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Effect of Seed Coating with Polymer, Fungicide and Insecticide on Seed Quality in Cotton During Storage*

Cotton is an important fiber crop, known as the 'king' of fiber and in recent times cotton called as the "White gold". Cotton belongs to Malvaceae family and is the most important commercial crop of India ranks first in both area and production. Cotton seed looses viability and vigour rapidly in storage as being the poor storer. The linted cotton seed hosts many pathogens and insect pests during storage and reduce the seed quality. To maintain the seed quality, it is advisable to delint the seed and protect from storage pathogens and insect pests by polymer coating, fungicide and insecticide treatments. Film coating is a new concept in which the plasticizer polymer forms a flexible film that adheres and protects fungicide and insecticide. 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 total seed weight may increase up to 1 to 2 per cent. The film formulations consists 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 material such that they can improve the germination and seedling growth. Cotton is the common cultivated crop of India. Hence, an attempt was made to prolong the shelf life of the seeds through seed management practices for ambient storage conditions.

A laboratory experiment was conducted at National Seed Project, University of Agricultural Sciences, Dharwad during 2004-05 to know the effect of polymer, fungicide and insecticide on seed quality during storage. The freshly harvested seeds were taken and delinted with sulphuric acid @ 100 ml per kg of seeds for 10 minutes, the seeds were washed in running water and dried to nine per cent moisture content and then, imposed with following seed treatment combinations.

Seed coating with polymer @ 3.00g per kg of seed (T_1), 4.00g per kg of seed (T_2), 5.00 g per kg of seed (T_3), T_1 + Thiram @ 1.50 g per kg of seed (T_4), T_2 + Thiram @ 1.50 g per kg of seed (T_5), T_3 + Thiram @ 1.50 g per kg of seed (T_6), T_1 + Imidacloprid @ 7.50 g per kg of seed (T_7), T_2 + Imidacloprid @ 7.50 g per kg of seed (T_8), T_3 + Imidacloprid @ 7.50 g per kg of seed (T_9), Thiram @ 1.50 g per kg of seed and Imidacloprid @ 7.50 g per kg of seed (T_{10}) and untreated control (T_0). Two kilogram of freshly harvested certified cotton (AK–235) seeds was taken for each treatment. The treatment of fungicide and insecticide was given before polymer coating. Utmost care was taken during mixing to have uniformity in coating and the seeds were air dried under shade for 24h to bring back to its original moisture content. The experiment was designed as Completely Randomized Block Design with four replicates. Then the seeds were packed in cloth bag and stored in ambient conditions of Dharwad. The tri monthly observations on germination percentage (Anon.,1996), vigour index (Abdul-Baki and Anderson, 1973), electrical conductivity(Presley,1959) and field emergence were recorded. The statistical analysis was done as per the procedure described by Panse and Sukhatme (1985).

Table 1. Influence of seed coating with polymer, fungicide and insecticide on germination (%) and vigour index of cotton seeds during storage

Treatments	Months after storage							
	Germination percentage				Vigour index			
	0	3	6	9	0	3	6	9
T_1	85.00 (67.21)*	81.20 (64.30)	75.00 (60.00)	68.91 (56.1)	2491	2145	1805	1530
T_2	85.00 (67.21)	81.60 (64.59)	75.80 (60.52)	70.60 (57.15)	2473	2164	1882	1634
T_3	85.00 (67.21)	81.90 (64.85)	76.90 (61.41)	71.30 (57.60)	2520	2237	1942	1679
T_4	85.00 (67.21)	83.90 (66.39)	79.60 (63.15)	74.10 (59.40)	2457	2368	2109	1853
T_5	85.00 (67.21)	84.10 (66.50)	80.10 (63.51)	74.90 (59.90)	2565	2376	2119	1896
T_6	86.00 (68.03)	84.80 (67.05)	80.60 (63.87)	76.10 (60.70)	2560	2434	2199	1976
T_7	85.00 (67.21)	82.80 (65.50)	77.90 (61.95)	72.52 (58.40)	2513	2283	2008	1762
T_8	85.25 (67.42)	83.20 (65.80)	78.40 (62.31)	73.30 (58.80)	2444	2321	2040	1781
T_9	85.00 (67.21)	83.50 (66.03)	79.10 (62.79)	73.60 (59.10)	2520	2351	2055	1808
T_{10}	86.00 (67.21)	85.10 (67.29)	81.50 (64.52)	77.40 (61.40)	2570	2457	2271	2054
T_0	85.00 (67.21)	79.00 (62.73)	67.00 (54.94)	52.00 (46.00)	2516	2039	1481	1023
Mean	85.20 (67.37)	82.83 (65.54)	77.41 (61.72)	71.34 (57.63)	2501	2284	1991	1727
S.Em ±	0.31	0.07	0.09	0.20	30.79	9.28	9.91	18.91
C.D at 5%	NS	0.206	0.255	0.582	NS	26.63	28.44	54.40

* - Values in the parenthesis are arcsine transformed values NS – Non-significant

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Table 2. Influence of seed coating with polymer, fungicide and insecticide on Electrical conductivity and Field emergence of cotton seeds during storage

Treatments	Months after storage							
	Electrical conductivity (dSm^{-1})				Field emergence (%)			
	0	3	6	9	0	3	6	9
T_1	0.863	1.014	1.300	1.500	77.50 (61.34)*	71.00 (57.42)	64.00 (53.13)	57.00 (49.00)
T_2	0.862	0.911	1.190	1.420	73.50 (61.32)	71.50 (57.73)	65.00 (54.33)	58.60 (49.97)
T_3	0.860	0.977	1.100	1.400	77.50 (61.34)	72.00 (58.05)	66.65 (54.73)	59.70 (50.60)
T_4	0.863	0.948	1.012	1.200	78.45 (62.34)	75.00 (60.00)	70.00 (56.79)	63.80 (53.00)
T_5	0.860	0.933	0.985	1.100	79.00 (62.73)	75.50 (60.33)	70.80 (57.29)	65.50 (54.00)
T_6	0.863	0.923	0.975	1.050	79.50 (62.34)	76.00 (60.67)	71.60 (57.80)	67.10 (55.00)
T_7	0.857	0.981	1.080	1.345	77.50 (61.67)	73.00 (58.69)	67.00 (54.94)	60.71 (51.20)
T_8	0.867	0.960	1.032	1.280	78.50 (62.38)	73.50 (59.02)	68.50 (55.86)	62.10 (52.00)
T_9	0.875	0.959	1.025	1.230	78.00 (62.02)	74.20 (59.47)	69.20 (56.29)	63.10 (52.60)
T_{10}	0.867	0.910	0.950	0.980	79.00 (62.73)	76.50 (61.07)	72.50 (58.37)	68.80 (56.00)
T_0	0.858	1.103	1.400	1.600	76.90 (61.26)	69.00 (56.17)	57.00 (49.02)	44.80 (42.00)
Mean	0.864	0.972	1.094	1.280	78.12 (61.95)	73.38 (58.93)	67.48 (55.32)	60.95 (51.33)
S.Em ±	0.012	0.008	0.011	0.007	1.01	0.15	0.14	0.14
C.D at 5%	NS	0.022	0.031	0.020	NS	0.43	0.42	0.41

NS – Non-significant

The germination percentage gradually decreased (77.40) and it was above minimum seed certification standards (70%) at the end of nine months of storage. The treatment with coating chemicals recorded significantly higher germination upto nine months of storage as compared to control. Among the different treatment combinations, the seeds coated with thiram @ 1.50 g per kg of seed and imidacloprid @ 7.50 g per kg of seed (T_{10}) recorded significantly higher germination (77.40%) followed by T_6 (seed coating with polymer @ 5.00 g per kg of seeds and thiram @ 1.50 g per kg of seeds) as compared to control (52.00%) (Table 1). The decline in germination percentage with advance in storage period may be attributed to ageing effect, leading to depletion of food reserves and decline in synthetic activity of embryo apart from loss of viability and storage condition. Thiram acts as protective agent against seed deterioration due to fungal invasion and physiological ageing as a result of which the seed viability was maintained for comparatively longer period of time (Savitri *et al.*, 1994) and also phytotonic effect of imidacloprid maintained the seed viability for longer period (Jarande and Dethe, 1994). These findings are in agreement with results obtained by Hunje et al. (1990) in cowpea. The film formed around seed act as a physical barrier, which has been reported to reduce leaching of inhibitors from the seed coverings and may restrict oxygen diffusion to the embryo (Duan and Burris, 1997). The higher germination percentage can be seen in polycoated seeds, it is due to increase in the rate of imbibition where the fine particles in the coating act as moisture attracting material or perhaps to improve germination. Increase in storage period decreases in vigour index, seedling dry weight, root and shoot length (Table 2 and 3) was noticed irrespective of seed treatments. Significantly higher vigour index and its parameters (germination and seedling length) was recorded in the seeds coated with thiram @ 1.50 g per kg of seed and imidacloprid @ 7.50 g pr kg of seed (T_{10}) followed by T_6 (seed coating with polymer @ 5.00 g per kg of seeds and thiram @ 1.50 g per kg of seeds) as compared to control. The decrease in the vigour index, root length, shoot length and seedling dry weight may be due to natural ageing induced decline in germination, decrease in dry matter accumulation in seedlings and decrease in seedling length. Such findings were reported by Savitri et al. (1998) in groundnut. A number of water soluble compounds such as electrolytes, sugars, amino acids and organic acids are released in the water. The electrical conductivity of seed leachate indicate the membrane integrity and quality of seed and it is negatively correlated with seed quality. Significantly lower electrical conductivity was recorded in the seed coated with thiram @ 1.50 g per kg of seeds and imidacloprid @ 7.50 g per kg of seeds (T_{10}) followed by T_6 (seed coating with polymer @ 5.00 g per kg of seeds and thiram @ 1.50 g per kg of seeds) as compared to control at the end of nine months of storage (Table 2). This variation in electrical conductivity of seed leachate indicating increased membrane permeability and decrease in integrity of seedcoat and celluar membrane deterioration. Such findings were reported by Vasundhara and Bommegowda (1999) in groundnut. The polymer film formed around seed act as a physical barrier, which has been reported to reduce leaching of inhibitors from the seed coverings and may restrict oxygen diffusion to the embryo (Duan and Burris, 1997). Significantly higher field emergence recorded in T_{10}, seed coating with thiram @ 1.50 g per kg of seed and imidacloprid @ 7.50 g per kg of seed followed

Table 3. Influence of seed coating with polymer, fungicide and insecticide on root length (cm), shoot lenhth (cm) and dry weight of seedling (mg/seedlings) of cotton seeds during storage

Treatments	Root length				Shoot length				Dry weight of seedlings			
0	3	6	9	0	3	6	9	0	3	6	9	
T_1	18.40	16.10	14.87	13.40	11.00	10.20	9.20	8.70	44.57	36.05	29.20	20.90
T_2	18.40	16.30	15.47	14.20	10.90	10.30	9.33	8.95	44.70	37.82	30.00	22.10
T_3	18.45	17.00	15.70	14.50	11.20	10.32	9.50	9.05	45.00	39.00	31.87	23.50
T_4	18.45	17.70	16.60	15.60	11.07	10.52	9.90	9.40	45.00	43.15	36.00	28.00
T_5	18.40	17.85	16.75	15.80	11.12	10.55	10.00	9.52	45.32	43.50	37.67	29.80
T_6	18.55	18.10	17.07	16.20	11.22	10.60	10.20	9.77	45.22	44.70	39.17	31.00
T_7	18.20	17.20	16.17	15.10	10.90	10.37	9.60	9.10	45.10	41.90	32.92	24.00
T_8	18.20	17.40	16.30	15.25	11.12	10.50	9.72	9.16	44.65	42.00	33.50	25.10
T_9	18.40	17.50	16.42	15.40	11.10	10.47	9.70	9.25	45.25	42.50	35.00	26.50
T_{10}	18.85	18.27	17.47	16.56	11.05	10.75	10.40	9.98	45.22	44.65	41.20	34.50
T_0	18.30	15.82	13.10	11.50	11.00	10.00	9.00	8.18	44.95	34.50	27.00	19.00
Mean	18.39	17.19	15.99	14.38	11.04	10.40	9.68	9.19	45.01	40.91	33.85	25.85
S.Em ±	0.289	0.059	0.05	0.157	0.11	0.06	0.04	0.10	0.40	0.31	0.28	0.21
C.D at 5%	NS	0.169	0.143	0.433	NS	0.19	0.12	0.29	NS	0.89	0.81	0.62

* - Values in the parenthesis are arcsine transformed values NS – Non-significant

by T_6 (seed coating with polymer @ 5.00 g per kg of seeds and thiram @ 1.50 g per kg of seeds) as compared to control at the end of nine months of storage (Table 2). The decrease in field emergence may be due to age induced deteriorative changes in cell and cell organelles and germination capacity of seed under natural soil condition. These results are in conformity with Muthuraj et al. (2002), who have recorded higher in field emergence can be seen in polycoated seeds, due to increase in the rate of imbibition where the fine particles in the coating act as moisture attracting material which improves seed soil interphase. Coating with hydrophilic polymer regulates the rate of water uptake, reduce imbibition damage and improve the emergence of soybean seeds (Hwang and Sung, 1991).

In conclusion, the higher germination percentage, field emergence, root length, shoot length, seedling vigour index, dry matter, lower lectrical conductivity were recorded in the seeds treated with thiram @ 1.50 g per kg of seed and imidacloprid @ 7.50 g per kg of seed followed by seed coating with polymer @ 5.00 g per kg of seeds and thiram @ 1.50 g per kg of seeds.

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