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Effect of seed treatments on viability and vigour of cotton seeds (*Gossypium hirsutum* L.) under ambient storage

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ABSTRACT : Delinted cotton seeds of cotton cv. Surabhi were dry dressed with 3 seed treating chemicals and 2 botanicals individually and in their combinations. Treated seeds were packed in paper bag and stored under ambient condition for 32 months. The bimonthly evaluation of seed lots for quality parameters revealed that Surabhi cotton seeds treated with *neem* kernal powder @ 10g/kg (or), carbendazim @ 2g/kg+ imidacloprid @ 5g/kg (or), imidacloprid @ 5g/kg+ *neem* kernel powder @ 10g/kg (or), *neem* leaf powder @ 10g/kg+ *neem* kernal powder@ 10g/kg protected the viability and it was recorded above minimum seed certification standards up to 16 months of storage and showed rapid decline of viability in further evaluations.

Key words : Botanicals, cotton seed, seed storage, seed treatment

Cotton (*Gossypium* spp.) is the "King of Natural Fibers" and a major cash crop of India. This crop offer employment opportunity for 60 million people. Cotton crop demands huge quantity of seeds for planting year after year. The seed replacement rate is 100 per cent in case of hybrids and 30 per cent for conventional varieties. Therefore, stability in seed supply chain must be guaranteed to the cultivators who are dependents of large scale producers. In the process of large scale seed multiplication and distribution, storage of carryover seed is inevitable. Cotton seeds are orthodox in nature and live for long however, the storage environment and period of storage plays a crucial role in promotion of seed decay and seeds are vulnerable over ambient storage and become unsuitable for planting. It has been reported reduction germination percentage of cotton seeds stored at high temperatures

Seed is described as the embodiment of life's continuity and renewability, during which many physiological factors limit their performance, includes poor germination, slow emergence, weak growth, and inadequate field stand. The cotton seeds deteriorate at a rapid rate sufficient to make them a poor planting material soon after the attainment of physiological maturity. During ageing lipid peroxidation and free radical production are believed to be the basic causes for seed deterioration. Unsaturation of free fatty acid components of lipoprotein membranes render them susceptible to peroxidative changes. Therefore, stabilization of the same by chemical or botanicals, reduce peroxidation and free radical reactions. Several seed treatments have been suggested for agricultural crops from time to time. Dry dressing of fresh seeds with halogen formulations (Iodine or chlorine based) has conferred beneficial effects by lowering lipid peroxidation and there by extension of vigour and viability of seeds under storage.

It was reported that seed treatments with chemicals could improve germination and inhibit the growth of fungi, seeds treated with agrosan stored under normal room conditions give fair field emergence. Dry seed treatment of

thiram, captan, bavistin @ 2g/kg has been advocated for french bean, okra, onion and tomato (Suresha *et al.*, 2012) and carbendazim + thiram @ 3g/kg for castor bean seeds (Marroni *et al.,* 2012.) Cotton seeds stored at low temperature maintained viability well above minimum seed certification standard (65%) for 16 months when they were packed in moisture vapour proof container, whether treated or not (Rathinavel, 2014). Keeping the above facts in mind, the present experiment was planned with a view to elucidate the combined effects of seed treating chemicals together with halogens and botanicals in curbing the physiological decay during ambient seed storage.

MATERIALS AND METHODS

The immediate harvested seeds of cotton varieties Surabhi and LRA 5166 were ginned and cleaned manually. The seeds were delinted using commercial grade sulphuric acid @ 100 ml/ kg of linted seed. Seeds were washed with water several times and shade dried to the moisture content of 8 per cent. Dried seeds were evaluated for germination under laboratory and field conditions. The seeds were dry dressed with carbendazim @ 2g/kg (T_1), iodine formulation @ 3g/kg(T_2), imidacloprid @ 5g/kg(T_3), *neem* leaf powder @ 10g/kg (T_4), *neem* kernal powder @ 10g/ kg (T_5), carbendazim @ 2g/kg+ iodine formulation @ 3g/kg (T_6), carbendazim @ 2g/kg+ imidacloprid @ 5g/kg (T_7), carbendazim @ 2g/ kg+ *neem* leaf powder @ 10g/kg (T_8), carbendazim @ 2g/kg+ *Neem* kernal powder@ 10g/kg (T_9), iodine formulation @ 3g/kg+ imidacloprid @ 5g/ kg (T_{10}), Iodine formulation @ 3g/kg+ *neem* leaf powder @ 10g/kg (T_{11}), iodine formulation @ 3g/ kg+ *neem* kernal powder @ 10g/kg (T_{12}), imidacloprid @ 5g/kg+ *neem* leaf powder @ 10g/ kg (T_{13}), imidacloprid @ 5g/kg+ *neem* kernel powder @ 10g/kg(T_{14}), *neem* leaf powder @ 10g/ kg+ *neem* kernal powder@ 10g/kg(T_{15}) and seeds without treatment was T_0. Care has been taken for proper dressing of above chemicals/ botanicals individually and in combinations. The treated seeds were packed in paper bag and stored under laboratory condition. The initial evaluation of seed quality was done soon after seed treatment and subsequently at 4 months interval and up to 32 months of storage. The seed quality were evaluated once in 4 months. Four hundred seeds in each treatment were sown in sand pots. The evaluation of normal seedling and germination percentage was recorded at 12 days after sowing. Measurements on seedling growth characters such as root length, shoot length and dry matter of seedling was taken in 10 normal seedlings. Seedling vigour index was computed. Twenty five seeds were taken at random and soaked in 25 ml of deionized water following pre washing and allowed for 16 h at room temperature. The seed steep water was decanted and referred to as seed leachate. The electrical conductivity of the seed leachate was measured with an Elico type CM 180 Conductivity Bridge with a cell constant of 1.0 and expressed as d/Sm. For estimating seed oil content, seeds from each treatment were dried at 70°C in a hot air oven for 8 h. Dried seeds (3g) were ground in a porcelain mortar, transferred to an extraction thimble and them placed inside the soxhlet extractor to which sufficient quantity of ether solvent (boiling point 40 to 60°C) was added. The flask was heated for 2 h until a minimum of 6-8 siphoning. The flask was taken out and subsequently placed in a hot air oven maintained at 70°C for 8 h, cooled in desiccators and weighed. The percentage of oil was then calculated. The free fatty acid (Karon and Altschul, 1944) was estimated using one g of oil thoroughly mixed with 50 ml of neutralized 95

per cent ethanol. The mixture was heated to boiling on a water bath and titrated against 0.02N NaOH to a faint pink red point using phenolphthalein as indicator. The free fatty acid was calculated as per cent oleic acid. The data thus recorded were analyzed for significance as described by Panse and Sukhatme (1967). The data on percentages were transformed into corresponding arc sine values before analysis.

RESULTS AND DISCUSSION

The seeds of cotton variety Surabhi under ambient storage have shown significant differences due to seed treatments and 32 months of storage. In both the varieties, the treated seeds maintained viability above the minimum seed certification standard of 65 per cent for a period of 16 months. The viability recorded soon after the seed treatment showed a significant and maximum enhancement of 14 per cent due to treatment @ (T_5) alone or in combination with (T_{14}), followed by 12 per cent and 11 per cent due to (T_7) and (T_{15}), respectively as against untreated seeds (T_0) (Table 1). After 16 months of storage, persistent higher viability (76%) was recorded in seed lots given treatment with (T_{11}) and (T_{13}), however, at the end of storage it was due to (T_7). The sharp decline in germination noticed at the end of 32 months of evaluation could be ascribed to deteriorative process taken place under ambient storage. Similar observations have been reported by , Rathinavel and Dharmalingam (2001 and 2002)

Table 1. Effect of seed treatments and storage periods on viability and seedling growth of cotton seeds under ambient storage cv. Surabhi

Treat-ment	Germination (%)				Root length (cm)				Shoot length (cm)			
	Initial	16 MAS	32 MAS	**Mean**	Initial	16 MAS	32 MAS	**Mean**	Initial	16 MAS	32 MAS	**Mean**
T_0	84 (66.5)	60 (50.8)	14 (21.9)	**61 (51.9)**	13.6	12.1	8.8	**11.4**	12.3	9.9	9.2	**10.1**
T_1	92 (73.7)	71 (57.4)	19 (25.5)	**69 (57.1)**	13.4	12.9	7.7	**11.6**	11.6	10.0	8.7	**10.0**
T_2	87 (68.9)	72 (58.1)	22 (28.0)	**68 (55.7)**	12.0	11.2	7.5	**11.3**	10.7	10.0	9.3	**10.0**
T_3	89 (70.7)	71 (57.4)	6 (14.0)	**66 (55.2)**	13.3	12.2	8.1	**11.1**	12.1	10.4	9.6	**10.3**
T_4	88 (70.0)	67 (55.0)	32 (34.4)	**67 (55.6)**	12.6	11.7	8.9	**11.6**	12.0	9.5	8.9	**10.0**
T_5	98 (82.8)	69 (56.2)	32 (34.3)	**71 (59.0)**	12.9	11.7	8.7	**12.2**	11.6	10.4	9.6	**10.5**
T_6	88 (70.4)	66 (54.5)	34 (35.6)	**67 (55.7)**	12.7	12.2	7.6	**11.8**	11.9	10.1	9.5	**10.1**
T_7	96 (78.8)	66 (54.3)	44 (41.6)	**69 (57.3)**	12.9	11.9	10.9	**11.9**	12.0	10.8	9.0	**10.5**
T_8	94 (76.0)	74 (59.4)	19 (25.8)	**67 (55.8)**	13.4	12.2	8.4	**11.8**	10.7	10.8	9.9	**10.5**
T_9	94 (76.0)	70 (56.8)	27 (31.3)	**67 (55.5)**	13.8	10.7	9.1	**11.8**	12.5	10.2	9.4	**10.5**
T_{10}	87 (69.0)	66 (54.7)	22 (28.0)	**66 (55.1)**	13.1	11.7	8.6	**11.5**	11.6	10.3	8.4	**10.3**
T_{11}	86 (68.0)	76 (60.7)	20 (26.5)	**68 (56.4)**	14.8	11.4	8.8	**11.5**	11.7	10.0	8.7	**10.1**
T_{12}	91 (72.8)	62 (52.0)	20 (26.6)	**63 (53.0)**	13.1	11.5	7.9	**11.4**	11.8	10.8	8.4	**10.2**
T_{13}	91 (72.6)	76 (60.7)	21 (27.3)	**68 (56.7)**	13.8	12.2	8.7	**12.0**	13.2	11.0	9.1	**10.6**
T_{14}	98 (81.9)	72 (58.1)	11 (18.9)	**66 (55.3)**	13.7	11.7	8.1	**11.8**	11.7	10.5	9.7	**10.5**
T_{15}	95 (77.1)	71 (57.5)	13 (20.8)	**68 (56.9)**	13.4	12.7	7.4	**11.5**	11.9	9.6	9.0	**10.0**
Mean	**91 (73.4)**	**69 (56.5)**	**22 (27.5)**	**67 (55.8)**	**13.4**	**11.9**	**8.4**	**11.6**	**11.8**	**10.3**	**9.2**	**10.3**
	T	P	TxP		T	P	TxP		T	P	TxP	
SEd	1.97	1.48	5.91		0.36	0.27	1.07		0.25	0.19	0.76	
CD (p=0.05)	3.91	2.93	11.73		NS	0.53	2.12		NS	0.38	1.52	

(Figures in parentheses indicate arc sine transformed values)

Table 2. Effect of seed treatments and storage periods on dry matter production (mg/10), seedling vigour and electrical conductivity (d/Sm) of cotton seeds under ambient storage cv. Surabhi

Treatment	Dry matter production (mg/10)				Seedling vigour				Electrical conductivity (d/Sm)			
	Initial	16MAS	32MAS	**Mean**	Initial	16MAS	32MAS	**Mean**	Initial	16MAS	32MAS	**Mean**
T_0	681	475	330	**534**	2049	1686	251	**1412**	0.319	0.408	0.556	**0.426**
T_1	714	466	339	**513**	2291	1637	332	**1504**	0.216	0.317	0.537	**0.364**
T_2	798	461	458	**564**	1969	1646	372	**1495**	0.195	0.232	0.353	**0.266**
T_3	770	484	364	**539**	1892	1496	102	**1433**	0.217	0.225	0.442	**0.306**
T_4	739	463	492	**557**	2033	1419	615	**1493**	0.229	0.264	0.466	**0.320**
T_5	849	476	491	**593**	2402	1747	630	**1661**	0.260	0.280	0.380	**0.306**
T_6	855	582	466	**573**	2014	1738	668	**1532**	0.242	0.292	0.401	**0.316**
T_7	961	464	391	**570**	2157	1739	702	**1587**	0.219	0.239	0.452	**0.314**
T_8	861	530	460	**583**	2066	1733	649	**1592**	0.265	0.286	0.390	**0.320**
T_9	744	520	368	**555**	2070	1618	520	**1525**	0.219	0.247	0.441	**0.303**
T_{10}	725	541	384	**558**	2117	1560	419	**1504**	0.233	0.325	0.502	**0.369**
T_{11}	771	488	477	**551**	2038	1719	378	**1563**	0.212	0.265	0.452	**0.322**
T_{12}	640	463	441	**534**	1944	1536	352	**1378**	0.224	0.333	0.521	**0.360**
T_{13}	670	545	413	**554**	2174	1593	415	**1572**	0.264	0.263	0.458	**0.330**
T_{14}	640	456	352	**522**	2196	1688	201	**1508**	0.265	0.292	0.388	**0.317**
T_{15}	774	462	361	**514**	2029	1508	216	**1474**	0.229	0.303	0.328	**0.288**
Mean	**762**	**492**	**412**	**550**	**2090**	**1629**	**426**	**1515**	**0.238**	**0.286**	**0.442**	**0.327**
	T	P	TxP		T	P	TxP		T	P	TxP	
SEd	19	14	58		85	64	256		0.017	0.016	0.042	
CD (p=0.05)	38	29	115		169	127	509		0.035	0.032	0.085	

and Patil *et al.,* (2002) during storage of cotton seeds for different periods. It was also noticed that the storage period has played a major role in deteriorative process and brought down the viability across the treatment, otherwise significant fall in viability was recorded in all treatments and the rate of decline was minimum in seed lots treated with (T_5), (T_7), (T_{14}) and (T_{15}) (Table 1).

The maintenance of viability by *neem* products might be due to the biocidal effects to insects and fungi. *Neem* products can act as ovicidal on seed storage pests and also reported to have 20 ingredients; therefore it is very difficult for any insect to develop the resistance. This also might be a reason for extend viability of the cotton seed treated with *neem* leaf powder and *neem* kernel powder.

The seeds treated with chemicals like carbandazim, imidacloprid and iodine formulation protected the seed well for a short period, and in the extended storage period, the efficacy chemicals gets reduced as evidenced by the lower viability recorded at the end of storage period. This observation is in conformity with the reports of Kumar and Santharam (2000) where they found that no decrease in the efficacy of the imidacloprid when treated seeds were stored for 3 months, but recoded a decline thereafter.

The reduction in seedling length, dry matter accumulation and seedling vigour was recorded high in untreated seeds than the treated seeds over a period of storage. Though it was recorded in treated seeds, it was less in seeds treated with (T_5), (T_7), (T_{14}), (T_{15}) when compared to rest of the treatments (Table 2). Similar findings were reported in cotton (Rathinavel and Dharmalingam, 2001 and 2002).

The low electrical conductivity values

Table 3. Effect of seed treatments and storage periods on free sugar (mg/seed), seed oil (%) and free fatty acid (g/ Oleic acid) of cotton seeds under ambient storage cv. Surabhi

Treat-ment	Free sugar (mg/seed)				Seed oil (%)				Free fatty acid (g/Oleic acid)			
	Initial	16MAS	32MAS	**Mean**	Initial	16MAS	32MAS	**Mean**	Initial	16MAS	32MAS	**Mean**
T_0	0.095	0.173	0.240	**0.224**	22.57	21.11	20.09	**21.334**	0.173	0.318	0.350	**0.284**
T_1	0.077	0.194	0.208	**0.193**	23.52	23.30	20.00	**22.166**	0.109	0.241	0.253	**0.207**
T_2	0.071	0.083	0.104	**0.117**	22.88	20.22	20.06	**21.194**	0.089	0.134	0.162	**0.133**
T_3	0.040	0.059	0.081	**0.103**	21.92	21.90	20.05	**21.236**	0.115	0.147	0.163	**0.147**
T_4	0.075	0.093	0.113	**0.132**	22.06	21.03	20.23	**21.016**	0.135	0.159	0.237	**0.183**
T_5	0.086	0.086	0.108	**0.131**	21.74	21.08	20.71	**21.054**	0.102	0.162	0.239	**0.173**
T_6	0.089	0.103	0.130	**0.144**	23.57	22.98	20.68	**22.304**	0.116	0.167	0.226	**0.175**
T_7	0.091	0.179	0.248	**0.208**	22.59	21.22	20.10	**21.394**	0.172	0.314	0.343	**0.279**
T_8	0.079	0.199	0.228	**0.193**	23.54	23.44	20.00	**22.246**	0.107	0.247	0.243	**0.204**
T_9	0.081	0.089	0.134	**0.132**	22.99	20.36	20.05	**21.268**	0.087	0.139	0.152	**0.130**
T_{10}	0.049	0.069	0.091	**0.120**	21.66	21.40	20.01	**21.124**	0.113	0.147	0.169	**0.148**
T_{11}	0.085	0.098	0.133	**0.143**	22.62	21.28	20.11	**21.126**	0.139	0.169	0.237	**0.179**
T_{12}	0.096	0.087	0.128	**0.145**	21.94	21.68	20.21	**21.204**	0.109	0.172	0.199	**0.161**
T_{13}	0.091	0.123	0.138	**0.151**	23.59	22.98	20.58	**22.430**	0.116	0.169	0.228	**0.176**
T_{14}	0.086	0.099	0.124	**0.136**	21.79	21.15	20.68	**21.094**	0.109	0.167	0.229	**0.176**
T_{15}	0.059	0.071	0.098	**0.112**	23.55	22.99	22.18	**22.848**	0.106	0.127	0.142	**0.126**
Mean	**0.327**	**0.098**	**0.133**	**0.144**	**22.658**	**21.758**	**20.359**	**21.565**	**0.119**	**0.186**	**0.223**	**0.180**
	T	P	TxP		T	P	TxP			T	P	TxP
SEd	0.007	0.006	0.016		0.23	0.21	0.57			0.010	0.009	0.023
CD (p=0.05)	0.013	0.012	0.033		0.47	0.43	1.14			0.193	0.018	0.047

registered across storage period for seeds treated with (T_5), (T_7), (T_{14}), (T_{15}) (Table 2) reflect up on its action to preserve the integrity of the cellular membrane.

The seed oil content decreased with increase in storage period; however, the reduction was observed less in treated seeds. In contrast free fatty acids (FFA) increased progressively with advancement of storage period. FFA accumulation was found less in *neem* kernel of *neem* leaf powder treated seeds (Table 3). The reason could be that these halogens might have discouraged the adsorption of atmospheric moisture and there by prevented the lipid peroxidation during storage. The higher FFA associated with lower germi-nation in untreated seeds in the study. From the above observations, it may be concluded that the seed treatment with the botanicals such as *neem* kernel powder or leaf powder in combination Imidacloprid and carbendazim have proved potentially good in extending the life of seeds under ambient conditions of storage.

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