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Quantitative and qualitative traits of *Gossypium hirsutum* L. as affected by agronomic practices

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Abstract

Among agronomic practices, cultivar selection and sowing time are considered as key management components in any cropping system to harvest a profitable seed cotton yield. The present studies were conducted to determine the effects of agronomic practices, i. e. sowing dates on quantitative and qualitative traits of cotton cultivars under irrigated arid climatic conditions. Field experiments were conducted for two years during 2004 and 2005. Two cotton cultivars CIM-473 and CIM-482 were sown on three sowing dates, 10 May, 01 June and 20 June during two consecutive crop seasons. Observations on quantitative, i. e. number of bolls m^{-2}, boll weight and seed cotton yield and qualitative traits were recorded and data were analyzed statistically by using MSTATC computer program. The results revealed that CIM-473 out yielded CIM-482 at all planting dates. However, higher productivity and quality were obtained in case of early sowing (May 10) as compared to the mid and later sowing dates (June 01 and June 20).

Key words: CIM-473, CIM-482, cotton, cultivars, management practices, sowing dates.

Introduction

Cotton (*Gossypium hirsutum* L.) is the leading fiber crop in the world being grown commercially in the tropical region of about more than fifty countries [21]. In Pakistan, cotton holds the first order cash crop. It is an established reality that all crops are responsive to environmental conditions [12]. Planting a crop too early appears with poor crop stand that results lower yield potential and alternatively, planting too late commonly becomes very vegetative and difficult to manage resulting in lower seed cotton yield [4,5]. The cotton cultivars differ in growth characteristics such as height, fruit development, drought tolerance, maturity, earliness, yield potential and many fiber characteristics [18]. The yield potential of a cultivar is mainly associated with appropriate sowing time, plant density, nutrient management and protection measures under prevailing agro-climatic conditions [2,4,5]. Therefore, selection of an appropriate sowing time in a particular region is very critical for higher productivity and economic returns for the growers. Significant work being carried out on sowing dates in many cotton producing countries revealed that late sowing usually resulted in less yield [12,14] and less quality characteristics due to a shortened fruiting period and delayed maturity as compared with normal sowing time [8,10]. Cotton is considered to be a responsive crop to its surrounding environments. Thus, an appropriate sowing date is very important for growers to ensure higher yield. Many other researchers also gave considerable importance to sowing date to harvest a profitable final yield and reported that delayed planting resulted in low seed cotton yield [12,14]. Development of a cotton crop is a full season process involving a complex balance between vegetative and reproductive allocation of assimilates. The increased reproductive and vegetative ratio indicates that better mobilization and utilization of photosynthates to develop bolls will result higher seed cotton yield with better fiber quality [11,19]. Delayed sowing produced more vegetative dry matter with higher value of yellowness that is considered undesirable quality of fiber by the textile industry [13,15]. It has been observed that cotton sown earlier or later than its optimum time shows a rapid decline in its yield. Abdel-Malak *et al.* [1] concluded that sowing of cotton in early season from April 15 to May 15 produced significantly higher plant height, sympodial branches, boll number, boll weight and seed cotton yield over that of late sowing.

Review from literature revealed that very little information is available regarding the impact of agronomic practices on quantitative and qualitative traits of cotton under irrigated arid climatic conditions. Keeping in view the importance of these agronomic practices, the present research was conducted to find out the effect of cultivars and sowing dates on productivity and quality characteristics of cotton under irrigated arid climatic conditions of Multan, Pakistan.

Materials and Methods

Description of experimental site: The field experiments were conducted during 2004 and 2005 at Central Cotton Research Institute (CCRI), Multan Pakistan (30°12′ N. 71°28′ E and 123 m above sea level). The site was situated in the primary cotton zone of Pakistan. The mean monthly meteorological conditions of a typical cotton season are presented in Fig. 1. The soil analysis at depth of 0-15 cm showed the values for various physico-chemical characteristics, i. e. EC 2.68 dSm^{-1}; pH 8.06; organic matter 0.83%; NO_3-N 5.50 mg kg^{-1}; $NaHCO_3$-P 13.0 mg kg^{-1}; NH_4OAC-K 125 mg

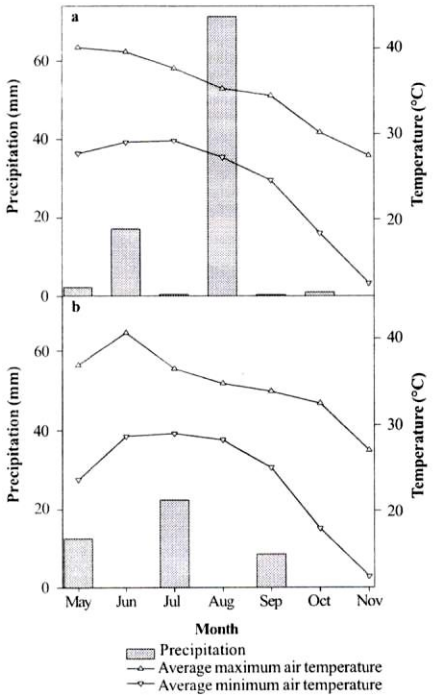

Figure 1. Mean monthly maximum air temperature, minimum air temperature and precipitation during 2004 (a) and 2005 (b) at Multan, Pakistan.

kg^{-1}; sand 15%; silt 30%; and clay 55%. The respective values for 15-30 cm depth were 2.76 dSm^{-1}, 8.11, 0.81%, 4.49 mg kg^{-1}, 12.0 mg kg^{-1}, 120.0 mg kg^{-1}, 14%, 29% and 57%, respectively. The detailed description can be found in our earlier work [4, 5].

Treatments and design: The treatments were included in the study were two cultivars, CIM-473 and CIM-482, and three sowing dates, 10 May, 1 June, and 20 June, for both years of field experimentation. The randomized complete block design with factorial arrangement was employed with three replications. The cultivars were allocated to the main plots, while sowing dates in subplots.

Crop husbandry practices: Bed furrows were prepared at 75 cm apart after seed bed preparation. The furrows were irrigated and delinted cotton seeds were dibbled manually on respective sowing dates during 2004 and 2005. The furrows were again irrigated 72 hours after dibbling the seeds to have successful germination and establishment of crop stand. The subsequent irrigations were applied at 10 days interval. The nitrogen at the rate of 100 kg ha^{-1} in the form of urea was applied in three equal splits at seed bed preparation, flowering and boll formation. The phosphorus at the rate of 60 kg ha^{-1} was applied in the form of triple super phosphate (TSP). Pendimethaline as pre-sowing herbicide was applied to control cotton weeds. All other agronomic practices were kept normal. The further details can be obtained in our previous manuscript [4, 5].

Statistical analysis: The data collected were analyzed statistically using MSTAT-C statistical computer package, while the differences among treatment means were compared using the least significant difference (LSD) test at 0.5% probability level [22].

Results and Discussion

A. Cotton productivity parameters

Number of bolls m^{-2}: The number of bolls m^{-2} for cultivars ranged from 79.5 to 115.3, while, for sowing dates it ranged from 70.5 to 122.5 during both years (Table 1). However, CIM-473 performed better than CIM-482. The CIM-473 produced 22% and 10% higher number of bolls m^{-2} than CIM-482 during 2004 and 2005, respectively (Table 1). Early sowing on May 10 produces the higher number of bolls m^{-2} as compared to later sowing dates (106.8 and 122.5 during 2004 and 2005, respectively) during both years. The response of sowing dates was in this sequence (May 10 > June 1 > June 20). The early sowing on May 10 produced 11% and 34% higher number of bolls m^{-2} than June 1 and June 20 sowing dates, respectively, during 2004. However, the subsequent figures for 2005 were 6% and 26% (Table 1).

Boll weight: The boll weight for cultivars ranged from 2.55 to 2.66 g, and for sowing dates it ranged from 2.53 to 2.63 g during both years (Table 1). The difference in boll weight was less as compared to the other parameters. However, the CIM-473 performed better than CIM-482 in case of boll weight. Similarly, May 10 sowing date also produced the higher bolls weight as compared to later sowing dates (Table 1).

Seed index: The seed index for cultivars ranged from 8.3 to 9.9, and for sowing dates it ranged from 8.4 to 9.8 during both years. However, CIM-473 performed better than CIM-482. Similarly, May 10 (early) sowing date also produced the higher seed index as compared to the later sowing dates (June 1 and June 20).

Seed cotton yield: The overall seed cotton yield was higher during 2005 as compared to 2004 and it ranged from 1581.3 to 2849 kg ha^{-1} among all treatments during both years of experimentation. The seed cotton yield for cultivars ranged from 1777.2 to 2649.7 kg ha^{-1}. However, CIM-473 performed better than CIM-482. The cultivar CIM-473 produced 28% and 9% higher seed cotton yield than the CIM-482 during 2004 and 2005, respectively. Early sowing (May 10) produced the highest seed cotton yield as compared to later sowing dates (June 1 and June 20). The response of sowing dates for seed cotton yield was in this sequence (May 10 > June 1 > June 20). The early sowing on May 10 produced 7% and 33%

Table 1. Quantitative traits of cotton as affected by agronomic practices.

Treatments	Bolls (m^{-2})		Boll weight (g)		Seed index (g)		Seed cotton (kg ha^{-1})		GOT (%)	
	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005
					Cultivars					
CIM-473	102.3	115.3	2.66	2.62	9.9	9.3	2330.2	2649.7	40.5	42.0
CIM-482	79.5	103.7	2.50	2.51	9.0	8.3	1777.2	2411.3	38.6	40.3
Mean	90.9	109.5	2.58	2.56	9.5	8.8	2053.7	2530.5	39.6	41.2
					Sowing dates					
10 May	106.8	122.5	2.63	2.61	9.8	8.7	2367.8	2849.0	40.1	41.6
01 June	95.5	115.5	2.58	2.57	9.7	8.6	2212.0	2761.5	39.8	41.4
20 June	70.5	90.5	2.53	2.52	9.5	8.4	1581.3	1981.0	39.0	40.7
Mean	90.9	109.5	2.58	2.56	9.7	8.6	2053.7	2530.5	39.6	41.2

GOT, ginning out turn.

Table 2. Qualitative traits of cotton as affected by agronomic practices.

Treatments	Staple length (mm)		Micro-naire (µg inch^{-1})		Fiber strength (tppsi)		Brightness (Rd)		Yellowness (+b)	
	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005
					Cultivars					
CIM-473	27.9	28.2	4.5	4.7	93.0	96.2	71.2	76.4	8.8	8.6
CIM-482	28.2	28.9	4.9	4.9	93.6	95.1	69.9	74.5	8.9	9.1
Mean	28.1	28.6	4.7	4.8	93.3	95.7	70.6	75.5	8.8	8.9
					Sowing dates					
10 May	28.3	28.7	4.8	4.8	92.7	96.0	70.7	75.1	8.7	8.8
01 June	28.0	28.9	4.7	4.6	94.3	96.4	71.0	76.3	9.0	9.4
20 June	27.9	28.4	4.6	4.4	92.5	94.6	69.8	75.1	9.2	9.3
Mean	28.2	28.7	4.6	4.6	93.2	95.7	70.5	75.5	8.9	9.2

higher seed cotton yield than June 1 and June 20 sowing dates, respectively, during 2004. However, the subsequent figures for 2005 were 3% and 33%, respectively. The results are in line with many scientists and also with our earlier findings [4,5].

Ginning out turn: The ginning out turn for cultivars ranged from 38.6 to 42.0% and for sowing dates it ranged from 39.0% to 41.6% during both years. However, CIM-473 performed better than CIM-482. Similarly, May 10 sowing date also produced higher ginning out turn than later sowing dates during both years.

B. Cotton quality parameters

The treatment differences had less effect on qualitative parameters as compared to the quantitative parameters. These quality characteristics are mainly attributed to the genetic makeup of the cultivars as compared to the impact of other treatments. The staple length for cultivars and sowing dates ranged from 27.9 to 28.9 mm during both years (Table 2). The micro-naire for cultivars and sowing dates ranged from 4.4 to 4.9 µg inch^{-1} during both years. The fiber strength for cultivars ranged from 93.0 to 96.2 tppsi, and for sowing dates it ranged from 92.5 to 96.4 tppsi during both years. The brightness (Rd) for cultivars and sowing dates ranged from 69.8 to 76.4 and these values for yellowness (+b) ranged from 8.6 to 9.4 during both years (Table 2). These results are in line with our earlier findings and many other works [4,7].

Conclusions

Early planting in Pakistan avails the advantage of agro-climatic conditions. The results revealed that early sowing (May 10) is recommended for achieving the higher quantitative and qualitative traits of cotton for benefits of the growers. However, further research is needed to apply these findings in other cotton growing regions.

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