



## Abiotic stress management in *desi* cotton (*Gossypium arboreum*) under rainfed condition

S. C. WADILE\*, N. E. PATHADE, S. S. CHITODKAR AND Y. J. PATIL

Mahatma Phule Krishi Vidyapeeth, Department of Agronomy, College of Agriculture, Dhule-424001

Email: scwadile72@gmail.com

**Abstract:** A field experiment was conducted during *kharif* 2018 at Agronomy Farm, College of Agriculture, Dhule. To study the effect of drought management on growth and yield of cotton under rainfed condition. The experiment was laid out in randomized block design with three replications and nine treatments *viz.*, T<sub>1</sub>- foliar spray of (Glycine betaine @ 0.3%) at 45-55 DAS, T<sub>2</sub>- foliar spray of (Kaolin @ 1.25%) at 45-55 DAS, T<sub>3</sub>- foliar spray of (KCl @ 0.3%) at 45-55 DAS, T<sub>4</sub>- seed treatment with (Proline @ 8.0%), T<sub>5</sub>- seed treatment with (Proline @ 8.0%) + Foliar spray of (Glycine betaine @ 0.3%) at 45-55 DAS, T<sub>6</sub>- seed treatment with (Proline @ 8.0%) + Foliar spray of (Kaolin @ 1.25%) at 45-55 DAS, T<sub>7</sub>- seed treatment with (Proline @ 8.0%) + Foliar spray of (KCl @ 0.3%) at 45-55 DAS, T<sub>8</sub>- seed treatment with (Proline @ 8.0%) + Water spray, T<sub>9</sub>- water spray alone. The results revealed that the significant difference among the drought management treatments with respect to growth and yield parameters, specific leaf weight, leaf water content and chlorophyll content were observed. The treatment T<sub>5</sub>- seed treatment with (Proline @ 8.0%) + Foliar spray of (Glycine betaine @ 0.3%) at 45-55 DAS recorded significantly higher yield (2491 kg/ha) than all treatments and it was 53.95 per cent higher than treatment T<sub>9</sub>- water spray alone (1147 kg/ha). The growth and yield parameters were also higher with treatment T<sub>5</sub>- seed treatment with (Proline @ 8.0%) + Foliar spray of (Glycine betaine @ 0.3%) at 45-55 DAS treatment compared to other treatments. The highest gross monetary return (₹ 131268/ha), net monetary return (₹ 80648/ha) and benefit:cost ratio (2.59) were obtained highest by the same treatment. The study indicated that seed treatment with (Proline @ 8.0%) + Foliar spray of (Glycine betaine @ 0.3%) at 45-55 DAS was found beneficial for achieving maximum seed cotton yield and net monetary return under rainfed condition.

**Key words:** Cotton, drought, glycine betaine, proline, relative water content

Cotton, the "White Gold" is also known as "King of Fibre Crops", and is the main raw material for textile industry. It is the most important global cash crop and controls economy of many nations. Cotton provides gainful employment to several million people in cultivation, trade, processing, manufacturing and marketing, sustaining directly or indirectly about 10 per cent of the population of India. In spite of having over 28 per cent world acreage under cotton, India accounts for only 14 to 15 per cent of the global production. The productivity/ha in our country is 568 kg/ha for the last few years with marginal ups and downs. The world's average is higher at about 688 kg/ha. The productivity in our country is lower as 70 per cent of cotton is under rainfed condition, which is characterized by uneven rainfall coupled with drought.

Plant response to drought is in two ways *viz.*, susceptibility and tolerance, which depends on the species, genotype and the developmental age of the plant. A strategy that tolerant plant often uses to overcome water deficit is the accumulation of solutes (osmotic adjustment) in the cell to help maintain plant water status, particularly under drought. Recent studies indicated that glycine betaine foliar spray enhanced osmotic adjustment and improved drought and heat stress tolerance (Cassandra and Oosterhuis, 1999). Research on similar lines is required to study the effect of other osmolytes on different genotypes.

Drought stress significantly limits crop production worldwide. Cumulatively, these factors are estimated to be responsible for an average 70 per cent reduction in agricultural

production. Drought stress threatens the ability of many countries to feed themselves. Drought not only causes a reduction in the average yield of crop but also causes, yield instability through high inter annual variation in yield. Furthermore, it has been predicted that in the coming years rainfall pattern will shift and become more variable due to increased global temperature. Thus, there is an urgent need to concentrate on the drought management practices to overcome yield losses. Keeping this in view, an attempt was made to study the effect of drought management practices on agronomic response of cotton under rainfed condition.

A field experiment was conducted during *kharif*, 2018 at Agronomy Farm, College of Agriculture, Dhule on medium deep black soil. The experiment was laid out in randomized block design with three replications and nine treatments *viz.*, T<sub>1</sub>- foliar spray of (Glycine betaine @ 0.3%) at 45-55 DAS, T<sub>2</sub>- foliar spray of (Kaolin @ 1.25%) at 45-55 DAS, T<sub>3</sub>- foliar spray of (KCl @ 0.3%) at 45-55 DAS, T<sub>4</sub>- seed treatment with (Proline @ 8.0%), T<sub>5</sub>- seed treatment with (Proline @ 8.0%) + Foliar spray of (Glycine betaine @ 0.3%) at 45-55 DAS, T<sub>6</sub>- seed treatment with (Proline @ 8.0%) + Foliar spray of (Kaolin @ 1.25%) at 45-55 DAS, T<sub>7</sub>- seed treatment with (Proline @ 8.0%) + Foliar spray of (KCl @ 0.3%) at 45-55 DAS, T<sub>8</sub>- seed treatment with (Proline @ 8.0%) + Water spray, T<sub>9</sub>- water spray alone. The crop was sown 25th June 2018 with a spacing of 45 x 22.5 cm. Fertilizers were applied as per the recommendation (50:25:25 Kg N, P<sub>2</sub>O<sub>5</sub>, K<sub>2</sub>O/ha and FYM 10 t/ha, (50%) N, (100%) P and K fertilizers were applied as basal and remaining 50 per cent N was applied at 30 DAS. The total rainfall during cropping period was 333 mm, received in 21 rainy days. The rainfall and rainy days during June, July, August, September, October, was 120.2, 97.8, 115.0, 0, 0 and rainy days were 8, 10, 3, 0, 0, respectively. The soil moisture was measured by the soil samples were collected from each net plot at 30,60, 90,120 and at harvest to determine soil moisture. Collected wet soil samples were weighted, dried to

constant weight in an oven at 105° C and reweighted. The moisture percentage was worked out by following the gravimetric method.

$$\text{Moisture percentage} = \frac{W1 - W2}{W2} \times 100$$

Where,

W1 = Weight of moist soil

W2 = Weight of oven dry soil

The treatment (T<sub>5</sub>) seed treatment with (Proline @ 8.0%) + Foliar spray of (Glycine betaine @ 0.3%) at 45-55 DAS recorded significantly the highest plant height (183.06 cm.), sympodial branches/plant (21.6) and dry matter/plant (185.67 g) than all treatment except it was *at par* with treatment (T<sub>1</sub>) the foliar spray of (Glycine betaine @ 0.3%) at 45-55 DAS and (T<sub>4</sub>) seed treatment with (Proline @ 8.0%).

Among physiological studies, the treatment (T<sub>5</sub>) seed treatment with (Proline @ 8.0%) + Foliar spray of (Glycine betaine @ 0.3%) at 45-55 DAS recorded significantly the higher Specific leaf weight of 667.0 mg/dm<sup>2</sup>, leaf water content 2.00 g and chlorophyll content 112.05 mg/100g respectively than all other treatment but it was *at par* with treatment (T<sub>1</sub>) the foliar spray of (Glycine betaine @ 0.3%) at 45-55 DAS, and (T<sub>4</sub>) seed treatment with (Proline @ 8.0%) and T<sub>6</sub>- seed treatment with (Proline @ 8.0%) + Foliar spray of (Kaolin @ 1.25%) at 45-55 DAS. Khalid nawaz and Muhammad Ashraf (2007) they reported that GB (Glycine betaine) applied at the vegetative growth stage leaf water potential and leaf turgor potential of the water stressed plants of both cultivars were increased due to foliar application of GB (Glycine betaine). Gadallah (1994) reported that proline either alone, or in combination with abscisic acid, significantly enhanced chlorophyll content, leaf relative water content and dry matter accumulation especially at low water potentials, Similar results were reported by Patil (1987) in sorghum and Amaregouda *et al.*, (1994) in wheat.

**Table 1.** Plant height (cm) of cotton as influenced periodically by different drought management treatments.

Treatments	Plant height (cm) At harvest	Sympodial branches/ plant At harvest	Dry matter of cotton (g/plant) At harvest
T <sub>1</sub> - Foliar spray of (Glycine betaine @ 0.3%) at 45-55 DAS	182.27	25.93	181.17
T <sub>2</sub> - Foliar spray of (Kaolin @ 1.25%) at 45-55 DAS	177.07	23.09	169.39
T <sub>3</sub> - Foliar spray of (KCl @ 0.3%) at 45-55 DAS	171.19	23.07	168.91
T <sub>4</sub> - Seed treatment with (Proline @ 8.0%)	181.31	25.67	180.83
T <sub>5</sub> - Seed treatment with (Proline @ 8.0%) + Foliar spray of (Glycine betaine @ 0.3%) at 45-55 DAS	183.06	26.53	185.67
T <sub>6</sub> - Seed treatment with (Proline @ 8.0%) + Foliar spray of (Kaolin @ 1.25%) at 45- 55 DAS	179.15	24.80	177.20
T <sub>7</sub> - Seed treatment with (Proline @ 8.0%) + Foliar spray of (KCl @ 0.3%) at 45-55 DAS	23.13 172.85	171.83	
T <sub>8</sub> - Seed treatment with (Proline @ 8.0%) + Water spray	169.65	22.50	167.47
T <sub>9</sub> - Water spray	163.21	20.73	162.83
SE (m) ±	1.24	0.59	2.71
CD at (p = 0.05)	3.72	1.78	8.13

**Table 2.** Physiological studies cotton as influenced periodically by different drought management treatments

Treatments	Specific leaf weight (mg/dm) At harvest	Leaf water content (g/leaf) At harvest	Chlorophyll content (mg 100/g) At 90 DAS	Total picked bolls	Average weight of seed cotton/ boll (g)
T <sub>1</sub> - Foliar spray of (Glycine betaine @ 0.3%) at 45-55 DAS	663.83	1.87	109.16	26.63	0.84
T <sub>2</sub> - Foliar spray of (Kaolin @ 1.25%) at 45-55 DAS	627.40	1.53	93.91	25.19	0.82
T <sub>3</sub> - Foliar spray of (KCl @ 0.3%) at 45-55DAS	626.26	1.47	88.78	24.96	0.68
T <sub>4</sub> - Seed treatment with (Proline @ 8.0%)	653.60	1.90	108.40	26.35	0.88
T <sub>5</sub> - Seed treatment with (Proline @ 8.0%) + Foliar spray of (Glycine betaine @ 0.3%) at 45-55 DAS	667.00	2.00	112.05	29.08	1.00
T <sub>6</sub> - Seed treatment with (Proline @ 8.0%) + Foliar spray of (Kaolin @ 1.25%) at 45-55 DAS	650.60	1.80	102.29	25.73	0.80
T <sub>7</sub> - Seed treatment with (Proline @ 8.0%) + Foliar spray of (KCl @ 0.3%) at 45-55DAS	646.97	1.57	99.99	25.27	0.80
T <sub>8</sub> - Seed treatment with (Proline @ 8.0%) + Water spray	621.53	1.40	88.57	20.48	0.69
T <sub>9</sub> - Water spray	619.20	1.27	75.55	19.54	0.67
SE (m) ±	7.25	0.10	4.35	1.33	0.08
CD at (p = 0.05)	22.58	0.32	13.06	3.40	NS

The treatment T<sub>5</sub> seed treatment with (Proline @ 8.0%) + Foliar spray of (Glycine betaine @ 0.3%) at 45-55 DAS recorded significantly higher seed cotton yield than all other treatments and it was 53.95 per cent higher than the treatment T<sub>9</sub>- water spray alone. The results in the present study corroborate the findings of Koraddi *et al.*, (1992) Similarly, Naidu *et al.*, (1995) reported that glycine betaine foliar spray resulted in 22 per cent higher yield over control. Gorham *et al.*, (1998) reported that, seed cotton yields were

highest with glycine betaine applied at squaring.

The highest gross monetary return of (₹131268/ha) net monetary return (₹ 80648/ha) and benefit cost ratio 2.59 was obtained from the treatment T<sub>5</sub> seed treatment with (Proline @ 8.0%) + Foliar spray of (Glycine betaine @ 0.3%) at 45-55 DAS followed by foliar spray of (Glycine betaine @ 0.3%) at 45-55 DAS (T<sub>1</sub>), seed treatment with (Proline @ 8.0%) (T<sub>4</sub>) and seed treatment with (Proline @ 8.0%) + Foliar spray of (Kaolin @ 1.25%) at 45-55 DAS (T<sub>6</sub>).

**Table 3.** Economics of cotton as influenced periodically by different drought management treatments

Treatments	Seed cotton yield (kg/ha)	Gross monetary returns (₹/ha)	Cost of cultivation (₹/ha)	Net monetary returns (₹/ha)	B : C ratio
T <sub>1</sub> - Foliar spray of (Glycine betaine @ 0.3%) at 45-55 DAS	2023	106922	48920	58002	2.24
T <sub>2</sub> - Foliar spray of (Kaolin @ 1.25%) at 45-55 DAS	1563	82799	48450	34349	1.70
T <sub>3</sub> - Foliar spray of (KCl @ 0.3%) at 45-55DAS	1280	67915	49420	18495	1.37
T <sub>4</sub> - Seed treatment with (Proline @ 8.0%)	2039	107609	50020	57589	2.15
T <sub>5</sub> - Seed treatment with (Proline @ 8.0%) + Foliar spray of (Glycine betaine @ 0.3%) at 45-55 DAS	2491	131268	50620	80648	2.59
T <sub>6</sub> - Seed treatment with (Proline @ 8.0%) + Foliar spray of (Kaolin @ 1.25%) at 45-55 DAS	1814	95819	50150	45669	1.91
T <sub>7</sub> - Seed treatment with (Proline @ 8.0%) + Foliar spray of (KCl @ 0.3%) at 45-55DAS	1644	86903	51120	35783	1.69
T <sub>8</sub> - Seed treatment with (Proline @ 8.0%) + Water spray	1330	70394	49620	20774	1.41
T <sub>9</sub> - Water spray	1147	60868	46520	14348	1.30
SE (m) ±	76.37	5773.50	-	2382.37	-
CD at (p = 0.05)	228.97	17308.95	-	7142.34	-

### CONCLUSION

The study indicated that the treatment T<sub>5</sub> seed treatment with (Proline @ 8.0%) + Foliar spray of (Glycine betaine @ 0.3%) at 45-55 DAS was found beneficial for achieving maximum seed cotton yield and net monetary return under rainfed condition.

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