FINREP97

July 94 - Jun 97

COTTON RESEARCH AND DEVELOPMENT CORPORATION

FINAL REPORT

Accepted

13.12.98

Adequate for this project

PROJECT TITLE: ACRI Plant Breeding Fibre Quality Laboratory.

PROJECT CODE: CSP56C

ORGANISATION: CSIRO Cotton Research Unit
Locked bag 59
Narrabri 2390

PRINCIPAL INVESTIGATOR:

Dr Greg Constable
CRC for Sustainable Cotton Production
CSIRO Cotton Research Unit
Locked bag 59
Narrabri 2390
ph 02 6799 1500; fax 02 6793 1186

Plain English summary

This project aims to provide fibre quality assessments for the Australian cotton breeding program and related projects by the operation and maintenance of a fibre testing laboratory at ACRI. The project supports the maintenance and operation of the Spinlab HVI (length/strength/micronaire) and the Shirley FMT 3 (maturity/fineness) equipment.

The significance and importance of the facility in assisting breeders is demonstrated by the progressive improvement in quality of recent CSIRO commercial releases. The objective each year is to provide length, strength, fineness and maturity estimates of cotton breeding and related research samples as rapidly and accurately as possible. In excess of 40,000 breeding samples have been tested in the fibre testing laboratory each season. Accuracy of the laboratory is very good as determined by the local testing comparisons.

A statistical analysis of fibre samples from the last four years has identified some relationships between different fibre properties. Micronaire was very closely related to fibre maturity and fineness. Neps were most closely associated with fibre maturity, fibre length uniformity and to a lesser extent with fibre fineness. These relationships will assist with setting critical values for each test when screening new varieties in the breeding program.

It is recommended a new instrument be purchased to replace the ageing FMT.

Background: The importance of determining fibre quality for cotton breeding

Besides yield, the major consideration affecting the return of cotton producers is quality. However, unlike yield, where simply 'more' is better, quality is not so easily defined nor is it so simply measured.

Whereas yield basically only requires measuring two components - the yield of seed cotton and the ginning out-turn, a number of assessments including fibre length, uniformity, strength, extension, fineness and maturity are needed to even roughly assess a cotton's suitability for manufacture. Different qualities then command different prices (penalties) so that for a certain weight of cotton, returns may differ.

What this means to research is that not only yield but also quality must be considered in judging the worth of a treatment - whether this be an agronomic, entomological or varietal variable. It is not simply good enough to conclude that any treatment has given a certain yield advantage, hence return, since accompanying quality changes could negate the advantage. The major consequence of this fact for breeding programs is the need for extensive quality monitoring as early as possible and as often as possible (since quality itself varies between environments) to decide the merit of genotypes as they progress through the breeding process.

The ability to rapidly evaluate quality ***on site*** means that we can commence screening genotypes for quality from the earliest generation (F2) that we select, and also evaluate our selections through all subsequent generations to ensure they continue to meet our standards. This ability to quality-screen throughout the breeding cycle has allowed us to increase efficiency of our breeding in that land, crop and staff inputs are not being 'wasted' on the growing and agronomic evaluation of quality-defective material as was the case when we could only quality test advanced generations. By this means we are now raising the quality levels of our overall material considerably and this is being reflected in our commercial releases. Confirmation of this assertion comes from several independent sources including for example:

(a) tributes by the German textile equipment manufacturer Schlafhorst at the Cotton Fibre Parameters and Instrument Testing Seminar held at Moree on the 7th December 1993. From test results of our cottons they made statements such as *"At this point it is only fair to congratulate you on these excellent fibre properties as well as on the outstanding yields .... Your chances to compete on the global cotton market should be second to none!"*

(b) and the progressive increase of the quality of our varieties has enabled just the conclusion quoted above to occur. Thus in a paper in the Nov/Dec 1993 edition of California-Arizona Cotton, a senior cotton analyst with Merrill Lynch, in a marketing article "San Joaquin Valley Cotton: where has the premium basis gone" states "*Australian high grade styles were extremely successful in emulating the strengths of SJV in Far Eastern markets .....*"

It will be apparent that the industry is indeed benefiting very substantially through the fibre quality facility in place at ACRI. It is vital that we retain and upgrade as necessary this testing capability so that our cotton farmers have the best possible cultivars available to compete on the world markets.

Objectives and achievements

Aim: Provide fibre quality assessments for the Australian cotton breeding program and related projects by the operation and maintenance of a fibre testing laboratory at ACRI.

Achievements: The significance and importance of the facility in assisting breeders is demonstrated by the progressive improvement in quality of recent CSIRO commercial releases. The objective each year will be to provide length, strength, fineness and maturity estimates of cotton breeding and related research samples as rapidly and accurately as possible.

This project supports the maintenance and operation of the Spinlab HVI (length-strength-micronaire) and the Shirley FMT 3 (maturity-fineness) equipment. Of particular importance in 1997, the HVI equipment was upgraded to a new model.

In excess of 40,000 breeding samples have been tested in the fibre testing laboratory each season.

The continued acceptance of Australian cotton on the local and export market relies on good and improving fibre quality. The CSIRO breeding program has had highly beneficial effects on the fibre quality of the Australian crop: fibre strength has been improved up to 30% in the last decade. The efficiency of the breeding programs in upgrading quality are largely dependent on having the ability to rapidly screen large numbers of selections.

Methodology

A Spinlab HVI and Shirley FMT are now operating in a new fibre testing laboratory at ACRI. The procedure is that breeding material is fibre tested as soon after harvest as possible so yield and fibre properties can be used for screening breeding lines in time for sowing in the following spring.

Throughput - Some 45,000 samples are tested each season. 66% of these are tested on both the Spinlab and FMT instruments and the remainder - 33% (single plant selections) are HVI tested only. A number of workers are trained as operators as necessary for testing. A double shift is worked for over four weeks besides continuous operation of the instruments. By this means all the samples were finished by early July and all the results, as planned were able to be taken into consideration for the following year's plantings.

Spinlab Performance - To align with industry changes, we changed to the use of HVI calibration cottons instead of the previously used International cottons. A change was also made to adopt the associated expressions of HVI strength (instead of Pressley strength), mean and upper half mean lengths (instead of 50% and 2.5% span lengths) and length uniformity index (instead of length uniformity ratio). The HVI equipment functioned well but there are continuing software problem yet to rectified by Spinlab (Knoxville, TN). The clamps used for strength testing were replaced mid-season.

Shirley FMT 3 Performance - Following substantial initial difficulties in re-calibrating the instrument, its operation has been acceptable. This type of instrument is essential to distinguish between fineness or immaturity for low micronaire samples.

Dust Reduction - A system which extracts dust from five contaminating sources and passes the contaminated air through two filters before re-channelling it back into the room has been brought into operation. In addition the waste from the FMT testing is now ejected below the building where a trolley on rails is used to collect and clear it daily. Dust hazards for operators have been substantially reduced by these measures.

Lint Conditioning - Air passing through the conditioning cabinet is now drawn from the dust system fan which exerts a more powerful flow than the independently operated fan used previously. Time needed for condition has been reduced to 12 hours allowing up to 1000 samples to be conditioned each 24 hours.

Results

This laboratory participates in the Cotton Classer's Association of Australia round tests for fibre samples on a regular basis. Our results are generally very good when compared with the CCAA average, with correlations exceeding 90% for most fibre measurements. In 1998, our HVI strengths were above average and FMT maturity were below average. We also participate in the Bremen International round tests.

The attached tables summarise fibre data from the main multi site variety trial run by CSIRO. The tables detail how new variety releases and breeding lines are making continued steps in improving fibre properties.

Association between fibre properties. Because of recent questions in the marketplace about micronaire, maturity and neps, we undertook a study to obtain information about these fibre properties and their association with one another. Samples (67) were kept from control varieties from four consecutive years from the ACRI site of the CSIRO Cotton Cultivar Trial. All samples had been harvested and ginned on the same equipment, so the data are a true measurement of variety and season effects. These samples had been tested on the HVI and FMT for all fibre properties. The samples were then tested with the AFIS-NEPS instrument at the Namoi Cooperative in Wee Waa. Of the four seasons data, there was only one season where there was a significant effect of variety: that showed the verticillium susceptible varieties such as CS50, Siokra 1-4, Siokra L23 and DP5690 to have higher neps than other varieties when that disease incidence was high in 1994/95 (Table 1). This result implied some effect of disease on fibre properties such as maturity.

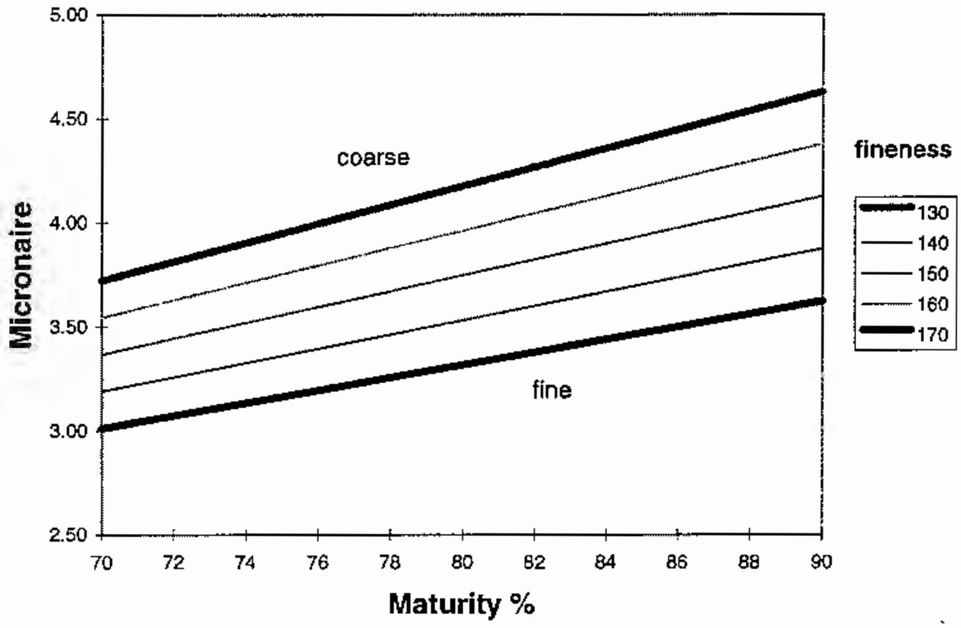
neps/g	1992/93	1994/95	1995/96	1996/97	mean
DP 90/5690/Pearl	113.1	224.3	123.5	165.1	156.5
Namcala	143.2	184.1	155.7	210.8	173.5
Siokra L23	104.2	251.5	141.6	153.6	162.7
Siokra 1-4	129.3	282.5	148.8	159.7	180.1
CS 50	127.6	290.5	128.5	183.7	182.6
Sicala V-2	108.7	145.9	128.7	158.5	135.4
CS 8S	97.3	164.3	196.3	153.4	152.8
CS 189+/Sicot 189	95.5	167.3	164.2	156.1	145.8
Siokra V-15/V-16	106.6	202.9	189.4	154.1	163.3
Siokra S324/S-101	138.7	175.0	156.4	206.9	169.3
mean	116.4	208.8	153.3	170.2	162.2

Ingard varieties were tested; their fibre properties were the same as their recurrent parent.

One step was to evaluate the relationship between fibre maturity, fibre fineness and micronaire. It was found there was a very close association between these properties, with fineness and maturity explaining 97% of the variation in micronaire in this data set. The equation was:

mic = 3.28 - 0.0189*fin - 0.034*mat% + 0.000501*fin*mat% (R^2=0.97)

That relationship is plotted in the following figure. It can be seen that varieties with fine, mature fibres (such as with Siokra V-16) can actually have a lower micronaire than varieties with coarser fibre. This aspect is often missed in marketing; the missing information is a measure of fibre maturity at the marketing level.

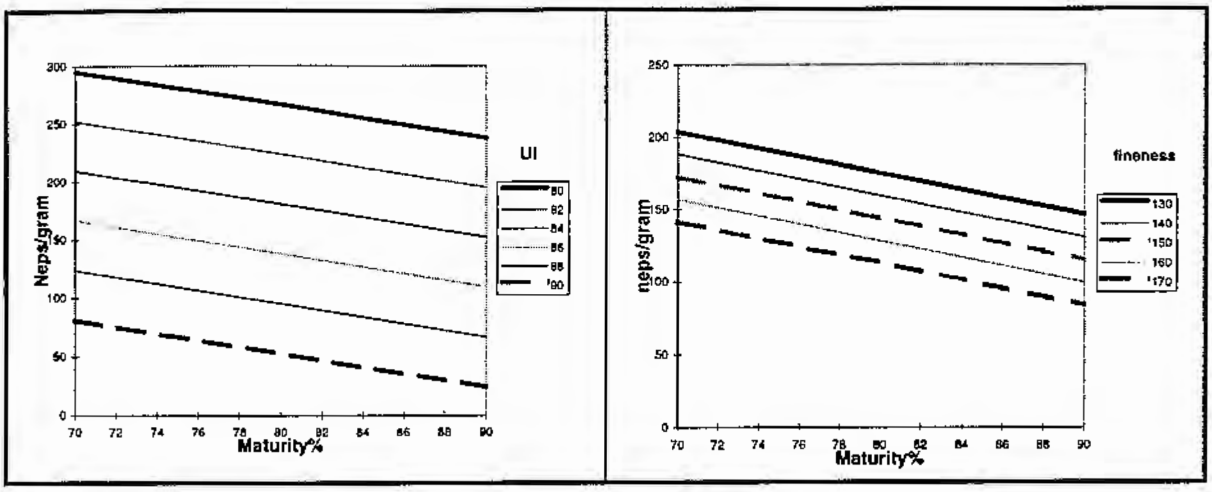


The association of HVI and FMT properties with neps was examined in the data set by multiple regression. It was found there was a significant effect of fibre maturity, uniformity and fineness on neps/gram; that regression explained 69% of the variation in neps of this range of varieties when pooled over four seasons. The equation was:

neps/g = 2423 - 2.86*mat% - 21.4*ui - 1.56*fin (R^2=0.69)

All of the effects on neps are logical: the least neps were found in mature, uniform and coarse samples. There were no significant interactions between fibre properties. The fitted relationship is shown in the following figures. The effect on neps was greater from uniformity than from fineness.

It must be emphasised that these data are from samples picked with a plot harvester and ginned on a 20-saw gin. The relationship between these results at this scale need to be compared with commercial samples with more aggressive harvesting, storing and ginning.



Discussion

The breeders are pleased with the capability of being able to aggressively screen for fibre properties in the breeding program. The acceptance of Australian cotton is good with both local and international spinners. The intention is to continue with maintaining or improving fibre properties as new varieties are released. The new Sicala 40 for example is a slight improvement in fineness and maturity over Sicala V-2, previously the most popular variety.

In particular, with the analysis of micronaire and neps, we have identified values for maturity, fineness and uniformity which will ensure that screening pressure can be applied to these fibre properties to ensure new variety releases have a genuine improvement in fibre maturity and neps.

Assessment of impact on the cotton industry

Approximately 90% of seed sales in Australia are of varieties bred at ACRI. Adoption of new varieties by the Australian cotton industry is very quick and dynamic. The release and adoption of Sicala 40 for the 1998 sowing is a good example: about 16% of the seed sales (for the record sowing) was of this variety in its first year of release.

Reputation of fibre properties in the market is important and intrinsic fibre properties is one component of that acceptance. There will be climate, management and processing effects on fibre properties and in general these effects are not acknowledged in the marketing process. It is relevant to note that there has not been a wet harvest for some years in Australia - buyers are expecting consistent fibre quality which is difficult to achieve in a variable climate.

Recommendations

We propose to continue to screen breeding lines with the fibre testing laboratory at ACRI. Because of the importance of maturity (not micronaire) and neps in marketing we will place more selection pressure on these parameters in future breeding.

The FMT instrument is reaching the end of its practical life: problems are occurring with calibration, service and parts. Given the importance of fibre maturity we recommend that a new FMT (or instrument such as AFIS measuring maturity and fineness) should be purchased in the near future. At this point in time we believe spinning tests should be done at a later stage in the variety release/processing stage.

Publications

Constable, G.A., Reid, P.E. and Thomson, N.J. (1996). CSIRO cotton varieties - performance 1995/96 In 'CSD Variety Trial Results 1996', pp.44.

Constable, G.A., Reid, P.E. and Ferguson, G. (1996). Performance of new CSIRO INGARD varieties In 'Proc. 8th Aust. Cotton Conf.' , pp.561-564

Reid, P.E., Constable, G.A., Thomson, N.J., Mann, G., Heal, L.J. and Patrick, C.M. (1996). CSIRO small scale variety trials for 1994/95 and 1995/96 In 'Proc. 8th Aust. Cotton Conf.' , pp.573-575

Patent and Licensing Agreements - Plant Breeders Rights for Sicala V-2i, Siokra V-15i, Siokra L-23i, Sicot S-8i and Sicot 50i.

	1994/95 ACCT MEANS OF ALL 13 SITES										
		LY	L%	LEN	UR	STR	EXT	MIC	MR	M%	FIN
1	DPL 16	1323	36.8	1.16	83.5	27.6	6.8	3.18	0.83	74.2	132
2	DPL 90	1500	38.2	1.15	83.5	30.4	5.8	3.29	0.85	75.5	135
3	NAMCALA	1418	36.4	1.17	84.3	33.6	4.9	3.20	0.88	78.4	126
4	SIOKRA 1-1	1485	40.3	1.16	83.6	28.5	6.1	3.25	0.88	78.2	129
5	SIOKRA L22	1499	39.5	1.20	83.3	31.6	5.9	2.95	0.80	71.5	123
6	SIOKRA L23	1580	40.1	1.18	83.6	31.5	5.8	3.12	0.83	74.3	129
7	SIOKRA S324	1606	40.5	1.15	84.3	28.1	6.1	3.42	0.91	80.3	133
8	SIOKRA 1-4/649	1586	40.1	1.20	84.2	29.9	6.4	3.22	0.89	78.6	127
9	SIOKRA V-15	1815	39.2	1.20	85.2	31.5	5.8	3.27	0.90	80.5	127
10	SICALA 34	1488	38.5	1.20	83.8	32.0	5.1	3.21	0.91	80.5	123
11	SICALA V-2	1822	39.9	1.18	84.4	31.0	5.5	3.39	0.89	79.1	135
12	CS 8S	1777	40.6	1.13	84.3	28.8	5.8	3.51	0.90	80.1	140
13	CS 50	1618	40.9	1.18	83.4	30.2	5.4	3.20	0.89	78.5	126
14	CS 189+	1713	38.4	1.18	83.7	30.5	5.8	3.38	0.89	78.9	134
15	83055-33-613	1825	40.0	1.16	84.1	30.8	5.6	3.22	0.85	76.0	131
16	86001-130-542	1777	39.4	1.15	84.0	29.6	5.9	3.53	0.91	80.5	139
17	86001-130-1220	1756	40.0	1.19	84.1	31.1	5.9	3.31	0.88	78.7	131
18	87029-176-58	1936	40.3	1.17	84.9	31.0	5.5	3.31	0.91	81.1	127
19	87029-176-353	1953	41.3	1.17	85.0	31.1	5.8	3.31	0.91	81.1	127
20	87029-176-405	1886	40.2	1.17	85.1	30.7	5.7	3.47	0.95	83.9	131
21	87029-176-500	1849	39.0	1.21	84.6	30.4	5.5	3.39	0.92	81.6	131
22	87029-176-506	1902	40.2	1.20	85.3	30.9	6.0	3.29	0.90	80.2	127
23	87029-176-562	1893	40.3	1.16	85.2	30.7	5.8	3.43	0.95	83.5	130
24	87029-176-834	1898	39.5	1.18	85.2	31.5	6.1	3.41	0.92	82.0	132
25	87029-176-1031	1880	39.8	1.20	85.1	31.2	5.6	3.25	0.90	80.4	125
26	87029-176-1100	1917	40.0	1.19	85.2	31.1	5.9	3.33	0.91	80.8	129
27	87262-168	1626	39.6	1.17	84.0	30.7	5.9	3.38	0.87	77.6	137
28	88201-343	1742	39.0	1.20	84.4	32.0	6.3	3.24	0.87	77.3	130
29	88203-97	1741	39.2	1.13	84.6	31.2	5.3	3.45	0.90	80.2	135
30	88208-214	1662	38.1	1.21	85.5	35.1	5.2	3.27	0.92	81.6	125
31	88210-115	1563	37.9	1.19	84.2	31.8	5.4	3.19	0.88	77.8	126
32	88210-442	1577	38.1	1.21	84.4	32.1	5.7	3.19	0.87	77.4	127
33	89007-33	1786	40.1	1.17	84.3	30.3	5.4	3.48	0.93	82.6	133
34	89007-239	1706	40.2	1.16	84.1	29.6	5.6	3.27	0.90	80.2	127
35	89009-45	1764	40.9	1.15	83.4	30.2	5.5	3.22	0.85	75.6	132
36	89013-114	1844	40.7	1.19	84.6	29.9	5.5	3.41	0.92	81.7	131
37	89026-309	1758	40.8	1.14	83.8	31.2	5.4	3.23	0.88	78.5	129
38	90001-113	1783	40.0	1.17	84.3	31.3	5.9	3.38	0.92	81.9	129
39	90001-781	1884	40.8	1.16	83.7	30.2	6.1	3.24	0.86	77.1	130
40	90001-894	1779	40.2	1.15	84.3	30.3	5.7	3.48	0.87	77.7	141
41	90003-118	1784	40.1	1.18	84.5	31.2	5.7	3.54	0.92	81.2	138
42	90003-217	1787	39.3	1.21	84.9	31.6	6.0	3.21	0.88	78.7	127
43	90003-332	1758	39.9	1.18	84.7	31.5	5.3	3.38	0.89	78.9	134
44	90005-456	1760	40.0	1.18	84.6	30.6	6.1	3.40	0.89	79.4	135
45	90005-674	1786	39.5	1.18	84.4	30.6	5.9	3.35	0.87	77.6	134
46	90005-757	1887	40.7	1.18	83.9	30.2	5.6	3.54	0.89	78.9	142
47	90012-26	1791	40.4	1.21	84.1	30.2	5.8	3.37	0.90	79.9	132
48	90012-512	1793	40.3	1.16	84.1	29.5	6.2	3.43	0.90	79.5	136

	1995/96 ACCT MEANS OF ALL 13 SITES									
		L%	LEN	UI	STR	EXT	MIC	MR	M%	FINE
1	DPL 16	36.37	1.160	83.96	25.26	7.62	3.64	0.936	83.1	141
2	DPL 5690	37.88	1.156	84.19	28.43	5.81	3.80	0.952	84.2	146
3	NAMCALA	35.42	1.174	84.76	31.07	4.52	3.43	0.945	83.7	130
4	SIOKRA 1-1	40.07	1.158	84.05	26.59	6.68	3.67	0.975	86.0	137
5	SIOKRA L22	39.35	1.197	83.78	28.25	5.96	3.50	0.934	82.6	135
6	SIOKRA L23	40.03	1.171	84.12	28.63	5.80	3.76	0.960	84.7	143
7	SIOKRA S324	40.32	1.144	84.78	26.91	6.70	3.87	1.002	87.9	144
8	SIOKRA 1-4	39.76	1.189	84.52	27.84	6.70	3.68	0.983	86.5	137
9	SIOKRA V-15	38.66	1.195	85.15	29.27	5.55	3.60	0.991	87.2	132
10	SICALA 34	38.45	1.195	84.53	29.94	4.48	3.82	1.033	89.9	138
11	SICALA V-2	39.20	1.177	84.97	29.55	5.25	3.78	0.975	85.9	143
12	CS 8S	39.73	1.119	84.62	27.37	6.13	3.89	0.973	85.6	148
13	CS 50	40.78	1.175	84.09	27.82	5.29	3.77	1.003	88.0	138
14	CS 189+	37.91	1.175	84.48	28.65	5.78	3.77	0.979	86.2	142
15	SICOT 189	39.25	1.194	84.58	29.23	5.84	3.77	0.976	85.9	142
16	87029-176-353	40.55	1.170	85.45	29.33	5.93	3.65	0.995	87.5	134
17	87029-176-506	39.67	1.201	85.64	28.75	5.94	3.61	0.984	86.7	134
18	87029-176-643	40.62	1.166	85.42	29.78	5.72	3.74	1.013	88.7	136
19	87029-176-977	38.68	1.202	85.78	30.47	4.98	3.71	1.005	87.9	136
20	87029-176-1100	39.52	1.185	85.56	29.56	5.88	3.62	0.988	86.8	133
21	87262-168	39.04	1.157	84.43	28.98	6.12	3.86	0.964	85.2	148
22	88201-343	38.87	1.198	85.22	29.63	6.42	3.71	0.966	85.1	141
23	89007-33	39.92	1.164	84.95	28.87	5.22	3.84	1.009	88.2	142
24	89007-58-506	39.05	1.194	85.74	29.48	5.55	4.10	0.982	86.5	157
25	89007-110-10	40.98	1.214	84.80	28.62	5.08	3.66	0.978	86.3	137
26	89007-110-52	41.15	1.175	84.85	28.79	5.07	3.96	1.005	88.1	147
27	89007-110-222	39.82	1.174	85.60	30.72	4.65	3.84	1.004	88.0	142
28	89007-110-437	40.07	1.165	85.76	29.93	6.05	3.87	0.995	87.5	144
29	89009-78-209	40.09	1.162	84.08	28.12	5.36	3.91	0.964	85.1	151
30	89009-78-408	40.48	1.164	84.15	28.28	5.70	3.48	0.925	82.2	134
31	89009-179-57	39.60	1.188	84.68	28.92	5.42	3.87	0.955	84.5	149
32	89009-179-164	39.78	1.185	84.92	30.62	4.95	3.73	0.952	84.1	143
33	89009-179-491	39.40	1.199	85.17	29.45	5.29	3.99	0.981	86.4	151
34	SIOKRA S-101	40.75	1.180	84.88	28.19	5.43	3.74	0.995	87.5	138
35	89205-134	40.05	1.150	84.09	28.05	6.78	3.75	0.982	86.5	140
36	89205-401	40.46	1.145	83.62	27.75	5.88	3.78	0.984	86.8	141
37	90001-781	40.38	1.162	84.22	28.45	6.36	3.61	0.952	84.2	138
38	90003-118	39.52	1.184	85.09	29.65	5.48	3.87	0.996	87.4	145
39	90003-217	38.95	1.209	85.44	29.92	6.14	3.64	0.972	85.8	136
40	90005-757	40.77	1.175	84.59	28.55	5.35	3.95	0.965	85.2	152
41	90012-512	39.61	1.161	84.77	28.62	6.55	3.80	0.975	85.9	144
42	90031-169	40.47	1.202	84.33	28.08	5.41	3.70	0.998	87.5	136
43	91014-211	39.28	1.198	85.01	28.95	4.80	3.82	1.012	88.7	140
44	91203-60	39.98	1.170	84.81	29.55	4.97	3.83	1.007	88.2	141
45	91203-228	39.30	1.189	85.31	30.45	5.90	3.79	0.998	87.6	140
46	91203-566	39.72	1.182	85.05	29.22	5.83	3.69	0.962	84.9	140
47	91203-667	39.97	1.162	84.75	29.15	6.28	3.69	0.969	85.5	139
48	90219-218	39.51	1.192	84.92	29.13	5.63	3.73	0.968	85.2	141

	1996/97 MEANS ACROSS SITES														
		LY	L%	LEN	UI	SF	STR	EXT	MIC	MIC2	MR	M%	FIN	Rd	b
1	DPL 16	1495	37.9	1.155	83.3	8.1	27.1	12.9	3.7	3.7	0.96	85	143	76.5	7.9
2	DELTA PEARL	1858	40.3	1.185	83.1	7.6	28.0	10.8	3.8	3.8	0.98	86	144	76.3	7.5
3	NAMCALA	1389	36.5	1.178	84.0	7.2	30.7	9.7	3.6	3.5	0.97	86	132	74.1	8.3
4	SIOKRA 1-1	1608	41.0	1.164	83.2	7.9	27.7	11.8	3.7	3.6	0.98	86	137	76.3	7.3
5	SIOKRA 1-4	1670	41.2	1.174	83.5	7.7	27.8	11.8	3.7	3.6	0.98	87	136	75.7	7.3
6	SIOKRA L23	1812	40.7	1.186	83.4	7.3	30.1	11.0	3.6	3.6	0.96	84	138	75.6	7.4
7	SIOKRA S-101	1831	41.6	1.185	84.0	7.1	28.0	10.7	3.7	3.6	0.99	87	136	74.4	7.3
8	SIOKRA V-15	1904	39.9	1.212	84.6	6.1	29.6	10.7	3.7	3.6	1.00	88	134	74.9	7.6
9	SIOKRA V-16	2025	40.7	1.194	84.9	6.3	30.0	11.0	3.8	3.7	1.01	88	135	74.7	7.5
10	SICALA V-2	1889	40.6	1.178	84.0	7.4	29.4	10.5	3.8	3.8	0.98	86	145	75.7	8.0
11	SICOT 189	1885	40.4	1.196	83.7	7.0	30.0	10.9	3.8	3.7	0.99	87	140	76.2	8.0
12	CS 50	1833	41.5	1.179	83.3	7.6	28.3	10.5	3.7	3.6	0.99	87	136	76.4	7.5
13	CS 8S	1910	41.3	1.130	83.8	8.3	27.9	11.4	3.9	3.8	0.99	87	146	77.3	7.5
14	89007-110-10	1900	41.8	1.216	83.7	6.6	28.6	10.2	3.6	3.6	0.98	87	136	75.7	7.7
15	89007-110-222	1991	40.7	1.168	84.8	6.7	30.2	9.9	3.9	3.8	1.01	88	142	75.7	7.7
16	89007-110-470	1935	41.8	1.189	83.7	7.2	28.1	10.3	3.8	3.7	0.99	87	139	76.4	7.6
17	89007-110-52	1961	41.7	1.172	84.0	7.2	28.8	10.4	3.9	3.9	1.00	88	146	75.9	7.8
18	89007-33	1863	41.0	1.167	83.8	7.5	28.5	10.5	3.9	3.8	1.01	88	141	75.9	7.7
19	89007-58-506	1876	40.3	1.200	84.7	6.3	30.3	10.8	4.0	3.9	0.98	87	152	74.5	7.7
20	89009-179-491	1879	40.6	1.194	83.9	6.8	30.0	10.6	3.8	3.8	0.97	85	146	74.1	7.8
21	89009-179-57	1892	40.9	1.193	83.8	6.9	29.7	10.6	3.8	3.8	0.96	85	146	74.5	7.7
22	89201-805	1907	41.8	1.170	83.1	7.9	28.4	11.0	3.7	3.7	0.99	87	137	76.1	7.7
23	89230-341-1024	1761	39.1	1.220	84.1	6.3	30.8	10.3	3.8	3.7	1.00	88	140	76.0	8.0
24	89230-341-1074	1813	38.4	1.229	83.9	6.3	30.2	10.2	3.8	3.7	0.98	87	140	75.3	8.2
25	89230-341-826	1787	39.7	1.211	84.5	6.2	31.1	10.1	4.0	3.9	1.01	88	148	75.7	8.2
26	89230-341-847	1795	40.4	1.261	84.2	5.6	30.7	9.9	4.0	3.9	1.00	88	148	75.1	7.9
27	90001-781	1973	41.4	1.168	83.3	8.0	29.1	11.4	3.6	3.6	0.97	85	138	76.3	8.2
28	90005-757	1962	42.1	1.166	83.8	7.5	28.7	10.6	3.9	3.9	0.98	86	151	75.4	7.6
29	90031-169	1880	41.6	1.200	83.4	7.2	28.5	10.8	3.7	3.6	0.99	87	135	75.4	7.5
30	90050-221	1906	39.6	1.186	85.0	6.5	30.1	10.6	3.8	3.7	1.01	88	139	75.7	7.7
31	91011-163	1977	41.2	1.158	83.9	7.7	28.5	10.7	4.0	3.9	1.03	89	144	75.1	7.6
32	91011-223	1984	42.1	1.149	84.2	7.6	28.4	11.0	3.9	3.8	1.00	88	144	74.8	7.9
33	91011-380	1951	41.2	1.162	84.4	7.4	29.6	10.8	4.0	4.0	1.00	88	149	75.0	7.7
34	91011-472	1879	40.8	1.175	84.5	6.9	29.0	10.3	3.8	3.8	1.01	89	138	74.8	7.6
35	91011-888	1893	41.5	1.165	84.4	7.2	29.0	10.7	3.7	3.6	1.02	90	132	76.0	7.6
36	91011-940	1945	40.8	1.215	84.6	6.2	30.0	10.6	3.8	3.8	1.00	87	141	74.1	7.7
37	91203-163	1856	40.5	1.174	84.5	7.0	29.7	11.0	4.0	4.0	0.97	86	154	73.8	7.7
38	91203-228	1865	40.3	1.194	84.0	6.9	31.0	11.4	3.8	3.7	0.99	87	138	75.7	7.6
39	91203-335	1856	39.9	1.190	84.6	6.5	28.9	10.4	3.9	3.7	1.02	89	137	77.0	7.7
40	91203-667	1825	40.8	1.175	83.4	7.7	30.1	11.4	3.6	3.6	0.98	86	137	75.5	8.1
41	91223-28	1861	40.4	1.204	84.4	6.4	30.6	10.7	3.8	3.7	1.02	89	134	76.4	7.7
42	SIOKRA L-23i	1900	41.1	1.166	83.4	7.7	29.2	11.0	3.7	3.6	0.94	83	143	75.9	7.5
43	SIOKRA V-15i	1859	39.7	1.191	84.3	6.7	29.2	10.8	3.7	3.6	1.00	87	134	75.7	7.5
44	SICALA V-2i	1969	40.6	1.172	83.9	7.4	29.4	10.6	3.8	3.8	0.97	86	146	75.5	8.0
45	SICOT S-8i	1959	41.0	1.147	83.5	8.1	28.6	11.1	3.9	3.9	0.99	87	150	76.8	7.5
46	SICOT 50i	1909	41.4	1.182	83.1	7.6	27.9	10.4	3.7	3.7	0.98	87	140	76.5	7.5
47	SIOKRA V-15 1076	1858	37.6	1.185	84.2	6.8	29.0	10.5	3.9	3.8	1.02	89	140	75.7	7.9
48	NUCOTN 37	1846	39.0	1.171	83.2	7.9	28.2	11.1	4.0	3.9	0.98	86	151	75.8	7.9