INTERNATIONAL JOURNAL OF COTTON RESEARCH AND TECHNOLOGY
Research Manuscript EISSN= 2707-5281 www.sciplatform.com

Assessment of seed cotton yield and fiber properties portrayal of some candidate cotton varieties in national coordinated varietal trials at changing environment of Sindh and Balochistan

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Author's Contribution	**Keerio, A.** written manuscript. **Anjum, R.** experiment layout, data analysed and table arrangements. **Channa, A.R. and Ahmed, S.** conducted experiment and data recorded.
Article History	*__Corresponding email address__: soomro.wahab@outlook.com **Received: 11 December 2019, Revised: 14 March 2020, Accepted: 09 April 2020, Published Online: 15 April 2020**
ABSTRACT	**Digital Object Identifier (DOI): https://doi.org/10.33865/IJCRT.002.01.0261**

Thirty six candidate cotton varieties developed by different breeders in Pakistan were tested consecutively for two years (2017 and 2018) and at seven locations of Sindh and Balochistan Provinces in national coordinated varietal trials (NCVT). The trials were conducted to explore seed cotton yield potential and fiber properties against two check varieties (CIM-602 and FH-142/IUB-13). As per claim of the breeders, the samples of all varieties for both the years were sent to four designated biotechnological laboratories for conducting biochemical tests also. The results revealed highly significant differences among the varieties for both the years. During the year 2017, on an average of six locations, top ten high yielding varieties recorded were GH-Haadi, Weal-AG-6, VH-189, GH-Mubarak, Weal-AG-5, MNH-1026, Badar-1(DG), FH-444, CIM-343 and TJ-Max(DG) which yielded 3434, 3407, 3342, 3255, 3251, 3248, 3185, 3154, 3134 and 3131 kg/ha seed cotton yield respectively. When the results of the 2018 trial were looked at, averagely top ten high yielding varieties were GH-Haadi, ICI-2121, CRIS-613, VH-383, VH-189, NIAB-898, FH-490, Cyto-225, Tahafuz-10(DG) and GS-Ali-7 with 3526, 3356, 3306, 3139, 3101, 3091, 3084, 3074, 3060 and 3026 kg/ha of seed cotton yield respectively. However, on an average of both the years (2017 and 2018), top ten high yielding varieties were GH-Haadi, VH-189, CRIS-613, Weal-AG-6, GH-Mubarak, Badar-1(DG), ICI-2121, Weal-AG-5, FH-940 and MNH-1026 producing 3480, 3221, 3186, 3155, 3113, 3083, 3057, 3054, 3042 and 3042 kg/ha of seed cotton respectively. As regards fiber properties, (04 candidate varieties) could qualify all fiber standards set by government. The biochemical test results received from all four laboratories revealed that on an average of four laboratories and two years, the trait purity range recorded was from 42 to 96 percent, whereas, quantification of Bt toxin ranged from 0.74 to 2.62. From the present study, it was concluded that almost 15-20 candidate varieties have the potential to be included among already approved varieties for commercial cultivation in the province of the Sindh and Balochistan.

Key word: Seed cotton yield, fiber traits, environment.

INTRODUCTION: Cotton (*G. hirsutum* L.) is an important cash crop and plays a key role as compared to all other crops (Screenivasan, 2004). Pakistan is 4th largest cotton producer in the world after China, USA and India (GOP, 2018). Cotton is a major crop of Pakistan after wheat; it occupies the largest area in Pakistan compared to other crops. It earns the country's largest export revenues. In addition to the lint, the seed of cotton for oil and meal accounts for 80 percent of the national production of oilseed. Cotton and cotton related products contribute 10 percent to gross domestic product (GDP) and 55 percent to the foreign exchange earnings of the country. In Pakistan, cotton was cultivated in an area of 2700 thousand hectares (approx. 6672 thousand acres) during the year 2017-18 with the production of 11.95 million bales, whereas, the lint yield in Pakistan for the same year was 752 kg/ha (approx. 305 kg acre). In Punjab, almost 100% Bt cotton with Mon53 event and Cry1Ac gene was sown on an area of 2053 thousand hectares (approx. 5073 thousand acres) which produced 8.78 million bales with lint yield of 669 kg/ha during the year 2017-18 (GOP, Cotistics, 2018). Five year's (2013-14 to 2017-18) data regarding cotton area, production and lint yield in Pakistan, Punjab and Sindh are depicted in table 2. The cotton crop is judged by the genotype and its interaction with the varied environments for yield potential and quality performance (Koutu and Shastry, 2004). Most of components of economic characters are indicative of the yield potential or the integrated cotton quality and are under the control of genes of various magnitudes and influences of the environments (Narayanan *et al.*, 2004). Stable cotton varieties with high yield potential are of paramount importance among the large number of varieties recommended for cultivation for a particular zone (Kairon *et al.*, 2000; Koutu and Shastry, 2004). In the recent years, the release of high yielding, heat and leaf curl virus disease resistant Bt cotton varieties with pre-fixed fiber quality standards by the government of Punjab have accelerated momentum to fulfil the requirements of growers, textile industry and other stakeholders. In this context, the Pakistan Central Cotton Committee (PCCC) is playing pivotal role by conducting the National Coordinated Varietal Trials (NCVT) on the candidate cotton varieties bred by public and private sector breeders. The two years NCVT is mandatory for variety approval process. Every year, NCVT is conducted at almost 17 locations of the Pakistan to test their adaptability and yield potential. If a variety excels the standard varieties in yield for consecutive two years in NCVT, that variety is forwarded in the Expert Sub Committee of the headed by Director General Agriculture Research Sindh (in case of Sindh province) for further process. The variety which qualifies the pre-fixed fiber properties standards is then recommended to Sindh Seed Council for approval and commercial cultivation in the Sindh. Distinctiveness, Uniformity and Stability (DUS) studies are also conducted by the Federal Seed Certification and Registration Department (FSC&RD) for two years of the candidate varieties simultaneously which are included in NCVT. These

trials/studies (NCVT, Spot examination and DUS) are mandatory for a variety to complete the variety approval process. Considering the above approval process for cotton varieties, the two years (2017 and 2018) data were extracted from the NCVT results distributed by Director Research, PCCC for evaluation of yield and fiber properties of candidate varieties and to see which varieties could qualify and fit in the variety approval process done by the Sindh Seed Council.

OBJECTIVES: The objective of this study to evaluate advance cotton genotypes for seed cotton yield and adoptability during two consecutive years at the environmental conditions of Sindh and Baluchistan. The suitable genotypes could be preferred for general cultivation in both provinces to boost up cotton production.

MATERIAL AND METHODS: The studies were carried out to screen out the most outstanding high yielding varieties in different agro-ecological zones of Sindh and Balochistan provinces. 36 candidate Bt cotton varieties from public and private sectors duly coded by the Director Research PCCC were sown and tested at four public sector research centers in Sindh (CCRI, Sakrand; CRS Ghotki, CRS Mirpurkhas, and ARI Tandojam) and three public sectors in Balochistan (CRS Sibi, CRS Lasbela@Uthal and ARI-Khuzdar) against two standard/check varieties (CIM-602 and IUB-13) during the years 2017 and 2018 in the month of May. The coded variety seed provided by the Director, Research, PCCC was sown on the bed and furrow at all the seven locations. The plot size, however, varied location-wise with the choice of the scientist or availability of land at the station who was deputed for conducting NCVT by the station in-charge. The trials were arranged in a randomized complete block design (RBCD) replicated three times at each location. The trials were agronomically and entomologically supervised and protected by the agronomist and entomologist of each location. The required yield data were recorded at all the stations when the crop was fully matured and was ready to harvest. The data were statistically analyzed after Gomez and Gomez (1984) calculating C.V. % and CD values at 5 % and 1% probability levels to differentiate the varieties included in the trials. Each year after compilation of data, the yield results are sent back to Director, Research PCCC with same variety codes. On the basis of yield and fiber properties results, the better performing varieties could then be released as a commercial variety for the general cultivation in the province of Sindh and Balochistan.

RESULTS AND DISCUSSION: Thirty six candidate cotton varieties were yield tested consecutively for two years (2017 and 2018) and at seven locations of Sindh and Balochistan Province in national coordinated varietal trials (NCVT). The trials were conducted to explore seed cotton yield potential and fiber properties of these candidate varieties against two standard/check varieties (CIM-602 and FH-142/IUB-13). The samples of all varieties for both the years were sent to four designated biotechnological laboratories for biochemical tests also. Table 1 shows the sources of the 36+2 standards cotton candidate varieties sown for two years in the Sindh and Balochistan during 2017 and 2018, cotton seasons at public sector research institutions. Table 2 depicts the cotton area, production and yield of Pakistan, Punjab and Sindh for the last five years (2013-14 to 2017-18) which serves as ready reference for the readers to judge the ups and downs in the cotton crop in the last half decade. Table 3 demonstrates the yield performance and also results of statistical analysis (CD in 1 and 5% level oprobability, includingng CV%) of the candidate varieties during 2017, whereas, table 4 revealed the yield and statistical analysis results for 2018 cotton season against the two check varieties. The two years average yield performance of candidate varieties was calculated and is presented in table 5.

Table 1: Candidate cotton varieties tested in National Coordinated Varietal Trials (NCVT) during 2017 and 2018

Sr. No.	Name of Candidate Variety	Source of variety
1	MNH-1026	Cotton Research Institute, Multan
2	BH-221	Cotton Research Station, Bahawalpur
3	BS-18	Bandesha Seed Corporation, Jahanian
4	CEMB-100 (DG)	Center of Excellence in Molecular Biology, Lahore
5	MNH-1020	Cotton Research Institute, Multan
6	FH-444	Cotton Research Institute, AARI, Faisalabad
7	CEMB-101(DG)	Center of Excellence in Molecular Biology, Lahore
8	ICI-2121	ICI Pakistan Limited, Multan/Lahore
9	Bahar-07	Bahar Seed Corporation, Rahimyar Khan
10	IUB-69	Islamia University, Bahawalpur
11	CIM-343	Central Cotton Research Institute, Multan
12	FH-490	Cotton Research Institute, AARI, Faisalabad
13	CIM-663	Central Cotton Research Institute, Multan
14	Cyto-515	Central Cotton Research Institute, Multan
15	CRIS-613	Central Cotton Research Institute, Sakrand
16	NIAB-898	Nuclear Institute of Agriculture & Biology, Faisalabad
17	GH-Haadi	Cotton Research Station, Ghotki
18	Badar-1 (DG)	4 Brothers Seed Corporation, Multan/Lahore
19	GH-Mubarak	Cotton Research Station, Ghotki
20	Tahafuz-10 (DG)	Suncrop group, Multan
21	Weal-AG-6	Allahdin Group, Multan
22	RH-Afnan	Cotton Research Station, Khanpur
23	CIM-602 Std-1	Central Cotton Research Institute, Multan
24	TJ-MAX (DG)	Robert Cotton Associates, Khanewal
25	Bahar-2017	Bahar Seed Corporation, Rahimyar Khan
26	RH-Manthar	Cotton Research Station, Khanpur
27	VH-189	Cotton Research Station, Vehari
28	Weal-AG-5	Allahdin Group of Companies, Multan
29	GS-Ali-7	Gohar Seed Corporation, Makhdum Rashid
30	NS-191	Neelum Seeds Private Limited, Jahanian
31	CIM-717	Central Cotton Research Institute, Multan
32	IUB-13 Std-2	Islamia University, Bahawalpur
33	SLH-6	Cotton Research Station, Sahiwal
34	AA-933	Ali Akbar Group, Multan
35	VH-383	Cotton Research Station, Vehari
36	Sitara-16	Agri Farms Private Limited, Multan
37	SLH-19	Cotton Research Station, Sahiwal
38	Cyto-225	Central Cotton Research Institute, Multan

Table 1 demonstrated that out of 36 candidate varieties, 13 were introduced by the private sector which shows the breeding ability of their research centers and strength of their R & D system. The data presented in table 3 and 4 revealed highly significant yield differences among the varieties during both years of trialing. In the year 2017, on an average of seven locations (table 3), top ten high yielding varieties recorded were GH-Haadi, Weal-AG-6, VH-189, GH-Mubarak, Weal-AG-5, MNH-1026, Badar-1 (DG), FH-444,

Table 2: Pakistan, Punjab and Sindh cotton area, production and yield for last five years (2013-14 to 2017-18).

Year-Wise	2013-14	2014-15	2015-16	2016-17	2017-18
			PAKISTAN		
Area (000 hectares)	2805.65	2958.30	2901.98	2488.97	2700.27
Production (000 million bales)	12768.88	13959.58	9917.41	10671.00	11945.60
Yield (kg/ha)	774	802	581	729	752
			PUNJAB		
Area (000 hectares)	2199.02	2322.85	2242.72	1815.34	2052.93
Production (000 million bales)	9145.00	10277.00	6343.00	6978.00	8077.00
Yield (kg/ha)	707	752	481	653	669
			SINDH		
Area (000 hectares)	567.98	596.21	621.25	636.65	611.68
Production (000 million bales)	3523.42	3572.54	3475.60	3596.88	3775.76
Yield (kg/ha)	1055	1019	951	960	1049

Source: Cotistics August 2018 Bulletin published by Pakistan Central Cotton Committee, Multan.

Table 3: Seed cotton yield (kg/ha) of thirty six cotton candidate varieties tested in NCVT at Seven locations of Sindh and Balochistan during 2017.

S. No.	Genotypes	Sindh				Balochistan			Average
		Sakrand	Mirpur Khas	Ghotki	Tandojam	Khuzdar	Lasbela	Sibi	
1	MNH-1026	3145	3603	3340	2751	3264	3851	2784	3248
2	BH-221	2416	2865	2384	2571	3624	3588	2904	2907
3	BS-18	2260	2590	2444	2272	2964	3588	2964	2726
4	CEMB-100 (DG)	2081	2989	2763	2272	2916	3612	2868	2786
5	MNH-1020	2428	2185	1992	2452	3804	3456	2520	2691
6	FH-444	3385	3123	2935	2691	2904	4006	3036	3154
7	CEMB-101(DG)	2846	3043	2350	2810	2832	3253	2940	2868
8	ICI-2121	2870	2511	2173	2195	3288	3516	2748	2757
9	Bahar-07	1842	2691	2908	3339	3120	3361	3012	2896
10	IUB-69	2775	2571	2387	3295	2484	3648	2868	2861
11	CIM-343	3408	2571	2783	3613	2832	3827	2904	3134
12	FH-490	2942	2691	2344	3365	2832	4210	2616	3000
13	CIM-663	2081	2810	3105	2092	2964	3229	2688	2710
14	Cyto-515	2583	2751	2619	2501	2736	3492	2568	2750
15	CRIS-613	3241	2930	1630	3622	3312	3971	2760	3067
16	NIAB-898	2870	2751	2072	2743	3216	3851	2652	2879
17	GH-Haadi	3672	2810	3374	3722	3168	4147	3144	3434
18	Badar-1 (DG)	2942	2631	2802	3293	2940	4844	2844	3185
19	CIM-602 Std-1	2882	2810	2558	2840	3492	4030	2784	3057
20	GH-Mubarak	3576	2810	3075	2895	3096	4126	3204	3255
21	Tahafuz-10 (DG)	2655	3947	1826	2551	2772	3827	2940	2931
22	IUB-13 Std-2	2464	2272	2830	2827	3180	3827	2892	2899
23	Weal-AG-6	3600	3050	3018	3277	3480	3947	3480	3407
24	RH-Afnan	3169	3707	2089	2937	3072	4066	2868	3130
25	TJ-MAX (DG)	3181	3767	2242	3046	2616	3708	3360	3131
26	Bahar-2017	2129	2212	2572	2929	2856	3086	2712	2642
27	RH-Manthar	3289	2272	2028	3055	2916	3995	2820	2911
28	VH-189	3636	3707	2868	2820	2820	4305	3240	3342
29	Weal-AG-5	3265	3707	2140	3220	3840	3468	3120	3251
30	GS-Ali-7	2990	2870	2914	3239	3384	3002	2940	3048
31	NS-191	2117	2392	2038	2856	3264	3887	3012	2795
32	CIM-717	2189	2810	2764	1927	3840	3480	3480	2927
33	SLH-6	2201	3408	2099	1789	2916	2870	3060	2620
34	AA-933	1938	2452	1800	2560	3036	3564	2808	2594
35	VH-383	2715	3648	1826	2139	3240	3229	2880	2811
36	Sitara-16	3038	3408	2708	3095	2832	3349	2520	2993
37	SLH-19	3301	3648	1908	2295	3396	4186	2964	3100
38	Cyto-225	2810	2691	2873	2261	3120	3755	2640	2879
	CD 5%	828.26**	629.54**	865.27**	954.4**	756.8**	435.39**	835.62**	---
	CD 1%	1092.9**	830.66**	1141.7**	1259.3**	998.58**	574.49**	710.7**	---
	CV%	19.67	13.64	23.17	21.58	15.36	7.35	11.31	---

Table 4: Seed cotton yield (kg/ha) of thirty six cotton candidate varieties tested in NCVT at seven locations of Sindh and Balochistan during 2018.

S. No.	Genotypes	Sindh				Balochistan			Average
		Sakrand	Mirpur Khas	Ghotki	Tandojam	Khuzdar	Lasbela	Sibi	
1	MNH-1026	2932	1943	2583	3104	3829	2513	2941	2835
2	BH-221	1735	2235	2440	3236	3470	3470	2933	2788
3	BS-18	2190	2016	2296	2519	3949	4188	3080	2891
4	CEMB-100 (DG)	1855	2085	2009	2108	3947	3292	2684	2569
5	MNH-1020	2501	1912	3157	2434	3231	2992	2876	2729
6	FH-444	2704	2084	2009	2651	3949	3111	2996	2786
7	CEMB-101(DG)	1819	1814	2296	2081	3947	3947	2371	2611
8	ICI-2121	3279	4189	3731	3638	2992	2872	2792	3356
9	Bahar-07	2597	2404	2009	3435	4069	3231	2777	2932
10	IUB-69	1627	1202	2009	2059	4069	3949	2992	2558
11	CIM-343	2262	1866	1866	3355	3470	4069	2986	2839
12	FH-490	2369	3483	3301	2784	3351	3470	2831	3084
13	CIM-663	2118	1789	1866	2879	4069	3949	3143	2830
14	Cyto-515	2118	4043	2009	2634	3470	3231	3007	2930
15	CRIS-613	3267	4386	2296	3405	3231	3323	3231	3306
16	NIAB-898	3087	3023	2296	3222	4069	2992	2947	3091
17	GH-Haadi	3135	3811	3301	2834	4308	4308	2987	3526
18	Badar-1 (DG)	2728	3082	3157	1749	4066	3588	2492	2980
19	CIM-602 Std-1	2615	3111	2368	2110	3615	3141	2753	2816
20	GH-Mubarak	3016	2737	2296	3064	3590	3231	2864	2971
21	Tahafuz-10 (DG)	2968	3108	2870	2036	3947	3947	2542	3060
22	IUB-13 Std-2	1906	2920	2691	1661	3799	3230	2663	2696
23	Weal-AG-6	3913	2612	2440	1989	3468	2631	3265	2903
24	RH-Afnan	2262	2686	1866	2382	4045	3351	2869	2780
25	TJ-MAX (DG)	1675	1518	2870	1372	3947	2272	2468	2303
26	Bahar-2017	2094	2507	1579	2576	4069	2872	3006	2672
27	RH-Manthar	2465	1002	3731	1674	4186	3229	2868	2736
28	VH-189	3135	3668	2727	1792	4066	3349	2967	3101
29	Weal-AG-5	1927	3037	2440	1615	3947	3827	3208	2857
30	GS-Ali-7	2657	4010	2296	2490	3829	2872	3030	3026
31	NS-191	2393	1812	2009	3410	3231	2872	2980	2672
32	CIM-717	1771	4255	1866	2007	4069	4188	2910	3009
33	SLH-6	1221	1629	2440	762	3349	2751	2989	2163
34	AA-933	2549	2924	2440	3071	3590	2872	3305	2964
35	VH-383	3434	3999	2296	1632	3947	3707	2956	3139
36	Sitara-16	2645	2295	2870	1964	3588	2870	3103	2762
37	SLH-19	2003	1179	2440	1345	4425	3947	2833	2596
38	Cyto-225	2010	4459	1866	2077	3949	4069	3087	3074
	CD 5%	170**	349**	632**	427**	433**	698**	485**	--
	CD 1%	227**	464**	842**	569**	577**	931**	646**	--
	CV%	4	9	16	9	7	13	10	--

MNH-1026, Badar-1 (DG), FH-444, CIM-343 and TJ-Max(DG), which yielded 3434, 3407, 3342, 3255, 3251, 3248, 3185, 3154, 3134 and 3131 kg/ha seed cotton yield respectively.

Regarding 2018 trial results (table 4), on an average of seven locations of the Sindh and Balochistan, top ten high yielding varieties were GH-Haadi, ICI-2121, CRIS-613, VH-383, VH-189, CIM-343 and TJ-Max(DG), which yielded 3434, 3407, 3342, 3255, 3251, 3248, 3185, 3154, 3134 and 3131 kg/ha seed cotton yield respectively. Regarding 2018 trial results (table 4), on an average of seven locations of the Sindh and Balochistan, top ten high yielding varieties were GH-Haadi, ICI-2121, CRIS-613, VH-383, VH-189, NIAB-898, FH-490, Cyto-225, Tahafuz-10 (DG) and GS-Ali-7 with 3526, 3356, 3306, 3139, 3101, 3091, 3084, 3074, 3060 and 3026 kg/ha of seed cotton yield respectively.

However, when the results of 2017 and 2018 (both seasons) were summed up, top ten high yielding varieties were GH-Haadi, VH-189, CRIS-613, Weal-AG-6, GH-Mubarak, Badar-1(DG), ICI-2121, Weal-AG-5, FH-940 and MNH-1026 producing 3480, 3221, 3186, 3155, 3113, 3083, 3057, 3054, 3042 and 3042 kg/ha of seed cotton respectively (table 5).

It is interesting to note that among top 10 high yielding varieties, only two varieties (GH-Haadi and VH-189) were with stable yield performance due to the fact that these varieties keep their superiority in individual year (2017 and 2018) and also when the average performance was looked at.

Other varieties showed their stability in a particular single year but were included in top 10 varieties when the yield results were averaged. Seeing the yield results, it is suggested that the top two high yielding varieties (GH-Haadi and VH-189) with

Table 5: Two year's average performance (seed cotton yield kg/ha) of thirty six cotton candidate varieties tested in NCVT at seven locations of Sindh and Balochistan during 2017 and 2018 cotton seasons.

Sr. No	Genotypes	Sindh				Balochistan			Average
		Sakrand	Mirpur Khas	Ghotki	Tandojam	Khuzdar	Lasbela	Sibi	
1	MNH-1026	3039	2773	2962	2928	3547	3182	2863	3042
2	BH-221	2076	2550	2412	2904	3547	3529	2919	2848
3	BS-18	2225	2303	2370	2396	3457	3888	3022	2809
4	CEMB-100 (DG)	1968	2537	2386	2190	3432	3452	2776	2677
5	MNH-1020	2465	2049	2575	2443	3518	3224	2698	2710
6	FH-444	3045	2604	2472	2671	3427	3559	3016	2970
7	CEMB-101(DG)	2333	2429	2323	2446	3390	3600	2656	2739
8	ICI-2121	3075	3350	2952	2917	3140	3194	2770	3057
9	Bahar-07	2220	2548	2459	3387	3595	3296	2895	2914
10	IUB-69	2201	1887	2198	2677	3277	3799	2930	2710
11	CIM-343	2835	2219	2325	3484	3151	3948	2945	2987
12	FH-490	2656	3087	2823	3075	3092	3840	2724	3042
13	CIM-663	2100	2300	2486	2486	3517	3589	2916	2770
14	Cyto-515	2351	3397	2314	2568	3103	3362	2788	2840
15	CRIS-613	3254	3658	1963	3514	3272	3647	2996	3186
16	NIAB-898	2979	2887	2184	2983	3643	3422	2800	2985
17	GH-Haadi	3404	3311	3338	3278	3738	4228	3066	3480
18	Badar-1 (DG)	2835	2857	2980	2521	3503	4216	2668	3083
19	CIM-602 Std-1	2749	2961	2463	2475	3554	3586	2769	2936
20	GH-Mubarak	3296	2774	2686	2980	3343	3679	3034	3113
21	Tahafuz-10 (DG)	2812	3528	2348	2294	3360	3887	2741	2995
22	IUB-13 Std-2	2185	2596	2761	2244	3490	3529	2778	2797
23	Weal-AG-6	3757	2831	2729	2633	3474	3289	3373	3155
24	RH-Afnan	2716	3197	1978	2660	3559	3709	2869	2955
25	TJ-MAX (DG)	2428	2643	2556	2209	3282	2990	2914	2717
26	Bahar-2017	2112	2360	2076	2753	3463	2979	2859	2657
27	RH-Manthar	2877	1637	2880	2365	3551	3612	2844	2824
28	VH-189	3386	3688	2798	2306	3443	3827	3104	3221
29	Weal-AG-5	2596	3372	2290	2418	3894	3648	3164	3054
30	GS-Ali-7	2824	3440	2605	2865	3607	2937	2985	3037
31	NS-191	2255	2102	2024	3133	3248	3380	2996	2734
32	CIM-717	1980	3533	2315	1967	3955	3834	3195	2968
33	SLH-6	1711	2519	2270	1276	3133	2811	3025	2392
34	AA-933	2244	2688	2120	2816	3313	3218	3057	2779
35	VH-383	3075	3824	2061	1886	3594	3468	2918	2975
36	Sitara-16	2842	2852	2789	2530	3210	3110	2812	2878
37	SLH-19	2652	2414	2174	1820	3911	4067	2899	2848
38	Cyto-225	2410	3575	2370	2169	3535	3912	2864	2976

stability in performance must be approved by the provincial seed council of Sindh and Balochistan to revive the cotton production of the provinces and not to waste/garbage this high yielding stuff. The fiber results of VH-189 are almost meeting prefixed fiber standards, whereas, GH-Haadi have low fiber length as per set standard, it might be due to environmental conditions and could be improved. Regarding fiber properties (table 6), 04 candidate varieties could qualified all fiber standards prefixed by the government. The biochemical test results (table 7) revealed that on an average of four laboratories and two years, the trait purity range recorded was from 42 to 96 percent, whereas, quantification of Bt toxin ranged from 0.74 to 2.62. From the present study, it was concluded that almost 15-20 candidate varieties have the potential to be included among already approved varieties for commercial cultivation in the province of the Punjab.

CONCLUSION: Thirty six candidate cotton varieties were evaluated at six locations of Sindh and Balochistan. On the basis of results during the two consecutive years (2017 and 2018), top ten high yielding varieties were GH-Haadi, VH-189, CRIS-613, Weal-AG-6, GH-Mubarak, Badar-1(DG), ICI-2121, Weal-AG-5, FH-940 and MNH-1026. It is note that among top 10 high yielding varieties, only two varieties (GH-Haadi and VH-189) were stable with yield performance due to the fact that these varieties maintained their superiority in individual year 2017 and 2018, also when the average performance was combined. Whereas, other varieties showed their stability in a particular single year but included in top 10 varieties, when the yield results were averaged. On the basis of yield performance, it is concluded that the top two high yielding varieties GH-Haadi and VH-189 are stable in yield performance and must be approved by the provincial seed council of Sindh and Balochistan to revive the cotton production of the provinces and not to waste/garbage this high yielding stuff

Table 6: Summary report of fiber quality.

Sr. No	Genotypes	GOT (%)	Mic.	Staple Length (mm)	Fiber strength (g/tex)	Fiber uniformity (%)	Fiber maturity (%)
	Standards	**>37.5**	**<5.0**	**28.00**	**>25.5**	**>80**	**>80**
1	MNH-1026	40.0	4.0	25.5	27.4	82.2	97.00
2	BH-221	38.3	4.0	26.0	27.3	81.7	91.00
3	BS-18	41.1	4.0	27.6	27.8	82.6	96.00
4	CEMB-100 (DG)	40.8	4.2	26.6	27.1	80.2	98.00
5	MNH-1020	37.7	4.2	27.8	27.6	81.9	97.00
6	FH-444	33.8	4.2	27.4	27.5	82.1	97.00
7	CEMB-101(DG)	40.0	4.1	27.0	29.7	81.9	91.00
8	ICI-2121	42.7	4.2	25.6	26.1	81.8	93.00
9	Bahar-07	41.7	4.2	24.9	26.0	79.8	94.00
10	IUB-69	32.7	4.5	24.9	26.2	81.9	90.00
11	CIM-343	39.1	3.7	27.0	28.0	82.0	89.00
12	FH-490	40.0	4.0	25.8	27.5	82.5	99.00
13	CIM-663	38.0	3.9	25.9	28.5	83.6	87.00
14	Cyto-515	39.0	3.9	26.4	27.5	82.0	89.00
15	CRIS-613	37.8	4.2	27.8	28.2	81.6	99.00
16	NIAB-898	39.2	3.3	28.2	28.0	80.1	93.00
17	GH-Haadi	37.0	4.5	25.9	27.1	83.1	99.00
18	Badar-1 (DG)	40.8	3.8	26.0	26.6	81.1	98.00
19	GH-Mubarak	41.1	4.3	25.3	26.1	81.0	88.00
20	Tahafuz-10 (DG)	36.7	4.0	28.0	29.4	83.7	96.00
21	Weal-AG-6	40.8	3.7	28.5	28.2	83.3	98.00
22	RH-Afnan	39.0	3.7	26.2	30.1	81.2	91.00
24	TJ-MAX (DG)	35.0	3.2	28.1	29.8	84.8	87.00
25	Bahar-2017	37.8	3.9	25.7	26.9	82.0	96.00
26	RH-Manthar	37.5	3.9	27.6	29.2	83.1	88.00
27	VH-189	38.3	4.4	28.7	27.8	84.5	89.00
28	Weal-AG-5	38.3	3.9	25.3	28.1	81.0	94.00
29	GS-Ali-7	36.0	3.9	26.9	27.8	83.4	97.00
30	NS-191	34.7	3.0	28.1	31.0	81.4	93.00
31	CIM-717	40.0	5.1	26.2	26.3	82.7	89.00
33	SLH-6	38.3	3.6	25.2	26.0	79.9	93.00
34	AA-933	40.0	4.4	27.7	29.4	83.3	94.00
35	VH-383	38.3	4.4	27.4	27.0	83.7	90.00
36	Sitara-16	35.8	4.2	25.7	26.3	80.3	93.00
37	SLH-19	40.0	3.9	25.5	25.9	79.9	93.00
38	Cyto-225	39.5	3.9	30.3	31.7	80.7	98.00

Source: Spot Examination of Cotton Candidate Varieties Held during 2018 at CCRI-Sakrand and fiber traits results were tested from CCRI-Multan.

Table 7: Biochemical test results (average of four laboratories).

Genotypes	2017		2018		Average of 2 years	
	Trait Purity	Quantification	Trait Purity	Quantification	Trait Purity	Quantification
MNH-1026	92	2.24	89	1.36	90.50	1.80
BH-221	65	2.30	76	2.37	70.50	2.34
BS-18	100	1.63	80	1.46	90.00	1.55
CEMB-100 (DG)	93	1.50	82	1.44	87.50	1.47
MNH-1020	77	2.63	55	0.87	66.00	1.75
FH-444	78	1.48	100	1.08	89.00	1.28
CEMB-101(DG)	92	1.45	100	2.66	96.00	2.06
ICI-2121	82	2.81	100	0.94	91.00	1.88
Bahar-07	85	1.05	64	1.47	74.50	1.26
IUB-69	85	2.04	64	1.00	74.50	1.52
CIM-343	75	2.45	100	1.23	87.50	1.84
FH-490	77	2.64	89	1.10	83.00	1.87
CIM-663	65	2.02	100	2.70	82.50	2.36

Genotypes	2017		2018		Average of 2 years	
	Trait Purity	Quantification	Trait Purity	Quantification	Trait Purity	Quantification
Cyto-515	77	2.00	80	1.59	78.50	1.80
CRIS-613	48	0.85	33	0.63	40.5	0.74
NIAB-898	78	1.53	64	1.00	71.00	1.27
GH-Haadi	85	1.57	100	2.01	92.5	1.79
Badar-1 (DG)	93	2.12	73	2.00	83.00	2.06
GH-Mubarak	82	1.11	80	1.45	81	1.28
Tahafuz-10 (DG)	82	4.14	72	1.09	77.00	2.62
Weal-AG-6	85	1.85	89	1.23	87.00	1.54
RH-Afnan	65	2.66	100	1.38	82.50	2.02
CIM-602 Std-1	85	1.41	100	1.54	92.50	1.48
TJ-MAX (DG)	85	2.01	100	1.62	92.50	1.82
Bahar-2017	85	1.05	89	1.04	87.00	1.05
RH-Manthar	77	2.00	89	1.33	83.00	1.67
VH-189	92	1.22	89	1.48	90.50	1.35
Weal-AG-5	93	1.35	62	1.26	77.50	1.31
GS-Ali-7	52	0.77	33	1.08	42.50	0.93
IUB-13 Std-2	82	1.80	64	1.18	73.00	1.49
NS-191	52	0.93	93	1.47	72.50	1.20
CIM-717	90	1.12	40	0.90	65.00	1.01
SLH-6	85	1.85	67	0.98	76.00	1.42
AA-933	82	2.17	75	2.43	78.50	2.30
VH-383	93	1.67	87	1.18	90.00	1.43
Sitara-16	85	3.07	89	1.41	87.00	2.24
SLH-19	52	1.62	67	0.91	59.50	1.27
Cyto-225	58	0.70	33	0.93	45.50	0.82

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