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IMPACT OF EARLY AND NORMAL SOWING DATES ON SEED COTTON YIELD AND FIBER QUALITY TRAITS OF ELITE COTTON (*GOSSYPIUM HIRSUTUM* L.) LINES

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Abstract

Changes of the climate bring ahead new pressure for cotton cultivation in Pakistan especially in Sindh province. In present study thirty four elite lines along with three local check varieties (Sadori, NIA-Noori and NIA-Ufaq) were tested under early 20th March and normal 20th April, 2015-16 and 2016-17 sowing dates at NIA, experimental farm. Four lines produced (22) sympodial branches plant^{-1}, two lines took more boll weight (4.0 g), five lines obtained long staple length ranges from (30.0 to 30.8 mm), eight elite lines took higher seed index ranges from (8.6 to 8.7 g) and three lines produced higher seed cotton yield kg ha^{-1} ranges from (2206 to 2314) under normal sowing date 20th April in comparison with early sowing 20th March seed cotton yield kg ha^{-1} ranges from (780 to 1049).

Key words: Climate change, Elite lines, Fiber quality, Seed cotton yield.

Introduction

Cotton (*Gossypium hirsutum* L.), an international agricultural commodity of which quality and quantity are subject to various whims of nature, occupies an important position in global status of commercial crops with annual impact of about >$50 billion in world's economy (OECD/FAO, 2019). The lint quality in general while particularly quantity of produce i.e. seed cotton yield is highly sensitive to climatic conditions. It can be seen in case of Pakistan where it is grown on 2.3 million hectares annually with average per hectare yield of approximately 600 kg ha^{-1} compared to 1,800 and 1,340 kg ha^{-1} for Australia and China, respectively (Anon., 2018; Anon., 2016). The quality of lint produce is also inferior (Anonymous, 2014), having short fiber length, coarse fiber fineness, lower uniformity, resulting in higher import of longer fiber and lower price of locally produced cotton lint.

Sustainable cotton production in the future will depend on the development of cotton varieties with higher yield potential and quality of seed cotton as well as better tolerance to biotic and abiotic stresses (Aiken, 2006).The sowing time in cotton plays important role in obtaining better seed cotton yield in a country where the climatic conditions vary among provinces (Saraz, 2008; Soomro *et al*., 2000). In Pakistan, cotton crop sown on 15th April (normal sowing time) gradually increases seed cotton yield by producing more number of fruiting branches, productive bolls and ultimately seed cotton yield per plant as compared to early sowing. Qayyum *et al.,* (1990) reported that sowing time of cotton crop plays main role in cotton production through its effect on vegetative and reproductive phases and thus total duration of crop. To decide the best time of cultivation in a specific area can often be complex. Seed cotton and fiber quality parameters could be assessed by sowing at different times i.e. early, normal and late. Late and early sowing times badly affects seed cotton yield and quality parameters. Cotton crop sown before in time reaches its reproductive phase in the hottest month of the year which causes serious yield losses (Rahman *et al*., 2007). Early sown crop contributes more towards vegetative growth rather than to seed cotton (Iqbal *et al*., 2012). Late sown crop is affected by low temperature at flowering and boll formation stages. Palomo *et al.,* (2000) observed highest number of plants per unit area in April sown cultivars as compared to cultivars sown in the month of June. Therefore, keeping in view the above facts, present study was planned to investigate the impact of early and normal sowing dates on seed cotton yield and fiber quality traits of elite cotton lines.

Material and Methods

The experimental site was NIA, Tandojam, Sindh, Pakistan. The mean monthly temperature ranges from a minimum of 14.7ºC in March to a maximum of 36.8ºC in October (Fig. 1). Thirty four elite lines along with three commercial check varieties Sadori, NIA-Noori and NIA-Ufaq were assessed at two different sowing dates 20th March (early) and 20th April (normal). The two consecutive years' (2015-16 and 2016-17) pooled data were recorded. The experimental field was prepared through mould board plough. The sowing was done on ridges. Nitrogen, Phosphorus and Potash fertilizers were applied at the recommended rates. The experiments were conducted in randomized complete block design (RCBD) in factorial arrangements. Six rows out of eight were harvested for recording yield data. Five plants were tagged for recording observations on sympodial branches per plant, boll weight (g) and seed index (g). Staple length (mm) was measured using fibrograph by taking forty grams of lint from each sample.

Statistical analysis: The data were collected and analyzed separately for each parameter and subjected to analysis of variance following Steel *et al*., (1997). The means comparison (LSD test at alpha 0.05) was computed using STATISTIX® VERSION 8.1. Values represent the mean (± SE) of three replicates. (Analytical software Statistix version 8.1: user's manual. 2005).

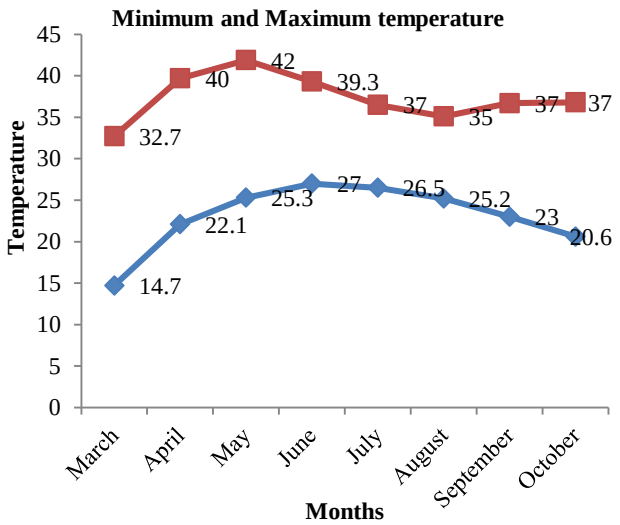

Fig. 1. Minimum and maximum temperature during the cotton growth period.

Results and Discussion

The crop sown in the month of April favorable temperature remained in the month of June and July (39.3 and 37 ^{0}C) that was ideal for flowering to boll formation period. When crop sown early; in the month of March, flowering overlap due to high temperature (42^{o}C) stress in the month of May that may be resulted in shedding of flowers and young bolls. Fig. 1. Temperature plays a critical role in the growth and maturity period of the crop. Leaf extension growth in upland cotton declined significantly at temperatures above 35°C (Bibi *et al*., 2010). The plant population, sympodial branches per plant, No, of bolls per plant, boll weight and seed cotton yield increases when crop sown on 1st April. The crop sown early or late produces lower seed cotton yield due to adverse environmental condition and shorter crop growth period (Khan *et al*., 2017).

The climate change is affecting to the agriculture production by its affecting on agriculture practices such as sowing time. Also, sowing time is one of the main factors affecting yield. Sowing time was selected as a key factor of cotton cultivars by many researchers around the world (Rabar F. Salih, 2019). There are marked environmental effects on the growth, yield and lint quality of cotton and growers should optimize yield and quality by selecting appropriate sowing time for a crop of cotton. Choosing the best time of sowing in a particular region can often be difficult, as it is a decision that must strike a balance between sowing too early and enduring problems associated with cold weather or sowing too late and losing potential yield. Sowing too early when cold weather can be predominant slows crop growth often leading to poor establishment, poor early growth and exposes the crop to many seedling diseases (Bange & Milroy, 2004). April 15 sowing produced highest bolls per plant, boll weight-g, seed cotton yield, staple length, strength and micronaire amongst the other sowing dates. Results further showed that CIM-602 ranked first in number of bolls/plant, weight per boll, seed cotton yield, staple length, strength and micrronaire in April 15th sowing (Ullah *et al.*, 2019). As a matter of fact, in the study carried out with the varieties that the cotton production can be made with early or middle early varieties (Copur & Yuka, 2016). This late planting of cotton cultivars influences the shedding power henceforth the last cotton yield (Rahman *et al*., 2016). Yield contributing boundaries like opened boll, average boll weight and 100-seed weight altogether shifted and highest seed cotton yield 3847 kg ha^{-1} was acquired by cv. MNH-886 when it was planted on April 30 (Mehboob *et al*., 2020). Higher seed cotton yield was produced from the prior planted cotton crop (Bilal *et al*., 2019).

Sympodial branches per plant: The sowing dates mean squares and their interaction were highly significant at (p<0.05) (Table 1). Four entries NIA-11, NIA-21, NIA-25 and NIA-34 took more sympodial branches plant^{-1} (22) in sowing date 20th April as comparison with sowing date 20th March sympodial branches plant^{-1} remained (14 to16) (Table 2). These results reported by the researchers (Copur, 2006; Baloach *et al*., 2002).

Boll weight (g): The data of boll weight gram showed that sowing dates and their interaction were highly significant at (p<0.05%) (Table 1). Two elite lines NIA-21 and NIA-23 took higher boll weight (4.0 g) were obtained in sowing date 20th April as compared with 20th March sown crop took 2.2 to 3.7 g boll weight (Table 2). Before time sowing or late sowing causes less number of bolls and boll weight that finally contributed to lower seed cotton (Usman & Ayatullah, 2016).

Staple length (mm): The data regarding staple length (mm) exhibit highly significant differences in sowing dates and their interactions at (p< 0.05%) in Table 1. Four elite lines NIA-26, NIA-13, NIA-02 and NIA-33 took long staple length ranges from (30.0 to 30.8 mm) in 20th April sowing date as compared with 20th March sowing date staple length mm ranges from 27.2 to 28.6 mm) Table 2). Sowing date 19th April took optimum fiber length as compare to all other sowing times (Usman & Ayatullah, 2016).

Seed index (g): Highly significant differences were observed among sowing dates and their interaction mean squares at (P< 0.05%) for seed index (Table 1). Eight elite lines NIA-02, NIA-04, NIA-14, NIA-15, NIA-19, NIA-29, NIA-32 and NIA-34 took maximum seed index ranges from (8.6 to 8.7 g) seed index in 20th April sown crop while minimum seed index g (5.0 to 6.7g) obtained in 20th March sowing (Table 2). Timely sowing had also shown positive effect on quality traits of cotton, such as seed index (Farzana *et al.*, 2005).

Seed cotton yield (kg ha^{-1}): Results reveal that three elite lines NIA-4, NIA-5 and NIA-11took higher seed cotton yield ranges from (2206 to 2314 kgha^{-1}) in 20th April sowing in comparison with 20th March sowing seed cotton yield which ranges from 780 to 1049 kgha^{-1} (Table 2). Late sown crop produces lower open bolls per plant and boll weight resulting in less seed cotton yield (Elayan *et al*., 2015). Sowing dates significantly affected seed cotton weight, ginning out turn and seed cotton yield. Cotton sown on 15th April recorded the highest yield of 3156 kgha^{-1} (Sheikh *et al.*, 2006).

Table 1. Mean square for agronomic traits of cotton elite lines evaluated under different sowing dates

Sources of variation	D.F	Sympodial branches plant^{-1}	Boll weight (g)	Staple length (mm)	Seed index (g)	Seed cotton yield (kgha^{-1})
Replicates	1	0.360	1.14890	0.5300	3.212	7770.47
Lines	33	3.094**	0.16214	0.8823**	0.247**	16282.9**
Sowing dates	1	564.184**	2.00184**	36.3286**	245.974**	4.36007**
Lines × sowing dates	33	2.654**	0.26032**	1.3139**	0.268**	10227.1**
Error	67	0.316	0.08442	0.3275	0.078	3162.74

* = Denotes significant; ** = Denotes highly significant; ns = Denotes non-significant

Table 2. Interactive effect of sowing dates and elite lines on seed cotton yield and fiber quality parameters of cotton.

Elite lines	Sympodial branches plant^{-1}		Boll weight (g)		Staple length (mm)		Seed index (g)		Seed cotton yield kg ha^{-1}	
	20th March	20th April	20th March	20th April	20th March	20th April	20th March	20th April	20th March	20th April
NIA-1	15 f-h	21 ab	2.5 c-e	3.8 a-c	28.4 a-f	28.9a-f	5.5 b-d	8.5a	1049f	2099 a-d
NIA-2	14h	18 c-e	3.0 a-e	3.0a-e	27.6 c-f	30.8 a	6.0 b-d	8.6a	1023fg	2153 a-c
NIA-3	15 f-h	17 d-f	3.0 a-e	3.0a-e	28.5 a-f	29.7a-f	5.7 b-d	8.1ab	969fg	1937 c-e
NIA-4	16 e-h	19 b-d	3.0 a-e	3.0a-e	27.4 ef	29.9a-e	6.0 b-d	8.6a	834fg	2206ab
NIA-5	15 f-h	21ab	3.2 a-e	3.1a-e	28.5 a-f	27.8 c-f	5.7 b-d	8.3a	942fg	2207ab
NIA-6	15 f-h	18 c-e	3.0 a-e	3.1a-e	28.0 c-f	29.9a-e	5.0d	8.1ab	942fg	2045b-e
NIA-7	15 f-h	18 c-e	3.0 a-e	3.5a-d	27.9 c-f	29.9a-d	6.0 b-d	8.5a	888fg	2099a-d
NIA-8	14 gh	19 b-d	3.0 a-e	3.0a-e	28.6 a-f	28.8a-f	6.0 b-d	8.3ab	969fg	2045b-e
NIA-9	14 h	18 c-e	3.5 a-d	3.2a-e	28.2 c-f	29.5a-f	6.7 b	8.2ab	942fg	2099a-d
NIA-10	16 e-g	19 b-d	3.0 a-e	3.2a-e	27.8 c-f	28.7a-f	6.0 b-d	8.2ab	915fg	1991b-e
NIA-11	14 gh	22 a	3.1 a-e	3.0a-e	28.0 c-f	29.3a-f	6.0 b-d	8.5a	996fg	2314a
NIA-12	14gh	18 c-e	3.0 a-e	3.0a-e	27.9 c-f	28.3b-f	5.0 d	8.3a	942fg	2099a-d
NIA-13	15 f-h	17d-f	3.0 a-e	3.0a-e	27.7 c-f	30.7ab	5.6 b-d	8.5a	996fg	2099a-d
NIA-14	14 h	18 c-e	3.4 a-e	3.2a-e	28.6 a-f	29.3a-f	6.0 b-d	8.7a	942fg	2045b-e
NIA-15	15 f-h	19b-d	3.0 a-e	3.2a-e	28.1 c-f	29.4a-f	5.0 d	8.6a	780g	2099a-d
Sadori	15 f-h	21ab	2.4 de	3.5a-d	28.3 b-f	27.8 c-f	6.0 b-d	8.0a	915fg	2045b-e
NIA-Ufaq	15 f-h	18 c-e	3.0 a-e	3.5a-d	28.5 a-f	28.4a-f	6.0 b-d	8.1ab	888fg	2045b-e
NIA-Noori	14gh	19b-d	3.0 a-e	3.0a-e	27.7 c-f	29.3a-f	6.0 b-d	8.2ab	834fg	1937c-e
NIA-19	15 f-h	18 c-e	3.0 a-e	3.0a-e	28.4 a-f	27.2f	5.7 b-d	8.7a	888fg	2045b-e
NIA-20	15 f-h	19b-d	3.8 a-c	3.5a-d	27.6 c-f	27.2f	5.6 b-d	8.3ab	915fg	2126a-d
NIA-21	15 f-h	22a	3.0 a-e	4.0a	28.1 c-f	28.3b-f	5.8 b-d	8.5a	942fg	2045b-e
NIA-22	15 f-h	18 c-e	3.8 a-c	3.5a-d	28.2 c-f	28.4a-f	5.0 d	8.1ab	969fg	1991b-e
NIA-23	14gh	19b-d	2.5 c-e	4.0a	28.5 a-f	28.3b-f	6.0 b-d	8.5a	942fg	1937c-e
NIA-24	14gh	16e-h	3.0 a-e	3.2a-e	28.5 a-f	29.0a-f	6.0 b-d	8.5a	996fg	2045b-e
NIA-25	16e-h	22 a	3.0 a-e	3.0a-e	28.5 a-f	29.0a-f	6.0 b-d	8.3ab	888fg	2099a-d
NIA-26	15 f-h	18 c-e	3.0 a-e	3.8ab	27.7 c-f	30.0 a-c	6.4 bc	8.3ab	888fg	2072a-e
NIA-27	15 f-h	19 b-d	3.0 a-e	3.0a-e	27.2 f	27.8c-f	5.0 d	8.5a	915fg	2152 a-c
NIA-28	15 f-h	18 c-e	3.0 a-e	3.5a-d	27.5 d-f	30.7ab	6.4 bc	8.3ab	942fg	2099a-d
NIA-29	15 f-h	20 a-c	3.0 a-e	3.0a-e	28.3 b-f	28.4a-f	5.0d	8.6a	915fg	2045b-e
NIA-30	15 f-h	20 a-c	2.2 e	3.5a-d	28.0 c-f	30.0a-d	6.0 b-d	8.4ab	996fg	1991b-e
NIA-31	15 f-h	20 a-c	3.0 a-e	2.6a-e	27.7 c-f	29.8a-e	5.0d	8.3ab	996fg	1937c-e
NIA-32	16e-h	19 b-d	2.6 a-e	3.5a-d	28.2 c-f	29.0a-f	5.5 cd	8.6a	888fg	2099a-d
NIA-33	14 gh	21ab	3.0 a-e	2.8a-e	28.2 c-f	30.8 a	5.0 d	8.4ab	834fg	1884de
NIA-34	14 gh	22 a	3.1 a-e	2.9a-e	28.2 c-f	29.0a-f	5.7 b-d	8.6a	780g	1830e

Means followed by different letters are significantly different from each other at $p<0.05\%$

Conclusion

The prime objective of present study was exploring the effect of sowing dates on seed cotton yield and fiber quality traits. In this study cotton elite lines NIA-4, NIA-5 and NIA-11 produced higher seed cotton yield, long staple length (mm) and higher seed index (g) which was grown in normal cotton sowing in the month of April. On the basis of this study, it is suggested that cotton sowing should be done in the month of April instead of early sowing in the month of March.

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