Pak. j. life soc. Sci. (2017), 15(3): 158-162 E-ISSN: 2221-7630; P-ISSN: 1727-4915

Pakistan Journal of Life and Social Sciences
www.pjlss.edu.pk

RESEARCH ARTICLE

Growth and Yield Response of Cotton Cultivars at Different Planting dates

Muhammad Abbas Farid[1], Muhammad Ijaz[2], Sajid Hussain[2], Mubshar Hussain[2], Omer Farooq[3], Abdul Sattar[4], Ahmad Sher[2], Aftab Wajid[1], Aman Ullah[1], and Muhammad Raheel Faiz[4]

[1]Department of Agronomy, University of Agriculture, Faisalabad, 38040, Pakistan
[2]College of Agriculture, Bahauddin Zakariya University, Bahadur Campus, Layyah, 31200, Pakistan
[3]Department of Agronomy, Bahauddin Zakariya University, Multan, 60000, Pakistan
[4]Institute of Agricultural Extension and rural Development, University of Agriculture, Faisalabad, 38040, Pakistan

ARTICLE INFO

Received: Sep 29, 2017
Accepted: Nov 05, 2017

Keywords
Cultivar
planting date
Seed cotton
Semi-arid

***Corresponding Author:**
sajid_nawaz76@ahoo.com

ABSTRACT

Cotton *(Gossypium hirsutum* L.) is an important fiber crop and is considered the back bone of Pakistan's economy. There are several yields limiting factors which create obstacles to achieve potential seed cotton yield. Among agronomic factors, planting time and cultivar selection are considered as key factors to get optimum seed cotton yield under a particular environmental condition. For this a field study was conducted to evaluate the effect of two planting dates 15th May and 15th June and three cotton cultivars (FH-114, FH-142 and MNH-886) on seed cotton yield at Sahiwal, Punjab (Pakistan) during 2014. The results indicated that sowing of cotton on 15th May significantly enhanced the seed cotton yield (3631.8 kg ha^{-1}) by 45% over the late planting of cotton on 15th June and also improved the yield components. The cultivar FH-142 performed superior in terms of leaf area index (LAI), total dry matter (TDM) (11018 kg ha^{-1}) and seed cotton yield (3281.0 kg ha^{-1}) as compared to the other cultivars. The different planting dates and cultivars significantly affected the sympodial branches per plant and average boll weight of the cotton crop. In conclusion, the selection of suitable cultivar (FH-142) and early planting of cotton at 15th May increased seed cotton yield under semi-arid conditions of Sahiwal.

INTRODUCTION

Cotton (*Gossypium hirsutum* L.) is an important fiber crop that occupies a central and key position in the world trade and also in the economy of Pakistan. Cotton is grown-up commercially for industrial purpose in the tropical and subtropical regions of more than seventy countries mostly in the longitudinal band between 37°N and 32°S. China, India, USA and Pakistan are major cotton growing countries. In Pakistan Cotton contributes 6.7% of value added in agriculture and 1.4% of GDP (GOP, 2014). Several studies have reported that earlier planting of cotton enhanced seed cotton yield over the late planting (Muhammad et al., 2002; Deho et al., 2009; Ali et al., 2009). A study revealed that earlier planting produced more yield including yield components like sympodial branches, average boll weight and ginning out turn than late planting (Arshad et al., 2007). Sowing date affects the plant height and ginning out turn (GOT%) significantly (Awan et al., 2011).

Cultivars vary in their genetic makeup and respond different to various biotic and abiotic stresses in addition to climatic conditions. So, cultivar selection and proper sowing time are keys to enhance seed cotton yield under different agro-ecological zones (Bange and Milroy, 2004; Iqbal et al., 2012). Different cultivars have their own genetic makeup to develop canopy, those having slow growth rate have less leaf area index result in reducing the efficiency of converting radiant light to photosynthates (Wajid et al., 2010). A study on temperature and sowing time impact on growth and development of cotton revealed that sowing too early facing problem of cold weather reduces boll weight while late sowing results in losing potential yield and poor ginning out turn (Bange and Milroy, 2004). Genotypes with diverse background vary in their development & dry material portioning and their relation to crop maturity with different sowing date and season length (Bange and Milroy, 2004). Cotton yield can be low by the number of factors including selection of inappropriate variety in an ecological zone as cultivar vary in number of bolls per plant, boll weight, sympodial branches, plant height, ginning out turn and seed cotton yield (Ehsan et al., 2008). Increasing day and night temperature will result in more evapotranspiration; water demand and respiration which in return cause low yield of cotton (Rasul et al., 2011). Increasing day temperature will require more irrigation demand for lowering the canopy temperature and to reduce boll abscission (Reddy et al, 2002). Sowing time optimization has much importance for growers to optimize seed cotton yield and quality. Best time of sowing in a region is often difficult as early sowing may result in seedling diseases (Bange and Milroy, 2004). The aim of this study was to evaluate impact of planting dates on growth and seed cotton yield of different cotton cultivars.

MATERIALS AND METHODS

Site and soil

The experiment was conducted at research farm of Cotton Research Station, Sahiwal, (31º 26'N, 73º06'E, 172m) latitude, longitude and altitude, respectively during summer season 2014. The soil type was clay loam having soil pH 8.1.

Experimental design and treatments

The trial was laid out in Randomized complete block design with split plot arrangements having 03 replications with net plot size of (3 m × 7 m). The planting dates (15 May and 15 June) were kept in main plot while cotton cultivars (FH-114, FH-142 and MNH-886) were placed in sub plot.

Weather conditions

Weather data during the whole crop season was observed at the observatory of Cotton Research Station Sahiwal, Punjab, Pakistan. The daily maximum, minimum temperature, relative humidity and rainfall were recorded (Table 1).

Crop husbandry and data collection

Sowing was carried out manually with row to row distance of 75 cm and plant to plant distance of 30 cm. All other agronomic operations like hoeing, irrigation, plant protection measures etc. were kept even for all the treatments. While the recommended amount of nitrogen, phosphorus and potassium was applied in the form of urea, diammonium phosphate and sulphate of potash at the rate of 250-100-100 kg per hectare respectively Data collection was done by tagging the 10 plants in each plot. Growth data like leaf area index (LAI) and total dry matter (TDM) were taken by harvesting of two plants after a specific time interval.

Following growth parameters were recorded from calculation of leaf area and dry mass. Leaf area index (LAI) was measured as proposed by Hunt (1978).

LAI = Leaf area / land area

Leaf area duration (LAD) was also estimated according to Hunt (1978).

$LAD = LAI_1 + LAI_2 \times (t_2 - t_1) / 2$

where LAI_1 and LAI_2 are the leaf area index at time t_1 and t_2, respectively.

Statistical analysis

Using the Fisher's analysis of variance technique, the results were compared and the (LSD) test at 5% probability were used for the comparison of different experimental unit means (Steel *et al.*, 1996).

Table 1: Weather conditions during crop growing season

Month- 2014	Temperature (°C)		Relative humidity	Rainfall (mm)
	Max.	Min.		
May	38.35	23.67	76.58	1.5
June	41.70	27.69	68.13	47.6
July	38.90	27.50	75.83	14.8
August	39.15	27.79	74.65	132
September	35.18	25.65	78.20	5
October	34.37	21.34	83.16	0
November	29.16	13.05	85.21	3.3

RESULTS AND DISCUSSION

Different planting dates significantly affected the leaf area index (LAI), leaf area duration (LAD), no. of sympodial branches plant^{-1}, total bolls per plant, average boll weight, total dry matter and seed cotton yield of cotton (Table 2). Likewise, cultivars also differed significantly for the LAI, LAD and yield and yield contributing traits. Early planting of cotton at (15 May) gave 35% more LAI than late planting of cotton at (15 June) (Table 2). While in case of cultivars, the maximum LAI was recorded in cultivar FH-142 (4.1) which was 10% more as compared to cultivar MNH-886. The minimum LAI was observed in cultivar FH-114 (Table 2). The optimum temperature at early growth of (15 May) planting date enhanced LAI with more radiation use efficiency, while late planting faced high temperature in early growth which ultimately affected the LAI. The early sown cotton crop gets benefit of nutrients and more interrupted radiation due to increase in the growth period (Ali et al., 2009).

Leaf area duration is the ability of leaves to remain photo synthetically active. Among the planting dates the highest persistency of leaf to remain active (270 days) was recorded at (15 May) planting date followed by 15 June planting date (Table 2). It might be due to favorable environmental and soil conditions at 15 May planting date. Among the cultivars the maximum LAD (249 days) was observed in cultivar FH-142, followed by that of cultivar MNH-886 which was statistically at par with that of cultivar FH-114 (Table 2). It might be due to difference in genetic material which enables the plant to behave differently.

The numbers of sympodial branches are an important parameter of seed cotton yield determination. Among the sowing dates the crop planted on 15 May significantly increased the number of sympodial branches per plant (19) 34% than crop planted on 15 June (Table 2). While in case of cultivars the maximum numbers of fruit bearing branches were produced by cultivar FH-142, followed by those of cultivar MNH-886 and FH-114 (Table 2). It might be due to the effect of temperature which was not too high at early crop growth stage where crop was planted on 15th May that is why crop grow well and possess more sympodial branches than late planting due to increased insect as well virus attack which reduced growth of crop as a whole. The maximum total bolls (36%) were produced when the crop was sown at 15 May than late planted 15 June cotton (Table 2). Among the cultivars the highest no. of total bolls per plant was computed in cultivar FH-114 that was statistically at par with cultivar FH-142 followed by cultivar MNH-886 (Table 2). It was revealed that early planting had more optimum conditions that permit the plant to produce more no. of bolls per plant.

Maximum average boll weight (3.3 g) was recorded at early sowing (15 May) 14% more than late planting (15 June). Among the cultivars, maximum average boll weight (3.5 g) was recorded with cultivar FH-142 followed by that of cultivar MNH-886, while minimum average boll weight was recorded with cultivar FH-114 (Table 2). The boll size of cultivar FH-142 was relatively large in size than that of cultivar MNH-886, while cultivar FH-114 boll size was too small as compared to those other cultivars. The late planting of cotton decreases the boll size and weight (Ali et al., 2009).

Effect of planting dates on TDM was recorded significant. Early sowing (15 May) produced 35% more TDM as compared to (15 June) late sowing date (Table 2; Figure 1). Among the cultivars the maximum TDM was observed in cultivar FH-142 that produced 9% more TDM than cultivar MNH-886 (Table 2; Figure 1). The minimum value of TDM was recorded in cultivar FH-114 due to its short growing season, early senescence of leaves, small size of leaf, boll size as well small height. The cultivar FH-142 gave maximum TDM due to its long height, large leaf size, boll weight etc. While the cultivar MNH-886 remained between both cultivars FH-142 and FH-114 in height, leaf size, boll weight.

Seed cotton yield is a collective effect of yield components under a particular environment. Highly significant effect of sowing dates on seed cotton yield was observed (Table 2). Planting date of May 15 gave almost 45% more seed cotton yield than late planting (June 15) (Table 2). The maximum seed cotton yield of 3631.8 kg ha^{-1} was produced when crop was sown early on May 15 and the lowest yield of 2014.5 kg ha^{-1} was produced with late sown crop on June 15 (Table 2; Figure 2). Among the cultivars the maximum seed cotton yield was recorded in cultivar FH-142 followed by that of cultivar MNH-886, while minimum seed cotton yield was recorded in cultivar FH-114. The cultivar FH-142 gave 17% and 24% more seed cotton yield as compared to MNH-886 and FH-114, respectively (Table 2; Figure 2). The more seed cotton yield in planting date (May 15) might be due to longer growing period availability and good crop establishment under mild temperature of early season. The late sowing of cotton decreases the yield contributing traits and ultimately the seed cotton yield (Arshad et al., 2007; Ali et al., 2009; Iqbal et al., 2012). In Fig. 1 the values of TDM goes on increasing with early planting as compared to late sown cotton while the cotton cultivar FH-142 showed supremacy over all other cultivars with the increase in days after sowing. In Fig. 2 the average increase in sympodial branches and boll weight per plant ultimately increased the seed cotton yield of the cotton crop.

Table 2: Effect of planting dates on growth, seed cotton yield and yield components of different cotton cultivars

Treatment	Seed cotton yield (kg ha^{-1})	TDM (kg ha^{-1})	LAI	LAD (days)	Sympodial branches plant^{-1}	Total boll plant^{-1}	Average boll weight (g)
Planting dates							
15th May	3631.8^{a}	12201^{a}	4.3^{a}	270^{a}	19^{a}	33^{a}	3.3^{a}
15th June	2014.5^{b}	8168^{b}	2.8^{b}	167^{b}	13^{b}	21^{b}	2.8^{b}
LSD value (P≤0.05)	593.3	1829	0.3	19	1.8	4	0.5
Cultivars							
FH-114	2474.7^{b}	9496^{b}	3.1^{b}	194^{b}	14^{b}	29^{a}	2.4^{c}
FH-142	3281.0^{a}	11018^{a}	4.1^{a}	249^{a}	18^{a}	28^{ab}	3.5^{a}
MNH-886	2713.8^{b}	10038^{ab}	3.5^{b}	212^{b}	15^{b}	25^{b}	3.2^{b}
LSD value (P≤0.05)	463.3	1029	0.5	27	3	3.0	0.4
Interaction	NS	NS	NS	NS	NS	NS	NS

NS= non-significant; TDM= total dry matter; LAI= leaf area index; LAD= leaf area duration

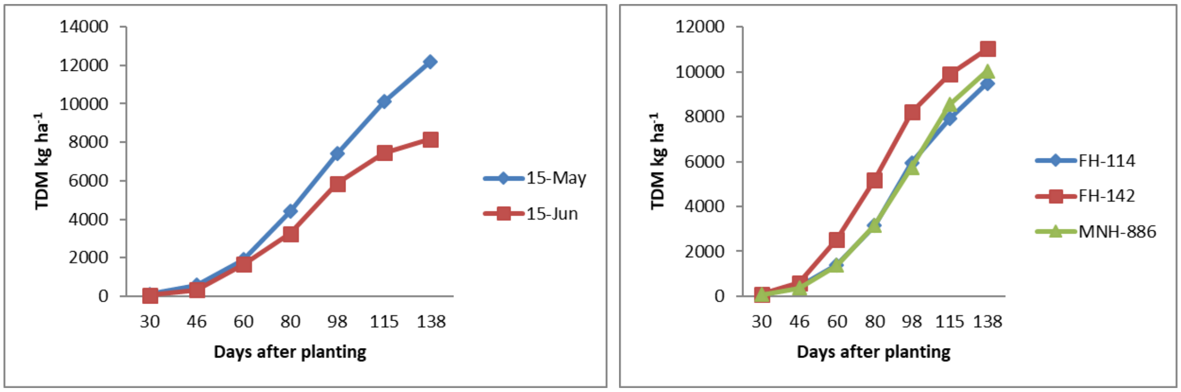

Fig. 1: Effect of planting dates and cultivars on temporal changes in total dry matter (TDM).

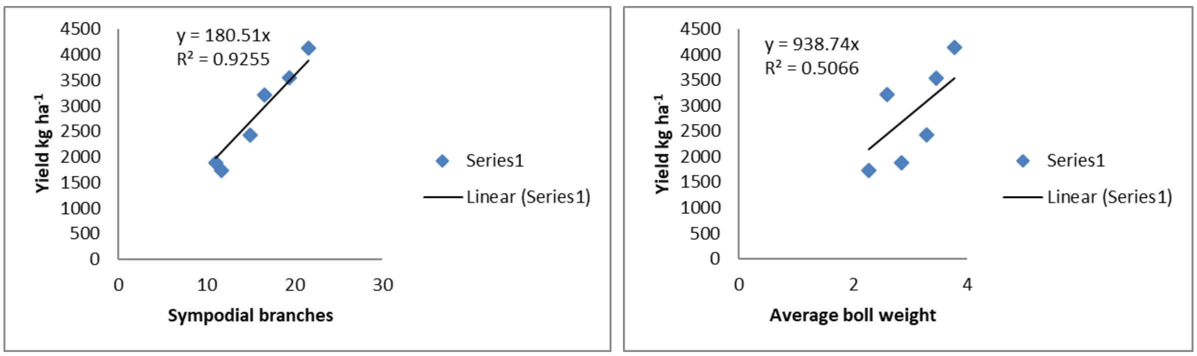

Fig. 2: Relationship of sympodial branches and average boll weight with seed cotton yield (kg ha^{-1}).

In conclusion, early planting (15th May) enhanced seed cotton yield by 45% over late planting (15th June). Hence, it was proved that selection of suitable cultivar (FH-142) was helpful to sustain and optimize yield.

Authors' contributions

All authors contributed equally in this manuscript.

REFERENCES

Ali H, MN Afzal, S Ahmad and D Muhammad, 2009. Effect of cultivars and sowing dates on yield and quality of *Gossypium hirsutum* L. Crop. Journal of Food Agriculture and Environment, 7: 244-247.

Arshad M, A Wajid, M Maqsood, K Hussain, M Aslam, and M Ibrahim, 2007. Response of growth, yield and quality of different cotton cultivars to sowing dates. Pakistan Journal of Agricultural Sciences, 44: 208-212.

Awan H, I Awan, M Mansoor, EA Khan and MA Khan, 2011. Effect of sowing time and plant spacing on fiber quality and seed cotton yield. Sarhad Journal of Agriculture, 27: 411-413.

Bange MP and SP Milroy, 2004. Growth and dry matter partitioning of diverse cotton genotypes. Field Crops Research, 87: 73-87.

Deho ZA, S Laghari, S Abro, MA Arain, SA Abro and Fakharuddin, 2009. Evaluation of cotton released/candidate varieties under different sowing dates at Tandojam conditions. Pakistan Journal of Biotechnology, 6: 109-113.

Ehsan F, A Ali, MA Nadeem, M Tahir and A Majeed, 2008. Comparative yield performance of new cultivars of cotton (*Gossypium hirsutum* L.). Pakistan Journal of Life and Social Sciences, 6: 1-3.

GOP (Government of Pakistan), 2014. Economic survey of Pakistan 2013-14. Ministry of Food, Agriculture and Livestock, (Federal Bureau of Statistics), Islamabad, Pakistan, pp: 23-41.

Hunt R, 1978. Plant Growth Analysis. The Institute of Bio Studies in Bio Edward Arnold (Pub.) Ltd., 96: 8-38.

Iqbal J, SA Wajid, A Ahmad and M Arshad, 2012. Comparative studies on seed cotton yield in relation to nitrogen rates and sowing dates under diverse agro-environment of Punjab. Pakistan Journal of Science, 64: 59-63.

Muhammad D, MM Anwar, and MN Afzal, 2002. Evaluation of different cotton varieties at different sowing dates. Basic and Applied Ecology, 19: 7-13.

Rasul G, QZ Chaudhry, A Mahmood and KW Hyder, 2011. Effect of temperature rise on crop growth and productivity. Pakistan Journal of Meteorology, 15: 53-62.

Reddy KR, PR Doma, LO Mearns, MYL Boone, HF Hodges, AG Richardson and VG Kakani, 2002. Simulating the impacts of climate change on cotton production in the Mississippi Delta. Climate Research, 22: 271-281.

Steel RGD, JH Torrie, and DA Dickey, 1996. Principles and Procedures of Statistics. A Biometrical Approach 3rd Ed McGraw Hill Book. International Co. New York, USA, pp: 400-428.

Wajid A, A Ahmad, T Khaliq, S Alam, A Hussain, K Hussain, W Naseem, M Usman, and S Ahmad, 2010. Quantification of growth, yield and radiation use efficiency of promising cotton cultivars at varying nitrogen levels. Pakistan Journal of Botany, 42: 1703-1711.