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Effect of moisture stress management practices on growth, yield and quality of *hirsutum* cotton

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ABSTRACT : Field experiments were carried out in winter, 2013 and summer, 2014 at College farm of Agricultural College and Research Institute, Tamil Nadu Agricultural University, Madurai to evaluate management strategies for combating moisture stress in cotton. The experiments were laid out in split plot design with 2 moisture regimes in main plot and six management practices in sub plot with 3 replications. The results revealed that, scheduling irrigation at and IW/CPE of 0.8 recorded higher growth, yield attributes and seed cotton yield as compared to IW/CPE of 0.4. Among the management practices, crop residue mulch at 5t/ha combined with foliar application of PPFM at 500 ml/ha twice at 75 and 90 days after sowing registered the highest mean seed cotton yield of 1755 kg/ha (pooled mean) and was comparable with crop residue mulch at 5t/ha combined with foliar application of PPFM at 500 ml/ha at 75 and 90 DAS and foliar application of KCl (1%) at 78 and 93 DAS. Significant reduction in fibre length, micronaire, bundle strength, maturity coefficient and Barlett's index was observed under moisture stress condition Crop residue mulch at 5t/ha + foliar application of PPFM at 500ml/ha at 75 and 90 DAS+ KCl (1%) at 78 and 93 DAS (S_6) registered the highest value of fibre length and the lowest value of micronaire.

Key words: Cotton, crop residue mulch, KCl, moisture stress, PPFM

Cotton is the most important cash crop of India known as King of apparel fibre. Cotton is primarily cultivated for its lint. Water deficit is the major abiotic factor limiting plant growth and crop productivity around the world. Approximately one third of the cultivated area of the world suffers from chronically inadequate supplies of water. Alleviation of water deficit stress through management practices like early planting and mulching has been known to farmers for a long time. Recent technological advances have provided scientists with a better understanding of the physiology of the crop, thereby enabling it to make predictions and schedule management practices to minimize yield losses due to water stress. Potassium is critically needed for maintaining plant water relationship, activating enzymes and translocation of sugars and starch out of leaves. All plant tissues emit methanol especially during early stages of leaf expansion. Foliar application of methanol increases the growth and yield of C3 plants. Mulching alters microclimate and has significant effect on C cycle processes. Hence, the present investigation was taken up to study the effect of PPFM, KCl and mulching in cotton singly or in combination on growth, yield and quality of cotton under moisture stress condition.

MATERIALS AND METHODS

Field experiments were carried out at the College Farm Madurai during winter 2013 and summer 2014 to evaluate the response of *hirsutum* cotton to moisture stress management practices. The experiments were laid out in sandy clay loam soil with a pH of 7.3. The experimental field was low in available nitrogen

(217 kg/ha), medium in available phosphorus (17.6 kg/ha) and high in available potassium (294 kg/ha). The experiments were laid out in split plot design with 3 replications on a net plot of 5.6 x 3.6m with test variety SVPR 4.

The treatments in the main plot included moisture regimes (M_1-IW/CPE ratio of 0.8 and M_2- IW/CPE ratio of 0.4) and management practices in subplot (S_1-Foliar application of PPFM (500 ml/ha) at 75 and 90 DAS, S_2- Foliar application of PPFM (500 ml/ha) at 75 and 90 DAS + Foliar application of KCl (1%) at 78 and 93 DAS, S_3- Crop residue mulch at 5t/ha, S_4- Crop residue mulch at 5t/ha + Foliar application of PPFM (500 ml/ha) at 75 and 90 DAS, S_5- Crop residue mulch at 5t/ha + Foliar application of KCl (1%) at 75 and 90 DAS and S_6- Crop residue mulch at 5t/ha + Foliar application of PPFM (500 ml/ha) at 75 and 90 DAS + Foliar application of KCl (1%) at 78 and 93 DAS). Need based plant protection measures were carried out. Observations on growth, yield attributes and seed cotton yield was recorded at maturity. Lint samples were collected after ginning in lab gin for analysis of quality characters through high volume instrument.

RESULTS AND DISCUSSION

Growth and yield of cotton : The plant height and the monopodia/plant were not influenced by the moisture regimes in winter, 2013 (Table 1). Among the management practices, crop residue mulch at 5t/ha + foliar application of PPFM (500 ml/ha) at 75 and 90 DAS + foliar application of KCl (1%) at 78 and 93 DAS (S_6) recorded the tallest plants and was comparable with crop residue mulch at 5t/ha + foliar application of PPFM (500 ml/ha) at 75 and 90 DAS (S_4). Significant reduction in plant height was observed with crop residue mulch at 5t/ha (S_3). The highest monopodia/plant was recorded in S_6 and was significantly superior to rest of the treatments. Crop residue mulch at 5t/ha + Foliar application of KCl (1%) at 75 and 90 DAS (S_5) registered the lowest monopodia and was comparable with application of crop residue mulch at 5t/ha (S_3) and foliar application of PPFM (500 ml/ha) at 75 and 90 DAS + foliar application of KCl (1%) at 78 and 93 DAS (S_2). Sympodia/plant was the highest with the application of crop residue mulch at 5t/ha + Foliar application of PPFM (500 ml/ha) at 75 and 90 DAS (S_4) and was followed the application of crop residue mulch at 5t/ha + foliar application of PPFM (500 ml/ha) at 75 and 90 DAS + foliar application of KCl (1%) at 78 and 93 DAS (S_6). Between the moisture regimes, IW/CPE ratio of 0.8 (M_1) registered higher 40.4 bolls/plant and mean boll weight (3.41g/boll). Among the management practices, application of crop residue mulch at 5t/ha + foliar application of PPFM (500 ml/ha) at 75 and 90 DAS + foliar application of KCl (1%) at 78 and 93 DAS (S_6) registered the highest 40.4 bolls/plant followed by application of crop residue mulch at 5t/ha + foliar application of PPFM (500 ml/ha) at 75 and 90 DAS (S_4). The highest mean boll weight of 3.37g/boll was recorded with the foliar application of PPFM (500 ml/ha) at 75 and 90 DAS + Foliar application of KCl (1%) at 78 and 93 DAS (S_2) and was comparable with S_6 and S_4. Between the moisture regimes, IW/CPE ratio of 0.8 (M_1) registered higher seed cotton yield of 1865 kg/ha. Among the management practices, crop residue mulch at 5t/ha + foliar application of PPFM (500 ml/ha) at 75 and 90 DAS (S_4) registered the highest seed cotton yield of 1920 kg/ha and was comparable with wide range of management practices involving foliar spray of PPFM and KCl. The lowest seed cotton yield of 1560 kg/ha was recorded with crop residue mulch at 5t/ha (S_3).

In summer 2014, between irrigation

Table1. Effect of stress management practices on growth and yield of *hirsutum* cotton

Treatment	Plant height (cm)		Monopodia/ plant		Sympodia/ plant		Bolls/ plant		Boll weight (g)		Seed cotton yield (kg/ha)	
	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
I_1- IW/ CPE ratio of 0.8	142.5	124.2	1.38	1.3	21.9	19.2	38.4	31.3	3.41	2.90	1855	1582
I_2- IW/ CPE ratio of 0.4	135.7	118.4	1.30	1.2	20.4	18.0	35.9	29.8	3.09	2.64	1459	1327
S.Ed	1.79	0.6	0.02	0.02	0.7	0.6	0.1	0.1	0.01	0.02	43	8
CD (p=0.05)	NS	2.56	0.08	NS	NS	NS	0.4	0.6	0.05	0.08	184	34
S_1- Foliar application of PPFM (75 and 90 DAS)	136.5	118.0	1.37	1.2	21.2	18.4	36.6	29.0	3.30	2.79	1775	1469
S_2- Foliar application of PPFM (75 and 90 DAS) + Foliar application of KC (l%) (78 and 93 DAS)	135.9	117.8	1.35	1.2	21.1	18.3	37.3	29.5	3.37	2.84	1817	1503
S_3- Crop residue mulch (5 t/ha)	132.2	114.6	1.34	1.2	20.9	18.1	36.7	29.6	3.17	2.67	1560	1289
S_4- Crop residue mulch (5 t/ha) + Foliar application of PPFM (75 and 90 DAS)	144.7	125.5	1.37	1.2	22.6	19.6	40.0	32.0	3.31	2.80	1920	1589
S_5- Crop residue mulch (5 t/ha) + Foliar application of KCl (1%) (75 and 90 DAS)	139.1	120.6	1.33	1.2	20.5	17.9	38.3	30.9	3.20	2.70	1574	1301
S_6- Crop residue mulch (5 t/ha)+ Foliar application of PPFM (75 and 90 DAS)and KCl (1%) (78 and 93 DAS)	150.7	130.7	1.42	1.3	22.3	19.3	40.4	32.3	3.34	2.82	1904	1576
S.Ed	3.0	2.6	0.02	0.01	0.7	0.6	1.1	0.7	0.05	0.05	172	14
CD (p=0.05)	6.1	5.3	0.03	0.03	1.4	1.2	2.3	1.4	0.11	0.10	354	29

NS - Non significant

regimes, scheduling irrigation at IW/CPE ratio of 0.8 registered taller plants (124.2 cm) as compared to IW/CPE ratio of 0.4 with 118.4 cm tall plants. The management practices also had a significant influence on plant height. Among the management practices, crop residue mulch at 5t/ha + foliar application of PPFM at 500ml/ha at 75 and 90 DAS + KCl (1%) at 78 and 93 DAS (S_6) recorded the tallest plants (130.7 cm) and was comparable with crop residue mulch at 5t/ha + foliar application of PPFM at 500 ml/ha at 75 and 90 DAS (S_4) and crop residue mulch at 5t/ha + foliar application of KCl (1%) at 78 and 93 DAS (S_5). Application of crop residue mulch alone 5t/ha (S_3) recorded the shortest plants (114.6 cm).

Sympodia/plant was not influenced by the irrigation intervals studied. Application of Crop residue mulch at 5t/ha +foliar application of PPFM at 500ml/ha at 75 and 90 DAS+ KCl (1%) at 78 and 93 DAS (S_6) recorded the highest 19.6 and was comparable with crop residue mulch at 5t/ha + foliar application of PPFM at 500ml/ha at 75 and 90 DAS (S_4). Crop residue mulch at 5t/ha + KCl (1%) at 78 and 93 DAS (S_5) registered the lowest 17.89 Sympodia/plant. Irrigation scheduling with IW/CPE ratio of 0.8 recorded higher bolls as compared to IW/ CPE ratio of 0.4. S_6 registered highest 32.28 bolls/ plant and it was comparable with S_4 (crop residue mulch at 5t/ha + foliar application of PPFM at 500ml/ha at 75 and 90 DAS) and S_5 (crop residue mulch at 5t/ha + KCl (1%) at 78 and 93 DAS). The lowest 28.99 bolls/plant was recorded on S_1 (Foliar application of PPFM at 500ml/ha at 75 and 90 DAS). IW/ CPE ratio of 0.8 recorded the heaviest boll 2.9 g/boll and was significantly superior to IW/CPE ratio of 0.4. Foliar application of PPFM at 500ml/ha at 75 and 90 DAS+ KCl 1% at 78 and 93 DAS (S_2) recorded the heaviest boll (2.84 g/boll) and was comparable with S_6, S_4 and S_1. Crop residue mulch at 5t/ha alone (S_3) registered the lowest mean boll weight of 2.67 g/boll. Irrigation scheduling with IW/CPE ratio of 0.8 recorded higher mean seed cotton yield of 1582 kg/ha as compared to 1327 kg/ha with IW/

Table 2. Effect of stress management practices on quality characters of *hirsutum* cotton

Treatment	2.5 per cent span length (mm)	Micronaire value	Bundle strength (g/tex)	Maturity coefficient	Barlett's index
I_1- IW/ CPE ratio of 0.8	24.81	3.41	21.90	0.775	0.480
I_2- IW/ CPE ratio of 0.4	23.70	3.58	20.84	0.758	0.468
S.Ed	0.04	0.01	0.08	0.001	0.001
CD (p=0.05)	0.19	0.05	0.35	0.005	0.003
S_1- Foliar application of PPFM (75 and 90 DAS)	24.52	3.50	21.46	0.764	0.475
S_2- Foliar application of PPFM (75 and 90 DAS) + Foliar application of KCl (1%) (78 and 93 DAS)	24.74	3.54	21.54	0.769	0.476
S_3- Crop residue mulch (5 t/ha)	24.47	3.46	21.38	0.767	0.476
S_4- Crop residue mulch (5 t/ha) + Foliar application of PPFM (75 and 90 DAS)	25.06	3.45	21.75	0.771	0.479
S_5- Crop residue mulch (5 t/ha) + Foliar application of KCl (1%) at 75 and 90 DAS	24.20	3.50	21.43	0.767	0.477
S_6- Crop residue mulch (5 t/ha) + foliar application of PPFM (75 and 90 DAS)and KCl (1%) at 78 and 93 DAS	25.12	3.41	21.89	0.775	0.480
S.Ed	0.36	0.05	0.31	0.012	0.009
CD (p=0.05)	0.71	0.11	NS	NS	NS

NS-Non significant

CPE ratio of 0.4. Among the management practices, S_4 (crop residue mulch at 5t/ha + foliar application of PPFM at 500ml/ha at 75 and 90 DAS) recorded the highest mean seed cotton yield of 1920 kg/ha in 2013 and 1589 Kg/ha and was comparable with S_6 (crop residue mulch at 5t/ha + foliar application of PPFM at 500ml/ha at 75 and 90 DAS+ KCl 1% at 78 and 93 DAS) 1576 Kg/ha and was significantly superior to the rest of the treatments. S_3 (crop residue mulch at 5t/ha) recorded the lowest mean seed cotton yield of 1560 kg/ha in 2013 and 1289 kg/ha in 2014. The yield increase due to mulching in combination with foliar application of PPFM singly or in combination with KCl was due to the cumulative effect of improvement in yield components *viz.,* sympodia and boll/plant and boll weight. The role of mulching in improving available soil moisture and consequently the dry mater production, boll weight and seed cotton yield was highlighted by Solaiappan (1998). The increased yield due to PPFM could be attributed to the combined effect of enhanced auxin and cytokinin, which allowed a balanced growth of shoot and root system. Besides, PPFM was found to increase the photosynthetic activity by enhancing the stomata, chlorophyll concentration and malic acid content of the crops (Madhaiyan *et al.,* 2004).

Quality characters : Significant increase in fibre length was observed with IW/CPE ratio of 0.8 as compared to IW/CPE ratio of 0.4. Among the management practices, S_6 registered an increased fibre length of 25.12mm (Table. 2) and was comparable with most of the treatments. Significant increase in micronaire value was observed under moisture stress condition (IW/CPE ratio of 0.4). The extension of cotton fibre is a process primarily dependent on turgor and carbohydrate supply and that the reduction in plant water status and photosynthesis that occur under conditions of water deficit stress would result in decreased fibre growth (Loka *et al.*, 2011). Crop residue mulch at 5t/ha + foliar application of PPFM at 500ml/ha at 75 and 90 DAS+ KCl (1%) at 78 and 93 DAS (S_6) registered then lowest micronaire value of 3.41 and was comparable with most of the treatments. Favourable nutrition and water status might have resulted in low micronaire value due to shading of lower bolls and leaves which might have reduced the amount of carbohydrate available to mature boils (Pettigrew, 2004).

REFERENCES

Loka, D.A, Oosterhuis, D.M and Ritchie, G.L. 2011. Water deficit stress in cotton. (In): D.M. Oosterhuis (ed). Stress physiology in cotton. The cotton foundation, Tennessee. pp. 37-72.

Madhaiyan, M., Poonguzhali, S, Senthilkumar,M, Seshadri, S, Chung, H, Yang, J, Sundaram, SP and Sa, T.M. 2004. Growth promotion and induction of systemic resistance of rice cultivar CO-47 (*Oryza sativa* L.) by *Methylobacterium* spp. *Bot. Bull. Acad. Sin.*, **45** : 315-24.

Pettigrew, W.T. 2004. Moisture effects on cotton lint yield, yield components and boll distribution. *Agron. J.* **96**: 377-83.

Solaiappan, V. 1998. Influence of intercropping and mulching properties of soil and crop productivity in rainfed cotton. *Madras Agricultural Journal*, **85** : 397-99.

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