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Evaluation of high yielding candidate cotton genotypes tested in National Coordinated Varietal Trial at different locations of Sindh and Balochistan

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	ABSTRACT **Digital Object Identifier (DOI): https:/doi.org/10.33865/IJCRT.002.01.0348**

The research was conducted during the two consecutive years 2018 and 2019; twenty eight (28) advance cotton strains were tested in national coordinated varietal trials (NCVT) at seven locations of Sindh and Balochistan. The results revealed highly significant difference among the varieties during both the years. On the basis of two years average performance only two candidate strains GH-Uhad and NIAB-135 showed their stability in yield performance during both the years. Therefore, it is recommended that top two high yielding varieties (*GH-Uhad and NIAB-135*) with stability in performance must be approved by the provincial seed council of Sindh and Balochistan to revive the cotton production of the provinces as well as national economy and not to waste/garbage this high yielding stuff and also suggested to cotton breeders utilization in hybridization/breeding program to evolve high yield variety.

Key word: Seed cotton yield, advance strains, locations, environmental.

INTRODUCTION Cotton (*Gossypium hirsutum* L.) is an important cash crop and plays a key role as compared to all other crops (Ahmad *et al.*, 2007). 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% to gross domestic product (GDP) and 55% to the foreign exchange earnings of the country. Koutu and Shastry (2004) reported that cotton is judged by genotypes to its interaction with environment for yield and quality performance. Singh *et al.* (2002) reported that evaluation and development of high yielding crop varieties are major aim of agricultural scientists to fulfil crop requirements to become self-sufficient.

In Pakistan, cotton was cultivated on 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, 2018). Five year's (2013-14 to 2017-18) data regarding cotton area, production and lint yield for Pakistan, Punjab and Sindh are depicted in Table-1. 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. 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 has accelerated momentum to fulfil the requirements of growers, textile industry and other stake holders. In this context, 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 research to select best suitable high yielding genotypes according to stability in both the provinces. The idea of study to identify an outstanding candidate strain to hold a place for commercial variety in future to boost up cotton production and national economy.

MATERIALS AND METHODS: The study was carried out to screen out the most appropriate high yielding varieties at seven locations of Sindh and Balochistan provinces.

Every year Pakistan Central Cotton Committee (PCCC) conducts National Coordinated Varietal Trials throughout Pakistan with the objectives to test the yield performance and adaptability of cotton candidate varieties developed by public and private sector cotton breeders. The 28 candidates Bt cotton strains from public and private sectors duly coded by the Director Research PCCC were tested at research centers in Sindh (CCRI, Sakrand; CRS Ghotki, CRS Mirpurkhas, and ARI Tandojam) and three centers at Balochistan (CRS Sibi, CRS Lasbela@Uthal and ARI-Khuzdar) against one standard/check variety CIM-602 during the years 2018-19 and 2019-20. The coded varieties seed provided by the Director Research, PCCC was sown on bed and furrow at all the seven locations. The plot size however, varied location-wise with the choice of the scientists or availability of land at the station who was deputed for conducting NCVT by the station in-charge. The trials were arranged in randomized complete block design with three replications at each location.

The experiment was conducted with randomized complete block design with three replications. The plot size was maintained 30'x10. The seed was planted on ridges with plant to plant and row to row distance was maintained at 30 cm and 75 cm respectively. The agronomic practices viz. weedicide, irrigation, thinning and inter-culturing were done uniform accordingly in all the replications. The fertilizer and plant protection measures were applied as per need whenever required. The 5 plants were tagged from each replication to record the data. 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 were 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 commercial variety for the general cultivation in the province of Sindh and Balochistan.

RESULTS AND DISCUSSION: Twenty eight candidate cotton varieties were tested during two consecutively years 2018 and 2019 at seven locations of Sindh and Balochistan Provinces in national coordinated varietal trials (NCVT). The research was conducted to evaluate cotton candidate varieties against commercial standard/check variety CIM-602 for seed cotton yield and environmental adaptability. The samples of these varieties were sent to four biotechnological laboratories for biochemical tests also. Table 1 shows the sources of the 28 + 1 standards cotton candidate varieties sown for two years in the Sindh and Balochistan during 2018 and 2019, cotton seasons at public sector research institutions. Table-1 indicated the cotton area, production and yield of Pakistan, Punjab and Sindh for last five years (2013-14 to 2017-18) which serves as ready reference for the readers to judge the ups and downs in cotton crop in last half decade. Table 2 demonstrates the yield performance and also results of statistical analysis (CD at 1 and 5% level of probability including CV%) of the candidate varieties during 2017, whereas, table 3 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 4.

Table 1: Cotton area of Pakistan, Punjab and Sindh with 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.

The mean performance of varieties during first year 2018 (table-2) revealed highly significant seed cotton yield differences among the genotypes, on an average of all locations, top ten varieties were found CIM-878, Rohi-1, VH-383, VH-189, FH-AM cotton 2017, CRIS-671, NIAB-135, VH-402, GH-Uhad and Cyto-511 which produced maximum seed cotton yield (kg ha^{-1}) with 3213, 3149, 3139, 3078, 3075, 3042, 3007, 2912, and 2908 respectively, as compared with remaining cotton candidate varieties as well as standard check CIM-602. Similar findings also reported by Khan *et al.* (2007) and Khan *et al.* (2008) who evaluated advance cotton genotypes in multiple environment and reported high yielding strains comparison with standard varieties. Sial et al. (2014) check yield performance of cotton genotypes and reported high yielding cotton varieties for commercial cultivation. Regarding the second year experiment results during 2019 (table 3) was surprised that the varieties which performed better during first year, that could not show their superiority in second year, because of their adoptability or due to influence of environmental conditions. On an average of second year top ten high yield varieties were; NIAB-1011, Rustam-11, GH-Uhad, FH-Super Cotton 2017, RH-670, NIAB-135, CIM-789, FH-AM Cotton 2017, Tassco-112, Tahafuz-12 (C-II) which given higher seed cotton yield 2945, 2908, 2857, 2682, 2643, 2588, 2562, 2534, 2509 and 2501 as compared with other candidate strains and also from standard check variety CIM-602. The present findings are according with Yasin *et al.* (2019) who also documented high yield cotton variety comparison with standard check. Ehsan *et al.* (2008) evaluated advance strains and reported high yield cotton genotype on the basis of yield performance. Jatt *et al.* (2007) assessed performance of cotton genotypes and high yield varieties recommended for commercial cultivation.

Table 2: Seed cotton yield (kg/ha) of 28 cotton candidate varieties tested in NCVT at 7 locations of Sindh and Balochistan during 2018-19.

S. No.	Genotypes	Sindh				Balochistan			Average
		Sakrand	Mirpur Khas	Ghotki	Tandojam	Khuzdar	Lasbela	Sibi	
1	Tassco-112	1735	1148	4305	1688	3231	3231	2616	2565
2	Tahafuz-12 (C-II)	1221	3157	4091	1256	3349	2512	2768	2622
3	Rohi-1	2561	2440	4487	1841	4069	4308	2335	3149
4	TJ-King (C-II)	2764	2296	2747	2045	4305	2272	2398	2690
5	Eye-111	2393	2153	3479	1857	4428	3710	2234	2893
6	Eye-20	1651	2870	2252	1194	3829	4069	2647	2645
7	Rustam-11	1998	1435	4984	1674	3710	3590	2762	2879
8	ICI-2424	1364	2009	3612	1930	3590	2872	2920	2614
9	IR-NIBGE-13	2142	2009	4684	2191	3590	2513	3069	2885
10	NIAB-135	2668	3157	3090	1978	3949	3710	2494	3007
11	NIAB-1011	2489	2296	3253	2547	3351	3111	2485	2790
12	VH-383	3434	2296	3999	1632	3947	3707	2956	3139
13	VH-189	3135	2727	3668	1632	4066	3349	2967	3078
14	VH-402	2513	2153	4319	1936	3949	3231	2286	2912
15	SLH-33	1149	2440	2601	984	3829	2633	2241	2268
16	RH-670	2202	2296	3935	1698	3710	2872	2496	2744
17	GH-Uhad	2513	2153	4319	1936	3949	3231	2286	2912
18	FH-155	1424	1579	3287	3181	3710	3710	2992	2840
19	FH-Super Cotton 2017	1675	2440	3749	1478	3590	3590	2756	2754
20	FH-AM Cotton 2017	1448	1866	4823	1940	4188	4308	2949	3075
21	BH-223	2226	2440	3577	1588	4069	3351	2817	2867
22	MNH-1035	1675	2009	2275	1633	4069	4069	2694	2632
23	CRIS-671	2645	3588	3346	1534	3949	3590	2641	3042
24	CRIS-673	2860	3014	1817	1659	3231	3231	2758	2653
25	Cyto-511	2262	2440	3482	1731	3949	3829	2664	2908
26	CIM-789	1603	1435	3986	1507	2633	3949	2671	2541
27	CIM-878	2142	4449	3763	1426	3949	3949	2812	3213
28	CIM-303	694	2009	3845	1211	3949	4069	2917	2671
29	CIM-602 (Std.)	2615	2368	3111	2110	3619	3141	2753	2817
	CD 5%	163.4**	197.8**	235.4**	186.3**	276.8**	410.2**	180.7**	---
	CD 1%	218.1**	295.3**	364.8**	278.8**	405.3**	513.6**	214.5**	---
	CV%	6.2	11.8	13.5	10.9	16.5	12.2	9.5	---

Table 3: Seed cotton yield (kg/ha) of 28 cotton candidate varieties tested in NCVT at 7 locations of Sindh and Balochistan during 2019-20.

S. No.	Genotypes	Sindh				Balochistan			Average
		Sakrand	Mirpur Khas	Ghotki	Tandojam	Khuzdar	Lasbela	Sibi	
1	Tassco-112	2114	2690	1630	2316	3395	3306	2110	2509
2	Tahafuz-12 (C-II)	2560	2942	2431	1965	2858	2738	2010	2501
3	Rohi-1	1925	2601	1467	1691	2961	2896	2535	2297
4	TJ-King (C-II)	1925	2601	1467	1691	2961	2896	2535	2297
5	Eye-111	1947	2661	1938	1831	2832	2792	3386	2484
6	Eye-20	1828	2661	1938	1831	2832	2792	3386	2467
7	Rustam-11	2847	2690	2301	1857	3745	3708	3206	2908
8	ICI-2424	2119	2691	1698	1536	2808	2732	2289	2268
9	IR-NIBGE-13	1960	2571	1485	1674	2571	2523	2641	2204
10	NIAB-135	2561	2930	1568	2646	2791	2565	3057	2588
11	NIAB-1011	3158	2810	2153	2134	3772	3713	2874	2945
12	VH-383	1851	2332	1677	2027	2675	2590	3117	2324
13	VH-189	1735	2571	1776	2475	1963	1901	2854	2182
14	VH-402	1572	2452	1113	2161	2353	2314	2119	2012
15	SLH-33	1850	2391	1155	2200	2478	2397	2572	2149
16	RH-670	2113	2212	1746	3693	3185	3115	2435	2643
17	GH-Uhad	2726	2690	2078	2312	4070	4037	2089	2857
18	FH-155	2607	2870	2139	2153	3220	2284	2102	2482
19	FH-Super Cotton 2017	2835	2451	1952	2432	3541	3522	2039	2682
20	FH-AM cotton 2017	1527	2332	1888	2536	3336	3306	2813	2534
21	BH-223	1915	2810	1458	2529	2433	2368	2967	2354
22	MNH-1035	2433	1401	1631	1176	2822	2816	2962	2177

23	CRIS-671	1945	2052	2395	2453	2929	2768	1948	2356
24	CRIS-673	2318	2429	1847	1948	2852	2804	2057	2322
25	Cyto-511	2232	2054	1692	1380	2815	2595	3119	2270
26	CIM-789	2151	1918	1889	2149	3476	3486	2863	2562
27	CIM-878	2672	2060	1730	1319	3745	3767	1931	2461
28	CIM-303	1200	1630	1800	1420	3334	3300	1734	2060
29	CIM-602 (Std.)	2248	2581	1295	2124	2918	2839	2312	2331
	CD 5%	136.8**	271.2**	223.7**	169.5**	202.4**	184.7**	227.1**	---
	CD 1%	201.4**	353.3**	403.6**	242.8**	381.3**	318.9**	436.8**	---
	CV%	8.4	14.5	12.8	11.2	15.8	12.4	11.5	---

Table 4: Two year's average performance (seed cotton yield kg/ha) of 28 candidate varieties tested in NCVT at 7 locations of Sindh and Balochistan during 2018-19 and 2019-20 Cotton Seasons.

Sr. No.	Genotypes	Sindh			Balochistan				Average
		Sakrand	Mirpur Khas	Ghotki	Tandojam	Khuzdar	Lasbela	Sibi	
1	Tassco-112	1925	1919	2968	2002	3313	3269	2363	2537
2	Tahafuz-12 (C-II)	1891	3050	3261	1611	3104	2625	2389	2561
3	Rohi-1	2243	2521	2977	1766	3515	3602	2435	2723
4	TJ-King (C-II)	2345	2449	2107	1868	3633	2584	2467	2493
5	Eye-111	2170	2407	2709	1844	3630	3251	2810	2689
6	Eye-20	1740	2766	2095	1513	3331	3431	3017	2556
7	Rustam-11	2423	2063	3643	1766	3728	3649	2984	2893
8	ICI-2424	1742	2350	2655	1733	3199	2802	2605	2441
9	IR-NIBGE-13	2051	2290	3085	1933	3081	2518	2855	2545
10	NIAB-135	2615	3044	2329	2312	3370	3138	2776	2797
11	NIAB-1011	2824	2553	2703	2341	3562	3412	2680	2868
12	VH-383	2643	2314	2838	1830	3311	3149	3037	2731
13	VH-189	2435	2649	2722	2054	3015	2625	2911	2630
14	VH-402	2043	2303	2716	2049	3151	2773	2203	2462
15	SLH-33	1500	2416	1878	1592	3154	2515	2407	2209
16	RH-670	2158	2254	2841	2696	3448	2994	2466	2693
17	GH-Uhad	2620	2422	3199	2124	4010	3634	2188	2885
18	FH-155	2016	2225	2713	2667	3465	2997	2547	2661
19	FH-Super Cotton 2017	2255	2446	2851	1955	3566	3556	2398	2718
20	FH-AM Cotton 2017	1488	2099	3356	2238	3762	3807	2881	2804
21	BH-223	2071	2625	2518	2059	3251	2860	2892	2611
22	MNH-1035	2054	1705	1953	1405	3446	3443	2828	2405
23	CRIS-671	2295	2820	2871	1994	3439	3179	2295	2699
24	CRIS-673	2589	2722	1832	1804	3042	3018	2408	2488
25	Cyto-511	2247	2247	2587	1556	3382	3212	2892	2589
26	CIM-789	1877	1677	2938	1828	3055	3718	2767	2551
27	CIM-878	2407	3255	2747	1373	3847	3858	2372	2837
28	CIM-303	947	1820	2823	1316	3642	3685	2326	2365
29	CIM-602 (Std.)	2432	2475	2203	2117	3269	2990	2533	2574

However, when the results of 2018 and 2019 (both seasons) mean performance were summed up, then top ten high yielding varieties were found Rustam-11, GH-Uhad, NIAB-1011, CIM-878, FH-AM cotton 2017, NIAB-135, VH-383, Rohi-1, FH-Super Cotton and CRIS-671 which produced maximum seed cotton yield (kg ha^{-1}) 2893, 2885, 2868, 2837, 2804, 2797, 2731, 2723, 2718 and 2699 as compared with other candidate strains and standard check variety CIM-602 (table 4). It is interesting to recorded that among top ten high yielding varieties, only two varieties (GH-Uhad and NIAB-135) were found stable during the both years and yield performance due to the fact that these varieties keep their superiority in individual year (2018 and 2019) and also when the average performance was looked at. Other varieties shown 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-Uhad and NIAB-135) with 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 results are in line with Shah *et al.* (2015) who evaluated candidate strains in national coordinated varietal trial in Sindh province with recommendation of high yield strains for commercial cultivation. Koutu and Shastry (2004) reported that performance of variety can be judged by the genotypes and its interaction with various environments for yield performance. Kairon *et al.* (2000) stated that stable cotton genotypes with high yielding potential are of paramount important among the large number of varieties recommended for cultivation for particular zone.

CONCLUSION: During the two consecutive years 2018 and 2019, twenty eight (28) advance cotton strains were tested in national coordinated varietal trials (NCVT) at

seven locations of Sindh and Balochistan. On the basis of two years average performance only two candidate strains GH-Uhad and NIAB-135 shown their stability in yield performance during both the years. Therefore, it is recommended that top two high yielding varieties (*GH-Uhad and NIAB-135*) with 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.

REFERENCES: Ahmad, R. T., M. U. Hassan, T. Muhammad and S. Ahmad, 2007. Seed cotton yield evaluation of some new cotton strains under multan conditions. Life sciences international journal, 1(4): 385-387.

Ehsan, F., A. Ali, M. A. Nadeem, M. Tahir and A. Majeed, 2008. Comparative yield performance of new cultivars of cotton (*Gossypium hirsutum* L.). Pakistan journal of life and social sciences, 6(1): 1-3.

Gomez, K. A. and A. A. Gomez, 1984. Statistical procedures for agricultural research. John Wiley & Sons.

GOP, 2018. Cotistics: A quarterly bulletin published by pakistan central cotton committee. August 2018, Old Shujabad Road, Multan.

Jatt, T., H. Abro, A. Larik and Z. Soomro, 2007. Performance of different cotton varieties under the climatic conditions of jamshoro. Pakistan journal of botany, 39(7): 2427-2430.

Kairon, M. S., P. Ramasundaram and M. V. Varugopalan, 2000. Agenda for new millennium. H. S. o. I. Agriculture (Ed.).

Khan, N., N. Muhammad and K. Noor-ul-Islam, 2008. Assessment of some novel upland cotton genotypes for yield constancy and malleability. International journal of agriculture and biology, 10(1): 109-111.

Khan, N. U., H. U. Khan, K. Usman, H. U. Khan and S. Alam, 2007. Performance of selected cotton cultivar for yield and fibre related parameters. Sarhad journal of agriculture, 23(2): 257.

Koutu, G. K. and P. P. Shastry, 2004. Characterization and identification of productive and high quality cotton species/genotypes cultivation practices suitable for different rain fed agro-ecological situations through farmer, participatory program. Proceed. International symposium on: Strategies for cotton production-A Global Vison-1: 213-215.23-25, November 2004, India.

Shah, S. Q., S. Samiullah, S. Ahmed, A. Qader, S. Ahmed and A. Hakeem, 2015. Seed cotton yield performance of some candidate cotton varieties in national coordinated bt trials in sindh province. Life sciences international journal, 9(1-4): 3121-3131-3124.

Sial, K. B., A. D. Kalhoro, M. Z. Ahsan, M. S. Mojidano, A. W. Soomro, R. Q. Hashmi and A. Keerio, 2014. Performance of different upland cotton varieties under the climatic condition of central zone of Sindh. American-Eurasian journal of agriculture and environmental sciences, 14: 1447-1449.

Singh, D., A. Pandey, U. Pandey and Bhonde, 2002. Effect of farmyard manure combined with foliar application of npk mixture and micronutrients on growth, yield and quality of onion. Newsletter national horticulture research development foundation, 21-22: 22.

Yasin, M., A. Ali, M. Shaheen, A. Khaliq, S. Ahmad, M. Rizwan, H. G. Abbas and Q. Ali, 2019. Characterization of yield potential for rh-662: A new high yielding, stress and salinity tolerant cotton variety. International journal of botany, 4 (2): 66-71.