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SCREENING OF COTTON GENOTYPES FOR YIELD TRAITS UNDER DIFFERENT IRRIGATION REGIMES

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ABSTRACT

Cotton is a drought sensitive crop, because of less capable water consumer. Nevertheless, cotton has physiological mechanism to adopt semi-arid climate, such as deep penetrating root systems. The leaves and fruit that can shed when plants are stressed under a flexible fruiting period. The experimental trial was conducted at the experimental area of Cotton Section, Agriculture Research Institute Tandojam during 2012. Ten genotypes viz; Hari dost, Sindh-1, Shahbaz-95, Malmal, Star-2, TS-501, H-71, H-121, H-122 and IR-3701 were sown in a split plot design having four replications. Three treatments including T_1; Control, T_2; five irrigations and T_3; three irrigations for drought tolerance were studied. Plant height (cm), sympodial branches plant^{-1}, bolls plant^{-1}, boll weight (g) and seed cotton yield plant^{-1} (g) were evaluated. The mean squares from analysis of variances showed that genotypes differed significantly for plant height, bolls plant^{-1}, sympodial branches plant^{-1}, boll weight and seed cotton yield plant^{-1}. Mean squares also showed that irrigation regimes cause significant impact on the yield traits. The genotypes Sindh-1, Shahbaz-95 and Star-2 performed well over the irrigation regimes for yield traits and pronounced minimum yield losses under less number of irrigations; hence selection could be made from these genotypes for developing drought tolerant cotton genotypes.

Keywords: Cotton genotypes, growth, water stress, yield traits.

INTRODUCTION

Cotton is a rapidly renewable, natural agricultural product. The cotton plant is a warm-weather shrub or tree that grows naturally as a perennial but for commercial purpose has been domesticated to grow as an annual crop. Cotton is one of the most important and widely grown crops in the world. On average in the world, cotton is planted on 33-35 million hectares every year, representing less than 2.5% of the world's arable land. Cotton is produced in the world under a great diversity of farming practices with some farmers using the newest and latest technology and other still employing more primitive agricultural techniques. Cotton production technology continues to improve. More than 100 million family

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units are engaged directly in cotton production. Nearly everywhere it is grown; cotton represents an important cash crop for farmers and an economically valuable part of the total economy. (Wakelyn and Chaudhry, 2010). It is also known as white gold because its fiber is white coloured. Due to water shortage, the production of cotton crop has been reduced every year. Water shortage in our country or especially in Sindh province location to location in upper Sindh water shortage is a major issue at time of sowing and lower Sindh water shortage seems to be a major issue at time of flowering or boll formation. Scarcity of water at time of peak flowering or boll formation causes flower sheding, low boll weight which reduce seed cotton yield plant^{-1}. It is also assumed that in strees condition bolls open forcely with low seed index and poor fiber quality.The response of cultivars to water deficit is also important to ideal cotton growth and estimate irrigation needs (Pace *et al*., 1999). The crop is linked to water disposal during the development of various agro-economic traits. Cotton lint yield is generally reduced because of reduced boll production, primarily because of fewer flowers and increased boll shedding when the stress is extreme during reproductive growth phase (Pettigrew, 2004). Therefore, stress significantly reduces crop production by affecting many agronomic traits like reduction in size and number of bolls per plant, plant height; above ground fresh weight and seed cotton yield (Malik *et al*., 2006). Many cotton breeders and cotton research institutes in country are engaged in developing new cotton genotypes which are drought resistant or stress tolerant, because shortage of irrigation water is icreased day by day. The present study was also part of such goals to determine the effects of irrigation intervals for agro-economic traits in domestic cotton.

MATERIALS AND METHODS

The experiment was conducted at the experimental area of Cotton Section, Agriculture Research Institute, Tandojam during the kharif season of 2012-2013. Ten genotypes viz; Hari dost, Sindh-1, Shahbaz-95, Malmal, Star-2, TS-501, H-71, H-121, H-122 and IR-3701 were arranged in a split plot design with three irrigation regime treatments, including T_1; Control (total 35 acre inch water was applied in 7 irrigations), T_2; five irrigations (25 acre inch applied in 5 irrigations) and $T_{3;}$ three irrigations (15 acre inch in three irrigations) with four replications. The soil was loamy and source of irrigation was canal water. The seed of all genotypes was hand drilled. After 15 days of emergence, thinning was done to maintain the plant population at a distance of 75 cm row to row and 30 cm plant to plant. All the cultural operations i.e. inter culturing; fertilizers (one bag DAP and two bags of Urea per acre were applied through broadcasting) and pesticides were applied accordingly. At the time of maturity, five plants were tagged at random from central row of each treatment and replication as per genotype for taking the observations such as plant height (cm), sympodial branches plant^{-1}, bolls plant^{-1}, boll weight (g) and seed cotton yield plant^{-1} (g). The analysis of variance was carried out according to Gomez and Gomez (1984), to determine the significant difference among the genotypes and irrigation regime treatments.

RESULTS AND DISCUSSION

The mean squares from analysis of variance showed that genotypes differed significantly for plant height, bolls plant^{-1}, sympodial branches plant^{-1}, boll weight and seed cotton yield plant^{-1}. Irrigation regimes and genotypes interaction were also significant for all the traits (Table 1). The results exhibited that irrigation regimes caused significant impact on the yield traits and their interaction (I x G) revealed that the cotton genotypes performed inconsistency over the irrigation regimes. Similar results were obtained by Soomro *et al*. (2011) who reported high inter-varietal differences for all the parameters under control as well as drought stress.To screen out cotton, medium tall plants are best for the desirable plant height, fruiting and boll setting. Among the cotton genotypes, maximum plant height (118.00 cm) was recorded from the cultivar-H-71 over all the irrigation regimes, followed by Hari dost (116.83 cm) and Shahbaz-95 (111.42 cm). However, the stature (115.63 cm) of plant height was tall in control plots (T_1) which subsequently declined in T_2 and T_3 (103.05 cm and 97.95 cm) treatment, respectively (Fig. 1). Similar results were obtained by Soomro *et al*. (2011) and Mehmood *et al.* (2006) who reported that early period of drought is more drastic to plant height.

Table 1. Mean squares from analysis of variances for yield traits of cotton genotypes under different irrigation regimes.

Sourece of variety	D.F	Plant height	Sympodial branches plant^{-1}	Bolls plant^{-1}	Boll weight	Seed cotton yield plant^{-1}
Replication	3	20.63	1.89	7.22	0.11	35.71
Irrigation	2	3310.31**	303.66**	1542.01**	19.84**	31666.56**
Error (a)	6	12.08	1.31	3.410	0.03	234.07
Genotypes	9	1173.47**	59.97**	295.18**	0.25**	2191.58**
I x G	18	51.40**	8.88**	27.82**	0.21**	437.23**
Error (b)	81	8.18	0.64	2.31	0.02	79.42

**= Significant at 1% probability.

Sympodial branches are more important in cotton crop and have direct correlation with seed cotton yield. These are fruiting branches. TS-501 set the maximum (15.58) number of sympodial branches plant^{-1}, followed by Sindh-1 with 15.42 over the irrigation regimes (Fig. 2), while the cultivar IR-3701 on an average recorded minimum (8.92) number of sympodial branches plant^{-1} under different irrigation regimes. However, cultivars showed maximum (15.63) sympodial branches plant^{-1} in T_1 (control) and subsequently reduced (12.08 and 10.20) in T_2 and T_3, respectively. Results showed that TS-501 and Sindh-1 produced minimum number of sympodial branches plant^{-1} under different irrigation regimes. The results are in accordance with Baloch *et al.* (2011) and Soomro *et al*. (2011) who observed that the number of sympodial branches plant^{-1} was declined under the stress conditions.

The trait bolls plant^{-1} has strong relation with seed cotton yield plant^{-1}. Maximum boll setting on plant gives more seed cotton yield plant^{-1}. In shortage of irrigation water boll shedding in cotton is decreased, hence seed cotton yield is reduced. Sindh-1 gave maximum (31.25) bolls plant^{-1}, followed by Shahbaz-95 (29.17) over the irrigation regimes (Fig. 3), whereas; Hari dost recorded minimum (16.83) bolls plant^{-1} over irrigation regimes. While maximum (29.08) bolls plant^{-1} were recorded in T_1 (control), then subsequent reduction under T_2 (22.35) and bolls plant^{-1} under T_3 (16.73). Irrigation water caused significant impact on reductions in bolls plant^{-1}, never the less cultivar Sindh-1 and Shahbaz-95 showed minimum bolls plant^{-1} under different irrigation levels; hence these genotypes should be grown under water deficit conditions and breeding programmes for developing the material for drought tolerance.

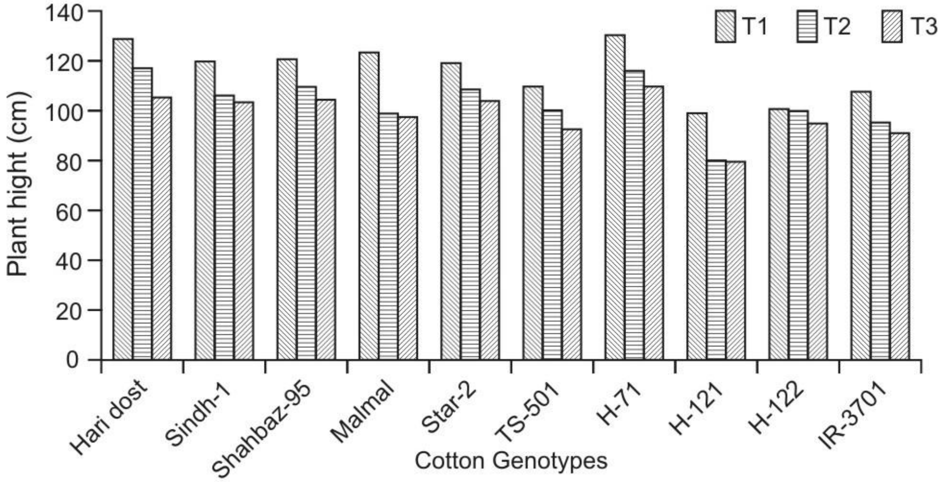

Figure1. Mean performance of cotton genotypes for plant height (cm) over the irrigation regimes.

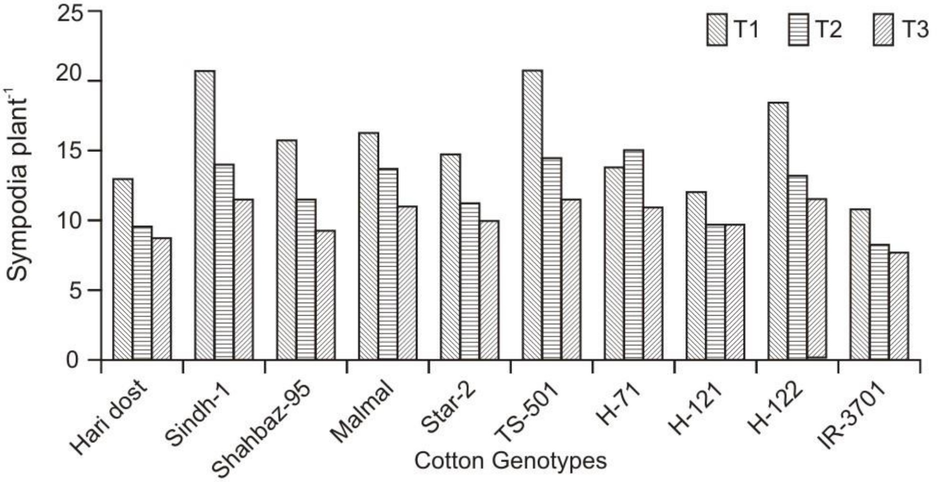

Figure 2. Mean performance of cotton genotypes for sympodial branches plant^{-1} over the irrigation regimes.

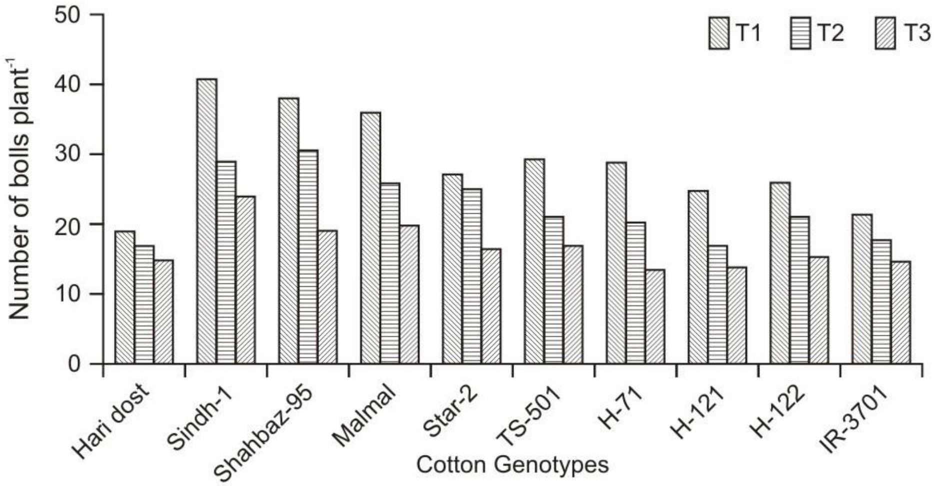

Figure 3. Mean performance of cotton genotypes for number of bolls plant^{-1} over the irrigation regimes.

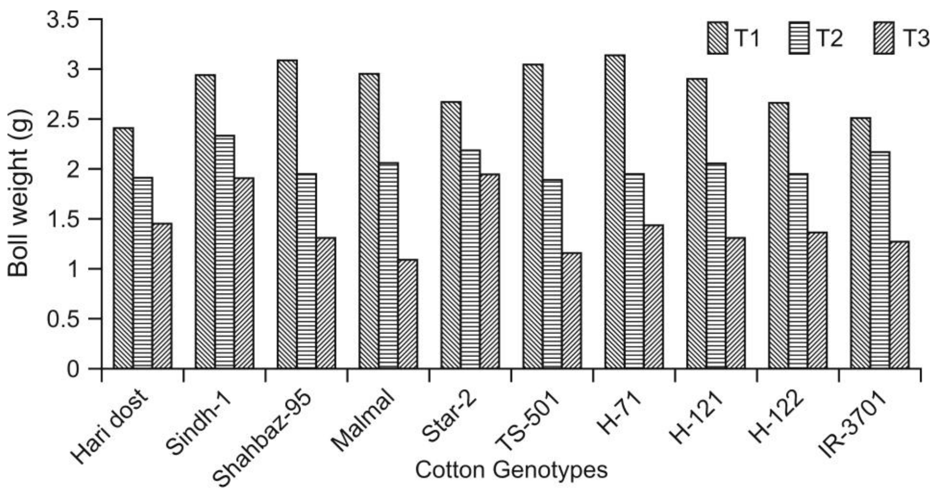

Figure 4. Mean performance of cotton genotypes for boll weight (g) over the irrigation regimes.

Bigger boll size gives maximum seed cotton yield plant^{-1}, but it was assumed that medium boll size produce highest seed cotton yield plant^{-1}. Water stress reduces the boll size. The maximum boll weight (2.38 g) was measured from Sindh-1, followed by Star -2 (2.26 g) under different irrigation regimes (Fig. 4). The control plots (normal irrigation) gave bigger bolls (2.82 g), followed by T_2 (5 irrigation = 2.03 g) and T_3 (3 irrigation = 1.41g) boll weight. Under the stress condition, boll weight was decreased significantly which suggests that cotton crop is more sensitive to water stress conditions, yet Sindh-1, Shahbaz-95 and Star-2 recorded minimum reduction in boll weight, thus these cultivars could be used in breeding programme for developing the drought tolerant cotton genotypes. Plaut *et al.* (1992) and Soomro *et al*. (2011) reported that limited supply of irrigation water during boll development can result in significantly lower yields.

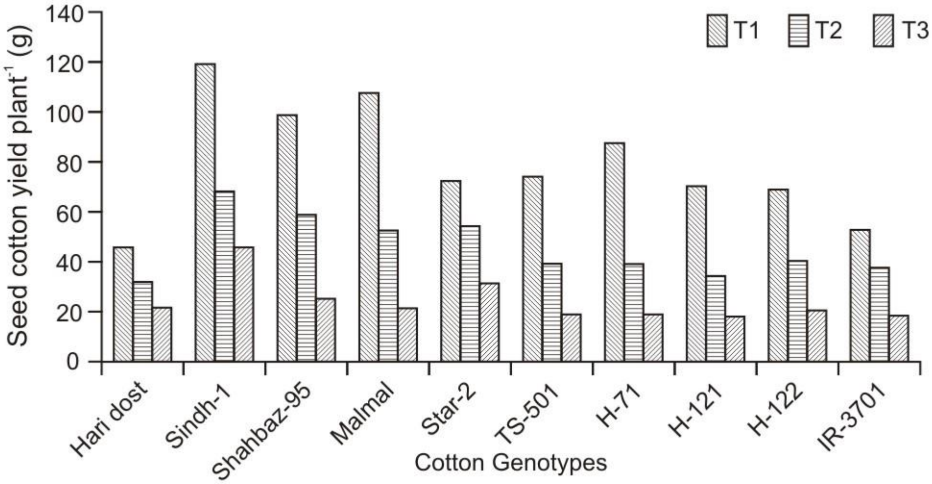

Figure 5. Mean performance of cotton genotypes for seed cotton yield plant^{-1} (g) over the irrigation regimes.

Primarily seed cotton yield depends upon the number of sympodial branches plant^{-1}, bolls plant^{-1} and boll weight and their traits directly contribute to obtain higher seed cotton yield plant^{-1}. Irrigation water caused significant impact on seed cotton yield plant^{-1}. Among the ten cotton genotypes evaluated, Sindh-1 recorded maximum (77.32 g) seed cotton yield plant^{-1}, followed by Shahbaz-95 (60.42 g) and Malmal (60.33 g) over the irrigation regimes (Fig. 5). While, on an average, maximum (79.43 g) seed cotton yield plant^{-1} was obtained from T_1 (control) and subsequently minimum from T_2 (45.38 g) and T_3 (23.60 g). Results further showed that Sindh-1, Shahbaz-95 and Malmal produced maximum seed cotton yield plant^{-1}, therefore these genotypes can be grown in water stress conditions and selection may be done for developing the drought tolerant cotton cultivars. Similar results were obtained by Mehmood *et al.* (2006) who observed that MNH-93, MNH-552, MNH-554, CIM-446, FH-900 and NIAB-Krishma can be called drought tolerant with respect to their yield. Ihsan *et al*. (2008) also reported that seed cotton yield was markedly affected under water stress in all cultivars except the outstanding performance of CIM-1100 and RH-510 proving their superiority to other cultivars in drought tolerance. Baloch *et al.* (2011) noted that non-significant interaction between irrigations and cultivars for seed cotton yield and boll weight exhibited varietal stability over irrigation regimes, whereas significant interactions between above parameters for plant height and bolls plant^{-1} suggested genotypic instability over irrigation treatments for these traits. Cultivar performance for all the traits in stress conditions was generally poor as compared to non-stress conditions. Cultivar CRIS-476 was found more susceptible to water stress conditions due to water stress susceptibility index

(WSSI) value and which gave lowest yield among all the cultivars in both irrigations regimes. Cultivar CRIS-485 maintained its plant height in both stress and non-stress conditions that could be a possible reason of producing maximum yield. In water stress conditions, plant height decreased significantly as compared to optimum irrigation conditions. Cultivar CRIS-485 being a highly tolerant to stress conditions also exhibited maximum boll weight in both stress and non-stressed conditions. Karademir *et al.* (2011) observed yield differences among genotypes under water stress and non-stress conditions. The results from two years studies indicated that seed cotton yield decreased by 48.04% due to water stress.

CONCLUSION

Water stress caused significant impact on seed cotton yield traits like plant height, sympodial branches plant^{-1}, bolls plant^{-1}, boll weight and seed cotton yield plant^{-1}. Among the cultivars, Sindh-1, Shahbaz-95 and Star-2 performed well over the irrigation regimes for yield traits and declined minimum seed cotton yield under different irrigation numbers.

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