PLANTING DATES AFFECTS ON SEED COTTON YIELD AND CONTRIBUTED CHARACTERS OF COTTON ADVANCE LINES UNDER CHANGING CLIMATIC CONDITIONS OF TANDOJAM, SINDH PAKISTAN

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ABSTRACT

Cotton crop is an imperative role in Pakistan’s economy. It faces several environmental situations which check its growth and production. Climate changes bring a head new pressure for cotton cultivation in the Pakistan especially in Sindh province. The present study was carried out at Nuclear Institute of Agriculture (NIA), Tandojam in 2021. Four advance lines NIA-88, M-32, NIA-Bt. 89 and NIA-Bt.90 along with two local check varieties IUB-2013 and CRIS-121 were evaluated under two planting dates viz. 1st April and 1st May having three replicates under randomized complete block design with factorial arrangements. The data depicted that crop sown on 1st April produced more seed cotton yield (2855.5 kg ha⁻¹) than sown on 1st May with (1674.4 kg ha⁻¹). Comparing the average varietal performance in both sowing dates, NIA-88 produced maximum seed cotton yield (2339.2 kg ha⁻¹) while minimum seed cotton yield (2137.2 kg ha⁻¹) was exhibited by check variety CRIS-121. Boll retention % was maximum (44%) in advance line NIA-88. The maximum number of bolls plant⁻¹ (42.0), sympodial branches plant⁻¹ (26.0), ginning out turn percentage (42.0), seed index (8.1g) and staple length (29.0mm) respectively was obtained in 1st April sowing date while minimum number of bolls plant⁻¹, sympodial branches plant⁻¹, ginning out turn percentage, seed index and staple length (33.0), (15.0), (36.3), (6.0g) and (27.0mm) took in 1st May sown crop. Associating the average varietal performance in both sowing dates NIA-88 produced maximum number of bolls plant⁻¹(44.0), sympodial branches plant⁻¹ (23.0), ginning out turn percentage (40.4), seed index (9.0g) and staple length (29.0mm) respectively. The results indicated that the planting dates and genotypes influenced on seed cotton yield and associated traits in current changing climate scenario for cotton crop.

Keywords: cotton, climate change, fiber quality, planting dates, seed cotton yield

INTRODUCTION

Pakistan is 5th largest producer of cotton in the world. Export of cotton and textile products have a share of around 60 percent in overall exports of the country. It contributes around 0.6% to GDP and 2.4% of the value added in Agriculture (GoP, 2021-2022). The most significant and manageable factor for cotton crop is optimum planting time for new cultivar in region (Jaffar, et al., 2023). The environment change is affecting the Agricultural production by affecting on managing practices such as planting time. Also, sowing time is one of the main factors affecting seed cotton yield. Cotton production is a form of production depending on environmental conditions. Cotton sowing should be from 1st March to 16th April for maximum and quality harvest (Iqbal, et al., 2021). In addition to the ecological differences, the differences in the cotton production techniques applied as well as genetic structure of the varieties grown in cotton production regions can lead to the formation of the yield and quality quite differently from each other (Killi, 2005). It is essential to examine optimum sowing time for developing full genetic potential of cotton under specific agro-climatic conditions (Kakar et al., 2012). For good crop formation, cotton crop demands warm soil and air temperature for better germination and emergence. Moreover, early planting leads to poor crop position while late sown crops are more vulnerable to insect pest and adverse environmental conditions (Gormus and Yucel, 2002). Many researchers found that sowing time was selected as a key issue of cotton cultivars (Salih et al., 2019). Additionally, late sown cotton crop initiates flowering later in the growing season, which will cause bolls to develop later in cooler conditions, lengthening...
the period from sowing to boll opening and delaying maturity (Bauer et al., 2000). Results revealed that seed cotton yield contributing parameters were expressively affected by planting dates (Niazi, 2005). Planting time efficiently impacts on seed cotton yield and yield traits in cotton. Early sowing is chosen than late sowing due to its progressive effects on various traits especially yield. (Saeed et al., 2014; Sharif et al., 2020) examined that seed cotton yield and fiber quality were affected by genotypes and planting times (Soomro et al., 2000) noted that the planting time has very important role in realizing maximum seed cotton yield in a country like Pakistan where the climatic conditions differ from province. Climatic factors such as temperature, wind, rainfall and relative humidity significantly affect the boll production of cotton (Cetin, et al., 2010). Therefore, keeping in view the above facts, present study was planned to investigate the impact of planting dates on seed cotton yield and fiber quality parameters of newly developed advance cotton lines for better cotton production.

MATERIALS AND METHODS
The field experiment was carried out at the experimental field of Nuclear Institute of Agriculture, Tandojam, Sindh, Pakistan during kharif season 2021. The experimental site was situated in a semi-arid subtropical climate, 14m above the sea level in Sindh province of Pakistan. The soil of experimental field was silty and sandy clay loam in texture (Soltanpur series). Four advance lines NIA-88,M-32, NIA-Bt. 89 and NIA-Bt.90 along with two local check varieties IUB-2013 and CRIS-121 were evaluated under two planting dates viz. 1st April and 1st May. The experiment was laid out in randomized complete block design with factorial arrangements with three replicates. The plot size was (4.6m x 6.1m = 28.06m²). The land was prepared well. The cotton sowing was done on ridges. Thinning, weeding, inter-culturing, fertilizer and insecticide application applied as per the recommendations. Fertilizers were applied at the recommended rates; N in the form of urea (115 kg ha⁻¹), P in the form of Diammonium Phosphate DAP (60 kg ha⁻¹) and K as Sulphate of Potash SOP (62.5 kg ha⁻¹). All P₂O₅ and K₂O along with 25% N were applied at the time of sowing by mixing in the soil, while remaining N was applied into two splits; first split 50% was applied at squaring and remaining 25% at the time of flowering stage. Five plants were selected randomly in each plot for taking data. Out of 6 rows, 4 were harvested for taking yield data. The data were recorded and analyzed for LSD at 0.05% after ANOVA by using statistical software, Statistix® Version 8.1, Analytical Software, 2005 Inc. Tallahassee, FL, USA.

RESULTS AND DISCUSSION
Sympodial branches plant⁻¹
The analysis of variance for sympodial branches plant⁻¹ showed that sowing dates, varieties mean squares were highly significant and their interactions were significant at (P<0.05%) are presented in (Table 1). The maximum number of sympodial branches plant⁻¹ (26) observed in 1st April sowing date as compared with 1st May (15) sympodial branches plant⁻¹ in (Table 2). Farid et al. (2017) also reported the increase of 34% more number of sympodial branches in early sowing than late sowing. In advance lines the maximum sympodial branches were found in advance line M-32 (22), followed by NIA-88 (21) branches respectively depicted in (Table 3). The significant differences among varieties for number of sympodial branches plant⁻¹ had also been reported by (Copur, 2006).

Number of bolls plant⁻¹
Number of bolls is essential yield contributing parameter. The analysis of variance for sympodial branches plant⁻¹ depicted that in planting dates, varieties mean squares were highly significant and their interactions were significant at (P<0.05%) in (Table 1). The maximum number of bolls plant⁻¹ (44) recorded in 1st April sowing date as compared with 1st May (33) bolls plant⁻¹ in (Table 2). The maximum number of bolls plant⁻¹ (44) recorded in advance lines and minimum number of bolls plant⁻¹ (36) was observed in check variety CRIS121in (Table 3). These results agreed with findings of (Jamro et al., 2017) who documented that subsequent delay in sowing time produced less number of bolls and a drastic decrease in number of bolls as sowing was delayed up to 30th May. Soomro et al., (2014) also confirmed the similar results of adverse effects of delayed sowing than early sowing.

Boll retention (%)
Boll retention percentage delicate to environmental situations. The boll retention % data showed that the planting date mean squares were non-significant, but varieties and their interactions were highly significant at (P<0.05%) in (Table 1). The maximum boll
retention (30%) was noted in 1st April sown whereas; minimum boll retention (28%) was observed in 1st May sown crop in (Table 2). The maximum boll retention percent was noted in advance line NIA-88 (44%) whereas; minimum boll retention (18%) was observed in check variety CRIS-121 showed in (Table 3). Sharif et al. (2020) reported that maximum bolls were taken in early planted crop.

Ginning out turn (%) 
The analysis of variance for ginning out turn% showed that sowing dates mean squares were highly significant whereas varieties and their interactions were non-significant at (P<0.05%) are presented in (Table 1). The data pertaining to ginning out turn percent reveals that the planting date 1st April produced maximum ginning out turn % (42.0%) as compared with 1st May (36.4%) ginning out turn percent depicted in (Table 2). In advance lines maximum ginning out turn percent (40.0%) was recorded in advance line NIA-88 in (Table 3). It has been reported that ginning out turn (GOT %) in different cotton cultivars may vary significantly (Fahad et al., 2008).

Seed index (g) 
Hundred seed weight is an important character in determining seed cotton yield, especially in seed cotton. The analysis of variance for seed index (g) depicted that sowing dates mean squares were highly significant and their interactions were significant at (P<0.05%) (Table 1). The maximum seed index (8.1g) was recorded in 1st April sowing date whereas minimum seed index (6.0g) was noted in 1st May crop sown (Table 2). The advance line NIA-88 produced maximum seed index (9.0g) whereas minimum seed index (6.0g) was recorded in advance line NIA-Bt.90 and check variety IUB-2013 respectively in (Table 3). Seed index were highly affected by sowing dates (Mohamed et al., 2016).

Staple length (mm) 
The staple length (mm) is an important fiber trait to determine the quality textile products (Mustafayev et al., 1999). The analysis of variance for staple length (mm) revealed that sowing dates mean squares were highly significant whereas advance lines and their interactions were non-significant (P<0.05%) (Table 1). The longer staple length (29.0mm) was recorded in 1st April sowing dates whereas; minimum staple length (27.4mm) was noted in 1st May sown crop (Table 2). In advance lines NIA-88 produced (28.4mm) staple length. The minimum staple length mm (27.3) was recorded in check variety IUB-2013 (Table 3).

Table 1. Mean square for agronomic traits of cotton advance lines evaluated under different planting dates

<table>
<thead>
<tr>
<th>Analysis of variance</th>
<th>Sympodial branches plant(^1)</th>
<th>No. of bolls plant(^1)</th>
<th>Boll retention %</th>
<th>GOT%</th>
<th>Seed index (g)</th>
<th>Staple length (mm)</th>
<th>SCY kg ha(^{-1})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rep.</td>
<td>0.08</td>
<td>1.36</td>
<td>24.992</td>
<td>2.348</td>
<td>0.0833</td>
<td>0.1078</td>
<td>30243.0</td>
</tr>
<tr>
<td>Planting Dates</td>
<td>1034.69**</td>
<td>1111.11**</td>
<td>37.414ns</td>
<td>243.880**</td>
<td>38.0278**</td>
<td>44.8900**</td>
<td>1.25507**</td>
</tr>
<tr>
<td>Advance Lines</td>
<td>19.18**</td>
<td>58.51**</td>
<td>441.321**</td>
<td>4.597ns</td>
<td>7.1167**</td>
<td>0.8958ns</td>
<td>29505.4ns</td>
</tr>
<tr>
<td>Planting Dates x Advance lines</td>
<td>15.89*</td>
<td>37.98*</td>
<td>72.36*</td>
<td>7.306ns</td>
<td>5.5611*</td>
<td>0.7900ns</td>
<td>124639**</td>
</tr>
<tr>
<td>Error</td>
<td>1.66</td>
<td>4.42</td>
<td>8.206</td>
<td>1.768</td>
<td>0.7803</td>
<td>0.3051</td>
<td>12395.5</td>
</tr>
</tbody>
</table>

** Highly significant; Significant, NS = Non-significant

Table 2. Effects of planting dates on Sympodial branches plant\(^1\), No. of Bolls plant\(^1\), Boll retention%, Ginning out turn%, Seed index (g), Staple length (mm) and Seed cotton yield (kg ha\(^{-1}\))

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Planting dates</th>
<th>LSD (P&gt;0.05%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1st April</td>
<td>1st May</td>
</tr>
<tr>
<td>Sympodial branches (^1)</td>
<td>26a</td>
<td>15b</td>
</tr>
<tr>
<td>No. of bolls plant(^1)</td>
<td>44a</td>
<td>33b</td>
</tr>
<tr>
<td>Boll retention%</td>
<td>30a</td>
<td>28b</td>
</tr>
<tr>
<td>Ginning out turn%</td>
<td>42a</td>
<td>36.4b</td>
</tr>
<tr>
<td>Seed index (g)</td>
<td>8.1a</td>
<td>6.0b</td>
</tr>
<tr>
<td>Staple length (mm)</td>
<td>29.0a</td>
<td>27.4b</td>
</tr>
<tr>
<td>SCY kg ha(^{-1})</td>
<td>2855.5a</td>
<td>1676.4b</td>
</tr>
</tbody>
</table>
Table 3. Interactive effects of planting dates and advance lines on agronomic traits of cotton

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Advance lines</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NIA-88</td>
</tr>
<tr>
<td>Sympodial branches plant</td>
<td>23a</td>
</tr>
<tr>
<td>No. of bolls plant</td>
<td>44a</td>
</tr>
<tr>
<td>Boll retention%</td>
<td>44a</td>
</tr>
<tr>
<td>Ginning out turn%</td>
<td>40a</td>
</tr>
<tr>
<td>Seed index (g)</td>
<td>9.0a</td>
</tr>
<tr>
<td>Staple length (mm)</td>
<td>28.4a</td>
</tr>
<tr>
<td>Seed cotton yield (kg ha⁻¹)</td>
<td>2339.2a</td>
</tr>
</tbody>
</table>

Figure 1. Meteorological data showing minimum, maximum temperature and humidity% during cotton crop season at Nuclear Institute of Agriculture, Tandojam

Seed cotton yield (kg ha⁻¹)
The analysis of variance for seed cotton yield kg ha⁻¹ (Table 1) depicted that sowing dates and their interactions were highly significant at (P<0.05%) whereas, advance lines were non-significant. The highest seed cotton yield (2855.5 kg ha⁻¹) was recorded in 1st April sowing date whereas lowest seed cotton yield (1676.0 kg ha⁻¹) was recorded on the 1st May sown crop (Table 2). Advance line NIA-88 took maximum seed cotton yield (2339.2 kg ha⁻¹) however minimum seed cotton yield (2137.2 kg ha⁻¹) was noted in check variety CRIS-121 (Table 3). Sowing date significantly affected on seed cotton yield (Huang. 2016). Sowing dates are an important factor affecting the yield and reproductive duration of crop. Climate change, an earlier planting date might be an efficient method for increasing seed cotton yield. Sharif et al. (2020) reported that crops sown on 10th April produced more seed cotton yield than planted on 10th May crop sown.

Meteorological data
Temperature is also a primary factor controlling rates of plant growth and development. Schrader et al. (2004) stated that high temperatures that plants were likely to experience inhibit photosynthesis. During crop grown season average minimum temperature 19.2°C and maximum 39.1°C was noted in the month of April and average minimum temperature 26°C and maximum 39.1°C recorded in the month of June and July which was suitable temperature remained at the time of flowering and boll formation. The relative humidity was remained 64% in the month of July Figure 1.

CONCLUSION
Planting date is an important factor affecting the seed cotton yield. With climate change, an earlier planting date might be an efficient method of increasing seed cotton yield. The present research work achieved that the seed cotton yield and associated traits were affected by planting times. Between the planting times early sowing (1st April) produced higher seed cotton yield, Ginning out turn %, more boll retention %. Among the advance line NIA-88 achieved maximum seed cotton yield and yield traits. The results of this study will be providing a standard for growers and management organizations to choose the optimum planting date for highest seed cotton yield.
date to increase seed cotton yield in their own areas.

AUTHOR’S CONTRIBUTION
Z. A. Deho: Conceptualized the main idea, conducted the experiment and wrote manuscript.

REFERENCES

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