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EFFICACY OF SEED TREATMENT ON STORABILITY OF COTTON SEEDS AND SEEDLING VIGOUR

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Abstract: Seedling vigour evaluated in terms of field emergence of fresh as well as halogen treated, two month stored cotton seeds from 18 genotypes revealed the existence of variability. The seedling growth improvement due to halogen treatment after two months of storage differed with genotype to the tune of 1.0% (HB224) to 15.0% (M12) with an average of 7.0% over control. Halogen treatment had also improved the root length, shoot length and dry matter production of seedlings emerged in the field. The storability of halogen treated and untreated seeds of cotton genotypes assessed through a rapid deteriorative process (accelerated ageing) revealed the positive effect of seed treatment in prolonging shelf life. The response of individual genotypes for halogen treatment varied widely but the over all gain due to treatment over control was 12.0%, 5.5%, 3.8%, 12.8%, 32.5% and 23.7% for standard germination, root length, shoot length, dry matter production, vigour index and eleptrical conductivity of seed leachate, respectively. The seed quality parameters did not show uniformity to categorize the genotype as good, medium and poor.

Key words: Cotton seed, halogen, seedling vigour, seed storage, viability.

INTRODUCTION

Seed vigour is an important aspect of quality, which controls field stand, establishment ability and performance. The problems associated with establishing vigorously growing cotton seedlings are often related to poor seed quality. High quality cotton seeds have the capacity to provide vigorous seedlings over a wide range of environments. Deterioration of high quality seed, can render seed worthless for planting although its germination per cent remains relatively high (Christiansen and Presley, 1967). Seed deterioration is a progressive process from the time of physiological maturity until the seed is dead. (Delouche, 1963). Rudrapal and Basu (1981) reported that chlorine, bromine and iodine in their vapour form reduce physiological deterioration of seeds. Tappel (1973) indicated that the loss of membrane functions might be one of the basic reasons. Schnathorst and Presley (1963) found that the increased cell permeability of deteriorated cotton seed allowed large quantities of cellular components to diffuse out when seed were placed in water. Accelerated ageing is a test for predicting the storability of seed lots. It is assumed that the process of deterioration under accelerated ageing enormously increased (Delouche, 1971; Deslouche and Baskin, 1973). Hence, the present study was carried out to know the existence of variability for planting quality of seed among the genotypes in relation to seed treatment and to elicit information on the efficacy of seed treatment in controlling seed deterioration under a rapid deteriorative process.

MATERIALS AND METHODS

Cleaned seeds of 18 cotton genotypes were taken for the study. One part of the seed form each genotype was treated with chlorine based halogen mixture @ 3g kg^{-1} [dehydrated calcium oxychloride, calcium carbonate and *arappu* leaf powder (*Albizzia amara*) @ 5:3:1]. Treated seeds were packed in 700 gauge polythene bags, heat sealed and kept for five days. Then the seeds were transferred to *gada* cloth bag to store under ambient condition for two months. To estimate the seedling vigour, field emergence potential was recorded initially and after two months of storage using both treated and untreated seeds from all the genotypes. One hundred and fifty seeds in three replications of 50 each were sown equidistantly at a uniform depth of 2 cm in raised flat beds adopting 5 cm spacing between seeds. After sowing, the beds were irrigated judiciously. On the 10th and 30th day of sowing, 10 seedlings were uprooted using digging fork to avoid root damage for growth measurements such as root and shoot length. The seedlings used for growth measurements were dried in a hot air oven at 85°C for 24 h, cooled in a desiccator, weighed and expressed as g per 10 seedlings.

To assess the seed storability, accelerated ageing technique was used. Treated and untreated

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Table 1. Effect of chlorine based halogen formulation on field emergence (%) of cotton genotypes

Genotype	Initial	2 months after storage		Mean
		Control	Halogenated	
MCU5	85 (67.75)	70 (56.79)	80 (63.27)	78 (62.54)
MCU9	87 (69.40)	77 (61.12)	82 (64.92)	82 (65.15)
LRA5166	76 (60.72)	74 (59.41)	75 (59.81)	75 (59.98)
Supriya	74 (59.35)	71 (57.23)	87 (68.60)	77 (61.73)
Anjali	80 (63.45)	75 (60.02)	81 (64.43)	79 (62.63)
MCU5VT	77 (61.12)	73 (58.93)	84 (66.53)	78 (62.19)
H777	79 (62.50)	70 (56.79)	79 (63.12)	76 (60.80)
MCU10	73 (58.93)	69 (56.01)	69 (56.47)	70 (57.14)
T7	71 (57.42)	69 (56.17)	75 (60.22)	72 (57.94)
M12	80 (63.45)	70 (56.80)	85 (66.98)	78 (62.14)
TCH1218	80 (63.53)	77 (61.27)	85 (67.53)	81 (64.11)
Suvin	72 (58.12)	60 (50.77)	73 (58.50)	68 (55.80)
TCB209	70 (56.82)	62 (51.76)	75 (60.01)	69 (56.19)
P4	83 (65.94)	78 (62.04)	83 (65.88)	81 (64.62)
G27	79 (62.51)	77 (61.13)	75 (60.22)	77 (61.29)
K11	73 (58.50)	65 (53.53)	61 (51.55)	66 (54.53)
Uppam Cotton	67 (55.15)	62 (51.95)	73 (58.78)	67 (55.29)
HB224	90 (71.62)	80 (63.49)	81 (63.96)	84 (66.36)
Mean	78 (62.01)	71 (57.51)	78 (62.27)	75 (60.59)
CD (0.05)	T	G	T x G	
	0.95	2.86	4.05	

Figures in parentheses are arc sine transformed values

seeds from each genotype were arranged in a single layer over a wire mesh and placed inside a small plastic container closed airtight. Then they were placed inside the accelerated ageing chamber maintained at 40 °C and 100 % RH for seven days (Delouche and Baskin, 1973). Soon after ageing, seeds were subjected to standard germination test as described by Dharmalingam and Basu (1978). Ten normal seedlings were used for root and shoot measurements and dry matter production. Vigour index was computed by multiplying the total length of seedling with germination percentage (Abdul-Baki and Anderson, 1973). Electrical conductivity of seed leachate from treated and untreated seeds was measured (Presley, 1958).

RESULTS AND DISCUSSION

Field emergence

The analysis of variance exhibited significant difference among genotypes and between treatments within genotypes. The field emergence potential of fresh seeds of 18 genotypes ranged between 67% (Uppam Cotton) and 90% (HB224). After two months of storage the genotype HB224 and MCU 9 had inherently higher field emergence potential (84 and 82%) while K11 and Uppam Cotton showed significantly poor performance with 66% and 67% respectively. During the storage period, the halogen treatment increased the seedling vigour in each one of the genotypes except MCU10 where it remained on par with fresh seeds. The overall gain due to treatment was 7% over control (Table 1).

Seedling vigour measured in terms of root length in the field emergence test 15 days after sowing (DAS) varied between 5.4 cm (MCU5VT) and 10.4 cm (MCU5) among the genotypes with a mean of 7.6 cm. The values recorded for the counterpart halogen treated seeds ranged between 6.8 cm (G27) and 13.1 cm (MCU 5) with a mean of 9.3 cm highlighting the variability prevailing among the geno-

Table 2. Effect of chlorine based halogen formulation on root length (cm) of seedlings from field emergence in cotton genotypes

Genotype	15 DAS			30 DAS		
	Control	Halogenated	Mean	Control	Halogenated	Mean
MCU5	10.4	13.1	11.8	17.5	18.3	17.9
MCU9	8.6	10.5	9.6	16.6	18.8	17.7
LRA5166	8.7	12.2	10.5	13.4	17.4	15.4
Supriya	7.8	9.0	8.4	13.7	16.6	15.1
Anjali	7.1	7.6	7.3	13.5	16.8	15.2
MCU5VT	5.4	7.5	6.5	13.9	16.7	15.3
H777	8.5	10.7	9.6	13.4	15.2	14.3
MCU10	7.6	11.2	9.4	12.7	13.7	13.2
T7	8.0	9.1	8.5	10.7	12.9	11.8
M12	7.2	8.2	7.7	14.9	16.0	15.5
TCH1218	7.0	8.4	7.7	-11.0	15.3	13.2
Suvin	10.1	11.1	10.6	13.8	15.9	14.9
TCB209	6.5	7.7	7.1	11.8	12.4	12.1
P4	7.5	8.8	8.1	11.8	14.3	13.3
G27	5.8	6.8	6.3	10.9	12.5	11.7
K11	5.6	8.2	6.9	12.6	14.5	13.6
Uppam Cotton	6.6	7.6	7.1	12.2	14.0	13.1
HB224	7.5	9.3	8.4	11.2	14.7	13.0
Mean	7.6	9.3	8.4	13.1	15.4	14.2
CD (0.05)	T	G	T x G	T	G	T x G
	0.33	0.99	NS	0.33	0.99	1.39

types as well as the beneficial effect of treatment to improve the root growth. The performances of individual genotypes as well as the overall effect brought out the significant superiority of halogen treatment with 22.3% improvement in root growth (Table 2). The measurements made 30 DAS in the field bed exactly reflected the earlier results in respect to genotypes and seed treatment with higher mean values, where MCU9 (18.8 cm) and MCU5 (18.3 cm) were significantly superior to all other genotypes and TCB 209 (12.4 cm) and G27 (12.5 cm) were inferior on this score (Table 2).

The shoot length measurements on 15 and 30 DAS also refelcted the results of root length. The variability for shoot length in genotypes 15 DAS was from 9.5 cm (Uppam Cotton) to 22.7 cm (MCU9) with a mean of 17.6 cm. The counterpart, halogenated seeds were in the order of 9.6 cm (Uppam Cotton) to 22.8 cm (MCU9) with a mean of 18.4 cm. The increment in shoot growth due to halogen treatment was about 4.5% at 15 DAS.

The data recorded at 30 DAS were parallel to that of the early observation made at 15 DAS except for their increased shoot growth in all the genotypes. The variability existed in the genotypes was carried through and the beneficial effect of halogen treatment amplified.

The dry matter production of seedlings also showed variation among the genotypes. MCU5, MCU9 and MCU5VT recorded significantly higher dry matter production and G27 and Uppam Cotton the lowest at 15 DAS while Anjali and Supriya recorded significantly higher values and G27 the lowest at 30 DAS. With each one of the genotypes, halogen treatment showed enhanced values with 8

Table 3. Effect of chlorine based halogen formulation on germination and root length of cotton genotypes after accelerated ageing

Genotype	Germination (%)			Root length (cm)		
	Control	Halogenated	Mean	Control	Halogenated	Mean
MCU5	45 (42.32)	55 (47.68)	50 (45.00)	11.0	16.2	13.6
MCU9	45 (41.93)	50 (45.00)	47 (43.47)	11.3	13.8	12.6
LRA5166	44 (41.55)	52 (46.15)	48 (43.85)	15.6	15.1	15.4
Supriya	55 (48.07)	76 (60.70)	66 (54.38)	16.7	15.6	16.2
Anjali	47 (43.09)	55 (47.68)	51 (45.38)	15.5	17.1	16.3
MCU5VT	35 (36.05)	47 (43.09)	41 (39.57)	11.3	12.6	12.0
H777	37 (37.63)	51 (45.76)	44 (41.70)	16.5	11.6	14.0
MCU10	37 (37.66)	43 (40.78)	40 (39.22)	13.4	12.9	13.2
T7	37 (37.26)	47 (43.47)	42 (40.36)	12.9	14.3	13.6
M12	37 (37.27)	41 (39.62)	39 (38.44)	9.9	15.2	12.6
TCH1218	43 (40.)78	53 (46.53)	48 (43.66)	15.8	16.0	15.9
Suvin	45 (41.93)	56 (48.45)	50 (45.19)	15.1	16.6	15.8
TCB209	37 (37.25)	40 (39.23)	38 (38.24)	15.6	14.7	15.1
P4	43 (41.16)	63 (52.73)	53 (46.95)	16.9	17.0	16.9
G27	39 (38.45)	51 (45.38)	45 (41.92)	11.1	10.3	10.7
K11	43 (40.78)	57 (49.26)	50 (45.02)	13.7	13.0	13.4
Uppam Cotton	31 (33.09)	47 (43.47)	39 (38.73)	14.0	15.7	14.8
HB224	41 (39.61)	63 (52.35)	52 (45.98)	20.9	23.7	22.3
Mean	41 (39.82)	53 (46.52)	47 (43.17)	14.3	15.1	14.7
CD (0.05)	T	G	T x G	T	G	T x G
	0.80	2.39	3.38	0.25	0.76	1.07

Figures in parentheses are arc sine transformed values

to 10% increase at 15 DAS and 13.7% increase at 30 DAS over control.

Accelerated ageing

The accelerated aged seeds revealed significant differences in germination among the genotypes, treatment and their interaction. The analysis of variance brought out the significant superiority of Supriya with 66% germination closely followed by P4, HB224 and Anjali having higher potential for storage. On the contrary the genotypes TCB 209, Uppam Cotton and M12 were having very low germination following accelerated ageing (Table 3). The remaining 11 genotypes were intermediary in their storage behaviour. The halogen treatment had offered a good amount of protection upon the stress imposed on seed during the accelerated ageing and it was very much evident in germination of Supriya, MCV5 and H777 seeds. It was also noticed from the study that the storage potential of the genotypes can be improved with halogen treatment as evident from the overall mean of 53% for halogen treated seeds as against 41.0% for control (Table 3).

The seedling vigour in terms of root length ranged form 9.9 cm (M12) to 20.9 cm (HB 224) in different genotypes. The analysis of variance brought out the significant superiority of HB224 (22.3 cm) out of the 18 genotypes (Table 3). Treated seeds had higher root length to the tune of 5.5% over control.

The results of shoot length reflected the results of root length in respect to genotypes as well as treatment. The gain due to halogen treatment was 3.8% over genotypes.

Table 4. Effect of chlorine based halogen formulation on vigour index and electrical conductivity of cotton genotypes after accelerated ageing

Genotype	Vigour index			Electrical conductivity (dS m^{-1})		
	Control	Halogenated	Mean	Control	Halogenated	Mean
MCU5	1180	1718	1449	0.624	0.257	0.440
MCU9	1282	1664	1473	0.277	0.277	0.277
LRA5166	1374	1553	1464	0.543	0.257	0.400
Supriya	1932	2580	2256	0.260	0.268	0.264
Anjali	1408	1750	1579	0.396	0.280	0.338
MCU5VT	899	1230	1065	0.483	0.331	0.407
H777	1152	1315	1234	0.454	0.449	0.452
MCU10	1040	1236	1138	0.295	0.258	0.277
T7	987	1318	1152	0.323	0.255	0.289
M12	940	1215	1077	0.247	0.315	0.281
TCH1218	1399	1694	1547	0.239	0.260	0.250
Suvin	1467	1955	1711	0.709	0.367	0.538
TCB209	1183	1186	1185	0.765	0.567	0.666
P4	1493	2157	1825	0.753	0.617	0.685
G27	880	1154	1017	0.411	0.383	0.397
K11	1161	1506	1334	0.387	0.343	0.365
Uppam Cotton	744	1254	999	0.389	0.207	0.298
HB224	1712	2988	2350	0.259	0.269	0.264
Mean	1235	1637	1436	0.434	0.331	0.383
CD (0.05)	T	G	T x G	T	G	T x G
	55.47	166.42	235.35	0.027	0.081	0.115

The dry matter production was significantly higher for P4 closely followed by Supriya. The lowest values were for genotype K11 and Suvin. The halogen treatment gave 12.8% more dry matter production over control.

The vigour index of seedlings differed among genotypes to the tune of 744 to 1932 (Table 4). HB224 and Supriya were superior with mean values of 2350 and 2256 respectively. The other four genotypes namely Uppam Cotton, G27, MCU5VT and M12 recorded significantly lower values. The halogen treatment accounted for 32.5 per cent vigour improvement.

The mean electrical conductivity of seed leachate of aged seeds was from 0.239 dS m^{-1} to 0.765 dS m^{-1}. The halogen treatment had uniform effect on all the genotypes and recorded significantly lower values. The reduction in electrical conductivity was to an extent of 23.7 per cent (Table 4) as compared to control.

Cotton seed deterioration is a progressive process, however the rate of deterioration differs from one genotype to another. It is influenced by an array of factors that include seed and environment. Any seed treatment that goes along with the routine post harvest operations would be most welcome and acceptable for easy adoption. One such approach is the halogen treatment given to fresh seeds to counteract the free radical production and to improve the shelf life of seeds. The improvement in seed quality parameters due to halogen treatment has also been reported in other crop seeds (Basu and Rudrapal, 1980; Rudrapal and Basu, 1981; Pal and Basu, 1988) and in cotton (Lakshmi, 1995; Chitra, 1995). Also, there are reports on genotypes with varying seed storage potential (Sivasubramaniam, 1986; Sekar, 1980).

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