

**VARIETAL DEVELOPMENT / IMPROVEMENT AT
CCRI, SAKRAND SINDH PAKISTAN
A. R. Soomro, B. A. Soomro, Kaneez Soomro
and A. W. Soomro
Central Cotton Research Institute
Sakrand Sindh Pakistan**

Abstract

Central Cotton Research Institute, Sakrand with the main objectives to carry out the basic/fundamental as well as applied research on cotton plant, in order to improve the socio-economic status of the farmers by boosting their per acre yield is progressing well in varietal developmental process.

In varietal evolution process, the institute has evolved CRIS-9, a high yielding variety in 1992. The proposal of another variety CRIS-5A (Marvi) was submitted before the variety approval committee, which recommended its approval as commercial variety to Sindh Seed Council in 1998. Four other high yielding varieties CRIS-19, CRIS-82, CRIS-133 and CRIS-134 have completed National Coordinated Varietal Trials (the final stage of variety test), their proposal for approval is under process.

CRIS-335, a very early maturing variety that opened 70 percent of total bolls after 110 days of planting as compared to 9 percent of NIAB-78, a widely grown variety in Sindh and 3 percent of CRIS-9 is also under evaluation process.

As regards development of insect resistant varieties, CCRI, Sakrand has developed CRIS-7A variety that is profusely hairy and is almost complete resistant against jassid.

Keeping in view the previous studies that okra leaf varieties are tolerant to some major insects like whitefly, heliothis and pink bollworm and boll rot disease, CCRI, Sakrand worked on breeding for okra leaf cotton varieties and has developed 11 new okra leaf strains.

This institute has worked on improvement in ginning outturn percent and has evolved four new strains CRIS-404, CRIS-405, CRIS-407 and CRIS-399 that possess ginning outturn from 40 to 44 percent. Similarly by continuous struggle this institute has also developed new long staple strains CRIS-399, CRIS-402, CRIS-155 and CRIS-157, which measure 33.5, 32.0, 31.5 and 31.0 mm staple length respectively.

The work on development of natural color cottons has also been carried out. Strains with eight different shades from khaki and green color cotton have been developed with

improvement in yield, lint percent, staple length, and uniformity ratio.

Introduction

Central Cotton Research Institute, Sakrand a multi-disciplinary mono-crop research organization was established by Pakistan Central cotton Committee in 1977. The main objectives are to carry out the basic/fundamental as well as applied research through coordinated, integrated and collaborative research approach on breeding & genetics, cytological, physiological, agronomical, pathological, entomological and fiber technological aspects of cotton plant, in order to improve the socio-economic status of the farmers by boosting their per acre yield. The research recommendations and improved agro-technological package developed by the Institute are disseminated to the doorsteps of the farmers through close liaison between the Institute and Agriculture Extension Department.

Central Cotton Research Institute, Sakrand now comprises of six research sections, namely breeding & genetics, cytogenetics, agronomy, physiology, entomology and pathology. Amongst others breeding & genetics section holds key position with the objectives to develop varieties that are high yielding and early maturing. The evolution of heat resistant varieties, which can tolerate the hot spell of June, July, and August months combined with insect pest resistance, is also the mandate of this section. Improvement in lint percent, staple length and fiber strength is prime need of the time, which is also included in the objectives.

Variety Development/Improvement

Development of High Yielding Varieties

In varietal evolution process, the institute has evolved CRIS-9, a high yielding variety in 1992. Another variety CRIS-5A (Marvi), which was included in national coordinated varietal trials (the final stage of variety tests) conducted at 21 locations of Pakistan from 1994 to 1996, secured first position in Sindh province (Table-1). The proposal of this variety was submitted before the variety approval committee, which recommended its approval as commercial variety to Sindh Seed Council.

The data of Table-1 revealed that among the five top yielding varieties out of sixteen in each year, CRIS-5A secured first, second and first positions during 1994, 1995 and 1996 respectively. Therefore one can easily draw the conclusion that CRIS-5A is high yielding variety of Sindh. The three years average data of 60 locations (Table-2) indicated that CRIS-5A excelled two check varieties NIAB-78 and Rehmani and other candidate varieties of Sindh and Punjab securing third position and proving its adaptability in the cotton belt of Pakistan.

Four other high yielding varieties CRIS-19, CRIS-82, CRIS-133 and CRIS-134 are also being tested in NCVT. The seedcotton yield data of 1997-98 cotton season of three region i. e. Sindh, Multan and Faisalabad are presented in Tables 3, 4 and 5 respectively.

On an average of six locations of Sindh Region (Table-3), all the four strains developed by CCRI, Sakrand were among the five top yielding varieties. CRIS-19 ranked first by producing 2578 kg/ha seedcotton followed by CRIS-134 (2543 kg/ha), CRIS-82 (2386 kg/ha). A new strain from Sahiwal, SLH-171 ranked fourth with 2204 kg/ha and again Sakrand variety CRIS-133 ranked fifth with 2190 kg/ha. The highest yielding Sakrand variety CRIS-19 yielded 36.7 percent more seedcotton than NIAB-78, the check variety.

In Multan Region, on an average of seven locations (Table-4), Sakrand varieties were among the top six strains. Highest yield of 2786 kg/ha was obtained from Bahawalpur strain BH-95, followed by CIM-435 (2572 kg/ha) and FS-643 (2543 kg/ha). Sakrand variety CRIS-134 produced 2449 kg/ha seedcotton yield and ranked fourth, this variety secured second position in Sindh Region also. Again Sakrand variety CRIS-19 ranked sixth and produced 2400 kg/ha, this variety secured first position in Sindh Region also. The fourth highest yielding Sakrand variety CRIS-134 produced 5.8 percent more seedcotton yield than NIAB-78.

The results of Faisalabad Region (Table-5) revealed that on an average of three locations, Sakrand varieties secured second, fourth and fifth positions maintaining their superiority in seedcotton yield and adaptability in whole of Sindh and Punjab provinces. Highest seedcotton yield of 1471 kg/ha was produced by Faisalabad variety FS-643 in Faisalabad Region followed by CRIS-82 (1397 kg/ha), VH-53 (1325 kg/ha), CRIS-134 (1261 kg/ha) and CRIS-19 (1196 kg/ha). The second best yielding Sakrand variety CRIS-19 produced 31.9 percent more seedcotton than NIAB-78, the check variety.

When the data of all the 16 locations of Sindh and Punjab were overall averaged (Table-5), Sakrand varieties CRIS-134, CRIS-19 and CRIS-82 secured first three positions by producing 2084, 2058 and 2028 kg/ha seedcotton yield respectively. Faisalabad variety ranked fourth with 2005 kg/ha whereas Bahawalpur variety BH-95 ranked fifth with 1970 kg/ha. The three top yielding Sakrand varieties CRIS-134, CRIS-19 and CRIS-82 produced 18.9, 17.4 and 16.3 percent more seedcotton yield respectively than NIAB-78, the check variety.

Development of Early Maturing and Beat Resistant Varieties

CRIS-335, a very early maturing variety that opened 70 percent of total bolls after 110 days of planting as compared

to 9 percent of NIAB-78, a widely grown variety in Sindh and 3 percent of CRIS-9 is also under evaluation process (Fig.1). This variety will leave milestone, as it will escape the attack of whitefly, which begins to flare-up in the middle of September. This pest has posed serious threat to cotton production in Punjab by transmitting clcv disease on 2000 acres in 1990-91, 35000 acres in 1991-92 and 6 million acres in 1992-93 seasons. CRIS-342 and CRIS-355 are also early maturing varieties with 40 percent boll opening after 110 days of planting.

As regards development of heat resistant varieties, plant-breeding section has developed CRIS-134 variety, which is capable of producing 32 bolls after 75 days of planting (the hottest days having an average temperature of 41 degree centigrade) as compared to NIAB-78 and CRIS-9, which formed 17 and 11 bolls respectively (Fig.2). No other variety has been developed so far which can form 32 bolls after 75 days of planting.

Development of Insect and Disease Resistant Varieties

As regards development of insect resistant varieties, CCRI, Sakrand has developed CRIS-7A variety that is profusely hairy and is almost complete resistant against jassid. The data are presented in Table-6 indicating two years average seedcotton yield of CRIS-7A compared with two commercial varieties NIAB-78 and CRIS-9. The trial during both the years received one spray against bollworm. On an average of two years, CRIS-7A, the profusely hairy variety encountered minimum attack of jassid and produced maximum seedcotton out-yielding two checks.

Keeping in view the previous studies that okra leaf varieties are tolerant to some major insects like whitefly, Heliothis and pink bollworm (Table-7) and boll rot disease, CCRI, Sakrand worked on breeding for okra leaf cotton varieties. These studies were under taken to evaluate the performance of okra leaf strains against normal leaf commercial checks NIAB-78 and CRIS-9 in respect of yield and insect/disease resistance.

The yield performance and boll rot disease resistance of okra leaf strains against normal leaf checks NIAB-78 and CRIS-9 was evaluated during 1997-98 season in randomized complete block design trial replicated four times. The trial received recommended agronomic practices without insecticide applications. The yield, quality characters and boll rot incidence data are presented in Table-8. The yield data revealed that almost all the okra leaf strains yielded better than NIAB-78 the check variety, which is grown on approximately 85 percent area of Sindh. Out of nine okra leaf strains, three were better yielders, two equally good and four gave low yield than CRIS-9, the second check variety of Sindh. Highest yield of 1985-kg ha⁻¹ was produced by CRIS-310, which was 27 percent higher than CRIS-9 and 35 percent than NIAB-78.

The data for lint percent revealed that two okra leaf strains ginned above 40 percent, only three okra leaf strains out of nine, recorded less lint percent than normal leaf checks. The same trend was observed in staple length and uniformity ratio data.

As regards boll rot disease, data presented in Table-8 indicated that all the okra leaf strains recorded minimum disease incidence as against two normal leaf checks. The boll rot disease incidence ranged from 0.5 to 2.2 percent in okra leaf strains as against 6.0 and 6.9 percent of CRIS-9 and NIAB-78 respectively.

The Institute has induced frego bract, nectariless and red plant color traits also in our high yielding strains developing nectariless and frego bract new strains which are under yield comparison trials. These traits are known to confer resistance against various insects.

After the heavy losses in cotton production caused by clcv disease in Punjab, this menace has appeared in Ghotki, Sukkur and Khairpur districts of Sindh. Even this disease has been observed in traces in Nawabshah district also. It can erupt suddenly and may cause disaster; therefore plant-breeding section initiated transferring clcv resistant genes from exotic as well as local cultivars in our high yielding varieties from 1996 cotton season. The recent studies show that clcv is controlled by single dominant gene and can be transferred through backcross technique. The material is in F₃ and BC₂ generation and is being screened at clcv hot spots of Ghotki district. Also four newly developed clcv resistant strains CRIS-464, CRIS-465, CRIS-466 and CRIS-467 have been bulked for testing in yield trials against standards.

Development of High Ginning Outturn and Long Staple Varieties

In 1914 commercial varieties of Pakistan possessed 32 percent ginning outturn, in 1945 it was 33 percent, similarly the ginning outturn in 1959, 1980 and 1992 was 35, 37 and 40 percent respectively (Fig-3). Consequently this section has worked on improvement in ginning outturn percent and has evolved four new strains CRIS-404, CRIS-405, CRIS-407 and CRIS-399 that possess ginning outturn from 40 to 44 percent (Fig-4).

Similarly in 1914 commercial varieties of Pakistan possessed 21 mm staple length, in 1945 the staple length was 24 mm, in 1959, 1980 and 1992 it was 26, 28 and 32 mm respectively (Fig-5). Plant breeding section by continuous struggle has developed new strains CRIS-399, CRIS-402, CRIS-155 and CRIS-157 which measure 33.5, 32.0, 31.5 and 31.0 mm staple length respectively (Fig-6).

Development of Naturally Colored Cotton Varieties

Exotic lines of naturally colored cottons (green and khaki) maintained in our gene pool are poor yielders having short

staple length (20-22 mm) and very low ginning outturn (25-28 percent). The work on development of natural color cottons has also been carried out. Strains with eight different shades from khaki and green color cotton have been developed with improvement in yield, lint percent, staple length, and uniformity ratio (Table-9). The eight color shades are:

Strain-1	Dark brown
Strain-2	Medium brown
Strain-3	Light brown
Strain-4	Dark green
Strain-5	Medium green
Strain-6	Light green
Strain-7	Medium greenish brown
Strain-8	Light greenish brown

References

- Bindra, O. S. 1985. Relation of cotton cultivars to the cotton-pest problem in the Sudan Gezira. *Euphytica* 34, 849-856.
- George, B. W. and Wilson, D. F. 1982. Infestation of okra leaf and normal leaf isolines by pink bollworm. p. 133 In Brown, J. M. (Ed.) Proceedings Beltwide Cotton Production Research Conferences. National Cotton Council of America, Memphis, TN.
- Khalifa, H. and Gameel, O. I. 1982. Breeding cotton cultivars resistant to whitefly (*Bemisia tabaci* (Genn) pp. 231-236 In Lamberti, F., Waller, J. M. and Vander Graff, N. A. (Eds) Durable resistance in crops. Plenum Press, New York.
- Mehetre, S. S. and Thombre, M. V. 1982. Note on the reaction of some promising mutants of upland cotton to the attack of bollworms. *Indian Journal of Agriculture Sciences*. 52, 474-476.
- Wilson, F. D. 1986. Pink bollworm resistance, lint yield and lint yield components of okra leaf cotton in different genetic backgrounds. *Crop Sci.* 26, 1164-1167.

Table 1. Performance of Five Top candidate varieties of Sindh and Punjab tested in NCVT for three years from 1994 to 1996 at eighteen locations of Sindh.

Year	Variety	Seedcotton yield (kg/ha)
1994	CRIS-5A	1891
	FH-679	1870
	DNH-29	1855
	CIM-360	1823
	NIAB-78	1801
1995	CRIS-5A	2459
	SLH-171	2493
	CIM-1100	2422
	FH-637	2416
	FH-679	2350
1996	CRIS-5A	2200
	CRIS-19	2139
	FH-634	2024
	Karishma	2045
	BH-89	1995

Table 2. Seedcotton yield (kg/ha) of CRIS-5A against Sindh and Punjab candidate varieties tested in NCVT from 1994 to 1996 (varieties mostly common in all years and at all locations)

Variety	1994			
	Sindh (7)*	Multan (9)*	F. Abad (5)*	
CRIS-5A	1891	2313	2385	
NIAB-78	1801	2438	2465	
Rehmani	1677	1979	1677	
CRIS-121	1686	2260	2163	
BH-89	1812	2501	2460	
SLH-171	-----	-----	-----	
MNH-329	1796	2441	2597	
MNH-395	-----	-----	-----	
DNH-40	-----	-----	-----	
Karishma	-----	-----	-----	
Variety	1995			
	Sindh (7)*	Multan (9)*	F. Abad (5)*	
CRIS-5A	1284	2459	2811	
NIAB-78	1377	2098	2531	
Rehmani	889	2034	2409	
CRIS-121	1329	2233	2733	
BH-89	1483	2348	2910	
SLH-171	1602	2494	2652	
MNH-329	-----	2193	2440	
MNH-395	1170	2153	2462	
DNH-40	1365	2242	2713	
Karishma	1637	1919	2956	
Variety	1996			
	Sindh (6)*	Multan (7)*	F. Abad (5)*	Average
CRIS-5A	2023	2368	2412	2216
NIAB-78	1494	2253	2220	2075
Rehmani	845	2178	1905	1733
CRIS-121	1590	2067	2409	2052
BH-89	1916	2426	2642	2278
SLH-171	2037	2259	2617	2277
MNH-329	1829	-----	-----	2216
MNH-395	1861	2052	2517	2036
DNH-40	1877	2272	2547	2169
Karishma	1725	2294	2569	2183

* Number of test locations

Table 3. Seedcotton yield (kg/ha) of NCVT conducted in Sindh Region during 1997-98

Code No.	Name of Strain	ARI, T. Jam	AEARC, T. Jam	CRSS, Kotdiji
V1	CRIS-82	2063	2191	1929
V2	CRIS-19	2745	2386	2467
V3	CIM-435	1444	2198	1256
V4	CIM-443	637	1794	556
V5	CRIS-133	1911	1891	1659
V6	NIAB-78	1740	2036	1516
V7	BH-95	2440	1911	2108
V8	VH-53	2224	2350	1902
V9	CRIS-134	2781	1758	2377
V10	RH-308	2323	1794	2045
V11	MNH-427	1381	1776	1273
V12	B-630	2269	1830	2072
V13	DNH-40	2206	1973	1973
V14	FS-643	2332	1749	2090
V15	MNH-465	1687	2045	1507
V16	SLH-171	2457	2135	2260

Table 3. Continued

Code No.	Name of Strain	CRS, M. Khas	CRI, Sakrand	CRS, Ghotki	Average of 6 sites
V1	CRIS-82	1570	4545	2017	2386
V2	CRIS-19	1615	4704	1549	2578
V3	CIM-435	1121	2201	1823	1674
V4	CIM-443	1076	2488	1753	1384
V5	CRIS-133	1435	4449	1794	2190
V6	NIAB-78	1255	3061	1707	1886
V7	BH-95	1570	2583	1920	2089
V8	VH-53	1255	2631	1689	2008
V9	CRIS-134	1660	4832	1847	2543
V10	RH-308	1390	2822	1893	2045
V11	MNH-427	987	3396	1670	1747
V12	B-630	1390	2727	2044	2055
V13	DNH-40	1524	3540	1883	2183
V14	FS-643	1435	2440	1963	2002
V15	MNH-465	1300	2201	1640	1730
V16	SLH-171	1345	3253	1775	2204

Table 4. Seedcotton yield (kg/ha) of NCVT conducted in Multan Region during 1997-98

Code No.	Name of Strain	CCRI, Multan	Jhandir Farm, Mailsi	PSC, Farm K. Wal	CRS, Bahawalpur
V1	CRIS-82	2039	2199	1788	2843
V2	CRIS-19	2505	2257	2022	2232
V3	CIM-435	2532	2793	2138	2682
V4	CIM-443	2929	3013	2731	2251
V5	CRIS-133	884	1463	1769	1166
V6	NIAB-78	1852	2458	2075	2305
V7	BH-95	2703	2793	1722	3516
V8	VH-53	1530	2075	1664	2697
V9	CRIS-134	2084	2726	2425	2870
V10	RH-308	1512	2429	1549	1812
V11	MNH-427	1592	2372	1626	1740
V12	B-630	2361	2625	1598	2816
V13	DNH-40	2442	2482	1913	2108
V14	FS-643	2438	2740	1769	3381
V15	MNH-465	1728	2224	1578	1964
V16	SLH-171	2349	2611	1750	2566

Table 4. Continued

Code No.	Name of Strain	CRS, R.Y. Khan	CRSS, Haroonabad	Thatta Gurmani Farm	Average of 7 sites
V1	CRIS-82	2726	2321	2192	2301
V2	CRIS-19	3037	2346	2403	2400
V3	CIM-435	2732	2879	2560	2572
V4	CIM-443	2155	1903	1932	2416
V5	CRIS-133	3113	1597	1603	1656
V6	NIAB-78	2840	2349	2328	2315
V7	BH-95	3367	2855	2543	2786
V8	VH-53	2503	2226	2226	2132
V9	CRIS-134	2445	2303	2290	2449
V10	RH-308	2602	2861	2523	2183
V11	MNH-427	2721	2830	2546	2204
V12	B-630	3024	2118	2120	2379
V13	DNH-40	2916	2125	2321	2372
V14	FS-643	3008	2364	2102	2543
V15	MNH-465	3134	2149	2124	2129
V16	SLH-171	3008	2272	2229	2398

Table 5. Seedcotton yield (kg/ha) of NCVT conducted in Faisalabad Region during 1997-98

Code No.	Name of Strain	ARSS Jhang	Risalewala Farm	CRS, Sahiwal	Average of 3 sites	Overall average of 16 sites
V1	CRIS-82	592	1649	2014	1397	2028
V2	CRIS-19	929	1421	1238	1196	2058
V3	CIM-435	835	1134	1187	1052	1766
V4	CIM-443	371	1285	1420	1025	1608
V5	CRIS-133	287	1470	362	706	1517
V6	NIAB-78	647	1402	1127	1059	1753
V7	BH-95	795	1149	1160	1035	1970
V8	VH-53	736	1081	2159	1325	1822
V9	CRIS-134	899	1267	1618	1261	2084
V10	RH-308	489	1263	513	755	1661
V11	MNH-427	489	1072	537	699	1550
V12	B-630	1003	1143	1159	1102	1845
V13	DNH-40	653	1158	933	915	1823
V14	FS-643	1181	1276	1957	1471	2005
V15	MNH-465	450	1075	588	704	1521
V16	SLH-171	914	1143	1440	1166	1923

Table 6. Average performance of CRIS-7A the jassid resistant variety at CCRI, Sakrand.

Strains	Seedcotton yield (kg/ha)			Average jassid per leaf
	1995	1996	Average	
CRIS-7A	2791	2093	2442	0.15
NIAB-78	2551	2033	2292	1.82
CRIS-9	2791	2063	2427	1.91

Table 7. Host plant resistance effects of okra leaf on major insects

Insect	Effect	Reference
Whitefly (Bemisia tabaci)	Reduced numbers	Khalifa and Gameel (1982) Bindra (1985)
Heliothis Spp.	Reduced numbers	Mehetre and Thombre (1982)
Pink bollworm	Increased egg/larval mortality	George and Wilson (1982), Wilson (1986)

Table 8. Average performance of okra leaf strains compared with two checks at CRI, Sakrand

Strain	Seedcotton yield (kg ha ⁻¹)	GOT (%)	Staple Length (mm)	Uniformity ratio (%)	Boll rot disease incidence (%)
CRIS-285	1450 c	34.4	27.2	55.8	1.2
CRIS-289	1374 c	33.6	27.4	55.4	1.8
CRIS-291	1527 c	37.6	28.1	54.8	0.9
CRIS-299	1298 c	35.0	27.5	53.7	1.3
CRIS-306	1450 c	40.6	25.6	52.6	1.1
CRIS-310	1985 a	36.0	26.4	52.7	0.5
CRIS-312	1298 c	40.3	25.6	56.6	2.2
CRIS-381	1374 c	31.5	28.3	59.5	1.8
CRIS-385	1603 b	36.0	28.1	54.3	0.8
NIAB-78 (Check)	1298 c	35.0	26.5	54.4	6.9
CRIS-9 (Check)	1450 c	36.0	26.5	52.9	6.0

Means followed by similar letters do not differ significantly from each other according to DMR Test

Table 9. Performance of newly bulked color cotton strains during 1999-2000

STRAINS	Seedcotton yield/plant (g)	GOT (%)	Staple length (mm)	Uniformity ratio (%)
Strain-1	81.3	35.0	25.0	60.4
Strain-2	110.3	34.8	24.5	49.5
Strain-3	82.5	34.3	24.2	50.1
Strain-4	90.2	33.3	26.8	49.7
Strain-5	51.5	32.9	27.7	51.9
Strain-6	64.8	35.4	27.5	55.0
Strain-7	110.0	30.7	24.0	58.8
Strain-8	87.5	34.8	26.4	50.5
NIAB-78 (Check)	57.3	34.6	26.4	52.0
CRIS-9 (Check)	67.5	35.7	26.1	52.5

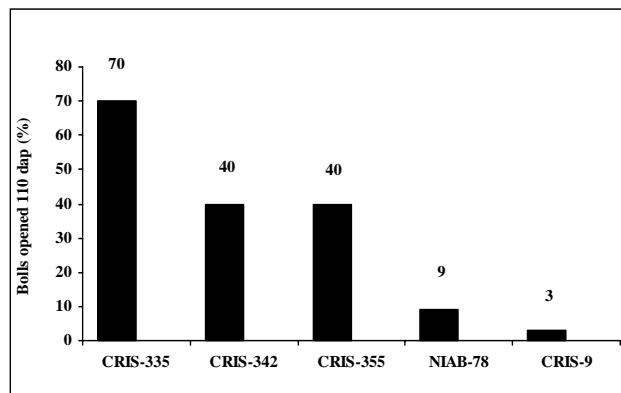


Figure 1. Earliness comparison of strains against two commercial checks NIAB-78 and CRIS-9 at CCRI, Sakrand

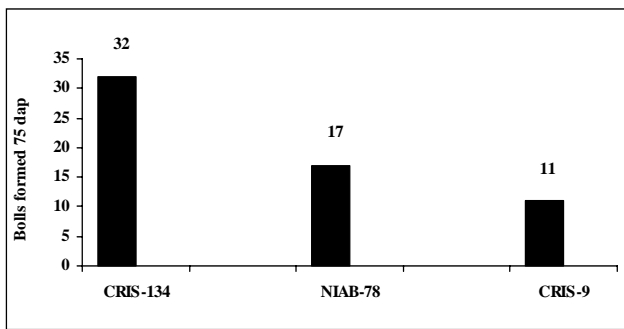


Figure 2. Heat resistance of CRIS-134 against two commercial checks NIAB-78 and CRIS-9 at the temperature of 41 degrees centigrade

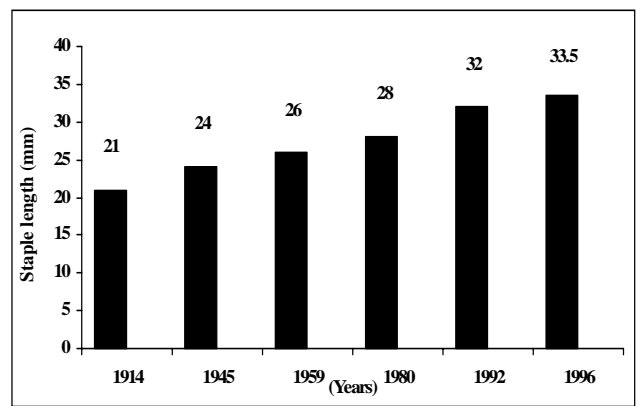


Figure 5. Improvement in staple length

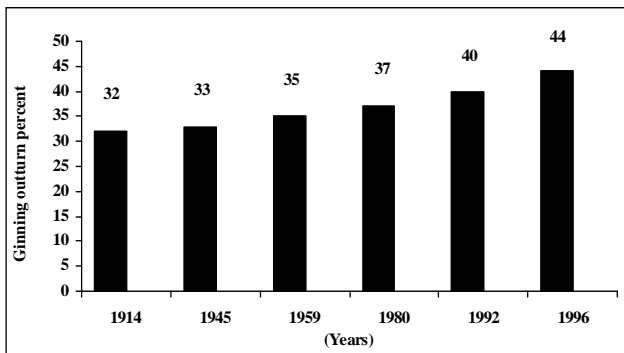


Figure 3. Improvement in ginning outturn percent

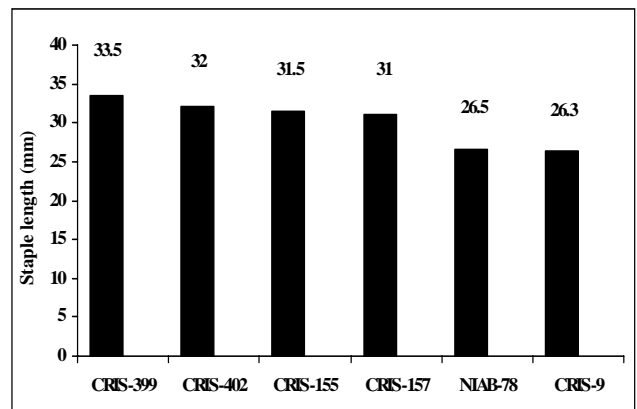


Figure 6. Staple length of new strains of CCRI, Sakrand compared with checks CRIS-9 and NIAB-78

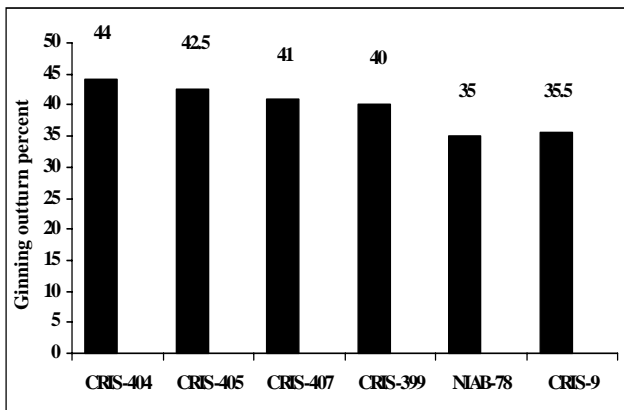


Figure 4. Ginning outturn percent of new strains of CCRI, Sakrand compared with two checks CRIS-9 and NIAB-78