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Evaluation of American cotton genotypes for morphological and growth parameters

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Abstract
Cotton is a cash crop of India and it plays a key role in the economy of the country for earning of foreign exchange. American cotton (*Gossypium hirsutum* L.) is the highest fibre producing specie of the world. The present study was conducted to check the comparison of morphological data, with check varieties AKH-081, PKV-Rajat and AKH-8828 at Cotton Research Unit, Akola during the year 2016 and 2017. The results of morphological traits revealed that field grown cotton genotypes showed variation in morphological characters and growth parameters. The highest plant height (122.60 cm) at harvest was observed in AKH-1303. Similarly, both maximum leaf area (37.25 dm^2) and total dry matter (68.30g) at harvest was reported in cotton check variety AKH-081 respectively. The best number of leaves (49.30) at harvest was recorded in AKH-1301 genotype. There were significant differences observed in morphological and growth parameters of cotton genotypes. The genotype AKH-1303 showed better performance in case of growth parameters like Leaf area index (2.07) and Absolute growth rate (-0.25g/day) at harvest stage.

Keywords: American cotton, genotypes, morphological, growth parameters

Introduction
Cotton is a cash crop of India and it plays a key role in the economy of the country for earning of foreign exchange. A lot of people get benefits from cotton in garments manufacturing, textile industry, production of edible oil and dairy industry (Ahmad *et al*. 2008) [1]. The significance of American cotton (*Gossypium hirsutum* L.) is obvious from the fact that it is the highest fibre producing species of the world. It has also been documented by numerous researchers in earlier studies that better performance in terms of yield of cotton hybrids over parents has been reported. Therefore, practical advancements are required to elevate the yield of cotton seed through constant selection of best yielding varieties having wide range of adaptation to climatic environments and location specific varietal selection. Diversity in cotton morphological and growth traits has been studied that can lead to identify the phenotypic changes. Hence the choice of best parental lines for prospective cotton breeding must be based on genetics other than geological diversity. In view of the above, present research work carried out with the objective to find out the Evaluation of cotton genotypes for growth and morphological parameters at Cotton Research Unit, Dr. P.D.K.V, Akola (M.S).

Material and methods
The experiment was conducted at experimental field of Cotton Research Unit, Dr. P.D.K.V., Akola, during 2016-17 and 2017-18. The topography of experimental field was fairly uniform, levelled and with a good drainage. The experiment was laid out in RBD design with three replications and twenty seven cotton varieties. The recommended package of practices was followed during the course of the investigation. The observation on growth parameters were recorded at various crop growth stages (60, 90, 120 DAS and at harvest) also yield and yield attributes were recorded. The morphological parameters i.e., plant height, number of leaves, leaf area and dry matter production $plant^{-1}$ and were measured. The seed cotton yield (g/plant) from each net plot was picked and the same weighed separately at each picking. The single boll weight was also recorded. The total seed cotton yield (kg ha^{-1}) worked out by summation of a quantity of seed cotton picked in all pickings. The collected pooled data was statistically analyzed by Panse and Sukhatme (1954) method.

Result and Discussion

1. Plant height (cm)

Plant height is an important morphological character in cotton, which provides seat for nodes and internodes from where monopodial and sympodial branches emerge and it play important role in determining morphological framework relating to productivity. The plant height significantly influenced by genotypes throughout its growth stage (Table 1). At 60 DAS, maximum plant height (61.63 cm) was recorded by genotype AKH-1303 and it successively increases with increase in crop growth stages. At harvest similar genotype recorded maximum plant height i.e. 122.60 cm. Next to that genotype AKH-2013-1 and AKH-2013-1 recorded maximum plant height (90.07 cm) at 90 DAS and (104.13 cm) 120 DAS growth stages. Sekloka *et al.* (2018) [12] recorded plant height in cotton genotypes ranged from 84.5.00-132.3cm while Bhutaka *et al.,* (2018) [2] recorded plant height from 123-127.06 cm which supports present findings.

2. Number of leaves

Number of functional leaves indicate speed of leaf production which provide food material to the plant which indirectly affect the seed cotton yield of the crop. The differences in number of leaves might be due to genetic variation of genotypes. In the present study, at harvest highest number of leaves (49.30) was observed in cotton genotype AKH-1301 while the lowest 27.63 number of leaves reported in AKH-10-3. In mean no. of leaves there were statistical differences observed among the cotton genotypes. Similar to these results (Patil *et al*. 2002; Gulshan *et al*. 2015) [10, 4] also reported that the no. of leaves varies significantly in different genotypes of cotton.

3. Leaf area plant^{-1} (dm^2)

Data in respect of leaf area per plant as influenced periodically by different genotypes (Table 1). The leaf area expanded progressively at 90 DAS. Thereafter, there was a decline in leaf area towards harvest stage due to leaf senescence. At 90 DAS, maximum leaf area per plant (47.72 dm^2) was observed in genotype AKH-1303.It successively decreases with increase in crop growth stage. At 90 DAS and 120 DAS similar genotype recorded maximum leaf area per plant i.e. 47.72 and 46.22 dm^2, respectively. Our results are divergent with that of Nalwade *et al*. (2013) [8], who find out that leaf area was ranged from 3712 to 4721 cm^2 among the tested cotton genotypes. These differences might be due to the differences in genotypes, environmental conditions and nutrients application.

4. Total dry matter plant^{-1} (g)

Total dry matter production per plant increased progressively up to 120 DAS. At harvest dry matter production decreased which was due to leaf senescence and picking of bolls mostly up to 120 DAS. Total dry weight was measured for all cotton genotypes. Variation observed in total dry weight ranging from 61.05 – 68.30g in cotton genotypes. The overall highest total dry matter at harvest among 27 genotypes was 68.30 g in check AKH-081. According to the published information Nalwade *et al.* (2013) [8], Zare *et al*., (2014) [15], Parlawar *et al.* (2017) [9] total dry matter of cotton genotypes were recorded.

5. Leaf area index

Data on leaf area index per plant as influenced periodically by different treatments. Leaf area index per plant was expanded progressively up to 90 DAS and decreased subsequently due to leaf ageing and senescence towards harvest. Genotype AKH-1303 (2.07) recorded highest leaf area index at all stages of crop growth and lowest Leaf area index (2.10) was observed in genotype AKH-8660 at harvest. Hosmath *et al.* (2012) [6] and Kumar *et al.,* (2017) [7] recorded significantly higher Leaf area index (2.12) and (3.68) at 60 DAS and 90 DAS respectively. Rekha G.O. (2007) [11], Hakoomat Ali and Raheel Atif Hameed (2011) [5], Gulshan *et al.,* 2015) [4] reported higher leaf area index in cotton which supports our results.

Absolute growth rate (g/day)

Absolute growth rate (AGR) is the increase in plant dry matter accumulation per unit time. The genotypes differed significantly for absolute growth rate. The differences between genotypes for AGR might be due to environmental condition. The maximum absolute growth rate was found in genotype AKH-1303 (-0.25g/day) at harvest and lowest AGR (-0.36g/day) was found in genotype AKH-10-3.Rekha G.O (2007) [11] recorded highest AGR (3.39g/day) in cotton. This is in accordance with Patil *et al.,* (2002) [10] and Ghule *et al.,* (2013) [3].

Relative growth rate (g/g/day)

The RGR was more during early stage and gradually decreased there after due to natural shedding of leaves. This indicated that RGR in cotton was more closely associated with vegetative growth. The significantly highest relative growth rate (0.013 g/g/day) at harvest was recorded in genotype (AKH-2013-1) and lowest RGR (0.0075 g/g/day) was recorded by genotype AKH-2012-9. Shukla *et al.* (2013) [13] and Y. Janaki Ramulu (2016) [14] recorded maximum RGR (0.018 g g-1 day-1 plant-1) and (0.037 g g-1 day-1plant-1) 60 DAS and 90 DAS respectively.

Table 1: Mean performance of morphological parameters of different hirsutum cotton genotypes at different growth stages during 2016-17 and 2017-18

Sr. No.	(Genotypes)	Plant height (cm)				No. of leaves				Leaf area (dm^2)				Total dry matter (g)			
		60 DAS	90 DAS	120 DAS	At harvest	60 DAS	90 DAS	120 DAS	At harvest	60 DAS	90 DAS	120 DAS	At harvest	60 DAS	90 DAS	120 DAS	At harvest
1	AKH-8660	43.43	64.61	69.23	90.27	44.61	69.63	40.45	39.87	16.33	39.13	38.87	30.49	9.74	32.16	71.26	63.13
2	AKH-31	46.03	71.60	77.33	91.93	61.14	78.66	48.68	43.87	24.00	47.34	37.14	33.42	10.10	38.01	73.90	66.32
3	AKH-073	46.50	70.93	76.27	89.47	44.37	62.25	34.35	33.27	22.04	46.28	40.17	34.84	9.95	33.53	71.33	63.63
4	AKH-976	36.70	62.27	69.27	89.40	45.34	65.86	37.12	35.50	23.25	43.77	36.23	33.84	11.72	40.74	71.41	63.13
5	AK-32	45.97	72.93	83.47	98.20	51.11	70.60	40.82	38.90	24.64	44.76	38.99	32.59	13.35	37.27	71.72	62.98
6	AKH-2006-2	39.83	84.87	93.27	108.13	40.81	61.73	32.78	31.70	24.01	44.70	38.82	35.13	9.63	30.62	70.38	61.05
7	AKH-09-5	41.50	63.67	69.80	89.53	47.07	66.66	37.45	35.50	20.59	47.13	37.39	35.08	10.57	30.76	71.08	61.76
8	AKH-10-2	40.37	60.73	69.40	90.27	48.91	61.86	40.15	37.03	19.38	43.37	38.33	35.77	10.14	31.09	71.34	61.20
9	AKH-10-3	42.37	65.40	72.40	89.60	49.14	42.60	29.82	27.63	19.23	45.37	34.80	32.04	16.10	42.54	74.32	63.64
10	AKH-10-10	41.43	70.40	80.00	90.53	45.41	63.11	31.42	28.70	22.01	44.75	37.96	33.63	14.43	32.17	73.99	64.43

11	AKH-2012-8	42.90	83.67	96.87	116.93	42.37	59.56	32.12	30.76	19.58	46.43	42.16	35.18	13.99	35.14	72.55	62.58
12	AKH-2012-9	50.43	73.67	82.07	109.73	36.54	44.03	39.42	27.70	25.16	44.71	34.44	34.15	16.51	42.54	75.86	66.90
13	AKH-2013-1	57.10	90.07	104.13	115.03	33.97	62.26	30.75	29.70	25.21	43.03	36.26	33.09	16.64	43.50	74.06	63.39
14	AKH-2013-2	60.17	87.10	102.80	103.27	44.84	64.89	39.28	37.60	24.00	45.96	35.41	33.45	13.53	34.87	73.90	63.70
15	AKH-2013-3	42.57	71.00	79.53	104.11	43.14	63.83	37.15	35.47	23.13	45.03	37.27	33.73	18.29	42.44	77.01	66.53
16	AKH-1301	53.83	83.13	99.80	100.73	50.67	62.87	53.22	49.30	20.51	47.32	37.33	34.41	14.07	34.18	73.96	64.13
17	AKH-1302	56.63	64.33	78.40	120.60	49.34	60.96	50.78	46.87	22.26	45.13	36.56	34.55	14.69	34.42	74.20	65.75
18	AKH-1303	61.63	89.27	103.47	122.60	56.47	75.53	51.78	47.77	25.59	47.72	46.22	34.42	11.82	43.66	77.21	66.77
19	CNHO-12	46.23	68.47	76.27	101.90	51.87	71.16	32.02	29.07	21.06	45.76	34.63	34.30	11.81	31.46	71.39	63.09
20	GV-22	57.10	71.53	82.80	121.77	45.71	63.09	42.72	39.10	23.85	46.50	33.84	30.68	14.30	33.73	73.75	64.66
21	IC-358555	43.50	68.00	87.13	95.27	48.57	64.47	47.22	38.97	19.74	46.32	37.95	37.14	12.79	32.90	72.69	63.82
22	IC-357342	46.17	64.20	72.40	104.93	49.34	65.11	38.75	32.10	22.72	46.86	36.51	36.12	14.15	32.98	72.98	63.79
23	IC-359088	42.37	87.40	95.93	99.73	53.91	72.32	41.88	32.63	22.56	46.55	35.51	31.53	9.80	30.69	70.60	61.60
24	AKH-081(check)	51.17	85.77	93.20	98.13	40.04	60.76	50.52	45.40	23.79	46.57	42.24	37.25	13.80	37.22	75.82	68.30
25	AKH-9916	52.50	83.33	94.53	116.27	50.20	67.36	35.48	33.10	21.00	46.36	40.20	34.05	15.20	39.04	71.42	62.75
26	PKV-Rajat(check)	51.30	68.93	76.80	117.53	51.34	71.25	39.95	30.47	24.09	45.81	35.41	35.16	14.25	43.50	73.35	64.54
27	AKH-8828(check)	43.17	72.00	82.07	114.33	52.77	71.31	41.32	32.87	24.33	47.17	38.81	35.75	15.02	36.02	72.25	63.25
'F' Test		Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
SE(m) ±		0.54	1.23	1.13	1.49	1.12	1.36	1.07	1.42	1.12	0.58	0.69	0.78	0.49	0.56	0.57	0.56
CD at 5%		1.53	3.49	3.2	4.24	3.18	3.87	3.04	4.02	3.37	1.65	1.96	2.22	1.4	1.6	1.6	1.60

Table 2: Mean performance of growth parameters of different hirsutum cotton genotypes at different growth stages during 2016-17 and 2017-18

Sr. No.	(Genotypes)	Leaf Area Index				Absolute growth rate (g/day)			Relative growth rate (g/g/day)		
		60- 90 DAS	90-120 DAS	120 DAS	At harvest	60-90 DAS	90-120 DAS	120 DAS-at harvest	60-90 DAS	90-120 DAS	120-at harvest DAS
1	AKH-8660	0.91	2.16	2.10	1.81	0.75	1.30	-0.27	0.013	0.010	-0.0018
2	AKH-31	1.40	2.63	2.35	2.02	0.93	1.20	-0.29	0.019	0.011	-0.0023
3	AKH-073	1.23	2.57	2.41	1.94	0.79	1.26	-0.26	0.018	0.009	-0.0017
4	AKH-976	1.29	2.38	2.20	1.88	0.67	1.02	-0.28	0.018	0.010	-0.0018
5	AK-32	1.37	2.49	2.33	1.97	0.80	1.15	-0.29	0.015	0.012	-0.0019
6	AKH-2006-2	1.24	2.49	2.33	1.95	0.63	0.99	-0.29	0.017	0.012	-0.0019
7	AKH-09-5	1.11	2.62	2.36	1.95	0.67	1.31	-0.33	0.016	0.012	-0.0022
8	AKH-10-2	1.07	2.41	2.28	1.99	0.70	1.34	-0.34	0.016	0.008	-0.0022
9	AKH-10-3	1.15	2.52	2.16	1.93	0.88	1.06	-0.36	0.014	0.008	-0.0022
10	AKH-10-10	1.16	2.49	2.17	1.87	0.68	1.01	-0.32	0.016	0.011	-0.0020
11	AKH-2012-8	1.24	2.58	2.47	1.95	0.71	1.25	-0.33	0.014	0.011	-0.0021
12	AKH-2012-9	1.32	2.49	2.21	1.90	0.65	1.33	-0.30	0.011	0.0075	-0.0018
13	AKH-2013-1	1.40	2.63	2.21	1.84	0.97	1.34	-0.28	0.019	0.013	-0.0016
14	AKH-2013-2	1.33	2.55	2.21	1.97	0.71	1.30	-0.34	0.014	0.009	-0.0022
15	AKH-2013-3	1.28	2.50	2.29	1.87	0.81	1.15	-0.35	0.012	0.011	-0.0021
16	AKH-1301	1.14	2.46	2.25	1.91	0.67	1.33	-0.33	0.013	0.011	-0.0021
17	AKH-1302	1.24	2.51	2.25	1.92	0.66	1.33	-0.36	0.013	0.012	-0.0018
18	AKH-1303	1.42	2.65	2.58	2.07	0.98	1.35	-0.25	0.015	0.012	-0.0019
19	CNHO-12	1.17	2.54	2.24	2.02	0.66	1.33	-0.28	0.014	0.011	-0.0018
20	GV-22	1.33	2.58	2.38	1.99	0.65	1.33	-0.30	0.012	0.011	-0.0019
21	IC-358555	1.10	2.57	2.34	1.91	0.67	1.33	-0.30	0.014	0.012	-0.0019
22	IC-357342	1.26	2.60	2.21	2.01	0.70	1.33	-0.31	0.013	0.012	-0.0019
23	IC-359088	1.26	2.59	2.18	1.97	0.69	1.33	-0.30	0.015	0.011	-0.0020
24	AKH-081 (check)	1.32	2.59	2.47	2.03	0.78	1.33	-0.30	0.015	0.010	-0.0018
25	AKH-9916	1.17	2.58	2.54	1.89	0.80	1.23	-0.30	0.014	0.008	-0.0018
26	PKV-Rajat(check)	1.34	2.55	2.18	1.95	0.89	1.33	-0.29	0.014	0.011	-0.0019
27	AKH-8828(check)	1.35	2.62	2.24	1.88	0.70	1.21	-0.30	0.013	0.010	-0.0019
'F' Test		Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
SE(m) ±		0.001	0.06	0.04	0.05	0.05	0.02	0.03	0.017	0.001	0.000
CD at 5%		0.003	0.16	0.11	0.15	0.15	0.07	0.08	0.048	0.003	0.002

Conclusion

Genotype AKH-1303 recorded significantly higher values of plant height (122.60 cm), leaf area (46.22 dm^2/plant), total dry matter (77.21 g/plant), absolute growth rate (-0.25 g/day) and leaf area index (2.07). On the basis of experimental study of cotton (*Gossipium hirsutum*) genotypes, AKH-1303 can be sown for obtaining higher seed cotton yield.

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