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Selection of novel upland cotton cultivars (*Gossypium hirsutum* L.) by investigating fiber quality and yield performance in multilocation trials of Bangladesh

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Abstract

Variety selection is the first and perhaps most critical decision of cotton producers. To explore the novel upland cotton cultivar, the present experiment was established at four cotton research farms, located in Rangpur, Dinajpur, Jessore and Gazipur District of Bangladesh during the season-2013-14. Investigations for varietal selection were performed based on evaluating the yield and ginning characteristics of strains. Among the tested strains, seven were promising lines encoded BC-0405, BC-037, JA-054, BC-0188, BC-0236, VN-35 and BC-063. One crossed materials of CDB (Cotton Development Board) encoded was also included, where CB-9, CB-10 and CB-11 were taken as local control. Interestingly, significant differences were obtained among the tested materials for different yield contributing individuals at different locations. Moreover, in combination of four locations data also showed major difference for the trait of number of vegetative braches per plant and node number of first sympodia. The highest amount of seed cotton yield was produced by JA/54 (2046kg/ha) which was followed by BC-037(2041kg/ha) cultivar and the lowest yield obtained from BC-0188 (1684kg/ha). They also produced high amount of lint, their GOT (Ginning out turn) % was moderately high and lint characteristics was medium. Surprisingly these two cultivars also showed well performance in all the locations, which indicates its wider environmental adaptability.

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Introduction

Upland cotton (*Gossypium hirsutum* L.) is one of the most important and leading commercial fiber crop in the world (Avgoulas *et al*., 2005; Ehsan *et al*., 2008). In Bangladesh cotton is called the silver cash crop. Cotton cultivation in Bangladesh received impetus in 1977 under comprehensive cotton development program by the Cotton Development Board (CDB) with four research farms. During the periods of 1994 to 1999, cotton cultivation become well admired in Bangladesh, while after 2000-the extension of cotton cultivation facing a critical situation (Shopan *et al*., 2012), showed descending trend due to the lack of high yielding, well adaptive and short duration variety.

As a major and leading natural fiber crop, cotton has a potentially broad genetic base, which reflected in the collection of *Gossypium* species and also the selection of the best one. In general, growers and agronomic managers always are looking into better ways to manage each of the major cotton types (Wells and Stewart, 2010). Although, cotton plants have a wider range of climatic and environmental adaptability, plant populations from differing genetic backgrounds often divergent in results due to the environmental response (Campbell *et al*., 2005). Such a response is known as the genotype-environmental interaction (Wiggins *et al*., 2013). Therefore, decisions on cotton variety selection are typically based on producers past experience with the varieties and production sites (Wiggins *et al*., 2013). As a selection of a productive variety provides a concrete foundation of building that made profitable of a growers in cultural program. Conversely, even the best growers find it difficulties to coax profitable yields from a poor variety that is not adapted to the region (Moser *et al*., 2000). In such circumstance, there is acute need to further exploit the available agricultural and agronomic resources for greater benefits. Bangladesh is an over populated country, owing to this increasing population growth rate, the demand of basics; food and cloth has also increased. To meet-up such a demand, indicates the tremendous scope for escalating the seed cotton yield in by overcoming yield constraints like use of low yielding varieties with poor quality seeds (Ehsan *et al*., 2008).

Towards the improvement of cotton cultivation scenario, Bangladesh Cotton Development Board with some other research center likes universities efforts therefore continuously made. They have designed and trial such type of experiments to find out the high yielding and short duration variety with wide range of adaptive potentiality. Although many high yielding cotton varieties have been developed and recommended for general cultivation in the past as a precedent while with time travels those varieties facing numerous challenges with changing environments. Therefore, it is a continuous process of scientist to lift-up seed cotton yield through the continuous selection of high yielding cotton cultivars with wide range of adaptability to edaphic and climatic conditions with site specific varietal selection (Ehsan *et al*., 2008). Consequently, assortment of comparative performance (agronomic and ginning) of the selected entries should need to evaluate with local control CB-9 (hairy leaves with high yield and low GOT%) ,CB-10 (smooth leaf, high yielding and medium GOT%) and CB-11(okra leaf, high yielding and medium GOT%) on Bangladesh through preliminary yield performance. Hence, the present experiment was desigened to test the yield and quality performance of seven new cotton cultivars under the prevailing conditions of multiplications of Bangladesh through comparing their agronomic traits and ginning characteristics with the control varieties.

Material and methods

Plant materials and experimental design

The present experiment was performed at 4(four) Cotton Research Farm, situated in Rangpur, Dinajpur, Jessore and Gazipur of Bangladesh during the year 20013-14. In this experiment 5(five) entries such as BC-0405, BC-037, JA/54, BC-0188 and BC-0236 included for investigation. The entry BC-063, and VN-35 were included depending their high yield potentialities that was found in the year 2011-12 through genotypes evaluation. The JA/54 cultivar was included for their better performance at Jagodishpur farm, the center of Bangladesh. The CB-9, CB-10 and CB-11 were taken as local check. The experiment was laid down in Randomized Complete Block Design (RCBD) with 3 (three) replications. Seeds were sown at the date of 25-7-13 to 6-8-13 in different locations.

Unit plot size was 10 × 3.6 m and plant spacing was 90cm × 45cm. Two to three water soaked and asataf (fungicide) treated seeds were sown at each hole during planting time.

Gap filling and fertilizer managements

Gap filling with seeds were done after one to two weeks of initial showing that is at the data of 31-7-13 to 15-8-13. Thinning was performed after 11 days and 21 days of seed emergence. Finally one seedling was kept in one stand.

For better nutrient management, green manure (sun-hemp) was ploughed down during the time of land preparation at the age of 45 days. In addition, decomposed organic matter was applied at the rate of 1.5 ton/ hectare of land during the time of final land preparation. Similarly as a basal dose the nutrient elements such as Nitrogen (N), Phosphorous (P), Potassium (k), Sulpher (S), Boron (B) and Zinc Sulphate (Zn) were also applied in the row at the rate of 23-81-52-18-8 and 8kg/ha of land, respectively. The rest 69 kg nitrogen of recommended dose was applied in 3 (three) equal splits (23kg/ha/ split) at 25, 42 and 55 days after seed sowing as top dressing. The nutrient was supplemented at 5-8 cm away from the plant, which was covered up with soil immediately to protect the volatilization loss of nitrogen. The rest 39kg (k) was applied at the time of third split of Nitrogen application (after 55 days of seed sowing).

Crop management operations

Seed cotton yield and fiber qualities significantly altered by a number of agronomic practices (Saleem *et al*., 2010). To minimize the alteration of yields and to make the experiments more thoughtful and authenticated, sets of interrelated crop management activities were performed during the period of cultivation. Weeding was performed, two times manually, while mulching between two rows was done by power tiller. At the third week of November and the 1st week of December irrigation water was used due to draught situation.

After 33-45 days of sowing first spray of chloropyriphose was applied against sucking pests such as Jassid and Aphid etc.

Other three spray of chloropyriphose in combine with pyrithroid were applied to control sucking and chewing (boll worms) pests. In all cases scouting based spray was followed. Attack of spodoptera was severe but drastic control measures by using pheromone trap the insects was kept under control. We also did hand picking and used light trap and zollaghur (molasses) trap for better pest managements and to kill moths and adults of the insects. As a result more or less insect reproduction was stopped which encouraged friendly agro-ecosystem to some extent.

To protect the fungal diseases, tilt, indofil and bavestone were sprayed at seedling and vegetative stage of the cotton plants. Moreover, insect attack and disease incident was keenly observed line wise to make sure for better plant growth.

Traits evaluation

To evaluate the cultivars, data were collected from middle two rows (10m x 1.8m) of each plot to minimize border effects. Data were collected from the number of vegetative branches, number of main stem node of first fruiting branch (NFB), number of primary fruiting branches/plant, number of secondary fruiting branches/plant, days to first flowering, days to first boll split, plant height, number of plants at harvested area, number of bolls pre plant, single boll weight and seed cotton yield per hector. All the data of above said traits were collected according to method discussed by Munk *et al.* (2007). In brief, measurements of plant height, node number, vegetative branches before the first sympodial branch and in pre-flower stages the absence or presence of flowering node number were collected with nodes above white flower considered to flowering cotton. Whole plants of all the seven cultivar were evaluated from random locations within the plot sampling in each location and ten consecutive plants in each of the three replicates for a total of thirty plants. In sequence to estimate mean boll weight seed-cotton samples were weighed and the mean weight of each sample was calculated by divided the sampled boll number (50). Lint percentage was obtained as the weight of lint expressed as a percentage of the weight of the seed-cotton sample.

Lint yield was calculated by multiplying the lint percentage by the seed-cotton weight (Avgoulas *et al.*, 2005). In order to evaluate the fiber quality seed cotton were analyzed in the center laboratory of Cotton Development Board (CDB), Bangladesh using HVI (High volume Instrument) equipment (Moser *et al.*, 2000). The fuzzy/fuzzless phenotypes were scored as described by (Ware, 1940) with the fuzzy seed corresponding to classes 1 to 11 and fuzzless seed corresponding to classes 12 to 16.

Statistical analysis

Data of above agronomic traits were collected from 10 (ten) randomized selected plants from each plot. Data were subjected to Analysis of variance (ANOVA) using statistical data software SPSS v.16. All the data were presented as the mean value for each treatment and calculated protected Least Significant Difference (LSD) values for all applicable traits (Zaman *et al.* (1982).

Table 1. Mean Performance of Yield Attributes of Tested Strains at Rangpur.

Variety/ Treatments	Number of Vegetative Branches/ Plant	NodeNnumber of 1st Fruiting Branch(N.F.B)	Number of PrimaryFruiting Branches/ lant	Number of SecondaryFruiting Branches/Plant	Daysto 1st Flowering	Days to 1st Boll Split	Plant Height (cm)	Number Of Bolls/Plant	SingleBoll Weight(g)	Seed Cotton Yieldkg/ha	Yield as % of CB-9
1BC -0405	2.83	7.10	17.17	13.43	61.67	150.67	136.53	20.83	5.00	1661	93
2.BC-037	2.50	7.13	15.30	15.13	59.00	149.00	129.30	27.60	4.93	1722	97
3.JA/54	2.17	6.10	18.00	14.33	60.67	147.00	124.00	24.83	5.13	1867	105
4.BC-0188	2.83	7.63	16.50	17.33	58.67	148.67	125.70	21.77	4.67	1689	95
5.BC-0236	2.33	7.00	16.50	13.77	59.00	149.33	130.20	21.53	4.87	1606	90
6.VN-35	3.40	7.03	18.30	18.07	62.00	154.00	132.10	27.57	5.13	1856	104
7.BC-063	3.00	7.40	17.63	17.73	60.00	150.00	141.33	24.63	4.73	1561	88
8.CB-9	3.67	8.17	15.93	22.37	63.33	152.67	132.03	22.63	5.50	1778	100
9.CB-10	2.23	6.77	17.37	13.30	57.67	130.00	122.07	24.17	5.77	1989	112
10.CB-11	4.17	7.57	16.00	23.27	59.00	137.67	122.27	21.27	4.67	1917	108
Level of sign:	**	*	Ns	*	*	**	ns	ns	*	ns	
LSD(.05)	0.69	0.94	2.22	6.82	3.06	4.84	18.36	8.71	0.63	.66	
%(CV)	13.85	7.61	7.65	22.5	2.97	1.92	8.3	20.12	7.34	12.11	

Note;*=Significant at 5% level ,**= Significant at 1% level ns=Non-significant.

Results and discussion

The selection of a variety is the first and possibly most critical decision that make every year by the cotton growers (Moser et al., 2000). Actually, decisions on cotton variety selections are usually based on past experience of a producer with the varieties and production sites (Wiggins et al., 2013).

Therefore, it is a continuous effort of plant scientist to develop new productive cultivar. In the present experiments, we have also showed an effort to lift-up seed cotton yield production through selection of high yielding cotton cultivars with wide range of adaptability to edaphic and climatic conditions with site specific varietal selection (Ehsan *et al.*, 2008).

Results from the analysis of variance for number of vegetative branches, number of main stem node of first fruiting branch (N.F.B), number of primary fruiting branches/plant, number of secondary fruiting branches/plant, days to first flowering, days to first boll split, plant height with seed cotton yield and yield components (lint yield, lint percentage, single boll weight) are presented in Table 1-4. All the data of a specific cultivar obtained from Rangpur, Dinajpur, Jessore and Gazipur District of Bangladesh during the season-2013-14. Mean performance of seed cotton yield attributes with ginning and lint characteristics in combined location of all the studied strains represents in Table 5 and Table 6.

Table 2. Mean Performance of the Yield Contributing Traits of the Tested Strain at Dinajpur.

Variety/ Treatments	Number of Vegetative Branches/ Plant	NodeNnumber of 1^{st} Fruiting Branch(N.F.B)	Number of Primaryuiting Branches/ plant	Number of Secondary FruitingBranches/ Plant	Daysto 1^{st} Flowering	Daysto 1^{st} Boll Split	Plant Heigh(cm)	NumberOf Bolls/Plant	SingleBoll Weight(g)	Seed Cotton Yieldkg/ha	Yield as % of CB-9
1BC -0405	3.30	7.53	21.63	11.73	61.00	150.66	102.76	29.03	4.66	1990	88
2.BC-037	3.00	6.67	19.13	13.73	55.33	148.00	96.06	37.20	5.50	2683	118
3.JA/54	3.97	6.27	18.50	13.73	61.00	154.66	87.53	25.06	5.53	2185	96
4.BC-0188	2.73	7.10	22.77	11.97	61.33	151.66	95.20	24.03	4.80	2101	93
5.BC-0236	3.13	7.03	22.53	13.87	62.33	149.66	95.53	27.86	4.90	2046	90
6.VN-35	4.23	7.43	27.80	11.90	65.33	163.00	95.96	29.73	5.06	1759	78
7.BC-063	3.07	7.10	28.63	11.93	60.66	155.33	95.36	23.20	4.80	1685	74
8.CB-9	3.60	7.20	20.30	11.23	62.00	150.33	85.23	21.06	5.00	2268	100
9.CB-10	2.87	6.90	19.06	13.20	63.00	161.33	84.13	24.30	5.23	1601	71
10.CB-11	4.37	7.03	32.03	14.87	59.33	154.33	111.43	30.60	5.70	2359	104
Level of sign:	*	ns	ns	ns	Ns	ns	ns	*	ns	ns	
LSD(.05)	1.06	0.94	10.48	2.79	6.33	22.81	18.08	7.78	0.92	1.42	
%(CV)	18.49	7.84	26.31	12.13	6.04	8.64	11.11	32.58	10.48	40.14	

Physiological growth and development

Our experimental results depicted that all the vegetative data of Rangpur except number of primary fruiting branches per plant, plant height, number of vegetative branches per plant, number of secondary fruiting branches per plant showed significant difference (Table1). From Table2, (at Dinajpur) observed that the treatment were statistically only different in number of vegetative branches per plant. Similarly, data from Gazipur showed significant difference only for number of primary fruiting branches per plant, whereas in Jessore number of vegetative branches per plant, number of secondary fruiting branches per plant showed statistically significance (Table4).

Table 3. Mean Performance of the Yield Contributing Traits of the Tested Strains at Sreepur, Gazipur.

Variety/ Treatments	Number of vegetative Branches/Plant	Node number of 1^{st} Fruiting Branch(N.F.B)	Number of PrimaryFruiting Branches/Plant	Number of Secondary Fruiting Branches/Plant	Days to 1^{st} Flowering	Days to 1^{st} Boll Split	Number of Bolls/ Plant	Plant Height (cm)	Single Boll Weight (g)	Seed Cotton Yield (kg /ha)	Yield as % of CB-9
1BC -0405	1.37	7.27	13.47	2.47	61.67	152.60	19.85	87.87	4.50	2255	115
2.BC-037	1.30	7.13	13.30	2.40	59.00	148.00	19.35	88.17	4.73	2077	111
3.JA/54	1.33	7.30	14.10	2.57	59.67	149.70	18.76	91.90	4.37	2149	104
4.BC-0188	1.37	6.73	15.40	2.47	60.67	149.27	17.73	101.83	4.73	1937	99
5.BC-0236	1.47	6.97	16.50	2.97	59.70	148.33	18.50	112.53	4.85	2215	113
6.VN-35	1.23	6.73	14.53	2.87	62.00	156.10	17.70	96.23	4.87	1950	97
7.BC-063	1.30	6.73	15.23	2.80	60.00	150.00	19.50	101.08	4.60	2139	109
8.CB-9	1.43	7.70	13.70	2.63	63.33	153.67	18.07	86.87	4.53	1955	100
9.CB-10	1.33	7.17	14.23	2.30	59.67	130.00	18.10	88.17	4.70	1862	95
10.CB-11	1.50	7.03	13.33	2.57	57.00	127.67	17.30	87.00	4.33	1770	90
Level of sign:	ns	ns	**	Ns	*	**	*	ns	ns	*	
LSD(.05)	0.73	4.76	2.85	4.23	3.45	3.79	8.97	16.7	1.75	1.92	
%(CV)	12.13	5.98	4.56	9.83	3.16	4.64	12.07	10.65	9.59	8.59	

Note;*=Significant at 5% level ,**= Significant at 1% level ns=Non-significant.

Interestingly, data from combined analysis showed significant different for the traits number of vegetative branches per plant and node number of 1^{st} (first) fruiting branch (Table 5), which have strong effect on seed cotton yield (Jenkins *et al*., 1990; Shopan *et al*., 2013).

Among the cultivars highest number of vegetative branches per plant was obtained from cultivar VN-35 which followed by JA/54 compare to local controls. On the contrary, BC-0405 showed best performance for number of 1st (first) fruiting branch which were followed by BC-037 cultivar (Table5).

Flowering and Boll maturation

In upland cotton, crop maturity as well as productivity is influenced by a number of physiological, phenological, morphological and environmental factors (Ye, *et al.*, 2006; Shah *et al.*, 2010). Therefore, selection for this complex trait in segregating populations may be misleading if proper understanding of the direct and indirect effects of these traits is not appropriately understood. For example results for days to first flowering and the days to first to boll split, these two variables have strong effect on seed cotton yield (Shah *et al.*, 2010).

Table 4. Mean Performance of the Different Yield Attributives Traits of the Tested Strains at Jagodishpur, Jessore.

Variety/ Treatments	Number of vegetative Branches/Plant	Node number of 1st Fruiting Branch(N.F.B)	Number of Primary Fruiting Branches/Plant	Number of Secondary Fruiting Branches/Plant	Days to First Flowering	Days to First Boll Split	Number of Bolls/ Plant	Plant Height (cm)	Single Boll Weight (g)	Seed Cotton Yield (kg /ha)	Yield as % of CB-9
1BC -0405	1.60	6.33	18.10	9.30	56.33	126.00	188.16	35.00	4.23	1328	74
2.BC-037	1.20	6.20	16.93	7.13	54.66	125.66	112.76	34.66	3.96	1581	88
3.JA/54	2.10	6.00	16.40	12.30	57.33	130.00	113.00	36.00	4.53	2081	115
4.BC-0188	2.20	6.40	15.80	13.76	54.00	128.00	105.66	35.00	4.03	1009	56
5.BC-0236	1.97	6.30	18.76	10.96	54.00	130.66	123.33	37.66	3.86	1376	76
6.VN-35	1.97	6.73	16.60	12.60	55.66	126.00	109.00	35.00	4.23	1463	81
7.BC-063	1.57	6.23	15.90	9.90	55.33	127.66	112.33	33.33	4.20	1443	80
8.CB-9	2.23	6.73	16.30	13.30	58.66	135.00	105.66	31.33	4.43	1805	100
9.CB-10	0.70	5.86	17.40	4.93	56.00	125.66	99.00	33.66	4.33	1761	98
10.CB-11	2.13	6.53	17.76	13.60	55.33	136.33	117.00	36.00	4.43	2010	111
Level of sign:	**	ns	ns	**	Ns	**	ns	ns	ns	ns	
LSD(.05)	0.44	0.64	2.10	2.45	2.10	3.08	16.43	3.93	1.50	132.88	
%(CV)	14.51	5.96	7.23	13.24	2.39	1.39	8.07	6.59	1.18	0.61	

They explored that early and rapid flowering coupled with shorter boll maturation period which strongly affect seed cotton production. Interestingly, in the present experiment we have also found that the moderate duration of maturation period from flowering to boll split showed best performance in seed cotton production. Again the examination of developmental behavior for flowering and boll split among the tested cultivar of upland cotton showed that BC-037 taken moderate duration of maturation period which is followed by JA/54 in all studied locations (Table 1-5).

Seed cotton yield stability in performance trials

Always a productive variety provides a solid foundation for edifice a profitable cultural program. In opposition, even the best growers will face difficulty to coax profitable yields from a poor variety that is not adapted to the region (Moser *et al.*, 2000). Similarly to maturity period single or mean boll weight and boll number per plant are important contributors of seed cotton yield. For example our experimental results showed that all the cotton cultivars differed from each other for seed cotton yield. Among the tested cultivar, JA/54 produced significantly maximum seed cotton yield (2046 kg ha-1) which followed by BC-037 (2041 kg/ha) and the lowest yield was produced by the cultivar BC- 0188 (1684 kg/ha; Table 5). Interesting features was that cultivar JA/54 produced highest number of boll (104/plant with maximum single boll weight (4.89) compare to the controls. Conversely, cultivar BC- 0188 produced lowest number pod (107) with minimum single boll weight (4.55).

Therefore, it is highly likely that boll weight with boll number is directly related to the final seed cotton yield of cotton similar to Avgoulas *et al.* (2005). They explored that high seed-cotton yield mainly correlated to its high number of bolls per unit area of land with mean boll weight. Similarly, GOT (Ginning Out Turn) was also significantly influenced by the different cultivars and again cultivar JA/54 produced highest GOT% (36.40) compare to controls (Table6), which is well agreed with (Ehsan *et al.*, 2008). Actually, there is a positive relationship between yield and ginning out turn percentage, as observed in our experimental results (Table 6) similarly to Khan *et al.* (1989).

Table 5. Mean Performance of the Yield Attributing Traits of the Tested Strains at Different Locations.

Variety/ Treatments	Number of vegetative Branches/Plant	Node number of 1st Fruiting Branch(N.F.B)	Number of Primary Fruiting Branches/Plant	Number of Secondary Fruiting Branches/Plant	Days to First Flowering	Days to First Boll Split	Number of Bolls/ Plant	Plant Height (cm)	Single Boll Weight (g)	Seed Cotton Yield (kg /ha)	Yield as % of CB-9
1.BC -0405	2.28	7.06	17.59	9.23	59.06	143.33	128.83	26.18	4.59	1809	93
2.BC-037	2.00	6.78	16.16	9.60	56.08	142.16	106.57	29.70	4.78	2041	106
3.JA/54	2.39	6.41	16.75	10.73	59.31	143.91	140.10	26.16	4.89	2046	105
4.BC-0188	2.28	6.96	17.61	11.38	57.58	143.99	107.09	24.63	4.55	1684	86
5.BC-0236	2.23	6.82	18.57	10.39	58.08	143.91	115.39	26.39	4.62	1811	93
6.VN-35	2.70	6.98	19.24	11.36	60.49	148.25	108.32	26.25	4.82	1757	90
7.BC-063	2.23	6.86	19.34	10.59	58.66	145.49	112.52	25.17	4.58	1732	89
8.CB-9	2.73	7.45	16.55	12.38	58.91	145.00	102.46	23.27	4.86	1952	100
9.CB-10	1.78	6.67	17.02	8.43	58.91	136.83	98.34	25.06	5.08	1803	92
10.CB-11	3.04	7.04	19.78	13.58	57.66	141.83	109.42	26.29	4.78	2014	103
Level of sign:	*	*	NS	NS	NS	NS	NS	NS	NS	NS	
LSD (.05)	0.62	0.48	3.56	3.21	3.78	7.06	19.49	3.69	0.41	362.71	
% (CV)	17.79	4.89	14.55	20.55	4.69	3.39	12.29	0.98	6.04	13.40	

Note;*=Significant at 5% level ,**= Significant at 1% level ns=Non-significant.

Fiber quality

Cotton fibers are single-celled trichomes that originate from the outer epidermis of the ovule. In present study we also observed the variation in lint yield and fiber quality of the tested cultivars. Experimental results showed that all of the location–year testing environments displayed similar interaction effects for lint yield and among the entities JA/54 produced highest lint (745 kg/ha) production compare to control, agreed with (Mthew *et al.*, 2013). Wang *et al.* (2004) also reported that high lint yield was changed by the change of varieties that considered as an important contributor for maximizing yield potential of a variety.

Moreover, the magnitude of genotypic potentiality for quality fiber production is also an important criterion to select a variety by the growers and other segments of the cotton business.

Fiber fineness, length, strength and micronaire values all are very important characteristics regarding the fiber quality of cotton and is very useful for textile industry (Campbell and Jones, 2005; Ehsan *et al.*, 2008; Mthew *et al.*, 2013). Our experimental results showed that with highest seed cotton yield cultivar JA/54 showed medium lint index, fiber length medium 50% span length and medium PSI values also which followed by BC-037. Previous studies also reported that fiber characteristics vary widely with plant variety and growing conditions (Campbell and Jones, 2005; Copur, 2006;). Means, cultivar JA/54 have well adaptive potential with different environmental sites. In contrast, JA/54 cultivar showed modest micronaire values (4.3; Table 6), an important characteristic to enhance the quality and value of fiber (Allen and Lorenzo, 2011).

Fuzz phenotypes

Variation of fuzz grade was also determined in current experiment. In general, normal cotton seed is covered with lint and fuzz. Lint is a textile fiber whereas fuzz is a short fiber and difficult to gin from the seeds (Efrem *et al.*, 2012). The variations of fuzzy phenotypes of all the tested cultivars were scored by 6-7 corresponding to fuzzy class described by Ware, (1940), which stand in moderate grade ofall the tested cultivars (Table 6).

Table 6. Mean Ginning Data and Lint Characteristics of the Promising Strains.

Variety/ lines/ Strains	Advanced Promising	Seed Cotton Yield kg/ha	GOT (%)	Yield of Lint (kg/ha)	Yield of Lint as % of CB-9	Seed Index (g)	Lint Index (g)	Fuzz Grade	50% Span Length (inch)	2.5 % Span Length (inch)	Micronaire Value	Presly Strength (PSI)
1BC -0405		1809	35.33	639	95	10.00	5.81	8	0.41	1.18	4.0	84.39
2.BC-037		2041	36.00	735	109	9.00	5.87	7	0.35	1.00	4.3	84.55
3.JA/54		2046	36.40	745	111	10.00	6.42	7	0.34	1.03	4.3	83.43
4.BC-0188		1684	34.00	573	85	10.00	3.43	7	0.39	1.10	4.3	82.30
5.BC-0236		1811	35.66	646	96	9.00	3.50	6	0.48	1.16	4.6	83.52
6.VN-35		1757	34.60	608	90	9.50	4.60	6	0.45	1.15	4.4	83.18
7.BC-063		1732	34.04	590	88	8.00	5.10	7	0.42	1.02	4.4	80.01
8.CB-9		1952	34.50	63	100	10.00	4.04	7	0.43	1.12	4.8	82.82
9.CB-10		1803	36.68	661	98	9.00	5.00	7	0.37	1.05	4.8	83.26
10.CB-11		2014	34.07	686	102	10.00	4.75	7	0.37	1.06	4.6	83.10

From proteomics analysis it has been shown that seventy-one protein species related to fuzz initiation and regulation of that during development of ovular trichomes could made the differences in fuzz grade of a cultivar (Turley and Ferguson,1996; Du *et al.*, 2013). Whilst, historically, it has been proven that fuzzless seed phenotypes strongly associated with both low lint yield and low lint percent (Efrem *et al.*, 2012). Means that moderate fuzz seed phenotypes of cultivars despite their positive attributes of high yield potential (Jackowski and Frydrych, 1999).

Conclusion

Based on deferential analysis using the indices individually or in combinations, it has been concluded that most yield-stable promising cultivar across the environments was JA/54. This showed 6% more seed cotton yield and 11% more lint production than the cheekCB-9 and BC-037 occupied the second position. Although, JA/54 cultivar showed moderate lint characteristics with fuzz grade but finally gives maximum seed cotton yield. As it is important to achieve the optimum but not the maximum quality level, and to meeting the specific purpose and use which allow the satisfactory yields. Therefore, these two lines may be forward to the advanced yield trial and the rest should need further investigation through preliminary yield trial.

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