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Impact of Different Seed Treatments on Quality Parameters of Cotton (*Gossypium Spp.*)

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ABSTRACT

The present work was done in the department of seed science and technology, CCS Haryana Agricultral University, Hisar aiming at to study the presowing treatments for improving seed quality in cotton varieties viz. RG-8, HD-123 (Gossypium arboreum), HS-6, H1098 (Gossypium hirsutum).On the basis of germination percentage each variety was divided into two lots ie. Lot A (Good),SG above 65% and Lot B (Marginal),S.G. between 50-60%. The seeds of both lots of cultivar were treated before sowing with GA_3(100ppm), Ascorbic acid (100 ppm), NaCl (100 mM), KNO_3 (10 mM) and H_2O + thiram @ 0.25% for 6 hours and the untreated lot act as control. The observations recorded in the laboratory were viz., standard germination (%), radicle length (cm), plumule length (cm), vigour index-I, vigour index-II, electrical conductivity (uSimon/cm/seed) and accelerated ageing (%). While speed of emergence and seedling establishment (%) were recorded in the field.

Key words: *Gossypium arboretum, Germination, Desi cotton and Americian cotton*

INTRODUCTION

Seed plays an important role in agricultural production, as quality seed is the basic input for enhancing productivity and production. Cotton (*Gossypium spp.*) is one of the most extensively cultivated commercial crops of the world. It is also known as white gold. In India cotton almost accounts for 73% of fiber consumption. India has the largest producer of cotton cultivation in the world estimated around 6.21 million metric tons[1]. India cotton production was 377 lakh bales of 170 kg from 122 lakh hectares with a productivity of 524 kg lint/ha[2]. The cotton productivity of Haryana is 2638 kg/ha[3].

Economically seed deterioration is a major problem in agricultural production[12].

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However, the loss of vigour and viability could be minimized by various presoaking seed treatments[5]. Physiological changes which occur are delayed germination, reduced seedling growth rate, decreased tolerance to adverse germination conditions and loss of germinability[4] membrane deterioration, low oxygen uptake and high CO_2 output. Seed treatments have been found effective in delaying and decreasing ageing damage[8,7]. Pre-sowing seed treatments with water, plant growth regulators, agro-chemicals, fungicides etc also have been reported to increase seed quality in several crop species.

MATERIAL AND METHODS

The factorial experiment in completely randomized block design (CRD) as well as in randomized block design (RBD) has been conducted for laboratory and field parameters respectively. The angular transformation was applied to the percent data and the transformed data was subjected to the statistical analysis on the basis of the model described by Panse and Sukhatme[13]. The seed material for the present investigation consists of four varieties of cotton (*Gossypium spp.*), each grouped into two categories Desi cotton and Americian cotton on the basis of germination. Six treatments viz T_0 = Untreated (control), T_1 = GA_3 (100 ppm for 6 hr), T_2 = Ascorbic acid (100ppm for 6 hr), T_3 = NaCl (100 mM for 6 hr), T_4 = KNO_3 (10 mM for 6 hr), T_5 = Hydration (6 hr) + Dry dressing with thiram @ 0.25% were taken for study. After each treatment, seeds were dried back to original moisture content. The observation on cotton includes Standard germination (%), Radicle length (cm), Plumule length (cm), Dry weight (mg), Vigour index-I, Vigour index-II, Electrical conductivity test (μs/cm/seed).

RESULTS AND DISCUSSION

Table 1: Means Values of different viability & vigour parameters of cotton seed lots with different pre-sowing treatments

LOT A (SG% above 65)

Sr. No.	Variety	Treatments	Character									
			SG(%)	RL(cm)	PL(cm)	DW(mg)	VI-I	VI-II	EC(μs)	AA(%)	SOE	SET(%)
1	RG-8	Control	(62.00)78	21.20	12.60	22.00	2636.40	1716.00	0.32	64(53.11)	4.77	(44.98)50
2	RG-8	GA_3	(53.70)65	9.90	13.40	15.00	1514.50	975.00	0.46	56(48.42)	1.35	(20.24)12
3	RG-8	Asc.acid	(60.64)76	13.30	12.00	13.50	1973.40	1053.00	0.32	64(53.11)	2.26	(31.29)27
4	RG-8	NaCl	(64.13)81	18.30	13.70	30.00	2470.50	2430.00	0.20	80(63.42)	4.79	(45.55)51
5	RG-8	KNO_3	(64.89)82	15.10	12.90	17.00	2296.00	1804.00	0.19	80(63.42)	5.44	(46.12)52
6	RG-8	H_20+THI.	(64.89)82	19.60	12.60	9.50	2640.40	1394.00	0.20	80(63.42)	4.88	(45.55)51
7	HS-6	Control	(55.53)68	17.30	17.20	37.00	2346.00	1734.00	0.46	66(54.31)	2.70	(33.19)30
8	HS-6	GA_3	(54.92)67	12.90	16.50	22.00	1976.50	1474.00	0.67	58(49.58)	2.11	(31.29)27
9	HS-6	Asc.acid	(55.52)68	12.70	12.30	21.50	1725.00	1483.50	0.53	60(50.75	2.69	(28.47)23
10	HS-6	NaCl	(56.77)70	16.80	17.60	22.50	2408.00	1575.00	0.35	67(54.92)	3.17	(33.19)30
11	HS-6	KNO_3	(60.65)76	21.00	17.00	27.50	2888.00	2014.00	0.31	64(53.11)	3.85	(37.44)37
12	HS-6	H_20+THI.	(58.03)72	23.00	19.80	27.50	3081.60	1980.00	0.35	62(51.92)	3.65	(36.85)36
13	H-1098	Control	(54.31)66	17.30	17.80	30.00	2052.60	1980.00	0.54	60(50.75)	2.35	(31.29)27
14	H-1098	GA_3	(51.33)61	11.80	17.10	30.00	1787.30	1830.00	0.83	52(46.12)	2.03	(27.26)21
15	H-1098	Asc.acid	(53.11)64	13.20	18.80	32.00	2048.00	2048.00	0.72	58(49.58)	2.89	(29.98)25
16	H-1098	NaCl	(55.53)68	18.30	17.00	20.50	1870.00	1394.00	0.50	62(51.92)	3.16	(34.43)32
17	H-1098	KNO_3	(59.33)74	21.40	17.70	30.00	2893.40	2220.00	0.45	64(53.11)	3.51	(36.25)35
18	H-1098	H_20+THI.	(56.77)70	18.60	15.50	23.00	2386.00	1615.00	0.49	62(51.92)	3.24	(35.04)33
19	HD-123	Control	(56.77)70	16.40	13.10	15.00	2065.00	1050.00	0.30	60(50.75)	3.36	(42.11)45
20	HD-123	GA_3	(53.11)64	8.40	11.90	16.50	1299.20	1056.00	0.35	50(44.98)	0.91	(17.43)9
21	HD-123	Asc.acid	(55.59)68	16.40	14.10	8.00	2074.00	544.00	0.33	57(49.00)	2.15	(27.95)22
22	HD-123	NaCl	(59.36)74	19.80	13.40	21.50	2456.80	1591.00	0.26	65(53.71)	3.39	(42.11)45
23	HD-123	KNO_3	(59.36)74	12.10	12.60	18.50	1827.80	1369.00	0.26	67(54.92)	3.79	(43.26)47
24	HD-123	H_20+THI.	(59.36)74	16.90	10.80	15.00	2048.80	1110.00	0.26	65(53.71)	3.72	(42.11)45
CD(P=0.01)												
For V X L X T Interaction			2.470	0.490	0.500	2.960	1.600	22.150	0.004	1.920	0.068	2.270

Table 1: (Contd…) LOT B (SG% between 50-60)

S No.	Variety	Treatments	Character									
			SG(%)	RL(cm)	**PL(cm)**	**DW(mg)**	VI-I	VI-II	EC(µs)	AA(%)	SOE	SET(%)
1	RG-8	Control	(49.58)58	14.50	11.20	11.50	1490.60	667.00	0.42	(47.24)54	2.15	25(29.98)
2	RG-8	GA_3	(49.00)57	18.60	0.15	9.00	1476.00	540.00	0.41	(48.42)56	1.46	15(22.77)
3	RG-8	Asc.acid	(49.58)58	16.20	12.20	1.00	1738.50	61.00	0.40	(49.58)58	2.10	21(27.26)
4	RG-8	NaCl	(56.77)70	19.30	11.90	11.50	2188.80	800.00	0.37	(53.11)64	3.14	31(33.81)
5	RG-8	KNO_3	(64.89)82	19.40	14.60	12.00	1464.00	1625.00	0.39	(48.42)56	3.34	34(35.64)
6	RG-8	H20+THI.	(55.52)68	13.50	11.70	25.50	1587.60	756.00	0.41	(50.75)60	2.64	32(34.25)
7	HS-6	Control	(48.42)56	12.40	13.80	16.00	1467.20	896.00	0.61	(42.68)46	1.78	19(25.82)
8	HS-6	GA_3	(39.20)40	11.00	14.30	13.00	1012.00	520.00	0.81	(33.19)30	0.73	7(15.31)
9	HS-6	Asc.acid	(47.28)54	18.40	12.40	26.00	1663.00	1404.00	0.72	(38.03)38	1.19	18(25.08)
10	HS-6	NaCl	(48.43)56	15.40	17.20	24.00	1825.60	1344.00	0.55	(41.53)44	1.84	22(27.94)
11	HS-6	KNO_3	(49.58)58	14.80	15.20	18.00	1740.00	1044.00	0.50	(43.83)48	2.65	26(30.64)
12	HS-6	H_20+THI.	(48.42)56	13.00	14.20	24.50	1523.20	1372.00	0.54	(40.37)42	2.09	20(26.55)
13	H-1098	Control	(47.85)55	12.10	13.80	22.50	1380.50	1237.50	0.68	(45.55)51	1.47	18(25.08)
14	H-1098	GA_3	(45.55)51	12.80	16.50	24.00	1494.30	1224.00	0.96	(49.27)42	1.15	16(23.54)
15	H-1098	Asc.acid	(46.70)53	14.60	16.20	23.00	1632.40	1219.00	0.75	(44.98)50	1.09	14(21.95)
16	H-1098	NaCl	(48.42)56	11.40	12.90	18.00	1360.00	1008.00	0.53	(47.27)54	1.59	19(25.81)
17	H-1098	KNO_3	(49.58)58	14.60	18.00	25.00	1890.80	1450.00	0.49	(47.27)54	3.56	41(39.79)
18	H-1098	H_20+THI.	(48.42)56	15.80	15.90	26.00	1775.00	1456.00	0.52	(46.12)52	3.09	32(34.43)
19	HD-123	Control	(49.58)58	16.40	12.70	12.50	1701.20	725.00	0.43	(47.85)55	2.33	26(30.64)
20	HD-123	GA_3	(46.12)52	8.40	13.60	16.50	1289.60	858.00	0.64	(43.83)48	1.83	15(22.77)
21	HD-123	Asc.acid	(47.28)54	16.40	13.70	4.50	1728.00	243.00	0.53	(46.12)52	2.12	23(28.64)
22	HD-123	NaCl	(53.12)64	19.80	14.10	18.00	1689.60	1152.00	0.32	(48.42)56	3.05	39(38.62)
23	HD-123	KNO_3	(51.53)62	12.70	11.40	21.50	1686.00	1290.00	0.33	(47.27)54	4.19	48(43.83)
24	HD-123	H_20+THI.	(50.75)60	18.00	13.80	18.50	1902.40	1073.00	0.37	(47.27)54	2.75	30(33.19)
CD(P=0.01)												
For V X L X T Interaction			2.470	0.490	0.500	2.960	1.600	22.150	0.004	1.920	0.068	2.270

Concentration of chemicals: GA_3=Gibberlic acid (100ppm); Asc. Acid= (!00ppm); NaCl=Sodium Chloride= (100mM); KNO_3= Potassium Nitrate(10mM); H_2O+THI= Water+Thiram @0.25%

Values in paranthesis are transformed data

DRY WEIGHT (mg.)

The range of dry matter accumulation varied from 1.00 to 37.00 mg. of seedling (Table 1). Lot B showed improvement in dry matter accumulation. Whereas it was decreased in Lot A (Table 2D). HD-123 was most responsive to the best treatment. Highest increase in dry matter accumulation was observed in KNO_3 treated HD-123 seeds (Table 2D). KNO_3 and H_2O + *Thiram* showed best results (at par). While NaCl, ascorbic acid and GA_3 showed -ve effects (Table 2C).

Table: 2A. Two way mean table between variety vs. lot of cotton

Variety	Lot A	Lot B	Mean
RG-8	17.83	11.75	14.79
HS-6	26.33	20.25	23.29
H-1098	27.58	23.08	25.33
HD-123	15.75	15.25	15.50
Mean	21.87	17.58	

CD (P=0.01) Variety=0.855 Lot=0.605 Variety X Lot=1.209

Table: 2B. Two way mean table between variety vs. treatment of cotton

Variety	Treatment						Mean
	Control	GA_3	A.A	NaCl	KNO_3	H_2O + Th	
RG-8	16.75	12.00	7.25	20.75	14.50	17.50	14.79
HS-6	26.50	17.50	23.75	23.25	22.75	26.00	23.29
H-1098	26.25	27.00	27.50	19.25	27.50	24.50	25.33
HD-123	13.75	16.50	6.25	19.75	20.00	16.75	15.50
Mean	20.81	18.25	16.18	20.75	21.18	21.18	

CD (P=0.01) Variety=0.855 Treatment=1.047 Variety X Treatment=2.094

Contd.

Table: 2C. Two way mean table between lot vs. treatment of cotton

Lot	Treatment						Mean
	Control	GA_3	A.A	NaCl	KNO_3	H_2O+Th	
A	26.00	20.87	18.75	23.62	23.25	18.75	21.87
B	15.62	15.62	13.62	17.87	19.12	23.62	17.58
Mean	20.81	18.25	16.18	20.75	21.18	21.18	

CD (P=0.01) Lot=0.605 Treatment=1.047 Lot X Treatment=1.481

See Abbreviations from Table 1.

The increase in dry matter of Lot B was more as compared to Lot A. KNO_3 and H_20 + *Thiram* increased dry matter accumulation significantly as compared to others. HD-123 showed maximum improvement in dry weight. The increase in dry matter accumulation may be attributed to the fact that sodium and potassium are involved in maintaining the tone, vigour and efficiency of plant. Hence sodium and potassium may be playing a critical role in enhancing the physiological efficiency of plant parts rather than the plant morphology as observed in potato[10]. Similar findings were reported in KNO_3, NaCl treated seeds of spring wheat[14] and cotton.

Table: 3 Vigour Index

The range of vigour index calculated by standard germination (%) multiplied by the dry weight (mg) varied from 61.00 to 2430.00 (Table 1). Lot B showed higher improvement as compared to Lot A (Table 3D). HS-6 was most responsive to the best treatments. Highest improvement in indices was observed in KNO_3 treated RG-8 seeds (Table 3D). KNO_3 showed best results followed by NaCl and then H_2O + *Thiram*. GA_3 and ascorbic acid showed adverse effect (Table 3C).

Table: 3A. Two way mean table between variety vs. lot of cotton

Variety	Lot		Mean
	A	B	
RG-8	2255.20	1647.58	1951.39
HS-6	2404.18	1538.53	1971.35
H-1098	2172.88	1588.96	1880.92
HD-123	1961.93	1666.13	1814.03
Mean	2198.55	1610.30	

CD (P=0.01) Variety=0.463 Lot=0.327 Variety X Lot=0.655

Table: 3B. Two way mean table between variety vs. treatment of cotton

Variety	Treatment						Mean
	Control		GA_3	A.A	NaCl	KNO_3	H_2O + Th	
RG-8	2063.50	1465.25	1855.95	2329.65	1880.00	2114.00	1951.39	
HS-6	1906.60	1494.25	1694.10	2116.80	2314.00	2302.40	1971.35	
H-1098	1716.55	1640.80	1840.20	1615.40	2392.10	2080.50	1880.92	
HD-123	1883.10	1294.40	1901.00	2073.20	1756.90	1975.60	1814.03	
Mean	1892.43	1473.67	1822.81	2033.76	2085.75	2118.12		

CD (P=0.01) Variety=0.463 Treatment=0.567 Variety X Treatment=1.134

Contd.

Table: 3C. Two way mean table between lot vs. treatment of cotton

Lot	Treatment						Mean
	Control	GA_3	A.A	NaCl	KNO_3	H_2O+Th	
A	2275.00	1644.37	1955.10	2301.32	2476.30	2539.20	2198.55
B	1509.87	1302.97	1690.52	1766.20	1695.20	1697.05	1610.30
Mean	1892.43	1473.67	1822.81	2033.76	2085.75	2118.12	

CD (P=0.01) Lot=0.327 Treatment=0.567 Lot X Treatment=0.802

D. Effect of Presowing treatments on vigour inderx II of various lots of cotton.

Treatment	Effect on lots		Effect on varieties			
	A	B	RG-8	HS-6	H-1098	HD-123
GA_3	-286.2	-95.8	-434	-318	-81.7	69.5
Ascorbic acid	-337.8	-149.6	-634.5	128.7	24.8	-494
NaCl	127.5	194.7	423.5	144.5	-407.7	484
KNO_3	231.7	470.9	523	214	226.3	442
H_2O+Thiram	-95.2	282.9	-116.5	361	-73.2	204

See Abbreviations from Table 2

Lot B seeds depicted higher improvement in vigour indices over lot A seeds. The treatments KNO_3, NaCl, H_2O + *Thiram* has an enhancing effect on the indices, whereas GA_3 and ascorbic acid showed adverse effect. The probable reason for increasing vigour of the seedling may be attributed to the growth regulating chemicals which might have stimulated and promoted the germination and vigour of the seedlings. Similar findings of presoaking treatments were also reported in KNO_3, ethrel treated Anjan seeds wheat restored the germinability and vigour[15], and so was in tomato and pepper seed[16]. Similar trend of increase in growth and vigour of plant was also reported by NaCl and hydration-dehydration in wheat[6] and Jute.

Table 2: Plumule Length (cm)

The mean values of PL ranged from 10.80 to 19.80 (Table 1). Lot B showed improvement in plumule length while Lot A showed decrease (except NaCl treatment) (Table 2). RG-8 was most responsive to all the treatments. Highest improvement was observed in GA_3 treated RG-8 seeds (Table 2). KNO_3 showed the best results followed by NaCl. While H_2O + *Thiram* and GA_3 were at par. Ascorbic acid showed adverse effects (Table 2).

A. Two way mean table between variety vs. lot of cotton

Variety	Lot A	Lot B	Mean
RG-8	12.86	12.76	12.81
HS-6	16.73	14.51	15.62
H-1098	17.31	15.55	16.43
HD-123	12.65	13.21	12.93
Mean	14.89	14.01	
CD (P=0.01)	Variety=0.146	Lot=0.103	Variety X Lot=0.207

B. Two way mean table between variety vs. treatment of cotton

Variety	Treatment						Mean
	Control	GA_3	A.A	NaCl	KNO_3	H_2O + Th	
RG-8	11.90	14.20	12.10	12.80	13.75	12.15	12.81
HS-6	15.50	15.40	12.35	17.40	16.10	17.00	15.62
H-1098	15.80	16.80	17.50	14.95	17.85	15.70	16.43
HD-123	12.90	12.75	13.90	13.75	12.00	12.30	12.93
Mean	14.02	14.78	13.96	14.72	14.92	14.28	
CD (P=0.01)	Variety=0.146	Treatment=0.179	Variety X Treatment=0.358				

Improvement in plumule lengths was observed better in Lot B. Radicle length increased by NaCl, H_2O + *Thiram* and KNO_3 treatment significantly better than GA_3 and ascorbic acid, while KNO_3 showed better shoot length followed by NaCl and H_2O + *Thiram*. Among varieties, HS-6 was better performer for radicle length, whereas RG-8 was better performer for plumule length than the others. The increase in seedling length by various presowing treatments can be due to the beneficial effect in uniform germination, due to intensified hydrolytic process, better uptake of nutrient and moisture, imparting stimulation for better establishment of seedling. Similar beneficial physiological and biochemical effects of presowing seed treatment were observed in cotton[17], corn, barley[9].

CONCLUSION

It is concluded from the present study that quality of seed in terms of (germinability and field performance) can be improved by applying presowing seed soaking treatment in both the seed lots and more so in the marginal quality seeds indicating that these treatments are more effective in low quality seeds.

RG-8 was better lab performer, whereas H-1098 was better field performer. KNO_3 was found most effective presowing treatment followed by NaCl and H_2O + Thiram. The viability and vigour of the seeds can be enhanced by presowing treatments of KNO_3 and followed by NaCl and H_2O + Thiram @ 0.25%.

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