



Final Report

Off Farm Series | Cotton Research & Development Corporation

*If you are participating in the presentations this year, please provide a written report and a copy of your final report presentation by 31 October.
If not, please provide a written report by 30 September.*

Part 1 - Summary Details

Please use your TAB key to complete Parts 1 & 2.

CRDC Project Number: CTFT 16 and CTFT16A

Project Title: Improving the Nep Levels in Australian Cotton

Project Commencement Date: 01/07/2006 **Project Completion Date:** 30/06/2010

CRDC Program: Value Chain

Part 2 – Contact Details

Administrator: Jo Cain, Administration Manager, Cotton Management & Improvement

Organisation: CSIRO Plant Industry

Postal Address: Locked Bag 59, Narrabri, NSW, 2390

Ph: 02 6799 1513 **Fax:** 02 6793 1186 **E-mail:** jo.cain@csiro.au

Principal Researcher: René van der Sluijs, Textile Technologist and Project Leader

Organisation: CSIRO Materials Science and Engineering

Postal Address: Henry Street, Belmont, Victoria, 3216

Ph: 03 5246 4000 **Fax:** 03 5246 4057 **E-mail:** rene.vandersluijs@csiro.au

Supervisor: Stuart Gordon, Stream Leader

Organisation: CSIRO Materials Science and Engineering

Postal Address: Henry Street, Belmont, Victoria, 3216

Ph: 03 5246 4000 **Fax:** 03 5246 4057 **E-mail:** stuart.gordon@csiro.au

Signature of Research Provider Representative: _____

Part 3 – Final Report Guide

(The points below are to be used as a guideline when completing your final report.)

Background

1. Outline the background to the project.

In today's highly competitive and incredibly diverse global textile market, product quality is paramount. In order for spinners to produce yarns that can be converted into high quality woven and knitted fabrics with little or no difficulty, emphasis is placed on fibre quality and the maintenance of this quality across the entire cotton processing pipeline.

The Australian Cotton CRC project 'Quality Issues for Australian Cotton from a Mill Perspective' surveyed more than 30 spinning mills in 2004 and 2005 for their perceptions of Australian cotton fibre quality. The survey, which also took samples from each mill's laydown, found the nep content in Australian cotton was too high compared with other premium Upland cotton growths and at the time, did not meet the requirements of domestic and more importantly international spinners. The survey and tests on a range of comparative growths confirmed previously anecdotal information; that the nep content in Australian cotton was high.

A nep can be defined as a small knot (or cluster) of entangled fibres consisting entirely of fibres (i.e. a fibre nep) or consisting of foreign matter (e.g. seed-coat fragment) entangled with fibres. Neps adversely affect the appearance of cotton yarns and fabric and are usually associated with lower yarn strength, higher ends-down in spinning and less uniform yarn. Dyed or printed fabric appearance is negatively influenced by the presence of neps. Neps often comprise immature or 'dead' fibres that absorb less dye and reflect light differently. They most often appear as white spots or 'flecks' on finished fabric. Although noticeable on fabrics dyed in lighter shades, these specks become particularly noticeable on fabrics dyed to dark shades, such as black, navy, brown and green. The effect causes fabrics to be down-graded or rejected as there are currently no effective means of covering or removing the imperfections once they are present in the fabric.

As a result, spinners require the nep content in cotton lint to be <250 neps/gram, which according to the latest Uster Statistics (2007) can be considered to be average, with 100 neps/gram considered to be excellent and >500 neps/gram poor. In 2002/03 the Australian Cotton CRC mill survey found nep levels in Australian cotton ranged from 164 – 496 neps/gram, with an average of 276 neps/gram.

CSIRO Materials Science and Engineering (CMSE) purchased an AFIS PRO instrument in 2005, which allowed for the first time, the nep levels in Australian cotton to be objectively surveyed. With CRDC funding in 2006/07 a survey of nep levels in Australian fibre commenced. A large number of bale samples were collected during the 2006/07, 2007/2008 and 2008/09 crop years and tested.

The three years during which these samples were collected were distinctly different. The Variety Trial Results published by Cotton Seed Distributors (CSD) show that during the 2006/07 season most regions experienced warmer than average conditions resulting in higher Micronaire values. In actual fact the 2005/06 and 2006/07 seasons were amongst the hottest on record¹. In contrast the 2007/08 season was the mildest season in the last 50 years, resulting in a lower and more variable Micronaire² and fibre maturity values. The 2008/09 season experienced above average temperatures. The exception was Central QLD (Emerald)³, which experienced flooding rains.

It is hoped that the information generated from this project will assist industry (growers, ginners, shippers and merchants) to gain a clearer understanding of the nep content in Australian cotton and allow the industry to benchmark the type and level of neps in Australian cotton (one of the recommendations made in The Curran Report of 1998). It is further hoped that information from this project will assist in growers realising that choosing the correct variety for their growing area as well management and defoliation practices can assist in controlling neps. Furthermore ginners, either as individuals or through the Australian Cotton Ginners Association, can implement measures to reduce nep content, and incorporate these measures into their Ginning BMP.

An added advantage of this project was that samples were also tested for fineness and maturity using the latest technology developed by CMSE. The outcomes of this project will also assist and feed into current/future projects focussing on ginning research, including farming, harvesting and ginning Best Management Practices and the CRC/CRDC Linking Farm Systems to Fibre Quality project.

Objectives

2. List the project objectives and the extent to which these have been achieved.

The aim of the project was to:

- Obtain accurate information on level and type of nep in Australian cotton.
- Benchmark the nep content in Australian cotton.
- Communicate results to industry bodies such as the Cotton Research and Development Corporation (CRDC) the Australian Cotton Shippers

¹ Stiller, W., and Richards, D., (2007), 'Weather Conditions 2006- 2007', CSD 2007 Variety Trial Results

² Stiller, W., Bange, M. and Kelly, D., (2008), 'Weather Conditions 2007- 2008', CSD 2008 Variety Trial Results.

³ Stiller, W., Bange, M. and Kelly, D., (2009), 'Weather Conditions 2008- 2009', CSD 2009 Variety Trial Results.

Association (ACSA), the Australian Ginners Association (ACGA) and the Cotton Classers Association of Australia (CCAA).

- Implement measures to reduce the nep content in Australian cotton.
- Verify that measures implemented have reduced nep content.

Methods

3. Detail the methodology and justify the methodology used. Include any discoveries in methods that may benefit other related research.

The AFIS PRO is an instrument for determining a range of fibre properties on an individual fibre/particle basis. Fibre properties measured by the system include length, including short fibre content (SFC), neps, seed coat neps (SCN), trash and dust. Background information on the AFIS can be found at the manufacturer's website www.uster.com. The AFIS is used predominantly for nep testing and an ASTM Test Method for a standardized nep test is available. Over 900 AFIS instruments are installed in 59 countries.

For the survey a large number of samples were collected with the assistance of the Australian Cotton Shippers Association (ACSA) and the Cotton Classers Association of Australia (CCAA). All members of the CCAA collected samples for testing during the 2006/07, 2007/08 and 2008/09 ginning season. One sample per gin run was collected by Australian Classing Services, Queensland Cotton Corporation, Auscott, Proclass, Weil Brothers, Reinhart and Northern Rivers Independent Classing. All Australian corporate (Auscott Limited, Dunavant Australia, Namoi Cotton Cooperative and Queensland Cotton Corporation) and private ginning companies (Brighann Ginning, North West Ginning, Koramba Ginning, Carroll Cotton, Clyde AG and Carrington Ginning) were included in the survey.

In total 3254 samples were collected. One thousand two hundred and twenty samples were collected during the 2008/09 season of which 1218 samples from 34 varieties were used for the analysis. Nine hundred and eighty two samples were collected during the 2007/08 season of which 929 samples from 35 varieties were used for the analysis. One thousand and forty six samples were collected during the 2007/06 season of which 895 from 33 varieties were used for the analysis. Samples with incomplete information and samples from variety trials were excluded from the analysis.

The project results provide a picture of the nep, SCN, SFC, fineness and maturity per variety, location and gin for the three years of the survey. A more comprehensive statistical analysis of results for the combined data was also conducted, in an attempt to explain the broad interactions (utilising an ANOVA within asreml) between variety, location and gin in nep content. For this analysis 2758 samples were used from 23 varieties. To make these analyses more relevant, samples from redundant varieties and less than 10 samples per variety, valley or gin were also not included.

Samples collected by the CCAA were forwarded to CMSE together with their bale number, High Volume Instrument (HVI) fibre properties, as well as growing area, variety and gin. Due to the sensitive nature of the results the various gins were given an identifier number known only to them.

The results obtained were compared to the 2007 Uster Statistics⁴, which has been collated by Uster Technologies Incorporated for close on fifty years. These statistics are widely used in the textile industry as a quality reference for the classification and benchmarking of fibres and yarns.

Table 1 below gives the Uster Statistic percentile values for neps and seed coat neps (SCN), SFC by weight (SFCw), maturity ratio and fineness (linear density) as determined by the AFIS instrument.

Table 1. Uster Statistics for Raw Cotton Lint

Percentile %	Neps count/g	SCN count/g	SFC(w) %	Fineness mtex	Maturity Ratio
5	110	8	4	145	0.95
25	190	15	6	155	0.93
50	270	22	7.8	163	0.90
75	370	28	9.8	173	0.87
95	450	35	11.5	181	0.85

Fibre Fineness and Maturity Determination

Fibre fineness or linear density (defined as the mass per unit length of a fibre, with the unit millitex (mg/km)) was determined by the CSIRO developed CottonscanTM. The approach to measuring fibre linear density is based on the direct method of measuring the total length of a known mass of the fibre snippets to calculate directly mass per unit length. Prepared and pre-weighed fibre snippets (~2mm in length) are suspended in an aqueous medium within the instrument prior to a measurement cell. The suspended snippets are pumped through the measurement cell where they are imaged and image analysis is used to determine the total snippet length within the image. The weight and length results are then combined to calculate a linear density value.

The maturity of the cotton was determined by combining the fineness measurement from CottonscanTM with the independently measured Micronaire value determined by HVI. The average fibre maturity was then calculated using Lord's empirical relationship between Micronaire, maturity ratio and fineness.

⁴ Uster Statistics 2007 CD ROM from <http://www.uster.com>

Although fineness was measured using the Cottonscan™ instrument and maturity was calculated we compared all the results from this survey to the Uster Statistics to benchmark Australian cotton.

Results

4. Detail and discuss the results for each objective including the statistical analysis of results.

Results for each of the 2006/07; 2007/08 and the 2008/09 seasons have previously been reported and are attached in Appendix 1. Please note that hereafter the 2006/07 crop will be referred to as the 2007 crop; the 2007/08 crop will be referred to as the 2008 crop and the 2008/09 crop will be referred to as the 2009 crop.

An overview of the results for the three seasons will now be presented followed by the overall results. Snap shots of the average nep, SCN, SFC, fineness and maturity values including the variation of the results for the three years are presented in the following Tables:

Table 2. Average nep content in neps/gram for 2007-2009 crop

	2007	2008	2009
Average	270	355	308
Minimum	146	150	170
Maximum	664	1407	884
Range	518	1257	714
Std. dev.	67	126	76

Table 3. Average SCN content in SCN per gram for 2007-2009 crop

	2007	2008	2009
Average	26	26	22
Minimum	9	10	9
Maximum	65	76	50
Range	56	66	41
Std. dev.	8.6	7.2	5.4

Table 4. Average SFC(w) in % for 2007-2009 crop

	2007	2008	2009
Average	9.6	9.6	8.6
Minimum	5.4	4.5	5.05
Maximum	49.9	19.2	15.3
Range	44.5	14.7	10.25
Std. dev.	2.8	1.8	1.4

Table 5. Average Cottonscan fineness in mtex for 2007-2009 crop

	2007	2008	2009
Average	204	191	198
Minimum	149	124	136
Maximum	289	244	236
Range	140	120	100
Std. dev.	15.0	17.5	12.8

Table 6. Average calculated maturity for 2007-2009 crop

	2007	2008	2009
Average	0.85	0.78	0.82
Minimum	0.62	0.40	0.60
Maximum	1.09	1.04	1.06
Range	0.47	0.64	0.46
Std. dev.	0.06	0.07	0.05

Combined (averaged) results for the 3 years for the various fibre properties are provided in Table 7.

Table 7. Average Combined Fibre properties

	Neps	SCN	SFC(w)%	Fineness	Maturity
Average	313	24	9.2	198	0.82
Minimum	150	9	4.5	124	0.40
Maximum	1407	76	26.9	255	1.09
Range	1257	67	22.4	131	0.69
Std. dev.	98.7	7.3	1.7	15.8	0.07

Further information on these results can be obtained from Appendix 1

Cotton Varieties

Over the three years of the survey, samples from 68 varieties were received and tested. As a number of these varieties have been phased out and only a few samples were received for a number of varieties, we will highlight only the 16 varieties grown in all of the three years. The average nep content for the three crop years of these 16 varieties is shown in Table 8.

Table 8. Average nep content in neps/gram for each variety per crop year

Variety	2007	2008	2009
DP 546BR	271	318	273
DP 556BR	245	466	224
Sicala 60BRF	315	361	361
Sicot 289B	266	331	276
Sicot 289BR	226	324	252
Sicot 43BR	298	340	288
Sicot 43BRF	305	328	310
Sicot 70BRF	231	331	294
Sicot 71	241	320	273
Sicot 71B	253	335	266
Sicot 71BR	273	371	296
Sicot 71RR	357	331	301
Sicot 75	334	338	282
Sicot 80BRF	276	345	294
Siokra V-16BR	265	410	333

The average nep results for the 16 varieties over the three years are shown in Figure 1. It is noted that at an average of 346 neps/gram, Sicala 60BRF had the highest nep content and at an average of 267 neps/gram, Sicot 289BR had the lowest nep content of the 16 varieties. Sicot 71 BR and Sicot 70BRF, the most popular grown varieties in Australia had an average nep content of 313 and 285 neps/gram respectively.

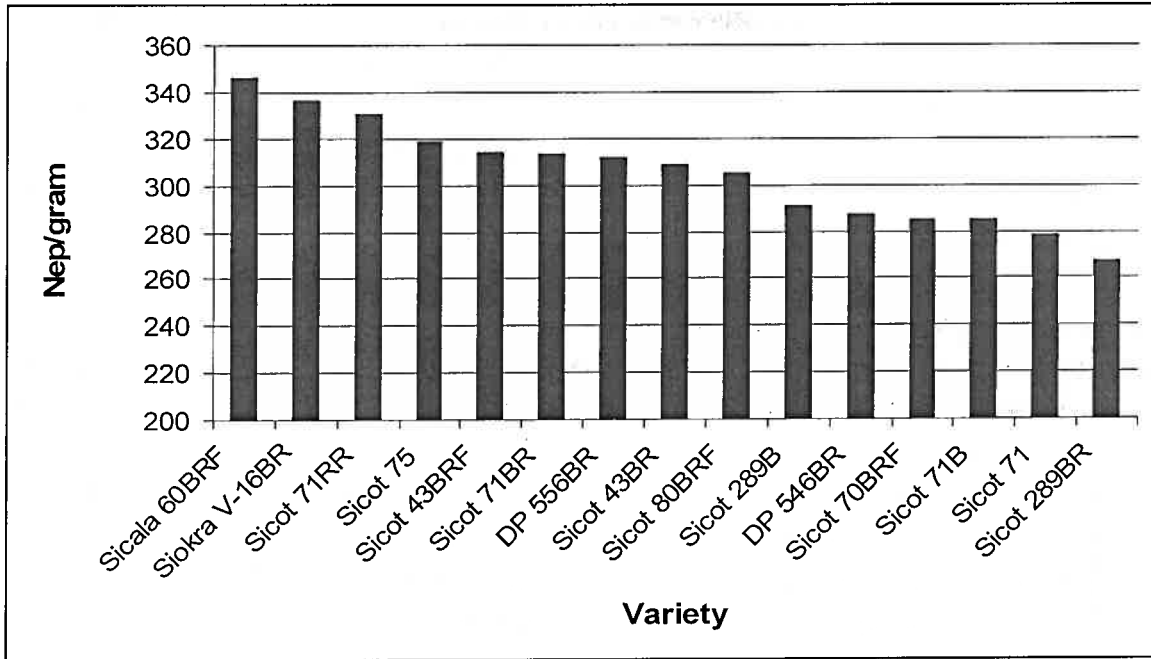


Figure 1. Average nep content per variety for 2007-2009 seasons

The samples received and tested originated from 10 growing areas. Unfortunately we did not receive any samples from Emerald, Theodore and Bourke in 2007, no samples from Bourke and Moura in 2008 and no samples from Moura in 2009. The average nep content for the three crop years of the valleys is shown in Figure 2.

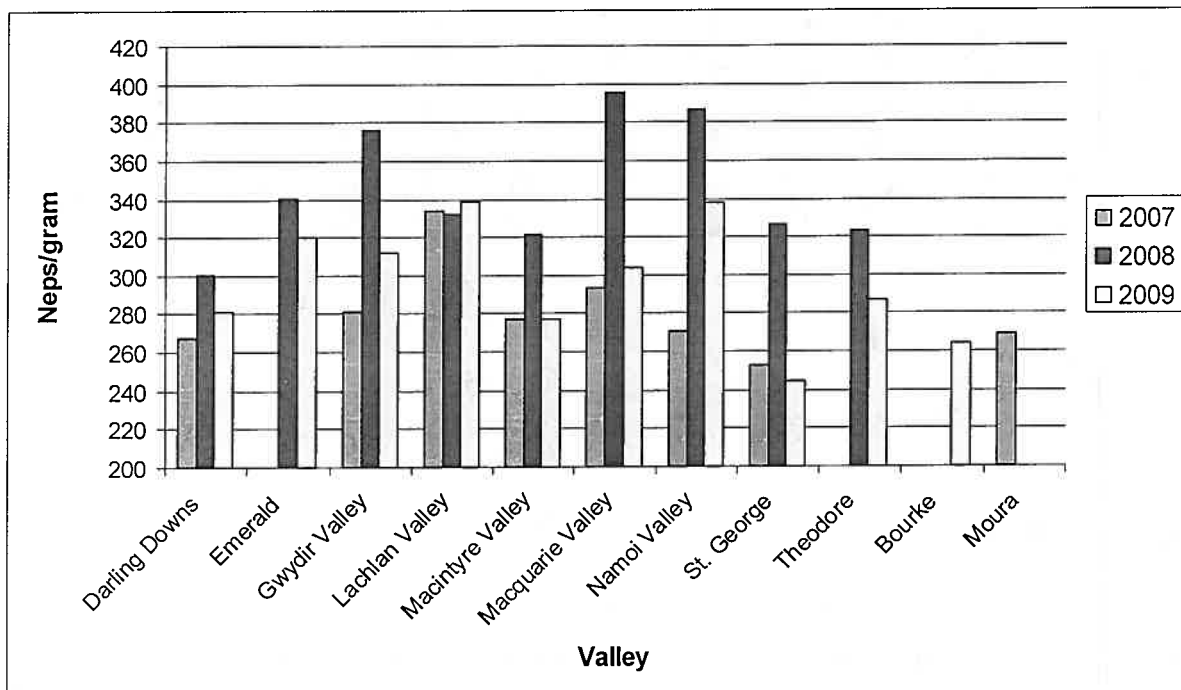


Figure 2. Average nep content per valley per crop year

Not surprisingly the 2008 crop year produced the highest average nep content across all the valleys as it was one of the mildest (coolest) seasons in the last 50 years. Most of the valleys with the exception of the Lachlan valley had less than half their

average days over 35°C and accumulated approximately 5% less degrees days during the season, with the exception of the Lachlan valley, which experienced a slightly warmer than average season². These conditions resulted in low Micronaire values, with 25% of the samples received having a Micronaire value of ≤ 3.8 and a correspondingly low maturity. Low fibre maturity leads to nep creation during ginning as fibres are more prone to bending and buckling.

The average nep results for the valleys over the three years are shown in Figure 3. If we ignore Emerald, Theodore, Bourke and Moura (as samples were not received) for the three years we note the Lachlan Valley with an average of 335 neps/gram had the highest nep content. The Lachlan valley is one of the most Southern growing areas of NSW. It has a shorter and cooler season that can lead to issues with maturity. Our results show that most of the cotton from that valley had a maturity of < 0.83 , which can be considered to be immature. It is also thus not surprising that the gin in that valley is also amongst the gins with the highest average nep content. At 275 neps/gram samples from St George had the lowest nep content, and correspondingly the three gins from this area had the lowest average nep content.

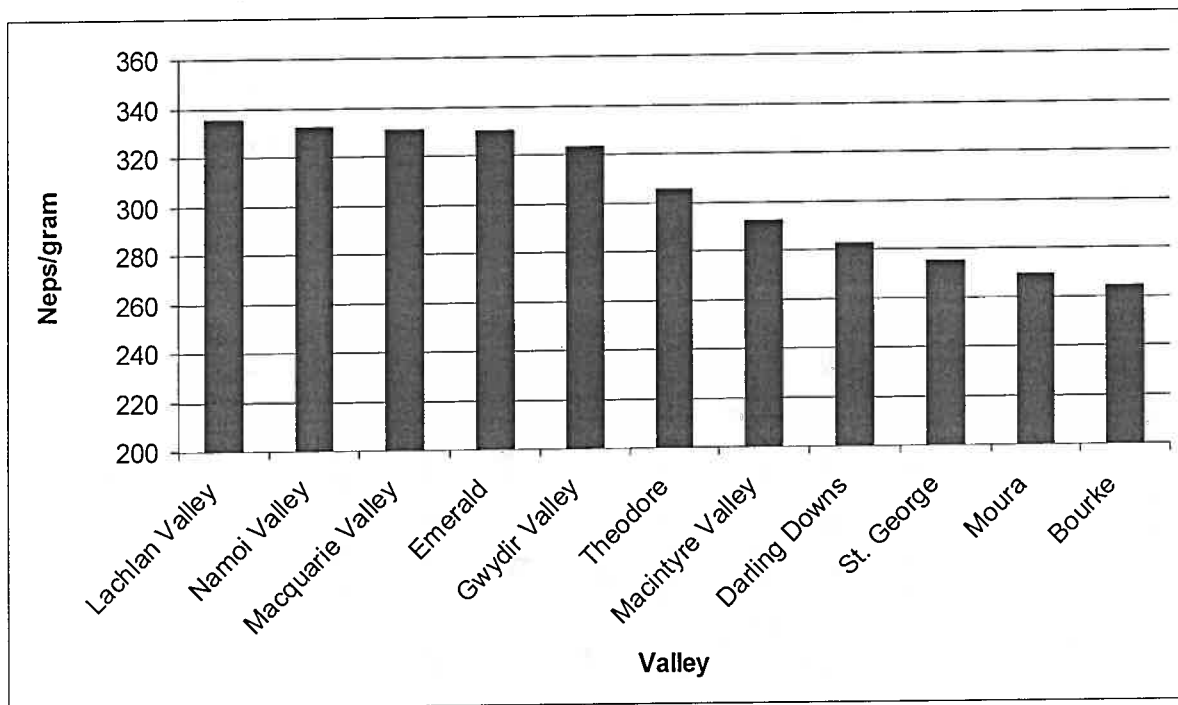


Figure 3. Average nep content per valley for 2007-2009 seasons

Over the three years samples from 34 gins were received and tested. As a number of these gins did not operate for at least two of the three years we highlight only the 28 gins that were operational for at least two of the three years. The average nep content for the three crop years from these 28 gins is shown in Table 9.

Table 9. Average nep content in neps/gram per gin per crop year

Gin Code	2007	2008	2009
1	242	*	320
2	251	268	245
4	342	410	338
5	300	317	333
7	211	*	261
9	245	435	290
10	252	276	304
12	246	*	307
13	292	512	359
14	296	402	252
15	276	349	319
16	316	207	315
17	226	316	247
18	312	324	295
19	261	446	301
20	211	290	300
21	245	*	287
22	249	348	270
23	266	325	362
24	248	308	278
25	243	319	280
26	299	*	290
27	283	413	387
28	240	388	257
29	368	326	351
31	208	280	246
32	263	360	303
33	*	385	250

*Gin not operational during this time or no samples received

The average nep result for the gins over the three years is shown in Figure 4. We note that at an average of 388 neps/gram that samples from gin number 13 had the highest nep content, followed by gin numbers 4, 27 and 29. If we ignore gin number 7 as only a few samples were received from that gin; at 245 neps/gram samples from gin number 31 had the lowest nep content. Six of the gins had an average nep content of <270 neps/gram, with nine gins averaging between 270 and 300 neps/gram and 13 gins averaging >300neps/gram – See Figure 4.

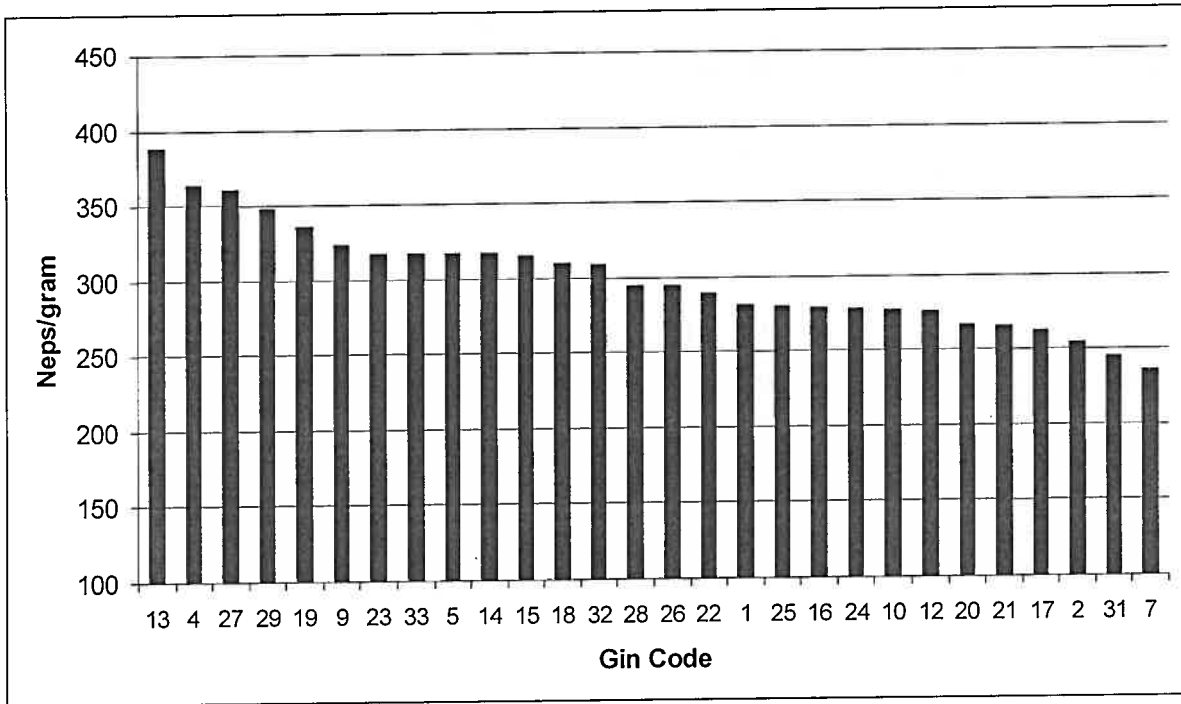


Figure 4. Average nep content per gin for 2007-2009 seasons

Statistical Analysis

In order to determine the relationship between the physical characteristics of the fibre and nep content and also to determine which fibre property is the best predictor of neps a correlation matrix was calculated. Fibre length, length uniformity, strength and Micronaire as measured by HVI instrument as well as fibre fineness from the Cottonscan™ and calculated maturity values were used in this analysis. Seed coat neps and SFCw as measured by the AFIS were also used.

Tables 10, 11 & 12 show the results for the 2007, 2008 & 2009 crop respectively, with the main predictors of neps highlighted.

Table 10. Correlations for 2007

	Length	Uniformity	Strength	Micronaire	Neps	SCN	SFC(w)	Fineness	Maturity
Length	1	0.45	0.44	-0.23	0.11	-0.04	-0.16	-0.25	-0.09
Uniformity	0.45	1	0.47	0.13	-0.18	-0.14	-0.26	0.06	0.14
Strength	0.44	0.47	1	-0.03	-0.06	-0.13	-0.16	-0.03	-0.01
Micronaire	-0.23	0.13	-0.03	1	-0.73	-0.19	-0.27	0.82	0.75
Neps	0.11	-0.18	-0.06	-0.73	1	0.35	0.37	-0.66	-0.46
SCN	-0.04	-0.14	-0.13	-0.19	0.35	1	0.24	-0.14	-0.15
SFC(w)	-0.16	-0.26	-0.16	-0.27	0.37	0.24	1	-0.26	-0.15
Fineness	-0.25	0.06	-0.03	0.82	-0.66	-0.14	-0.26	1	0.23
Maturity	-0.09	0.14	-0.01	0.75	-0.46	-0.15	-0.15	0.23	1

Table 11. Correlations for 2008

	Length	Uniformity	Strength	Micronaire	Neps	SCN	SFC(w)	Fineness	Maturity
Length	1	0.56	0.44	0.14	-0.26	-0.26	-0.39	0.05	0.23
Uniformity	0.56	1	0.43	0.40	-0.41	-0.25	-0.51	0.32	0.42
Strength	0.44	0.43	1	0.35	-0.43	-0.05	-0.39	0.26	0.38
Micronaire	0.14	0.40	0.35	1	-0.80	-0.11	-0.31	0.93	0.90
Neps	-0.26	-0.41	-0.43	-0.80	1	0.28	0.48	-0.76	-0.70
SCN	-0.26	-0.25	-0.05	-0.11	0.28	1	0.30	-0.08	-0.13
SFC(w)	-0.39	-0.51	-0.39	-0.31	0.48	0.30	1	-0.20	-0.39
Fineness	0.05	0.32	0.26	0.93	-0.76	-0.08	-0.20	1	0.67
Maturity	0.23	0.42	0.38	0.90	-0.70	-0.13	-0.39	0.67	1

Table 12. Correlation for 2009

	Length	Uniformity	Strength	Micronaire	Neps	SCN	SFC(w)	Fineness	Maturity
Length	1	0.52	0.27	-0.38	0.12	-0.05	-0.40	-0.41	-0.17
Uniformity	0.52	1	0.41	-0.03	-0.28	-0.04	-0.51	-0.04	0.00
Strength	0.27	0.41	1	-0.05	-0.19	0.03	-0.31	-0.13	0.05
Micronaire	-0.38	-0.03	-0.05	1	-0.66	0.02	-0.04	0.79	0.77
Neps	0.12	-0.28	-0.19	-0.66	1	0.15	0.45	-0.58	-0.44
SCN	-0.05	-0.04	0.03	0.02	0.15	1	0.19	-0.02	0.06
SFC(w)	-0.40	-0.51	-0.31	-0.04	0.45	0.19	1	0.05	-0.12
Fineness	-0.41	-0.04	-0.13	0.79	-0.58	-0.02	0.05	1	0.22
Maturity	-0.17	0.00	0.05	0.77	-0.44	0.06	-0.12	0.22	1

Table 13 shows the results for the three years combined

Table 13. Correlations for three years combined

	Length	Uniformity	Strength	Micronaire	Neps	SCN	SFC(w)	Fineness	Maturity
Length	1	0.43	0.24	-0.32	0.13	-0.11	-0.34	-0.22	-0.26
Uniformity	0.43	1	0.42	0.11	-0.22	-0.08	-0.35	0.09	0.08
Strength	0.24	0.42	1	0.08	-0.16	0.00	-0.14	0.07	0.05
Micronaire	-0.32	0.11	0.08	1	-0.67	-0.04	-0.07	0.72	0.78
Neps	0.13	-0.22	-0.16	-0.67	1	0.23	0.30	-0.58	-0.43
SCN	-0.11	-0.08	0.00	-0.04	0.23	1	0.41	-0.09	0.02
SFC(w)	-0.34	-0.35	-0.14	-0.07	0.30	0.41	1	-0.13	0.01
Fineness	-0.22	0.09	0.07	0.72	-0.58	-0.09	-0.13	1	0.13
Maturity	-0.26	0.08	0.05	0.78	-0.43	0.02	0.01	0.13	1

The results show that in all cases Micronaire always emerged as the most significant fibre property in terms of determining nep levels with the next most important fibre property being fineness followed by maturity, SFC, length uniformity and strength. When focussing on the combined results; Micronaire had a correlation coefficient of 0.67, fineness at 0.58, SFC at 0.30, length uniformity at 0.22 and strength at 0.16.

The results show that generally nep content increased as Micronaire, fineness, maturity, uniformity ratio and strength decreased and SFC increased. These results are not surprising and are similar to a previous extensive study⁵.

There does not seem to be any significant fibre property that can be used to predict SCN as all the correlations are not very strong.

Figure 5 plots neps as a function of Micronaire for the three crop years, with the outlier values removed. The graph shows that as the Micronaire values increase the nep values decrease. The only anomaly is a number of data points from the 2008 crop year that seem to have high nep values irrespective of the Micronaire values. These data points are from gin number 27, which has emerged as amongst the gins with the highest average nep content.

⁵ van der Sluijs M.H.J.,(1996) ' *The Influence of Fibre Properties on neps in South African Cotton* ', Masters dissertation,168 pg

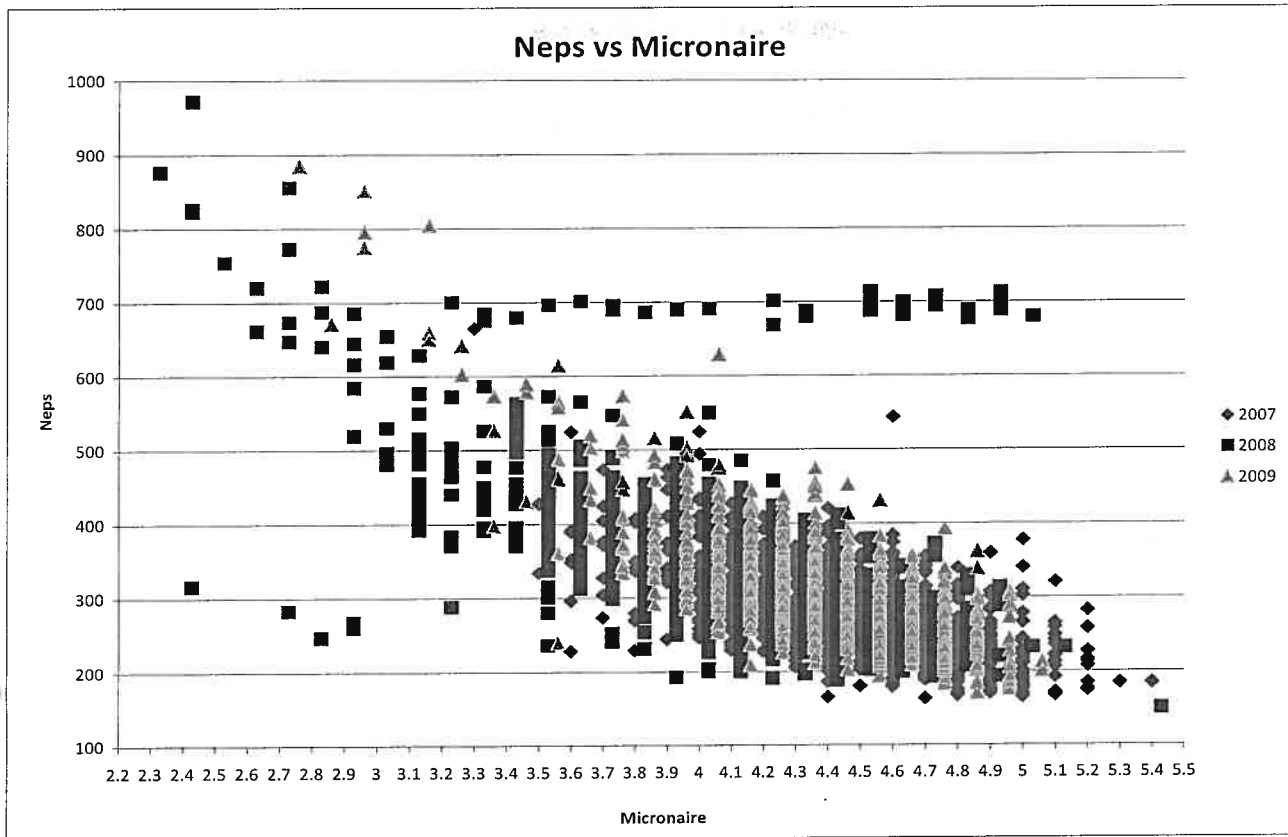


Figure 5. XY chart of Micronaire vs. neps for the three years (2007, 2008 & 2009).

An ANOVA was conducted to determine which of the following factors; variety, valley, gin and crop year, have significant impacts on neps.

Neps ~ Variety + Valley + Gin + Year

Terms:

	Variety	Valley	Gin	Year	Residuals
Sum of Squares	1640968	1406253	3158357	2027365	18647268
Deg. of Freedom	22	8	33	2	2692

Residual standard error: 83.22812

Estimated effects may be unbalanced

	Df	Sum of Sq	Mean Sq	F Value	Pr(F)
Variety	22	1640968	74589	10.7681	0
Valley	8	1406253	175782	25.3766	0
Gin	33	3158357	95708	13.8168	0
Year	2	2027365	1013682	146.3396	0
Residuals	2692	18647268	6927		

The ANOVA found crop year was the most significant factor followed by valley, gin and variety. When considering the crop year one takes into consideration the weather conditions experienced during that crop year. For instance the 2008 crop year was one of the mildest (coolest) seasons in 50 years resulting in the production of mainly fine and immature fibre, which is more prone to bending and buckling and a propensity to nep. This resulted in the 2008 crop year having the highest nep content of the three years. In contrast the 2007 crop year experienced one of the hottest years on record resulting in the production of mainly coarse and largely mature fibre that do not bend and buckle easily; thus resulting in the 2007 crop year having the lowest nep content of the three years.

The effect of crop year on nep levels is proven by adding Micronaire into the equation and running another ANOVA. The significance of the crop year drops away with Micronaire assuming the dominant influence with valley, gin and variety continuing to have the same relationship to each other.

Neps - Variety + Valley + Gin + Micronaire + Year

Terms:

	Variety	Valley	Gin	Micronaire	Year	Residuals
Sum of Squares	1640968	1406253	3158357	9692302	62104	10920227
Deg. of Freedom	22	8	33	1	2	2691

Residual standard error: 63.70287

Estimated effects may be unbalanced

	Df	Sum of Sq	Mean Sq	F Value	Pr (F)
Variety	22	1640968	74589	18.381	0.000000000
Valley	8	1406253	175782	43.317	0.000000000
Gin	33	3158357	95708	23.585	0.000000000
Micronaire	1	9692302	9692302	2388.410	0.000000000
Year	2	62104	31052	7.652	0.000485536
Residuals	2691	10920227	4058		

A previous study on Australian cotton found that Micronaire is dependant on the effect of temperature⁶. Table 14 gives the average temperature and Micronaire at the major growing areas in the 9 locations during the three crop years. The results represent the temperature for each major town in each valley over the three years with the average Micronaire values for each valley each year.

Table 14. Average temperature at major growing areas during 2007-2009

Growing Area	Crop year	Average Temperature	Average Micronaire
Dalby	2007	25.7	4.4
Dalby	2008	22.5	4.1
Dalby	2009	25.2	4.3
Emerald	2008	26.4	4.2
Emerald	2009	27.1	4.2
Goondiwindi	2007	29.1	4.4
Goondiwindi	2008	25.3	4.2
Goondiwindi	2009	27.3	4.4
Hillston	2007	26.9	4.6
Hillston	2008	24.7	4.0
Hillston	2009	26.4	3.9
Moree	2007	28.4	4.5
Moree	2008	23.6	4.1
Moree	2009	26.6	4.3
Narrabri	2007	28.3	4.5

⁶ Bange .M.P., Constable, G.A., Johnston D.B. and Kelly, D., (2010), 'A method to Estimate the Effects of Temperature on Cotton Micronaire', Journal of Cotton Science,14,pp 164-172.

Narrabri	2008	23.7	4.2
Narrabri	2009	27	4.3
St George	2007	29.9	4.6
St George	2008	25	4.2
St George	2009	29.1	4.4
Theodore	2008	26.5	4.4
Theodore	2009	27.5	4.4
Warren	2007	27.8	4.5
Warren	2008	23.9	4.1
Warren	2009	27.4	4.3

Figure 6 relates the average temperature estimated during the period of fibre development (thickening phase) with Micronaire for the combined data. The figure shows that there is a largely linear response to daily average temperatures (r^2 0.51), with the degree of fibre thickening (maturity of the fibre) associated with higher temperatures.

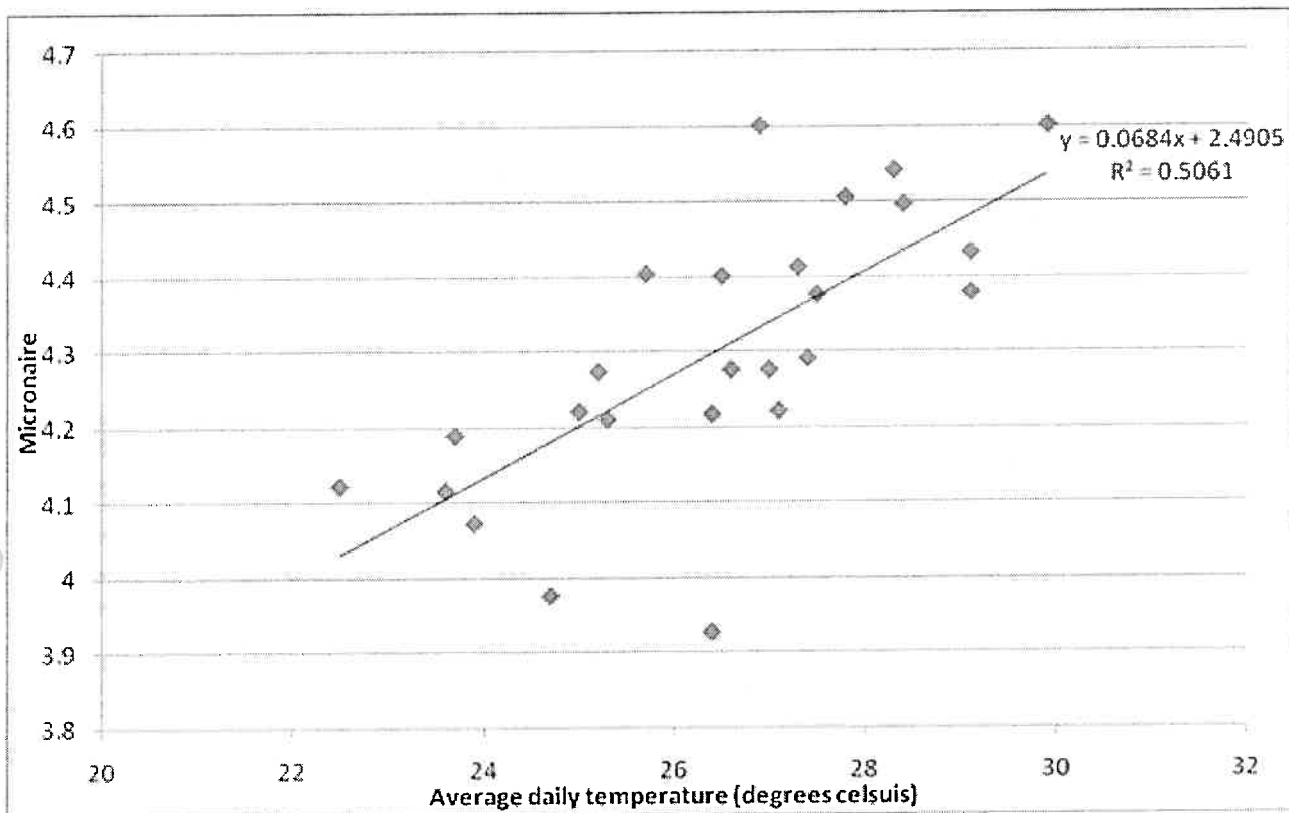


Figure 6. Micronaire vs average daily temperature

A detailed ASReml analysis of the neps data was also conducted as this type of analysis better estimates the comparisons across varieties and gins than a raw analysis because of the non-orthogonal nature of the data set. Table 15 shows sums of squares for each factor in the ASReml analysis. The results show that the crop year had a large impact on neps (25.1% of variation) followed by gin (20.1% of variation) followed by variety (7.1% of variation).

Table 15. Sums of squares for each factor in ASReml analysis

Neps	Component	Percent of SS
Year	1366.4	25.0
Variety	388.2	7.1
Gin	1100.4	20.1
Variety x Gin	416.6	7.6
Variety x Year	126.5	2.3
Gin x Year	574.5	10.5
Variety x Gin x Year	1248.8	22.8
Error	246.2	4.5

These results are similar to the ANOVA that found that crop year was the most significant factor followed by valley, gin and variety. Valley did not feature in the ASReml analysis as, with the exception of the Lachlan Valley, Emerald, Moura and Theodore, cotton from the other valleys are ginned at a number of gins which reduces the effect of valley.

The reasons for crop year having such a large impact have already been highlighted in the last paragraph on page 15.

Gin number had a very large effect on neps. As was highlighted in Figure 4, gin numbers 13, 4, 27 and 29 had significantly higher neps than the other gins. Variety was significant for neps, with Sicala 60BRF, Siokra V16BR, Sicot 71RR and Sicot 75 having significantly higher neps than most other varieties. The rest of the varieties were similar in nep content. There are some unique issues with each of the varieties with high neps:

- Sicala 60BRF is a Bollgard II stacked with Roundup Ready Flex variety which is usually only grown in the south (cooler to reduce fibre maturity) and it only occupied 3% of the survey samples.
- Siokra V-16BR is a Bollgard II stacked with Roundup Ready okra leaf variety usually grown as dryland cotton and it only occupied 0.58% of the survey samples.
- Sicot 71RR is a Roundup Ready variety often grown as Bollgard II unsprayed refuge (often later in maturity); and only occupied 5.6% of the survey samples.
- Sicot 75 is a conventional cotton variety usually only grown as dryland cotton and it only occupied 1.9% of the survey samples.

It's important to note that over the three years very few samples had <250 neps/gram and the industry needs to focus on its ginning practices, crop management, variety selection and on variety fibre characteristics.

Outcomes

5. Describe how the project's outputs will contribute to the planned outcomes identified in the project application. Describe the planned outcomes achieved to date.

The nep content of Australian cotton has for the first time been objectively and independently measured. Analysis has shown that Micronaire is the most significant fibre property in terms of determining nep levels with the next most important fibre property being fineness followed by maturity, short fibre content, length uniformity and strength. Generally nep content increases as Micronaire, fineness, maturity, uniformity ratio and strength decrease and short fibre content increase. When considering factors such as crop year, valley, gin and variety; crop year and gin were the most significant followed by variety. This information should assist growers realising that choosing the correct variety for their growing area as well management and defoliation practices can assist in controlling neps. Furthermore ginners, either as individuals or through the Australian Cotton Ginners Association, can implement measures to reduce nep content and incorporate these measures into the Ginning BMP. As varieties and practices keep changing (for example only 30% of the samples were Bollgard II/RRFlex varieties, which now occupies over 80% of the Australian crop area) it is recommended that this nep survey, perhaps on a smaller scale, be continued on a yearly basis in order to continually monitor the nep content in Australian cotton and to gauge improvements with improved ginning practices and the release of new varieties. We must also remember that although neps do not form part of the Premium and Discount sheets this may be changed in the future as neps become more of an issue. Once the Mill Survey has been completed Australian cotton will be benchmarked to other growths which are used by the mills that use Australian cotton.

6. Please describe any:-
- technical advances achieved (eg commercially significant developments, patents applied for or granted licenses, etc.);
 - other information developed from research (eg discoveries in methodology, equipment design, etc.); and
 - required changes to the Intellectual Property register.

N/A

Conclusion

7. Provide an assessment of the likely impact of the results and conclusions of the research project for the cotton industry. What are the take home messages?

The purchase by CMSE of the AFIS PRO and funding from the CRDC has given the Australian cotton industry the opportunity to accurately and objectively determine the nep content of its Upland cotton. An additional benefit is that fibre fineness, using the Cottonscan™ and the calculated maturity can also be evaluated.

This report gives the industry information on the average results of Australian cotton in terms of nep and seed coat nep content, short fibre content, fineness and maturity. Two thousand seven hundred and fifty eight cotton samples from 23 varieties, 9 growing locations and ginned at 26 gins were analysed. The results show that the quality of the cotton can be considered good with 73% of the samples achieving Australian base grade quality. The samples have an average nep content of 313 neps/gram, an average of 24 seed coat neps/gram, and an average short fibre content of 9.2%. This is above the nep content of ≤ 250 neps/gram preferred by

international fine count spinners and also above the 270 neps/gram considered which is considered to be average according to the 2007 Uster Statistics. The average seed coat neps and short fibre content are also considered to be above average according to the Uster Statistics.

The average fineness of Australian cotton 198 mtex, which is coarser than the 160 to 180 mtex required for the production of high quality fine count yarns. The average maturity was 0.82 which suggests that the Australian crop could be considered to be immature. Correlations show that Micronaire is the most significant fibre property in terms of determining nep levels with the next most important fibre property being fineness followed by maturity, short fibre content, length uniformity and strength. Generally nep content increases as Micronaire, fineness, maturity, uniformity ratio and strength decrease and short fibre content increase. When considering factors such as crop year, valley, gin and variety; crop year followed by gin and variety were the most significant.

Extension Opportunities

8. Detail a plan for the activities or other steps that may be taken:
 - (a) to further develop or to exploit the project technology.
 - (b) for the future presentation and dissemination of the project outcomes.
 - (c) for future research.

With the objective measurement phase of the Mill Survey project currently in progress and once completed we will be able to benchmark Australian cotton with other growths used by customers of Australian cotton. Information will be forwarded to the three industry bodies (ACSA, ACGA and CCAA). Individual gins will be provided with their performance in this Nep Survey from which they will be able to benchmark their performance to the other gins that were operational during the survey. Results will be published in the local industry media.

8. A. List the publications arising from the research project and/or a publication plan.
(NB: Where possible, please provide a copy of any publication/s)

Three interim reports have been circulated within the industry. It is envisaged that the findings from this project will be presented in the local cotton industry media. The data set will be further mined, with a number of scientific papers are currently under consideration.

- B. Have you developed any online resources and what is the website address?

N/A

Part 4 – Final Report Executive Summary

Spinners require the nep content in cotton lint to be < 250 neps/gram which according to the latest Uster Statistics of 2007 can be considered to be average with 100 neps/gram considered to be excellent and < 500 neps/gram to be considered poor. The mill survey (Quality Issues for Australian Cotton from a Mill Perspective, CRC, 2004) which obtained subjective and objective information, confirmed anecdotal information that the nep content in Australian cotton is considered too high when compared with other premium Upland cotton growths available on the world market and does not meet the requirements of domestic and more importantly international spinners. The purchase by CSIRO Materials Science and Engineering (CMSE) of the AFIS PRO instrument in 2005; the nep content of Australian cotton was, for the first time, objectively determined by an independent organisation.

The Nep Survey project provides the industry information on the average results of Australian cotton in terms of nep and seed coat nep content as well as short fibre content, fineness and maturity. The results of Two thousand seven hundred and fifty eight cotton samples were used to calculate the overall results. These samples represent 23 varieties, 9 growing locations and 26 gins.

The results show that the quality of the cotton sampled can be considered good with 73% of the samples achieving Australian base grade quality. The samples had an average nep content of 313 neps/gram, an average of 24 seed coat neps/gram, and an average short fibre content of 9.2%. This is above the nep content of ≤ 250 neps/gram preferred by international fine count spinners and also above the 270 neps/gram considered to be average according to the 2007 Uster Statistics. The average seed coat neps and short fibre content are also considered to be above average according to the Uster Statistics.

Correlations show that Micronaire is the most significant fibre property in terms of determining nep levels with the next most important fibre property being fineness followed by maturity, short fibre content, length uniformity and strength. Generally nep content increases as Micronaire, fineness, maturity, uniformity ratio and strength decrease and short fibre content increase. When considering factors such as crop year, valley, gin and variety; crop year followed by gin and variety were the most significant.

It is hoped that information from this project will assist in growers realising that choosing the correct variety for their growing area as well management and defoliation practices can assist in controlling neps. Furthermore ginners, either as individuals or through the Australian Cotton Ginners Association, can implement measures to reduce nep content and incorporate these measures into their Ginning BMP. As varieties and practices keep changing it is further recommended that follow up studies should be conducted to determine any changes in the average nep content of Australian cotton. Current gin project proposals are under consideration which may have a positive impact on nep levels in Australian cotton.

Acknowledgements

The author gratefully acknowledges the assistance of Graham Higgerson, Mike Bange, Greg Constable and Shiming Lui in compiling this report and of Mmes. Susan Miller, Geni Kozdra, Liz Coles and Sue Horne for testing the samples is also gratefully acknowledged.

Appendix 1

2007 Crop

The 2007 Australian cotton crop produced 1,342,900 bales from 128,840 hectares with an average yield of 7.90 bales per hectare. Seventy eight percent of the cotton was grown in New South Wales, mainly in the Gwydir, Macintyre, Namoi and Macquarie Valleys. The rest of the crop was grown in Queensland mainly in the Darling Downs, Emerald, Biloela/Theodore and St. George areas. The majority of the cotton was irrigated with only 3% of the crop being dryland cotton.

Ninety two percent of the crop had a staple length of 1 1/8 inch or longer, with 68% of the crop achieving 1 5/32 inch or longer. The majority of the crop had a Micronaire value of 4.6 to 4.9, with 44% of the crop falling into the premium Micronaire range of 3.8 to 4.5. Eighty seven percent of the crop had a strength of 29 gpt, with 69% of the crop achieving a strength of 30 gpt and above. Almost 82 % of the cotton was graded 21-3. Eighty five percent of the crop achieved base grade or better.

As mentioned earlier 895 samples from 33 varieties were analysed from the 2007 crop. Fifty eight percent of the samples achieved the Australian base grade quality which is staple length above 1 1/8 inch, strength above 29 gpt and micronaire in the range of 3.5-4.9.

Nearly 92% of the varieties were CSIRO bred varieties with the rest being Deltapine varieties. Sixty percent of the samples were Sicot 71 (Conventional, Bollgard II⁷, Bollgard II/Roundup Ready, and Roundup Ready⁸), followed by 10% Sicot 80 (Conventional, Bollgard II, Bollgard II Roundup Ready Flex,⁹ Liberty¹⁰ and Roundup Ready), 8% Sicot 289 (Bollgard II, Bollgard II Roundup Ready and Roundup Ready) and 6% Sicala 43 (Conventional, Bollgard II, Bollgard II Roundup Ready, and Roundup Ready). There were also a small number of Siokra varieties.

⁷ Registered trait of Monsanto

⁸ Registered trait of Monsanto

⁹ Registered trait of Monsanto

¹⁰ Registered trait of Bayer

Table 16. Breakdown of samples per variety

Variety	Samples	Variety	Samples
Sicot 71BR	404	DP 510RR	6
Sicot 80BRF	76	Siokra 16BR	4
Sicot 71B	73	Sicot 75	4
Sicot 289BR	49	Sicot 43BRF	4
Sicot 71	38	Siokra 24B	2
Sicot 43BR	34	Sicot 80RR	2
Sicala 60BR	30	Sicot 80L	2
DP 611BR	27	DP 556BR	2
DP 408B	27	Siokra 16RR	1
Sicot 71RR	22	Sicot 80	1
Sicala 60BRF	19	Sicot 73	1
DP 546BR	15	Sicot 70BRF	1
Sicot 289RR	14	Sicot 14B	1
Sicot 80B	10	Sicot 43	1
Sicot 43B	9	Sicala 40BR	1
Sicot 289B	8	DP 570B	1
Sicot 43RR	6		

The cotton samples collected were grown in eight valleys. At 26%, the majority of cotton was grown in the Gwydir Valley, followed by the Namoi Valley with 24%, the Macquarie Valley with 16%, the Macintyre Valley with 15% and the Darling Downs with 13%. The remainder of the cotton was grown in the Lachlan Valley, St George, and Moura. It is unfortunate that no samples were received from Emerald and Biloela/Theodore. Table 18 gives a breakdown of the number of samples collected from the valleys and varieties.

Table 17. Varieties associated with locations

Valley Variety	Darling Downs	Gwydir Valley	Lachlan Valley	Macintyre Valley	Macquarie Valley	Moura	Namoi Valley	St George
DP 408B	8	10		6			3	
DP 510RR	1	2		2	1			
DP 546BR	4	2		3	1		5	
DP 556BR		1					1	
DP 570B		1						
DP 611BR	4	3			3		14	3
Siokra 16BR		4						
Siokra 16RR				1				
Siokra 24B	1				1			
Sicala 40BR			1					
Sicot 43							1	
Sicot 43B	5						4	
Sicot 43BR	6		9	8	8		3	
Sicot 43BRF		1	1	1	1			
Sicot 43RR			5		1			

Sicala 60BR	5	4	1	6	6		8	
Sicala 60BRF	2	2	2	3	4		6	
Sicot 14B	1							
Sicot 289B		3		1	1		2	1
Sicot 289BR	6	5	1	5	9		18	5
Sicot 289RR		9		1	4			
Sicot 70BRF				1				
Sicot 71	1	15		10	4		8	
Sicot 71B	14	14	4	19	7	1	13	1
Sicot 71BR	39	111	14	56	76	2	105	1
Sicot 71RR		12		4	4		2	
Sicot 73							1	
Sicot 75		1		3				
Sicot 80		1						
Sicot 80B	3	3		4				
Sicot 80BRF	21	32	3	3	9		7	1
Sicot 80L				2				
Sicot 80RR		2						

The cotton was ginned at 32 gins across Australia. Table 18 gives a breakdown of the various gins and the number of samples collected.

Table 18. Gins and number of samples collected

Company	Gin location	Samples
Auscott	Midkin	60
Auscott	Narrabri	103
Auscott	Trangie	44
Auscott	Warren	52
Brighann	Moree	24
Carrington	Goondiwindi	4
Carroll	Carroll	16
Dunavant	Dalby	47
Dunavant	Emerald	26
Dunavant	Moree	14
Koramba	Boomi	49
Namoi	Ashley	48
Namoi	Boggabri	23
Namoi	Carinda	16
Namoi	Hillston	40
Namoi	Macintyre	45
Namoi	Merah North	19
Namoi	Moomin	1
Namoi	Mungindi	31
Namoi	Trangie	5
Namoi	Wathagar	21
Namoi	Yarraman	25

North West	Moree	33
QC	Cecil Plains	23
QC	Collymongle	12
QC	Dalby	31
QC	Dirranbandi	1
QC	Emerald	6
QC	Moura	12
QC	Warren	18
QC	Wee Waa	16
QC	Beardmore	30

Neps

The average nep content for the 2007 crop was 270 neps/gram, which is similar to the 50 percentile line as reported in the Uster Statistics. The median was 257 neps/gram; ranging from 146 to 664 neps/gram with a standard deviation of 67. Figure 7 gives a breakdown of the results.

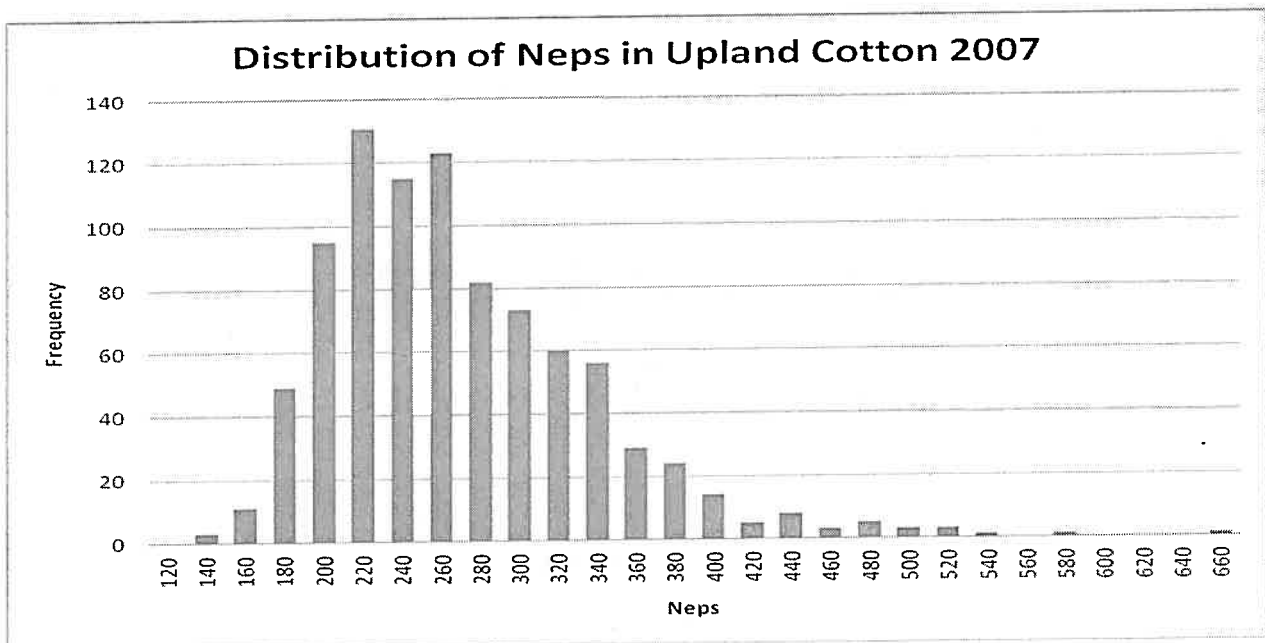


Figure 7. Distribution of neps in 2007 Upland cotton crop

Ten percent of the samples had a nep content of < 200 neps/gram with 62% of the samples had a nep content >200 and < 300; 24% of the samples had a nep content > 300 and < 400 with 4% of the samples had > 400 neps/gram.

Figure 8 gives a breakdown of neps per variety. The varieties that averaged > 300 neps/gram were; Sicala 43 RR, Sicot 71RR, Sicala 40BR, Sicala 43, Sicala 60 BRF, Sicot 289BR and Sicala 43BRF.⁵ The highest sample was 664 neps/gram, from Sicot 71BR in the Macintyre Valley and the lowest sample was 146 neps/gram, from Sicala 60 BR also from the Macintyre Valley.

⁵ Although the nep content for Sicot 14B, Sicot 80L, Sicot 75 and Sicot 80RR were also above >300 neps/gram they are not included as there were less than 5 samples for each variety.

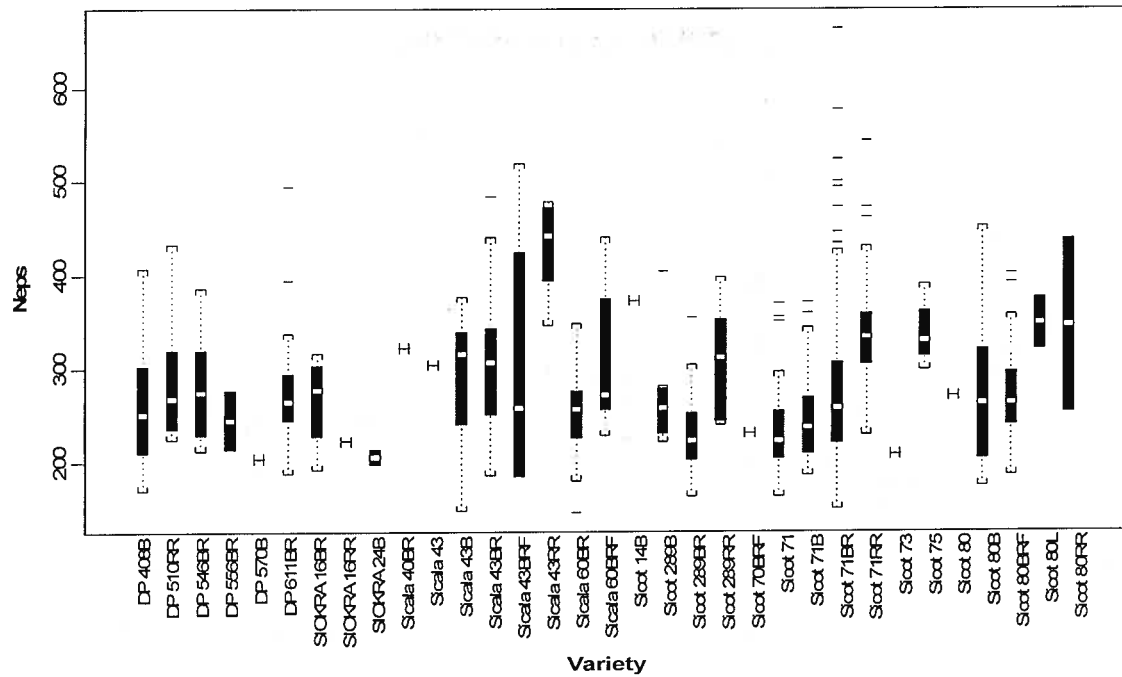


Figure 8. Distribution of nep content per variety

Figure 9 gives a breakdown of neps per location. The location that averaged > 300 neps/gram was the Lachlan Valley although the Macintyre, Maquarie and Namoi Valleys showed large variability.

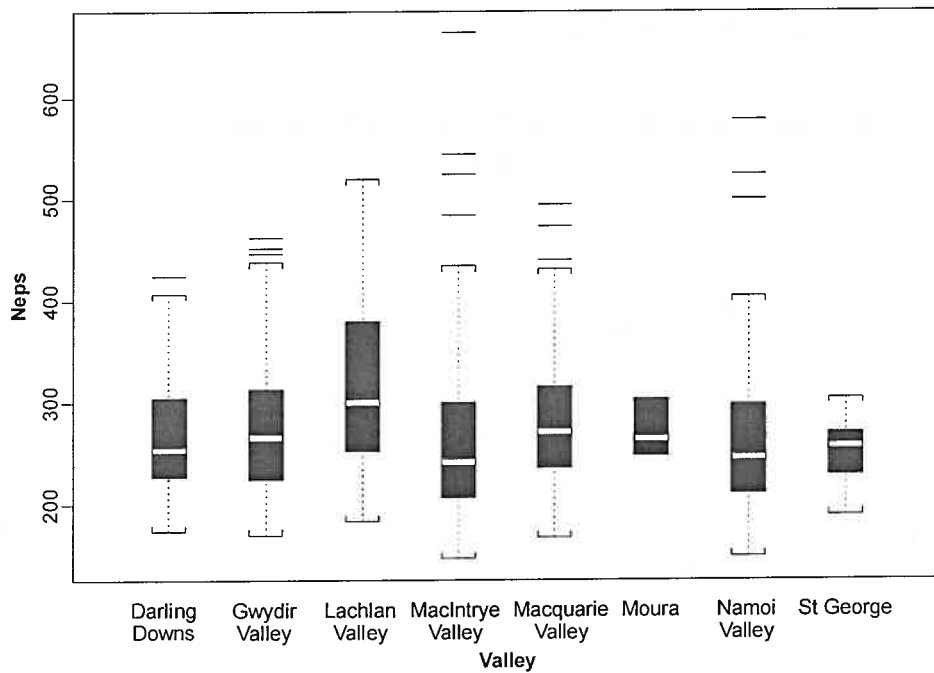


Figure 9. Distribution of neps per valley

Figure 10 gives a breakdown of nep content per gin. The gins that averaged > 300 neps/gram were gin numbers 4, 16, 29 and 32. The gin that averaged the least number of neps was gin 31 at 194 neps/gram with gin 29 averging the most neps at 368 neps/gram. The lowest nep count was recorded by gin number 31 and the highest nep count was recorded by gin number 4.

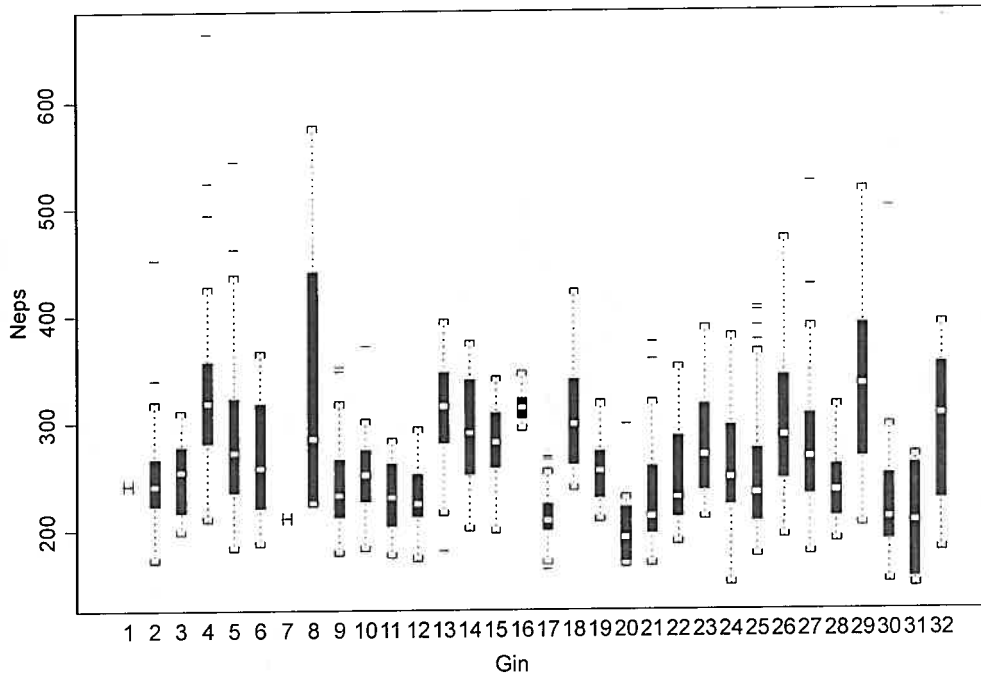


Figure 10. Distribution of neps per gin

Seed coat neps

The average seed coat nep content for the 2007 crop was 26 neps/gram. When compared to the Uster Statistics this falls between the 25 to 50 percentile lines which can be considered to be above average. The median was 25 neps/gram; ranging from 9 to 65 neps/gram with a standard deviation of 8.6. Figure 11 gives a breakdown of the results.

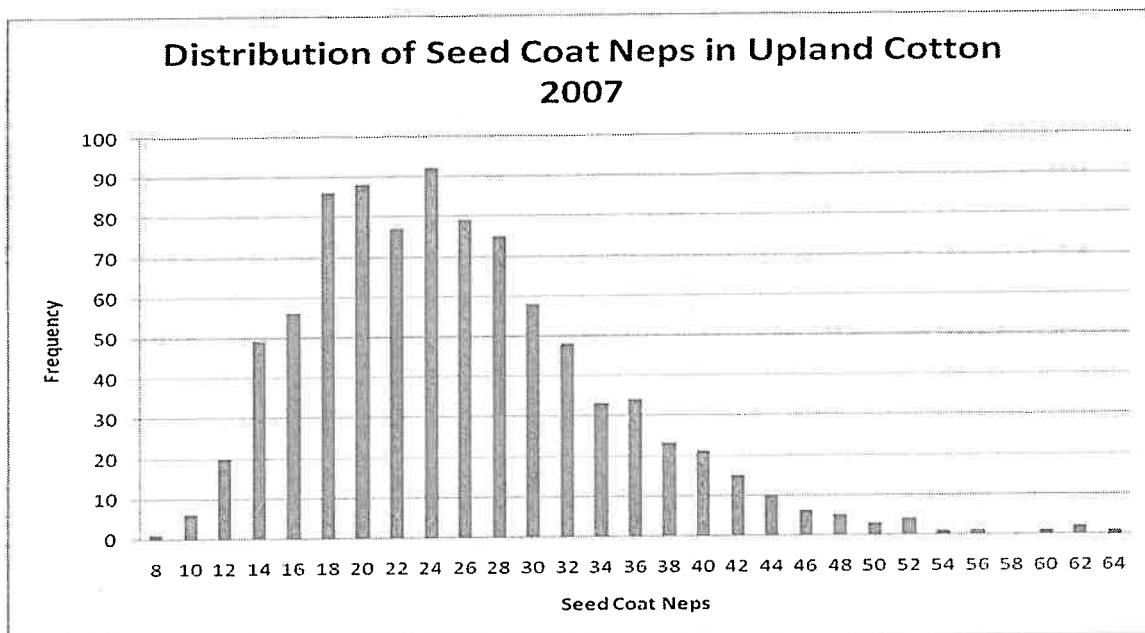


Figure 11. Distribution of seed coat neps in 2007 Upland cotton crop

Figure 12 gives a breakdown of seed coat neps per variety. The variety that averaged > 30 seed coat neps/gram was DP408B⁶. At 65 seed coat neps/gram Sicot 80BRF had the highest seed coat nep content and at 6 seed coat neps/gram Sicala 43 had the lowest seed coat nep content.

⁶ Although the nep content for Sicot 14B and Sicala 40BR were also above >30 seed coat neps/gram they are not included as there were less than 5 samples for each variety.

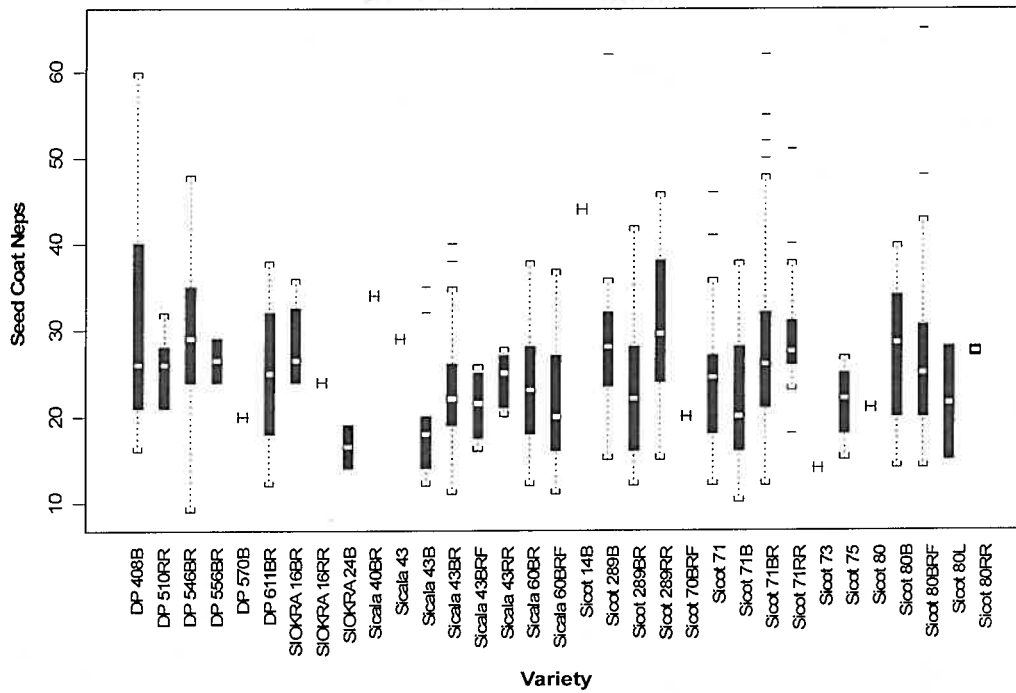


Figure 12. Distribution of seed coat nepts per variety

Figure 13 gives a breakdown of seed coat nepts per valley. The location that averaged > 30 nepts/gram was Moura, although the Darling Downs, Maquarie, Gwydir and Namoi Valley's showed large variability.

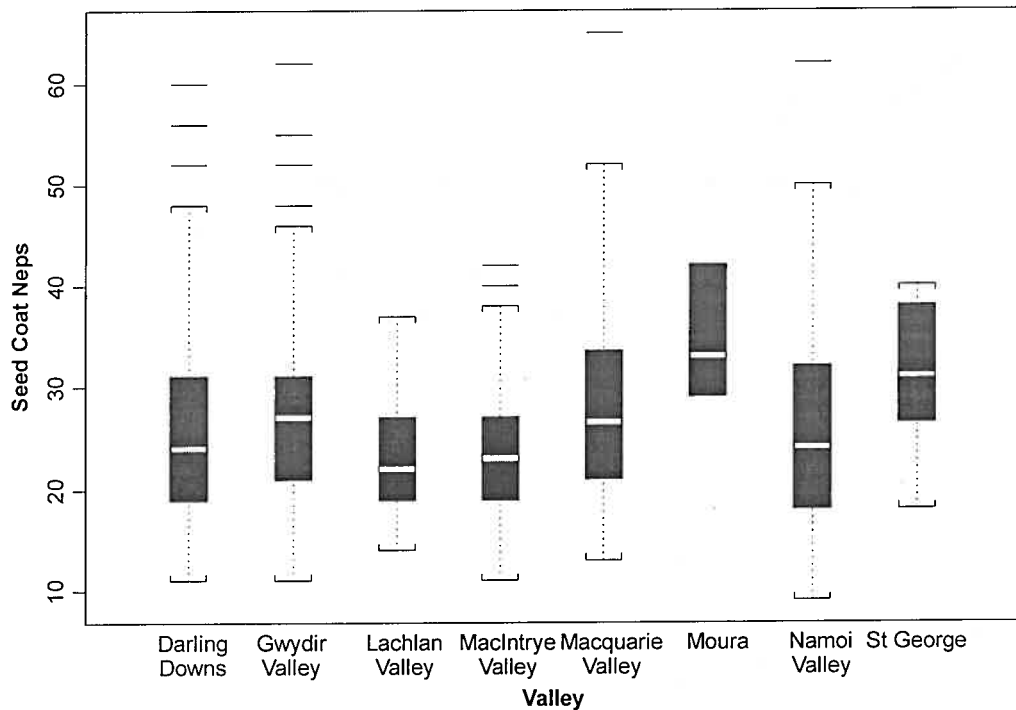


Figure 13. Distribution of seed coat nepts per valley

Figure 14 gives a breakdown of seed coat nepts per gin. The gins that averaged > 30 seed coat nepts/gram were gin numbers 4 and 9, with gin number 8, 25 and 27 averaging 30 seed coat

neps/gram. The gins that averaged the least number of seed coat neps were gin numbers 6,12 and 14⁷ at 16 seed coat neps/gram with gins 4 and 31 averging the most seed coat neps at 33 neps/gram. The lowest seed coat nep count was recorded by gin number 32 and the highest seed coat nep count was recorded by gin number 4.

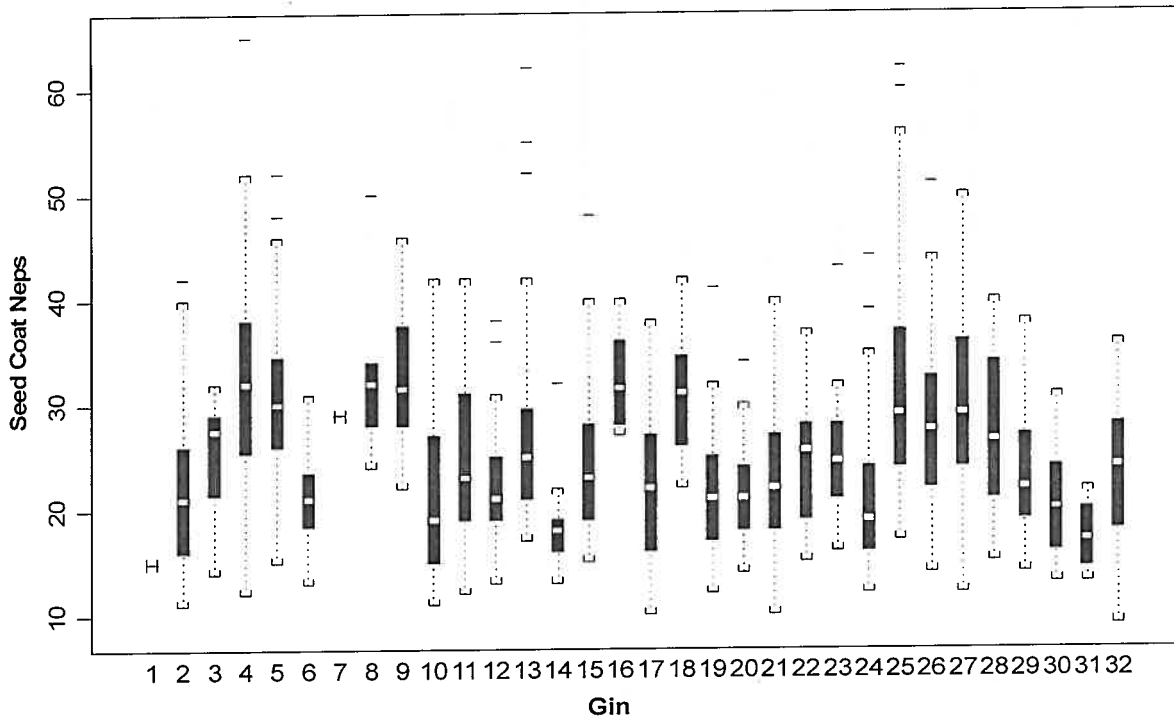


Figure 14. Distribution of seed coat neps per gin

Short Fibre content

The average short fibre content by weight for the 2007 Upland crop was 9.62%. The median was 9.3% and the range is from 5.4% to 49.9% with a standard deviation of 2.8. To give a better indication of the short fibre content Figure 15 shows an expanded distribution of the results.

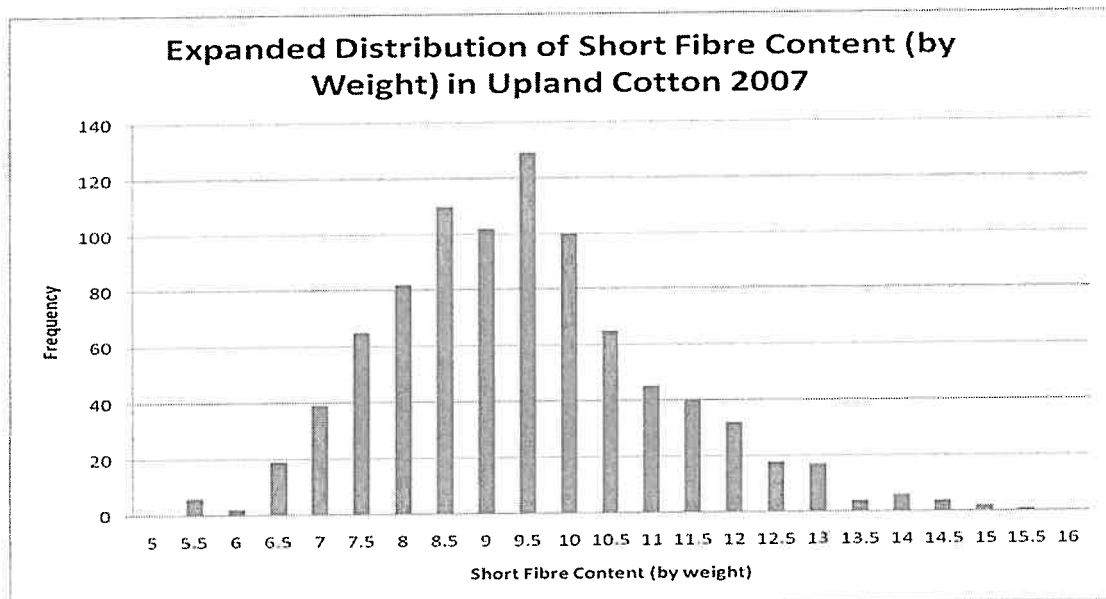


Figure 15. Expanded distribution of short fibre content in 2007 Upland cotton crop

⁷ Gin 1 and 31 was not considered as < 5 samples.

Figure 16 gives a breakdown of short fibre content per variety. The varieties that averaged > 10% short fibre content are; Sicot 43RR, DP510RR, DP611BR, Sicot 289B and Sicot 80B⁸. At 38.6% Sicot 43RR had the highest short fibre content and at 5.4% Sicot 71BR had the lowest short fibre content.

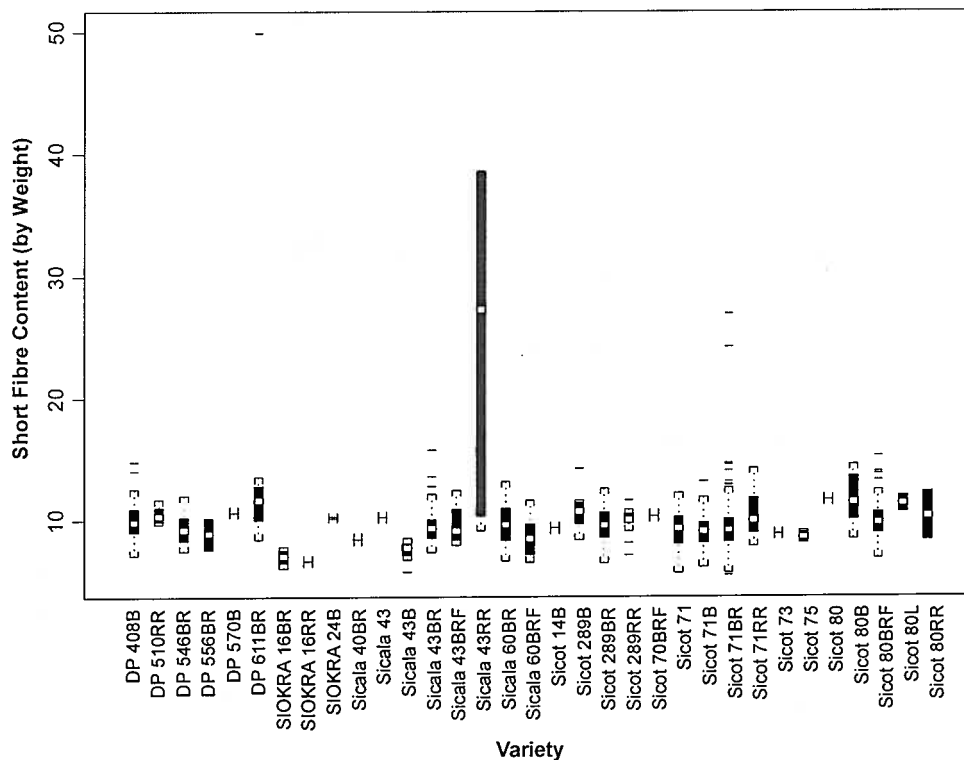


Figure 16. Distribution of short fibre content per variety

Figure 17 give a breakdown of the short fibre content per valley. All the valley's averaged around 10% short fibre content with the Namoi, Lachlan and Macquarie Valley's showing large variability.

⁸ Although the short fibre content for Sicot 80 and DP570B were also above > 10% they are not included as there were less than 5 samples for each variety.

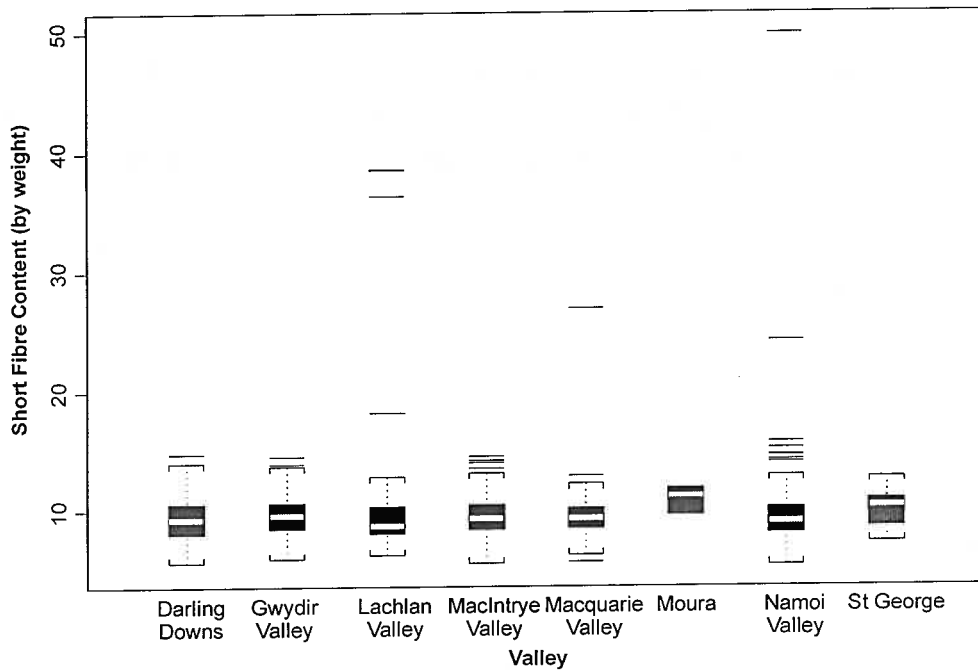


Figure 17. Distribution of short fibre per valley

Figure 18 gives a breakdown of short fibre content per gin. The gins that averaged > 10 % short fibre content were gin numbers 13, 16, 18, 29, 30 and 32 with gin numbers 2, 3, 4, 5, 8, 10, 12, 21, 22 and 28 averaging 10%. The gins that averaged the least short fibre content were gin numbers 6, 11, 14 and 30⁹ at 7% with gin 29 averging the highest short fibre content at 16%. The lowest short fibre content was recorded by gin 4 and the highest short fibre content was recorded by gin number 31.

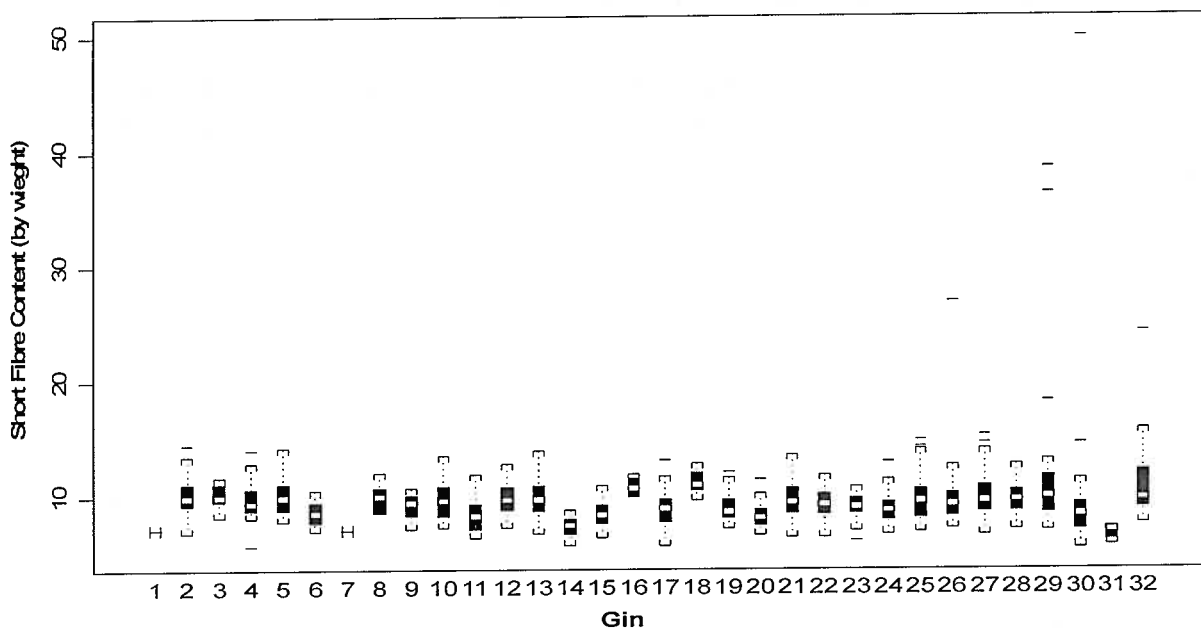


Figure 18. Distribution of short fibre content per gin

⁹ Gin 1, 7 and 31 was not considered as < 5 samples.

Fineness

The average fineness content for the 2007 crop was 204 mtex. The median was 205 mtex and the range was from 149 to 289 mtex with a standard deviation of 15.

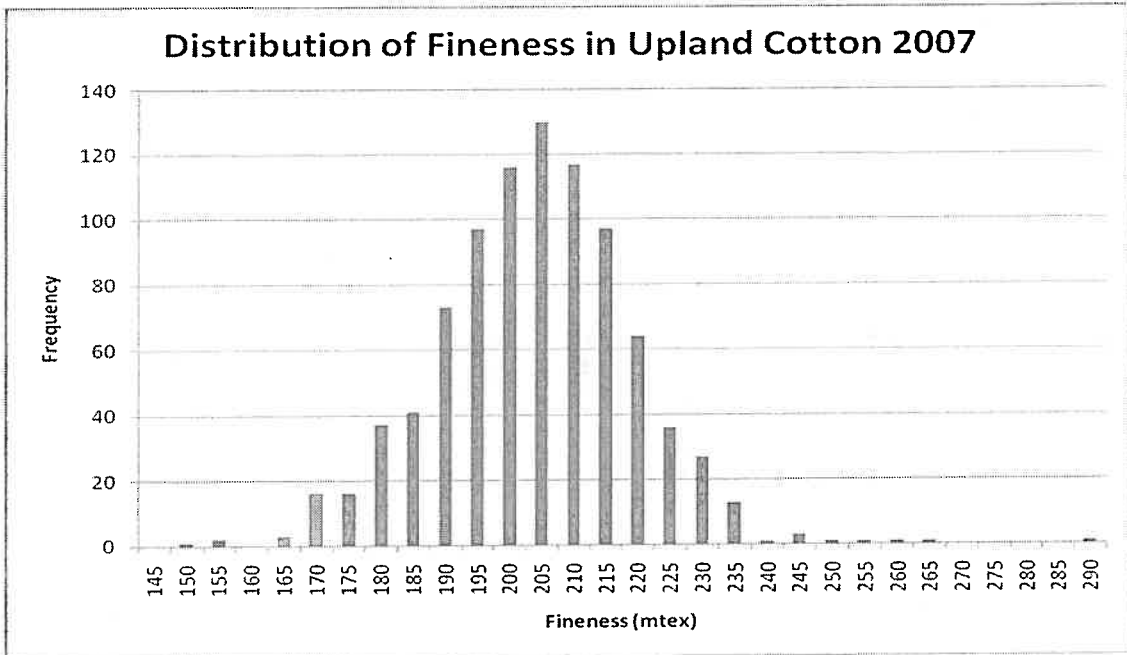


Figure 19. Distribution of fineness in 2007 cotton crop

Figure 20 gives a breakdown of fineness per variety. The varieties that averaged > 200 millitex are; DP546BR, Sicala 60BR, Sicot 289B, Sicot 289BR, Sicot 71, Sicot 71B, Sicot 71BR and Sicot 80¹⁰. At 289 millitex Sicot 80B had the coarsest fibre and at 149 millitex Sicot 43RR had the finest fibre.

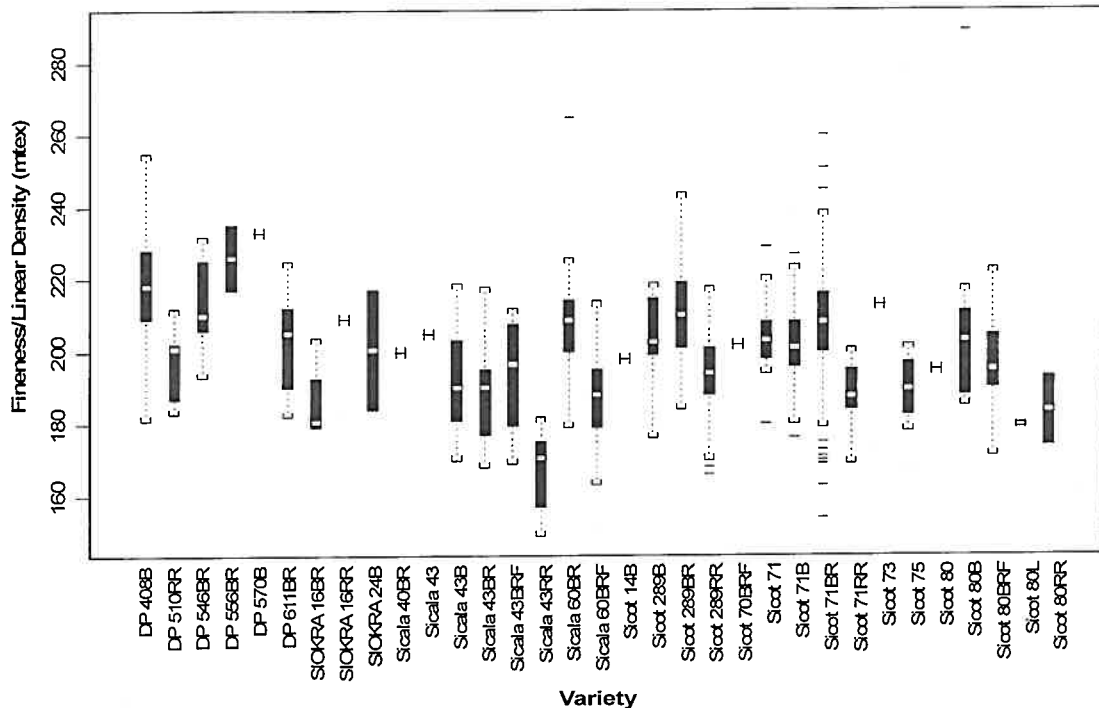


Figure 20. Distribution of fineness per variety

¹⁰ Although the fineness for Sicot 73, Siokra 16RR, Siokra 24B, DP408B, DP556BR, DP570B, Sicot 43 and Sicot 70BRF was also above > 200 they are not included as there were less than 5 samples for each variety.

Figure 21 gives a breakdown of fineness per valley. All the valley's averaged around 200 millitex with all valley's showing large variability.

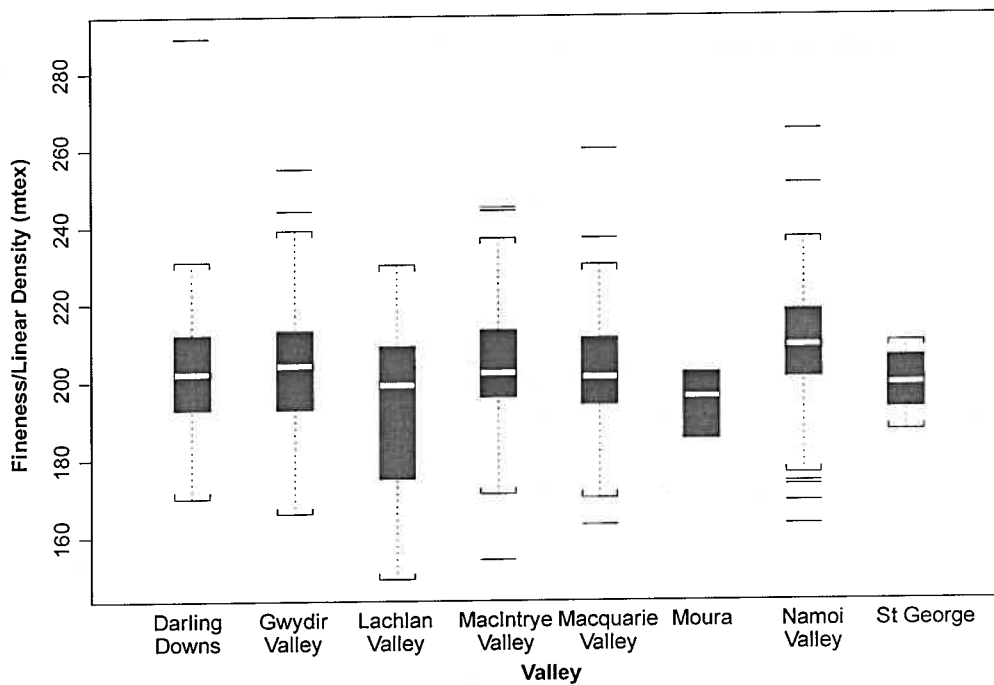


Figure 21. Distribution of fineness per valley

Figure 22 gives a breakdown of fineness per gin. The gins that averaged > 200 millitex were gin numbers 2, 3, 6, 8, 11, 12, 13, 15, 17, 20, 21, 22, 25, 26, 28, 30 and 32¹¹ with gin number 19 averaging 200 mtex. The gins that averaged the finest cotton was gin 29 at 187 millitex with gin 32 averaging the coarsest fibre at 215 millitex. The finest fibre was recorded by gin 29, whilst the coarsest fibre was recorded by gin number 25.

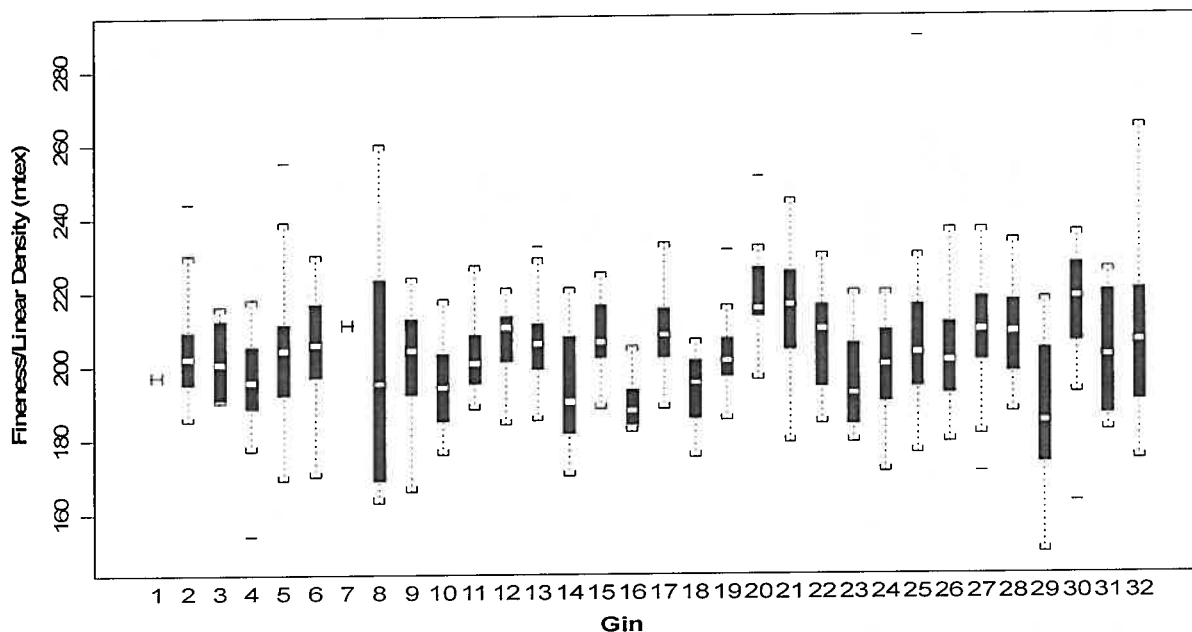


Figure 22. Distribution of fineness per gin

¹¹ Although the fineness above > 200 gin 7 and 31 are not included as there were less than 5 samples for each gin.

Maturity

The average calculated maturity of the 2007 crop was 0.851. The median was 0.856 and the range was from 0.623 to 1.089 with a standard deviation of 0.061.

Forty one percent of the samples were considered to be immature with a calculated Maturity < 0.85.

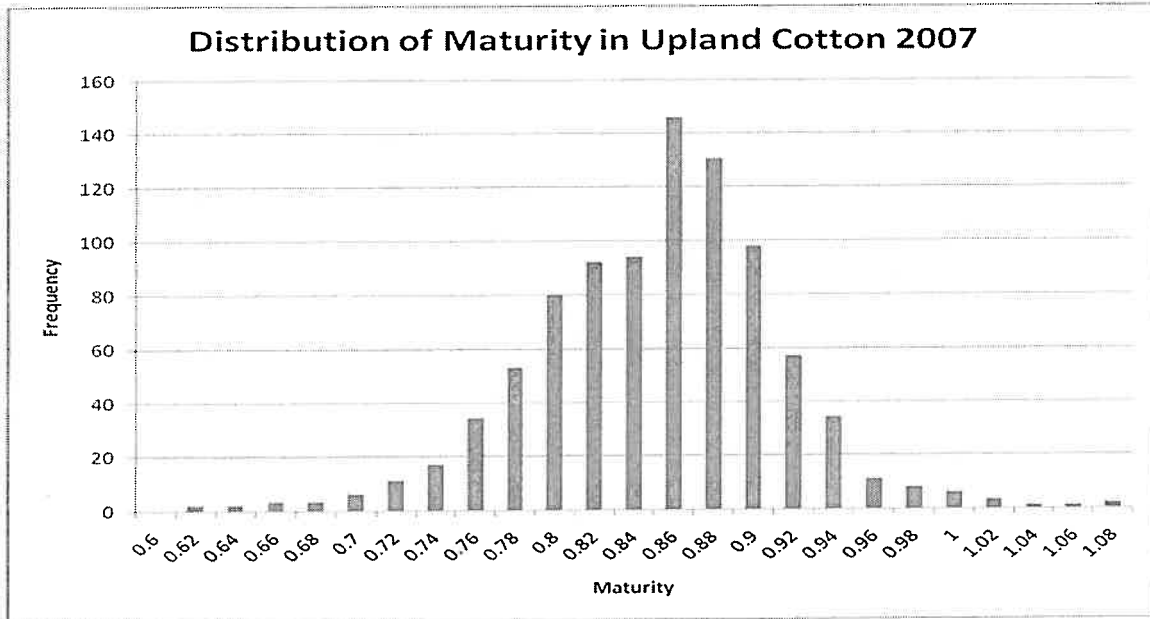


Figure 23. Distribution of Maturity in 2007 cotton crop

Figure 24 gives a breakdown of maturity per variety. The varieties that averaged < 0.83 are; DP408B, DP611BR, Sicala 40BR, Sicot 43B, Sicala 60BR, Sicot 289RR and Sicot 80B¹². At 1.09 Sicot 71RR provided the most mature sample and at 0.62 Sicot 71BR provided the most immature fibre sample.

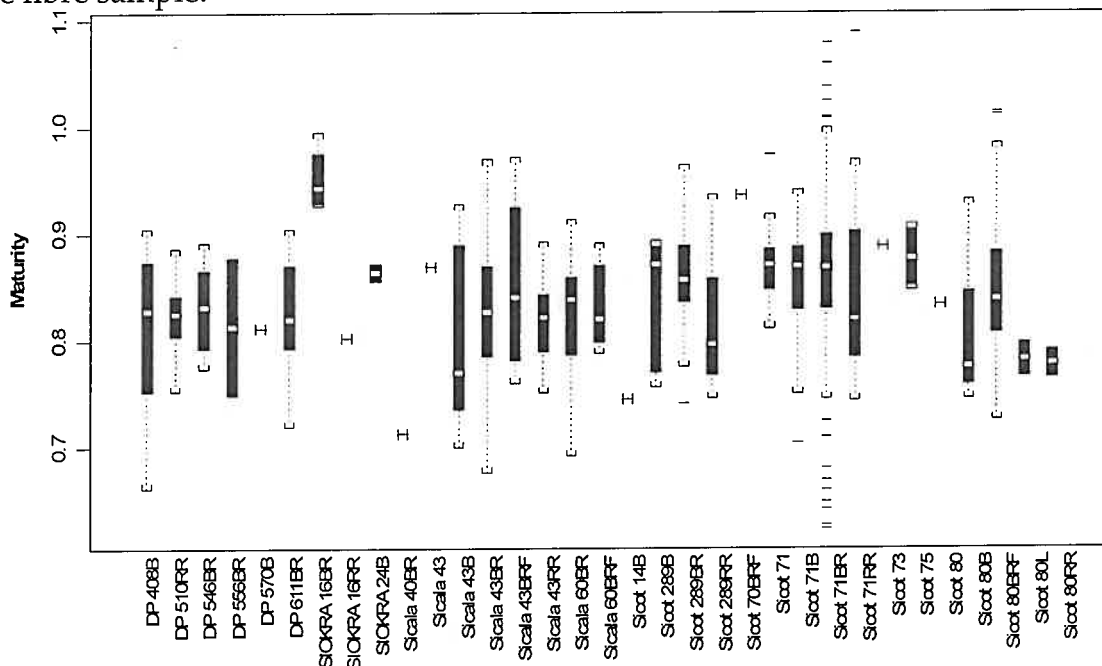


Figure 24. Distribution of Maturity per variety

¹² Although the maturity for variety Sicot 80RR, Sicot 80L DP, 556BR DP570B and Sicot 14B was also above < 83 they are not included as there were less than 5 samples for each

Figure 25 gives a breakdown of maturity per valley. All the valley's averaged around 0.83 with all valley's showing large variability.

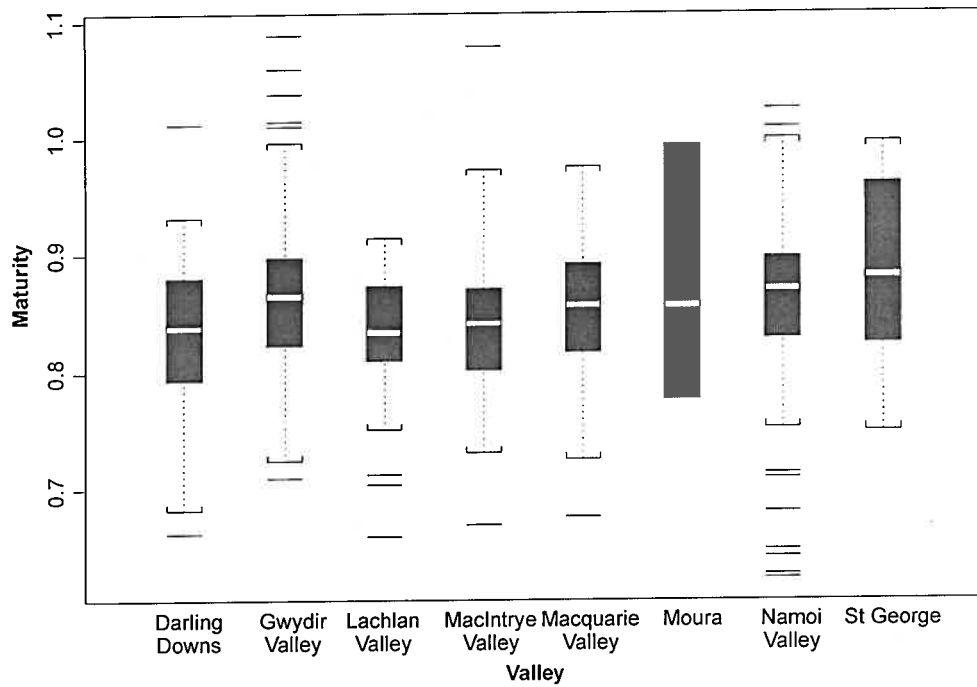


Figure 25. Distribution of maturity per valley

Figure 26 gives a breakdown of maturity per gin. The gins that averaged > 0.83 were gin number 10, 14, 18, 25, 26, 27 and 29 with gin number 3, 24 and 30 averaging 0.83.

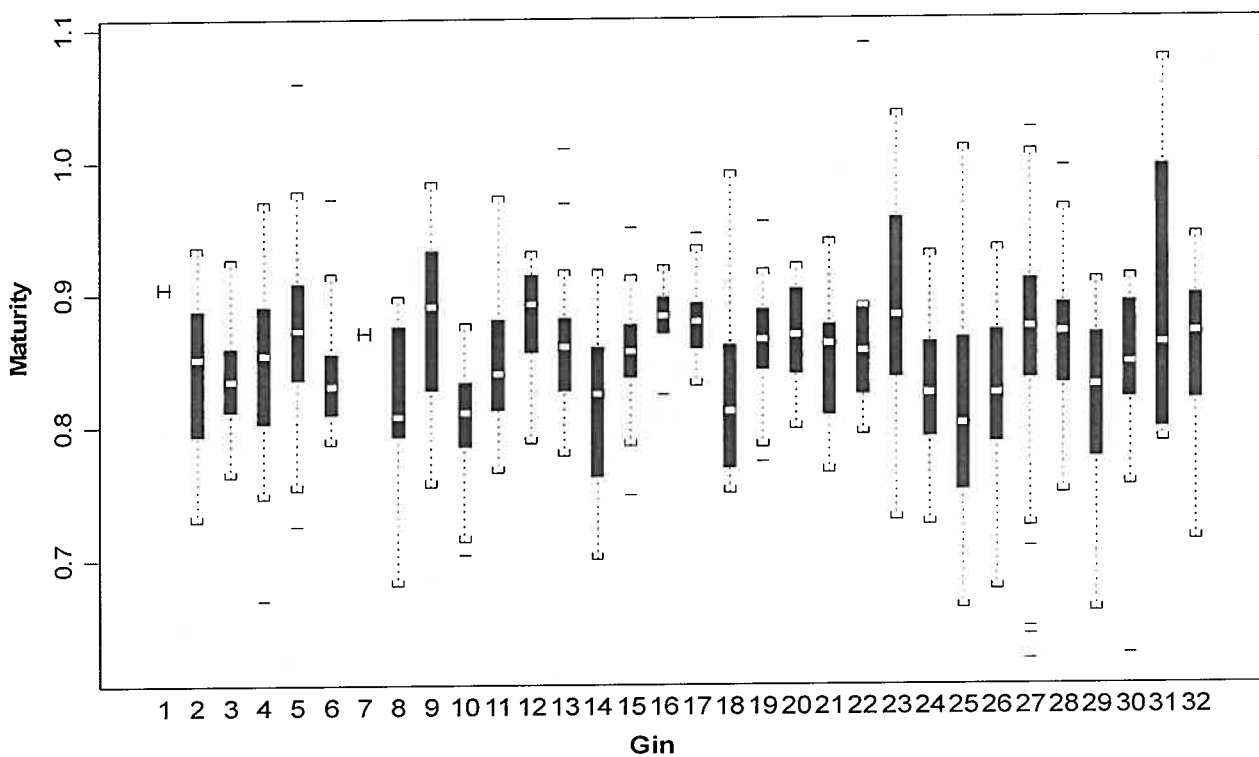


Figure 26. Distribution of maturity per gin

2008 Crop

The Australian cotton crop in 2008 produced 601,810 bales from 68,585 hectares with an average yield of 8.77 bales per hectare. The continued drought conditions experienced during the 2008 season led to the smallest crop in 30 years.

Seventy percent of the cotton was grown in New South Wales, mainly in the Namoi, Gwydir, Macintyre and Macquarie Valleys. The rest of the crop was grown in Queensland mainly on the Darling Downs, St. George, Emerald, Biloela/ Theodore and Dirranbandi. The majority of cotton was irrigated with only 5.5% dryland cotton. No Pima cotton was grown during this season.

The quality of the 2008 crop was summarised by ACSA as follows;

Ninety six percent of the crop had a staple length of 1 1/8 inch or longer, with 73 percent of the crop achieving 1 5/32 inch or longer. The majority of the crop had a Micronaire value of 3.8 to 4.9 Micronaire, with 52% of the crop falling into the premium Micronaire range of 3.8 to 4.5. Eighty percent of the crop had a strength of 29 gpt, with 56% of the crop achieving a strength of 30 gpt and above. Almost 93% of the crop achieved base grade or better.

As mentioned earlier 929 samples from 35 varieties were analysed from the 2007 crop. Sixty three percent of the samples collected for the 2008 Nep Survey achieved the Australian base grade quality which is staple length above 1 1/8 inch, strength above 29 gpt and micronaire in the range of 3.5-4.9.

Nearly 78% of the varieties were CSIRO bred varieties with the rest being Deltapine varieties. Fifty percent of the samples were Sicot 71 (Conventional, Bollgard II, Bollgard II/Roundup Ready, and Roundup Ready), followed by 15% Sicot 80 (Conventional, Bollgard II, Bollgard II Roundup Ready Flex, Liberty and Roundup Ready), 9% Sicala 60 (Bollgard II Roundup Ready Flex and Roundup Ready), 6% Sicot 70 (Bollgard II Roundup Ready Flex), 5% Sicala 43 (Bollgard II, Bollgard II Roundup Ready and Bollgard II Roundup Ready Flex) and 5% Sicot 289 (Bollgard II, Bollgard II Roundup Ready and Roundup Ready). There were also a small number of samples from a number of other varieties.

Table 19. Breakdown of samples per variety

Variety	Samples	Variety	Samples
Sicot 71BR	317	Sicot 289B	8
Sicot 80BRF	132	Siokra V-16BR	8
Sicot 71B	89	DP12BRF	7
Sicot 70BRF	55	Siokra 24B	3
Sicala 60BRF	52	Sicot 14B	3
Sicot 71RR	35	Sicot 73	3
Sicot 43BR	32	DP961BRF	3
Sicot 289BR	27	DP556BR	2
Sicot 60RR	27	DP 546BRR	2
DP 408B	23	Sicala 45B	2
Sicot 71	22	Sicot 80B	2

Sicot 75	17	Sicala 43B	1
DP 546BR	16	Sicot 80L	1
DP 611BR	16	DP 18RRF	1
Sicot 43BRF	12	DP576B	1
Sicot 289RR	9	DPX032B	1

The cotton samples collected were grown in nine valleys. At 29%, the majority of cotton samples were grown in the Namoi Valley, followed by the Darling Downs with 22%, Gwydir Valley with 18%, the Macquarie Valley with 11% and the McIntyre Valley with 9%. The remainder of the cotton samples were grown in Emerald, Biloela/Theodore, Lachlan Valley and St George. Table 20 gives a breakdown of the number of samples collected from the valleys and varieties.

Table 20. Varieties associated with locations

Valley Variety	Darling Downs	Emerald	Gwydir Valley	Lachlan Valley	Macintyre Valley	Macquarie Valley	Namoi Valley	St George	Theodore
DP 12BRF			1			2	4		
DP 18RRF						1			
DP 408B	2	5	1				12		3
DP 546BR	2		4			2	8		
DP 546BRR			2						
DP 556BR		1				1			
DP 576B	1								
DP 611BR	4	4			4	2	2		
DP 961BRF						3			
DPX032B							1		
Sicala 45B	2								
Sicala 60BRF	23		1	9		4	15		
Sicala 60RR	11					7	9		
Sicot 14B	3								
Sicot 289B	6						2		
Sicot 289BR	8		3		9		7		
Sicot 289RR			5		4				
Sicot 43B							1		
Sicot 43BR	8			11		11	2		
Sicot 43BRF	2			6	1	1	2		
Sicot 70BRF	9	1	8		2	5	28		2
Sicot 71	6		10		2	1	6		
Sicot 71B	4		5		25		41	4	7
Sicot 71BR	25	30	50		28	61	112	1	10
Sicot 71RR			32			3			
Sicot 73							3		
Sicot 75	3		5		2		3		4
Sicot 80B	2								
Sicot 80BRF	81	3	32		2		13	1	
Sicot 80L	1								
Siokra 24B	2	1							
Siokra V-16BR		1	7						

Table 21 gives a breakdown of the various gins and the number of samples collected.

Table 21. Gins and number of samples collected

Company	Gin location	Samples
Auscott	Midkin	54
Auscott	Narrabri	151
Auscott	Trangie	88
Brighann	Moree	2
Carrington	Goondiwindi	13
Carroll	Carroll	49
Dunavant	Dalby	110
Dunavant	Emerald	42
Dunavant	Moree	54
Koramba	Boomi	21
Namoi	Ashley	15
Namoi	Boggabri	21
Namoi	Hillston	42
Namoi	Macintyre	28
Namoi	Merah North	20
North West	Moree	39
QC	Beardmore	8
QC	Cecil Plains	58
QC	Dalby	37
QC	Emerald	3
QC	Moura	26
QC	St George	21
QC	Wee Waa	27

Neps

The average nep content for the 2008 crop was 355 neps/gram. The median was 325 neps/gram and the range was from 150 to 1407 neps/gram with a standard deviation of 126. Figure 27 gives a breakdown of the results. As per Table 1 the average nep content falls between the 50 and 75 percentile lines of the Uster Statistics, which is above the preferred value of 250 – 270 neps/gram.

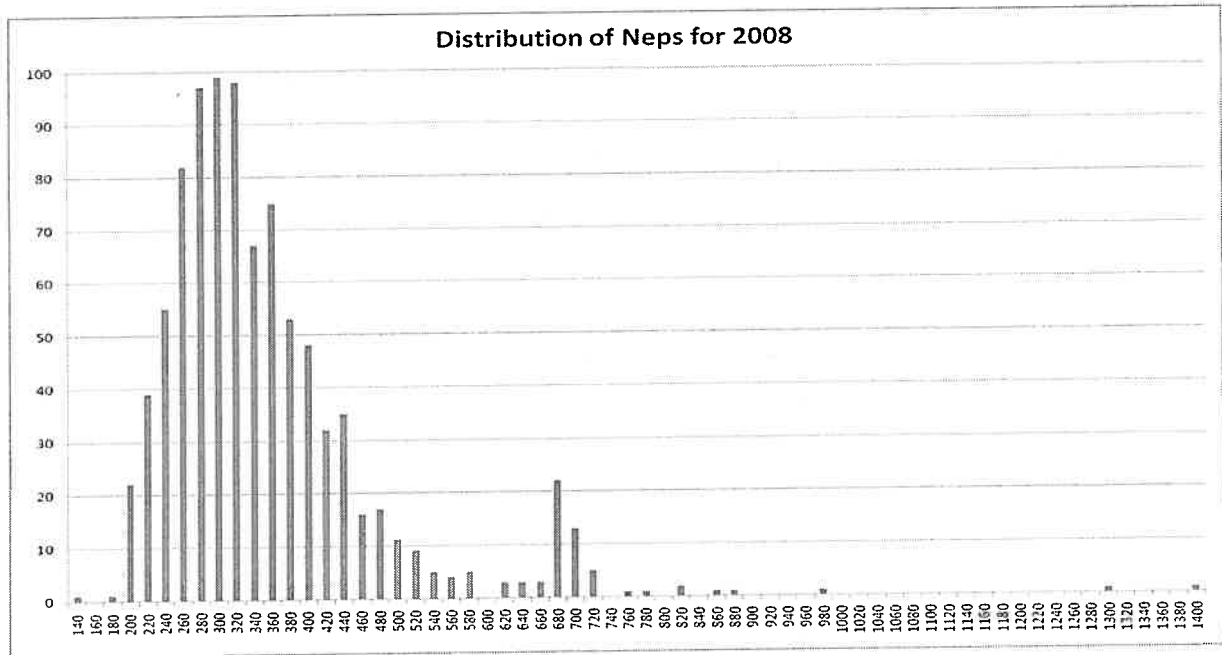


Figure 27. Distribution of neps in 2008 cotton crop

Three percent of the samples had a nep content of < 200 neps/gram, 40% of the samples had a nep content >200 and < 300, 37% of the samples had a nep content > 300 and < 400 and 20% of the samples having > 400 neps/gram.

Figure 28 gives a breakdown of neps per variety. Only 4 varieties averaged < 300 neps/gram; Sicala 45B, Sicot 14B, Sicot 80B and Sicot 80L. The highest sample was 1407 neps/gram, from Sicot 71BR in the Gwydir Valley and the lowest sample was 150 neps/gram, from Sicot 80BRF, from the Darling Downs.

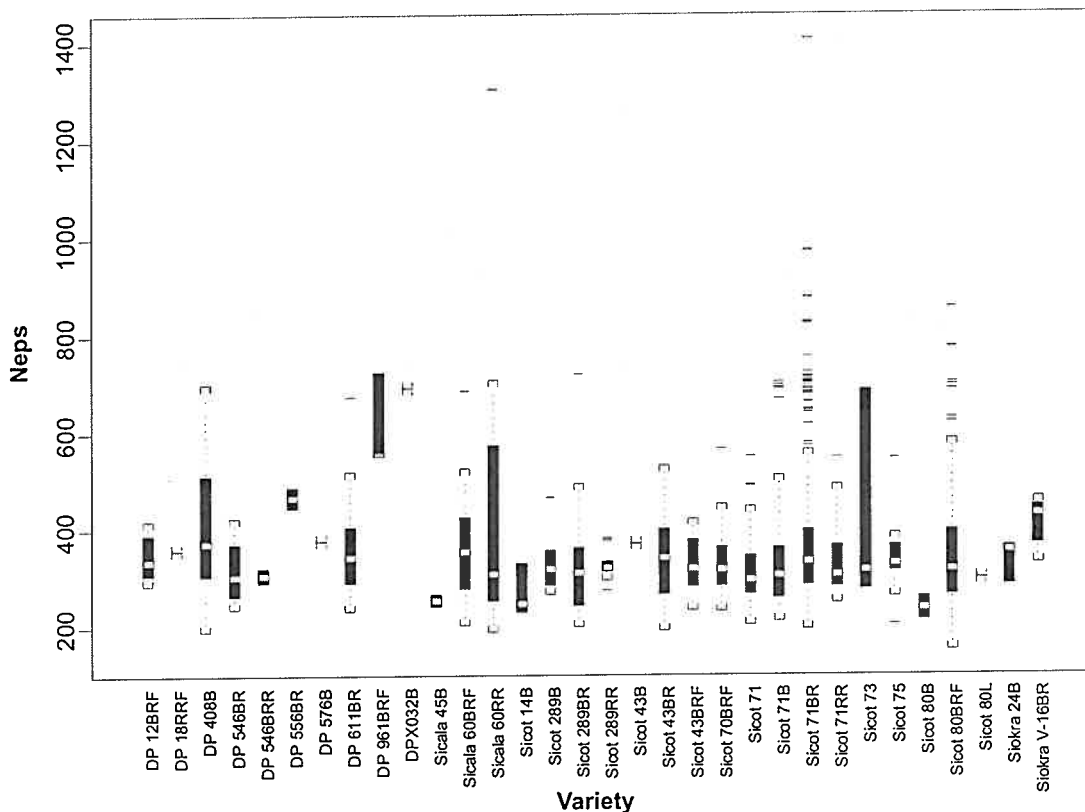


Figure 28. Distribution of nep content per variety

Figure 29 gives a breakdown of neps per location. No location averaged < 300 neps/gram. At 301 neps/gram the Darling Downs had the least number of neps and the Macquarie, Macintyre and Gwydir Valley's the most neps. All the valley's with the exception of Emerald, St George, Theodore and Lachlan Valley, showed large variability.

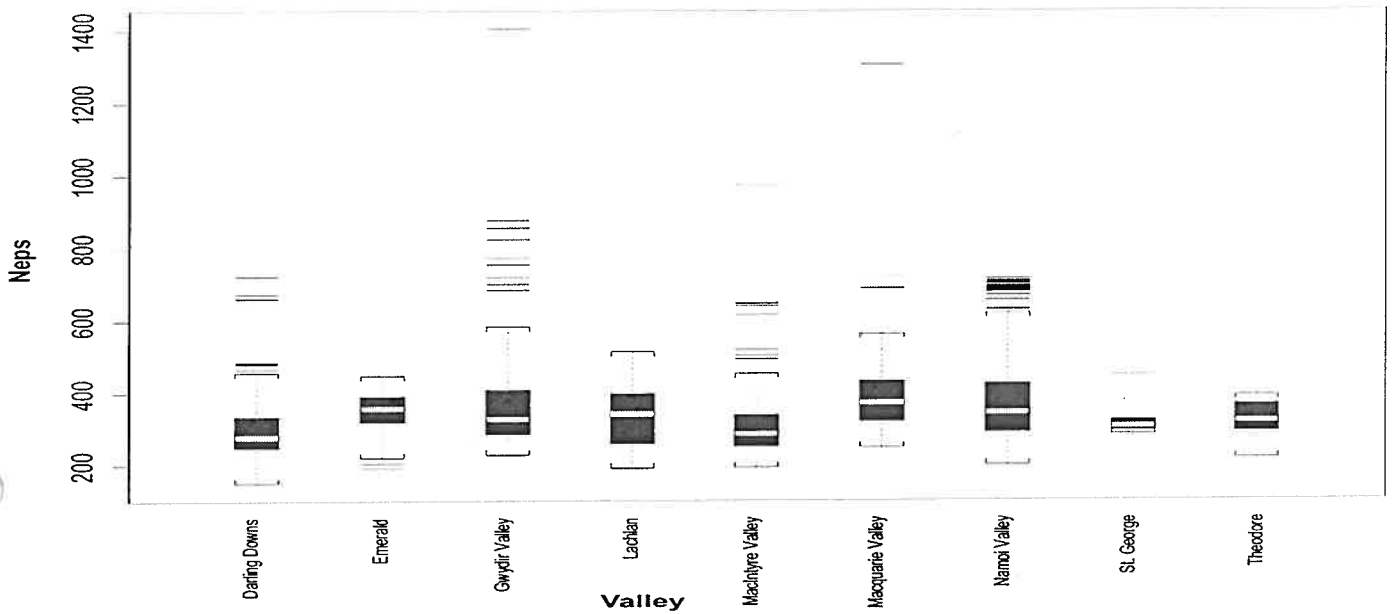


Figure 29. Distribution of neps per valley

Figure 30 gives a breakdown of nep content per gin. The gins that averaged < 300 neps/gram were gin numbers 2, 10, 16, 20 and 31. The gin that averaged the least number of neps was gin number 16 at 207 neps/gram, with gin number 13 averging the most neps at 512 neps/gram. The lowest nep count was recorded by gin number 25 and the highest nep count was recorded by gin number 19.

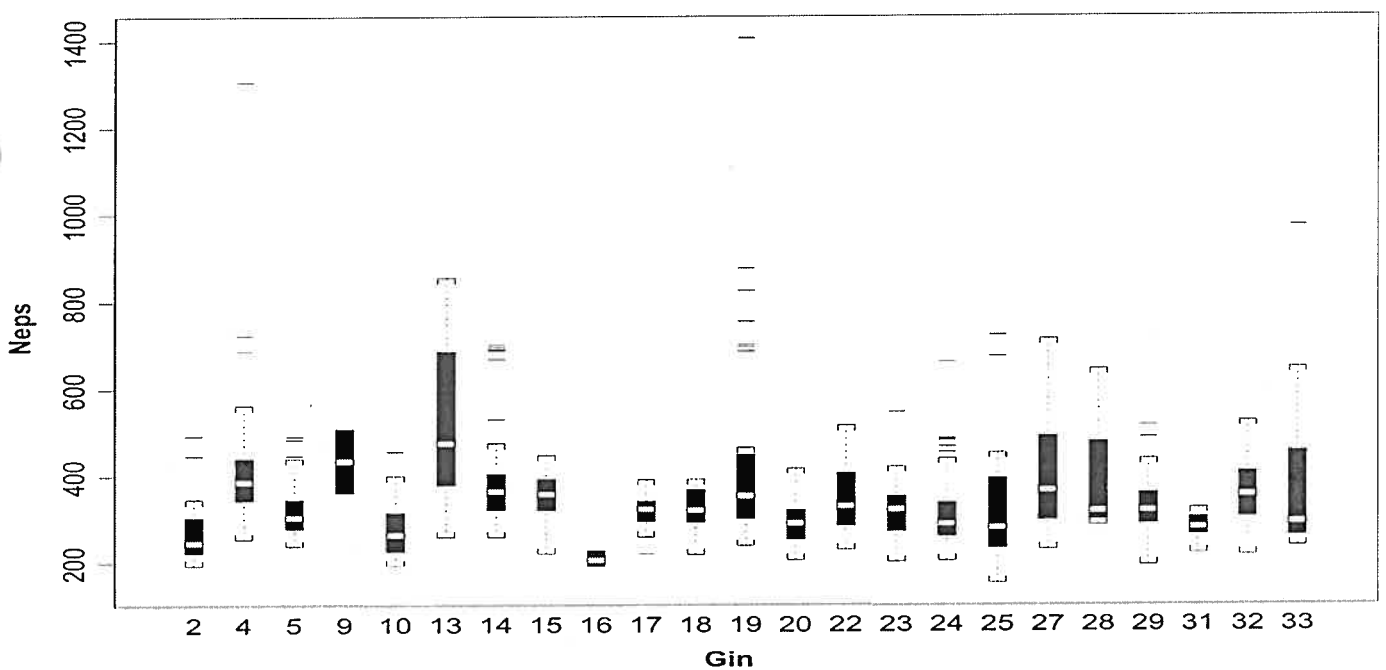


Figure 30. Distribution of neps per gin

Seed coat neps

The average seed coat nep content for the 2008 crop was 26 neps/gram. The median was 25 seed coat neps/gram and the range is from 10 to 76 neps/gram, with a standard deviation of 7.2. Figure 31 gives a breakdown of the results. As per Table 1 the average seed coat nep content falls between the 50 and 75 percentile lines of the Uster Statistics.

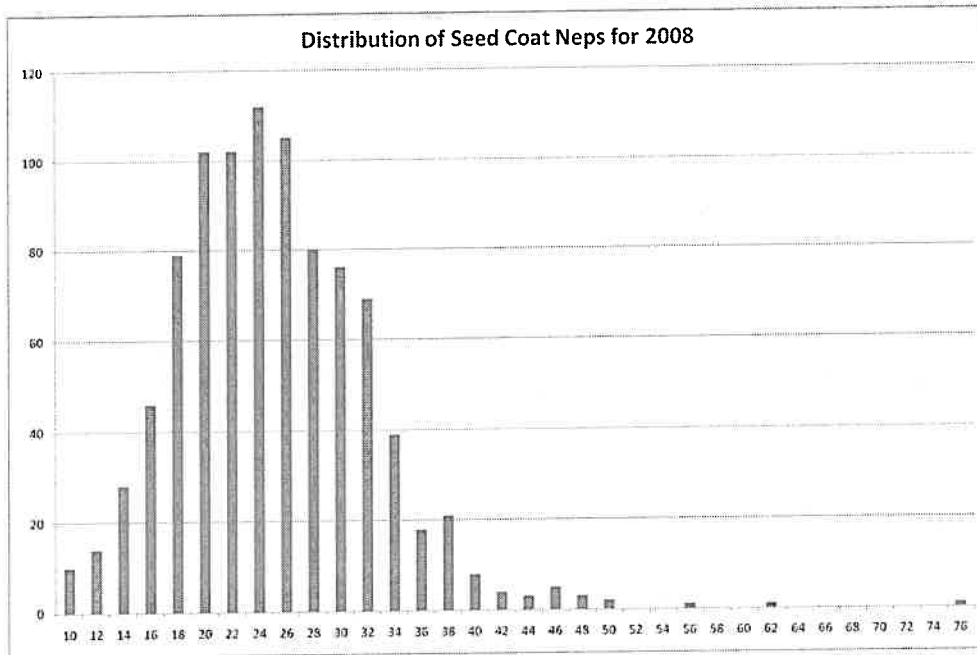


Figure 31. Distribution of seed coat neps in 2008 cotton crop

Figure 32 gives a breakdown of seed coat neps per variety. The varieties that averaged > 30 seed coat neps/gram were DP546BRR, Sicot 14B and Sicot 75. At 76 seed coat neps/gram Sicot 71BR had the highest seed coat nep content and at 10 seed coat neps/gram Sicot 71B, Sicot 80BRF, Sicot 71BR, Sicot 289 and Sicot 70BRF had the lowest seed coat nep content.

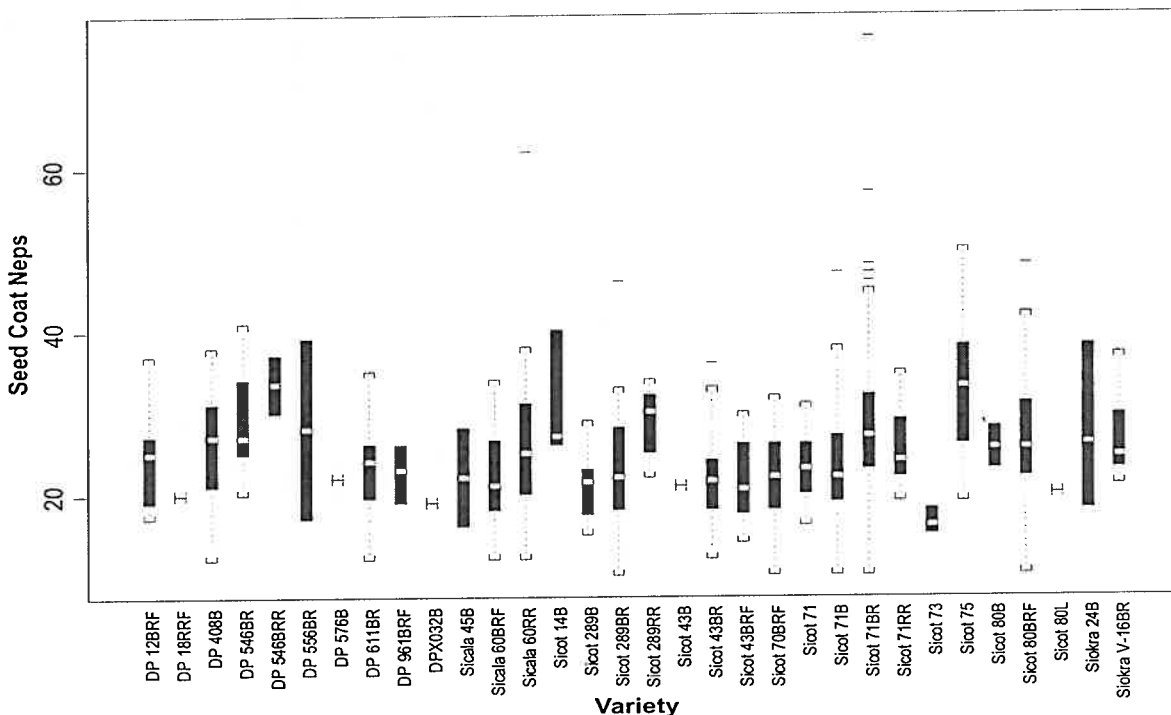


Figure 32. Distribution of seed coat neps per variety

Figure 33 gives a breakdown of seed coat neps per valley. The locations that averaged > 30 neps/gram were Theodore, Emerald and St. George. With the exception of the Lachlan Valley all the valley's showed large variability.

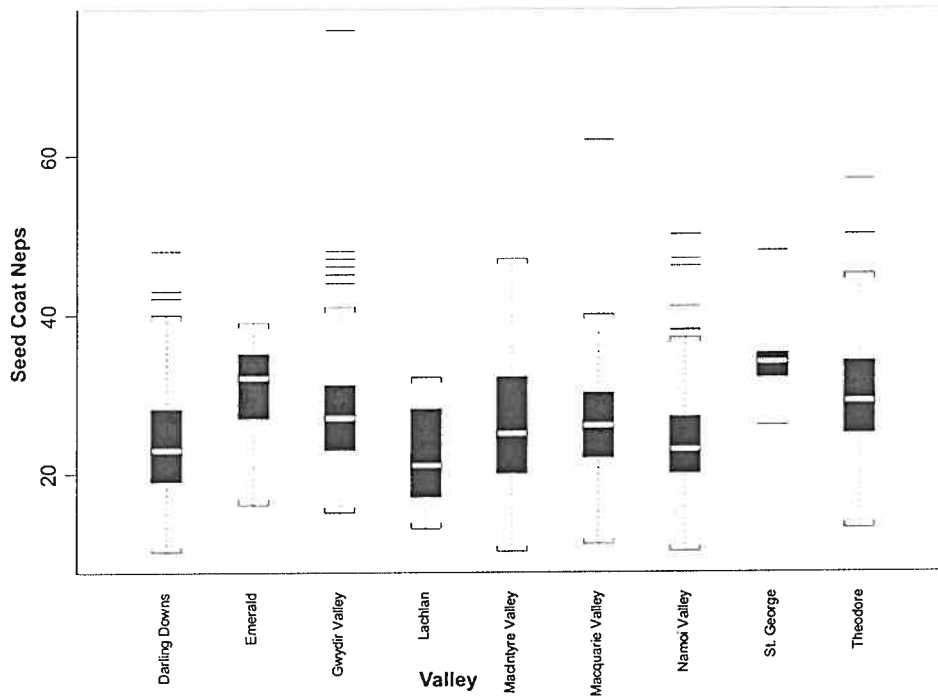


Figure 33. Distribution of seed coat neps per valley

Figure 34 gives a breakdown of seed coat neps per gin. The gins that averaged > 30 seed coat neps/gram were gin number 15, 18 and 28. The gins that averaged the least number of seed coat neps were gin number 2, 9, 10, 16 and 31. The lowest seed coat nep count was recorded by gin number 2, 23, 25 and 27 and the highest seed coat nep count was recorded by gin number 19.

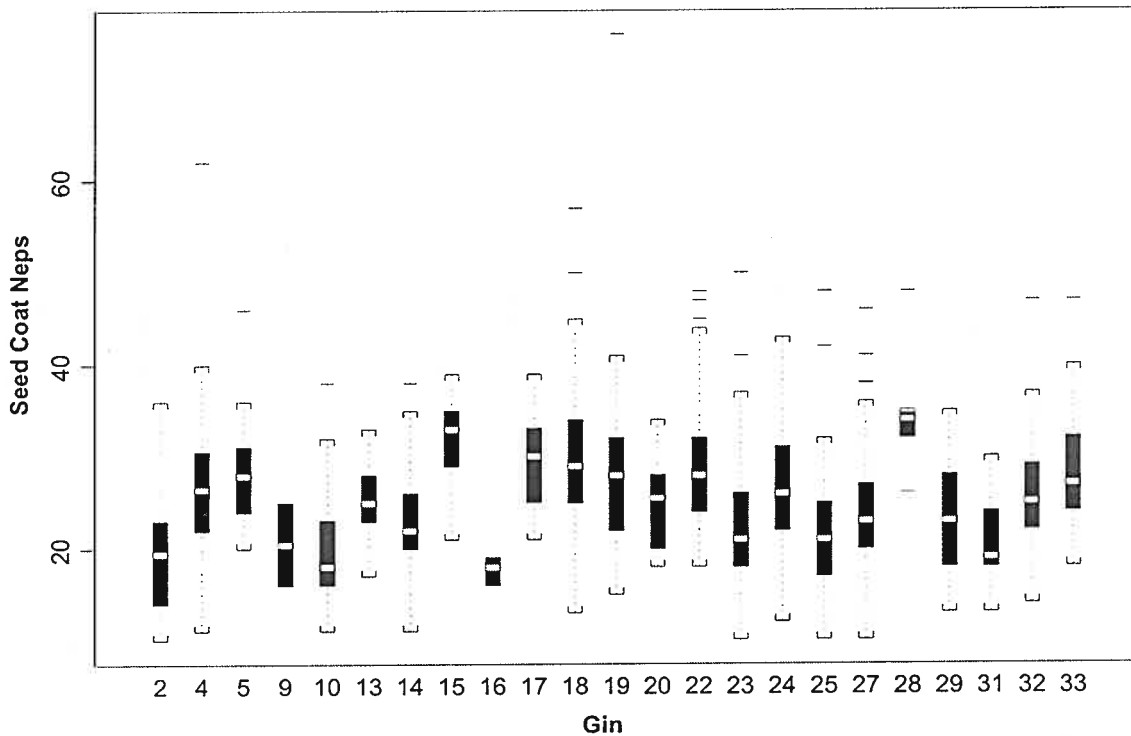


Figure 34. Distribution of seed coat neps per gin

Short Fibre content

The average short fibre content by weight for the 2008 crop was 9.6%. The median was 9.4% and the range is from 4.5% to 19.2% with a standard deviation of 1.8. Figure 35 gives a breakdown of the results. As per Table 1 the average short fibre content falls between the 50 and 75 percentile lines of the Uster Statistics.

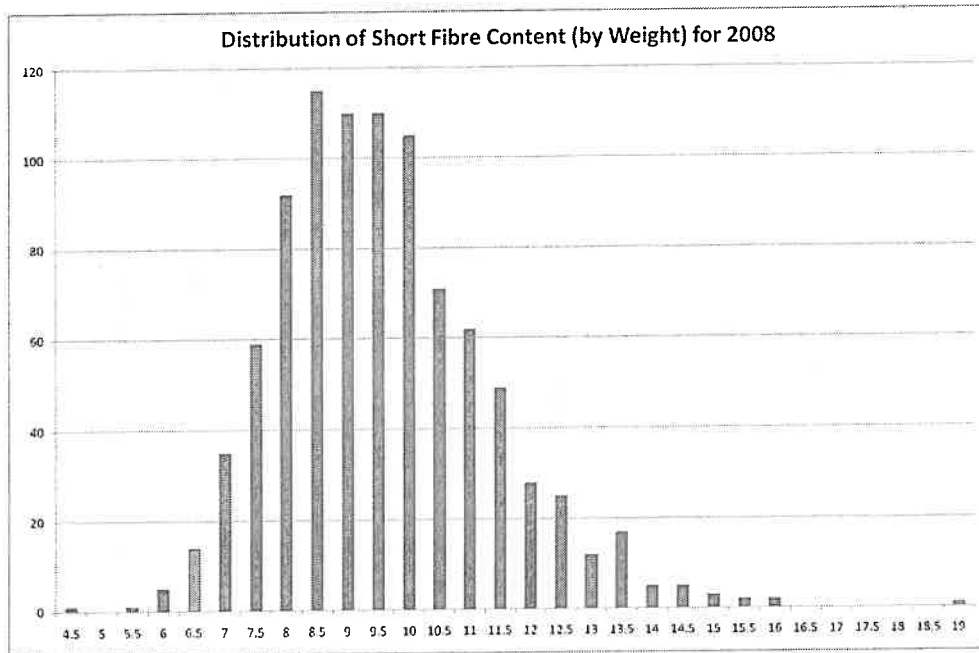


Figure 35. Distribution of short fibre content in 2008 cotton crop

Figure 36 gives a breakdown of short fibre content per variety. The varieties that averaged > 10% short fibre content are; DP 12BRF, DP 18RRF, DP 546BR, DP 546RR, DP 556BR, DP 611BR, DP 961BRF, DPX032B, Sicot 14B, Sicot 289RR, Sicot 70B, Sicot 80B and Siokra 24B. At 19.2% Sicala 60RR had the highest short fibre content and at 4.5 % Sicot 71 had the lowest short fibre content.

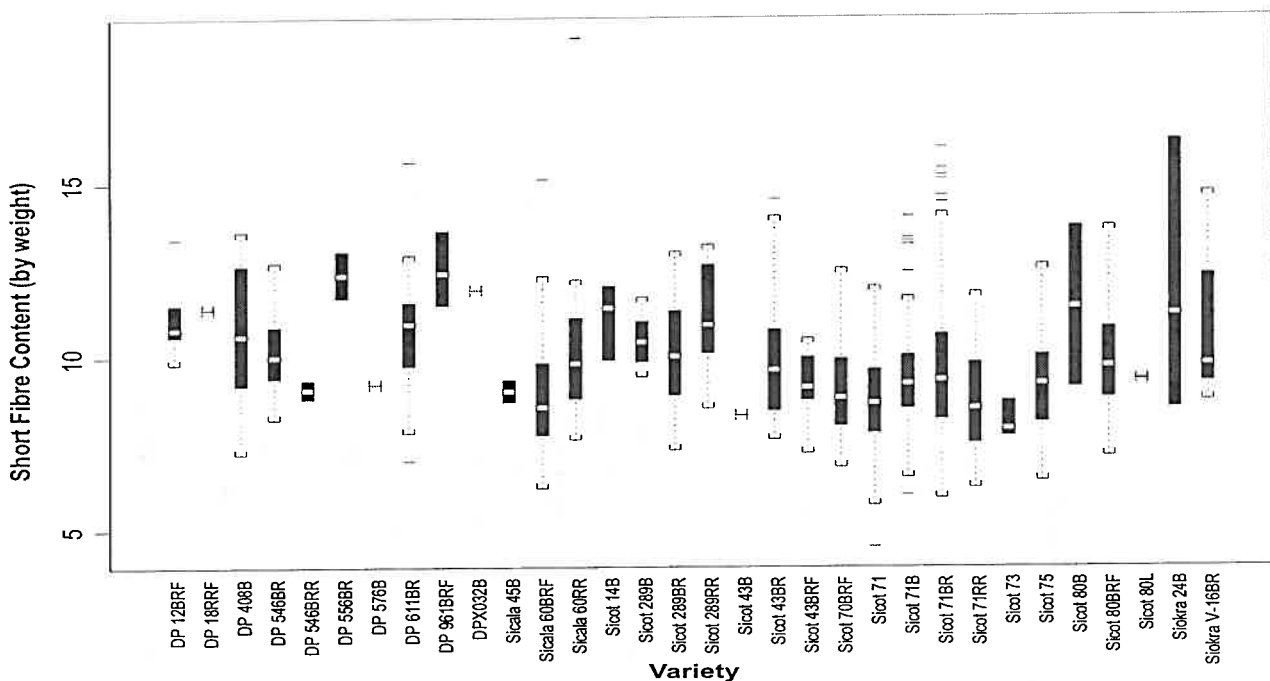


Figure 36. Distribution of short fibre content per variety

Figure 37 gives a breakdown of the short fibre content per valley. All the valley's averaged around 10% short fibre content. With the exception of St George and the Lachlan Valley, all the valley's showed large variability .

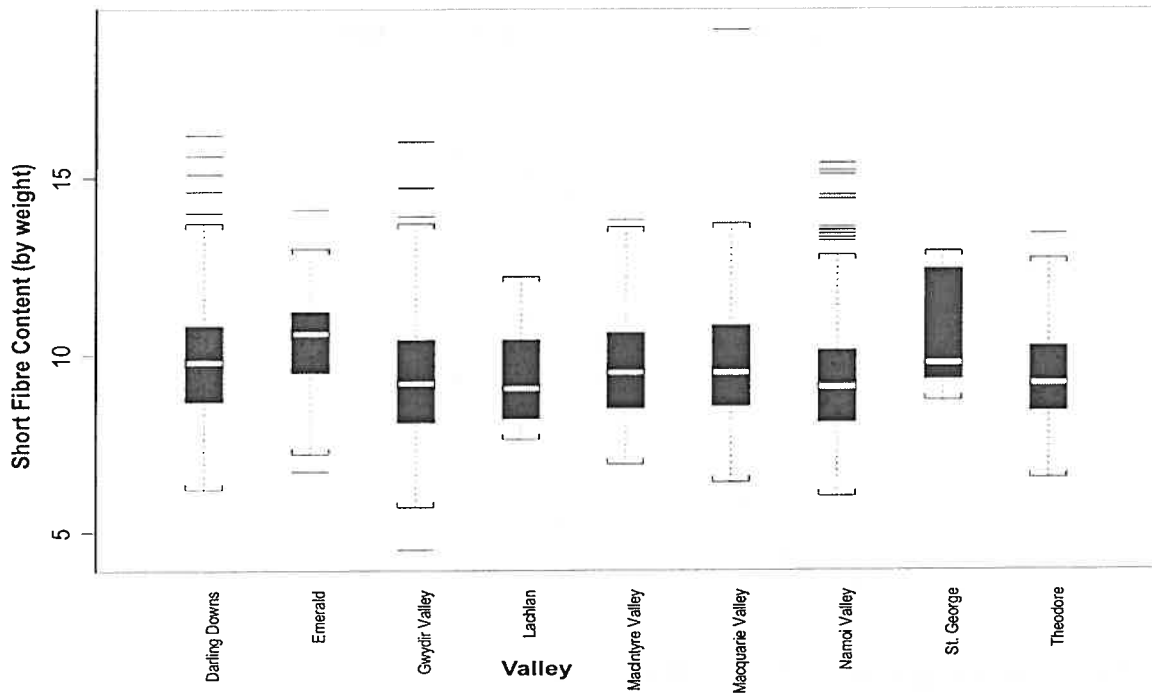


Figure 37. Distribution of short fibre per valley

Figure 38 gives a breakdown of short fibre content per gin. The gins that averaged > 10% short fibre content were gin number 2, 15, 28 and 32 with gin number 13, 10, 19 and 33 averaging 10%. The gins that averaged the least short fibre content were gin numbers 5, 16, 20 and 30 with gin 9 averging the highest short fibre content. The lowest short fibre content was recorded by gin 22 and the highest short fibre content was recorded by gin number 4.

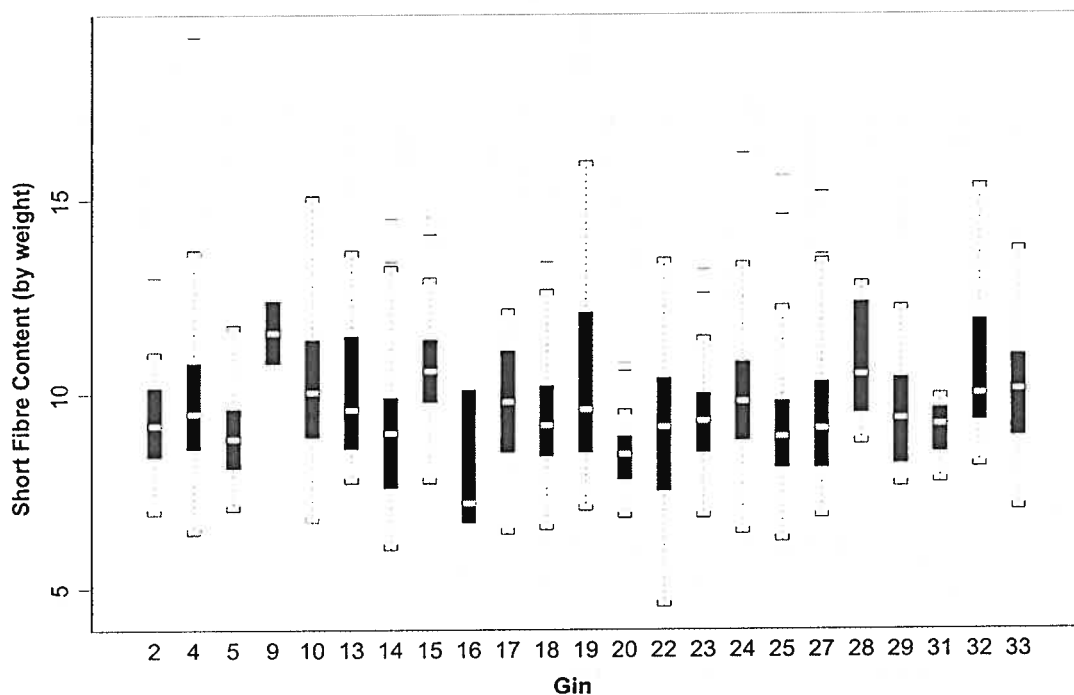


Figure 38. Distribution of short fibre content per gin

Fineness

The average fineness for the 2008 crop was 191 mtex. The median was 192 mtex and the range was from 124 to 244 mtex with a standard deviation of 17.5. Figure 39 gives a breakdown of the results.

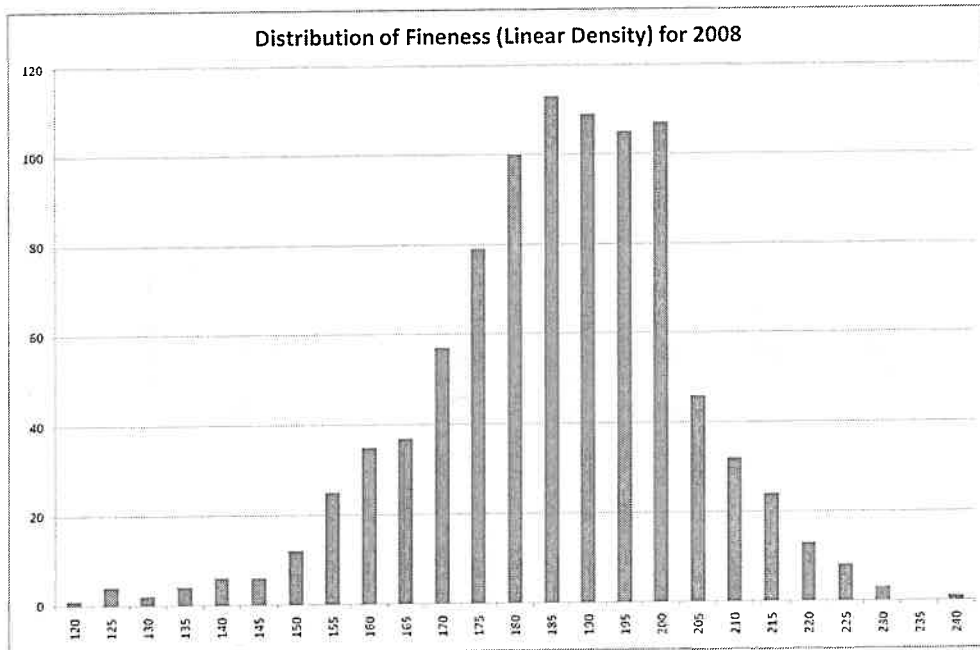


Figure 9. Distribution of fineness of 2008 cotton crop

Figure 40 gives a breakdown of fineness per variety. The varieties that averaged > 200 millitex are; DP 546RR, Sicala 45B, Sicot 14B and Sicot 80B. At 244 mtex and 124 mtex Sicot 71BR had both the coarsest fibre and finest fibre.

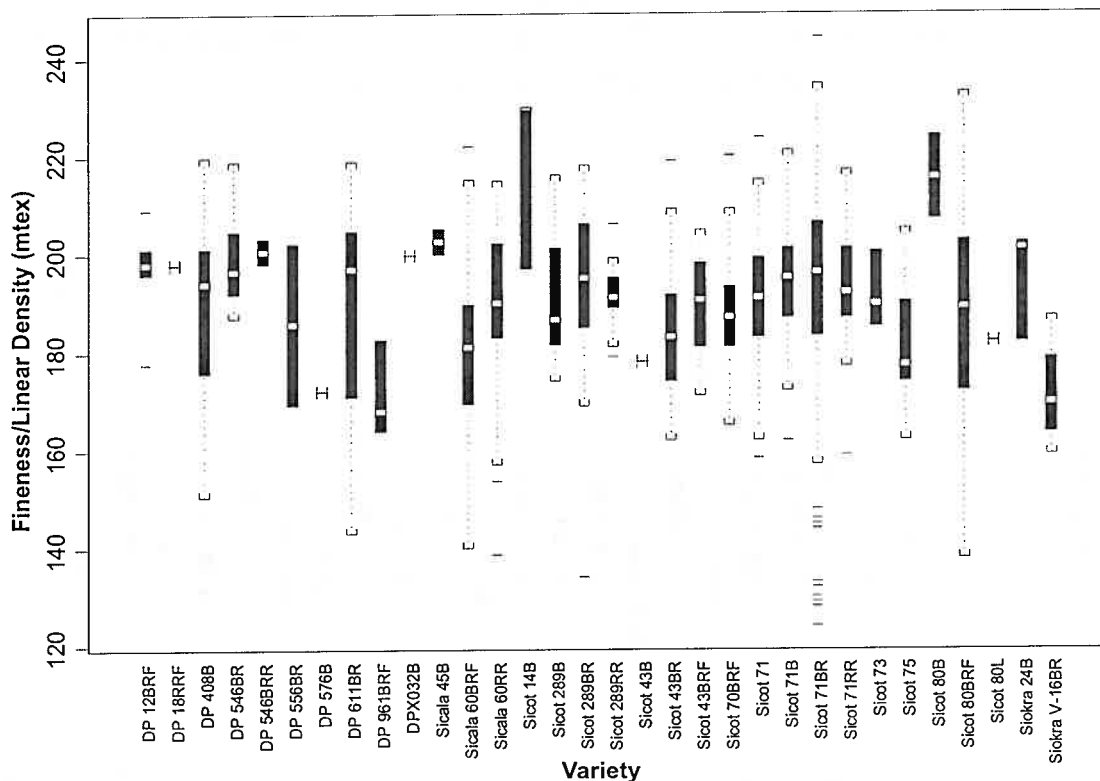


Figure 40. Distribution of fineness per variety

Figure 41 gives a breakdown of fineness per valley. All the valley's averaged between 180 and 200 mtex with all valley's showing large variability.

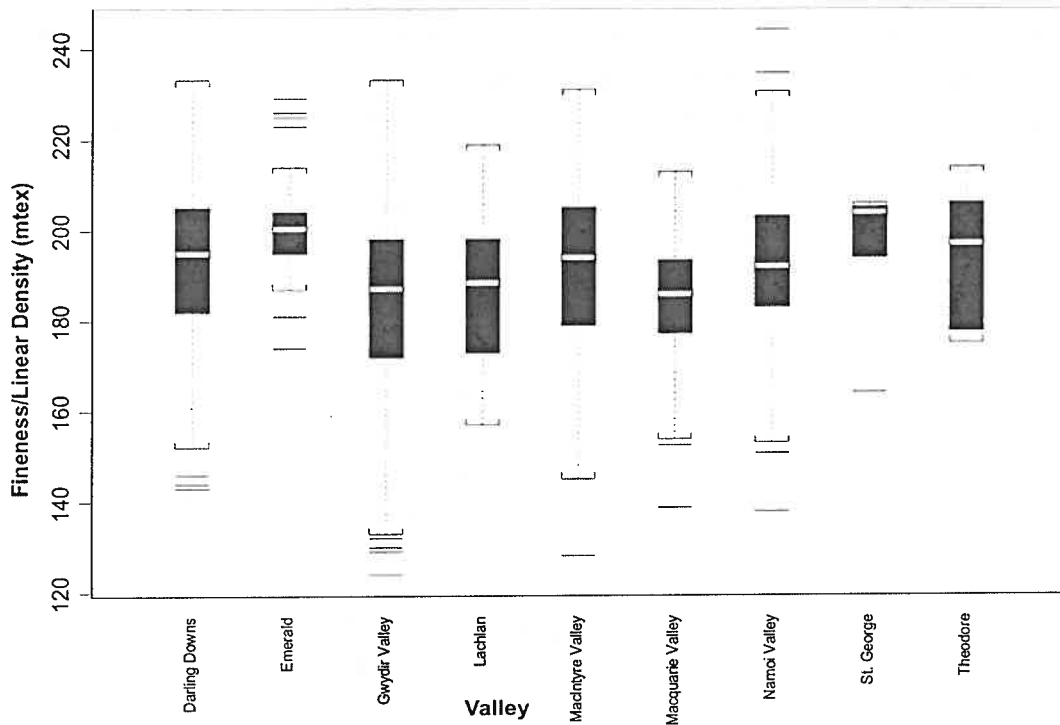


Figure 41. Distribution of fineness per valley

Figure 42 gives a breakdown of fineness per gin. All the gins averaged < 180 > 200 mtex, with the exception of gin numbers 9, 13 and 19 that averaged >170 <180 mtex. The gin that averaged the finest cotton was gin 13 at 170 mtex with gin 15 and 16 averaging the coarsest fibre at 200 mtex. The finest fibre was recorded by gin 19, whilst the coarsest fibre was recorded by gin number 27.

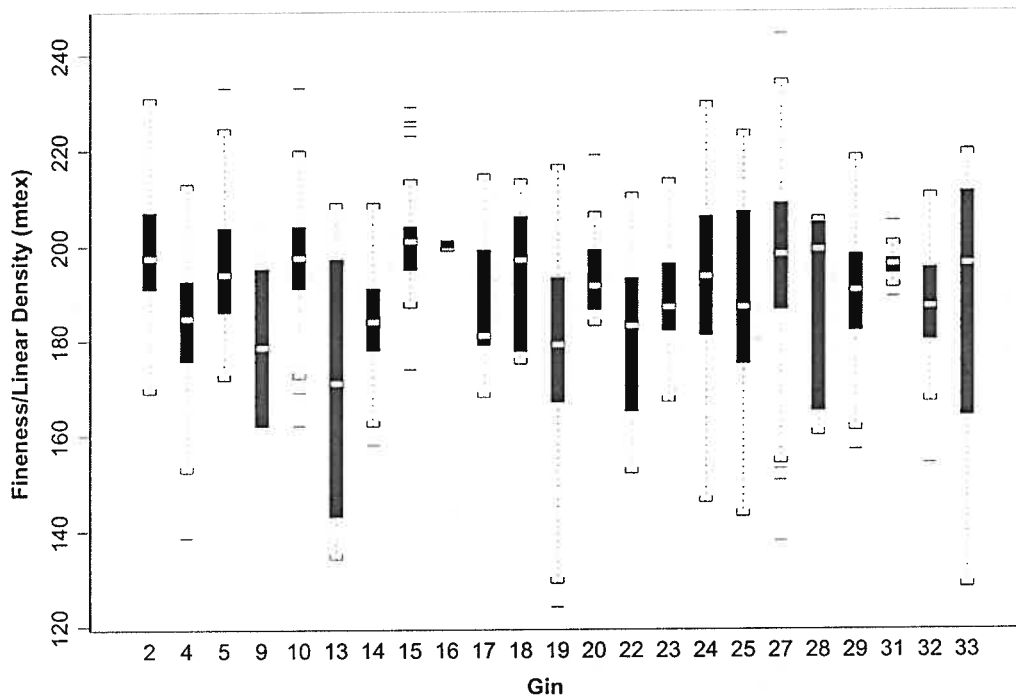


Figure 42. Distribution of fineness per gin

Maturity

The average calculated maturity of the 2008 crop was 0.78. The median was 0.79 and the range is from 0.40 to 1.04 with a standard deviation of 0.07. Figure 43 gives a breakdown of the results. Eighty five percent of the samples can be considered to be immature with a calculated maturity ratio < 0.85. This is not unexpected considering that the 2008 crop season was one of the mildest seasons in the last 50 years, resulting in a lower and more veritable Micronaire.

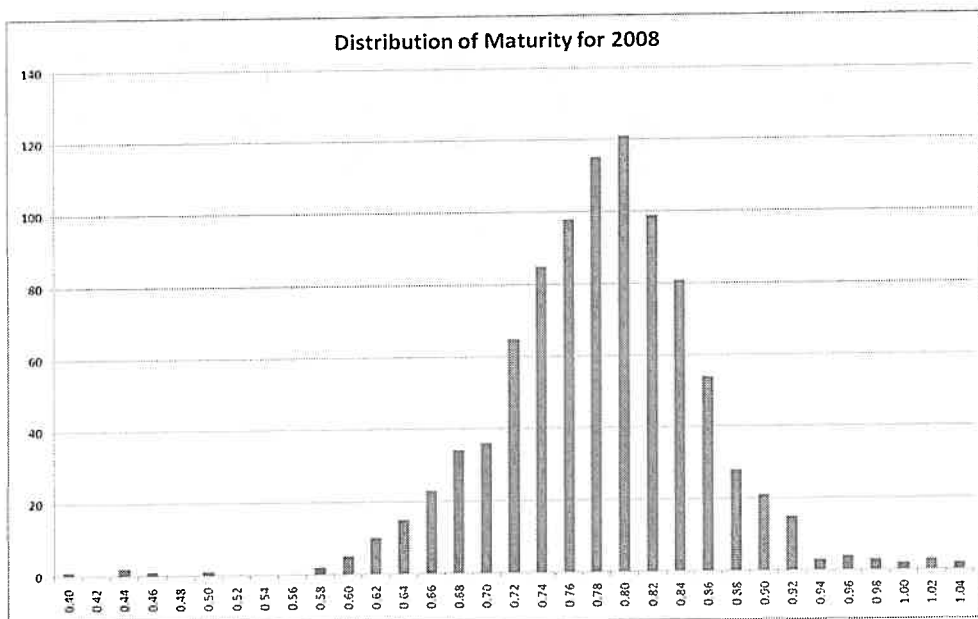


Figure 43. Distribution of maturity in 2008 cotton crop

Figure 44 gives a breakdown of maturity per variety. All the varieties averaged < 0.83. At 1.04 Sicot 71B and DP 408B provided the most mature sample and at 0.40 Sicot 71BR provided the most immature fibre sample.

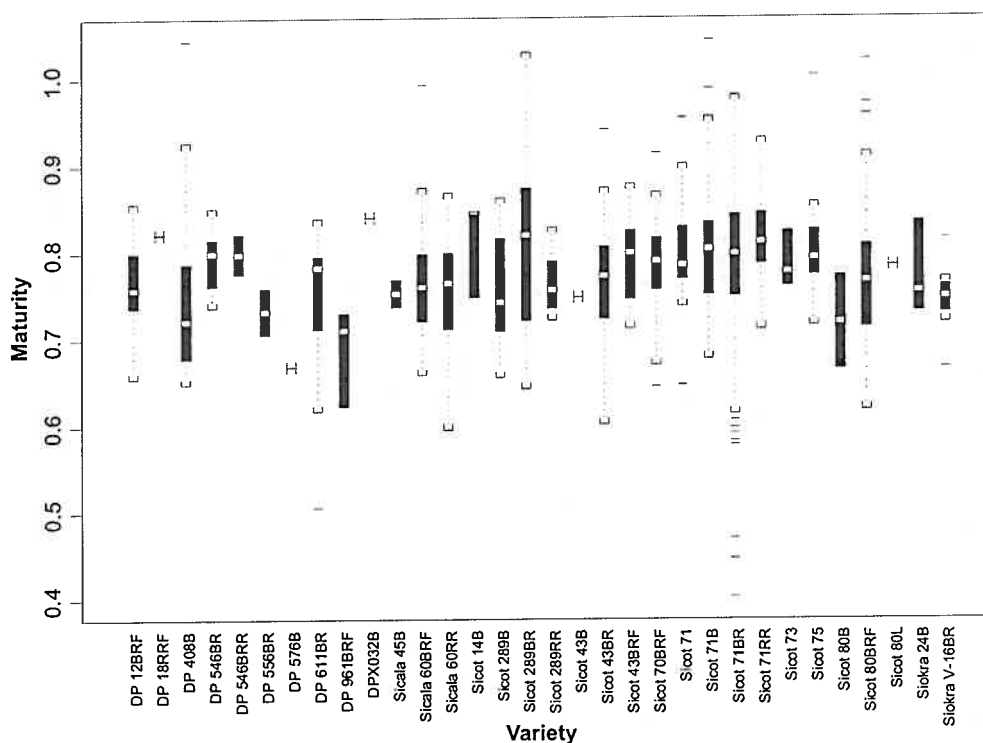


Figure 44. Distribution of maturity per variety

Figure 45 gives a breakdown of maturity per valley. All the valley's, with the exception of Theodore averaged < 0.83 with all valley's showing large variability.

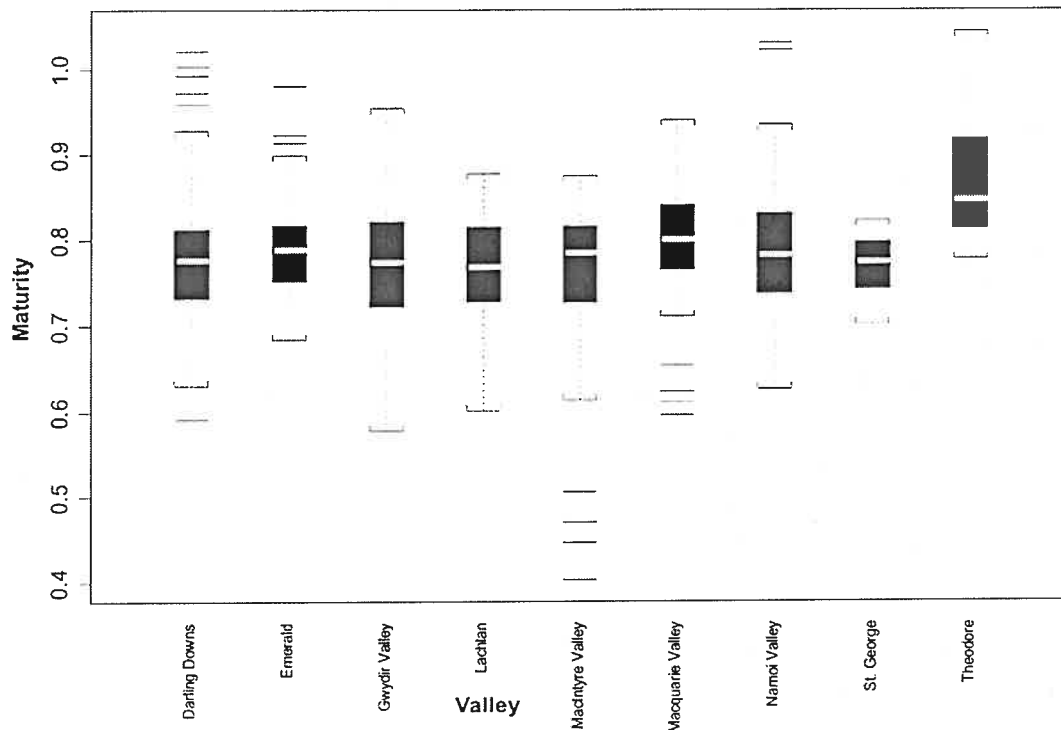


Figure 45. Distribution of maturity per valley

Figure 46 gives a breakdown of maturity per gin. All the gins, with the exception of gin number 16 and 18, averaged < 0.83.

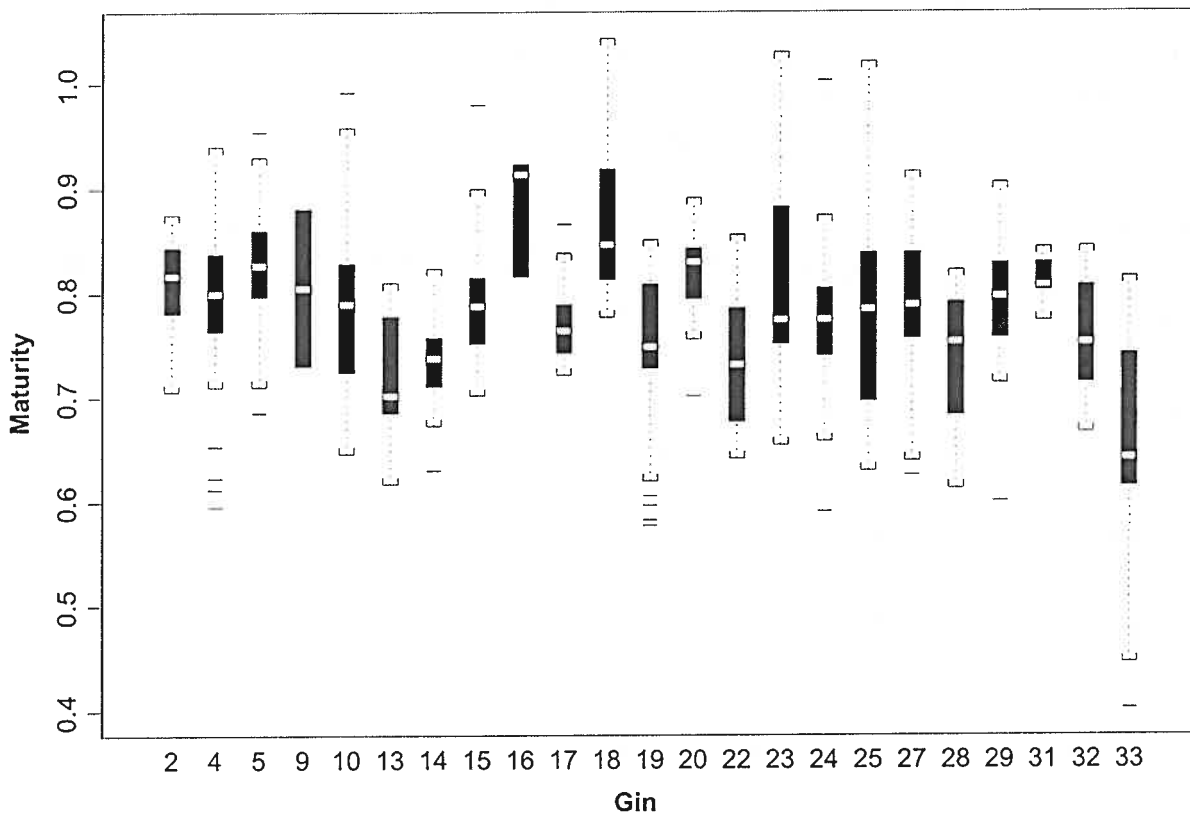


Figure 46. Distribution of maturity per gin

2009 Crop

The Australian cotton crop in 2009 produced 1,494,300 bales from 161,390 hectares with an average yield of 9.26 bales per hectare.

Sixty one percent of the cotton was grown in New South Wales, mainly in the Namoi, Gwydir, Macintyre and Macquarie Valleys. The rest of the crop was grown in Queensland mainly on the Darling Downs, Dirranbandi, Emerald, St. George and Biloela/ Theodore. The majority of cotton was irrigated, with only 5.2% dryland cotton.

The quality of the 2009 crop was summarised by ACSA as follows:

Ninety eight percent of the crop had a staple length of 1 1/8 inch or longer, with 84 percent of the crop achieving 1 5/32 inch or longer. The majority of the crop had a Micronaire value of 3.8 to 4.9 Micronaire, with 81% of the crop falling into the premium Micronaire range of 3.8 to 4.5. Twenty five percent of the crop had a strength of 29 gpt, with 53% of the crop achieving a strength of 30 gpt and above. Almost 86% of the crop achieved base grade or better.

As mentioned earlier 1218 samples from 34 varieties were analysed from the 2009 crop. Seventy five percent of the samples collected for the 2009 Nep Survey achieved the Australian base grade quality which is staple length above 1 1/8 inch, strength above 29 gpt and Micronaire in the range of 3.5-4.9.

Nearly 98% of the varieties were CSIRO bred varieties with the rest being Deltapine varieties. Seventy seven percent of the samples were from the Sicot 71 family (conventional and combinations of Bollgard II, Roundup Ready and Roundup Ready Flex), followed by 10% Sicot 80 family (conventional and combinations of Bollgard II, Roundup Ready, Roundup Ready Flex and Liberty Link) and 3% each of the Sicot 75, Sicot 60 and Sicot 43 families (also with a number of traits). There were also a small number of samples from a number of other varieties.

Table 22. Breakdown of samples per variety

Variety	Samples	Variety	Samples	Variety	Samples
Sicot 70BRF	478	Siokra V-18BR	18	DP 412B	1
Sicot 71BR	200	Sicot 43BRF	14	DP 556BR	1
Sicot 71RR	98	Sicot 289BR	12	Sicot 45RRF	1
Sicot 71BRF	71	Sicot 43BR	11	Sicot 289RR	1
Sicot 80BRF	65	Sicot 81	7	Sicot 80L	1
Sicot 71B	48	Sicot 43RRF	6	Siokra 24B	1
Sicot 75	31	DP 546BR	5	Siokra V-16B	1
Sicot 80RRF	40	Sicala 60BR	5	Siokra V-16R	1
Sicala 60BRF	25	Siokra V-16BR	4	Siokra V-18	1
Sicot 71	23	Sicot 80RR	3	Siokra V-18B	1
DP 210 BRF	20	Sicot 289B	2		
Sicot 71RRF	20	Sicala 45B	2		

The cotton samples collected were grown in ten valleys. At 28%, the majority of cotton samples were grown in the Gwydir Valley, followed by the Namoi Valley with 22%, Macintyre Valley with 15%, Darling Downs with 14% and Emerald with 8%. The remainder of the cotton samples were grown in Macquarie Valley, St George, Lachlan Valley, Biloela/Theodore and Bourke. Table 23 gives a breakdown of the number of samples collected from the valleys and varieties.

Table 23. Varieties associated with locations

	Bourke	Darling Downs	Emerald	Gwydir Valley	Lachlan Valley	Macintyre Valley	Maequarie Valley	Namoi Valley	St George	Theodore
DP 240BRF			6		1	2		11		
DP 412B				1						
DP 546BR				1			2	2		
DP 556BR								1		
Sicala 45B		2				1				
Sicala 45RRF										
Sicala 60BR		1					4			
Sicala 60BRF	2	11	1	2	8		1			
Sicot 289B		2								
Sicot 289BR				3		7				2
Sicot 289RR		1								
Sicot 43BR		5			1		1	4		
Sicot 43BRF					12	2	2			
Sicot 43RRF				4						
Sicot 70BRF	2	79	80	132		47	32	75	24	7
Sicot 71			3	12				5	3	
Sicot 71B		8	1	17		7		14		1
Sicot 71BR		22	3	35		58	16	66		
Sicot 71BRF		8	2	26		3	7	22		3
Sicot 71RR		3		25		44	10	16		
Sicot 71RRF				13		4	1	2		
Sicot 75				24		2		4		1
Sicot 80BRF		25		25		3		11		1
Sicot 80L				1						
Sicot 80RR		1		2						
Sicot 80RRF		2	3	11		7		17		
Sicot 81		2		5						
Siokra 24B								1		
Siokra V-16B								1		

Siokra V-16BR				1		1		2		
Siokra V-16R								1		
Siokra V-18		1								
Siokra V-18B		1								
Siokra V-18BRF		3		2				13		

Table 24 gives a breakdown of the various gins and the number of samples collected.

Table 24. Gins and number of samples collected

Company	Gin location	Samples
Auscott	Narrabri	164
Dunavant	Dalby	114
Brighann	Moree	100
Dunavant	Emerald	95
North West	Moree	71
Auscott	Midkin	70
Koramba	Boomi	62
Namoi	Ashley	53
Auscott	Trangie	51
Dunavant	Moree	46
Namoi	Merah North	37
Namoi	Boggabri	32
QC	Dalby	30
Namoi	Mungindi	28
Namoi	McIntyre	40
QC	Cecil Plains	24
Namoi	Wathagar	24
QC	Dirranbandi	22
Namoi	Hillston	22
QC	St George	22
Auscott	Warren	22
QC	Wee Waa	19
QC	Beardmore	18
QC	Moura	15
Carroll	Carroll	11
Namoi	Moomin	11
Clyde AG	Bourke	5
Carrington	Goondiwindi	5
QC	Emerald	5

Neps

The average nep content for the 2009 crop was 308 neps/gram. The median was 295 neps/gram and the range was from 170 to 884 neps/gram with a standard deviation of 76. Figure 47 gives a breakdown of the results. As per Table 1 the average nep content falls between the 50 and 75 percentile lines of the Uster Statistics, which is above the preferred value of 250 – 270 neps/gram.

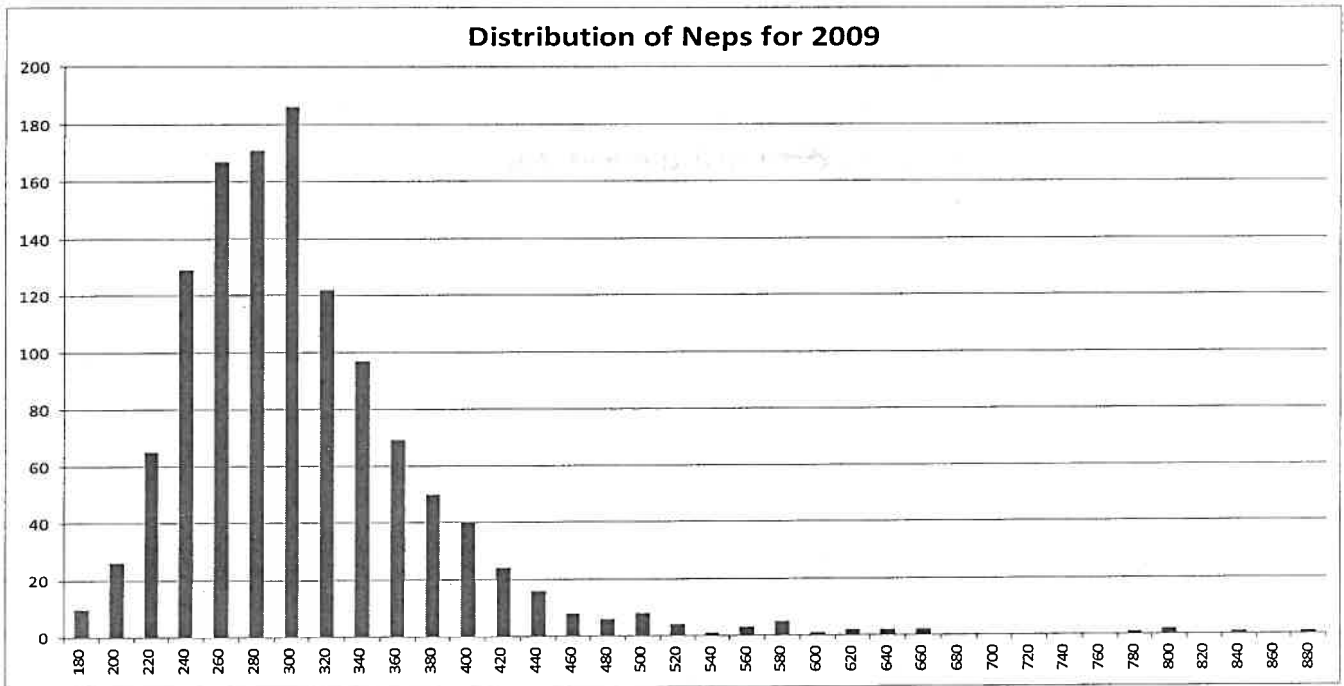


Figure 47. Distribution of neps in 2009 cotton crop

Less than one percent of the samples had a nep content of < 200 neps/gram, 46% of the samples had a nep content >200 and < 300, 43% of the samples had a nep content > 300 and < 400 and 10% of the samples having > 400 neps/gram.

Figure 48 gives a breakdown of neps per variety. As can be seen in Figure 2, twenty six of the varieties averaged < 300 neps/gram; twenty averaged > 300 and < 400 and 2 varieties, Sicala 60BR and Sicot 80RRF averaged > 400 neps/gram. The highest sample was 884 neps/gram, from Sicot 80RRF in the Gwydir Valley and the lowest sample was 170 neps/gram, from a Sicot 71BR sample from the Gwydir Valley.

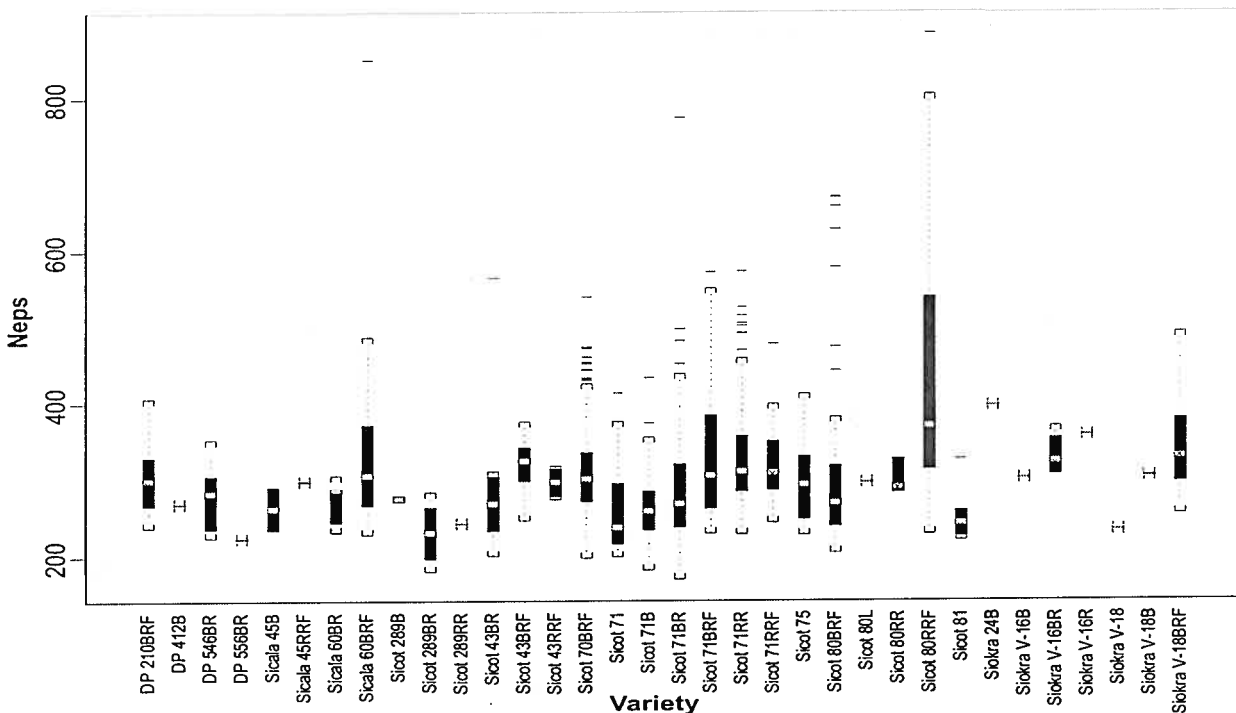


Figure 48. Distribution of nep content per variety

Figure 49 gives a breakdown of neps per location. Five locations averaged < 300 neps/gram, with the Lachlan, Namoi, Gwydir and Macquarie Valley's as well as Emerald averaging > 300 neps/gram. At 245 neps/gram St George had the least number of neps and the Lachlan and Namoi Valley's the most neps.

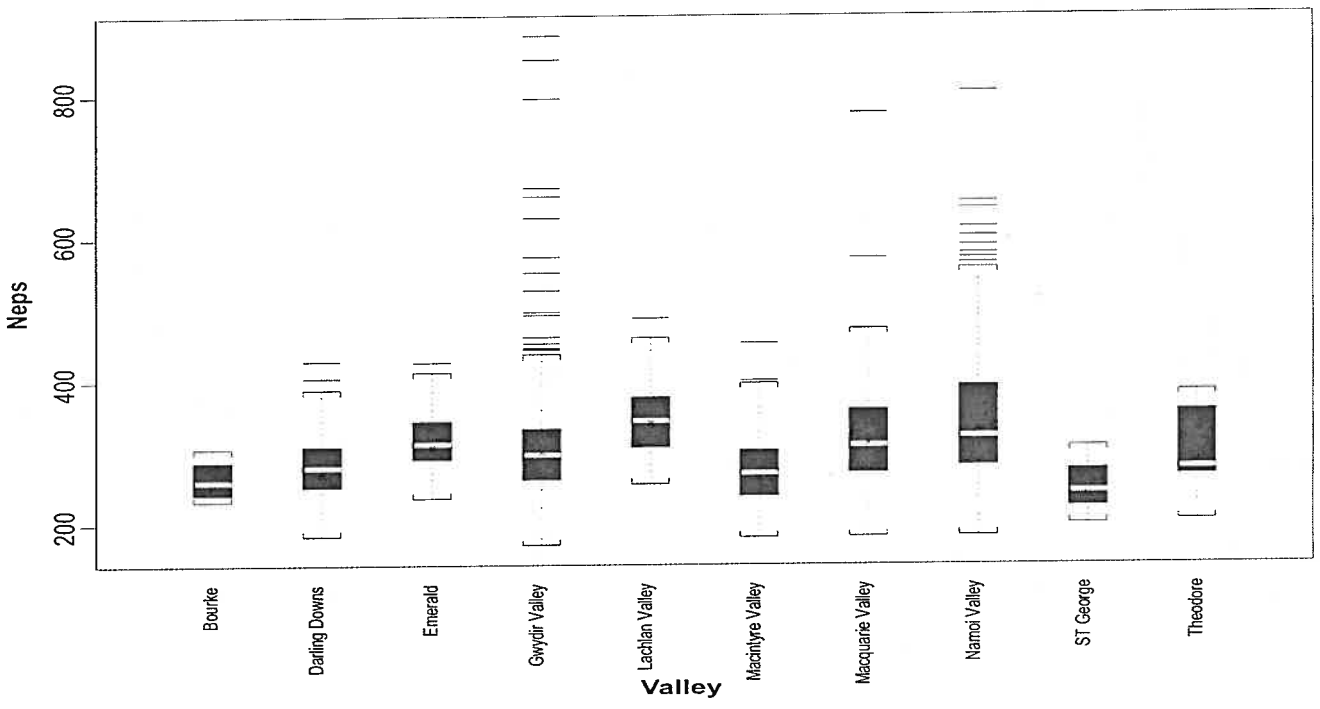


Figure 49. Distribution of neps per valley

Figure 50 gives a breakdown of nep content per gin. Seventeen gins averaged < 300 neps/gram, with gin numbers 1, 4, 5, 10, 12, 15, 16, 23, 29 and 32 averaging > 300 and < 400 and gin number 13 and 27 averaging > 400 neps/gram. The gin that averaged the least number of neps was gin number 31 at 240 neps/gram, with gin number 13 averaging the most neps at 462 neps/gram. The lowest and highest nep count was recorded by gin number 13.

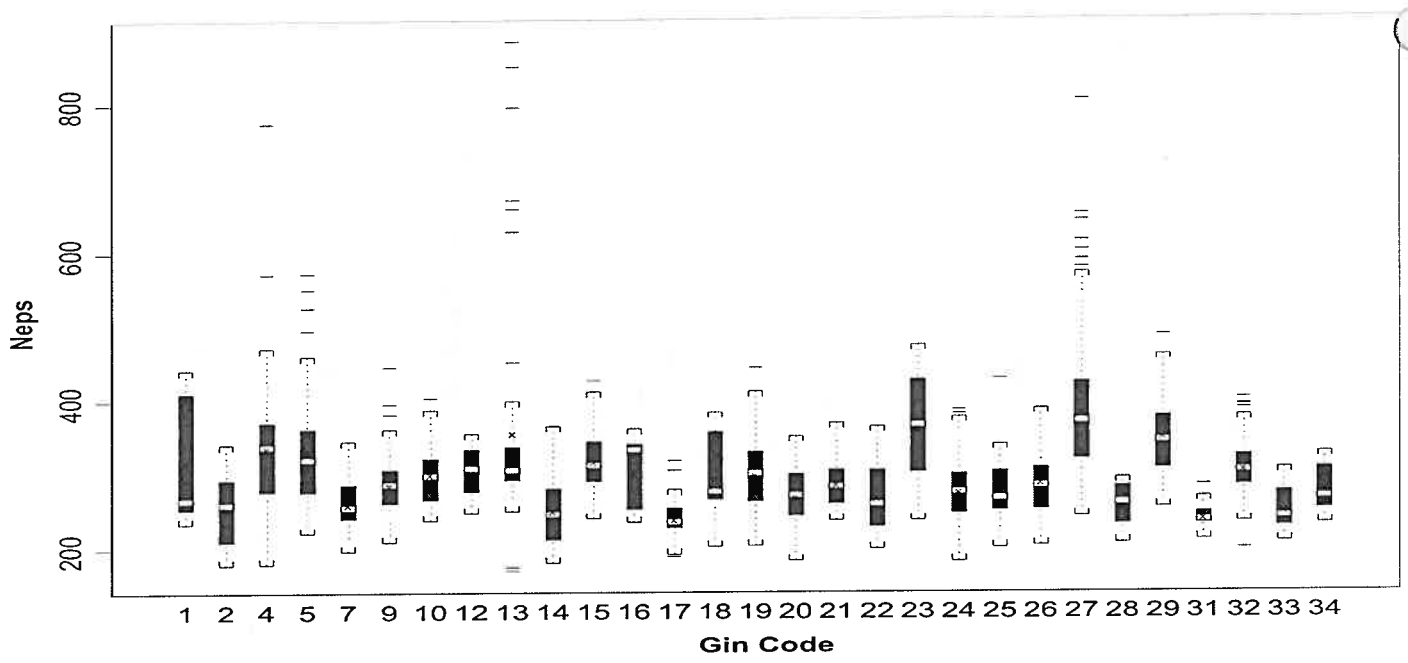


Figure 50. Distribution of neps per gin

Seed coat neps

The average seed coat nep content for the 2009 Upland crop was 22 neps/gram. The median was 21 seed coat neps/gram and the range was from 9 to 50 neps/gram, with a standard deviation of 5.4. Figure 51 gives a breakdown of the results. As per Table 1 the average seed coat nep content falls between the 25 and 50 percentile lines of the Uster Statistics.

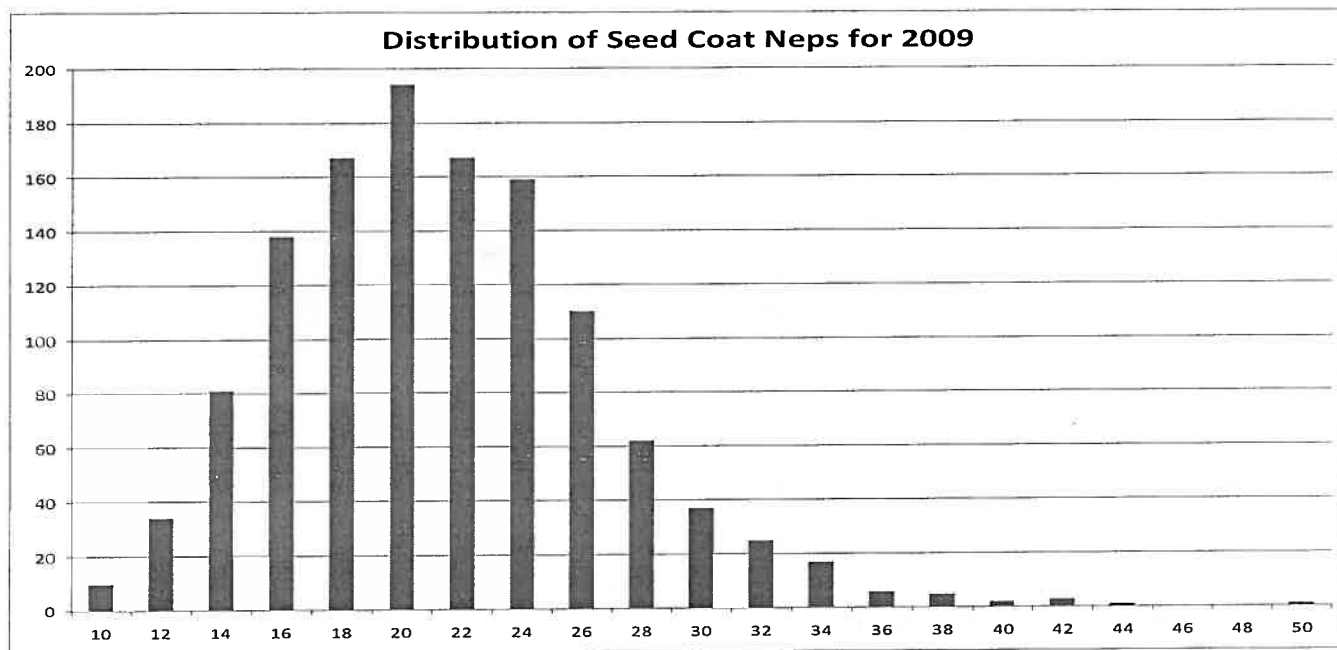


Figure 51. Distribution of seed coat neps in 2009 cotton crop

Figure 52 gives a breakdown of seed coat neps per variety. All the varieties averaged < 30 seed coat neps/gram. At 50 seed coat neps/gram a sample of Sicot 71B had the highest seed coat nep content and at 9 seed coat neps/gram a sample of Sicot 71BRF had the lowest seed coat nep content.

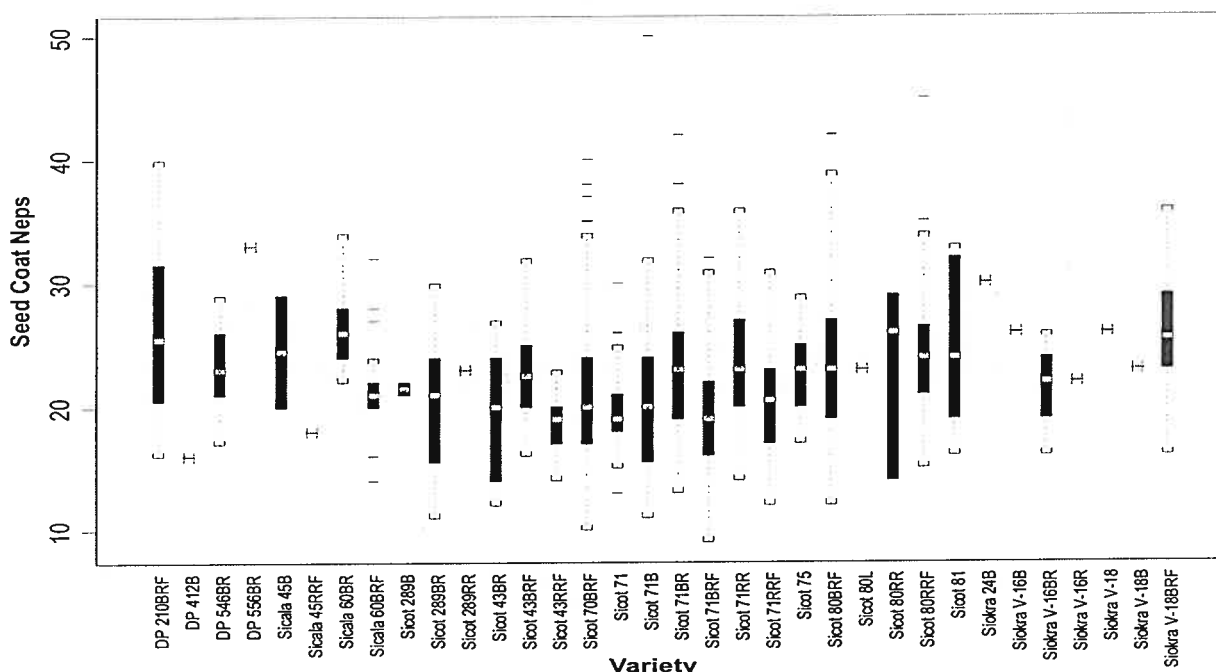


Figure 52. Distribution of seed coat neps per variety

Figure 53 gives a breakdown of seed coat neps per valley. All the locations averaged < 30 neps/gram. With the exception of Bourke (which only had 4 samples) all the valleys showed large variability.

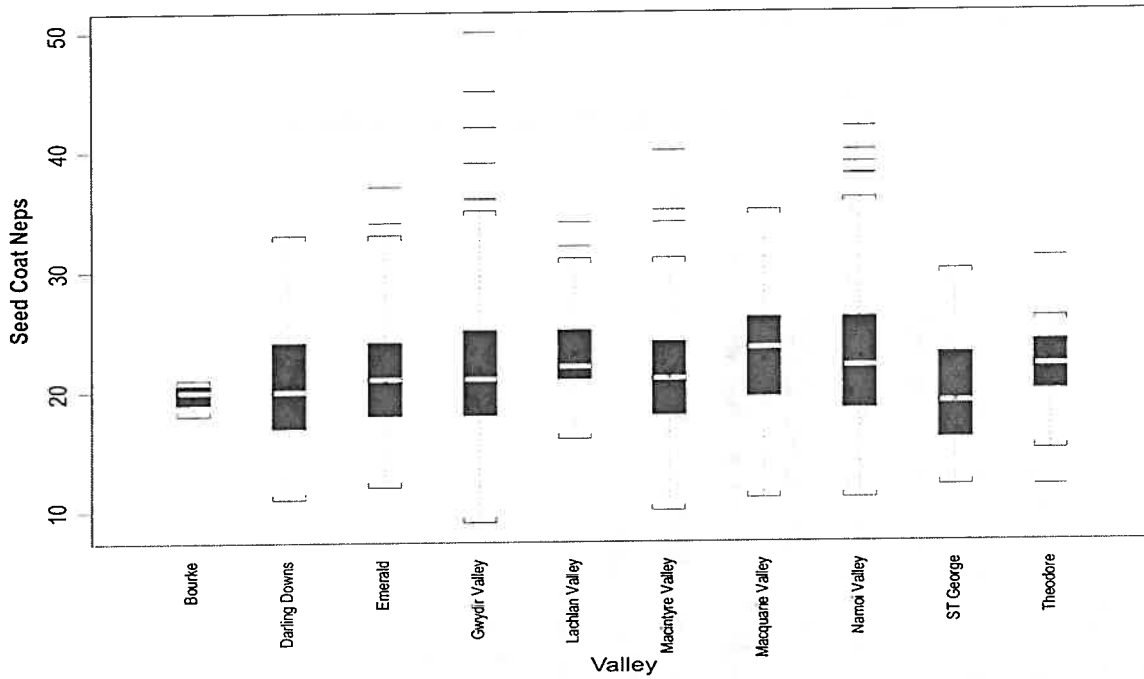


Figure 53. Distribution of seed coat neps per valley

Figure 54 gives a breakdown of seed coat neps per gin. The gins that averaged < 20 seed coat neps/gram were gin numbers 2, 10, 14, 19 and 31. The lowest seed coat nep count was recorded by gin number 19 and the highest seed coat nep count was recorded by gin number 28.

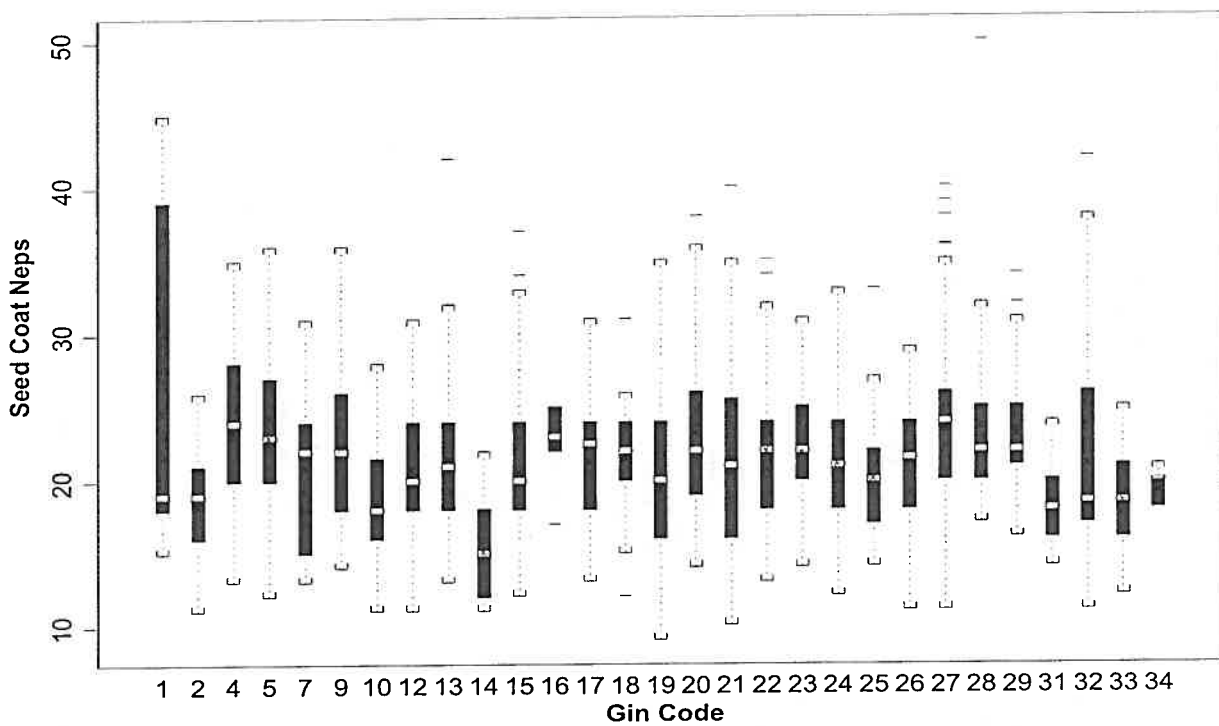


Figure 54. Distribution of seed coat neps per gin

Short Fibre content

The average short fibre content by weight for the 2009 crop was 8.6%. The median was 8.5% and the range was from 5.05% to 15.3% with a standard deviation of 1.4. Figure 55 gives a breakdown of the results. As per Table 1 the average short fibre content falls between the 50 and 75 percentile lines of the Uster Statistics.

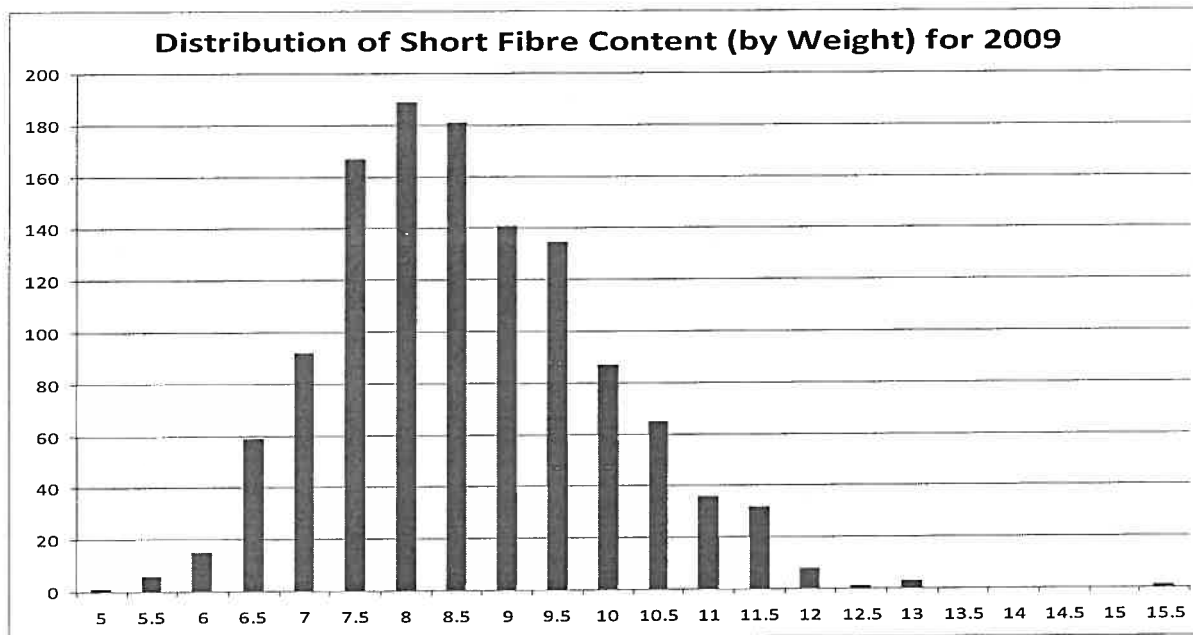


Figure 55. Distribution of short fibre content in 2009 cotton crop

Figure 56 gives a breakdown of short fibre content per variety. Most of the varieties averaged < 10% short fibre content with the exception of Sicot 289B, Sicot 81 and Siokra V-16R. At 15.3% a Sicot 71BR sample had the highest short fibre content and at 5.0% a Sicot 71BRF sample had the lowest short fibre content.

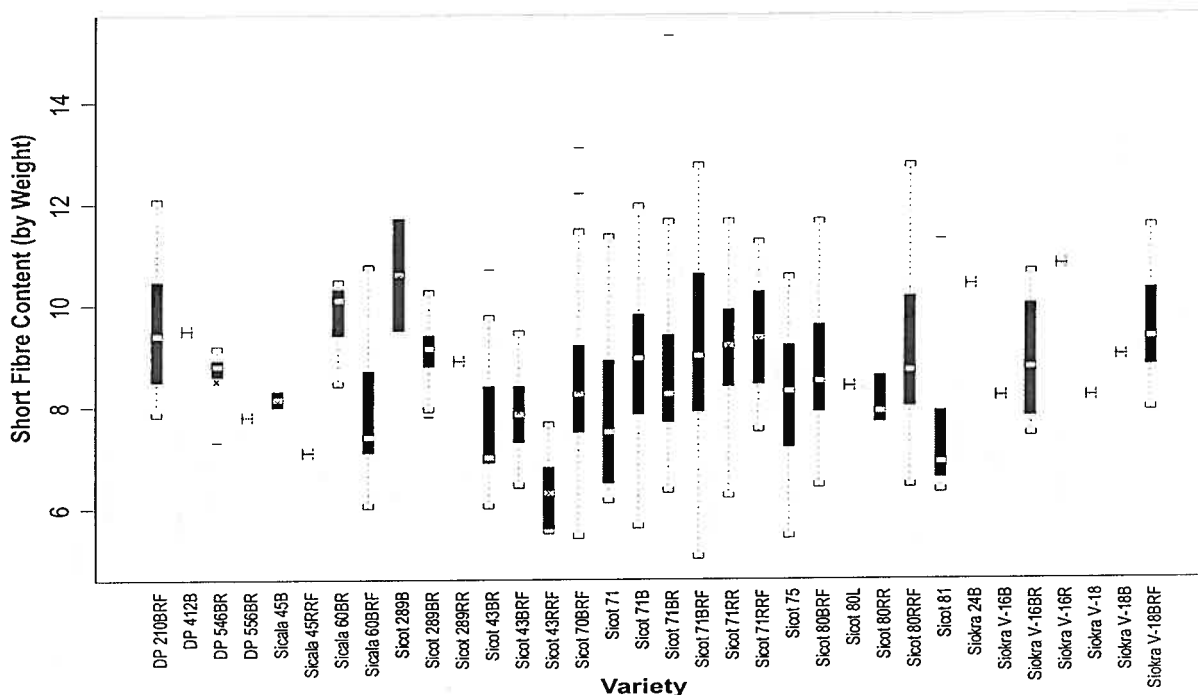


Figure 56. Distribution of short fibre content per variety

Figure 57 gives a breakdown of the short fibre content per valley. All the valley's averaged < 10% short fibre content. With the exception of Bourke and the Lachlan Valley, all the valleys show large variability.

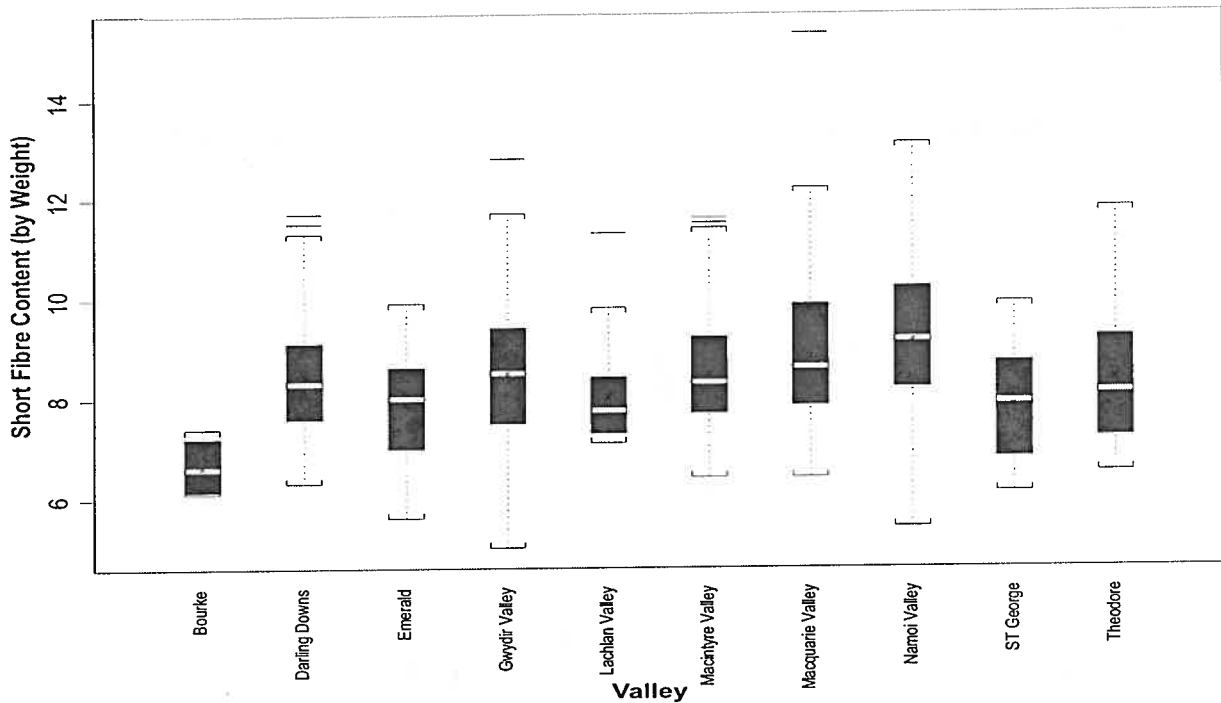


Figure 57. Distribution of short fibre per valley

Figure 58 gives a breakdown of short fibre content per gin. All the gins averaged < 10% short fibre content. The gins that averaged the least short fibre content were gin numbers 7, 14 and 34 with gin 23 and 27 averging the highest short fibre content. The lowest short fibre content was recorded by gin 5 and the highest short fibre content was recorded by gin number 4.

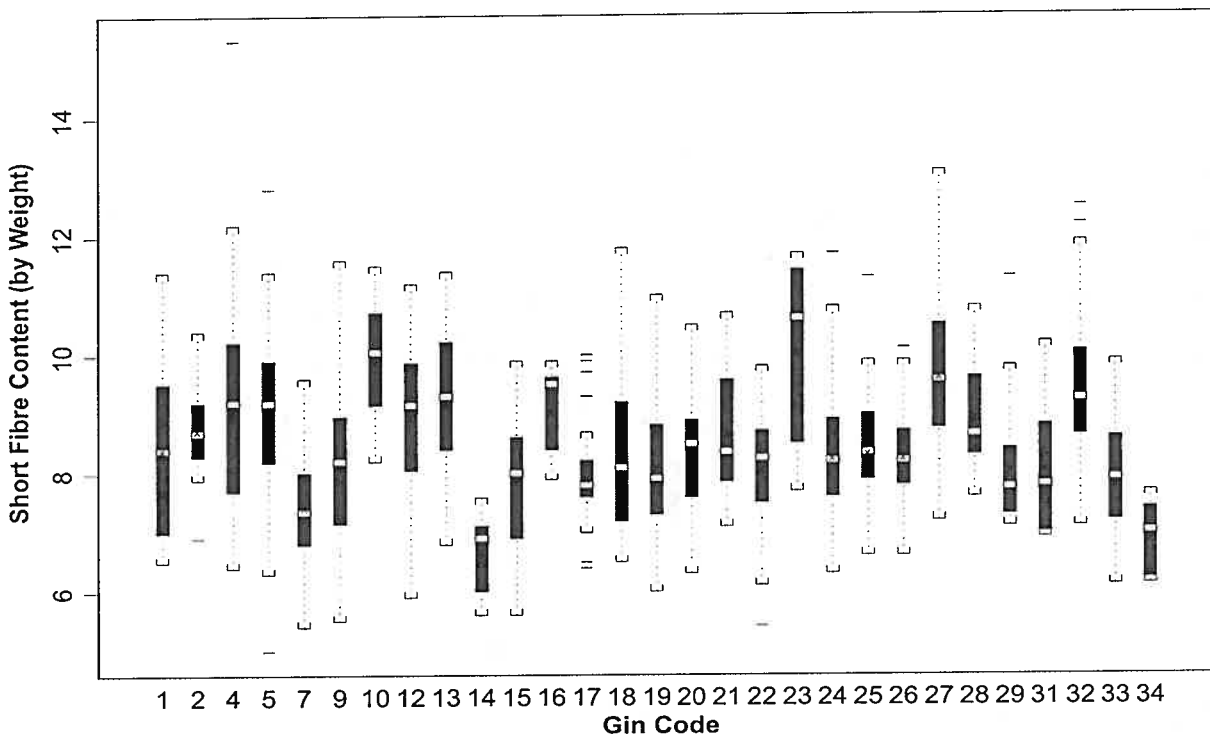


Figure 58. Distribution of short fibre content per gin

Fineness

The average fineness for the 2009 Upland crop was 198 mtex. The median was 198 mtex and the range is from 136 to 236 mtex with a standard deviation of 12.8. Figure 59 gives a breakdown of the results.

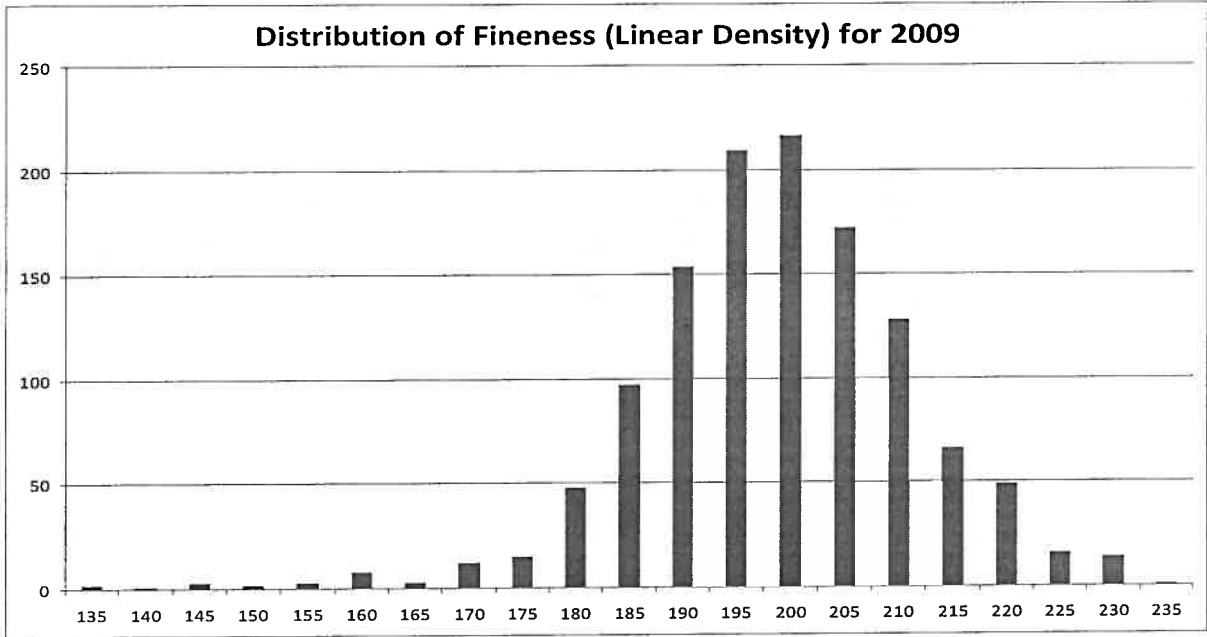


Figure 59. Distribution of fineness of 2009 cotton crop

Figure 60 gives a breakdown of fineness per variety. As can be seen in Figure 60, eighteen varieties that averaged < 200 millitex with the rest averaging ≥ 200 millitex. At 236 mtex a Sicot 71B sample had the coarsest fibre and at 136 mtex a Sicala 60BRF sample had the finest fibre.

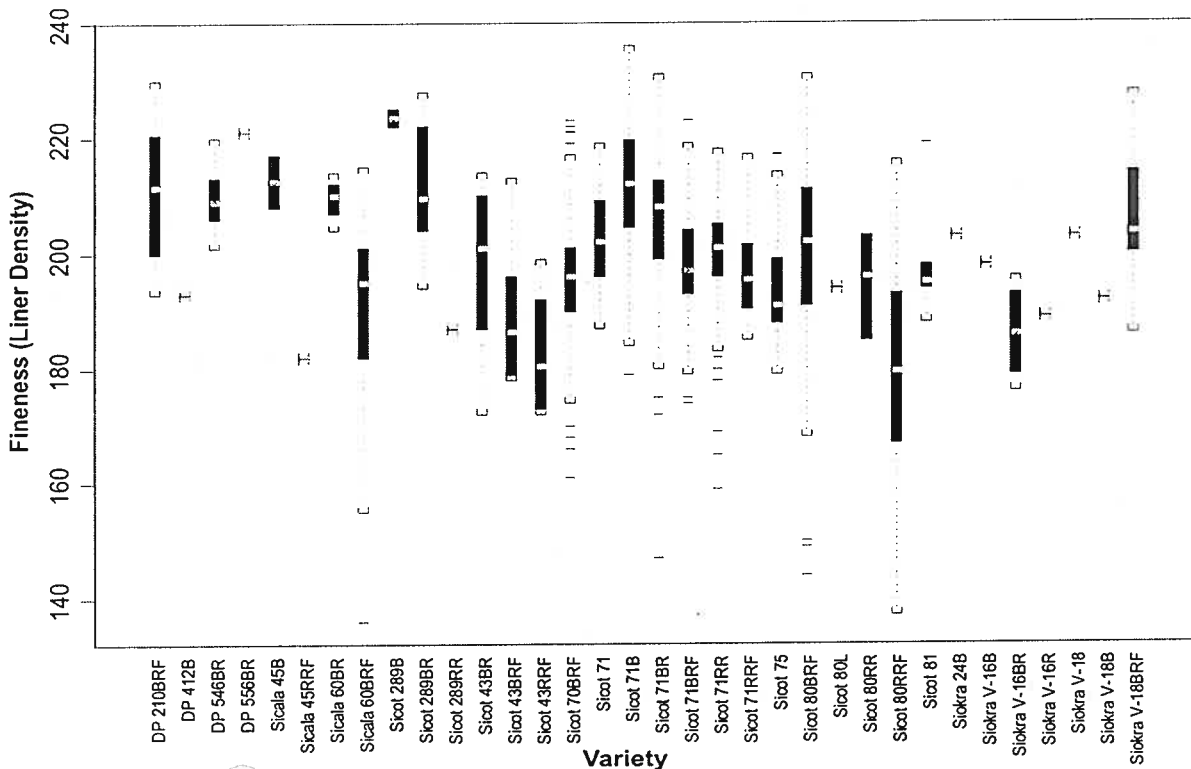


Figure 60. Distribution of fineness per variety

Figure 61 gives a breakdown of fineness per valley. All the valley's averaged between 180 and 200 mtex with the exception of Bourke, St George and Theodore all valleys show large variability.

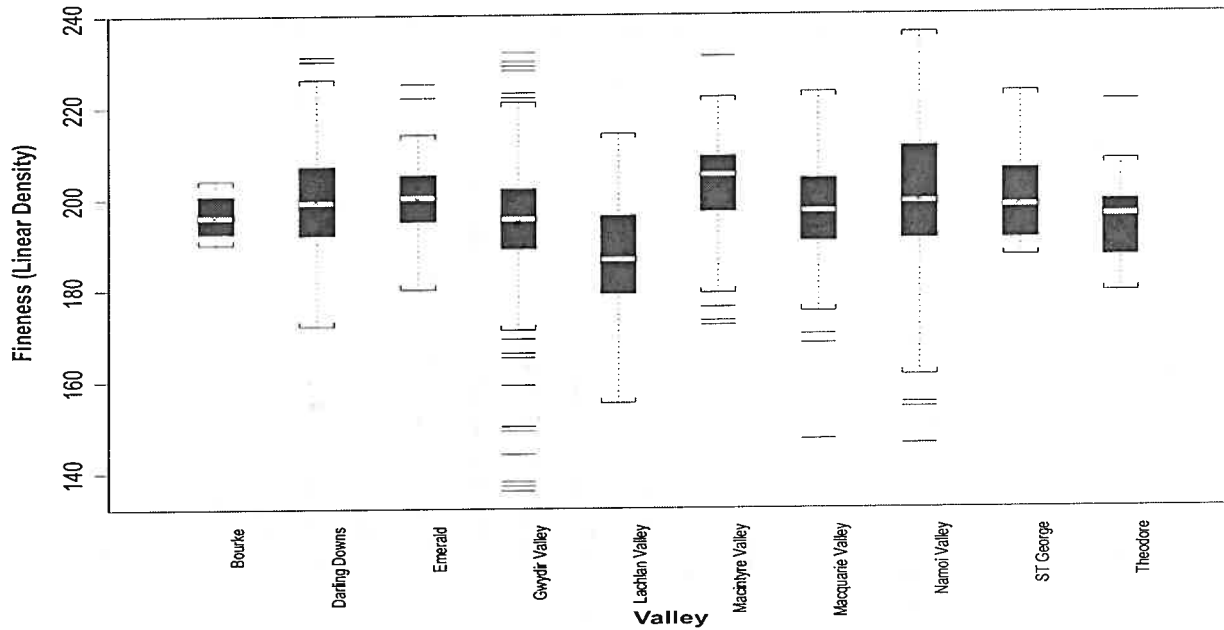


Figure 61. Distribution of fineness per valley

Figure 62 gives a breakdown of fineness per gin. All the gins averaged about 190 mtex, with the exception of gin number 13. The gin that averaged the finest cotton was gin 13 at 177 mtex with gin 28 averaging the coarsest fibre at 214 mtex. The finest fibre was recorded by gin 13, whilst the coarsest fibre was recorded by gin number 14.

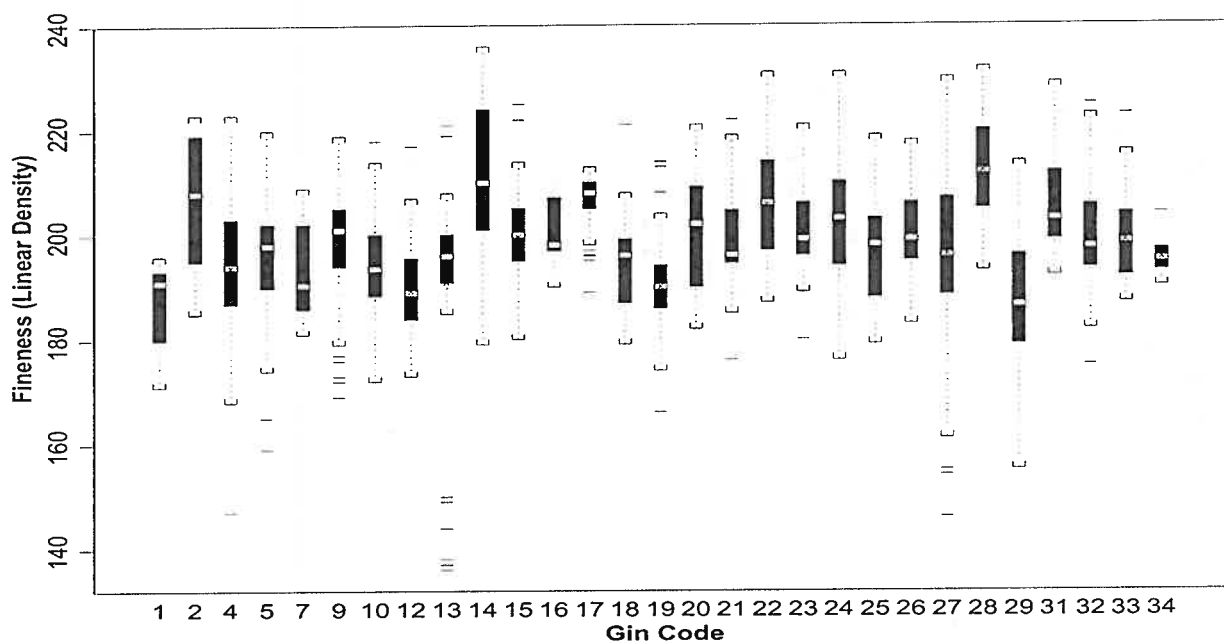


Figure 62. Distribution of fineness per gin

Maturity

The average calculated maturity of the 2009 crop was 0.82. The median was 0.82 and the range was from 0.60 to 1.06 with a standard deviation of 0.05. Figure 63 gives a breakdown of the results. Seventy five percent of the samples can be considered to be immature with a calculated maturity ratio < 0.85. By comparison the average maturity of the 2008 Upland crop was 0.78, ranging from 0.40 to 1.04 with a standard deviation of 0.07, with 85% of the samples considered to be immature.

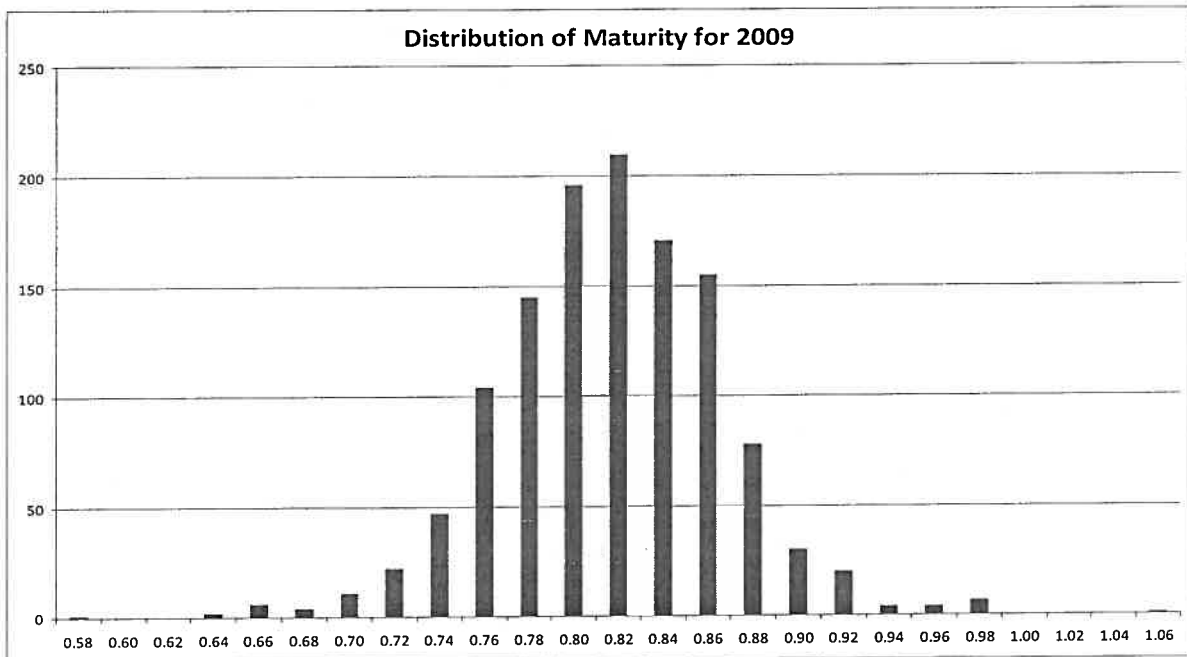


Figure 63. Distribution of maturity in 2009 cotton crop

Figure 64 gives a breakdown of maturity per variety. All the varieties averaged < 0.83. At 1.06 Sicot a 71B sample provided the most mature sample and at 0.59 a Sicot 71BR sample provided the most immature fibre sample.

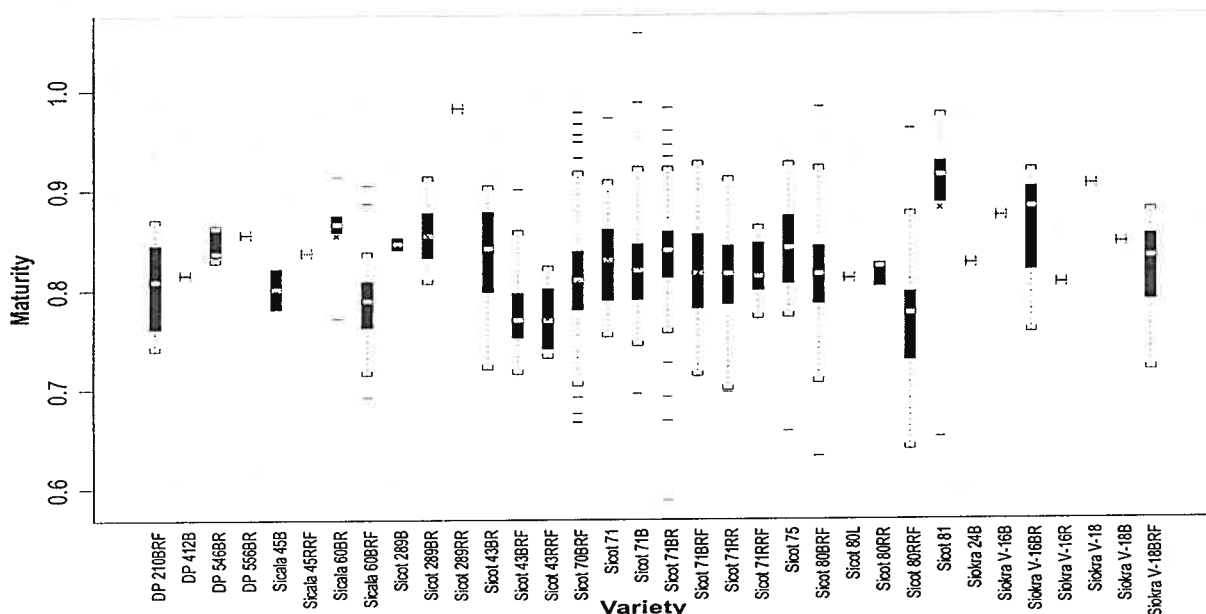


Figure 64. Distribution of maturity per variety

Figure 65 gives a breakdown of maturity per valley. The Lachlan Valley, Emerald, Gwydir, Namoi and Macintyre Valley's averaged < 0.83 with all valley's, with the exception of Bourke and Emerald, showing large variability.

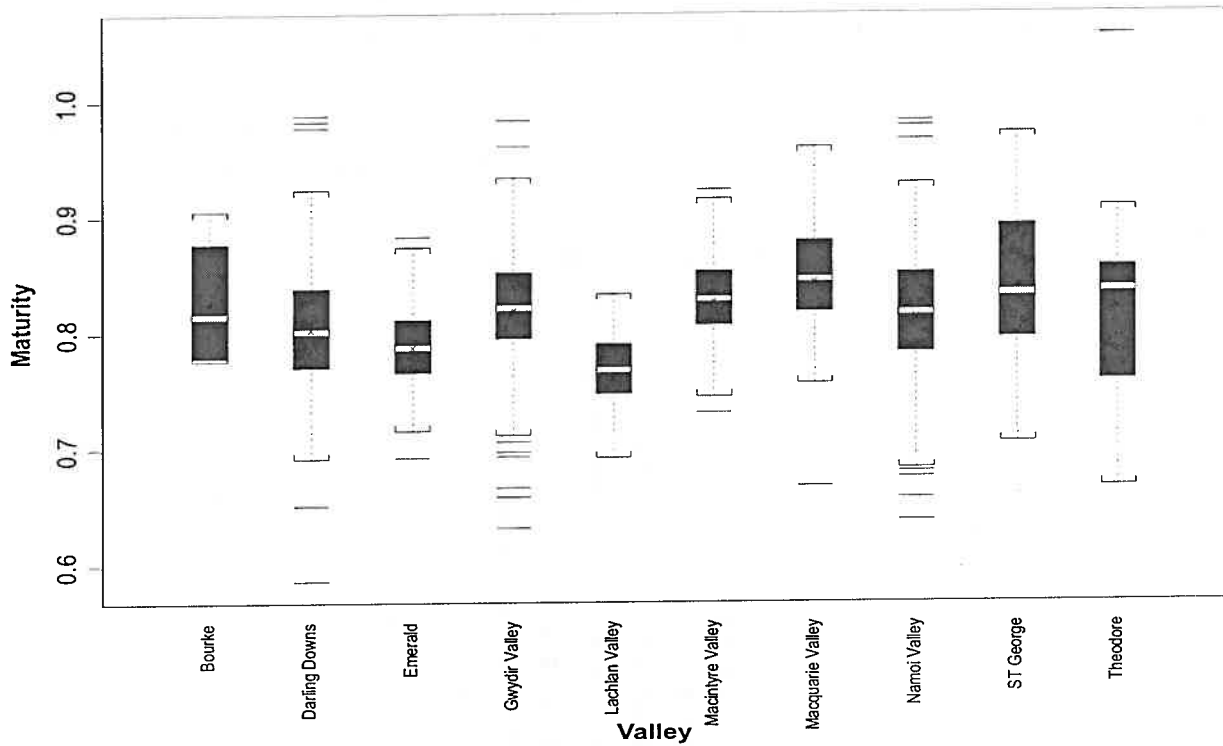


Figure 65. Distribution of maturity per valley

Figure 66 gives a breakdown of maturity per gin. Most of the gins, with the exception of gin numbers 2, 4, 18, 19, 20, 25, 26 and 34, averaged < 0.83.

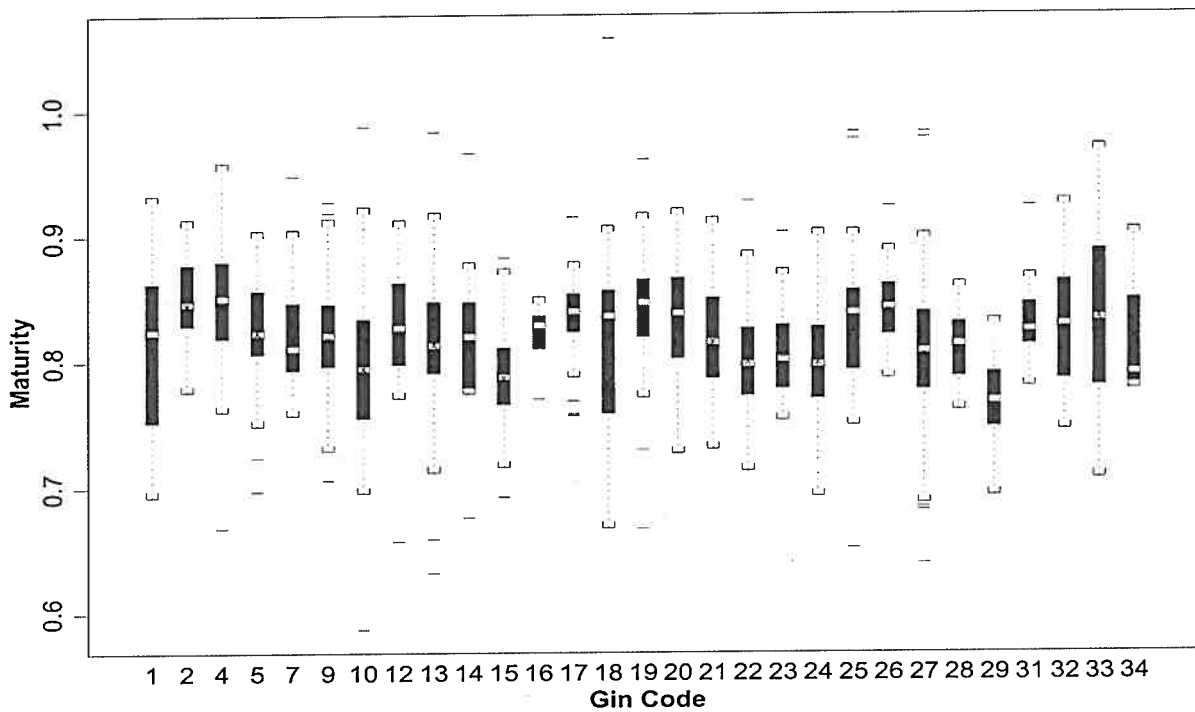


Figure 66. Distribution of maturity per gin

Combined

As mentioned earlier 2758 samples from 23 varieties from 9 valleys and ginned at 26 gins were analysed to determine the average values over the past three crop years. Table 25 gives a breakdown of the varieties and the number of samples from each variety that was used in this analysis.

Table 25. Breakdown of samples per variety

Variety	Samples	Variety	Samples
Sicot 71BR	861	DP 611BR	39
Sicot 70BRF	506	Sicot 80RRF	38
Sicot 80BRF	267	DP 546BR	36
Sicot 71B	199	Sicot 43BRF	28
Sicot 71RR	155	Sicala 60RR	27
Sicala 60BRF	86	Sicot 289RR	22
Sicot 289BR	85	DP 210BRF	20
Sicot 71	82	Sicot 71RRF	20
Sicot 71BRF	71	Sicot 289B	18
Sicot 43BR	62	Siokra V-18BRF	18
Sicot 75	52	Siokra V-16BR	16
DP 408B	50		

The cotton samples originated from 9 valleys. At 25%, the majority of cotton samples were grown in the Gwydir Valley and Namoi Valley, Darling Downs with 16%, Macintyre with 14% and Macquarie Valley with 10%. The remainder of the cotton samples were from Emerald, Lachlan Valley, St George and Theodore. Table 26 gives a breakdown of the number of samples collected from the valleys by variety.

Table 26. Varieties associated with locations

	Darling Downs	Emerald	Gwydir Valley	Lachlan Valley	Macintyre Valley	Macquarie Valley	Namoi Valley	St George	Theodore
DP 210BRF		6		1	2		11		
DP 408B	10	5	11		6		15		3
DP 546BR	6		7		3	5	15		
DP 611BR	8	4	3		4	5	12	3	
Sicala 60BRF	36	1	4	17	3	5	20		
Sicala 60RR	11					7	9		
Sicot 289B	8		3		1	1	4	1	
Sicot 289BR	14		11	1	21	8	23	5	2
Sicot 289RR	1		12		5	4			
Sicot 43BR	19			12	3	19	9		
Sicot 43BRF	2		1	18	1	4	2		
Sicot 70BRF	83	81	124		50	37	103	19	9
Sicot 71	4	3	37		12	4	19	3	
Sicot 71B	26	1	35	4	51	2	67	5	8
Sicot 71BR	76	33	190	7	134	144	265	2	10

Sicot 71BRF	8	2	26		3	7	22		3
Sicot 71RR	3		69		48	17	18		
Sicot 71RRF			13		4	1	2		
Sicot 75	3		30		7		7		5
Sicot 80BRF	127	3	85	1	8	9	31	2	1
Sicot 80RRF	2	3	9		7		17		
Siokra V-16BR		1	12		1		2		
Siokra V-18BRF	3		2				13		

Table 27 gives a breakdown of the various gins and the number of samples collected from each gin.

Table 27. Gins and number of samples collected

Company	Gin location	Samples
Auscott	Narrabri	406
Dunavant	Dalby	248
Auscott	Midkin	179
Auscott	Trangie	167
Dunavant	Emerald	160
North West	Moree	140
Koramba	Boomi	131
Namoi	Ashley	114
Dunavant	Moree	114
Brighann	Moree	111
QC	Cecil Plains	100
Namoi	McIntyre	90
QC	Dalby	87
Namoi	Boggabri	75
Namoi	Merah North	75
Auscott	Warren	74
Carroll	Carroll	69
Namoi	Hillston	64
QC	Wee Waa	58
QC	Beardmore	54
Namoi	Mungindi	54
QC	Moura	50
QC	St George	45
Namoi	Wathagar	45
Carrington	Goondiwindi	34
QC	Emerald	14

Seventy three percent of the samples used for this combined study achieved the Australian base grade quality which is staple length above 1 1/8 inch, strength above 29 gpt and Micronaire in the range of 3.5-4.9.

Neps

The average nep content for the samples was 313 neps/gram. The median was 296 neps/gram and the range was from 150 to 1407 neps/gram with a standard deviation of 98.7. Figure 67 gives a breakdown of the results.

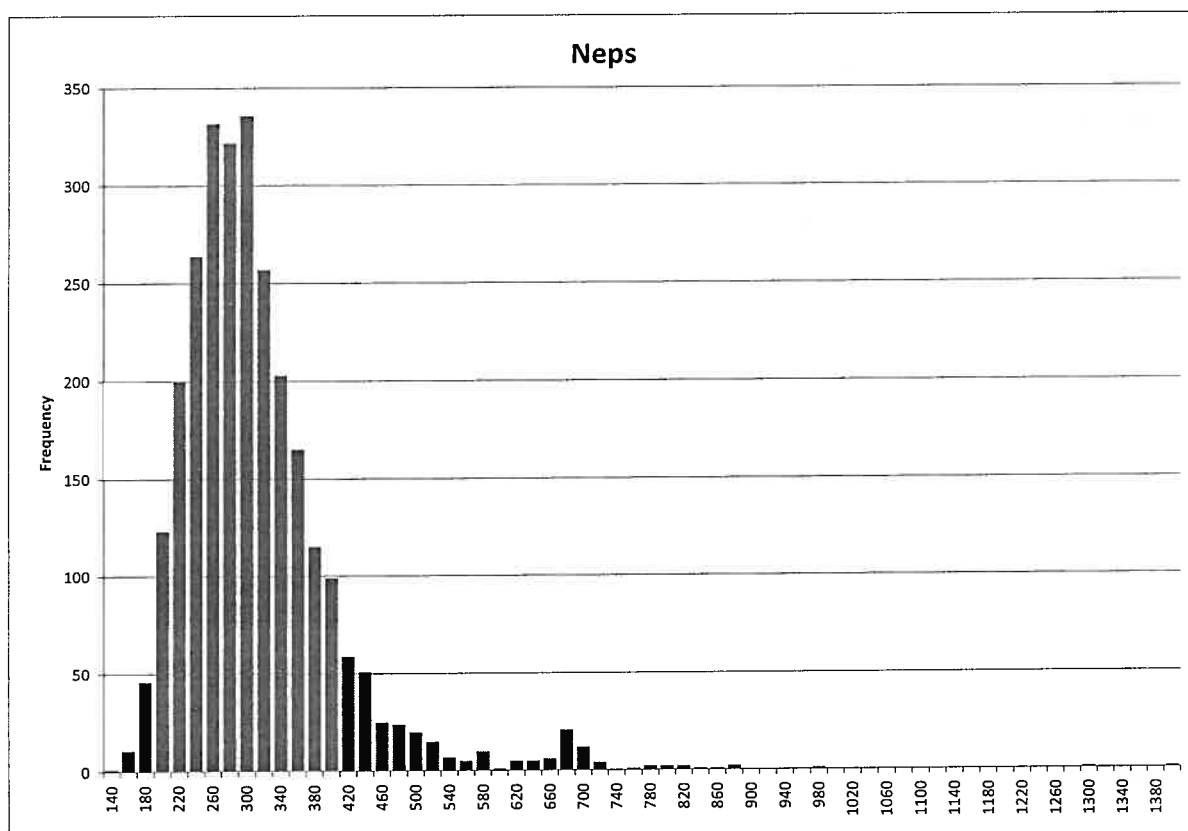


Figure 67. Distribution of neps

Further analysis reveals that just over 2% of the samples had a nep content of < 200 neps/gram, 57% of the samples had a nep content >200 and < 300, 30% of the samples had a nep content > 300 and < 400 and 10% of the samples had > 400 neps/gram. Three percent of the samples are above 500 neps/gram and are mainly from the 2008 crop, which had a low Micronaire, irrespective of variety and location, due to low maturity values. A large number of these samples were also ginned by gin 27 which averages above 300 neps/gram. Twenty one percent of the samples had a nep content of ≤ 250 neps/gram and in comparison with the Uster Statistics, 35% of the samples had a nep content of ≤ 270 neps/gram which can be considered to be average.

Figure 68 gives a breakdown of neps per variety. Of the 23 varieties, only six averaged < 300 neps/gram; sixteen averaged > 300 and < 400 and 1 variety, Sicala 60RR > 400 neps/gram. The highest sample was 1407 neps/gram, from Sicot 71BR in the Gwydir Valley and the lowest sample was 150 neps/gram, from Sicot 80BRF, from the Darling Downs.

Neps

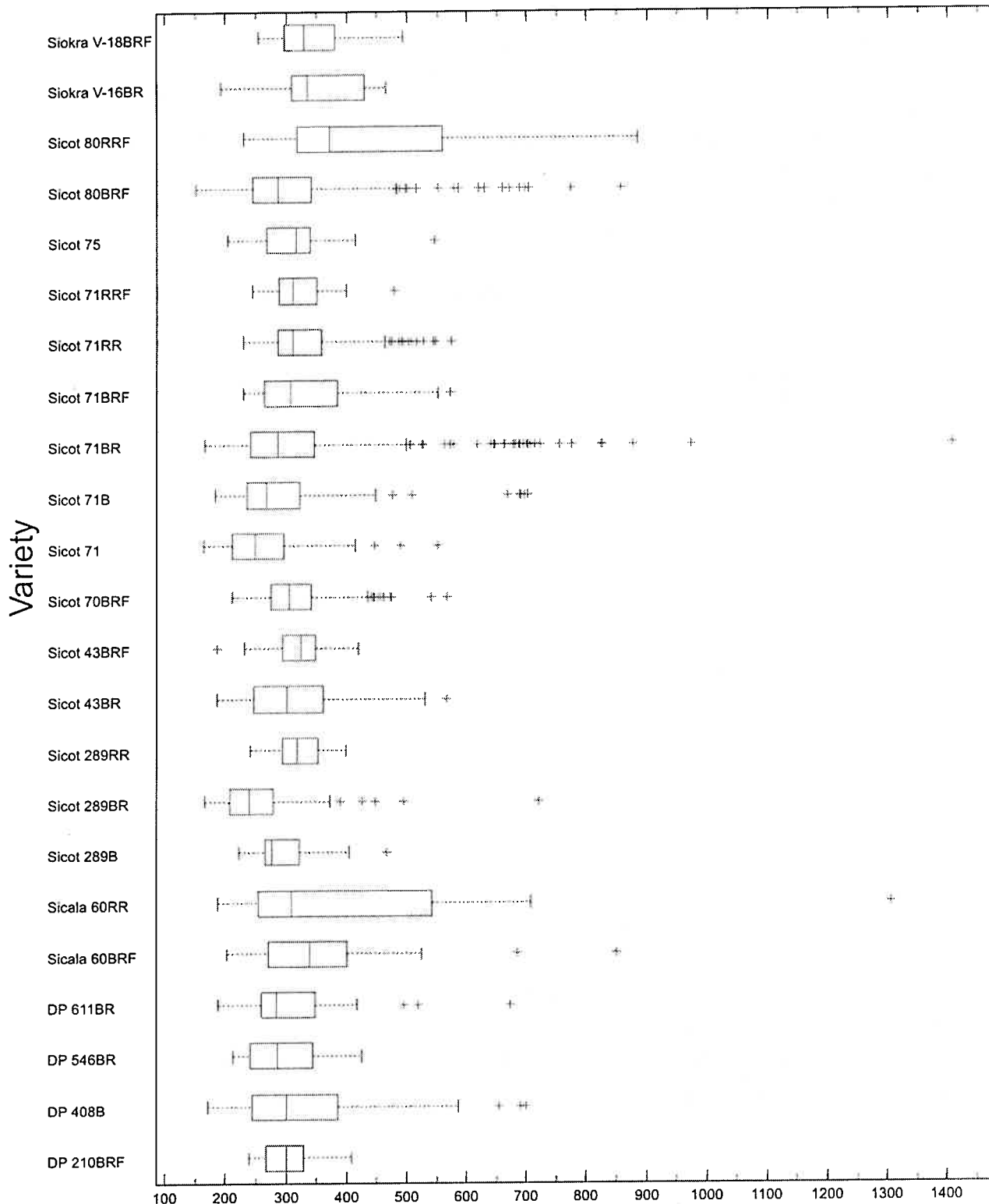


Figure 68. Distribution of nep content per variety

Figure 69 gives a breakdown of neps per location. Four locations averaged < 300 neps/gram, with Emerald, Gwydir, Macquarie and Namoi valley's as well as Theodore averaging > 300 neps/gram. At 269 neps/gram St George had the least number of neps and at 358, 332 and 331 neps/gram respectively, the Namoi and Macquarie valley as well as Emerald the most neps.

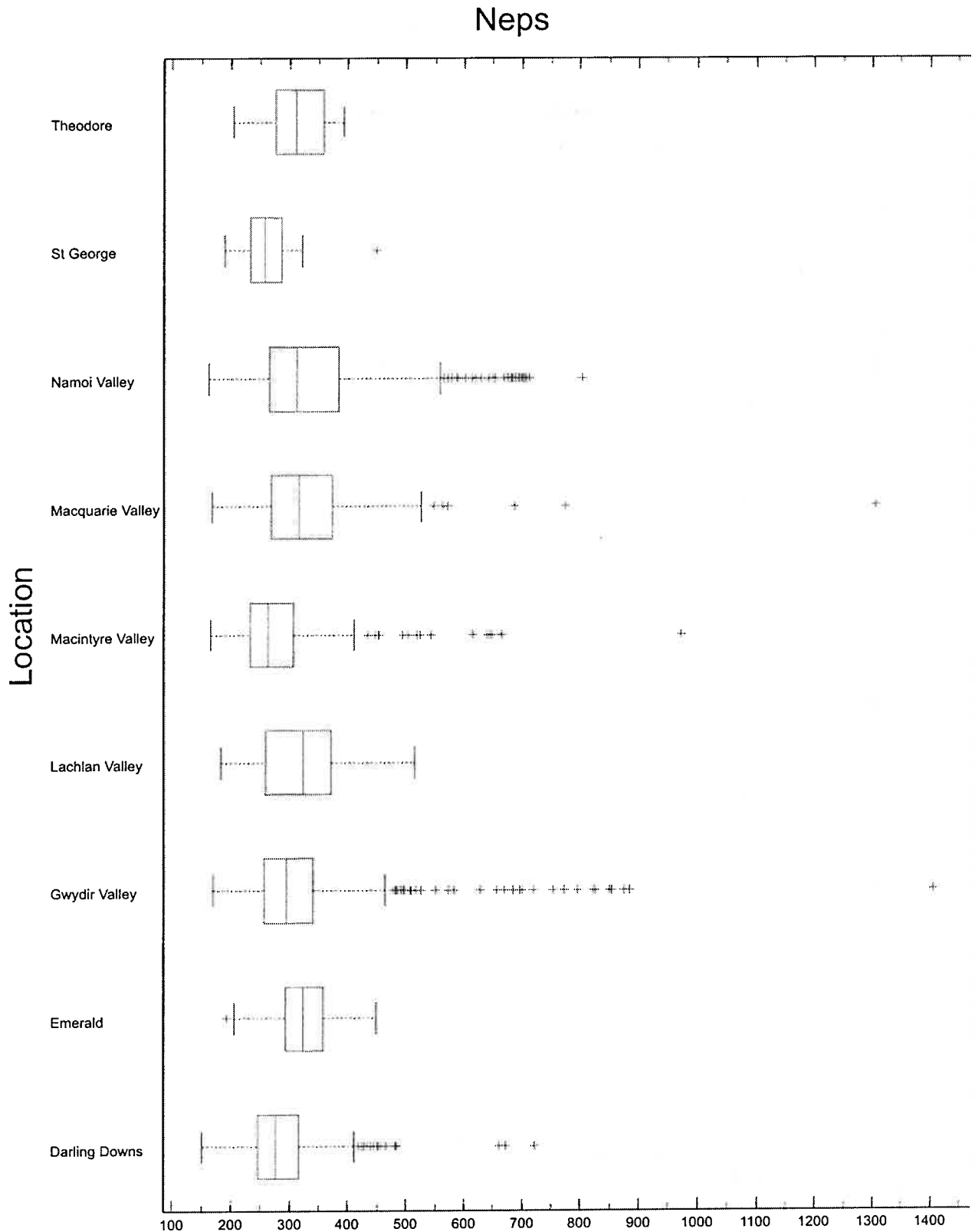


Figure 69. Distribution of neps per valley

Figure 70 gives a breakdown of nep content per gin. Eighteen gins averaged < 300 neps/gram, with gin numbers 1, 4, 5, 10, 12, 15, 16, 23, 29 and 32 averaging > 300 and < 400 and gin number 13 and 27 averaging > 400 neps/gram. The gin that averaged the least number of neps was gin number 17 at 224 neps/gram, with gin number 4 averaging the most neps at 370 neps/gram. The lowest nep count was recorded by gin 25 and the highest by gin number 19.

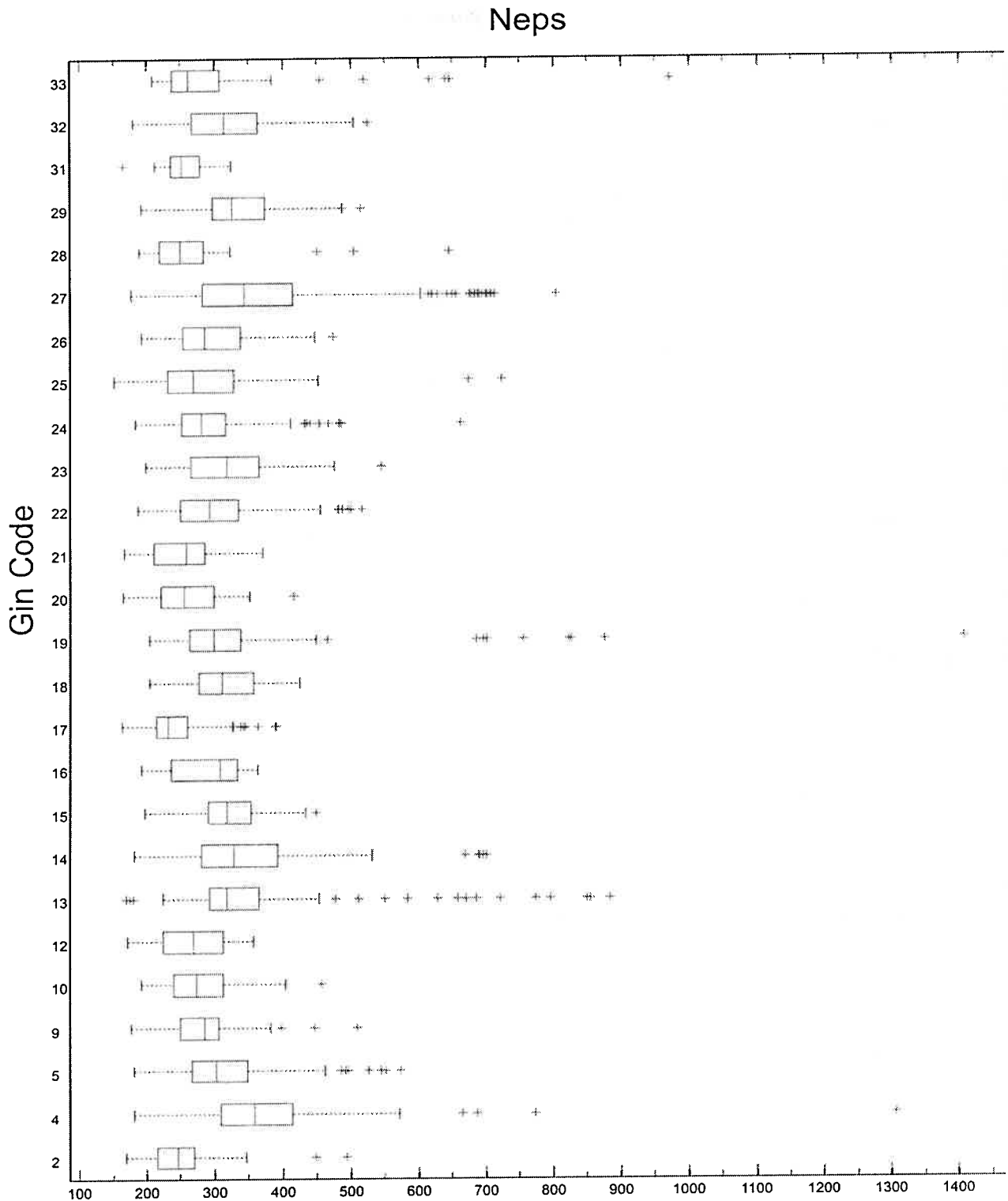


Figure 70. Distribution of neps per gin

Seed coat neps

The average seed coat nep content for the Australian crop was 24 neps/gram. The median was 23 seed coat neps/gram and the range was from 9 to 76 neps/gram, with a standard deviation of 7.33. Figure 71 gives a breakdown of the results. As per Table 1 the average seed coat nep content falls between the 25 and 50 percentile lines of the Uster Statistics. Forty eight percent of the results were ≤ 22 neps/gram with 93% of the samples ≤ 35 neps/gram.

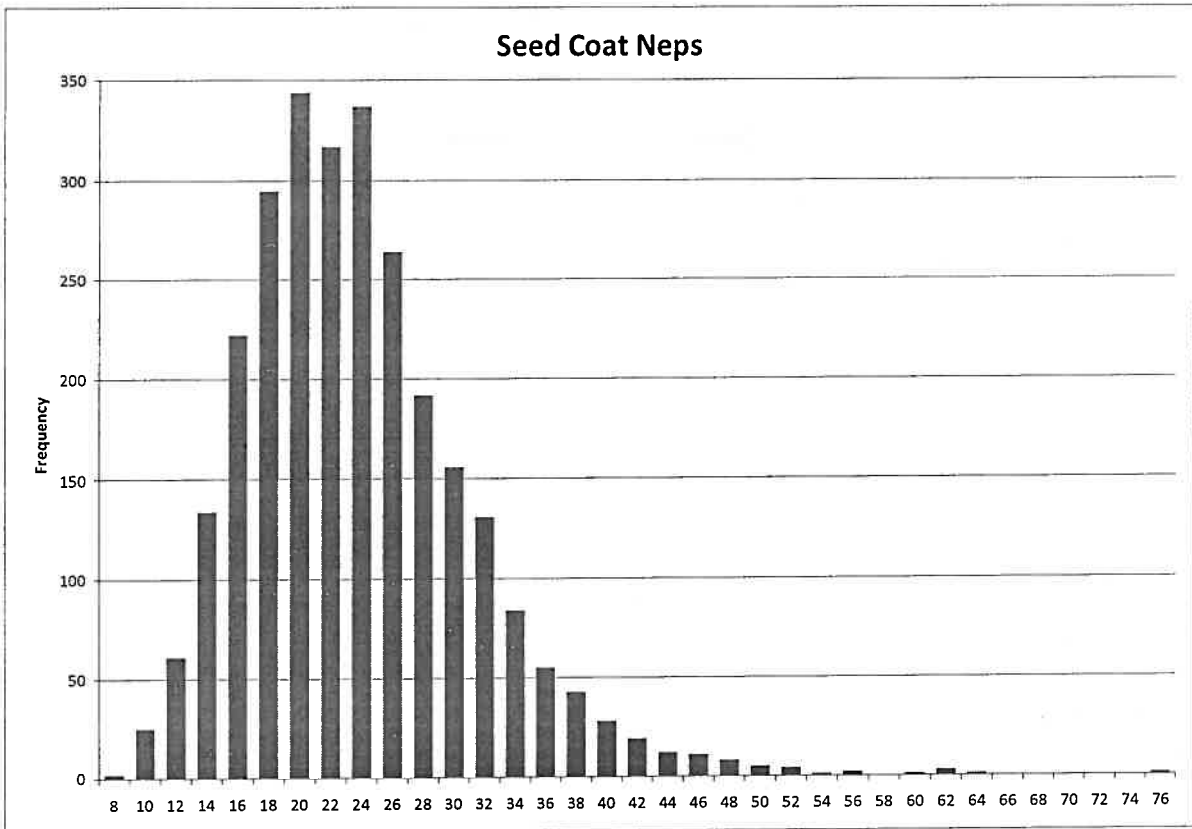


Figure 71. Distribution of seed coat neps

Figure 72 gives a breakdown of seed coat neps per variety. All the varieties averaged < 30 seed coat neps/gram. At 20 seed coat neps/gram Sicot 43 BRF averaged the least number of seed coat neps and at 29 seed coat neps/gram DP 210BRF and DP 408B had the highest average seed coat nep content.

Seed Coat Neps

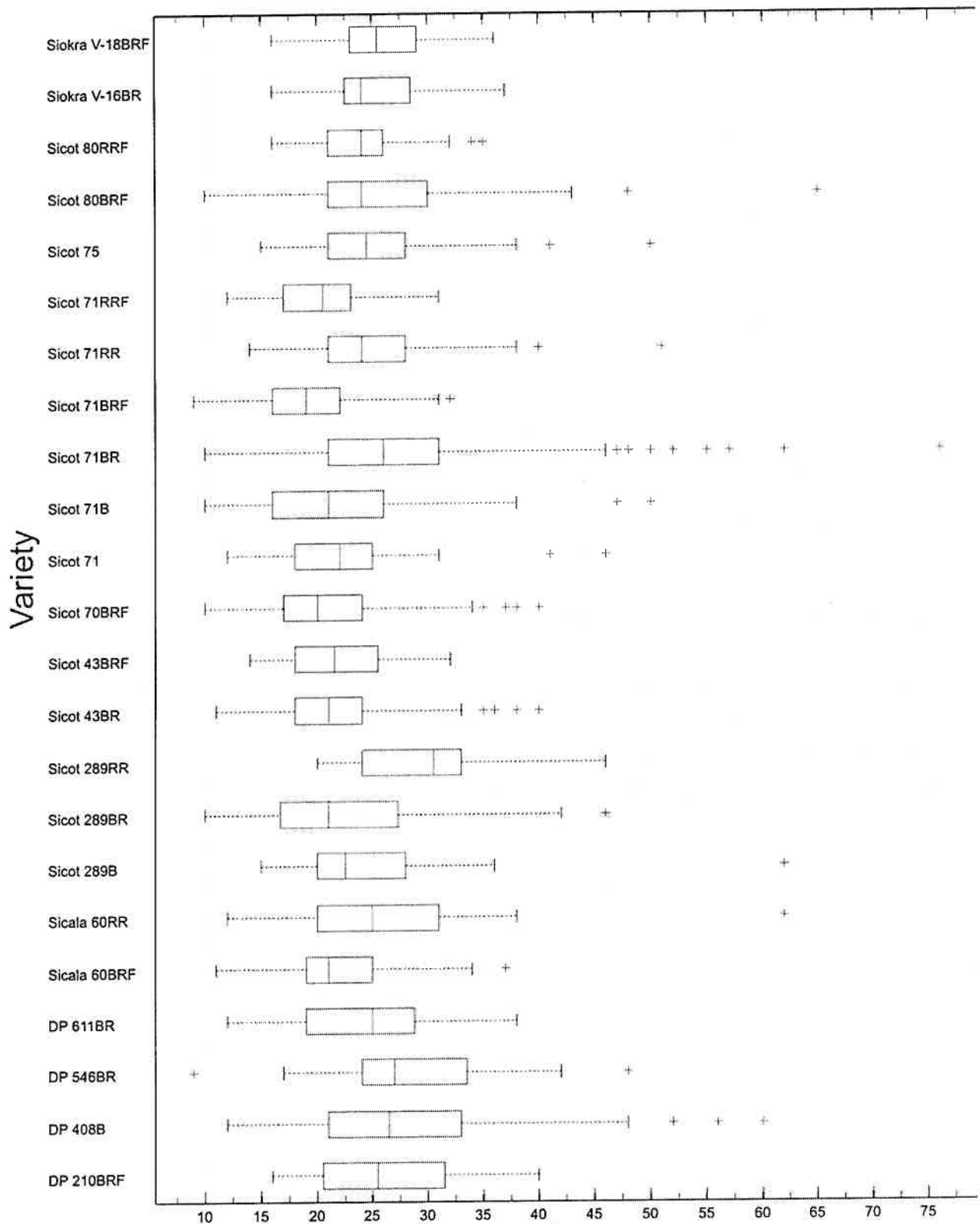


Figure 72. Distribution of seed coat neps per variety

Figure 73 gives a breakdown of seed coat neps per valley. All the locations averaged < 30 neps/gram, with St George and Theodore averaging the highest seed coat nep content.

Seed Coat Neps

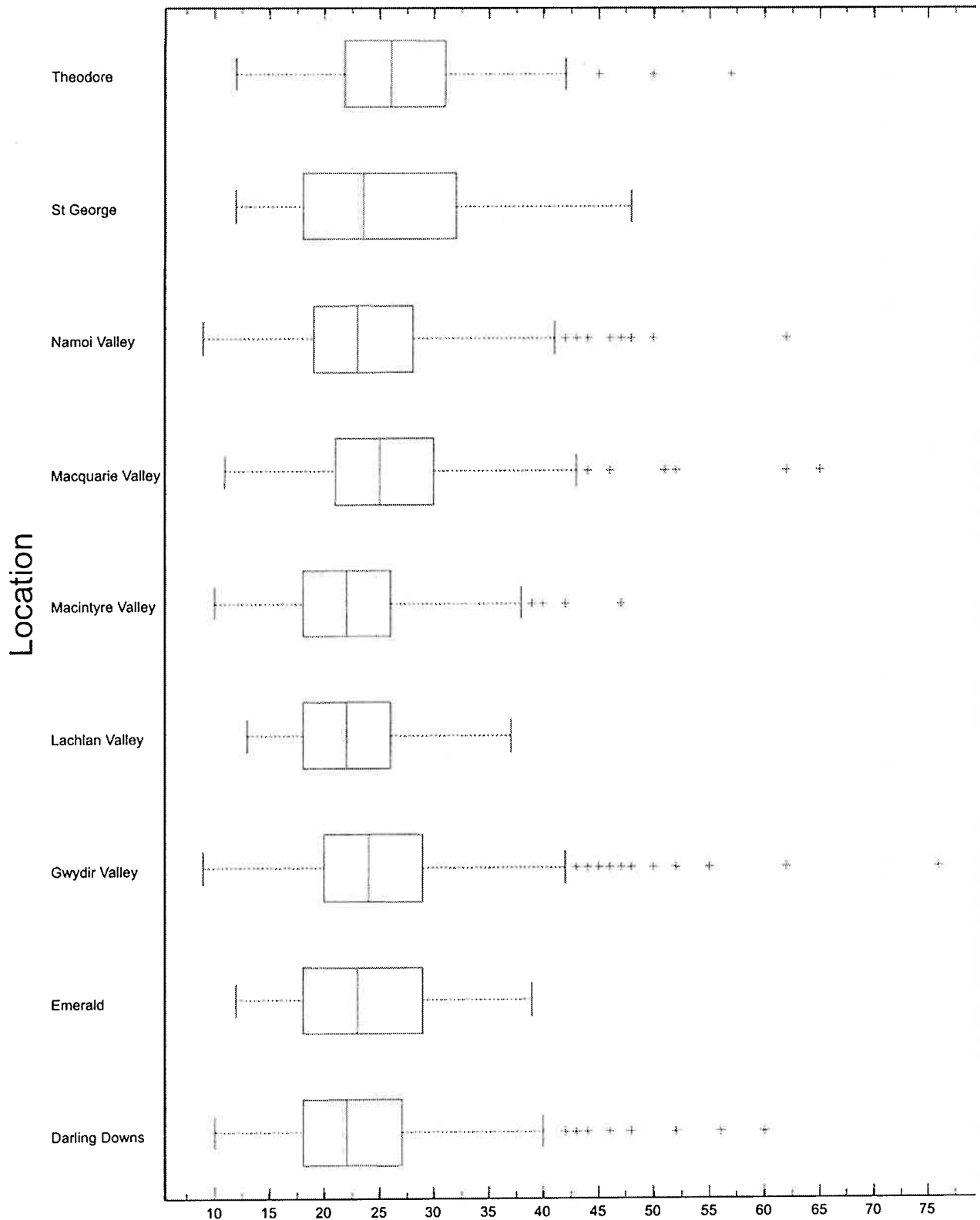


Figure 73. Distribution of seed coat neps per valley

Figure 74 gives a breakdown of seed coat neps per gin. All the gins averaged ≤ 30 seed coat neps/gram, with the exception of gin number 25. The lowest average seed coat nep count was recorded by gin numbers 31 and 32 and the highest average seed coat nep count was recorded by gin number 25, probably due to seed coat content of DP 408B that was ginned.

Seed Coat Neps

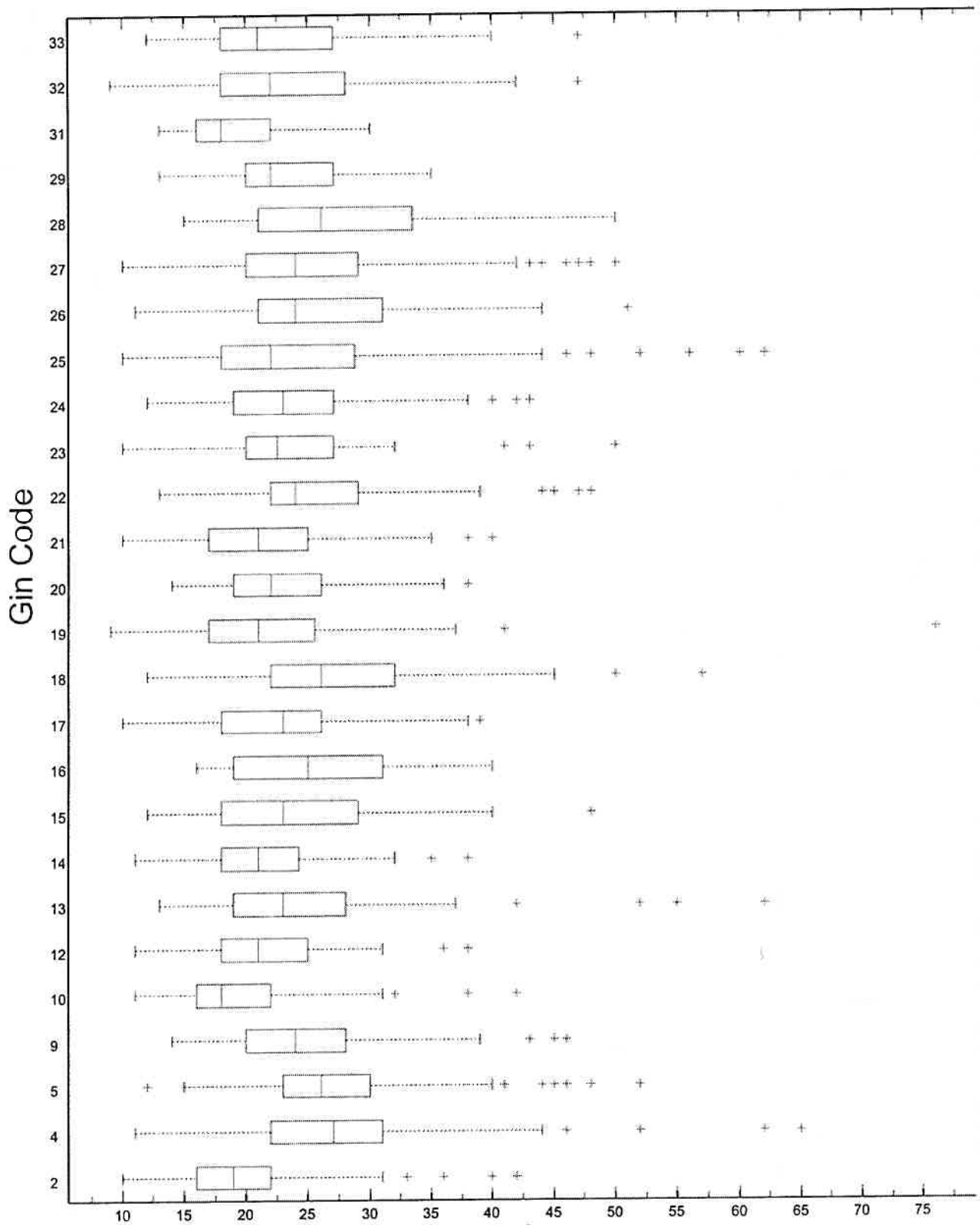


Figure 74. Distribution of seed coat neps per gin

Short Fibre content

The average short fibre content for the Australian crop was 9.2%. The median was 9.0% and the range was from 4.5% to 26.9% with a standard deviation of 1.65. Figure 75 gives a breakdown of the results. As per Table 1 the average short fibre content falls between the 50 and 75 percentile lines of the Uster Statistics. Twenty three percent of the results are $\leq 7.8\%$ and 75% of the results are $\leq 9.8\%$.

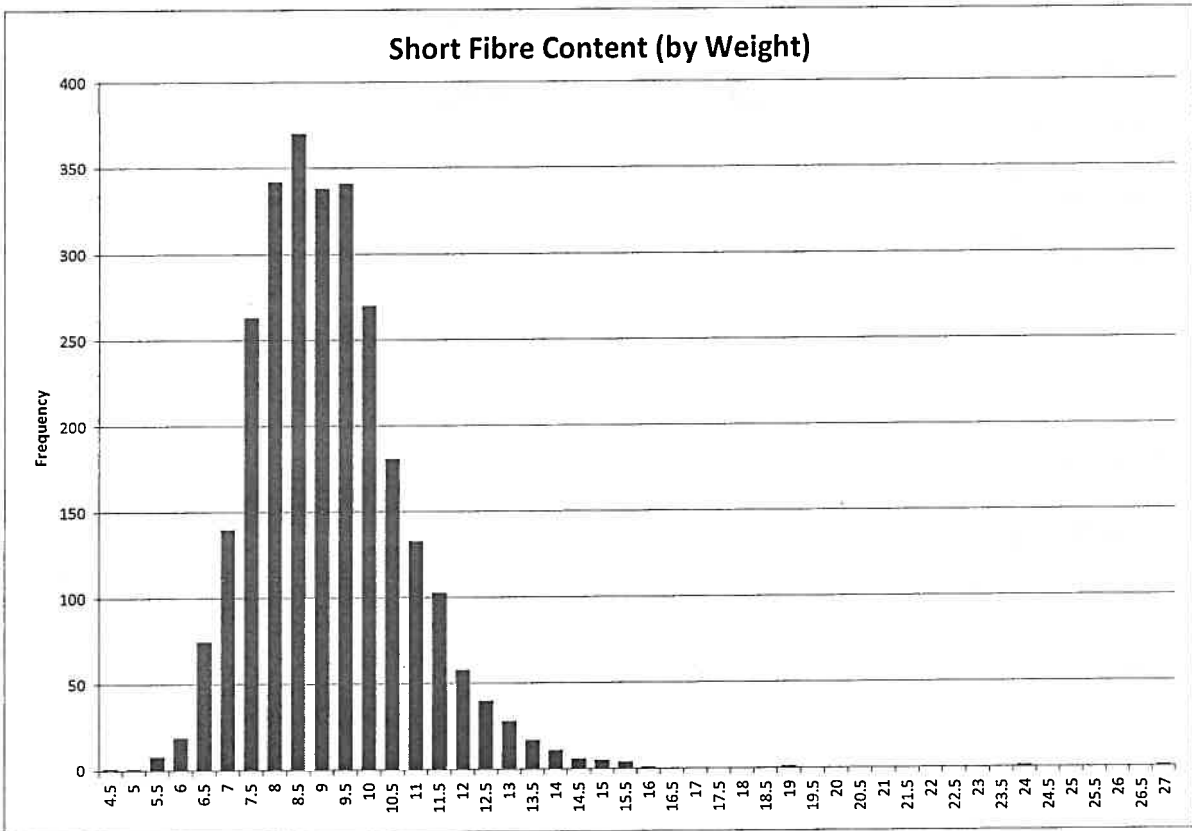


Figure 75. Distribution of short fibre content

Figure 76 gives a breakdown of short fibre content per variety. Most of the varieties averaged < 10% short fibre content with the exception of DP 408B, DP 611BR, Sicala 60 RR and Sicot 289B. At 24.2% a Sicot 71BR sample had the highest short fibre content and at 4.5 % a Sicot 71 sample had the lowest short fibre content.

Short Fibre Content (by Weight)

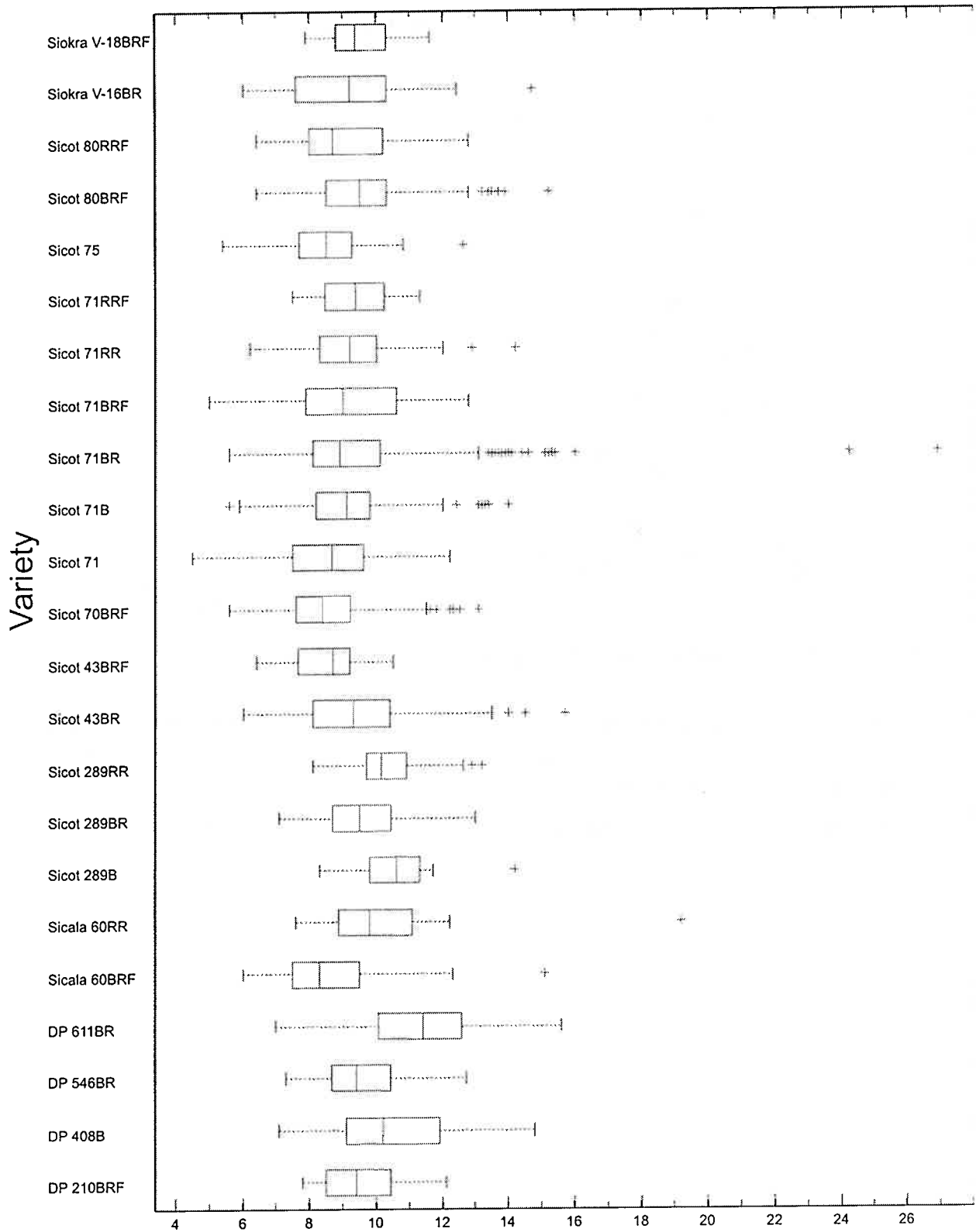


Figure 76. Distribution of short fibre content per variety

Figure 77 gives a breakdown of the short fibre content per valley. All the valley's averaged < 10% short fibre content.

Short Fibre Content (by Weight)

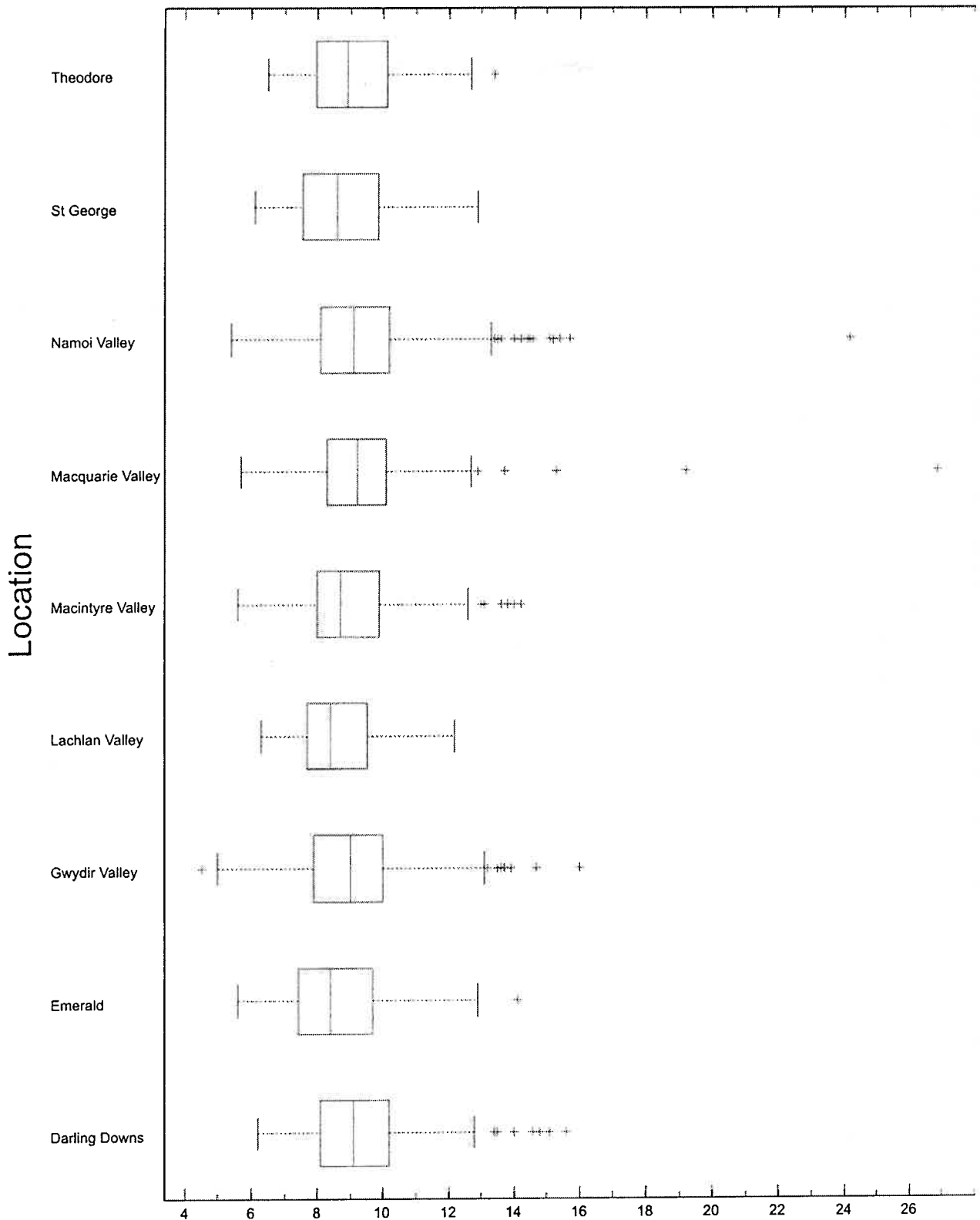


Figure 77. Distribution of short fibre per valley

Figure 78 gives a breakdown of short fibre content per gin. Twenty two gins averaged < 10% short fibre content. Gin numbers 4, 18, 21 and 25 averaged > 10%. The gins that averaged the least short fibre content were gin numbers 14 and 31 with gin 18 averging the highest short fibre content.

Short Fibre Content (by Weight)

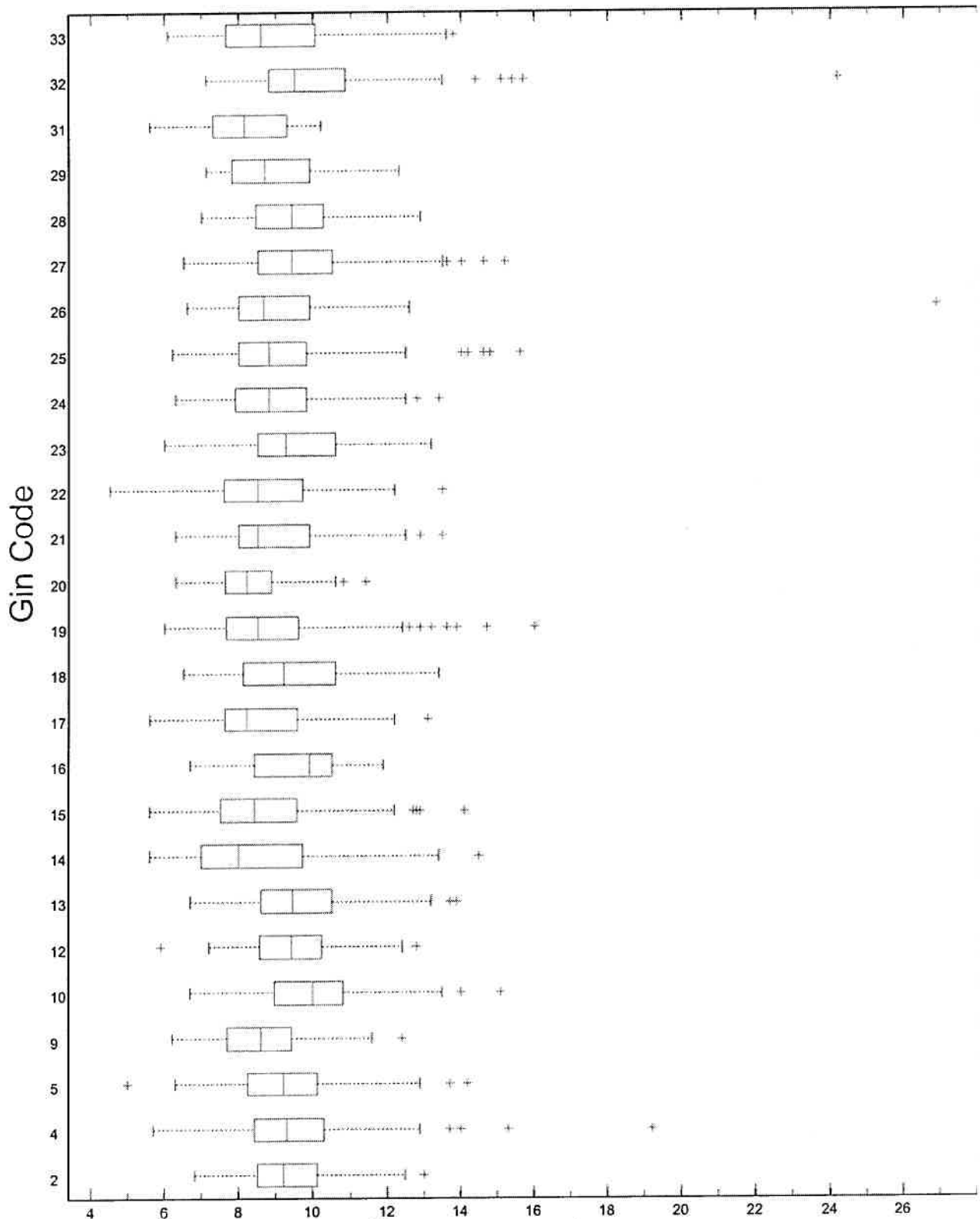


Figure 78. Distribution of short fibre content per gin

Fineness

The average fineness for the samples was 198 mtex. The median was 198 mtex and the range is from 124 to 255 mtex with a standard deviation of 15.75. Nearly 86% of the crop during these three years was coarser than 181 mtex. Figure 79 gives a breakdown of the results.

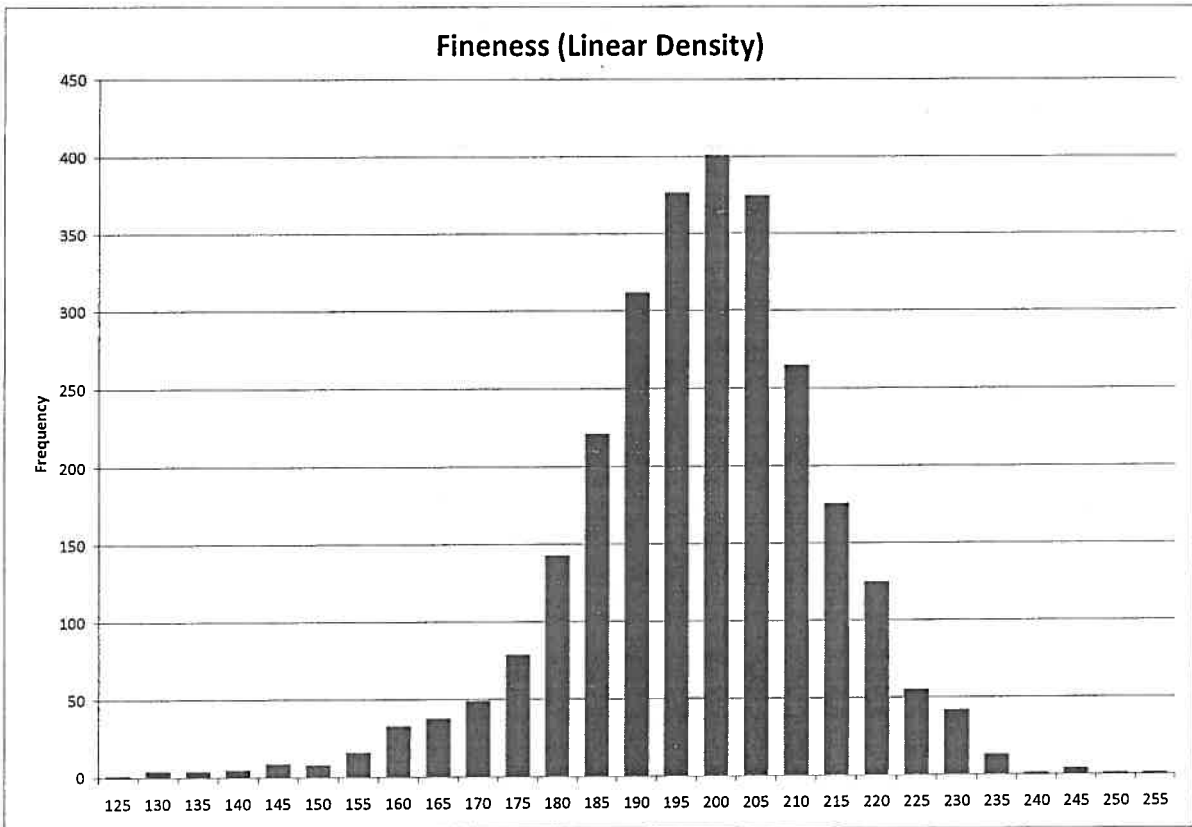


Figure 79. Distribution of fineness

Figure 80 gives a breakdown of fineness per variety. Nineteen varieties averaged < 200 millitex with the rest averaging ≥ 200 millitex. At 245 mtex a Sicot 71BR sample had the coarsest fibre and at 150 mtex a Sicala 80 BRF sample had the finest fibre.

Fineness (Linear Density)

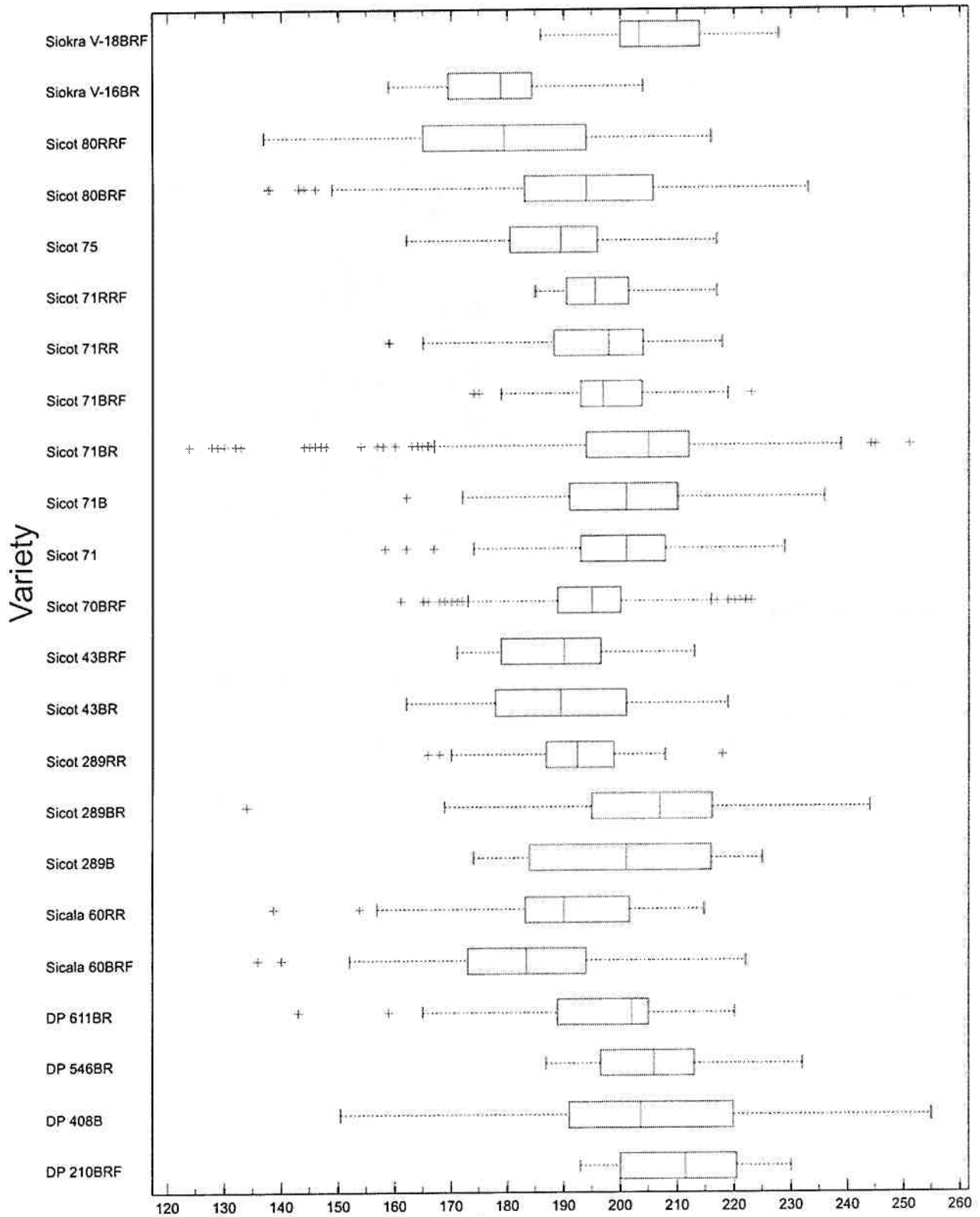


Figure 80. Distribution of fineness per variety

Figure 81 gives a breakdown of fineness per valley. All the valley's averaged between 190 and 200 mtex.

Fineness (Linear Density)

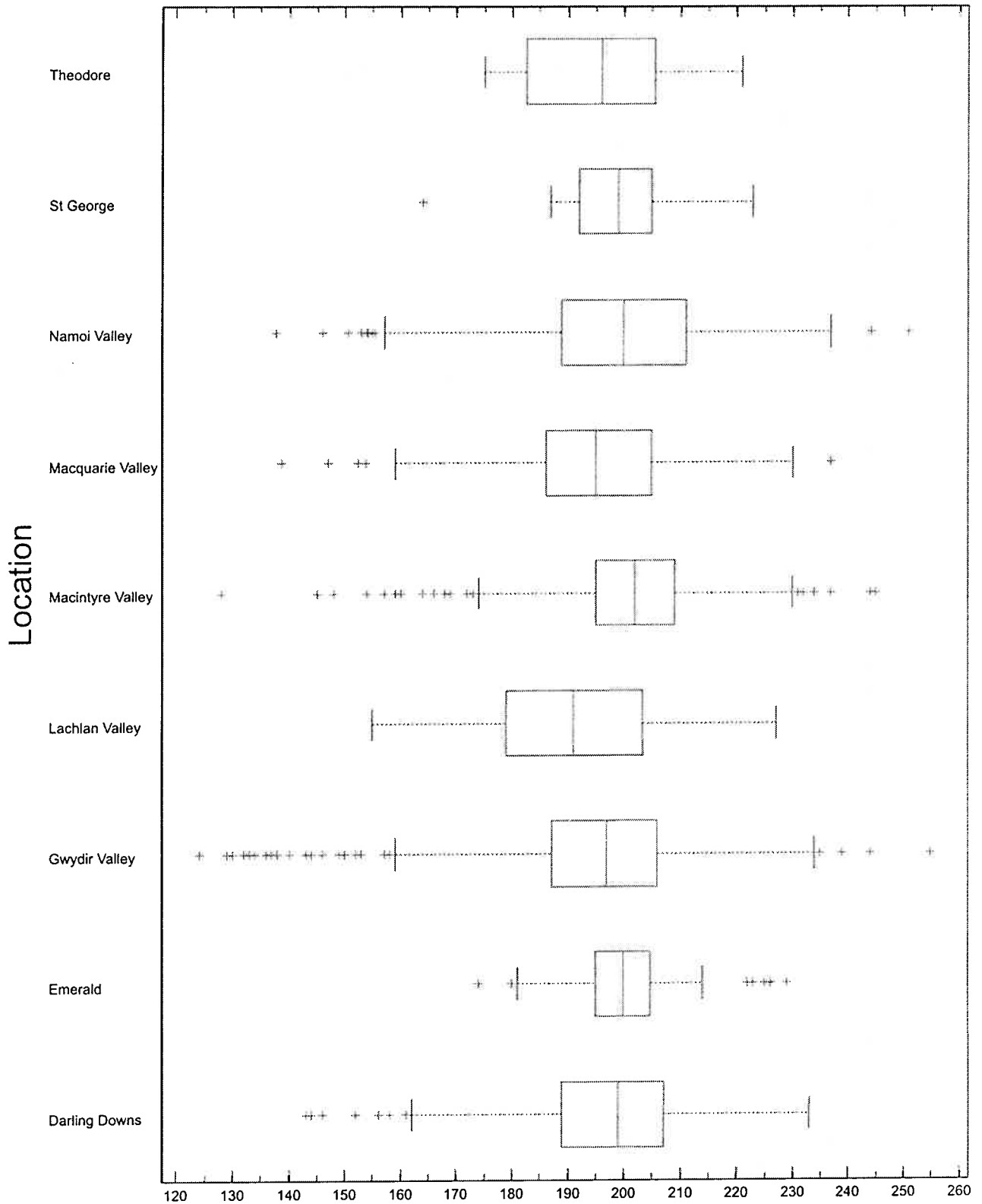


Figure 81. Distribution of fineness per valley

Figure 82 gives a breakdown of fineness per gin. All the gins averaged between 185 and 215 mtex. The gin that averaged the finest cotton was gin 4 at 188 mtex with gin 21 averaging the coarsest fibre at 214 mtex. Interestingly gin 4 averages the highest nep content and Figure 86 shows that the average maturity for cotton ginned is < 0.85. In contrast gin 21 at 241 neps/gram has one of the lowest average nep content and Figure 86 shows that the average maturity for the cotton ginned is > 0.85.

Fineness (Linear Density)

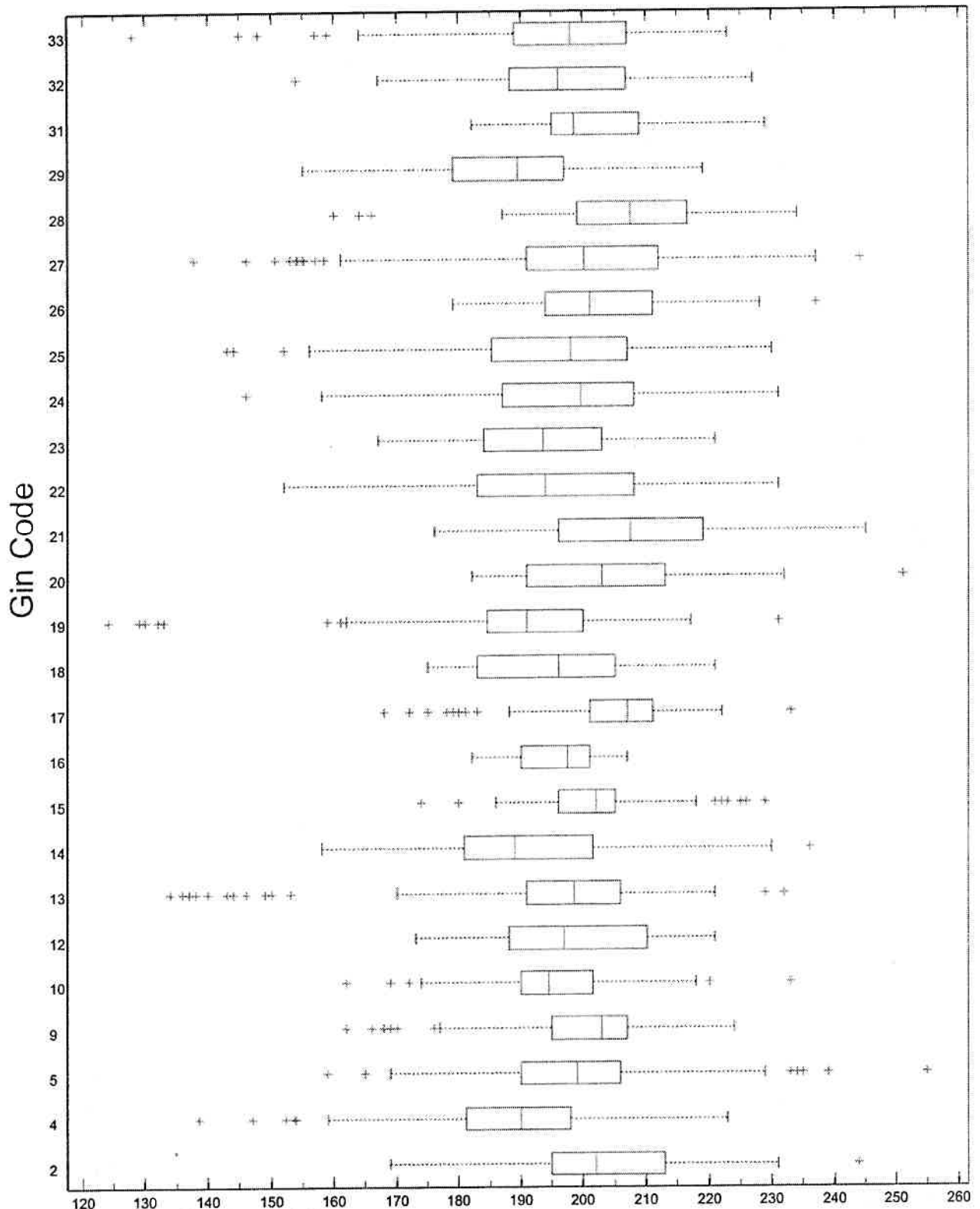


Figure 82. Distribution of fineness per gin

Maturity

The average calculated maturity for the samples was 0.82. The median was 0.82 and the range was from 0.40 to 1.09 with a standard deviation of 0.067. Figure 83 gives a breakdown of the results. Seventy percent of the samples can be considered to be immature with a calculated maturity ratio of < 0.85.

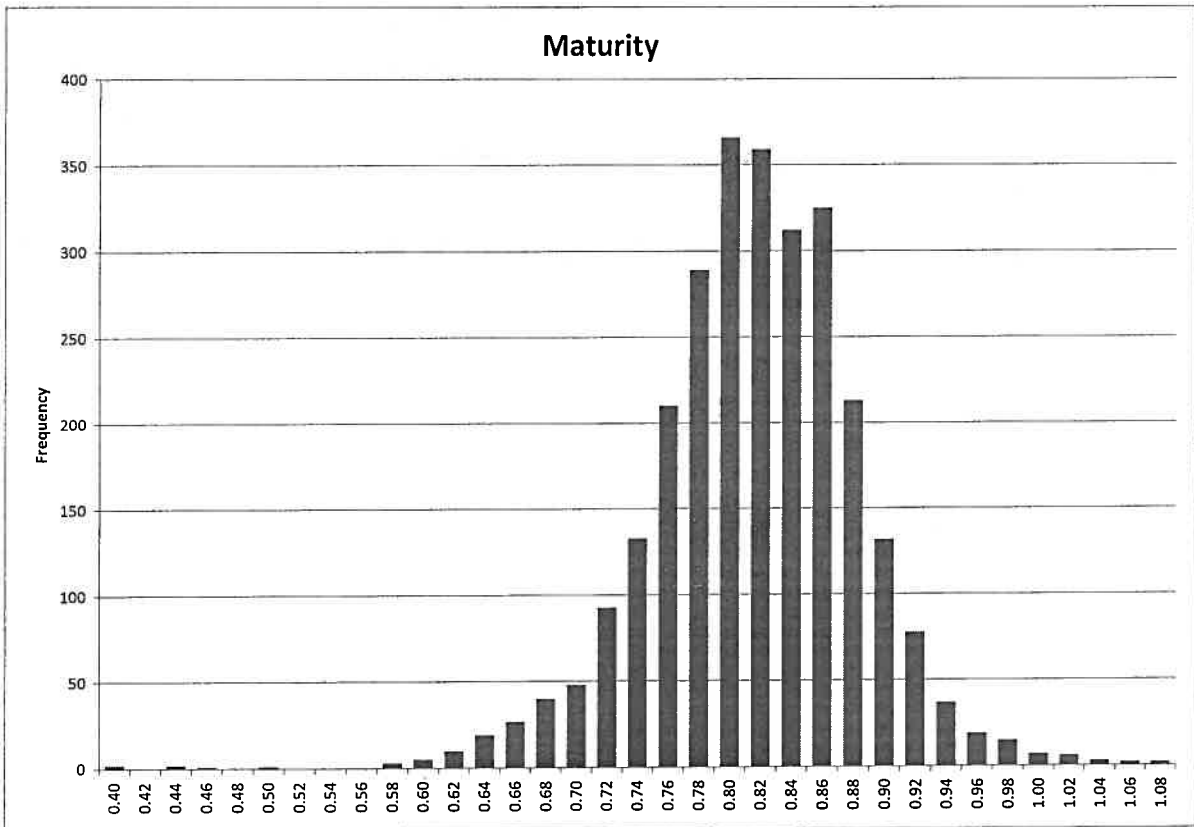


Figure 83. Distribution of maturity

Figure 84 gives a breakdown of maturity per variety. All the varieties averaged < 0.85 with the exception of Sicot 289 BR which averaged 0.85. At 1.04 a DP 408B sample provided the most mature sample and at 0.60 a Sicot 43 BR sample provided the most immature fibre sample.

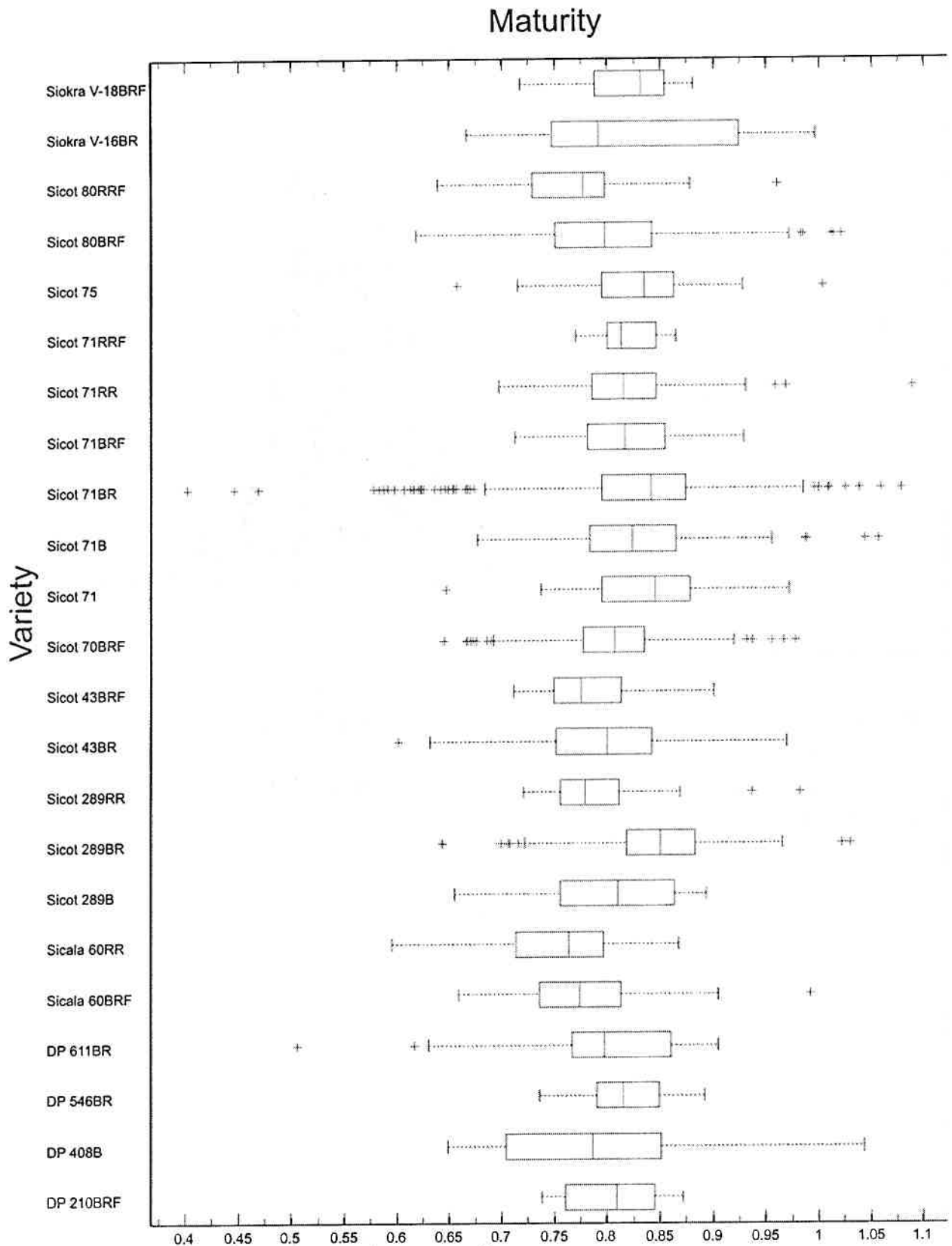


Figure 84. Distribution of maturity per variety

Figure 85 gives a breakdown of maturity per valley. All the valley's averaged < 0.85 with the exception of Theodore and St George which averaged ≥ 0.85 . The gin that ginned most of the cotton from St George also averaged the least number of neps.

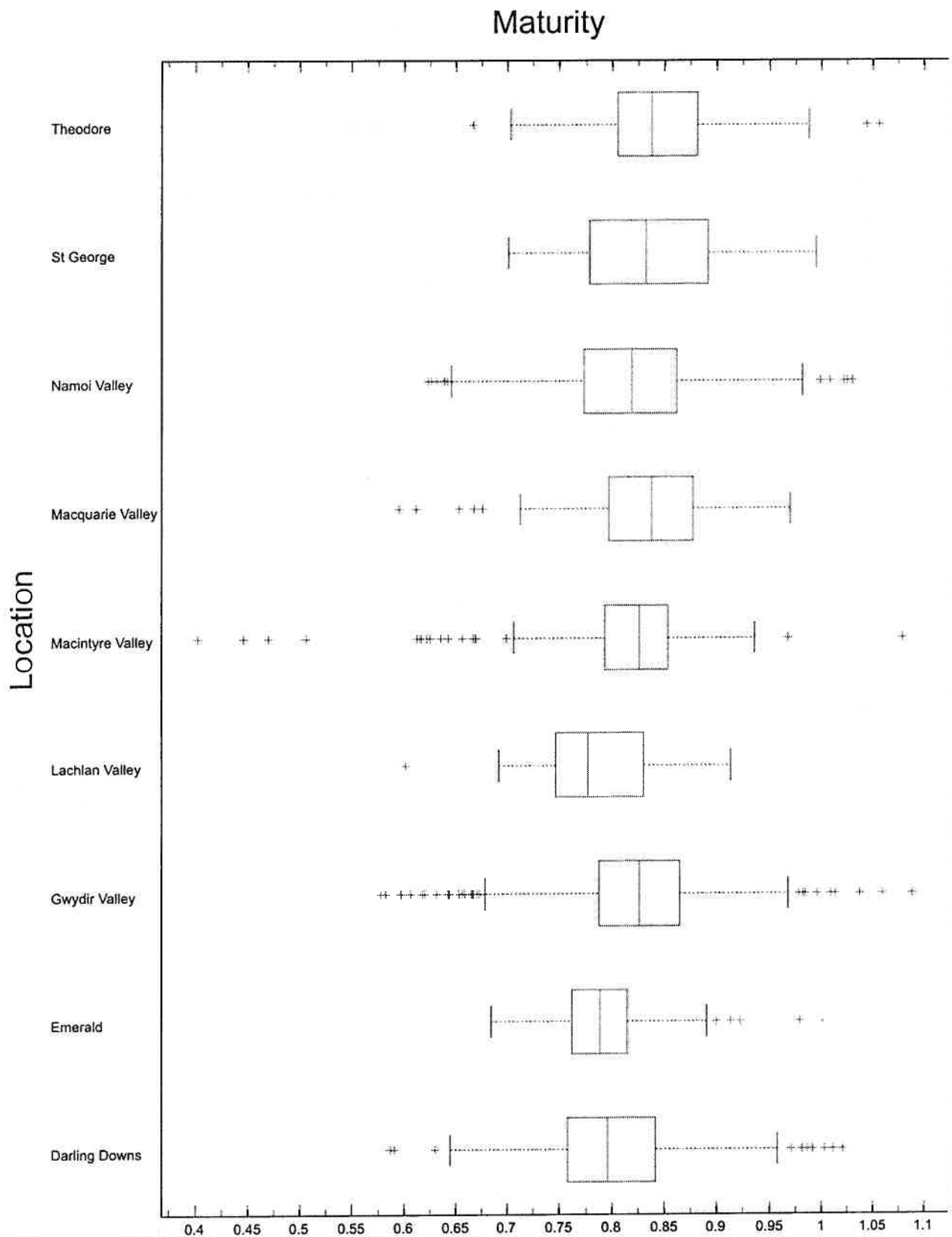


Figure 85. Distribution of maturity per valley

Figure 86 gives a breakdown of maturity per gin. Eight of the gins (2, 5, 15, 16, 17, 20, 21 and 24) averaged > 0.85 with the rest of the gins averaging < 0.85 .

Maturity

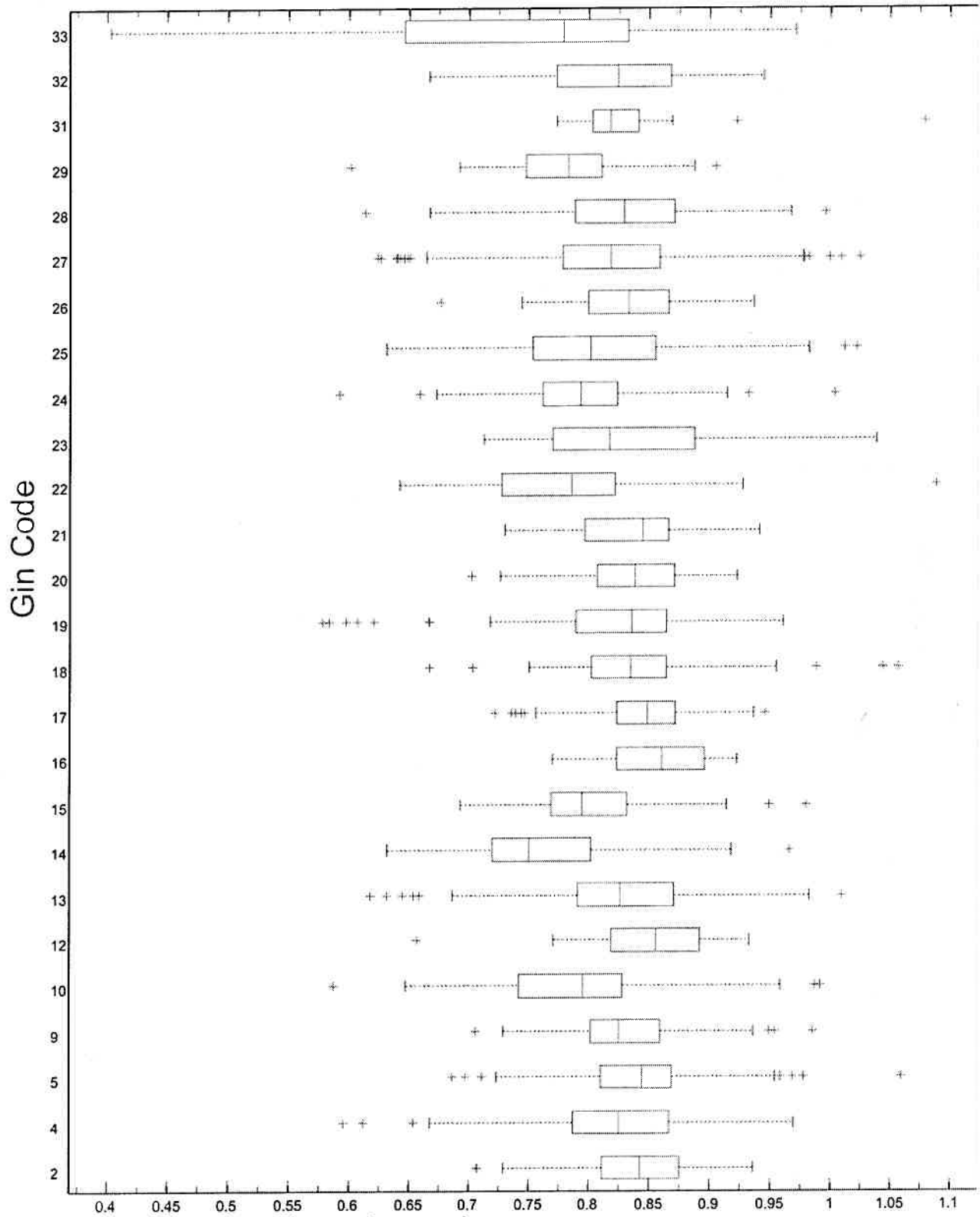


Figure 86. Distribution of maturity per gin