)									
Mercuric chloride 0.005	52	141	18	83	220	28	93	311	28
Mercuric chloride 0.01	45	135	16	82	281	30	92	284	26
Captan 0.1	70	236	30	82	265	32	97	295	28
Captan 0.2	87	208	30	93	274	31	91	302	30
Bavistin 0.05	58	182	27	86	261	32	91	287	31
Bavistin 0.1	41	127	15	79	243	32	98	268	26
Thiram 0.1	71	251	33	83	282	32	98	301	29
Thiram 0.2	85	210	30	94	312	33	96	300	32
Dithane M-45 0.1	58	242	30	75	226	27	100	295	27
Dithane M-45 0.2	59	191	29	76	259	31	91	305	29
L.S.D. at 0.05 P	5	12	3	5	14	NS	5	13	NS
L.S.D. at 0.01 P	7	16	5	7	19	NS	6	18	NS

Other details same as in Table 1.

DISCUSSION

The results confirm the beneficial effect of hydration-dehydration treatments on the maintenance of vigour and viability of wheat seeds as reported earlier (Basu and Dasgupta, 1974; Mandal and Basu, 1983). However, before germination placement, the seed should be soaked in water for 1-2 hr after sterilization with mercuric chloride to prevent fungal attack. The beneficial effect of hydration-dehydration treatment has been attributed to restoration of bioorganelles by enzymatic cellular repair or counteraction of lipid peroxidation and free radical reactions (Basu and Rudrapal, 1982). Soaking in water before germination may also enable the low vigour seed to undertake repair of biochemical lesions or quench free radical reactions in a relatively short time than in a slow imbibing dry seed placed for germination.

Besides the aforesaid physiological reasons, the wet seed placement may remove the fungal spores from the seed especially when the seed is surface-sterilized with dilute fungicide solution before the germination test. Otherwise, dry placement would reduce germinability. Even when fungicides were used as dry-dressings prior to storage, the fungal invasion could not be altogether checked resulting in a rather inconsistent germinability of seeds of different treatments. In general, the control as well as the hydrated-dehydrated seeds were only marginally benefited by the fungicidal dry dressings. Further, after presoaking with water, with or without surface sterilization, the effects of fungicides dressings were not discernible.

The question which surfaces in this context is whether we should use the fungicides before storage or not. Wallace and Mills (1970) tested the efficacy of sixteen seed dressing chemicals in different forms for their effects on the viability of wheat, barley and oats seeds. Two hundred days after the treatments they found that none of the chemicals completely prevented infection by storage molds. Hampton (1979) treated wheat and barley seed with a number of fungicides and showed that the seeds could be safely stored upto 12 months but the germination of barley seeds treated with carboxin and carboxin plus thiram was significantly reduced after 18 months of storage. Germination of captan treated wheat seed was reduced after 24 months of storage. The situation therefore is still not clear and needs further critical appraisal.

As regards the effects of soak-dry treatment employing water soluble fungicides, it appears from the present study that simple hydration-dehydration treatment in water is quite useful for wheat seed preservation, and storage after water-soaking-drying followed by presoaking in water before germination (preferably after surface sterilization) is more effective than soaking-drying in fungicide solution prior to storage but not followed by soaking before germination test.

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