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Effect of Sowing Date on Crop Phenology, Growth, Development and Yield in Cotton Hybrids

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ABSTRACT

In the current scenario of changing climate throughout the world, identification of suitable crop genotypes for the future predicted climate is gaining importance. An experiment was conducted using six cotton hybrids grown with two dates of sowing D1(Normal) and D2 (Delay) in RBD design at Agricultural Research Station, University of Agricultural Sciences, Dharwad, Karnataka during Kharif 2012. The hybrids were evaluated for genotypic variability for growth, phenological, biophysical parameters, yield and yield attributing characters under rainfed condition. The results indicated that the number of days to 50% boll opening was more in D1(142.1 days) as compared to D2(133.4). The duration of boll growth in D1 was 59.38 days while in D2 it was 46.39 days. Significant increase in boll weight of all the hybrids in D2 was observed as compared to D1. The yield increase was about 25.82% in D1 compared to D2. Further, there was decrease in LAI, SPAD readings and number of monopodia in D2 as compared to D1, which is the main reason for decrease in seed cotton yield in D2.

Key words: *Dates of sowing, TDM, LAI, SPAD and Phosynthetic rate*

INTRODUCTION

Cotton occupies a prime position among the commercial crops grow in India. It is an important crop grown for fiber, fuel and edible oil. It is cultivated in about 9.0m ha in the country. In Andhra Pradesh alone, it is grown in an area 10.46 lakh, ha producing 43.9 lakh bales mainly under rainfed conditions. Cotton plant has indeterminate growth habit, which is greatly influenced by the time of sowing due to different environment conditions. Cotton being a long duration crop, should be sown at the earliest, so as to provide an optimum seasonal conditions coinciding with the vegetative and reproductive phase to exploit the full potential of the variety[2]. Delay in the time of sowing resulted in reduced yield and it was mainly due to production of less number of buds and bolls in addition to the increased boll worm attack. The preliminary investigations on recently introduced Bt. Cotton indicated that the Bt. Hybrids are early in maturity and resistant to boll worms.

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As cotton is grown mainly under rainfed conditions, in Andhra Pradesh, sometimes the sowings may be delayed due to unfavorable climatic conditions i.e., delayed monsoon or continues heavy rains. The present investigation is taken up with an idea for finding the suitability of Bt. Cotton with respect to yield and quality under delayed sowing conditions and also to know the variation in physiology of cotton both in Cotton due to delayed sowing.

MATERIALS AND METHODS

The field experiment was conducted with six cotton hybrids sown on two dates of sowing D1(Normal) and D2 (Delay) at 15 days' interval during kharif 2012 at Agricultural Research Station, Dharwad Farm, University of Agricultural Sciences, Dharwad, Karnataka, India. The six Bt cotton hybrids are Bunny BG-II, G.Cot-Hy-8, G-cot-Hy-12, LHH-144 /12, Ankur-0328 Bt and RAH-100. First date of sowing was 03-07-2012 (D1) and second was 18-07-2012 (D2). The crop was raised following recommended package of practices. Weather parameters for the crop growing season were recorded from the meteorological observatory of research station.

Leaf photosynthetic rate was determined with infrared gas analyzer (IRGA) (LiOCOR-1600). The measurements were performed between 1000 and 1300 h at PARX1700 $mmolm^{-}2\ s^{-}1$ during cloud-free days on four randomly selected plants per plot during 50% flowering stage and the mean was recorded. Leaf area index (LAI) was measured by canopy analyzer and leaf chlorophyll content was measured by SPAD meter (chlorophyll content). Growth and yield attributes on plan basis was recorded as mean of five plants. Yield on hectare basis was worked out from net plot yield.

RESULTS AND DISCUSSION

1. Morphological Parameters

Plant height:

Plant height differed significantly between the dates of sowing, genotypes and their interaction (Table 1). Among the dates of sowing D1 recorded significantly less plant height (61.7 cm) as compared to D2 (65.6 cm). Among the genotypes, Bunny Bt BG-II recorded the highest plant height (73.1 cm) while G cot Hy-8 recorded the least (59.9 cm). In first data of sowing (D1) and second date of sowing Bunny Bt BG-II recorded the highest plant height (73.8 and 72.5 cm respectively), where as in D1 G cot Hy-8 recorded the least (50.8) and in D2 DHH-263 recorded the least (61.2).

No of sympodia and No of Monopodia/ plant:

There were significant differences between the genotypes for number of sympodia /plant. But there were no significant differences between dates of sowing or the interaction effects. Among the genotypes Bunny Bt BG-II recorded the highest of number of sympodia (17.63) while G cot Hy-8 recorded the least (14.13). There was no significant difference for number of monopodia for dates of sowing or genotypes or their interaction (Table 1).

Total dry matter:

The total dry matter differed among genotypes only. The dates of sowing and the interaction effects were non significant. Among the genotypes Gcot Hy-12 recorded significantly highest TDM (102.7 g/plant) while G.cot Hy-8 recorded significantly least TDM (82.5 g/plant) (Table 1). Result are in accordance with the results presented by Satyanarayanrao and Setty[5] wherein they indicated that the lower dry matter production was due to low leaf area index under delayed sown conditions.

2. Phenological parameters

No of days to 50% squaring:

There was significant difference between the dates of sowing and genotypes. However, the interaction effects were non significant (Table 2). The number of days for 50% squaring in D1 was 62.7 days which was significantly early as compared to D2 which recorded 66.3 days. Among the genotypes LHH 144/12 recorded least days for 50% squaring (62.8) while Bunny Bt BG-II and Ankur-028 Bt BG-II recorded significantly more number of days (65.7 and 65.5 days respectively).

No of days to 50% flowering:

The dates of sowing and the genotypes differed significantly in number of days to 50% flowering while the interaction effects were non significant (Table 2). Among the dates early sowing (D1) recorded significantly less number of days for 50% flowering (82.5 days) where as in D2 86.7 days were recorded. Among the genotypes LHH-144/12 recorded the least number of days for 50% flowering (83.5) while Bunny Bt BG-II recorded the significantly more number of days for 50% flowering (86.2).

No of days to 50% boll opening:

There was significant difference between the dates of sowing and genotypes for number of days to 50% boll opening. But their interaction effects were non significant. Among the dates D1 recorded significantly more number of days for 50% boll opening (142.3 days) while D2 took least number of days (133.7 days). Among the genotypes Bunny Bt BG-II took least number of days (136.7), while LHH-144/12 took highest number of days (139.2) days for 50% boll opening.

3. Physiological parameters:

Photosynthesis rate:

The rate of photosynthesis showed non significant difference between the dates and the interaction effects. However, there was significant difference between the genotypes. Among the genotypes, Bunny Bt BG-II recorded significantly high rate of photosynthesis (16.5) while LHH-144/12 recorded the least (11.77) (Table 3).

Leaf area index:

There were significant differences for genotypes. However, there was no significant difference between dates and interaction effects. Among the genotypes, G cot Hy-12 recorded the highest LAI (2.97) while G cot Hy -8 recorded the least (2.35) (Table 3).

Chlorophyll content (SPAD readings):

There was significant difference among the genotypes for SPAD readings but the effects of dates of sowing and the interaction effects were non significant (Table 3). Among the genotypes G cot Hy-8 recorded highest SPAD readings while G cot Hy-12 recorded significantly less value (40.94).

4. Yield and yield parameters

Seed cotton yield:

The **s**eed cotton yield of the cotton hybrids at two dates of sowing is presented in Table 4. There was significant difference between dates of sowing and genotypes and their interaction. There was significant difference between dates of sowing. The first date of sowing D1 recorded significantly more yield (765 kg/ha) as compared to D2 (608 kg/ha). Among the genotypes Bunny Bt BG-II recorded highest yield (881 kg/ha) followed by Ankur-028 Bt BG-II, while the hybrid LHH-144/12 (474 kg/ha) recorded the least yield followed by G. Cot Hy-8 (592 kg/ha). The results are in agreement with Sivasankaran *et al*[6]., Buttar *et al*[1]., Lalage *et al*[3]., and Sankarnarayana *et al*[4]., where in they reported that irrespective of varieties sowing recorded higher yield and further Bt.cotton varieties recorded higher yield compared to non Bt's.

No. of bolls / plant:

There was no significant difference between the dates of sowing and the interaction effects. However, the genotypes differed significantly. Among the genotypes, Bunny Bt BG-II recorded significantly more number of bolls (19.6) followed by Ankur-028 Bt BG-II while LHH-144/12 recorded the least number of bolls (12.2).

Boll weight:

The boll weight showed non significant difference between dates of sowing and the interaction effects. But there was significant difference between the genotypes. Among the genotypes Bunny Bt BG-II recorded significantly more boll weight (5.43 g/boll) followed by Ankur-028 Bt BG-II (4.83 g/boll) while, DHH-263 recorded the least boll weight (4.23g/boll) followed by LHH-144/2 (4.24).

Table 1: Morphological parameters in cotton hybrids

Sl. No.	Genotypes	Plant Height (cm)	Monopodia (No./Plant)	Symopodia (No./Plant)	Total dry matter (g/plant)
	D1				
1	Bunny BG-II	73.8	2.47	17.20	80.67
2	Ankur -028 BG-II	69.9	2.00	17.23	88.33
3	G.Cot-Hy-8	50.8	1.80	13.60	86.33
4	LHH-144 /12	56.9	2.00	14.20	99.33
5	DHH-263	69.6	2.07	14.33	111.33
6	G-cot-Hy-12	61.5	2.33	15.60	101.67
	Mean	**63.74**	**2.11**	**15.36**	**94.61**
	D2				
1	Bunny BG-II	72.5	1.47	18.07	93.67
2	Ankur -028 BG-II	70.1	1.60	17.27	104.67
3	G.Cot-Hy-8	66.9	1.40	14.67	78.67
4	LHH-144 /12	64.5	1.67	14.20	95.33
5	DHH-263	61.2	1.47	13.93	93.67
6	G-cot-Hy-12	65.3	1.13	14.47	103.67
	Mean	**66.74**	**1.46**	**15.43**	**94.94**
	D1 & D2 Mean				
1	Bunny BG-II	73.1	1.97	17.63	87.2
2	Ankur -028 BG-II	70.0	1.80	17.25	96.5
3	G.Cot-Hy-8	58.9	1.60	14.13	82.5
4	LHH-144 /12	60.7	1.83	14.20	97.3
5	DHH-263	65.4	1.77	14.13	102.5
6	G-cot-Hy-12	63.4	1.73	15.03	102.7
G. Mean		**65.2**	**1.78**	**15.40**	**94.8**
For comparing :					
	SEm ±	**0.22**	**0.17**	**0.28**	**2.59**
	CD @ 5%	**1.31**	**NS**	**NS**	**NS**
Genotypes (G)					
	SEm ±	**1.99**	**0.14**	**0.54**	**5.07**
	CD @ 5%	**5.88**	**NS**	**1.59**	**14.95**
Interaction (DxG)					
	SEm ±	**2.82**	**0.20**	**0.77**	**7.17**
	CD @ 5%	**8.31**	**NS**	**NS**	**NS**

Table 2: Phenological parameters in Cotton hybrids

Sl. No.	Genotypes	Days to 50% flowering	Days to 50% squaring	Days to 50% boll opening
	D1			
1	Bunny BG-II	83.67	63.00	141.0
2	Ankur-028 BG-II	83.33	63.33	142.0
3	G.Cot-Hy-8	81.67	61.67	143.0
4	LHH-144 /12	82.00	61.67	143.3
5	DHH-263	83.00	64.00	141.0
6	G-cot-Hy-12	82.67	62.67	142.3
	Mean	**82.72**	**62.72**	**142.11**
	D2			
1	Bunny BG-II	88.67	68.33	132.3
2	Ankur -028 BG-II	88.00	67.67	132.0
3	G.Cot-Hy-8	87.67	66.67	133.0
4	LHH-144 /12	85.00	64.00	135.0
5	DHH-263	85.67	65.67	134.7
6	G-cot-Hy-12	87.33	67.33	133.7
	Mean	**87.06**	**66.61**	**133.44**
	D1 & D2 Mean			
1	Bunny BG-II	86.2	65.7	136.7
2	Ankur -028 BG-II	85.7	65.5	137.0
3	G.Cot-Hy-8	84.7	64.2	138.0
4	LHH-144 /12	83.5	62.8	139.2
5	DHH-263	84.3	64.8	137.8
6	G-cot-Hy-12	85.0	65.0	138.0
G. Mean		**84.9**	**64.7**	**137.8**
For comparing :				
Dates (D) **SEm ±** **CD @ 5%**		**0.41** **2.51**	**0.28** **1.67**	**0.23** **1.43**
Genotypes (G) **SEm ±** **CD @ 5%**		**0.53** **1.57**	**0.54** **1.59**	**0.41** **1.21**
Interaction (DxG) **SEm ±** **CD @ 5%**		**0.75** **NS**	**0.77** **NS**	**0.58** **NS**

Table 3: Physiological parameters in Cotton hybrids

Sl. No.	Genotypes	Photosynthetic rate (μ mol co_2/ m^2/ s^{-1})	Leaf area index	SPAD Values
	D1			
1	Bunny BG-II	15.13	3.12	42.30
2	Ankur -028 BG-II	15.23	3.06	44.90
3	G.Cot-Hy-8	13.17	3.12	46.30
4	LHH-144 /12	13.53	2.40	46.37
5	DHH-263	14.53	3.52	44.63
6	G-cot-Hy-12	14.4	3.31	41.87
	Mean	**14.33**	**3.09**	**44.40**
	D2			
1	Bunny BG-II	16.50	2.44	41.23
2	Ankur -028 BG-II	15.37	2.40	41.07
3	G.Cot-Hy-8	12.87	2.35	45.27
4	LHH-144 /12	11.77	2.65	44.33
5	DHH-263	14.23	2.69	42.83
6	G-cot-Hy-12	15.03	2.97	40.00
	Mean	**14.30**	**2.58**	**42.46**
	D1 & D2 Mean			
1	Bunny BG-II	15.82	2.78	41.77
2	Ankur -028 BG-II	15.30	2.73	42.99
3	G.Cot-Hy-8	13.02	2.74	45.79
4	LHH-144 /12	12.65	2.53	45.35
5	DHH-263	14.38	3.11	43.73
6	G-cot-Hy-12	14.72	3.14	40.94
G. Mean		**14.31**	**2.84**	**43.43**
For comparing :				
Dates (D)				
	SEm ±	**0.28**	**0.21**	**0.59**
	CD @ 5%	**NS**	**NS**	**NS**
Genotypes (G)	**SEm ±**	**0.54**	**0.14**	**0.61**
	CD @ 5%	**1.60**	**0.41**	**1.79**
Interaction (DxG)				
	SEm ±	**0.77**	**0.19**	**0.86**
	CD @ 5%	**NS**	**NS**	**NS**

Table: 4: Yield and yield parameters in cotton hybrids

Sl. No.	Genotypes	Seed cotton yield (Kg/ha)	Boll wt. (g/boll)	Number of bolls/plant
	D1			
1	Bunny BG-II	1011	5.28	20.47
2	Ankur-028 BG-II	1035	4.65	18.20
3	G.Cot-Hy-8	604	4.00	14.60
4	LHH-144 /12	545	4.03	10.33
5	DHH-263	726	4.15	16.40
6	G-cot-Hy-12	672	4.50	17.33
	Mean	**765**	**4.44**	**16.22**
	D2			
1	Bunny BG-II	751	5.58	18.80
2	Ankur -028 BG-II	680	5.00	19.13
3	G.Cot-Hy-8	580	4.67	15.60
4	LHH-144 /12	404	4.45	14.07
5	DHH-263	567	4.30	14.27
6	G-cot-Hy-12	666	4.92	15.60
	Mean	**608**	**4.82**	**16.24**
	D1 & D2 Mean			
1	Bunny BG-II	881	5.43	19.6
2	Ankur -028 BG-II	857	4.83	18.7
3	G.Cot-Hy-8	592	4.33	15.1
4	LHH-144 /12	474	4.24	12.2
5	DHH-263	646	4.23	15.3
6	G-cot-Hy-12	669	4.71	16.5
G. Mean		**687**	**4.63**	**16.2**
For comparing :				
Dates (D) **SEm ±** **CD @ 5%**		**22.1** **134.4**	**0.16** **NS**	**0.35** **NS**
Genotypes (G) **SEm ±** **CD @ 5%**		**39.3** **115.8**	**0.17** **0.51**	**1.00** **2.95**
Interaction (DxG) **SEm ±** **CD @ 5%**		**55.5** **163.7**	**0.25** **NS**	**1.41** **NS**

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