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Studies on amelioration of water stress in cotton through use of osmoprotectants and chemicals

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ABSTRACT : A field experiment was conducted during *kharif* 2006 and 2007 at Regional Agricultural Research Station, Lam Farm, Guntur to know the effect of osmoprotectants and chemicals in ameliorating the water stress and seed cotton yield in black cotton soils under rainfed conditions. Of all the chemicals tried, foliar application at 75 and 85 days after sowing with calcium chloride (0.25%)+ potassium nitrate (0.5%) recorded significantly higher yield (1671 kg/ha) followed by thiourea (500ppm) (1588 kg/ha), potassium nitrate (1.0%) (1585 kg/ha) and Diothitol (20 ppm) (1537 kg/ha) and the seed cotton yield improvement in these treatments can be attributed to the higher number of sympodia, bolls per plant and boll weight.

Key words : Cotton, foliar application, seed cotton yield

In abiotic stresses, moisture stress is the main factor. The unpredictable nature of rainfall and frequent dry spells during the crop period accounts for wide fluctuations in yield and quality of the product. Cotton plants are sensitive to moisture stress at all growth stages. Of all the stages, flowering stage of cotton is highly sensitive. Moisture stress at flowering stage greatly reduces the biomass and yield. Osmoprotectants are small molecules that act as osmolytes and help organisms to survive extreme at osmotic stress and tolerance of crops.These molecules accumulate in cells and balance the osmotic differences between the cell's surroundings and the cytosol under several environmental stresses such as temperature, salt, drought and chilling. Keeping these points in view, the present study was conducted to know the impact of various osmoprotectants and chemicals in alleviating the moisture stress in cotton crop under rainfed conditions.

MATERIALS AND METHODS

A field experiment was conducted in *kharif,* 2006-2007 and 2007-2008 at Regional Agricultural Research Station, Lam Farm, Guntur under rainfed conditions to ameliorate water stress in cotton through use of osmoprotectants and chemicals in a randomized block design with 10 treatments and 3 replications and an American *hirsutum Bt* cotton genotype Bunny was used as the test entry. The experimental soil was black cotton soil in texture having slightly alkaline pH (7.84) , low organic carbon (0.59%), low available nitrogen (195kg/ha), medium phosphorous (18kg/ha) and high available potassium (290kg/ha). The experiment conducted with 10 treatments *viz.,* T_1 - calcium chloride (0.25%), T_2 - potassium nitrate (0.5%), T_3 - potassium nitrate (1.0%), T_4 - calcium chloride (0.25%) + potassium nitrate (0.5%), T_5 - thioglycolic acid (100 ppm), T_6- Mercaptaethylamine (100 ppm), T_7-diothiotol (20ppm), T_8 - thiourea (500 ppm), T_9 - Water spray and T_{10} - Control.

The crop was sown in the second fortnight of July in both the years and recommended doses of fertilizers (120:60:60 NPK kg/ha) were applied in all the plots.. During 2006-2007, the cotton crop received a total rainfall of 535.2 mm rainfall in 37 rainy days and the crop experienced moisture stress during boll development and boll maturity period. During 2007-2008, the crop received a total rainfall of 821.5 mm rainfall in 40 rainy days and the crop experienced drought almost throughout the crop growth period. In both the years, foliar spray of each chemical was given at 75 and 85 days (at 10 days interval during reproductive stage) after sowing. Plant protection

Table 1. Effect of different chemicals on growth parameters yield, fibre quality and yield components of cotton

Treatments	Plant height (cm)	Mono-podia/ plant	Sym-podia/ plant	Bolls/ plant	Boll weight (g)	Seed cotton yield/ plant (g)	*Kapas* yield (kg/ha)	Increase over control	Lint index	Seed index	GOT (%)	2.5 per cent span length (mm)	Micro-naire (10-6 g/in)	Stre-ngth (g/tex)	Elon gation (%)	Uni-formity ratio
T_1	154.44	2.1	27.68	38.66	4.47	91.33	1665	10.92	6.7	11.68	36.47	30.06	4.63	21.06	5.8	48.76
T_2	157.22	2.21	27.1	39.55	4.51	93.33	1686	12.33	6.81	11.75	36.5	30.15	4.69	21.8	5.9	49.1
T_3	165.99	2.74	27.77	41.44	4.55	100	1761	17.32	6.94	11.95	36.68	30.48	4.75	22	5.96	49.7
T_4	176.77	2.66	29.44	44.55	4.56	133	1884	25.51	7.05	12.67	37.63	30.58	4.79	22.9	6	52.4
T_5	151.44	1.99	26.77	36.33	4.44	90.66	1652	10.06	6.63	11.6	36.42	29.49	4.61	21.03	5.8	48.36
T_6	151.44	1.99	25.77	35.99	4.42	88.66	1597	6.35	6.62	11.61	36.31	29.71	0.62	20.96	5.8	47.46
T_7	165.77	2.33	27.99	40.88	4.51	98.33	1754	16.86	6.83	11.88	36.55	30.34	4.64	21.83	5.9	49.5
T_8	174.33	2.77	28.77	43.32	4.54	102.33	1790	19.25	7.02	12.2	36.9	30.54	4.75	22.7	5.96	51.76
T_9	149.88	1.99	25.55	35.21	4.36	84.66	1595	6.26	6.57	11.03	36.01	29.34	4.6	20.33	5.73	47.26
T_{10}	141.55	1.99	23.44	33.77	4.33	83	1501	-	6.35	10.87	35.67	28.81	4.55	20.06	5.7	47
SEm+	6.61	0.23	1.07	1.88	0.06	5.3	70.06		0.15	0.45	0.84	0.7	0.08	0.6	0.08	1.29
CD (p=0.05)	19.66	NS	3.18	5.59	0.17	15.76	208.13	-	NS	NS	NS	NS	NS	NS	NS	NS
CV(%)	7.2	17.7	6.9	8.4	12.2	9.6	7.2	-	3.9	6.5	4	4.1	3	4.9	2.6	4.6

measures were taken as and when necessary. The data on growth and yield parameters were collected as per the standard procedures.

RESULTS AND DISCUSSION

The pooled data on the effect of different chemicals and nutrients on seed cotton yield , ancillary characters and fibre analysis are presented in Table 1. Significantly higher plant height was recorded in T_4 followed by T_8, T_3 and T_7 over control. No significant influence was noticed due to water spray in plant height. The sympodia/plant were significantly high in almost all the treatments except T_9 and T_6 as compared to control. No significant influence was noticed on monopodia/plant due to different treatments. The bolls produced/plant were significantly high in T_4 followed by T_8, T_3 and T_7 over control. The results are in accordance with the findings of Brar and Brar (2001) and Promola Kumari *et al.,* (2008). Significantly higher boll weight was noticed in T_4 and it was *on par* with T_3, T_7 and T_8 and significantly higher when compared to control.

The seed cotton yield/plant and/ha were significantly high in T_4 followed by T_8, T_3 and T_7 over control. The increase in seed cotton yield with the application of potassium nitrate was also observed by Singh *et al.,* (2004). The significant increase of seed cotton yield obtained with the foliar application of calcium chloride (0.25%) + potassium nitrate (0.5%) was 25.51 per cent more as compared to control. Similarly, the significant increase of 19.25, 17.32 and 16.86 per cent was obtained with the application of T_8, T_3 and T_7 respectively. This increase in yield due to water spray was in significant. The increased yield due to osmoprotectants may be due to the development of resistance in plant to water stress by a complex mechanism which is associated with osmotic adjustment and antioxidants production. Kusuka *et al.*, (2005) stated that the application of potassium nitrate contributes to osmotic regulation. The results of the present study are in full agreement with the findings of Brar and Brar (2004) and Promola Kumari *et al.,* (2008). The increase in seed cotton yield with the application of potassium nitrate was also observed by Singh *et al.*, (2004). Neither positive nor negative influence was noticed on fibre quality parameters due to different foliar sprays applied on cotton under moisture stress conditions.

CONCLUSIONS

The foliar application of calcium chloride (0.25%)+ potassium nitrate @ 0.5% at 75 and 85 days after sowing recorded significantly higher number of sympodia and this is *on par* with thiourea (500ppm), diothiotol (20 ppm) and potassium nitrate (1.0%) . Significantly higher bolls were recorded in calcium chloride (0.25%) + potassium nitrate (0.5%) followed by and potassium nitrate (1.0%) , thiourea (500ppm) and diothiotol (20 ppm). The higher boll weight was also recorded by calcium chloride (0.25%)+ potassium nitrate (0.5%) followed by thiourea (500ppm), potassium nitrate (1.0%) and diothiotol (20 ppm). The treatment with calcium chloride (0.25%) + potassium nitrate (0.5%) recorded significantly higher yield (1671 kg/ha) followed by thiourea (500ppm) (1588 kg/ha), potassium nitrate (1.0%) (1585 kg/ha) and diothitol (20 ppm) (1537 kg/ha) and the seed cotton yield improvement in these treatments can be attributed to the higher number of sympodia, bolls/plant and boll weight and these foliar treatments can be recommended to ameliorate the moisture stress for getting higher yields under rainfed conditions.

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