

## EFFECT OF PRE-SOWING SEED TREATMENT WITH CHEMICALS AND GROWTH REGULATORS FOR DROUGHT TOLERANCE AND YIELD OF COTTON (*Gossypium hirsutum* L) UNDER RAINFED CONDITION

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Experiments were carried out with cotton MCU. 10 in order to find out the effect of pre-sowing chemicals and growth regulators for drought tolerance and high yield under rainfed condition. In the present study, it was found that soaking the cotton seeds either in CCC. 500 ppm or 2 percent KCl for 12 hours followed by 5 hours shade drying and sown as dry seeding has given an increased kapas yield under rainfed condition. Above treatments were supported by high Relative Water Content, more accumulation of proline, high Chlorophyll Stability Index, more leaf area and high dry matter production during growth period under drought condition.

Cotton production has created a good impact on the economy of India. Besides irrigated crop, it is also grown as rainfed crop in black soil area of Southern districts of Tamil Nadu. The present area under cotton in Southern districts is about 1.75 lakh hectares. Out of this, about 60-70 per cent of the area is under rainfed condition. Pre-sowing seed treatment is considered as one of the important dry farming techniques for rainfed crops. Generally, the sowing time can be adjusted in such a way to get the rainfall at critical stages of water requirement of the crops. At time, failure of rainfall at those critical stages will affect the germination, growth and development of plant and subsequently yield. In order to withstand the drought stress, pre-sowing seed treatment should be adopted for rainfed crops. Field

experiments in Azerbaidyan, under moderately saline conditions, with seeds soaked in a 0.2% Mg So4 solution before sowing, resulted in yield increase of 29.8 percent of seed cotton (Azizbekova, 1962).

### MATERIALS AND METHODS

Experiments were carried out under rainfed condition in black soil area of Regional Research Station, Aruppukottai during the year 1984-85 and 1985-86. The cotton variety MCU.10 was used in this experiment. The seeds were given with the following treatments. T<sup>1</sup> = Control; T<sup>2</sup> = Water soaking, T<sup>3</sup> = MH-500 ppm, T<sup>4</sup> = CCC-500 ppm, T<sup>5</sup> = Succinic acid 0.09%; T<sup>6</sup> = CaCl - 0.25%, T<sup>7</sup> = KCl-2%; T<sup>8</sup> = D Mannitol-2%; T<sup>9</sup> = NaCl-2% and T<sup>10</sup> = Coating the seeds with paste made of ash (500

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g/kg of seeds) + 3% gum. The seeds were soaked in solutions for 12 hours (linted seeds) and dried under shade for 5 hours. After shade drying, the seeds were treated with thiram 4g/kg of seeds and sown in plots of 8x5 size as pre-monsoon sowing. The field trial was conducted under rainfed condition with basal application of N 40 and P 20 per hectare. The germination, seedling weight and vigour Index were worked out with data collected from Laboratory studies. The field emergence was recorded in the field itself. Plant samples were collected

at vegetative, flowering and harvest stages and worked out the leaf area, dry matter production, Relative Water Content (RWC) and yield of kapas at harvest stage. The proline content (Bates et al., 1973) and Chlorophyll Stability Index (Murthy and Majumdar, 1962) were estimated at flowering stage.

RESULTS AND DISCUSSION

a) Seed and Seedling Characters (Table 1)

1) Germination :  
In the first year (1984 - 85)

Table 1. Seed and Seedling characters

Treatment	Germination %		Field Emergence %		Seedling Weight mg		Vigour Index	
	1984-85	1985-86	1984-85	1985-86	1984-85	1985-86	1984-85	1985-86
	T <sub>1</sub> Control	59.50	81.00	76.05	68.00	40.82	38.30	2429
T <sub>2</sub> Water soaking	76.00	79.00	68.35	82.00	42.50	38.30	3230	3026
T <sub>3</sub> MH 500 ppm	60.50	68.00	53.84	65.00	43.32	36.70	2621	2496
T <sub>4</sub> CCC-500 ppm	69.50	86.00	74.35	93.00	43.32	40.00	3011	3440
T <sub>5</sub> Succinic acid 0.09%	75.00	81.00	81.17	74.00	45.00	38.30	3375	3179
T <sub>6</sub> CaCl-0.25%	65.00	83.00	75.20	84.00	41.66	33.30	2708	2764
T <sub>7</sub> KC1-2%	69.00	85.00	76.02	90.00	43.32	40.00	2990	3400
T <sub>8</sub> D. Mannitol-2%	60.00	67.00	77.76	89.00	43.32	33.30	2599	2231
T <sub>9</sub> NaCl-2%	55.00	63.00	70.92	82.00	45.00	40.00	2475	2400
T <sub>10</sub> Ash+Gum 3%	54.00	82.00	70.35	86.00	45.82	33.30	2932	2722
Treatment SE	2.31**	2.27**	0.85	5.31*	2.87	1.88	2.87	213.18**
CD at 0.05 P level	6.85	6.73	N.S.	15.77	N.S.	NS	NS	633.22

the germination percentage was more for the seeds treated with water soaking, Succinic acid 0.09%, CCC, 500 ppm and KC1-2% when

compared to the control, But in the second year (1985-86), it was found that seeds treated with CCC-500 ppm (86%) and KC1 2% [85%] had recor-

ded maximum germination percentage than control (68%) and other treatments.

(ii) Field emergence :

The seeds treated with Succinic acid 0.09% and D. Mannitol had higher, values for field emergence than other treatment in the first year, In the second year, the seeds soaked in CCC-500 ppm (93)% and KC1-2% (90%) recorded maximum values than control (68%) and other seed treatments.

(iii) Seedling weight and vigour Index :

Regarding seedling weight and vigour Index, all the treatments had higher values than control in the

first year, 1984-85. In the second year (1985-86), both the characters were expressed more values for the treatments CCC-500 ppm (40g, 3440) 2% KC1 (40g, 3400) and succinic acid 0.09% (38g, 3179) while in the case of control, it was only 38g, 3102 respectively.

In considering the over all performance of treatments viz. CCC-500 ppm and KC1 2%, had favourable effect on seed and seedling Characters in both years. This was in agreement with the work of Manohar and Mathur (1966)

2. Leaf area (LA) at vegetative, flowering and harvest stages (Table 2)

Table 2. Leaf Area (sq cm) at Vegetative, Flowering and Harvest Stages

Treatment	Vegetative		Flowering		Harvest stages	
	1984-85	1985-86	1984-85	1985-86	1984-85	1985-86
T <sub>1</sub> Control	479	1108	1880	2751	1891	3148
T <sub>2</sub> Water soaking	489	1315	1782	2879	1943	2888
T <sub>3</sub> MH-500 ppm	402	849	1543	2417	2224	1528
T <sub>4</sub> CCC-500 ppm	634	1155	1416	2825	1943	2742
T <sub>5</sub> Succinic acid 0.09%	494	1189	1886	2998	1897	3116
T <sub>6</sub> CaCl-0.25%	572	1091	1936	2679	2008	4218
T <sub>7</sub> KC1-2%	519	1208	1960	3329	2056	3610
T <sub>8</sub> D. Mannitol-2%	462	1165	2068	3179	2083	3198
T <sub>9</sub> NaCl-2%	551	1267	2098	3872	2926	4047
T <sub>10</sub> Ash+Gum 3%	493	1151	2089	2529	2098	2711
Treatment S E	37.32*	154.19	217.33	449.56	228.03	511.62
C D at 0.05 P level	110.87	NS	NS	NS	NS	NS

In the first year (1984-85) at vegetative stage, CCC-500 ppm, CaCl 0.25%, NaCl 2% and KCl 2% treated seeds recorded maximum values of LA than the control. In the second year (1985-86), LA was more for the treatments viz. water soaking, NaCl 2%, KCl-2%, Succinic acid 0.09% and CCC-500 ppm when compared to the control and other treatments.

In the first year (1984-85) at flowering stage, the LA was high for the treatments viz; NaCl-2% Ash+GUm 3%, D.Mannitol-2% and KCl 2% and low for the treatments CCC-500ppm and MH-500 pm when compared to the control. In the second year (1985-86), it was found that the following treatments viz. NaCl 2%-

2% D. Mannitol - 2% Succinic acid 0.09% and CCC-500 ppm recorded maximum leaf area at flowering stage.

At the harvest stage, it was found that LA was more for the treatments viz. MH-500 ppm, Ash + gum 3%, D. Mannitol - 2% KCl-2% and CaCl-0.25% than the control in the first year. In the second year (1985-86), the maximum LA was observed in treatments viz. MH 500 ppm CaCl - 0.25%, NaCl-2% and KCl-2% than the control.

### 3. Total Dry matter production (TDMP) at Vegetative, flowering and harvest stages (Table 3) :

Table 3. Total dry matter production (g) at Vegetative, flowering harvest stages

Treatment	Vegetative		Flowering		Harvest stages		
	1984-85	1985-86	1984-85	1985-86	1984-84	1985-86	
T <sub>1</sub> Control	4.08	8.76	23.1	29.9	50.7	60.2	
T <sub>2</sub> Water soaking	4.09	10.86	20.4	37.6	59.1	76.9	
T <sub>3</sub> MH-500 ppm	3.37	6.38	15.9	28.3	73.9	77.3	
T <sub>4</sub> CCC-500 ppm	5.58	8.82	16.4	32.9	77.1	69.5	
T <sub>5</sub> Succinic acid 0.09%	4.22	9.93	21.7	35.1	58.6	79.3	
T <sub>6</sub> CaCl 0.25%	4.67	8.74	23.5	25.8	68.6	86.6	
T <sub>7</sub> KCl-2%	4.59	9.97	23.7	37.5	68.6	72.2	
T <sub>8</sub> D. Mannitol-2%	4.07	9.54	26.5	36.1	56.1	58.5	
T <sub>9</sub> NaCl-2%	4.53	10.47	25.3	45.1	69.2	72.7	
T <sub>10</sub> Ash+gum 3%	4.37	9.19	25.5	30.1	58.2	79.9	
Treatment	S E	0.39	1.36	2.48	6.06	6.73	10.23
	C D	NS	NS	NS	NS	NS	NS

at 0.05 P level

At vegetative stage, during first year (1984-85), it was found that TDMP was higher for the treatment viz. CCC-500 ppm, CaCl-0.25% and NaCl-2% recording 5.58g, 4.67g, 4.59 and 4.53 g. respectively when compared to control (4.08g). In the second year (1985-86), the same trend was maintained with more effect towards the treatments CCC-500 ppm, KCl 2% and NaCl 2% in respect of TDMP at vegetative stage.

Regarding TDMP at flowering stage in the first year (1984-85) the treatments viz. D. Mannitol-2%, Ash + Gum 3%, NaCl-2% and KCl-2% recorded maximum values than the control. In the second year (1985-86) except MH-500 ppm and CaCl-0.25% other treatments were recorded higher values for TDMP when compared to

the control.

In respect of TDMP at harvest stage, it was more for the treatments viz. CCC-500ppm (77.1g), MH-500ppm (73.9g), NaCl-2% (69.2g), KCl-2% and CaCl-0.25% (68.6g) when compared to the control (50.7g) in the first year (1985-86). The TDMP in the second year, it was recorded more values for the treatments viz. CaCl 0.25%, Ash + gum 3%, Succinic acid - 0.09%, water soaking and KCl-2% than the control.

#### 4. Relative Water Content (RWC) at vegetative, flowering and harvest Stages (Table-4)

The RWC is considered as an important factor for drought tolerance. In the first year (1984-85), the treatments viz. CCC-500 ppm (92.2%),

Table 4 Chlorophyll stability Index (CSI) and proline content at flowering stage

Treatment	CSI (OD Value)		Proline content leaf /ug/mg of fresh	
	1984-85	1985-86	1984-85	1985-86
T <sub>1</sub> Control	0.026	0.039	1.448	1.985
T <sub>2</sub> Water soaking	0.024	0.042	1.266	1.536
T <sub>3</sub> MH-500 ppm	0.022	0.024	0.448	2.267
T <sub>4</sub> CCC-500 ppm	0.014	0.034	1.810	2.182
T <sub>5</sub> Succinic acid 0.09%	0.016	0.047	1.085	2.529
T <sub>6</sub> CaCl 0.25%	0.004	0.039	1.720	2.023
T <sub>7</sub> KCl-2%	0.006	0.028	1.993	2.190
T <sub>8</sub> D.Mannitol-2%	0.016	0.047	2.083	2.261
T <sub>9</sub> NaCl-2%	0.016	0.042	2.263	2.055
T <sub>10</sub> Ash+gum 3%	0.008	0.035	2.355	2.080



KCl 2% (92.7%) and water soaking (92.0%) recorded maximum RWC at vegetative stage than the control (91.4)%. In the second year (1985-86), the same trend as in the first year was recorded in respect of RWC at vegetative stage. The RWC is considered as an important drought tolerance index and here, it is found that both the treatments viz. CCC-500 ppm, and KCl 2% had recorded more values of RWC in both years.

In the first year (1984-85) at flowering stage, the RWC (89.6%) was high for the treatment viz. CCC-500 ppm Water soaking and KCl-2% when compared to the control (83.5%) In the second year (1985-86), treatments KCl-2% (88.5%), Water soaking,

(87.5%) NaCl-2 % (87.3%) and CCC-500 ppm (87.0%) recorded maximum values of RWC that the control (84.9%).

In the first year (1984-85), the RWC was maximum for the treatments, viz. D. Mannitol-2%, CaCl-0.25% NaCl-2%, Succinic acid - 0.09% and CCC-500 ppm than the control at harvest stage. But in the second year (1985-86), the following treatments viz. MH-500 ppm, KCl-2% CCC-500-500 ppm and NaCl-2% recorded high values of RWC than the control.

#### 5. Chlorophyll Stability Index (CSI) and proline content at flowering stage [Table 5]

Table. 5 Relative Water Content (%) at vegetative, flowering and harvest stages

Treatment	Vegetative		Flowering		Harvest stages	
	1984-85	1985-86	1984-85	1985-86	1984-85	1985-86
T <sub>1</sub> Control	91.4	80.4	83.5	84.9	85.3	84.9
T <sub>2</sub> Water soaking	92.0	86.9	89.6	87.5	85.0	83.4
T <sub>3</sub> MH-500 ppm	90.4	84.2	88.1	80.2	85.8	88.1
T <sub>4</sub> CCC-500 ppm	92.2	90.9	89.6	87.0	87.5	86.5
T <sub>5</sub> Succinic acid 0.09%	88.7	83.3	86.6	86.6	87.9	84.4
T <sub>6</sub> CaCl-0.25%	90.0	83.6	83.6	84.7	88.8	79.7
T <sub>7</sub> KCl-2%	92.7	85.8	89.6	88.5	85.8	86.7
T <sub>8</sub> D. Mannitol 2%	90.5	84.2	89.1	82.4	89.8	80.6
T <sub>9</sub> NaCl-2%	89.7	86.8	88.6	87.3	88.0	86.2
T <sub>10</sub> Ash+Gum 3%	90.9	85.1	85.3	86.0	85.5	85.6
Treatment SE	1.49	2.91	1.61	1.88	1.75	3.72
CD at 0.05 P level	NS	NS	NS	NS	NS	NS

## i] Chlorophyll Stability Index [CSI:]

The low OD values for the treatments viz. CaCl-D.25%, KCl-2% Ash+Gum 3% and CCC. 500 ppm indicated high CSI at flowering stage in the first year [1984-85]. In the second year [1985-86], CSI was more for the treatments viz. MH 500 ppm, KCl-2% and CCC 500ppm when compared to the control.

## ii] -Proline content :

In the first year [1984-85], the accumulation of proline was more for the treatments viz. Ash+Gum 3% NaCl-2% , D. Mannitol -2% ,KCl-2% and CCC.500 ppm than the control. In the second year (1985-86), the proline accumulation for the treatments succinic acid-0.09% . D. Mannitol-2 % . KCl-2% MH-200 ppm and CCC-500 ppm was high than the control. It has been suggested that the accumulation of proline may be a protective agent; the application of proline helped wheat plants to recover from drought [Tyankova, 1967].

## 6. Yield of kapas at harvest stage [Table 6] and rainfall during crop seasons [Table 7]

In the first year (1984-85), the yield of kapas recorded for the treatments viz. CCC. 500 ppm (1844 kg/ha), KCl-2% (1720 kg/ha) was more than the control (1484 kg/ha.) In the second year (1985-86), even-though yield of kapas was not statistically significant, the numerical values indicated the same trend as

in the first year. It was observed that CCC-500 ppm treatment recorded kapas yield of 1440 kg/ha and KCl-2% recorded 1319 kg/ha whereas the control recorded only 1095 kg/ha. in the second year.

Table 6 Yield of Kapas at harvest stage

Treatment	Yield of kapas (Kg/ha)	
	1984-85	1985-86
T <sub>3</sub> Control	1484	1095
T <sub>2</sub> Water soaking	1538	1127
T <sub>5</sub> MH-500 ppm	1192	1070
T <sub>4</sub> CCC 500 ppm	1844	1440
T <sub>2</sub> Succinic acid 0.09%	1602	1200
T <sub>4</sub> CaCl-0.25%	1610	1107
T <sub>2</sub> KCl-2%	1720	1319
T <sub>8</sub> D.Mannitol 2%	1580	1164
T <sub>4</sub> NaCl-2%	1606	1242
T <sub>10</sub> Ash+Gum 4%	1604	1240
Treatment SE	0.82	0.42
CD at 0.05 P level	NS	NS

The Kapas yield increase for the treatments viz. CCC-500ppm and KCl-2% in two years (1984 85 and 1985-86) was supported by the favourable high values for the physiological parameters like germination, field emergence, vigour Index, LA, TDMP, RWC, CSI and Proline content at different stages of crop growth under rainfed condition. Manohar and Mathur (1966) found that when seed treatment was given before sowing improved the germination. promoted

plant growth and increased the crop survival and this was in agreement with the present work.

Table 7 Rainfall during crop seasons (1984-85 and 1985-86)

Month	Rainfall(mm) 1984-85 (First year)	Rainfall(mm) 1985-86 (Second year)
September	173.4	28.8
October	63.4	58.8
November	75.6	145.4
December	10.4	25.8
January	54.8	5.2
February	—	20.2
March	16.0	2.6
Total	393.6	286.8

Moreover, the rainfall data showed that during the growth period in the first year (1984-85), there was enough soil moisture available for initial germination and also for vegetative and flowering stage of the crop. But at boll formation stage, there was less rainfall in December '84 (10.4mm), the crop was able to withstand drought due to pre-sowing seed treatment. In the second year (1985-86), there was limited rainfall during initial as well as boll formation stages. Under both stages, the crop was able to tolerate the drought situation due to pre-sowing seed treatment with CCC-500 ppm and 2% KC1 and this was reflected on yield increase over control.

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