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Cotton
Research and Development Corporation

Final report on project CSP 40C:

Breeding Improved Cotton Varieties

Dr. G.A. Constable (Principal Research Scientist)
Mr. P. Reid (Senior Experimental Scientist)
Dr N.J. Thomson (CSIRO Fellow)
CSIRO Cotton Research Unit,
PO BOX 59,
Narrabri. 2390.

Copy sent to John Grellman 24/10/95 AL.

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CSIRO
AUSTRALIA

Breeding Improved Cotton Varieties

SUMMARY:

This project aimed to continue the steady improvements in developing improved cotton varieties adapted to Australian growing conditions and markets.

The project has been very successful. Over the term of this project there have been major releases of new varieties:

- CS 6S was replaced by CS 7S, which was replaced by CS 8S in 1994. This early maturing variety now occupies 4% of seed sales. Although the area is not large, this variety is very important for short season areas and for late sowings.
- CS 50 was introduced in 1992 as a high yielding mainstream variety. It has been very successful, with up to 20% of seed sales each year.
- CS 189+ was released in 1993. It has been very successful in the Macintyre and Queensland. In 1995 it occupies 16% of seed sales. A higher yielding replacement is due in 1996.
- Siokra L23 was introduced in 1992. It has slightly higher yield, higher fibre strength and better fibre length uniformity. It has been an important variety for full season irrigated situations where verticillium wilt is not present. Siokra L22 and L23 occupy 12% of seed sales in 1995.
- Sicala V-2 replaced Sicala V-1 in 1994 having demonstrated 7% greater yield in large scale trials. Sicala V-2 has excellent verticillium tolerance and premature senescence tolerance and wider than expected general adaptation has seen it become the largest selling variety with 40% of seed sales in 1995.
- Siokra V-15 was released in 1994 as our first okra leaf variety with verticillium tolerance. Its impact has been dramatic, with 12% seed sales in 1995.

The breeding program contains many new lines with improved yield, adaptation and fibre quality. These lines are being evaluated for possible release.

The introduction of transgenic cotton has progressed rapidly in the past three years. Backcrossing of CSIRO lines with the Coker variety containing the Bt gene was undertaken in this project. In 1995, there was an 8 ha seed increase block of Bt cotton in Kununurra. This will provide the first commercial seed for 1996 or 1997.

Project title: **BREEDING IMPROVED COTTON VARIETIES**

Aim: Develop improved cotton varieties adapted to Australian growing conditions and markets.

Industry significance: Until this breeding program released varieties, Australian growers were completely dependent on foreign-bred cultivars which had obvious shortcomings. This program is dedicated to producing cottons that will continue to provide resistance to local diseases and pests besides progressively increasing yield and improving quality. By this means the stability and competitiveness of the Australian industry will be strengthened and fostered, assuring its long term future. In 1995, CSIRO varieties had about 93% of the Australian cotton planting seed market.

Research project summary: The funds requested were needed to enable:

(a) continuation of the steady improvements being effected for Australian farmers in the "traditional" avenues of yield, regional adaptation, quality and disease/pest resistance by the CSIRO core breeding program.

(b) additional novel "new" genes for improvement that have been made available through the techniques of genetic engineering e.g. Bt resistance and herbicide resistance to be incorporated into our commercial releases.

The additional demands imposed by (b) on top of the traditional necessitated greatly increased breeding activity. Practically this meant handling vastly bigger numbers of breeding lines throughout the program.

Significance

Until this breeding program released varieties, Australian growers were completely dependent on foreign-bred cultivars which had obvious shortcomings. This program is dedicated to producing cottons that will increasingly provide resistance to local diseases and pests besides progressively increasing yield and improving quality. By this means the stability and competitiveness of the Australian industry will be strengthened and fostered, assuring its long term future. In 1995, CSIRO varieties had about 93% of the Australian cotton planting seed market.

Staffing

Research staff

Dr G.A. Constable*°	40%
Mr P.E. Reid *	90%
Dr N.J. Thomson *	20%
Mr C.M. Patrick *	80%
Mr L.J. Heal *	90%
Mr T. McCumstie +	100%
Ms L Carpenter *	10%
Mr M Barnes °	10%
Mr T Murphy +	100%
Mr I Eliades +	100%

* CSIRO funded
\+ CRDC funded
° CRC funded

Other collaborating staff :

Mr G. Mann, Dept. Primary Industries Qld, Biloela.
Dr D. Llewellyn, CSIRO Canberra
Dr. B. Lyon, University of Sydney
Dr. R. Downes, CSIRO Canberra

BUDGET - CSP 40C

Item	1992/93 $	1993/94 $	1994/95 $
A STAFFING			
Salaries			
(Mr T McCumstie)	24,859	26,572	26,848
Other costs	1,599	1,686	1,708
Worker's Insur.	621	664	671
Super. Contrib.	3,083	3,295	3,329
TOTAL STAFFING	30,162	32,217	32,556
B TRAVEL			
Allowances	6,048	6,282	6,474
TOTAL TRAVEL	6,048	6,282	6,474
C OPERATING			
Vehicle Lease	4,000	7,785	7,911
Field Experiments	4,500	4,500	4,500
Electronic Data capture	1,600	1,600	1,600
Photographic supplies	800	800	800
Casual Labour	99,305	99,305	101,474
Greenhouse costs	7,000	7,000	7,000
Vehicle running costs	4,400	4,400	4,400
Insurance	2,235	2,235	2,235
Laboratory analyses	1,500	1,500	1,500
Audit fee			75
Weighing system	2,500		
Insecticide applicators	1,500		
TOTAL OPERATING	129,340	129,125	131,495
D CAPITAL			
Disc planter	10,000		
TOTAL CAPITAL	10,000		
TOTAL REQUESTED	175,500	167,624	170,525

RESEARCH

Background

The CSIRO field breeding program is a mature project in that the breeding lines and procedures have now been established for a number of years. The following table shows the evolution of the program from the 1970's. Of particular note is the continued emphasis on yield and adaptation to Australian conditions and the change in emphasis of characters such as fibre quality, verticillium wilt tolerance and Bt cotton from special purpose to overall objective - ie all varieties are aimed to have those characteristics in the future.

	1972-74	1975-91	1992-94	1994+
OVERALL OBJECTIVES	Yield Adaptation	Yield Adaptation Quality Blight res	Yield Adaptation Quality Blight res	Yield Adaptation Quality Blight res Verticillium tol Bt
TB1 Full season project objectives	Host Plant Resistance (frego bract, glabrous leaf)	HPR (okra leaf, frego, glabrous, nectariless)	HPR (okra, frego, glabrous, nectariless, allelochemical)	HPR (okra, frego, glabrous, nectariless, allelochemical)
TB2 Objectives of special purpose projects	Earliness, quality	Earliness Verticillium tol Dryland	Earliness Verticillium tol Dryland Bt Nutrition Cold tolerance	Earliness Cold tolerance Verticillium tol+ Fusarium tol Dryland (WUE) *G barbadense* Nutrition Herbicide tol Coloured cotton

Collaboration/CRC linkages

The CSIRO field breeding program is fully coordinated with the Biotechnology sub-program (headed by Dr. D. Llewellyn) based in Canberra. Their material is sent to Narrabri for evaluation as soon as it becomes available. All Narrabri and Canberra CSIRO staff are full time in kind contributions to the CRC for Sustainable Cotton Production. Dr Bruce Lyon at the University of Sydney is also collaborating with the breeding program in a number of projects.

CRC Linkages: All staff associated with this project are full-time in-kind contributions from their employers to the CRC. Conventional plant breeding is sub-program 3.1 of the Improvement program in the CRC.

RESULTS

Up to 10,000 plots are sown each season, both on the research station and on commercial farms. At Biloela, Theodore, Emerals and the darling Downs, these trials are sown and harvested by Gavin Mann (DPIQ), operating out of Biloela. This system enables the breeding program to cover Queensland with a detailed network of trials. Appendix 1 shows a summary of results for the Australian Cotton Cultivar Trial at 13 locations each year.

A. Regional Adaptation

i) Varieties for cool eastern and southern areas. During the period of this project there has been a rapid changeover in early maturing varieties. CS 8S (line 308) generally performed well in trials in the 93/94 season and it has completely replaced CS 7S for 94 plantings. CS 8S is more widely adapted than CS 7S, being 11% higher yielding over all environments and 5% in cooler areas. Another normal leaf short season type (Line 523) is continuing to be evaluated as a possible replacement for CS 8S.

A new short season okra leaf (Line 114) showed promise in 93/94 trials and is being considered as a replacement for Siokra S324. Line 114 has superior yield (up to 25%), Verticillium wilt tolerance and fibre quality.

Material from Ross Downs project (CSP 64C) is currently being evaluated and is also included in crosses with line 114 mentioned above.

ii) Varieties for the central mainstream area. CS 50 and Siokra L23 continue to be the major varieties in this area where Verticillium wilt is not a problem. The 93/94 season was very difficult with water shortages, premature senescence and Verticillium wilt having significant impacts. Thus CS 50 overall was not as outstanding as in previous seasons.

Seed sales of the high quality Sicala 34 continue to suffer from the lack of significant quality premiums and the lack of water in the Gwydir Valley where most is normally grown. The slightly improved Siokra 1-4-649 confirmed its advantage over the old 1-4 and has replacement the old version in 94 plantings.

iii) Varieties for "hot" outlying western and northern areas. A number of very high lint % types from the good hot area line 183 were evaluated in the 93/94 season. However, some problems were experience in the gins with very small seeds and despite their good yields, no further direct work is planned with this family. It will be used as a parent.

iv) Dryland. Our irrigated varieties continue to perform well in the dryland situation. Best in the cooler dryland areas is Siokra 1-4 while in the hotter environments Siokra L22 and L23 are superior. The better staple length of L22 has maintained its premier status in the hotter areas. Siokra V-15 performed well in 93/94 dryland trials and its suitability is being further investigated.

B. Verticillium wilt Tolerance/Resistance

Sicala V-2 has replaced V-1 for 94 plantings. Sicala V-2 has excellent Verticillium wilt and premature senescence tolerance and yielded exceptionally well in 93/94 CSD trials topping 9 of 18 irrigated trials. Over 4 seasons Sicala V-2 has averaged 7% more yield than V-1. It is the largest selling variety for 94 planting.

CS 189+ performed well under a wide range of situations in the 93/94 season and continues to show very good Verticillium wilt tolerance. Its more erect plant habit has seen it substituted for Sicala V-2 when lodging is considered a serious problem. An improved version of CS 189+ (line 1220), will be available for commercial use in 1996/97.

Our first Verticillium wilt tolerant okra leaf, Siokra V-15, performed well in trials in 1993/94 and is being grown commercially in 94/95. Improved Siokra V-15 types are under evaluation.

C. Host Plant Resistance

i) Bt cotton. The incorporation of Bt genes into our major varieties has reached the backcross 5 stage for the CryIA(c) gene and the CryIIA is one generation behind. In the 94/95 season the first field season of single plant selection and progeny screening will take place with CryIA(c) material. At this stage small commercial plantings are possible in 1996 with larger areas in 1997. A crossing program is underway to include single and double Bt genes into all commercial varieties and promising lines.

ii) Conventional HPR characters. A number of characters such as Super Okra leaf, Sub Okra leaf, glabrous, frego, high gossypol and high tannin have been established in a high yielding Siokra L23 background. This material has reached the progeny row stage. There is limited evidence from the USA of positive interactions between these HPR characters and the Bt gene. This result will be followed up by crosses during the next three years of the breeding program field evaluation of pest resistance in association with CRDC project CSE43C (Gary Fitt).

D. Fibre Quality

Our thrust to raise the general quality of our varieties continues to be very successful and also continues to generate some very high quality types which warrant further evaluation. A new high quality type (Line 214) has been under wide scale testing. This line has excellent fibre length (1.24 inch), uniformity (86%), strength (33.7 g/tex), maturity (0.94) and fineness (142 tex). The line has larger bolls than Sicala V-2 and Siokra L23.

E. Technology Transfer

The breeding team have attended all cotton field days, meetings and extensive CSD tours. At those venues all issues of the breeding program are presented, viz current varieties, their characteristics and areas of particular regional or agronomic adaptation, and new promising lines for potential release in future years. All data is presented to the industry via written material produced by CSIRO and CSD.

F. Publications

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Constable, G.A., Reid, P.E. and Thomson, N.J. (1994). Raingrown cotton varieties. Proc Seventh Australian Cotton Conference, Broadbeach, p203-209.

Fitt, G.P., Mares, C.L., Wilson, L.J., Thomson, N.J. (1992) Development of resistance to insects in Australian cotton varieties. 1992 Aust. Cotton Conf. Proc. pp 307-322

Luckett, D.J., Williams, E.R., Reid, P.E. and Thomson, N.J. (1992). Irrigated plot trials in cotton: quantifying end effects and the influence of plant size upon intergenotypic competition. Aust. J. Agric. Res. 43, 181-190

Reid, P.E. (1992). CSIRO Short season varieties. 1992 Aust. Cotton Conf. Proc. pp 123-127

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Reid, P.E., Thomson, N.J., Mann, G., Patrick, C.M., Heal, L.J. and Constable, G.A. (1994). The Australian Cotton Cultivar Trial results for the last two seasons. Proc Seventh Australian Cotton Conference, Broadbeach, p427/429.

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Williams, E.R., Luckett, D.J., Reid, P.E. and Thomson, N.J. (1992) Comparison of locations used in cotton breeding trials. Aust. J. Exp. Agric. 32, 739-746.

	1992/93 ACCT													
		WA	ER	MV	MN	BK	CO	MO	BB	SG	DD	BI	BM	MEAN
37	84009-47-523	1389	1863	2105	1810	1840	1763	1972	2117	2304	1480	1978	2309	1911
20	83055-33-613	1677	1993	2211	1743	1831	1757	2000	1893	2115	1484	1986	2211	1908
45	86203-97	1529	1840	2049	1865	1713	1737	1903	2197	2264	1423	2004	2304	1902
30	83203-183-149	1609	1744	1850	1870	1409	1728	1985	2304	2276	1372	2122	2515	1899
23	83055-33-1111	1702	1915	2110	1862	1819	1658	1834	1996	2020	1478	1921	2287	1883
29	83203-183-103	1429	1752	1896	1872	1379	1781	1992	2377	2205	1290	2094	2380	1871
31	83203-183-155	1611	1789	1834	1884	1200	1707	1925	2352	2204	1320	2081	2512	1868
32	83203-183-183	1463	1773	1893	1838	1422	1657	2012	2303	2273	1265	2090	2320	1859
34	83203-183-594	1470	1706	1879	1910	1418	1721	1922	2364	2063	1286	2109	2462	1859
22	83055-33-1102	1534	1944	2109	1752	1756	1632	1856	1916	2081	1467	1939	2266	1854
13	CS 50	1431	1730	1921	1779	1501	1695	1865	2173	2282	1281	2091	2459	1851
24	83055-33-1323	1571	1966	2135	1770	1675	1654	1786	1904	2005	1502	1982	2224	1848
36	84009-47-166	1412	1802	1997	1731	1719	1714	1946	2026	2243	1414	1950	2182	1845
33	83203-183-459	1366	1659	1915	1867	1369	1778	1943	2347	2130	1304	2099	2285	1838
26	83055-95-308	1320	1755	2005	1741	1675	1733	1930	2014	2180	1350	2026	2265	1833
40	86209-337	1471	1588	1737	1748	1616	1809	1852	2249	2212	1219	2093	2393	1832
46	89009-11	1448	1782	2045	1764	1617	1603	1913	2112	2102	1428	1968	2178	1830
28	83203-183-26	1404	1651	1789	1855	1334	1578	1868	2304	2165	1303	2176	2493	1827
27	83203-183	1404	1641	1947	1654	1441	1677	1950	2183	2202	1302	2142	2362	1825
48	89009-301	1386	1739	1996	1694	1763	1611	1922	2239	2054	1309	1958	2218	1824
41	87029-176	1499	1752	1936	1764	1671	1698	1952	2002	2077	1353	2004	2169	1823
25	83055-33-1348	1563	1794	2111	1733	1619	1658	1857	1952	1983	1405	1936	2170	1815
7	SIOKRA L23	1404	1668	1774	1704	1405	1686	1856	2268	2178	1251	2068	2375	1803
16	82237-175-189	1331	1541	1887	1682	1559	1720	1978	2156	2228	1169	2104	2287	1803
15	82237-175-156	1378	1552	1721	1641	1643	1748	2049	2126	2123	1253	2047	2285	1797
19	82268-263-733	1353	1766	2055	1698	1673	1676	1905	1984	2105	1329	1892	2120	1796
35	83203-510-115	1387	1629	1806	1729	1616	1624	1788	2247	2092	1275	2073	2273	1795
9	SIOKRA 1-4/649	1369	1552	1634	1804	1704	1796	1828	2104	2137	1196	2077	2318	1793
47	89009-109	1393	1788	1888	1623	1626	1580	1986	2098	1889	1332	1948	2256	1784
38	86001-130	1333	1648	2108	1714	1517	1564	1911	2083	2077	1418	1913	2099	1782
17	82237-175-290	1348	1571	1799	1725	1570	1733	1872	2104	2066	1250	2034	2302	1781
21	83055-33-861	1493	1881	2051	1717	1516	1592	1805	1970	1917	1444	1830	2122	1778
8	SIOKRA S324	1431	1608	1767	1780	1709	1665	1753	2022	2101	1393	1845	2201	1773
42	87029-481	1460	1693	1948	1620	1423	1625	1925	2030	2013	1359	1995	2171	1772
10	SICALA 34	1326	1513	1790	1678	1550	1669	1794	2102	2150	1235	2006	2248	1755
18	82268-263-42	1344	1782	1964	1635	1447	1529	1871	1965	2068	1348	1820	2222	1750
5	SIOKRA 1-4	1316	1546	1567	1751	1661	1784	1697	2092	2122	1171	2034	2231	1748
6	SIOKRA L22	1362	1590	1646	1676	1457	1604	1782	2238	2077	1244	2024	2266	1747
11	SICALA V1	1498	1762	2006	1672	1495	1581	1741	1868	1893	1376	1840	2158	1741
44	87239-336	1337	1632	1702	1618	1545	1644	1773	2096	1940	1211	2046	2308	1738
14	CS 189	1319	1598	1865	1685	1473	1536	1874	2010	2057	1275	1930	2063	1724
2	DPL 90	1251	1648	1817	1587	1450	1528	1840	2068	1979	1260	1901	2190	1710
12	CS 7S	1394	1668	1909	1697	1510	1537	1633	1882	2042	1374	1865	2008	1710
4	SIOKRA 1-1	1347	1427	1704	1593	1464	1617	1786	1984	2117	1220	1913	2286	1705
43	87031-126	1258	1646	1685	1459	1458	1528	1651	2036	1931	1194	2007	2191	1670
39	86201-630	1114	1540	1734	1263	1208	1451	1813	1974	1918	1103	1879	2127	1594
1	DPL 16	1045	1439	1483	1359	1390	1399	1655	1776	1873	1107	1684	1962	1513
3	NAMCALA	1212	1362	1690	1435	1286	1229	1645	1674	1551	1206	1538	1881	1476

	1993/94 ACCT													
		WA	BR	MV	MN	BK	MO	BB	SG	DD	TH	BI	BM	MEAN
20	83055-33-613	2016	1612	2140	1510	1932	1878	1846	1797	1578	1738	1814	1716	1798
29	86001-130-72	1812	1380	1949	1732	2043	2007	1943	1760	1235	1708	2005	1947	1793
33	86001-130-1220	1702	1351	2001	1793	1948	1863	1844	1797	1174	1775	2106	1979	1778
15	CS 8S	1795	1592	1952	1438	1878	2137	1875	1613	1510	1796	1960	1774	1777
34	86001-130-1305	1799	1230	1970	1763	1986	1900	1916	1766	1193	1796	2063	1897	1773
13	SICALA V-2	1896	1557	2174	1625	1868	1930	1785	1788	1488	1606	1830	1666	1768
43	89009-45	1718	1449	2038	1657	1954	2028	1884	1521	1424	1793	1876	1813	1763
21	83055-33-1111	2066	1523	2098	1560	1885	1771	1794	1787	1478	1647	1767	1727	1759
25	83203-183-155	1710	1246	1816	1675	2003	1879	2062	1499	1157	1774	2155	2122	1758
30	86001-130-78	1535	1405	1989	1679	1958	1952	1937	1661	1175	1763	2089	1913	1755
31	86001-130-806	1675	1259	2011	1633	1907	1895	1950	1758	1337	1767	1969	1903	1755
40	88203-97	1722	1274	2003	1589	2035	1879	1832	1712	1298	1882	1911	1894	1753
27	84009-47-163	1561	1352	1994	1477	1937	1813	1746	1720	1504	1986	1990	1889	1747
26	83203-183-594	1565	1276	1879	1756	1898	2072	1925	1514	1130	1686	2123	2029	1738
10	SIOKRA V-15	1849	1446	1912	1500	1933	1937	1765	1583	1541	1722	1866	1686	1728
38	88201-343	1805	1404	1937	1514	1977	1880	1838	1503	1363	1675	1999	1829	1727
23	83203-183-130	1603	1273	1673	1720	2034	1952	2010	1549	1259	1661	1956	1984	1723
22	83203-183-55	1695	1384	1691	1700	1985	1997	1912	1538	1149	1577	2079	1920	1719
45	89009-301	1757	1399	1858	1558	1780	1972	1794	1600	1383	1710	2037	1766	1718
28	84009-47-523	1545	1525	2065	1330	1999	1792	1685	1676	1508	1822	1913	1699	1713
44	89009-272	1802	1285	1916	1557	1836	1969	1859	1554	1376	1624	1942	1770	1708
18	CS 189+	1489	1282	1944	1730	1871	1835	1890	1673	1205	1636	1957	1900	1701
41	89007-110	1887	1485	2054	1544	1894	1838	1639	1637	1311	1674	1772	1681	1701
35	86001-130-1335	1511	1211	1811	1720	1898	1975	1921	1610	1230	1604	1968	1922	1698
39	88201-401	1622	1331	1888	1608	1789	1843	1747	1658	1346	1807	1982	1755	1698
32	86001-130-1057	1696	1221	1949	1601	1830	1822	1858	1604	1093	1561	2038	1944	1685
24	83203-183-149	1481	1241	1870	1747	1810	1848	1853	1513	1226	1594	1956	2034	1681
37	88201-207	1622	1345	1773	1697	1851	1792	1813	1462	1296	1685	1867	1855	1672
47	89026-96	1743	1215	1973	1434	1802	1812	1741	1689	1438	1685	1770	1756	1672
46	89013-114	1757	1546	2014	1236	1969	1608	1562	1561	1498	1747	1683	1687	1656
48	89026-207	1838	1225	2078	1649	1623	1870	1700	1694	1295	1428	1748	1718	1656
17	CS 189	1627	1271	1771	1610	1945	1960	1719	1478	1143	1538	1919	1834	1651
16	CS 50	1666	1402	1810	1393	1926	1796	1888	1389	1109	1608	1869	1850	1642
7	SIOKRA L23	1625	1198	1896	1615	1868	1846	1874	1367	1083	1474	2014	1964	1635
12	SICALA V-1	1819	1325	1918	1535	1658	1714	1713	1756	1239	1570	1761	1577	1632
9	SIOKRA 1-4/649	1856	1312	1704	1273	2036	1649	1733	1364	1136	1759	1852	1774	1621
36	86209-337	1785	1302	1722	1319	2022	1780	1748	1339	1053	1553	1933	1801	1613
42	89007-239	1813	1563	1944	1265	1932	1681	1590	1381	1424	1446	1656	1622	1610
19	82237-175-189	1609	1301	1584	1475	1896	1863	1850	1308	1028	1341	2036	1838	1594
2	DPL 90	1531	1167	1573	1550	1828	1821	1849	1466	1071	1529	1849	1874	1592
6	SIOKRA L22	1532	1198	1576	1398	1840	1842	1840	1344	1045	1454	1898	1855	1569
5	SIOKRA 1-4	1800	1277	1670	1152	1989	1550	1689	1350	1068	1714	1747	1749	1563
14	CS 7S	1496	1351	1867	1260	1757	1802	1535	1393	1372	1490	1631	1628	1549
11	SICALA 34	1550	1273	1600	1356	1889	1720	1813	1267	1080	1225	1941	1738	1538
8	SIOKRA S324	1678	1196	1712	1131	1984	1492	1572	1284	1077	1731	1560	1629	1504
4	SIOKRA 1-1	1617	1061	1575	1214	1907	1638	1556	1186	973	1523	1748	1628	1469
1	DPL 16	1361	996	1467	1285	1670	1502	1515	1306	914	1432	1479	1648	1381
3	NAMCALA	1392	996	1675	1372	1518	1501	1258	1284	1088	1429	1285	1490	1357

1994/95 ACCT ALL 13 SITES														
	WA	BR	MV	MN	BK	CO	MO	BB	SG	DD	TH	BI	BM	MEAN
19 87029-176-353	1779	1472	2089	2154	1638	2082	1990	2531	1832	2184	1572	2256	1804	1953
18 87029-176-58	1892	1481	2097	2262	1625	2083	1981	2454	1805	1913	1678	2139	1756	1936
26 87029-176-1100	1756	1520	1895	1930	1557	2060	2101	2405	1794	2033	1804	2213	1848	1917
22 87029-176-506	1709	1480	2035	1948	1577	2016	1977	2424	1841	2081	1611	2157	1865	1902
24 87029-176-834	1754	1521	1908	1924	1640	2070	1899	2497	1781	2181	1543	2131	1820	1898
23 87029-176-562	1704	1379	2048	2026	1586	1954	1984	2388	1710	2068	1788	2170	1807	1893
46 90005-757	1850	1560	1930	1914	1612	2156	1942	2480	1822	2082	1555	2039	1585	1887
20 87029-176-405	1732	1476	2022	1849	1571	2022	1898	2402	1779	2101	1667	2148	1852	1886
39 90001-781	1821	1236	2049	1886	1681	1896	1914	2327	1847	2199	1761	2132	1749	1884
25 87029-176-1031	1685	1463	2018	1959	1611	1998	1908	2415	1748	2066	1679	2076	1817	1880
21 87029-176-500	1616	1485	2118	1876	1561	1913	1958	2435	1715	2048	1539	1992	1776	1849
36 89013-114	1735	1581	1913	1850	1579	2085	1897	2430	1718	2257	1424	2056	1447	1844
15 83055-33-613	1749	1238	1981	1868	1603	1928	1815	2281	1848	2127	1598	1986	1698	1825
11 SICALA V-2	1709	1225	2011	1859	1639	1947	1840	2235	1858	2128	1620	1921	1691	1822
9 SIOKRA V-15	1652	1378	1936	1912	1477	1894	1814	2351	1735	2054	1557	2063	1772	1815
48 90012-512	1639	1026	1912	1880	1613	1856	1755	2347	1507	1812	1939	2084	1933	1793
47 90012-26	1558	1321	1817	1804	1459	2005	1798	2268	1686	2044	1634	2109	1785	1791
42 90003-217	1646	1116	1779	1833	1797	1863	1733	2223	1766	1822	1800	2044	1807	1787
33 89007-33	1550	1440	1749	1901	1439	1929	1873	2330	1744	2077	1627	2032	1532	1786
45 90005-674	1752	1366	1683	1819	1530	1920	1774	2255	1711	1978	1720	2008	1704	1786
41 90003-118	1447	1303	1817	1764	1704	1809	1647	2151	1861	1975	1774	2252	1687	1784
38 90001-113	1565	1334	1952	1785	1517	1855	1784	2300	1789	1993	1595	2116	1595	1783
40 90001-894	1572	1306	1942	1899	1538	1889	1848	2292	1802	1953	1438	1982	1668	1779
16 86001-130-542	1560	1115	1943	1824	1630	1700	1797	2199	1731	2002	1792	2024	1790	1777
12 CS 8S	1548	1429	1957	1743	1470	1901	1880	2195	1663	1935	1493	2210	1681	1777
35 89009-45	1518	1185	1862	1825	1589	1891	1741	2055	1673	1982	1683	2136	1790	1764
44 90005-456	1528	1302	1687	1712	1576	1868	1662	2330	1671	1834	1682	2268	1760	1760
43 90003-332	1685	1274	1783	1824	1653	1816	1594	2106	1859	1918	1634	2069	1645	1758
37 89026-309	1702	1215	1778	1775	1644	1855	1851	2219	1776	2090	1486	1919	1543	1758
17 86001-130-1220	1600	1168	1762	1652	1675	1822	1661	2158	1696	1978	1742	2072	1836	1756
28 88201-343	1575	1239	1694	1787	1546	1983	1702	2162	1602	1890	1643	2093	1736	1742
29 88203-97	1605	1180	1731	1702	1623	1961	1520	2224	1526	1863	1774	2060	1870	1741
14 CS 189+	1548	1124	1722	1824	1606	1703	1701	2107	1632	1904	1639	1929	1831	1713
34 89007-239	1584	1479	1935	1825	1462	1924	1592	2109	1569	1892	1372	1973	1460	1706
30 88208-214	1492	1324	1705	1696	1537	1810	1451	1998	1655	1853	1555	1900	1625	1662
27 87262-168	1339	821	1488	1700	1586	1671	1708	2043	1536	1443	1768	2033	2004	1626
13 CS 50	1271	1198	1314	1801	1423	1944	1417	2192	1601	1285	1609	2068	1908	1618
7 SIOKRA S324	1391	1359	1312	1759	1358	1971	1590	2193	1600	1355	1398	2062	1525	1606
8 SIOKRA 1-4/649	1361	1112	1164	1652	1327	1930	1589	2288	1605	1094	1618	2070	1803	1586
6 SIOKRA L23	1222	1050	1391	1672	1489	1745	1511	2033	1436	1336	1652	2081	1924	1580
32 88210-442	1439	810	1821	1639	1514	1707	1327	1951	1578	1598	1621	1929	1571	1577
31 88210-115	1488	746	1723	1717	1423	1727	1485	2025	1523	1476	1659	1821	1509	1563
2 DPL 90	1141	927	1275	1447	1483	1660	1351	2022	1552	1318	1554	1803	1975	1500
5 SIOKRA L22	1349	960	1134	1635	1377	1743	1446	1989	1446	1279	1443	1916	1765	1499
10 SICALA 34	1267	1139	1124	1566	1338	1923	1373	1942	1373	1143	1493	2057	1612	1488
4 SIOKRA 1-1	1008	1096	1092	1635	1244	1894	1645	2116	1454	1062	1358	2042	1653	1485
3 NAMCALA	1396	1033	1307	1473	1317	1545	1361	1857	1406	1422	1371	1549	1395	1418
1 DPL 16	1065	864	1041	1431	1226	1536	1278	1849	1412	966	1329	1656	1550	1323