RESEARCH ARTICLE

EFFECT OF DATE OF SOWING ON GROWTH AND DEVELOPMENT OF COTTON

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Abstract: A field experiment was conducted during *kharif* seasons of 2013-14 at Main Cotton Research Station, Navasari Agricultural University, Surat to assess the effect of environment on cotton growth and development. The experiment was laid out in split plot Design comprising three dates of sowing as main plot and six genotypes as sub plot treatments replicated thrice. The result was indicated that no of days and GDD required to attain different phenological stages are significantly higher in normal sown condition. *Bt* hybrids required less no. of days and GDD to attain all phenological stage as compare to Non *Bt* Hybrids. G.Cot. Hy-8 BG-II was required lower GDD and days to attain all phenological stages. The Plant height, no. of sympodia, no. of bolls per plant and seed cotton yield was significantly decreased in delayed sown condition. ANKUR-3028 BG-II has significantly higher plant height, no. of sympodia, no. of bolls per plant and seed cotton yield as compare to other genotypes.

Keyworlds: Cotton, Climate change, Date of sowing, GDD, Growth

INTRODUCTION

Climate change is extremely affecting agriculture production. Deviation in temperatures will eventually reduce yields and increase the incidence of pests and diseases. Changes in precipitation are likely to lead to crop failures and production declines. There will be some gains depending on crops grown and regions. This evaluation applies largely to the regional impacts of cotton production (Cotton and Climate Change, 2011). In India cotton is the crop which affects the GDP of India. Cotton is stand for long time in the field and encounter different environments during their life cycle of 150 days to 210 days. The temperature and Growing Degree Days (GDD) represent two important spatially-dynamic climatic variables, as both play vital roles in influencing forest development by directly affecting plant functions such as evaporation, photosynthesis, plant respiration, plant water and nutrient movement. Crop growth and development refers to the increase in crop height, volume or area and weight in a certain time scale (Gudadhe *et al.*, 2013). The seed cotton yield per unit area is affected by a number of factors including land selection, sowing time, weeding, irrigation, chemical fertilizers etc. Of these, sowing period plays significant role in crop production process (Varlev *et al*., 2000 and Mohammad *et al*., 2015). Ariyo (1987) evaluated sowing 15 okra genotypes in 5 different environments and the results showed a significant environmental effect for all studied characters. Olasantan and Olowe (2006) reported that sowing dates significantly affected on vegetative growth, flowering, fruiting and harvesting stages (El-Waraky, Y. B., 2014). Climate change will impact on many facets of cotton physiology.

An integrative research process will be needed to assess the exact effect of climate change will have on cotton production (Michael Bange, 2007). Thereof, in this study effect of date of sowing on cotton growth and development has been carried out.

MATERIAL AND METHOD

A field experiment was conducted during *Kharif*-2013 at Main Cotton Research Station, Navasari Agricultural University, Surat to assess the effect of environment on cotton growth and development. The soils of the experimental field was clayey in texture having pH 7.3, medium in organic carbon (0.42 %) and available phosphorus and high in available potash (565 kg/ha).The experiment was laid out in split plot Design comprising three dates of sowing viz., D-1= early sowing (20 June 2013), D-2= normal sowing (11 July 2013), iii) D-3= Delayed sowing (6 August 2013) as main plot and six genotypes namely NCS-145 BG-II, RAH-100, G.Coy. Hy.-8 BG-II, G.Cot. Hy. 12, ANKUR-3028 BG-II, FHH-141as sub plot treatments replicated thrice. 1.20 m x 0.45 m plant spacing was kept and fertilized with 240:40:00 N:P:K. In each plot recommended agronomic practices were followed and plant stand was uniformly maintained. The observation were recorded on five randomly selected plants form each plot at harvest for all the traits viz., plant height, No. of sympodia, and yield components *viz.*, number of bolls per plant, average boll weight (g), and seed cotton yield per plant (g). The weather conditions *viz.*, rainfall, temperature and relative humidity were obtained from the main cotton Research Station, Surat. Heat units accumulated in each stage were calculated as per the equation (Growing degree days = $\sum[(T_{max} + T_{min}) /2 - T_b]$, T_b: base temperature. Statistical analysis was carried out at 5% level for

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significance, with date of sowing as main plot and genotypes as sub plot.

RESULT AND DISCUSSION

Phenology

Result showed that days required to attain different phonological stages differ significantly due to different dates of sowing and genotypes (Table-1). There was significant difference between dates of sowing for all phenological stages. The days to 50 % squaring, days to 50 % flowering, days to 50 % boll opening and days to maturity was significantly reduced as observed in delayed sowing (D-2) and early sowing. The genotype, G. Cot Hybrid-8 BG-II was earliest considering all phenological stages followed by Ankur-3028 BG-II while RAH-100 was required more days for all phonological stage. The interaction of sowing dates and genotype for all phonological stage except maturity days showed significant. G. Cot Hybrid-8 BG-II sown in early condition required less days for 50% squaring, 50% flowering and 50% boll opening followed by G. Cot Hybrid-8 BG-II sown in delayed condition and NCS-145 BG-II and ANKUR-3028 BG-II sown in early condition. while RAH-100 sown in normal condition was required more days for 50% squaring, 50% flowering and 50% boll opening followed by RAH-100 sown in delayed condition and LHH-144 sown in normal condition. Similar result was observed by Ghulam *et al.* (2014) and Mohammad *et al*. (2015), The result was also in accordance with result found by Sikder (2009) and Taher *et al.* (2015) for wheat.

Growing Degree Days (GDD)

The growing degree days to attain different physiological stage for cotton genotypes in different climate are presented in table -2. No. of GDD required was significantly lower in early sown condition for 50 % squaring, 50 % flowering, 50 % boll opening, while significant reduction was observed in number of GDD for maturity in late sown condition. The Genotype RAH-100 required significantly higher no of GDD for 50 % squaring, 50 % flowering, 50 % boll opening and maturity. The trend also showed that non Bt hybrids required higher no of GDD as compared to Bt hybrids for all phonological stage. The similar results were reported by Hebbar *et al.* (2002), Gudadhe *et al.* (2013) and Bandhopadhyay *et al.* (2008).

Plant height and sympodia per plant

The plant height and number of sympodia at harvest showed significant difference due to date of sowing and genotypes (Table-3). The plant height and number of sympodia were significantly reduced under delayed sowing whereas significant higher in early sowing and it was at par with normal sowing. Mohammad *et al.* (2015) who was reported that plant height and number sympodia per plant was significantly higher in early sown date. Plant height was significantly higher in ANKUR-3028 BG-II (114 cm) while G.Cot. Hy-8 BG-II showed significantly lower plant height. No of sympodia was observed significantly higher in ANKUR-3028 BG-II and it was at par with G.Cot. Hy-8 BG-II and NCS-145 BG-II. The significant interaction was observed for plant height. ANKUR-3028 BG-II sown in early condition attended significant higher plant height which was at par with G.Cot. Hy-12 sown in early condition and ANKUR-3028 BG-II sown in Normal condition. Plant height was observed significantly lower for G.Cot. Hy-8 BG-II sown in delayed condition which was at par with G.Cot. Hy-12 and RAH-100 sown in delayed condition. The plant height was significantly affected due to environment and genotypes (Hussain *et al.* 2007).

Yield and yield component

Table 4 showed that the significant reduction was observed in mean number of bolls in delayed sowing. Significantly higher no. of ball was observed in genotype ANKUR-3028 BG-II which was at par with G.Cot. Hy-8 BG-II. The average boll weight was significantly reduced for delayed sowing. Significantly higher boll weight was observed in ANKUR-3028 BG-II which was at par with NCS-145 BG-II. Plant seed cotton yield attain significantly higher in early sowing and it was at par with normal sowing. The genotype Ankur-3028 BG-II recorded significantly highest seed cotton yield per plant (118 g) over rest of the genotypes. Interaction for sowing date and genotype was significant. Ankur-3028 BG-II recorded significantly highest seed cotton yield per plant sown in early condition while LHH-144 showed lowest seed cotton yield per plant in delayed sawn condition. The seed cotton yield was significantly lower in late sown condition was also reported by Mohammad *et al.* (2015), Khalid *et al*. (2016).

Table 1. Phenological parameters in cotton genotypes under early, normal and delayed sown condition during *kharif 2013.*

Genotypes	Phenological Stages															
	Days to 50 % squaring				Days to 50 % flowering				Days to 50 % boll opening				Days to maturity			
	D-1	**D-2**	**D-3**	**mean**	**D-1**	**D-2**	**D-3**	**mean**	**D-1**	**D-2**	**D-3**	**mean**	**D-1**	**D-2**	**D-3**	**mean**
NCS-145 BG-II	65	70	67.3	**67.4**	83.7	90.3	84.3	**86.1**	128.7	133.3	132.3	**131.4**	149.3	167.3	151.7	**156.1**
RAH-100	67	77.3	75	**73.1**	85.3	99	95	**93.1**	129.7	141.3	142.7	**137.9**	154.3	172.3	161.3	**162.7**
G.Cot. Hy-8 BG-II	60	65	63.3	**62.8**	77.3	85.7	81.3	**81.4**	120.3	130.3	129.7	**126.8**	141.0	162.7	147.3	**150.3**

G.Cot. Hy-12	71	71	69.7	**70.6**	90.3	94	86.7	**90.3**	133.3	137.7	136.7	**135.9**	153.0	171.0	155.3	**159.8**
ANKUR-3028 BG-II	65	67.3	65.3	**65.9**	82.3	88	84.7	**85.0**	123.3	135.3	130.3	**129.6**	144.3	162.7	149.3	**152.1**
LHH-144	71	74.7	69.3	**71.7**	89.3	95.7	89.3	**91.4**	131	140.7	137.7	**136.5**	151.7	174.3	156.7	**160.9**
Mean	**66.5**	**70.9**	**68.3**		**84.7**	**92.1**	**86.9**		**127.7**	**136.4**	**134.9**		**127.7**	**136.4**	**134.9**	
LSD (p≤0.05)																
Sowing Dates (D)	1				1.8				1.2				0.8			
Genotype (V)	1				1				1.6				2			
D x V	1.8				1.8				2.7				NS			

Table 2. Growing degree days required by cotton genotypes under early, normal and delay sown condition during *kharif 2013*

Genotype	Growing Degree Days															
	Days to 50 % squaring				Days to 50 % flowering				Days to 50 % boll opening				Days to maturity			
	D-1	**D-2**	**D-3**	**mean**	**D-1**	**D-2**	**D-3**	**mean**	**D-1**	**D-2**	**D-3**	**mean**	**D-1**	**D-2**	**D-3**	**mean**
NCS-145 BG-II	1204	1307	1292	**1268**	1564	1699	1636	**1633**	2451	2515	2473	**2480**	2837	3064	2745	**2882**
RAH-100	1240	1447	1450	**1379**	1598	1872	1836	**1769**	2472	2661	2619	**2584**	2922	3136	2875	**2978**
G.Cot. Hy-8 BG-II	1107	1206	1215	**1176**	1439	1607	1574	**1540**	2285	2466	2435	**2395**	2688	2996	2686	**2790**
G.Cot. Hy-12	1314	1327	1338	**1327**	1700	1769	1680	**1716**	2544	2590	2532	**2555**	2900	3117	2795	**2937**
ANKUR-3028 BG-II	1204	1254	1254	**1237**	1537	1654	1643	**1611**	2346	2549	2444	**2447**	2748	2997	2712	**2819**
LHH-144	1314	1403	1332	**1350**	1680	1802	1729	**1737**	2499	2648	2546	**2564**	2877	3162	2813	**2951**
Mean	**1231**	**1324**	**1313**		**1586**	**1734**	**1683**		**2433**	**2571**	**2508**		**2829**	**3079**	**2771**	
LSD (p≤0.05)																
Sowing Dates (D)	20.7				36.8				20.8				13.2			
Genotype (V)	20.6				20				27.6				31.6			
D x V	38.2				47.8				48.1				NS			

Table 3. Growth characters in cotton genotypes under early, normal and delay sown condition during *kharif 2013*

Genotype	Plant Height (Cm)				Number of sympodia per plant			
	D-1	D-2	D-3	mean	D-1	D-2	D-3	mean
NCS-145 BG-II	116.0	113.7	88.3	**106.0**	23.7	23.4	18.8	**22.0**
RAH-100	106.0	102.5	85.6	**98.0**	20.7	19.7	14.8	**18.4**
G.Cot. Hy-8 BG-II	97.7	89.7	74.6	**87.3**	23.3	23.8	19.7	**22.3**
G.Cot. Hy-12	126.0	108.7	81.4	**105.4**	21.7	21.1	16.2	**19.7**
ANKUR-3028 BG-II	126.3	125.1	90.7	**114.0**	24.3	24.0	18.8	**22.4**
LHH-144	111.0	111.0	87.9	**103.3**	21.7	21.0	15.9	**19.5**
Mean	**113.8**	**108.5**	**84.8**		**22.6**	**22.2**	**17.4**	
LSD (p≤0.05)								
Sowing Dates (D)	7.74				2.69			
Genotype (V)	5.8				2.78			
D x V	10.04				NS			

Table 4. Yield contributing characters in cotton genotypes under early, normal and delay sown condition during *kharif 2013*

Genotype	No. of Bolls per plant				Avg. boll wieght (g)				Seed cotton yield per plant (g)			
	D-1	D-2	D-3	mean	D-1	D-2	D-3	mean	D-1	D-2	D-3	mean
NCS-145 BG-II	39.8	38.3	28.7	**35.6**	3.1	3.7	3.3	**3.4**	124.7	124.9	65.9	**105.2**

RAH-100	32.0	31.7	24.0	**29.2**	2.5	3.0	2.6	**2.7**	80.7	83.3	51.5	**71.8**
G.Cot. Hy-8 BG-II	43.4	38.0	29.0	**36.8**	2.7	3.4	3.0	**3.0**	115.7	107.1	67.6	**96.8**
G.Cot. Hy-12	34.3	34.0	28.3	**32.2**	2.6	3.1	2.7	**2.8**	102.3	101.4	64.9	**89.5**
ANKUR-3028 BG-II	45.7	40.3	31.3	**39.1**	3.2	3.8	3.4	**3.5**	144.3	136.6	73.0	**118.0**
LHH-144	28.2	28.3	23.7	**26.7**	2.5	3.1	2.6	**2.7**	79.0	76.2	50.2	**68.5**
Mean	**37.2**	**35.1**	**27.5**		**2.8**	**3.4**	**2.9**		**107.8**	**104.9**	**62.2**	
LSD (p≤0.05)												
Sowing Dates (D)	4.03				0.08				12.59			
Genotype (V)	3.16				0.16				8			
D x V	NS				NS				13.85			

REFERENCES

Ariyo, O.J. (1987). Stability of performance of okra as influenced by planting date. *Theor. Appl. Genet*, 74: 83- 86.

Bandhopadhyay *et al.* (2008). Predicting cotton production using infocrop-cotton simulation model, remote sensing and spatial agro-climatic data. *Current Science*, 95(11): 1570-1579.

Cotton and Climate Change: (2011). Impacts and Options to Mitigate and Adapt. International Trade Centre (ITC). Geneva: ITC, xii, 32

El-Waraky, Y. B. (2014). Effect of Sowing Date, Plant Density and Phosphorus Fertilization on Seed Yield of Okra. *Alex. J. Agric. Res.*, 59(1): 27-41.

Ghulam, M., Ehsanullah, Saif-ul-Malook, Muhammad, S., Muhammad, K. Shahbaz, U. C. and Qurban, A. (2014). A review of production for various Bt and non Bt cotton varieties in Pakistan. *Nature and Science*, 12(11): 81-91.

Gudadhe, N. N., Neeraj, K., Pisal, R. R., Mote, B. M. And Dhonde, M. B. (2013). Evaluation of Agrometeorological Indices in Relation to Crop Phenology of Cotton (Gossipium spp.) and Chickpea (Cicer aritinum L.) at Rahuri Region of Maharashtra. *Trends in Biosciences*,6 (3): 246-250.

Hebbar, K. B., Venugopalan, M. V., Rao, M. R. K., Gadade, G. D., Chatterji, S., and Mayee, C. D. (2002). Effect of sowing dates and fertilizer levels on phenology, growth and yield of cotton. *Indian Journal of Plant Physiology*, 7(4): 380–383.

Hussain, M., Ahmad, A. and Zamir, S.I. (2007). Evaluation of agro-qualitative characters of five cotton cultivars (*Gossypium hirsutum* L.) grown under Toba Tek Singh conditions. *Pak. J. Agri. Sci*., 44(4): 575-580.

Khalid, U., Ayatullah, Niamatullah, K. And Sohrab, K. (2016). Genotype-by-sowing date interaction effects on cotton yield and quality in irrigated condition of dera ismail khan, pakistan. *Pak. J. Bot*., 48(5): 1933-1944.

Michael, Bange (2007). Effects of climate change on cotton growth and development. *The Australian Cottongrower*, June-July: 41-45.

Mohammad, S., Akram, S., Abdul, R., Jamil, K., Muhammad, Y., Adnan, N. S., Nadil, S., Allah, B., Muhammad, Y. B. (2015). Influence of Different Planting Scheduling and Cultivar on the Growth and Yield of Cotton Crop. *Journal of Biology, Agriculture and Healthcare*, 5 (1) : 192-203.

Olasantan, F. O. and Olowe, V.I. (2006). Effect of sowing dates on response of okra (Abelmoshus esculentus) to intercropping with contrasting cassava cultivars. *International J. Tropical Agric*, 24: 1 – 2.

S. Sikder. (2009). Accumulated Heat Unit and Phenology of Wheat Cultivars as Influenced by Late Sowing Heat Stress Condition. Journal of Agriculture & Rural Development, **7**(1&2): 57-64.

Taher, B. F., Eman, I. El., Mosaad, K. H., and Ahmed, M. (2015). Evaluation and prediction of some wheat cultivars productivity in relation to different sowing dates under North Sinai region conditions. *Annals of Agricultural Science*, 60(1): 11–20.

Varlev, I., Popova, Z. and Gospodinov, I. (2000). Cotton sowing technologies. Productivity enhancement in cash crops. *Proc. 1st Int. Conf. Lisbon, Portugal, September*, 311-319.