GENETIC VARIABILITY FOR YIELD AND QUALITY CHARACTERISTICS IN SOUTH AFRICAN COTTON GERMPLASM

(Gossypium hirsutum L.)

by

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DECLARATION

I declare that the thesis hereby submitted by me for the Philosophiae Doctor degree at the University of the Orange Free State is my own independent work and has not previously been submitted by me at another university/faculty. I furthermore cede copyright of the thesis in favour of the University of the Orange Free State.

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DEDICATION

To my parents: Japeth and Elizabeth

For their care and love

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CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND

Cotton (Gossypium spp.) is an important crop worldwide and is cultivated in extended areas in developed as well as in developing countries. The economic and social importance of cotton is very significant and the crop has been known to mankind over the centuries. Its importance as clothing material was recognised in the early times and the crop has therefore been cultivated since prehistoric times. It is certainly a crop that has been associated with old civilisations and contributed greatly to industrial and economic development in many countries. The great value and need for cotton products has made the crop to survive as one of the world's most widely cultivated and major cash crop, despite the stiff competition it faces from man-made fibres.

1.2 CLASSIFICATION

Cotton is considered as a fibre crop because one of its main products, for which it is widely cultivated, is lint which is made up of fibres. It belongs to the family Malvaceae and the genus Gossypium. There are many species in the genus gossypium, some of which are cultivated while others are wild relatives. The cultivated species are important in that they produce fibres which are spinnable whereas the wild relatives produce naked seeds (without fibres), or very short unspinnable fibres. However, wild relatives are also useful in that they contribute some useful genetic traits for the improvement of cultivated cultivars (Meredith *et al*, 1996).

Four of the cultivated species are considered to be of major agricultural importance. These produce spinnable lint which is of great value to the spinning and textile industry. Two of the four species are diploids (2n = 2x = 26) and are represented by *Gossypium arboreum* and *Gossypium herbaceum* (L). The diploid cottons are still grown in Asia and are often referred to as Asiatic cottons. The other two species are tetraploids (2n = 4x = 52) and are represented by *Gossypium barbadense* (L), often referred to as Sea Island or Egyptian cotton, and *Gossypium hirsutum* (L) or Upland cotton. *Gossypium hirsutum* (L) is by far the most widely cultivated cotton species in the world. It is reported to be contributing over 90% of the total cotton produced worldwide, *G.barbadense* contributes about 5% and diploids or Asiatic cotton also contributes about 5%.

1.3 IMPORTANCE OF COTTON

The importance of cotton was recognised in pre-historic times. The early hand weavers used the lint or fibres produced from the cotton seeds for weaving to produce clothing material. The invention of spinning machines later, made the work of the weaver much easier and the demand for lint increased. This widened the cultivation of the crop. Cotton is a unique crop because nearly all its parts can be utilised beneficially. The crop was, for a long time, cultivated mainly for its lint. Recently cotton seed has also gained importance as industrial raw material. Cotton is not as not only an important economically in international trade, but is also used locally to clothe a substantial portion of the world's population. The clothing material obtained from cotton is both comfortable and utilitarian. As a natural fibre and feed source, cotton is a renewable source, and this gives it the advantage to compete favourably with the synthetic fibres, from an environmental and ecological point of view.

Summarily, cotton is primarily important as a fibre crop but for its seed it is also important as a food and feed crop.

1.3.1 Cotton lint

Lint is the most important industrial raw material for which cotton is widely cultivated. It is composed of fibres which are single cell-outgrowths from the outer layer of the seed coat. The fibres increase both in length and thickness forming some fluffy stuff over the cotton seed which is easily removed from the seed surface by the gins. Lint can be of different colours naturally, but the most widely cultivated cottons produce white lint. Separated from the seed, lint can be processed into various useful products such as : thread, clothing material, blankets, carpets, rugs, padding and cushioning materials, filters, felts, wigs, absorbents, films, medical or surgical wool and other industrial materials such as viscose, rayon, etc.

1.3.2 Cotton seed

Cotton seed has also attracted recognition as an important industrial raw material. It is considered the world's second most important oil seed (Cherry & Lefler, 1984). This has drawn attention to cotton seed quality in terms of oil and protein contents, due to world's demand for food and feed, as reported by Turner *et al* (1976). Cotton seed contains both oil and protein of good quality. The oil can be extracted from the seed and purified into edible vegetable oil or used in the processing of products such as soap, cosmetics, pharmaceuticals, lubricants and also culinary products. Protein extracts are used in the processing industry to make fortified flours. The remainder of the seed can be processed into animal feed cakes, while the husks can be processed into fertilisers.

1.3.3 Cotton production

Cotton in ranked high among the world's economically important crops. This is due to very many products which are processed from cotton, and the ever increasing demand for such products. Cotton production is reported to be on the increase. International Cotton Advisory Committee (1997), reported cotton lint production to be 19,736 metric tons for the season 1996/97, as compared to 18,714 metric tons for the season 1994/95. This increase may be attributed to various factors. It could be the result of the continuous increase in the land area allocated to cotton production from year to year, a high rate of adoption of improved production technology, or a combination of both factors stated. Sources available, however, indicate that the area under cotton cultivation has been stagnant and that the increase is due to adoption of new technology as stated by Barbosa (1994) and Hayden (1994). The technologies being adopted include increased use of irrigation, better varieties and better management of pests and the crop. Constable (1998) noted the impact made by breeders in adapting cotton for a wide range of cropping systems. He also mentioned some important developments such as development of early maturity in cotton cultivars to allow production in short or dry seasons; tolerance to diseases, thus allowing production in areas where such diseases have built up; and significantly, tolerance to insect pests through morphological characteristics such as hairs and gossypol content. He further states other developments such as transgenic Bt cotton, ensuring that the production systems can be more successful or resume under circumstances where insect pests are a problem; and transgenic tolerance to herbicides which will have a bearing on some cropping systems, allowing changes in weed control and in row spacing and mechanical harvesting methods.

Malik (1998) also mentions pest management and weed control programs as particularly interacting well with fertilization to obtain profitable yields. Balanced nutrient approach based on accurate fertility information and an integrated farm planning has also enabled better yields and quality in cotton.

Current production in the Republic of South Africa is 50,000 tons of lint and is supposed to bring farmers an annual income of R330 million. Increased production to meet the domestic demands is projected at 80,000 tons of lint and should earn farmers R530 million (Personal communication - Steenkamp, 1997).

1.4 COTTON IMPROVEMENT

Cotton as an important world crop, has gained much attention in crop research. Early research on cotton started with selection of useful species and establishment of their adaptability. Niles (1982) quotes Watt as saying "the first great cultural triumph in the USA was the selection and acclimatisation of annual forms capable of setting and maturing fruit before advent of killing frost". The annual day neutral stocks that emerged from intensive selection among the perennial short day tropical stocks, became the first authentic American (US) cottons. This was followed by improvement of lint yield and its stabilisation through searches for resistance to diseases and insect pests, and identification of physiologically and agronomically suitable genotypes. The impact made by the breeders as mentioned by Constable (1998) came through addressing the problems of seasons (water or heat) disease and insect tolerance, as a consequence of which cotton yields continue to rise.

1.4.1 Genetic variation in cotton

Species of Gossypium exhibit a wide range of variation in both qualitative and quantitative traits. This is a great advantage which has enabled greater room for manipulation of the genes and has led to greater improvements of various cotton characteristics. The wide range of genetic variations still leaves room for further manipulation or exploitation and improvement. Fryxell (1984) discusses the wide range of variation that exists in the genus Gossypium. Growth habit in cotton, a typically woody perennial shrub, ranges from sub-shrubs to fully arborescent species, with intermediate types as well. Hairiness varies in amount or density, type, and distribution on the vegetative parts of cotton plant. This was observed by Smith (1964). Variation is also exhibited in maturity period, gossypol content, boll characteristics, pollen colour, stem colour, seed size, seed fuzziness, oil and protein content, and fibre characteristics such as colour, length, strength, fineness and uniformity. Variation is also found in response of cotton to biotic and abiotic stresses.

1.4.2 Advances in cotton improvement

Earlier cotton breeding research emphasised more on yield increase on a per unit land area basis. Cotton, however, faces competition from man-made fibres and therefore fibre quality has to be improved in consideration of the textile industry requirements, especially following the development of fast spinning machines. Introduction of desirable traits to adapted cultivars from germplasm sources is therefore a continuous process. The quality of fibres produced is determined by inherent factors and environmental influence. Improvement of fibre properties therefore begins with improved varieties through genetic manipulation, with objective evaluation of these properties, which involves development of longer and finer fibres, improved fibre maturity strengths and elongation, reduction in soft fibre contents and neppiness, while improving the evenness of all fibre characteristics, as observed by Kechagia *et al*, (1998).

Advances have been made to improve some of the characteristics which are considered major contributors to lint yield and quality. This characteristics include: number of bolls per plant; boll size; locules or carpels per boll; seeds per boll; seed size, lint and seed indices; ginning out turn (GOT) or lint percentage, fibre strength, length, uniformity and fineness. In breeding improved cotton varieties, attempt was made to combine most of the traits in one line or lines which will constitute a variety. Identifying optimum breeding procedures for synthesising a single population that combines a high proportion, if not all, of the favourable alleles existing in several source populations is a challenging task. According to Bailey & Comstock (1976), the success of such incorporation, however means substantial genetic improvement in the net worth of the best populations. Meredith (1999) however points out that combining all useful traits into a single genetic background does not always result in a genotype whose performance can be predicted by individual trait effects.

There are many examples of genetic variation in Gossypium, which have been utilised in improvement advances in cotton. Hairiness is one of such examples which has been successfully utilised in genetic improvement of cotton resistance to insect pest. Soomro (1998) discusses the utilisation of hairiness in Pakistan to develop a profusely hairy cotton variety CRIS-74 which needs no insecticidal spray against jassids (Empoasca spp) and yet it is agronomically at par with commercial varieties like NIAB-78 and CRIS-9. Normally hairiness is controlled by the H1 allele, and can afford resistance to jassids which suck sap from cotton plants. H1 in combination with H2 allele produces dense pubescence which enhances resistance to bollworm. Lee (1964, 1984 and 1986), van Schaik *et al* (1976) and Smith (1992) reported that the hairiness trait is associated with adverse effects on lint fibres. Increased pubescence is said to be associated with decreased fibre length, increased micronaire and lower elongation. Hairless or smooth leaf provides resistance to *Heliothis zea* by reducing oviposition by the insect and yet Ha (1987) reports that this trait is associated with reduced lint yield. Kloth (1993) reported significantly higher lint percent from Pilose (heavily hairy) lines than normally hairy ones, which contradicted earlier report by Lee (1984) that there were no significant differences.

At the Tobacco and Cotton Research Institute (TCRI), Cornellisen (1997) discussed a program to develop jassid resistant varieties through incorporation of hairiness to adapted cultivars or breeding lines to address the problems of limited resource farmers in the Republic of South Africa. Knowledge of inheritance and effect of this trait on yield and quality of lint is essential. Other advances in cotton improvements were discussed by Soomro (1998) and they include utilisation of traits such as okra leaf which confers earliness and tolerance to pink bollworm and whitefly, frego bract, nectariless and red cotton plants.

Lint yield and fibre quality characteristics are quantitative and complex. Ketata *et al* (1976), and ICAC (1997) reported that in attempt to aggregate useful alleles into one genotype or genotypes a better understanding of genetic factors determining the more important agronomic characteristics involved in the increase of lint yield and its quality, and relationship between these factors is essential. Kapoor (1998) mentioned that development of an efficient breeding methodology necessitates analysis of genetic architecture of quantitatively inherited characters such as yield and its components, and understanding the nature of gene actions involved in the expression of such characters is helpful in deciding the breeding procedures to be used in the improvements of these characters. Henning & Teuber (1996) emphasised the essence of having knowledge of correlated response between traits undergoing selection and, of any undesirable traits, before selection is initiated. Harrel *et al* (1976) mentions that genetic studies have shown both positive and negative associations between yield and quality components, and yet in the plant breeder's perspective, both lint yield and quality need to be maximised in attempt to develop superior commercial cultivars.

It is therefore essential in any breeding programme to make estimates of genetic variances and heritabilities throughout all stages, so as to be able to answer any pertinent questions (Dudley & Moll, 1969). Kabikambi *et al,* (1997) sites Tikka (1975) emphasising knowledge of the association of yield components with each other and with yield as being helpful in improvement of complex characteristics such as yield for which direct selection is not very effective.

1.5 AREA AND OBJECTIVES

High cotton yield is an important goal for breeders and producers of cotton. Cotton fibre quality is a very important factor affecting lint price in world cotton marketing. Genotype and environment play a major role in determining yield and quality of cotton. Since genotype and environment are main players in the determination of these characteristics, and the improvement of these characteristics involves manipulation of genes through introduction of desirable traits from source populations into adapted genotypes, an understanding of gene actions and inheritance of such traits should be undertaken.

These kind of studies have been done elsewhere but there are variations in the findings which may be attributed to variation in environment, genotypes and also cultural practices. This study was conducted with this view in mind, using genotypes available in the germplasm at the TCRI, under the conditions prevailing in the Republic of South Africa.

The objectives of this study are:

(i) To study the genetic variability for yield and quality characteristics in South African cotton germplasm;

(ii) Identifying suitable parental lines to use in the local cotton breeding programme for the improvement of yield and quality characteristics.

(iii) To study the heritabilities and correlated response of economic important characteristics in cotton.

(iv) To investigate the possibility of hybrid breeding in cotton

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

The prime concern of cotton breeders has for a long time been lint yield. Peeters & Sweenen (1994) stated in their report that since cotton fibres are the primary product of cotton cultivation, targets of crop improvement have included yield and quality. Green & Culp (1989) stated that emphasis in cotton breeding should be simultaneous improvements of yield and fibre quality, especially fibre strength, in order to meet the demands of the cotton producer as well as the textile industry as it progresses to new spinning technologies and durable press processing. A meaningful cotton improvement programme thus looks at lint yield and quality together, without sacrificing the other. Gannaway (1982) cautions breeders to have balance in varietal development as large improvements in one property results in rapid development of deficiencies in other properties. The genetics of the two are complex and are inherited quantitatively, having many components contributing to their sum total expression. Coyle & Smith (1997) stated that lint yield and fibre quality in upland cotton *(G. hirsutum L.)*, are interrelated through a series of individual components that include number of bolls per unit area, mean fibre length, weight per unit length as well as a series of within boll components. Within boll components include number seeds per boll, lint weight per unit seed surface area, number of fibres per seed or the number of fibres per unit seed surface area. (Coyle & Smith 1997; Smith & Coyle 1997).

Components contributing to lint yield include number of bolls per plant or unit area, seeds per boll, boll size, seed size, ginning out turn (GOT) or lint percentage, number of sympodia per plant, fruiting sites per plant, etc. Components of lint quality include fibre length, fibre fineness, fibre strength, uniformity, etc. The significance of the contributions of these components varies. Sambramurphy *et al* (1995) found number of bolls per plant, followed by ginning out turn (lint percentage) as the major contributing components to yield. Poehlman (1983) points out the physical features that determine the yield of a cotton plant as being number of bolls per plant, the size of bolls, lint percentage and number of seeds per boll. Seeds per boll are being considered due to the fact that lint is produced from the cells on the surface of the seed and so the larger the seed surface area, the more the lint produced.

The final yield and quality of the lint fibre is affected by the interaction of all these components and the environment. Dippenaar *et al* (1998) reported that localities contributed to 75% of the variation that occurred in seed cotton values whereas cultivars accounted for 3.25% and interaction between localities and seasons accounted for 8.5%. Knowledge of genetic variation and heritability of yield and quality traits is essential to a cotton breeder, because successful selection of superior genotypes will depend on high heritability of traits. Myres & Bordelon (1995) emphasised knowledge of heritability of traits, as facilitating development of upland cotton varieties. Knowledge of correlations among traits is also very useful in a selection programme. Singh *et al* (1995) recommended selection criteria on yield components rather than on yield per se, as effective for simultaneous improvement of yield and boll weight. Green & Culp (1989) and Culp & Green (1989) obtained results which indicated that simultaneous improvement of yield and quality of lint fibres should be possible.

2.2 ORIGIN AND SPECIES

Cotton has been cultivated in warmer climates of the world since prehistoric times. It is now cultivated as far as latitude 47 °N in the Ukraine and down to the Southern tip of the African continent. It has been an important crop in India for more than 3000 years (Poehlman, 1987). Cotton was used as clothing material in Brazil, Peru and Mexico long before the discovery of America. Many kinds of the early cottons grown in the cotton belt in the U.S were importations from the Mediterranean area, Mexico, Southern America and the West Indies. They were mainly perennial in their growth habit or they required a photo period different from that found in the latitude of the southern states. They varied in boll size, staple length, fibre strength and in may other respects. However, they possessed great genetic plasticity, and they were eventually molded into productive and adaptable types, a major breeding achievement (Poehlman, 1987).

Cotton belongs to the genus Gossypium. Poehlman (1987) reports that the genus has 34 species; 30 of which are diploid and four are tetraploids. Fryxell (1984) reports that the genus has 39 species and Peeters & Swennen (1994) quote Fryxell (1992) reporting about 50 species in the genus. According to Poehlman (1987), the diploid species ($2n=2x=26$), are assigned to six genomes designated A, B, C, D, E and F. These are presented in Table 2.2. Genomes A,B, E and F are basically African or Asian in origin. The species of the genome C are Australian in origin and those of genome D are American in origin. The American species may be found from Arizona to Peru, but mostly growing wild in Mexico. The chromosomes of the American diploid species are smaller than those of the African and Asian diploid species. Tetraploid species arose out of hybridization between cytotypes A and D followed by spontaneous chromosome doubling. Brewbaker (1964) suggests that upland cotton, *G.*

hirsutum is an allotetroploid having two genomes; genome A from an Asian species and genome D from an American species.

[T]able 2.2 Some representative species of Gossypium grouped by chromosome number and geographic origin

	Chromosome		Genome	Geographic	
	2n	Size	Symbol	Origin	Cultivation
	Diploid species	**from Asia**	**Africa and Australia**		
G. herbaceum	26	Large	A1	Africa	cultivated
G. aboreum	26	Large	A2	India	cultivated
G. anomatum	26	Medium	B1	Africa	wild
G. stuftianum	26	Large	C1	Australia	wild
G. stocksii	26	Large	E1	Indo-Arabia	wild
G. longicalyx	26		F1	Africa	wild
		Diploid species	**from America**		
G. thurberi	26	Small	D1	America	wild
G. armourianum	26	Small	D2	America	wild
		Telraploid	**Species**		
G. lirsutum	52	26 large, 26 small	(AD)1	America	cultivated
G. barbadense	52	26 large, 26 small	(AD)2	America	cultivated
G. tomentosum	52	26 large, 26 small	(AD)3	Hawai	wild
G. caicoense	52	26 large, 26 small	(AD)4	Brazil	wild

From Poehlman (1987)

2.3. IMPORTANCE OF COTTON IN THE REPUBLIC OF SOUTH AFRICA

Cotton is one of the five major crops produced on commercial standards in South Africa (Dippenaar-Schoeman, 1999). The cotton industry in the R.S.A is one of the largest employment sectors, and therefore contributes towards social and economic upliftment in the country (Agrimarket Info, 1998). Production is increasing and this can be seen in production statistics report in Table 2.3 and world statistics (1CAC, 1998a). Current R.S.A crop estimates show an increase of about 30% over that of the previous season and is attributed mainly to the result of a 27% increase in irrigation hectares as well as improved yields. This increase is necessary on account of the present demand-and-supply position where less than 50% of the local demand is provided. This is also reflected in 1CAC (1998b) report on production and consumption.

Yield and quality improvement of cotton is undertaken by Tobacco and Cotton Research Institute (TCRI), near Rustenburg, in North-western Province. The Plant Breeding Division at the Institute is responsible for developing new genotypes that will produce more efficiently under existing or potential environmental conditions, through manipulation of gene frequencies (ARC-TCRI Report, 1997). The division has various programmes aimed at improving genotypic backgrounds for improved production in dry land, irrigation and short growing season conditions, resistance to verticilium wilt and nematodes. Cotton germplasm collection is done on a continuous basis and by the time of the ARC-TCRI report (1997), the germplasm consisted of 1376 accessions. Most of the introductions range from exotic collections from Central America, early US germplasm releases and registered cultivars and local African collections from South Africa, Zimbabwe and Mozambique (Van Heerden *et al,* 1987). Improved cultivars are recommended on the basis of yield, fibre length, fibre strength, micronaire, fibre percentage, good adaptability and tolerance to diseases.

able 2.3 Cotton: Area planted, production producer price, price index and gross value

Production year April - March	Area planted[1]	Production			Average producer price of seed-cotton	Price index[3]	Gross value	Marketing year[4] April - March
		Lint[2]	Seed	Seed-cotton				
	1 000 ha	t			R/t	1995=100	R1 000	
1966/67	*	11 467	19 985	32 763	151.01	8.0	5 195	1967/68
1967/68	*	14 076	24 532	40 217	148.10	7.8	6 254	1968/69
1968/69	*	21 681	37 787	61 946	142.60	7.6	9 275	1969/70
1969/70	*	15 167	26 416	43 306	150.36	7.9	6 842	1970/71
1970/71	24	13 133	22 889	37 623	162.52	8.6	6 403	1971/72
1971/72	*	13 100	22 831	37 429	190.19	10.1	7 474	1972/73
1972/73	*	15 141	26 389	43 260	217.41	11.5	9 875	1973/74
1973/74	*	35 082	61 143	100 234	339.78	18.0	35 760	1974/75
1974/75	46	36 198	63 088	103 423	240.51	12.7	24 412	1975/78
1975/76	26	13 236	23 268	37 817	352.77	18.6	12 869	1976/77
1976/77	*	31 179	54 341	89 083	454.65	24.1	40 044	1977/78
1977/78	*	45 816	79 851	130 903	389.21	20.6	50 373	1978/79
1978/79	100	50 626	88 234	144 646	435.93	23.1	62 342	1979/80
1979/80	120	58 798	102 477	167 994	486.88	25.7	80 868	1980/81
1980/81	115	51 279	89 372	146 511	511.68	27.0	74 120	1981/82
1981/82	107	32 973	57 467	94 209	509.18	26.9	45 850	1982/83
1982/83	105	24 294	42 341	69 411	627.47	33.2	41 667	1983/84
1983/84	99	29 594	51 578	84 554	712.98	37.6	57 509	1984/85
1984/85	107	40 388	70 391	115 394	837.80	44.3	92 393	1985/86
1985/86	126	40 638	70 826	116 109	862.04	45.5	95 650	1986/87
1986/87	160	51 293	89 396	146 551	933.84	49.3	143 273	1987/88
1987/88	182	68 618	119 591	196 051	1 029.41	54.4	192 980	1988/89
1988/89	174	65 731	114 560	187 803	1 073.80	56.7	192 545	1989/90
1898/90	123	52 318	91 183	149 480	1 324.75	70.0	190 102	1990/91
1990/91	91	40 641	70 831	116 117	1 275.21	67.3	141 228	1991/92
1991/92	48	18 489	32 224	52 826	1 316.17	69.5	66 526	1992/93
1992/93	35	11 122	19 384	31 777	1 414.64	74.7	42 703	1993/94
1993/94	67	23 708	41 320	67 737	1 572.56	82.9	106 521	1994/95
1994/95	54	22 288	38 845	63 680	1 910.46	100.0	120 867	1995/96
1995/96	90	39 682	69 160	113 377	2 230.00	116.9	265 884	1996/97
1996/97	83	25 348	44 178	72 423	2 430.00	127.8	176 417	1997/98
1997/98[5]	90	36 646	63 869	104 703	2 500.00	131.8	264 972	1998/99

Source: ABSTRACT OF AGRICULTURAL STATISTICS 1999

) Hectares for the RSA only
) Lint production by RSA ginners from RSA, Namibia, Zimbabwe and Botswana seed cotton
) Index figures are for calendar years, e.g. marketing year 1995/96 = 1995
) Until 1993/94, marketing year, March to February
) Preliminary

2.4 GENETIC VARIATION

As mentioned in Chapter One, genetic variation in the genus Gossypium is quite wide, both in qualitative and quantitative traits.

Yield

Variation exists among *G. hirsutum* genotypes. Yield (seed cotton and lint) is a complex trait with numerous components contributing to it. The expression and magnitude of variation will therefore depend on the contributions of these components and the interaction between them and environmental factors.

Lint percent or ginning out turn

Variation exists between genotypes of *G hirsutum*. This may range from as low as less than 28% to 45% or over.

Boll size or boll weight

Boll size or weight has a great variability. Meredith (1984) quotes Kerr as stating that boll size established in different cultivar types or groups of cultivars, varies with environment, cultural conditions and yield levels. He sites average boll size of cultivars Pima S-5 to be 3.5g. Observations and studies of data from various researchers give boll sizes ranging from less than 3.5g to 8.0g and over.

Seed index

Fryxell (1984) discusses the variation of seed sizes in terms of dimensions (i.e. length). Seed index or weight of 100 seed sample can be anything from 7.0g or less to 15.0gm, plus or minus.

Seeds per boll

Variation may depend on number of locules or carpels per boll. There may be three to five (Meredith, 1984) locules, depending on the genotypes, and several to 8 or more seeds per locule. The variation may then be from ten or less to 40 or more seeds per boll. Average may be 35.0 seeds per boll.

Locules per boll

Fryxell (1984) gives a variation of three to five locules per boll. Observations also show some genotypes with up to 6 locules per boll.

Bolls per plant

Environmental factors influence the number of bolls that mature per plant. Insect pests, length of growing season, water and nutrient levels may affect the number of bolls set. Variation could be from 10 or less to 40 or more.

Plant height

Plant height for G hirsutum can be from less than 1.0 m to 2 m (Fryxell, 1984).

Hair count

This can range from none (completely smooth types) to heavily pubescent genotypes. Lee (1985) quotes estimates from other workers as ranging from more than 20 trichomes per 1cm transect of abaxial surface of leaf (densely pubescent) to completely glabrous (hairless). Hairs also vary in shape and can appear single or branched.

Fibre length

Fibre length may be 1.0mm from the wild cottons with unspinable fibres or naked seeds. Simmonds (1984) indicates lengths of 15 $\pm$ 5mm for short fibres, to 50 $\pm$ 5mm for extra long fibres, especially from Sea Island cottons. He gives a range of 25mm or less to 35mm for G hirsutum.

Fibre strength

This may vary from under 18 to 35 cN/tex units.

Fibre fineness or micronaire

According to the classification of Simmonds (1984) this is associated with fibre length. Shorter fibres are very coarse and micronaire values will be high, while longer fibres are very fine and their micronaire values or readings will be low. This may range from 2.0 (super fine) to over 6.5 readings (very coarse), for upland cotton.

Fibre uniformity

This may be affected by environmental factors which may result in immature fibres. It can range from under 50% to over 80%.

2.5 COMBINING ABILITY

Combining ability has become increasingly important in plant and animal breeding, especially in testing procedures for studying and comparing the performance of lines in hybrid combinations (Griffing 1956b). Knowledge about it, in a population, is useful for rapid progress in any crop improvement programme, as it enables a breeder to select parental lines with good combining abilities for economic characteristics. Information about combining ability and heterosis among cotton gene pools and populations, was found to be essential, in order to maximize F2 hybrid development Tang *et al* (1993a). The same applies to development of elite germplasm. Combining ability studies can yield information on gene action in a base population, thereby aiding in the selection of parents for producing crosses and segregating population (Meredith, 1984).

In this study the testing procedure utilises a diallel crossing system. A diallel crossing system is one in which a set of inbred lines is chosen and crosses among these lines which are made giving rise to a maximum of p^2 combinations (Griffing, 1956b). Wricke & Weber (1986) describe it as a case when there is only one group of k parents which are used as both males and females. This puts a restriction on only bisexual genotypes. Hayman (1960) considers a diallel cross as a set of inbred lines together with the complete set of their F1 progenies - a total of n^2 families. Sughroue & Hallauer (1997) describe a diallel cross as making all possible crosses among a group of genotypes. Diallel analysis includes two forms of combining ability:

(i) General combining ability

(ii) Specific combining ability

These are the first two successive levels of diallel analyses (Wright, 1985).

2.5.1 General combining ability (GCA)

Sprague & Tatum (1942) are quoted by many authors, as the ones who first defined the two forms of combining ability (Griffing 1956b, Baker 1978, Falconer & MacKay 1996). They defined general combining ability as "the average performance of a line in hybrid combination". Falconer & MacKay (1996) define general combining ability of a line as the mean performance of the line in all its crosses, expressed as a deviation from the mean of all crosses. It is therefore important to know and to select lines with good or high combining ability values for characteristics of economic importance, for the improvement of these characteristics.

<u>Yield</u>

Lint yield is the most important factor in cotton production and most breeding programmes focus on improving yield. It is therefore useful to identify lines which have high general combining ability for this characteristic. Many researchers have performed combining ability analyses on cotton yield, and found significant GCA effects. Keerio *et al* (1995) reported significant GCA values for seed cotton yield and all its primary components. Green & Culp (1990) and Ecweku & Alabi (1995) observed significant GCA for lint yield. Tang *et al* (1993a) also observed positive and significant effects for lint yield.

<u>Ginning out turn</u> (GOT)

Ginning out turn or lint percentage is an important characteristic for determining lint yield and improvement in yield, especially lint yield, which favours high GOTs. Baloch *et al* (1996) observed the importance of GCA effects for ginning out turn. Ecweku & Alabi (1995) in their analysis of variance for combining ability found that GCA mean squares were highly significant for GOT. Tang *et al* (1993a) observed that GCA effects of parents, positive or negative were major contributors to lint percentage. He was able to identify one parent line which, used as a female parent, had hybrids with higher lint percentage or GOT, than other hybrids with different female parents. Coyle & Smith (1997) also reported significant variance for GCA in their study.

Boll size (BS)

BS or boll weight is one of the primary components of yield. It is logical to assume that the bigger or heavier the boll, the higher the yield for that genotype. Tang *et al* (1993a) observed six parental lines with significant positive GCA effects, while four exerted significant negative GCA effects.

Sadykhova (1986) was able to identify varieties with high combining ability. Keerio *et al* (1995), XuXian *et al* (1995) and Baloch *et al* (1995), also reported significant general combining ability variances for boll size.

Seed index (SI)

This is one of the components of lint yield. Gencer & Kaynak (1994) observed highly significant GCA variance for 100 seed weight (SI). Six of the twelve parents had positive GCA effects. Coyle & Smith (1997) stated the importance of selecting for seed size which could positively, influence lint yield.

Lint index

LI is a component of lint yield. Xu Xian *et al* (1995) and Keerio *et al* (1995) reported highly significant GCA variance for this characteristic.

Seeds per boll (SB)

Seeds per boll are important as a component of lint yield. Coyle & Smith (1997) reported that more seeds per boll were desirable for lint production within the boll due to greater amount of surface area. They also observed significant GCA variance for SB in their study.

Boll number per plant

Boll number per plant (or per unit area) has a direct bearing on yield and is one of the major contributors or components of yield. Gencer & Kaynak (1994) observed highly significant GCA value for number of bolls per plant and seven out of the twelve parents studied, had positive GCA effects. Sadykhora *et al* (1986), Xu Xiang *et al* (1995) and Baloch *et al* (1996) have also reported significant GCA for boll number per plant. Baloch *et al* (1996), suggested that selection based on number of bolls will simultaneously improve cotton yield because they observed consistency in estimates of combining ability for boll number and yield.

Fibre length (FL)

Green & Culp (1990) observed significant GCA for fibre length. In their studies Gencer & Kaynak (1994) also observed significant GCA for FL and eight out of twelve parental lines in the study recorded positive GCA. Coyle & Smith (1997) recorded significant GCA for FL and so did Tang *et al* (1993b). Zhang & Sun (1994) observed that fibre length was among the cotton characteristics controlled by additive major genes, an indication of significant GCA effects.

Fibre strength

Green & Culp (1990) reported significant GCA effects in their study involving two methods of measuring fibre traits. For standard laboratory instrumentation (SLI) method, three of the five parents had significant GCA effects, one of which was negatively significant, and for high volume instrumentation (HVI) method, only one line had significant but negative GCA effects. The other four were positive but not significant. Fibre strength determined by a third method, ring spun tests, in the same study four of the five parental lines have significant GCA effects, with only one of the four having negative significant GCA effects. Smith & Coyle (1997) reported fibre strength as one of the fibre quality parameters that had GCA variance ranging from 80 to 95% of the total combining ability variance. This indicates significance of GCA effects. Coyle & Smith (1997) again reported positive GCA effects for FS, with significance recorded in one of the two years of their study. Tang *et al* (1993b) reported fifteen out of 20 parents recording significant GCA effects, of which three were positive and twelve were negative. Gencer & Kayak (1994) also reported highly significant GCA for fibre length.

Micronaire (MC)

MC or fibre fineness was reported positive and significant by Gencer & Kayak (1994). Tang *et al* (1993b) reported a significant GCA variance. Thirteen out of 20 parental lines had significant GCA effects and eight were positively significant. Coyle & Smith (1997) observed positive and significant GCA variances. Green & Culp (1990) also reported positive, though not significant, GCA mean squares in their analysis of variance for both SLI and HVI methods of measuring fibre properties.

Fibre uniformity

Green & Culp (1990) recorded significant GCA for one of the methods used for measuring fibre quality properties. Coyle & Smith (1997) also observed significant GCA variance for fibre uniformity in one of the two years of their study. It was also positive though not significant, in the second year. Tang *et al* (1993b) reported significant GCA variance for both male and female parents. Gencer & Kaynak (1994) recorded significantly positive GCA variance for fibre uniformity with five out of the twelve parents having positive values.

2.5.2 Specific combining ability (SCA)

Sprague & Tatum (1942) are quoted by many authors as having defined specific combining ability as a case in which certain combinations do relatively better or worse than would be expected on the basis of the average performance of the lines involved. According to Falconer & Mackay (1996), any particular cross has an expected value which is the sum of the general combining abilities of its two parental lines. The cross may however deviate from this expected value to a greater or lesser extent. It is this deviation which they call specific combining ability of the two lines in combination. Knowledge about SCA among hybrid combinations is very useful.

Khadhi *et al* (1996) concluded from their study that crosses with high and significant SCA effects, accompanied by high heterosis and good perse performance, were the most suitable for commercial exploitation. Baicaixlao *et al* (1998) observed from their study, that characters with higher SCA were controlled by non-additive effects of genotype and their heritability was lower.

Yield

Keerio *et al* (1995) in their study of genetics of seed cotton yield and its primary components observed significant SCA for seed cotton yield and its primary components. Soomro *et al* (1995) also observed highly significant SCA variance for seed cotton yield per plant. Baloch *et al* (1996) suggested that SCA for seed cotton yield was very important. Tang *et al* (1993a) observed that SCA effects for lint yield were small compared to GCA effects; Gencer & Kaynak (1994) observed significant SCA for seed cotton yield.

Ginning out turn (GOT)

GOT is an important component of yield as it determines lint yield from seed cotton yield. Ecweku & Alabi (1995) studied genetic effects of yield and its components. Their analysis indicated highly significant specific combining ability variance for lint percentage (GOT). Green & Culp, (1990) observed positive SCA for GOT, but it was not significant, which suggested that SCA was less important than GCA for GOT. Similar results were obtained by Gencer & Kaynak (1994), whereby SCA was positive but not significant. Coyle & Smith (1997) observed significant SCA variance in the two years of their study which suggests some dominant gene action for this characteristic.

Boll size (BS)

Boll size or weight of seed cotton per boll, is one of the primary components of yield. It is logical to assume that the larger the BS the higher the yield expected. Keerio *et al* (1995) observed significant SCA for all components of seed cotton yield, which includes BS. Xu Xian *et al* (1995) and Ecweku *et al* (1995) also reported highly significant SCA variance for BS. Tang *et al* (1993) observed positive and significant SCA, though smaller than GCA. Gencer & Kaynak (1994) observed positive but small and not significant SCA for BS.

Seed index (SI)

Small but significant SCA variance for SI was recorded by Gencer & Kaynak (1994), indicating that both additive and dominant effects play /significant roles in 100 seed weight or SI. Keerio *et al* (1995) , Xu Xian *et al* (1995) and Baloch *et al* (1996) observed highly significant GCA variance for SCA.

Lint index (LI)

Significant SCA for LI was again observed by Keerio *et al,* (1995) , Xu Xian *et al* (1995) and Baloch *et al* (1996).

Seeds per boll (SB)

Coyle & Smith (1997) observed small, positive but significant SCA variance in one of the two years' results and concluded that there was dominant gene action expressed.

Number of bolls

Small but positive and significant SCA variance, was reported by Gencer & Kaynak (1994) for number of bolls. Tang *et al* (1993a) observed no significance and inconsistency of SCA effects across environments, for number of bolls. Keerio *et al,* (1996) ad Xu Xian *et al* (1995) reported significant SCA variances for all the primary component of seed cotton yield, which include number of bolls per plant or per unit area.

Plant height (PH)

According to the study of Gencer & Kaynak (1994), SCA was not significant, though positive, for PH.

Fibre length (FL)

FL had positive but not significant SCA, according to the study of Gencer & Kaynak (1994). Similar results were reported by Green & Culp (1990). Tang *et al* (1993b) reported that in most of the crosses, SCA effects were small for all the characteristics studied including FL.

Fibre strength (FS)

Tang *et al* (1993b) reported that most hybrids in their study had small SCA effects for all the fibre characteristics studied. They reported, however, two crosses having positive and significant SCA values for fibre strength. They also observed significant interaction between environment and fibre strength. Green & Culp (1990) reported small, positive but not significant SCA effects, in all the three methods they used for measuring fibre quality characteristics. Gencer & Kaynak (1994) observed positive and highly significant variance for FS. Coyle & Smith (1997) reported small, positive SCA variances for two years, with significance expressed in one year.

Micronaire (MC)

Coyle & Smith (1997) observed small but significant SCA variance for MC in both years of their study. Gencer & Kaynak observed small SCA variance but did not detect significance. Green & Culp (1990) in their study involving methods of measuring fibre quality characteristics observed small and non-significant SCA variance for MC. Tang *et al* (1993b) observed small but significant SCA variance. They also observed significant interaction between environment and SCA.

Fibre uniformity (FU)

Tang et al (1993b) observed small and non-significant SCA variance for FU. Similar results were observed by Green & Culp (1990) in their study involving different methods of measuring fibre quality characteristics.

2.5.3 GCA/SCA ratio

The GCA/SCA ratio has been used for determining the prevalence of GCA or SCA, and therefore estimating which type of gene action is involved in controlling a particular characteristic. Mean squares for GCA and SCA from anova can be used to calculate the ratio. A larger GCA variance than SCA variance gives a ratio of more than unity, indicating the prevalence of additive gene effects. The reverse of this would indicate prevalence of non-additive or dominant gene effects.

Gencer & Kaynak (1994) calculated GCA/SCA ratios of some of the yield, yield components and fibre technological properties. All of the characteristics they studied had a ratio of more than unity. This indicates the predominance of GCA effects. They concluded that plant height, seed cotton weight per boll (boll size), ginning percentage (lint percentage or ginning out turn), fibre length, fineness (micronaire) and fibre uniformity were directly related to the effects of additive genes. They also concluded that both additive and dominance effects play significant roles in number of bolls per plant, seed cotton yield per plant, number of carpels, 100 seed weight (seed index) and fibre length, although significance of additive gene effects is higher. Fibre length, according to them, had additive and dominance genetic variances almost equal to each other.

2.6 HERITABILITY

Allard *et al* (1960) used the term heritability to specify the proportion of total variability that is due to genetic causes. In another way, the term is defined as a measure of the correspondence between phenotypic values and breeding values (Jones, 1986; Falconer & MacKay, 1996 and Hanson, 1963). The term heritability has been further divided into broad sense and narrow sense heritabilities. Hanson (1963) defined heritability in the broad sense as a consideration of total genetic variability in relation to genotypic variability and heritability in the narrow sense as a consideration of only additive portion of the genetic variability in relation to the phenotypic variability. Heritability in the narrow sense can be useful in making selection progress estimates.

There are, however, problems in obtaining reliable heritability estimates. These may be obtained at a high cost in terms of time required to develop appropriate genotypic populations, and to evaluate them with adequate number of years and locations (Meredith, 1984). Sometimes not all basic assumptions are met or the number or quality of genotypes are deficient. Jones (1986) mentions the restrictions of heritability estimates. They apply to the population studied, in the generations, using the same experimental techniques, under similar environmental conditions. The higher the estimate of narrow sense heritability the greater the potential for breeding gains.

Knowledge of the relative heritabilities of the various traits and their genotypic and phenotypic correlations can aid in the design of efficient breeding systems where many traits need to be improved simultaneously (Jones, 1986).

Early work as compiled by Meredith (1984) gives an indication of heritability of some of the cotton yield and fibre properties and are given in Table 2.6 below.

Table 2.6 : Heritability estimates for yield, yield components and fibre properties

Yield	Lint %	Boll wt.	Seed Index	Lint Index	Seed per boll	Fibre Length	Fibre Strength	Fibre fineness	Reference
0.59	0.9	0.77	0.87	0.81	-	0.79	0.9	0.68	Al-Jibouri (1958)
0.66	0.9	0.51	0.87	0.78	0.34	0.9	0.86	0.67	Miller (1958)
0.52	-	0.6	-	-	0.34	0.56	0.86	0.08	At Rawi and Kohel (1969,1970)
0.29	0.28	-	-	-	-	0.46	0.52	0.52	Baker and Verhalen (1975)

Source: Meridith (1984)

From this table, it can be seen that fibre properties, have high heritabilities. Tang *et al* (1997) also found that fibre length and strength had generally high heritability. Characters like yield are often much influenced by environmental effects and their heritability is therefore low (Wricke & Weber, 1986). Zhang & Sun (1994) also observed that heritability of yield is generally lower than that for yield components and fibre properties.

Yield

Tang *et al,* (1996) observed highly significant and positive broad sense (h^2_b) and narrow sense (h^2_n) heritability for lint yield. Of the four studies reported by Meredith (1984), three had high and positive h^2_n and one had low but positive h^2_n for lint yield. Zhang & Sun (1994) observed non additive gene action for seed cotton yield. Kapoor (1994) reported significant additive component for seed cotton yield.

Ginning out turn (GOT) or fibre percentage

Both h^2_n and h^2_b were highly significant and positive for lint yield (Tang *et al* 1996). Meredith (1984) also reported high positive h^2_n. Gencer & Kaynak (1994) and Kapoor (1994) reported GOT to be under the control of additive genetic factors.

Boll size or weight

Gencer & Kaynak (1994) observed additive gene factors being more influential on boll size. Both h^2_n and h^2_b were positive and highly significant for lint yield (Tang *et al* 1996). Meredith(1984) also reported high and positive h^2_n. All the three studies reported by Meredith (1984), showed high and positive h^2_n. Kapoor (1994) reported significant additive components.

Seed index

Gencer & Kaynak (1994) reported seed index to be under the control of additive gene factors. Zhang & Sun (1994) also reported additive gene effects being predominal for inheritance of seed index.

Lint index

High and positive values of h^2_n were reported in the two studies compiled by Meredith (1984). Zhang & Sun (1994) also reported similar results.

Fibre length

Highly significant and positive h^2_b was observed by Tang B (1996). Gencer & Kaynak (1994) observed highly significant additive genetic effects for fibre length and Meredith (1984) reported high positive h^2_n in all the four sets of results of the four experiments he compiled.

Fibre strength

Tang *et al* (1996) reported highly significant and positive h^2_b, with h^2_n being small in magnitude but positive and significant at $p<0.05$. Four of the results reported by Meredith (1984) showed high and positive h^2_n. Gencer & Kaynak (1994) and Zhang & Sun (1994) both reported additive gene effects to be more influential on fibre strength.

Fibre micronaire

Three out of the four sets of results reported by Meredith (1984) had high and positive h^2_n. Tang *et al* (1996) observed positive and highly significant h^2_b and also positive but less significant ($p<0.05$) h^2_n. Gencer & Kaynak (1994) and Zhang & Sun (1994), observed additive gene effects as predominant.

Fibre uniformity

Like all other fibre characteristics fibre uniformity was under the control of additive gene factors (Zhang & Sun, 1994).

2.7 CORRELATIONS AND CORRELATED RESPONSE

Correlations or relationships between two metric traits can be positive or negative. Falconer & MacKay (1996) discuss interest attached to correlated characteristics being of three reasons: genetic causes of correlation through the pleotropic action of genes; changes brought about by selection and natural selection.

2.7.1 Correlations of characteristics

Two types of correlations are commonly discussed in plant breeding and these are phenotypic and genetic correlations. Phenotypic correlation is association between two characteristics that can be directly observed from measurements of the two characteristics in a number of individuals in a population. (See Table 2.5.1). Genotypic correlation is association of breeding values (Falconer, 1996), which are additive genetic variances. High values of genotypic correlations may indicate considerable genetic association between the characteristics tested. Genotypic and phenotypic correlations between characters are important because they indicate the correlated response that may occur during selection of a simple trait (Akanvou *er al,* 1997). Meredith (1984) compiled some of the early findings and are presented in Table 2.7.1.

Table 2.7.1 Genotypic correlations between lint yield and other traits

Lint yield vs other traits	Miller and Rawlings (1967)	Meredith and Bridge (1971)	Fotiadis and Miller (1973)	Scholl and Miller (1976)
	r_g SE	r_g SE	r_g SE	r_g SE
Lint %	0.90 ± 0.12	0.70 ± 0.14	0.79 ± 0.09	0.84 ± 0.08
Boll weight	0.14 ± 0.23	-0.43 ± 0.22	-0.14 ± 0.15	-0.04 ± 0.14
Seed index	-	-0.45 ± 0.15	-0.62 ± 0.12	-0.28 ± 0.15
Fibre length	0.02 ± 0.20	-0.47 ± 0.18	-0.18 ± 0.14	-0.36 ± 0.13
Fibre strength	-0.69 ± 0.14	-0.54 ± 0.17	-0.46 ± 0.15	-0.36 ± 0.14
Fibre elongation	0.71 ± 0.19	0.03 ±0.20	0.02 ± 0.18	0.38 ± 0.16
Fibre micronaire	0.42 ± 0.1.	0.42 ± 0.19	0.62 ± 0.12	0.54 ± 0.12

Source: Meredith (1984)

r_g = genotypic correlation coefficient

<u>Yield</u>

According to earlier studies, lint yield was found to be positively correlated with lint percentage or ginning out turn (Table 2.7.1). Tang *et al* (1996) estimated correlation coefficients among yield and fibre traits of F2 hybrid populations of upland cotton. He observed that lint yield had highly significant r_a (additive) and r_g (genotypic) correlations with lint percent; boll number per plant, fibre elongation (only r_a) and micronaire. Rp (phenotypic) correlation was significant with lint percent and micronaire. Lint yield had significant negative r_a and r_g correlations with boll weight, fibre strength and fibre length. Rp correlation was also detected for boll weight, fibre strength and elongation.

Carvalho *et al* (1994) reported positive correlations between seed cotton yield and number of bolls per plant, boll weight and plant height. Gomma (1995) also reported highly significant correlations between seed cotton yield and number of bolls per plant and also micronaire.

Ginning out turn (GOT) or lint percent

Tang *et al* (1996), observed significant positive r_a and r_g correlations between GOT with number of bolls per plant, fibre elongation, micronaire and lint yield, but r_a and r_g correlations were significantly negative with boll weight and fibre strength. He observed significant positive r_p correlation with boll number and micronaire and significant negative r_p correlation with boll weight and fibre strength.

Boll size (or boll weight)

Observations of Tang *et al* (1996) showed negative r_a with all the characteristics under study. It had positive and significant r_g with fibre strength and negative and significant r_g with boll number and micronaire.

Boll number

Tang *et al* (1996) observed significant and positive r_a with lint yield. r_g was positively significant with fibre length (2.5% span length). r_p was not significant with any trait. Gomma (1995, Zhu (1994), Dedaniya & Pethani

(1994) and Carvalho *et al* (1994) similarly observed positive genetic correlation between number of bolls per plant and seed cotton yield.

<u>Micronaire</u>

Observations of Tang *et al* (1996), showed positive and significant r_a, r_g and r_p with lint yield, significantly negative correlations; r_g with fibre length (50% span length) and r_p with fibre strength.

<u>Fibre strength</u>

Negatively significant r_a, r_g and r_p with lint yield, and fibre length (r_p only); were observed by Tang *et al* (1996).

<u>Fibre length</u>

No r_a correlation was detected with all the characteristics studied, positive and significant r_g correlation was detected with boll number and elongation, and r_p was positive and significant with fibre strength (Tang *et al*, 1996).

2.7.2 Correlated response

Correlated response concerns the change of the correlated character Y when character X is selected. Mather & Jinks (1982) attribute differences caused by selection to redistribution by recombination of genes within chromosomes. Selection will therefore pick out recombinant chromosomes and wherever the genes controlling a second character are intermingled along the chromosome with those controlling the operative character, recombination of the one set will mean recombination of the other. Fixation by selection of the redistributed gene combinations for the one character will then mean fixation of redistributed gene combinations for the other, with consequent possibility of a change in phenotype. A second character will thus show a correlated response to a selection which did not aim at altering it, though the magnitude and direction of this correlated response may well be unpredictable. According to Falconer & MacKay (1996), the consequent change of character Y is given by the regression of the breeding value of Y on the breeding value of X, and he gives appropriate formula for this regression. The response of a correlated character can therefore be predicted if the genetic correlation and the heritabilities of the two characters are known. Through correlated responses, it might be possible to achieve more rapid progress under selection for a correlated response than from selection for the desired character itself. This is indirect selection, a term referred to as selection applied to some character other than the one it is desired to improve (Falconer & MacKay, 1996). Jones (1971) observed that when genetic correlations were significant the realised response fitted expectations well but when genetic correlations were non-significant, the realised responses were generally unimportant as predicted. Knowledge of such responses can assist breeders in making prudent selections and in the design of improved breeding procedures. Tang *et al* (1996) observed additive correlation of 1.00, between lint yield and lint percentage and suggested that indirect selection for yield improvement , by selecting for lint percentage, should be as effective as direct selection for lint yield in the populations he studied. Correlated response was observed by Miller & Rawlings (1967) from unselected traits, when he selected for lint yield. Lint percent increased; weight per boll and seed index decreased; number of seeds per boll tended to increase, though there were fluctuations; lint index appeared unaffected; fibre length and strength decreased while fibre elongation and micronaire increased.

2.8 HETEROSIS

Heterosis is a special form of expression of characters in the F1 generation. It's a genetic phenomenon resulting from heterozygosity (Shigeru *et al,* 1998), usually described as superiority of F1 hybrid performance over some measure of parental performance, i.e. hybrid vigour. This usually refers to the increase in size or rate of growth of offspring over parents (Duvick, 1999). Falconer & MacKay, (1996) describe heterosis as the difference between the hybrid and the mean of the two parents and this is often expressed as a percentage of the mid-parent. The other type of heterosis is high parent heterosis, which is the difference between the hybrid and the high parent. Lamkey & Edwards (1999) suggest that high parent heterosis is preferred in some circumstances, particularly in self-pollinated crops, for which the goal is to find a better hybrid than either of the parents.

Much research has been done on cotton but there is very little worldwide use of heterosis in the crop (Meredith, 1999). Earlier studies on heterosis in cotton were compiled and summarised by Meredith (1984). These are presented in Table 2.8. These studies indicated average heterosis for lint yield being 18.0% with a range of 3 - 33%. Lint percentage (GOT) heterosis was low, only 1.5% as its components, seed index (3.4%) and lint index (4.2%). Heterosis in fibre properties was very low with fibre length (2.0%), fibre strength 0.01%) and fibre fineness (0.0%). Niles & Feaster (1984) cite Davies (1978) as having quoted several authors that had reported heterosis for yield in intra-hirsutium hybrids. In the review, a report from India had indicated a 138% increase in net yield of an F1 hybrid over a commercial check cultivar. This was the first commercial exploitation of heterosis in an intra-hirsutium hybrid H4 in 1970 (Randhawal & Singh, 1994). This was the greatest degree of heterosis noted and yet other reports indicated heterosis for yield in the order of

17%. Niles & Feaster (1984) also reported fibre properties as not showing appreciable heterosis, hence making *G hirsutum* crosses appear to afford little potential for improvement of fibre properties. A high heterosis for seed cotton yield (171%) over its high parent G67 was reported by Busu (1994). Busu (1996) also reports heterosis breeding as having made the most significant contributions in improvement of both yield and fibre quality in recent times. This was the first major success of hybrid cotton in the world, and it was produced in India. Following this success, India reports about 48% of its cotton from F1 hybrids (Chaudhry, 1997a) with 40% of this production coming from *G. hirsutum x G. hirsutum.* Wells & Meredith (1986) reported 213.8% heterotic effect in yield of F1s.

Tang *et al* (1993a) observed positive F2-MP heterosis for lint yield, no positive heterosis for lint percentage (GOT) significant positive HP and MP heterosis for boll weight and positive heterosis for boll number.

Miller & Marani (1963) reported significant F1-MP heterosis in a diallel cross with lint yield having the greatest (27.5%) and relatively small for lint percentage or GOT and boll weight. Lee *et al* (1967) also obtained similar results.

Several workers have reported (MP) heterosis for yield and its components ranging between 8 and 24% (Meredith & Bridge, 1972; Meredith, 1990; Tang *et al* 1993a).

Tang *et al* (1993b) reported low but significant heterosis for fibre strength (3.4%), and micronaire (6.5% and 5% in two crosses), 2.5% SL (1.1) and 50% SP (2.0 - 2.5%).

Table 2.8 **Heterosis for yield, components of yield and fibre properties**

	Components						Fibre Properties			
Yield	Lint%	No of bolls	Boll weight	Seed index	Seed/boll	Lint index	Length	Strength	Fineness	Reference
5.5	2.7	9	7.1	9.7	6	1.4	2.8	5.6	1.4	Al-Rawi and Kohel (1969,1970)
305	0.6	-	-	-	-	-	0	0	0	Baker and Verhalen (1973)
14	1.6	-	-	-	-	-	1.9	0.5	0.2	Baker and Verhalen (1975)
9.6	1.1	4.1	13.4	1.5	2	2.8	2.8	0.2	0	El-Adl and Miller (1971)
18.8	2	33.9	5.4	3	-	5.5	1.2§	0.0*	-	Kine and Tilley (1947)
26	1.7	-	8.5	3.9	-	-	2.8§	-1	-0.1	Lee et al (1967)
20	0.7	10.3	7.3	3.8	2.3	4.6	-	-	-	Marani (1963)
19.6	1.6	6.2	8.8	1.5	1.1	6.7	1.1	0.3	1.6	Marani (1968a, 1968b)
22.7	1.1	-	13.4	0.2	-	-	2.8	0.2	0	Meredith & Bridge (1972)
16.7	2	-	9.1	-	-	-	2.4	-1.3	-1.5	Meredith et al (1970)
19.6	0	-	5.6	-	-	-	0.08	-2.3	1.3	Miller and Lee (1964)
27.5	1.5	-	8.9	-	-	-	3.6	3.3	-	Miller and Marani (1963)
-	-	-	-	-	-	-	2.8	-4.7	-2.9	Quisenberry (1975)
14.9	2.5	6	5.7	-	-	-	-	0.0*	-0.1	Thompson (1971)
33++	-	25	7	-	12	-	-		-	Turner (1963)
18	1.5	13.5	8.3	3.4	4.7	4.2	2	0.1	0	Mean
8.21	0.7	11.38	2.69	3.1	4.5	2.12	1.18	2.46	1.3	standard error

\+ **Heterosis = 100 x (F1 - mid-parent/mid-parent**

++ **Seed cotton yield, all othes lint yield**

§ **Length measured as upper half mean, all others 2.5% span length**

• **Strength reported as Presseley units, all others are π units**

CHAPTER THREE

MATERIALS AND METHODS

3.1 EXPERIMENTAL MATERIAL

The material for this study consists of genotypes among those found in the germplasm collection at the Tobacco and Cotton Research Institute (T.C.R.I.) at Rustenburg, in the Republic of South Africa. Progenies were derived through crossing the parental genotypes selected from the germplasm. Parental genotypes and their progenies, therefore formed the material for this study. The material was evaluated at two different locations for two seasons; in 1997/98 and in 1998/99.

3.1.1 Parental genotypes

This study involved six parental genotypes. Selection for these genotypes was considered on the basis of variability among characteristics contributing to lint yield and quality of fibres. There was also variation in the level of hairiness among them. The genotypes included varieties or cultivars that had been developed and released for commercial production, elite breeding lines in advanced stages of testing and one accession which was in its early stages of evaluation. Levels of homozygosity for the characters studied were assumed sufficient, though more generations of selfing would have been preferable. The six parental genotypes are briefly discussed below. Their pedigree and origins are presented in Table 3.1.

IRCO

This accession was obtained from West Africa. It is very hairy and is being evaluated for yield and quality attributes. It is also being used in the crossing programme aimed at improving resistance of other breeding lines to the jassids (Empoasca spp.), by conferring the hairy trait into these lines. Jassids are among the major pests of cotton. They suck the sap from the leaves and cause the leaves to dry up. This accession is also supposed to have a high ginning out turn (GOT) or lint percentage.

The seeds for this accession were obtained from selfed bolls (second cycle of selfing). This accession is a recurrent selection from three families: Allen, Truimph (both of American origin) and Nkourala (of African origin).

PALALA

This is a breeding line that has gone through final stages of testing. It has been included in the national list of registered varieties and recommended for release as a commercial variety, in South Africa. Palala has the same pedigree as Marico, a variety that is already released. The difference is in the levels of hairiness. Marico was developed as a smooth variety, but Palala was developed from a single plant selection for its hairiness. This characteristic gives it an added genetic advantage, over Marico, for resistance to jassids. It is comparatively a high yielder with satisfactory fibre quality characteristics. The seeds were obtained from seed multiplication plots, with open pollinated bolls.

OR27

This is an elite line which is among those in advanced stages of testing. It is a fairly or normal hairy line and gives satisfactory lint yield and fibre quality characteristics. This line has an added good characteristic of big bolls. The seeds were obtained from seed plots with open pollinated bolls.

2131-2-5

This is also an elite line which is in advanced stages of testing. According to Du Plessis & Van der Westhuizen (1997), it was developed for short rain season areas. It has a short maturity period of between 120 to 125 days. This is a much shorter period compared to 160 days taken by conventional cotton varieties. It is a normal hairy line with reasonably good yield and fibre quality characters. Seeds were obtained from seed plots, but open pollinated bolls.

DPAc90

This is one of the old commercial cultivars. It was developed in the United States of America by the Delta and Pine Land Company, and released in 1981 for its excellent fibre strength and high yield potential according to Smith & Coyle (1997) and Coyle & Smith (1997). It has short-statured plants with relatively small bolls. The yield is reasonably good, but comparably low against the newly developed varieties. Its ginning out turn is high. The seeds for this cultivar were obtained from seed plots, but open pollinated bolls. It is a smooth or glabrous type.

SICALA

This is a commercial variety which has been in cultivation for quite a time. It was developed by the Australian cotton company, Clark Cotton. It is, like DPAc90, a smooth variety and produces good yields and good quality characteristics. Like the other entries, its seeds were obtained from seed plots with open pollinated bolls.

Table 3.1.1 Pedigree and origin of parental genotypes

ENTRY	PEDIGREE	ORIGIN	GENOTYPE	SEED SOURCE
IRCO	[Allen: Truimph: Nkoraula]	Nigeria (CIRAD-AC)[1]	H++.Y.	Isolated seed plots
PALALA	DPA C90 X 86/4/21 xAJE	South Africa (T.C.R.I.)	H+.Y+	Isolated seed plots
OR27	Tamcot sp2 x OR8	South Africa (T.C.R.I.)	H.Y.B+	Isolated seed plots
2131-5	Nebo x (LB5160 x SJ1) x (PD6 x Nebo 108)	South Africa (T.C.R.I.)	H.Y.	Isolated seed plots
DPAc90	Commercial	U.S.A. (Delta and Pine land Co.)	H-.Y-.B-.	Isolated seed plots
SICALA	Commercial	Australia (Clark Cotton Co.)	H-. Y+	Isolated seed plots

[1] Centre for International Co-operation in Agricultural Research and Development.

H =Hairiness; H++ means very hairy; H+ is medium hairy; H. is normal hairy; H- is smooth or glabrous.

Y = Yield; Y+ is high yield, Y. is medium yield, Y- is low yield.

B = Boll Size; B+ is large bolls; B- is small bolls.

3.1.2 Progenies

The progenies used in this study were generated through crossing the six selected parental genotypes in a half-diallel mating design. Twenty plants of each of the genotypes were raised in pots, in the glass house, during the winter time of 1997 and 1998. To enhance the growth and development of the plants, NPK [2:3:4(33)zn] fertilizer was added to the pots three times, with the first application done just before squaring. The other two applications were done at weekly intervals following the first one. Application was done by first applying water to the pots and then drilling six holes approximately four cm deep, into the soil. The holes were equidistantly distributed round the pots. Six grams of the fertilizer were then equally apportioned into the six holes, lightly covered and a little bit of water applied. Water was supplied to the plants through drip irrigation system and pest control was ensured by regularly spraying the plants with appropriate insecticides. The pest mainly observed in the glass house were aphids, white flies and later on, red spider mites.

Crosses were made using hand emasculation and pollination technique. Flowers of the maternal parents were emasculated in the evening, prior to the day they would normally open. The pistil of the emasculated flower was pushed into a straw tube cut to 3 cm length and folded over at the top end. This helped to eliminate chances of any foreign pollen getting into the stigmatic surface of the emasculated flower, and also kept the stigma moist. The following morning, pollen from a fully opened flower from a paternal parent was dusted on to the stigma of the emasculated maternal flower and the pistil pushed back into the straw again. Pollination was usually done between 9.00 and 10.00 am, to maximise seed set and reduce flower abortion. Kausar *et al* (1998) reported a decrease of boll retention from 58.31% to 30.00% when pollinations were delayed from 9.00 - 10.00 am to 10.00 - 11.00 am. Fifteen crosses were raised from this mating design according to the formula:

$n=p(p-1)/2$

where n = the number of possible crosses according to this design and

p = the number of parens involved.

The design and the number of crosses resulting from it are shown in Table 3.2.

[2]Table 3.2 - Half diallel mating design and the crosses generated for the study

Females	IRCO	PALALA	OR27	2131-5	DPAc90	SICALA
IRCO	s					
PALALA	x	s				
OR27	x	x	s			
2131-2-5	x	x	x	s		
DPAc90	x	x	x	x	s	
SICALA	x	x	x	x	x	s

[2]s = selfed parent

x = cross

The crosses and selfs from the plants, planted in May 1997 were harvested in October 1997 and they were the source of seed for evaluation, as F1s, parents in the 1997/98 season. In May 1998 another lot of parental genotypes were planted in the glass house and the same process was repeated to generate F1s and selfed parents for evaluation in the 1998/99 season. This was repeated because the material was evaluated under the hail net in the 1997/98 season, and it was thought that the same material should be evaluated under normal open field conditions as well.

Seeds for experimental material were raised by ginning the seed cotton harvested from crosses and selfs, acid delinting the fuzzy seeds and dressing the seeds with a fungicide called Vitavax.

3.2 EXPERIMENTS

A total of four diallel experiments were conducted for two seasons, in 1997/98 and 1998/99, at two different locations.

3.2.1 Entries and experimental design

Twenty one entries were included in this study to evaluate lint yield and quality characteristics, in all the trials conducted. These included the six parental genotypes and the fifteen progenies generated from the half diallel mating among the six genotypes. The entries which appeared in all the trials conducted are listed below:

1. IRCO
2. PALALA
3. OR27
4. 2131-5
5. DPAc90
6. SICALA
7. PALALA x IRCO
8. OR27 x IRCO
9. OR27 x PALALA
10. 2131-5 x IRCO
11. 2131-5 x PALALA
12. 2131-5 x OR27
13. DPAc90 x IRCO
14. DPAc90 x PALALA
15. DPAc90 x OR27
16. DPAc90 x 2131-5
17. SICALA x IRCO
18. SICALA x PALALA
19. SICALA x OR27
20. SICALA x 2131-5
21. SICALA x DPAc90

In the diallel cross the number of entries is given by the formula

$$\frac{n\cdot(n+1)}{2}$$

according to Griffing (1956b). In each of the crosses listed above, the parent on the left of the cross sign is a maternal parent, while the one on the right of the cross sign is a paternal (pollen source) parent.

Two trials were conducted in 1997/98 season, one at each of the two locations. The experimental material evaluated in this season comprised of the F1 progenies and their parents. Two trials were again conducted in 1998/99 season, one at each of the two locations. The experimental material comprised of again F1s and their parents. A randomised complete block design was used throughout the evaluations. This design was chosen as the most commonly used and also applicable to this diallel study (Griffing, 1956b). The experiments planted during 1997/98 and 1998/99 seasons consisted of three replications each.

3.2.2 Experimental locations

Two locations were used to evaluate the experimental material in this study. They were:

1. Tobacco and Cotton Research Institute (T.C.R.I.) at Rustenburg;
2. Loskop Agricultural Experiment Station at Groblersdal.

These locations are approximately 300 km apart, are ecologically distinct and fall under different cotton production regions. There are eight distinct cotton producing areas in the Republic of South Africa. These have been demarcated using different criteria, such as altitude, rainfall, day degrees (temperature) etc. (Dippenaar *et al* 1991, 1992; Dent *et al* 1987). The regions are:

1. The Lower Orange River
2. The Northern Cape
3. The Western Transvaal
4. The Northwestern Transvaal
5. The Limpopo Valley
6. The Central Transvaal
7. The Eastern Transvaal
8. The Northern Natal

These regions can be seen in Figure 7, Appendix A. The figures 1 to 8 correspond though the naming slightly differs. Rustenburg falls under the Northwestern Transvaal region while Loskop falls under The Central Transvaal region. These two locations have outstandingly different soil types. The soil at the T.C.R.I. are of dark gray heavy clay type of Arcadia Form, belonging to the Rustenburg Family. This soil has a high clay content (66% clay) with a pH. of around 7.0. At Loskop Agricultural

Experiment Station, the soil is a red sandy clay loam of Hulton Form, belonging to the Ventersdorp Family. This soil has a low clay content, ranging from 20 - 25% in the top soil, to 30 - 35% in the subsoil, with a pH. of around six. The cotton growing seasons also differ in these regions. The one in the Central Transvaal region is longer than that in the Northwestern region.

3.2.3 Land preparation and soil sampling

All land preparations were done according to established standard procedures.

3.2.3.1 Seedbed preparation

This involved two ploughings, discing and harrowing to get fine tilth. First ploughing was done at the onset of winter and the second ploughing plus the other operations were done in summer close to the time of planting.

3.2.3.2 Soil sampling and analysis

Soil at the two locations were sampled and analysed for soil nutrients in both seasons. At Loskop soil was also analysed for nematode presence, also in both seasons.

Nutrient analysis

For nutrient analysis soil was taken from three depths; between 0 - 30cm, between 30 - 60 cm and between 60 - 90 cm. Six sites were selected around the trial site in a manner that was representative of the whole site. Using an auger, soil was sampled from these depths, and all six samples at the same depth were put in one bag and mixed thoroughly to form one soil sample. The analysis covered elements such as N, P, K, Ca, Mg, Cl. and Zn. Results of the analysis indicated a low level of fertility at Loskop and it was recommended that NPK [2:3:4 (33) Zn] fertiliser be applied to the trial site at the rate of 400 kg/ha after planting, by hand application method. Fertility level at Rustenburg was good but the whole block of 5.3 ha, where the trial was sited, received a general application of 300 kg of fertiliser NP [2:3:4 (33) Zn], which was broadcast and raked in before planting.

Nematode analysis

Nematodes usually abound in sandy soils and hardly exist in heavy clay soil. The analysis for nematodes was therefore done only at Loskop for both seasons (1997/98 and 1998/1999). Each trial site was marked out into corresponding number of blocks or replicates. From each block four samples were taken from four sites which were randomly selected and were considered representative of the block. Using a soil auger, soil up to a depth of 30 cm was collected from each site. The soil samples from the four sites in a block were mixed in one bag to make one sample for analysis.

Analysis revealed that samples from the field in which trial EXPT2 was planted in 1997/98 season, had a high number of nematode spp, especially Paratrichodorus spp. It was therefore recommended that a nematicide (Temik) should be applied along the furrows before placing cotton seeds, and this was done at the rate of 4 gm Temik per 4 meter row. Analysis of the soil sample from the trial sites in 1998/99 season indicated a low level of nematodes. It was therefore not necessary to apply a nematicide according to the advice from the Nematologists at the Institute.

3.2.4 Planting of trials

All the trials were hand planted and the Institute's recommended spacings were followed.

3.2.4.1 1997/1998 Season's trials

Two trials were planted, one at each of the two locations. They were Diallel EXPT1 at Rustenburg, and Diallel EXPT2 at Loskop. These trials consisted of F1 progenies plus their parents. At Loskop diallel EXPT2 was planted on 10 November 1997 and one week later, on 18 November 1997, diallel EXPT1 was planted at Rustenburg also. The trials were planted late in the growing season which normally starts in mid-October, due to delay in maturing of the F1 seeds.

At both locations the trials were planted under a hail net. In order to fit the trial within the hail net dimensions, plots consisted of two rows, each four meters long. The spacing between rows was one meter and between plant stations within the row, was 0.2 meters apart. These were recommended spacings at the Institute.

A shallow furrow, approximately 3 - 4 cm deep was made along a marked plot row and seeds were then placed along the furrow at a spacing stated above. As mentioned earlier in Loskop, Temik was applied in the furrows before seed placement. Two seeds were placed at each station, due to limited number of F1 seeds produced. Two to three cow pea *(Vigna unguiculata L.)* seeds were also placed with the cotton seeds at the same station. The idea was that the cow pea seed would germinate faster than cotton seeds. The cow pea seedlings would help in breaking the soil crust at germination thereby ensuring easy emergence of cotton seedlings. A chain link, with graduations of 0.2m was placed along the furrows to ensure accuracy of spacing within the row. The seeds were then covered lightly. A path or an alley, three meters wide, was left between the blocks to enable tractor operations, especially spraying. Also border rows were planted on either sides of the blocks.

3.2.4.2 1998/1999 Season's trials

Two trials were planted, one at each of the two locations. The two trials were diallel EXPT3 at Rustenburg and diallel EXPT4 at Loskop. They were a repeat of the 1997/1998 season's trial which consisted of F1 progenies plus their parents. At Rustenburg, diallel EXPT3 was planted late on 23 November 1998 due to delay in maturing of F1 bolls of the crosses involving one maternal parent. The first flush of flowers of this maternal parent all aborted and it was the subsequent flowers which were used in the crosses. At Loskop, diallel EXPT4 was planted on 25 November 1998. Heavy rains added to the delay in planting at this location. The same procedure of planting in 1997/1998 season was followed, except Temik was not applied in any of the 1998/1999 season's trials. Same spacing was used as in 1997/1998 season. An alley of 3 m width was left between blocks or replicates, to enable operations such as insect pest application using a tractor. Plots consisted of one row, 9 m long.

3.2.5 Management of trials

Management of trials was done well at both locations in both seasons. Recommended management practices were followed.

3.2.5.1 Weed control

The trials were kept weed free by applying herbicides immediately after planting. This was followed by water irrigation with overhead sprinklers. The herbicides used were Cotogard and Dual. Subsequent weeds were hoed up or uprooted by hand. The cow pea seedlings used to break the soil crust were pulled out as soon as cotton seedlings had emerged and established well, to eliminate inter-competition. Cotton seedlings were thinned to one plant per station as early as 3 - 4 weeks after planting to avoid intra-competition.

3.2.5.2 Water supply

Adequate moisture for the plants was ensured through overhead sprinkler irrigation during periods of no rain. At Loskop in the 1997/1998 season the trial received a total of 978 mm of water, out of which 527 mm were supplied through irrigation. In the 1998/1999 season at Loskop a total of 774.7 mm of water were received, out of which 225 mm were supplied through irrigation. At Rustenburg rainfall figures as well as those for irrigation for the 1997/1998 season were not available for the trial site under the hail net. In 1998/1999 season, rainfall figures received at the trial site were 318 mm. This figure was recorded up to the end of January 1999. There were, however, a few more showers in February and March which are not recorded. Through irrigation 145 mm were supplied to the plants.

3.2.5.3 Insect pest control

Insecticides were applied at both locations for insect pest control. Knapsack sprayers were used for the trials under the hail net in 1997/1998 season and the tractor mounted boom sprayers were used for application in the field for 1998/1999 season's trials at both locations. Pesticides applied were Thioflo (Endosulfan), Curacron (Profenotos), Rogor (Dimethoate) and Agrimec (Abamectrin). These were used to control different pests which included boll worms, white flies, jassids and red spider mites. The last two were observed only at Loskop.

3.3 CHARACTERISTICS MEASURED

Yield and lint quality were the main characteristics under study. The major components of these characteristics were therefore measured for subsequent analysis. Yield and its components were measured either directly or calculated using appropriate formulae. Components for yield included seed cotton yield, lint yield, boll number, boll size, seeds per boll, seed index, lint index and ginning out turn. Other agronomic characteristics measured, and relating to yield included, fruiting branches, fruiting sites, harvested boll, plant stand and plant height.

Lint quality components included fibre length, fibre length uniformity, fibre strength and fibre fineness (micronaire). These measurements were done at the South African Cotton Board Fibre Laboratory, in Pretoria, using a High Volume Instrument (H.V.I). Lint samples were submitted for each of the plots in the experiments for fibre analysis. All fibre quality components were determined from twenty five boll samples (in 1997/1998 season) and the fifty boll samples (in 1998/1999 season). These bolls samples were picked randomly from each plot, ginned and a sample of lint weighing 50 g, (30 g for 25 boll samples) was submitted for fibre analysis. Well opened bolls were picked for this analysis.

3.3.1 Yield

Total seed cotton and lint yield were obtained from total plot harvest. Harvesting was done more than once and the seed cotton harvests were bulked, weighed, ginned, and the lint also weighed. In 1997/1998 season stand counts were generally low and harvests were made from all the plants in the plot. In 1998/1999 season outer plants one on either side of the row, top plants, were not harvested to eliminate border plant effects.

3.3.2 Number of bolls

Number of bolls per plant or per unit area is an important indicator of the performance of a cotton genotype. To determine this, five plants were randomly selected in each plot. The number of bolls formed (TBF) on each of these plants was counted. It was also observed that not all the bolls formed on the plant opened well. Counting the number of bolls that were harvested (HB) and therefore contributed to plot yield, gave and indication of extent of damage (by pests) and weather conditions. Averages of the five plants gave indication of the number of bolls formed or harvested per plant. These averages can also be used to calculate the number of bolls per unit area of land, by multiplying the average with the number of plants occupying the corresponding area, following the spacing used.

3.3.3 Boll size

Boll size, measured by its weight, can be used as an indicator of performance of a genotype. The larger the boll the heavier the yield expected. Large bolled genotypes are thus considered high yielders. Five fully opened bolls were picked, one from each of the five randomly selected plants per plot. The bulked seed cotton was weighed. The mean weight of this total weight gave an indication of boll size for the particular plot or genotype. From boll size, yield per plant or per unit area, can also be calculated as a product of boll size and number of bolls per plant or per unit area.

3.3.4 Ginning out turn (or lint percentage)

Ginning out turn is another useful trait that is used as indicator of performance of a genotype. Described as a percentage of lint obtained from a sample of seed cotton, genotypes with high ginning out turn values are thus preferable because they yield more lint. Two methods were used for determining ginning out turns. The five boll samples used for determining boll sizes were ginned and ginning out turn for each plot determined. Fifty boll samples (25 bolls for 1997/1998 season) which were picked from each plot for fibre quality analysis, were also used for determining ginning out turns. In both cases, seed cotton weights were taken before ginning and the lint obtained from each sample was weighed. The weight of lint was then expressed as a percentage of the seed cotton sample.

3.3.5 Number of seeds per boll

Seeds are the units of production of lint. Fibres grow from the outer cells of seed surfaces. The larger the seed surface the more the lint produced. It is therefore another good indicator of the genotype's yield performance. The mean of the number of seeds obtained from a five-boll sample from each plot was used for the determination of the number seeds per boll.

3.3.6 Seed index

This parameter has also a relationship with the yield potential of a genotype, as seed is considered to be a unit for lint production. It is expressed as the weight of 100 seeds. The five boll samples used in determination of boll sizes were used for determining seed indices. A sample of 100 seeds from each plot was weighed and the trial mean of each genotype determined from plot weights and replications. Seed size has a correlation with lint percentage and also size of boll, hence small seeds have a larger total surface area and are associated with small bolls and high lint out turn.

3.3.7 Lint index

Lint index, like seed index, has also a direct relationship with yield potential of a genotype. It simply describes the weight of lint obtained from a seed cotton sample of a hundred cotton seeds. This parameter was calculated from the measurements on the five boll seed cotton samples for each plot. This was obtained using the formula:

$$x = 100 \text{ X } {}^{y}/_{s}$$

where x is the lint index value,

y is the lint weight obtained from the five boll seed cotton samples and

s is the number of seed obtained from the five boll seed cotton samples.

3.3.8 Fibre length

This is a measure of fibre or staple length in mm and is one of the fibre quality characters the textile industry is interested in. This was determined by the South African Cotton Board Fibre Laboratory, using the H.V.I. system. Lint samples were submitted for each plot. Usually a sample of lint is passed through a rotating drum and the fibres get combed in a special way, straightening them. The high volume I nstrument then gives a reading of both 50% and 2.5% span length as a value which 50% and 2.5% of the combed fibres equal to or exceed, respectively.

3.3.9 Uniformity of fibre length

This is also an important lint quality characteristic determining the maturity of the fibres. The value is taken as a ratio of 50% span length to 2.5% span length of a sample of combed fibres. This value is important in determining the spinning performance and utility of the lint. Higher values are an indication that the yarn spun from such fibres will be uniform in size and strength, with less wastage of fibres as well.

3.3.10 Fibre strength

This quality characteristic is useful for spinners. High value or high tensile strength of the fibres are needed for good spinning, properties, especially with modern fast spinning machines. The strength of the fibre is measured as a force required to break a bundle of fibres which are secured between clamps, set at 32 mm apart. This strength is expressed in g/tex or CN/tex units.

3.3.11 Fibre fineness (micronaire)

This parameter measures the texture of cotton fibres. Cotton fibres may be graded into soft and silky or coarse and harsh. Fineness is expressed in micronaire units. It is a measure of the rate of flow of air, at standard pressure, through standard volume of cotton lint. The finer the fibre, the slower the rate of air flow and hence, the lower the micronaire value. This quality characteristic is also important for the type of textile product expected. All fibre quality characteristics were determined on the lint samples submitted to the South African Cotton Board Fibre Analysis Laboratory in Pretoria.

3.3.12 Hairiness

The parental genotypes used in the half diallel crosses in this study, had variation in the levels of hairiness. It was therefore necessary to establish the levels of hairiness in the progenies as well as parental genotypes and study their correlations to yield and quality characteristics. Samples of leaves were taken from the five plants randomly selected from each plot. These are the same plants used in the determination of boll size. To ensure consistency in the age of the leaves, they were picked at a constant position on the plant. The fifth leaf from the apex of the main shoot of the cotton plant was used. The first leaf was taken as a fully opened leaf at the apex. The under surface of each leaf was examined under the microscope. Two areas on either side of the midrib were examined. A microscope field at 3.2 X 10 magnification was fitted at the confluence of the midrib and the main primary veins, near the leaf base. The number of hairs in the microscope field was counted and the mean of the two readings was taken as the number of hairs for the leaf, per area of microscope field. The leaf area observed was approximately 32.46 mm^2 determined by using a graph paper and a linear scale device. The mean of the five means (two counts per leaf) was obtained as an indicator of the hair counts for the genotype in a particular plot.

3.3.13 Plant height

The five plants selected in each plot were measured and their mean gave an estimate of plant height for the plants in that particular plot. This parameter may have a relationship with the yield performance of the genotype.

3.3.14 Number of locules (carpels) per boll

Number of locules per boll was determined on the five selected plants in each plot. The five bolls picked for determining boll size were used for determining this character. Locules of each of the bolls were recorded and their mean determined for a genotype in a particular plot. It can be assumed that, the more locules, the bigger the boll and hence, the higher the expected yield.

3.4 STATISTICAL ANALYSIS

All the data collected were subjected to statistical analyses. Computer program, Agrobase 98, was used for all the analyses performed.

3.4.1 Analysis of variance (Anova)

Anova was performed for randomised complete block design using analysis of variance sub-menu and ACB statistics command - analysis of comple block (Agrobase, 1998). Two anovas were performed, and these were, combined and simple analyses

3.4.1.1 Combined analysis of variance

Combined analysis for diallel experiments one, two, three and four was performed. The results of the four diallel experiments were combined by appending the separate files and analysing using the ACB statistics command from analysis of variance sub-menu. This does the same analysis as GxE except it does not give stability analysis. It was performed to estimate performance of genotypes across locations and assess genotypes x location interaction effects. The analysis provided means, mean squares, F-values and probability levels of significance, least significant differences (LSD) and coefficients of variation (CVs).

3.4.1.2 Simple analysis of variance

Each of the four diallel experiments one, two, three and four, were analysed separately to assess the performance of each genotype at each location. The analysis was done through ACB statistics command of Analysis of Variance sub-menu of Agrobase 98, and it provided means, mean squares, F-values and probability levels of significance LSD and CV.

3.4.2 Performance of genotypes

Mean squares from the anovas for each of the four diallel experiments were used to assess the levels of significant differences among genotypes, locations and genotype x location interaction effects. Least Significant Differences (LSD) were used to separate mean differences and rank the genotypes. Coefficients of variation were also used to determine the magnitude of experimental error. EXCELL computer program was used to draw the charts (histograms) based on means of the genotypes.

3.4.3 Combining Ability

A diallel analysis was performed separately for each of the Diallel experiments one, two, three and four, following detection of significant F-values for the genotypes. Griffing (1956b) and Singh & Chaudhry (1979) emphasised detection of significant F-values for the genotypes as a prerequisite for analysis of combining abilities. Method 2, Model 1, of Griffing (1956b) was used for the analysis. Model 1 for fixed effects is recommended when there are fewer parents and the concern is to compare the combining abilities of the actual parents involved in the experiment with identification of superior combinations. (Griffing 1956b, Baker, 1978). Eberhart & Gardner (1996) recommend that breeders and geneticists should be using Model 1 (fixed model) because they are usually interested in genetic information about a particular set of parents. Method 2 assures no reciprocal effects and so the parents and one set of F1s were analysed. The various steps involved in the analysis of data in Method 2 are the same as in Method 1 and so the statistical model used is the same except the reciprocal factor is removed.

Hence:

$$Y\ddot{y} = m + gi + gj + sij + \frac{1}{bc}\ \Sigma\Sigma eijkl$$

i,j = 1,2 ...., n

k = 1,2 ...., b

l = 1, 2 ...., c

where m is the population mean

Yij is the mean of ixjlt genotype over k and l

gi is the general combining ability (g.c.a.) effect of ilt parent

gj is the general combining ability (g.c.a.) effect of jlt parent

sij is the interaction, i.e. specific combining ability effect

$\frac{1}{bc}$ ΣΣeijkl is the mean error effect.

Analysis of variance for combining ability, with expected mean squares - E(MS), is presented in Table 3.4.3.1.

Table 3.4.3 .1 **Anova for combining ability analysis (Method 2)**

Source	DF	SS	MS	E(MS)	Variance component estimates
g.c.a	n - 1	Sg	mg = $\frac{s1}{n-1}$	$\sigma^2 e + \sigma^2 5 + (n+2)\sigma^2 g$	$\sigma^2 g = \frac{1}{n+2}(Mg - Ms)$
s.c.a	$\frac{n(n-1)}{2}$	Ss	ms = $\frac{s2}{n(n-1)/2}$	$\sigma^2 e + \sigma^2 5$	$\sigma^2 5$ = Ms - Me
error	rb - 1	Se	me = $\frac{s3}{rb-1}$	$\sigma^2 e$	$\sigma^2 e$ = Me

This table was derived from Singh & Chaudhry (1979), and figures in columns for DF and SS substituted with appropriate symbols and formulae.

3.4.3.1 General combining ability

Using the formulae by Singh & Chaudhry (1979), Sums of squares due to g.c.a.
(Sg) are estimated as:

$$Sg = \frac{1}{n+2}[\Sigma(Yi + Yii) - \frac{4}{n} Y^2 ..]$$

General combining ability variance ($\sigma^2 e$) is calculated as given in the formula in Table 3.4.3.

General combining ability effects were estimated from the formula:

$$gi = \frac{1}{n+2}[\Sigma(Yi + Yii) - \frac{2}{n} Y ..]$$

Least Significant Differences (LSD) for testing differences between effects was calculated using the formula:

LSD = SE X t = $\sqrt{}$variance (gi - gj) x t p (t=0.5)

3.4.3.2 Specific combining ability

Using the formulae from Singh & Chaudhry (1979) sums of squares due to s.c.a were estimated as:

$$Ss = \Sigma\Sigma Yij^2 - \frac{1}{n+2}\Sigma (Yi + Yii)^2 + \frac{2}{(n+1)(n+2)} Y^2$$

Specific combining ability affects were estimated using the formula:

$$Sij = Yij - \frac{1}{n+2}(Yi. + Yii + Y.j + Yjj) + \frac{2}{(n+1)(n+2)} Y..$$

Least significant difference (LSD) for testing difference between effects, was calculated using the formula:

$$LSD = SE \ X \ t = \sqrt{variance\ (Sij)} \times tp\ (t=0.5)$$

3.4.3.3 G.C.A : S.C.A. Ratio

This ratio was calculated to study the predominance of the effects and assess the relative importance of additive or non-additive effects. The ratio will indicate whether the character is controlled by additive or non-additive (dominant) gene action (Sing *et al*, 1986). The mean squares for G.C.A and S.C.A were used for calculating these ratios (Msgca : MSsca)

3.4.4 Heritability

Heritability defined as a ratio of genotypic to phenotypic variance (Wricke & Weber, 1986), is calculated from the formula:

$$h^2 = \frac{\sigma^2 g}{\sigma^2 p} = \frac{V(G)}{V(p)}$$

This defines broad sense heritability. When defined as the ratio of additive genetic variance to phenotypic variance (Falconer & Mackay, 1996) it is calculated from the formula:

$$h^2 = \frac{VA}{Vp}$$

This defines narrow sense heritability. The former expresses the extent to which genotype influences the phenotype, while the latter expresses extent to which the phenotypes are determined by the genes, transmitted from the parent.

Variance components were estimated using Agrobase 98 computer program. Diallel analysis, from Plant Breeding sub-menu, using Griffing's (1956b) Method 2, Model 2, was performed. The analysis provided additive and dominance variances.

Broad sense heritability was calculated from the formula:

$$h^2 = \frac{\sigma^2 g}{\sigma^2 p}$$

Narrow sense heritability was calculated from the formula:

$$h^2 = \frac{\sigma^2 A}{\sigma^2 p}$$

Where $\sigma^2 A$ = Additive genetic variance = $2\,\sigma^2 g.c.a$

$\sigma^2 g$ = Total genetic variance = $2\,\sigma^2 g.c.a + \sigma^2 sca$

$\sigma^2 p$ = Phenotypic variance = $\sigma^2 g + \sigma^2 E$

3.4.5 Correlations and correlated response to selection

Phenotype and genetic correlations were calculated as well as correlated response to selection.

3.4.5.1 Phenotypic correlations

A correlation is the ratio of the appropriate covariance to the product of the two standard deviations (Falconer & Mackay, 1996).

Phenotypic correlation can be calculated from the formula:

$$rp = \frac{covp}{\sigma px\ \sigma py}$$

where rp = phenotypic correlation between characters X and Y

covp = phenotypic covariance

σpx or σpy = phenotypic variance of character X or Y

Phenotypic correlations were calculated using a computer program Agrobase 98, sub-menu Statistics and statistic command Corr. This was based on phenotypic means. The analysis provides correlation coefficients, for both positive and negative, estimates together with their probabilities, such that a probability near zero indicates significant correlation, and near 1.00 indicates no correlation (Agrobase, 1997).

3.4.5.2 Genetic correlation

Genetic correlation can be obtained using the formula (Falconer & Mackay 1996):

$$r_A = \frac{covxy}{\sqrt{(var_x\ var_y)}}$$

where r_A = additive genetic correlation

covxy = covariance of the characters X and Y

var_x or var_y = variance of character X or Y, respectively

Correlations were calculated using Agrobase 98 computer program, as with phenotypic correlations. Calculations were based on GCA effects.

3.4.5.3 Correlated response to selection

This was calculated to study correlated response of character Y, when selection is applied to character X. This was calculated from the formula (Falconer & Mackay 1996):

$$Cr_y = ih_x\ r_A\ \sigma_{AY}$$

where:

Cr_y = correlated response of character Y

I = intensity of selection, obtained from selection intensityTable 2 of Becker (1984), depending on intensity to be applied. For this study, i was taken as 1.492

h_x = square root of heritability (narrow sense) of character X

r_A = genetic correlation between characters X and Y.

σ_{AY} = square root of genetic additive variance (standard deviation) of character Y.

3.4.6 Heterosis

Two types of heterosis were calculated based on mean values of the genotypes:

Mid-parent heterosis (Average heterosis)

This is measured as the deviation of the offspring from mid-parent value, often expressed as a percentage of mid-parent value. Heterosis is dependent on dominance and loci without dominance will not cause heterosis. (Falconer & Mackay, 1996). Mid-parent heterosis can be calculated from the formula:

$$H_{F1} = \frac{M_{F1} - MÞ}{MÞ} \times 100$$

Where:

H_{F1} = Heterosis for F_1 cross

M_{F1} = Mean performance or value of F_1 cross

MÞ = mean of two parents (Þ) obtained from the mean values (M) of the two parents

High parent heterosis (useful heterosis)

This was calculated from the mean values of the F_1 cross and high parent, using the formula:

$$H_{F1} = \frac{M_{F1} - MHp}{Mhp} \times 100$$

where:

MF_1	=	Mean value of F_1 cross
Mhp	=	Mean value of high parent

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Combined analysis of variance

A combined analyses of variances were performed using all the data. The data set consists of four half diallel trials conducted at Rustenburg and Loskop, during the years 1997/98 and 1998/99 respectively. These half-diallel trials consists of parents and their F_1-progenies.

4.1.1 Parents and F1 crosses 1997/8 and 1998/99 experiments

Combined anova was done across locations to investigate location, genotypic and genotypic location interaction effects.

4.1.1.1 Parents and F1 crosses 1997/98 and 1998/99 experiments

The mean squares for the various scources of variation of the first data set were listed in Table 4.1.1.1.

Genotypes

Highly significant differences (P=0,01) exist among the different entries for nearly all the characteristics. The only exceptions were seed index (SI) and locules per boll (LB).

Locations

The locations effect were highly significant for almost all the different characteristics measured. No significant location effects were evident for seed index (SI) and fibre strength (FS).

Genotype x location interaction

The genotype x location interaction effects were significantly ($P<0.01$) different for most of the characteristics measured. Significant differences were not recorded for; G.O.T.1 (based on 5-boll sample); boll size (BS) seed index (SI); lint index (LI); seeds per boll (SB) and locules per boll (LB).

1.1.1 Combined anova: Mean squares for various cotton agronomic and quality characteristics

SOURCE	DF	SCYP	SCYPLT	LYP	LYPLT	GOT1	GOT2	B5	SI	LI	SB
LOC	3	552658053**	100294.57**	8098276.70**	14411.37**	77.93**	103.72**	51.01**	28.61	18.04	212.08**
BLOCK IN LOC	8	717962.6**	951.18**	108774.20**	145.63**	4.03	7.14**	0.70*	36.22	1.11	5.86
GENOTYPE	20	2053946.0**	1328.40**	312419.84**	200.84**	16.28**	19.40**	3.61**	35.07	3.89**	25.29**
G x L	60	378238.8**	489.30**	57983.88**	80.17**	5.41	2.92**	0.46	25.17	0.78	7.95
RESIDUAL	160	148,839.1	189.83	23,074.56	30.08	5.14	1.02	0.33	26.53	0.57	7.28

SOURCE	DF	LB	TBF	HB	UHB	PH	HC	FL	FS	MC	FU
LOC	3	1.35**	2340.35**	2403.75**	345.68**	259825.95**	2472.06**	9.57**	1.05	8.74**	150.80**
BLOCK IN LOC	8	0.23	62.59**	29.25**	15.48**	1066.34**	139.33**	0.59*	3.33**	0.29**	9.44**
GENOTYPE	20	0.28	36.20**	25.90**	13.96**	720.24**	3349.43**	14.35**	4.29**	0.30**	9.02**
G x L	60	0.2O	35.81**	15.80**	12.68**	201.75**	91.46**	0.57**	1.18**	0.13**	3.65**
RESIDUAL	160	0.2	14.79	8.44	4.91	56.20**	45.18	0.25	0.55	0.05	2.01**

*,** = Significantly different at P<0.05 or P<0.01 level of probability

4.1.2 Simple analysis of variance

Analysis of variance was done for each characteristic measured and for each location or experiment separately. Mean squares and levels of significance are presented in the anova's, Table 4.1.2.1 up to Table 4.1.2.4.

4.1.2.1 Rustenburg EXPT1 1997/98 (Parents + F1 crosses)

Anova Table 4.1.2.1 presents mean squares for the genotypes. Highly significant differences (P<0.01) were detected between the genotypes for most of the characteristics except seed cotton yield per plant (SCYPLT), G.0.T. for 5-boll sample (G.O.T.1), seeds per boll (SB), and locule per boll (LB).

4.1.2.2 Loskop EXPT2, 1997/98 (Parents + F1 crosses)

Mean squares are presented in Table 4.1.2.2. Differences between genotypes were highly significant (P<0.01) for all the characteristics measured.

4.1.2.3 Rustenburg EXPT3, 1998/99 (Parents + F1 crosses)

Anova Table 4.1.2.3 presents estimated mean squares for the various characteristics. Highly significant differences (P<0.01) were detected between the genotypes for most of the characteristics except, HB and UHB which were significant at P<0.05 level and G.O.T.1; LI, LB, TBF and PH, which showed no significant differences.

4.1.2.4 Loskop EXPT4, 1998/99 (Parents + F1 crosses)

Estimated mean squares are presented in Anova Table 4.1.2.4. Highly significant differences (P<0.01) were detected between genotypes. SCYPLT was significant at P<0.05 level while no significant differences were detected for BS, SI, SB, LB, HB and MC.

Table 4.1.2.1 SIMPLE ANOVA: Mean Squares for various cotton agronomic and quality characteristics Rustenburg EXPT1 1997/98 (P + F1)

SOURCE OF VARIATION	D.F.	SCYP	SCYPLT	LYP	LYPLT	GOT1	GOT2	BS	SI	LI
BLOCKS	2	409571.03**	836.99**	76493.76**	146.31	19.25**	10.86**	1.69**	3.79**	2.64**
GENOTYPES	20	210256.81**	98.12**	37927.51**	18.38**	34.62	6.12**	1.2O	2.99**	1.46**
RESIDUAL	40	45822.69**	54.05**	7927.41**	8.96**	25.68	1.24	0.2O	0.42	0.2O

SOURCE OF VARIATION	D.F.	SB	LB	TBF	HB	UHB	PH	HC	FL	FS	MC	FU
BLOCKS	2	8.1O	0.12	60.91*	19.68*	24.72	3174.63**	144.43**	0.07	6.89**	0.57**	16.66*
GENOTYPES	20	8.18	0.36	27.93*	15.57**	24.58**	408.94**	700.48**	4.20**	3.05**	0.29**	5.17
RESIDUAL	40	5.43	0.35	13.16	4.97	9.36	90.33	14.66	0.22	1.04	0.1O	3.81

*,** = significantly different at PL0.05 or P<0.01 level of probability, respectively

Table 4.1.2.2 SIMPLE ANOVA : Mean squares for various cotton agronomic and quality characteristics Loskop EXPT2, 1997/98 (P+F1)

SOURCE OF VARIATION	D.F.	SCYP	SCYPLT	LYP	LYPLT	GOT1	GOT2	BS	SI	LI	SB
BLOCKS	3	308571.01**	146.64	40226.87*	15.82	8.79	3.85	0.37	0.61	0.66	0.71
GENOTYPES	20	628586.42**	601.85**	96,761.84	100.28**	8.22	8.69**	1.21**	7.93**	1.99**	15.59
RESIDUAL	60	68,637	69.25	10,410.68	13.73	5.94	2.15	0.28	3.12	0.32	9.58

SOURCE OF VARIATION	D.F.	LB	TBF	HB	UHB	PH	HC	FL	FS	MC	FU
BLOCKS	3	0.03	12.88*	1.86	4.67	0	15.28	1.57**	3.09*	0.06	26.02**
GENOTYPES	20	0.09*	24.19**	13.35**	6.06**	0	738.42**	4.82**	3.38**	0.34**	5.34**
RESIDUAL	60	0.04	3.87	3.41	2.32	0	54.96	0.38	0.97	0.04	1.11

*,** = significantly different at P<0.05 or P<0.01 level of probability, respectively

able 4.1.2.3 SIMPLE ANOVA: Mean Squares for various cotton agronomic and quality characteristics Rustenburg EXPT3, 1998/99 (P + F1)

SOURCE OF VARIATION	D.F.	SCYP	SCYPLT	LYP	LYPLT	GOT1	GOT2	BS	SI	LI
BLOCKS	2	1722812.89**	2405.98**	249918.54**	365.50**	0.81	10.81**	0.69*	1.44*	0.41
GENOTYPES	20	1528614.33**	1776.14**	231834.18**	266.42**	7.7O	5.70**	1.35**	2.73**	1.97
RESIDUAL	40	254,761.31	448.83	36,927.15	67.95	10.76	0.39	0.19	0.42	1.68

SOURCE OF VARIATION	D.F.	SB	LB	TBF	HB	UHB	PH	HC	FL	FS	MC	FU
BLOCKS	2	7.21	0.72	108.09*	83.65*	5.31	222.28**	221.03*	1.36*	2.36**	0.14*	1.74
GENOTYPES	20	12.24**	0.41	44.76	35.70*	4.01*	256.37**	1199.20**	3.95**	1.16**	0.08**	3.72**
RESIDUAL	40	4.52	0.36	25.37	16.79	1.97	36.54	49.8O	0.31	0.18	0.02	1.35

*,** = significantly different at PL0.05 or P<0.01 level of probability, respectively

Table 4.1.2.4 SIMPLE ANOVA : Mean squares for various cotton agronomic and quality characteristics Loskop EXPT4, 1998/99 (P+F1)

SOURCE OF VARIATION	D.F.	SCYP	SCYPLT	LYP	LYPLT	GOT1	GOT2	BS	SI	LI
BLOCKS	2	362,983.51	468.28	57,018.29	63.09	1.82	3.17*	0.12	3.91	0.84*
GENOTYPES	20	913195.99**	420.39*	136658.52**	71.07**	9.09**	7.11**	1.28	4.39	1.19**
RESIDUAL	40	231,040.25	184.93	37,677.48	28.63	1.88	0.65	0.71	2.91	0.2O

SOURCE OF VARIATION	D.F.	SB	LB	TBF	HB	UHB	PH	HC	FL	FS	MC	FU
BLOCKS	2	7.14	0.03	62.85*	11.OO	26.09	868.44**	180.11*	0.76*	0.24	0.43**	16.28**
GENOTYPES	20	15.69	0.06	55.13**	12.7O	17.72**	660.17**	1192.43**	3.85**	0.88**	0.07	5.90**
RESIDUAL	40	12.21	0.05	16.85	8.57	6.79	97.91	53.46	0.22	0.2O	0.05	1.64

*,** = significantly different at P<0.05 or P<0.01 level of probability, respectively

4.1.2.5 Performance of genotypes

The mean performance of the parents and crosses of each diallel experiment were studied separately for each characteristic. The LSD (P<0.05) were used to identify significant differences among the means of the parents and the crosses.

4.2.1 Rustenburg EXPT1, 1997/98 (Parents + F1 crosses)

Seed Cotton Yield

The means of the parental lines and the F1 crosses for seed cotton yield per plot (SCTR) are illustrated in Figure 4.2.1.1 (Appendix B) and listed in Table 4.2.1. Significant differences exist among the parents and among the crosses. Palala and 2131-2-5 ranked the highest among the parents with no significant difference between the two. Irco yielded significantly lower than these two, but was not significantly different from OR27, DPAc90 and Sicala. 2131-2-5xPalala ranked the highest among the crosses but was not significantly different from 2131-2-5xIrco, PalalaxIrco, DPAc90xOR27 and DPAc90xPalala.

Palala and 2131-2-5, the highest yielders among the parents also produced the cross with the highest yield.

Figure 4.2.1.2 shows that genotype 2131-2-5 had the highest mean seed cotton yield of the parents. The mean is significantly higher than the means of OR27 and 2131-2-5. Sicala had the second highest seed cotton yield which is significantly higher than that of OR27 and DPAc90.

Cross 21xPA had the highest seed cotton yield per plant. The seed cotton yield was significantly higher than five of the other crosses. They are ORX1R, 21XOR, DPX21, S1X21 and S1XDP. No significant differences were found among the rest of the F1-crosses for mean boll yield per plant.

Lint Yield (LY)

Figure 4.2.1.3 illustrates the mean lint yield per plant (LYP). Significant differences existed among the parental lines as well as their F1-crosses. The parental lines 2131-2-5 and Palala had the highest mean yield for lint yield per plant. Their mean yields were significantly higher than those of IR, OR and SI. No significant differences exist among the rest of the parental lines.

The F1-crosses 2131-2-5xIR and 2131-2-5xPalala ranked the highest among the crosses. The mean lint yield of these two crosses were significantly higher than those of SIXIR, SIXPA, 21XOR, SIXOR, SIXDP. The rest of the crosses did not show significant differences among them. It appears that the parental lines 2131-2-5 and Palala transferred their superiority with regard to their mean lint yield, to their offspring.

Figure 4.2.1.4 illustrates the means for the lint yield per plant (LYPLT). The genotype 2131-2-5 ranked the highest among the parents. Its mean lint yield per plant was significantly higher than for the cultivars Irco, Palala, DPAc90 and OR27. It did not differ significantly from Sicala.

The cross SicalaxOR27 had the highest lint yield per plant among the crosses. It differs significantly from the crosses SicalaxPalala, Sicalax2131-2-5, 2131-2-5xOR27 and OR27xIrco. These crosses did not show significant differences with regard to one another. The pattern of superiority of parents among crosses was not clear. The cross with the highest ranking came from parents that ranked low, indicating some heterotic effects.

<u>Ginning out turn</u> (G.O.T)

The mean ginning out turn (GOT1) (based on five boll sample) are illustrated in Figure 4.2.1.5. Significant differences were not found between the genotypes in the anova. Mean differences could not therefore be separated by the LSD. Variation was limited among parents. Among crosses, too, there was little variation with only 2131-2-5xPalala being outstandingly lower than the rest.

Figure 4.2.1.6 present means for GOT2 (based on 25 boll sample). Significant differences were found among the parents and crosses. 2131-2-5 ranked highest among the parents, and was significantly different from Palala, OR27, Irco and Sicala. Sicala was significantly lower than all the other parents.

DPAc90x2131-2-5 ranked highest among the crosses, but was not significantly different from 2131-2-5xIrco and DPAc90xIrco. SicalaxPalala was the lowest among crosses, but was not significantly different from 2131-2-5xPalala, SicalaxOR27, SicalaxIrco and OR27 Palala.

3121-2-5, the highest ranking parent was involved in the top two crosses indicating that it transferred some of its superiority to its offspring.

<u>Boll mass</u> (BM)

Figure 4.2.1.7 presents the means for boll mass. Significant differences were found among both the parents and the crosses.

OR27 had the heaviest bolls among parents. It was significantly different from Sicala, Irco, Palala and DPAc90, the latter being significantly lower than the rest of the parents. OR27xIrco ranked the highest among crosses, but did not differ significantly from 2131-2-5xIrco and 2131-2-5xOR27. SicalaxDPAc90, PalalaxIrco, SicalaxPalala, DPAc90xPalala and DPAc90xIrco ranked low, and were not significantly different from one another.

OR27, a parent with the heaviest boll mass appears to have transferred its superiority to its offspring in the top three crosses.

Seed Index (SI)

The seed indexes of the parents and the crosses were illustrated in Figure 4.2.1.8. The genotype OR27 ranked the highest of the parents. It's seed index were significantly higher than the rest of the parental lines. Genotype 21 had the second highest seed index which is significantly higher than the other three cultivars. No significant differences exists among IR, PA and DP for seed index.

The seed index of ORx1R, 21xOR, DPxOR were significantly higher than most of the other crosses. Indication that OR27 transferred its superiority with regard to seed index in most of the cases to its offspring.

Lint Index (LI)

Means for LI are presented in Figure 4.2.1.9. Significant differences were detected among the parents and crosses.

OR27 ranked highest among parents and differed significantly from all the other five parents. 2131-2-5 ranked second and was also significantly different from the remaining four parents, which were not significantly different from one another.

Among the crosses, DPAc90xOR27 ranked the highest and differed significantly from the eleven crosses. There were no significant differences between it and crosses OR27xIrco, 2131-2-5xIrco, and 2131-2-5xOR27. There were no significant differences found between the 10 crosses with the lowest lint indices

OR27 was common as a parent among the first five crosses, indicating that trait was passed on from the parent to the progeny.

<u>Seeds per boll</u> (SB)

Figure 4.2.1.10 gives the means for SB. The analysis of variance did not show any differences among the genotypes, and was not possible to separate the means. From the means, there was little variability between the parents. DPAc90 had the lowest number of seed and this may be logical since it is characterised by small bolls.

<u>Locules per boll</u> (LB)

Figure 4.2.1.11 gives the means for LB. The low level of significant differences in the anova could not be separated by the LSD (Gomez & Gomez,1986). OR27 had the lowest number of locules among the parents, but little variability exists.

<u>Total bolls formed per plant</u> (TBP)

Total boll means are presented in Figure 4.2.1.12. Irco ranked highest among the parents, but was not significantly different from Sicala and 2131-2-5. OR27 ranked lowest, but did not differ significantly from Palala and DPAc90.

SicalaxPalala ranked highest among crosses., though it did not differ significantly from the other six next in ranking. 2131-2-5xOR27 ranked the lowest, but did not differ significantly from seven other crosses with low TBP values.

<u>Harvestable bolls per plant</u> (HBP)

Figure 4.2.1.13 illustrate the means for HBP. Significant differences were recorded among parents and crosses.

2131-2-5 had the highest number of HBP among parents, but did not differ significantly from Palala, Irco, Sicala and DPAc90. OR27 was significantly lower than the other parents.

DPAc90xOR27 ranked the highest among the crosses, though it did not differ significantly from the next six crosses in ranking. 2131-2-5xOR27 significantly ranked the lowest but did not differ significantly from three crosses with low rankings.

Transferring of superior effects from parent to offspring was evident in cross 2131-2-5xPalala.

Unharvestable bolls (UHB)

In Figure 4.2.1.14 the means for UHB are illustrated. Significant differences were found among the parents and among the crosses. Irco had the highest number of unharvestable bolls, among parents though not significantly different from Sicala and 2131-2-5. Palala had significantly the lowest number but was not significantly different from OR27 and DPAc90. Palala had significantly lower boll number than Irco, Sicala and 2131-2-5.

SicalaxIrco had the highest unharvestable boll number among crosses and differed significantly from most of the crosses, except SicalaxPalala, 2131-2-1xOR27 and OR27xIrco. DPAc90x2131-2-5 had the lowest number of unharvestable bolls, and it did not differ significantly from the rest of the crosses, except for the top five.

Sicala and Irco maintained their influence on their offspring.

Plant Height (PH)

The average plant heights were illustrated in Figure 4.2.1.15. Significant differences existed among the parents and the crosses. The parents did not vary much in height, except DPAc90 which was significantly shorter than the rest.

SicalaxPalala, SicalaxIrco and OR27xIrco were significantly taller than most of the crosses with no significant difference among the rest of the crosses. DPAc90xIrco and DPAc90x2131-2-5 were significantly shorter than the rest of the crosses.

Hair Count (HC)

The number of hair per leaf were illustrated in Figure 4.2.1.16. Large genetic differences were found among the parents and F1-crosses. The hairs per leaf of IR and PA exceed the 40 000 level and is significantly higher than the rest of the parents. The number of hairs per leaf in OR and 21 is very close to 20 000 which is significantly higher than the number of hairs of DP and SI. DP and SI is almost hairless.

The crosses with the largest number of hairs per leaf is PAxIR, ORxIR and ORxPA. Their number of hairs is significantly higher than the rest of the crosses. The hair count of 21xIR and 21xPA is significantly higher than the rest of the crosses. The next group is DPxIR, SIxIR and 21XOR which have significantly higher hair counts than the rest of the crosses. The next group of crosses, with more or less 20 000 hairs is DPxPA, SIxPA, DPxOR and SIx21. The offspring of the hairless parents SIxDP, have almost no hair count.

Fibre length (FL)

Means in Figure 4.2.1.17 indicate some significant differences among the parents and among the crosses.

The average fibre length of the parental lines PA, OR and 21 is significantly longer than that of IR and DP.

Among crosses, SicalaxOR27, SicalaxPalala, Sicalax2131-2-5, SicalaxDPAc90 and 2131-2-5 had significantly longer fibre lengths comparing with the rest of the crosses. Sicala appears to have transferred its superiority to most of its offsprings.

DPAc90xIrco had the shortest fibres and was significantly different from the rest of the crosses.

Fibre strength (FS)

Significant differences were found in Figure 4.2.1.18 for fibre strength among both parents and crosses. OR27 was significantly different from the rest of the parents. 2131-2-5 Sicala and OR27 were not significantly different from one another, while Palala had the strongest fibres but was not significantly different from Irco and DPAc90. Cross 2131-2-5xOR27 ranked the highest but was not significantly different from SicalaxPalala and SicalaxOR27. This shows that OR27 transferred its superiority to its offsprings. DPAc90xPalala ranked lowest but was not significantly different from PalalaxIrco, 2131-2-5xIrco and OR27xIrco.

Micronaire (MC)

MC means in Figure 4.2.1.19 indicate significant differences among both parents and crosses. DPAc90 had the highest micronaire units among crosses but there was no significant difference between it and Palala, 2131-2-5 and OR27. Irco and Sicala had the lowest units and were not significantly different. DPAc90xOR27 had the highest units among crosses but was not significantly different from DPAc90xIrco, 2131-2-5xIrco, DPAc90xPalala, 2131-2-5xPalala, OR27xPalala, OR27xIrco, PalalaxIrco and DPAc90x2131-2-5. SicalaxIrco had the lowest units, but dit not differ significantly from the remaining six crosses.

Fibre Uniformity (FU)

Very little variability exists among the means for fibre length in Figure 4.2.1.20.

Discussion

Significant differences existed among the parents and the F1s (Table 4.2.1) due to variability available in most of the characteristics measured especially for seed cotton yield, lint yield, seed index, lint index, bolls per plant and hair count. There was less variability for ginning out turn and fibre quality characteristics. For seed cotton and lint yields, the best lines produced the best crosses as in 2131-2-5xPalala for SCYP and LYP. This indicates that the best parents transferred their superiority to their offspring. Most of the crosses performed above the parents pointing towards heterotic effects. For GOT, the crosses DPAc90x213-2-5 and 2131-2-5xIrco originated from the best parents, which indicates transmission of its superiority from the parents to their offsprings (Fig. 4.2.1.16). Some crosses performed equal to, or even better than the best parents. For BS, OR27 which is characterised by large balls and DPAc90 which is characterised by small balls. Crosses involving OR27 emerging the highest in ranking as in OR27xIrco and 2131-2-5xIrco. Those involving DPAc90 ranked the lowest. Most of the crosses surpassed their high parents, indicating some heterotic effects.

The pattern for SI is similar to that of BS with OR27 characterised by large seeds producing some of the best crosses in ranking (2131-2-5xOR27). Most crosses also surpassed their highest parent. For SB the transfer of effects from the parents to their offspring was not quite clear. Sicala was involved in some of the crosses with the highest number of seeds. Means of LB surprisingly showed that OR27 with characteristically large bolls, ranked the lowest. Variability is low, because most early selections must have aimed at more locules per boll (4 - 5 locules). The transfer of this character to its offspring is not quite clear, though some crosses indicate heterotic effects, like in DPAc90xOR27. Number of bolls per plant had an unclear pattern of transfer of the character to the offsprings. Irco ranking the highest for number of bolls formed per plant (TBF), also had the highest number of unharvested bolls. Irco, as the most hairy parent could have afforded protection against some insect pest but a very little number of the bolls did open. Palala, second best parent for hairiness had, however, fewer balls formed, more balls harvested and least number unharvested. UHB contributes negatively to yield, and a parent or a cross with less unharvested bolls would be ideal to use as a breeding parent. The cross OR27xPalala indicated that plant height is very easily transferred from the parents to their offspring. Most of the crosses also surpassed their parents indicating some heterotic effect.

Both fibre length and fibre strength showed limited variability among the parents as well as among the crosses.

Micronaire values were generally low compared with the acceptable range of 3.5 to 4.5. Irco had the lowest value, which was unexpected of a highly hairy line. However crosses involving IR as a parent, ranked high. Fibre uniformity showed very little variation among parents as well as among crosses.

Table 4.2.1 Means for various cotton agronomic and quality characteristics Rustenburg 1997/98 (Parents + F1s)

GENOTYPES	SCYP	SCYPLT	LYP	LYPLT	GOT1	GOT2	BS	SI	LI	SB	LB	TBF	HB	UHB	PH	HC	FL	FS	MC	FU
Irco	304.78	27.87	120.81	11.00	40.50	39.51	4.42	7.82	5.33	33.00	4.13	24.50	9.33	15.10	119.00	45.00	25.82	21.73	2.70	48.73
Palala	742.69	27.04	299.52	10.90	38.21	40.15	4.27	8.42	5.20	31.13	4.27	16.93	9.93	7.00	118.53	40.33	28.96	21.17	3.37	50.60
OR27	446.60	19.56	179.83	7.88	39.83	39.94	5.84	10.86	7.46	31.73	2.87	14.13	5.47	8.67	120.80	24.00	28.87	24.27	3.23	50.83
2131-2-5	717.07	36.18	304.42	15.31	40.92	41.74	5.31	9.60	6.64	32.53	4.20	22.90	10.07	12.00	117.47	17.67	28.96	23.09	3.27	52.87
DPAc90	469.52	20.73	196.45	8.68	42.30	40.29	3.69	7.30	5.40	28.47	4.07	16.80	8.00	8.80	103.87	0.67	26.67	21.59	3.50	50.97
Sicala	405.40	31.61	154.24	12.01	36.81	37.84	4.81	35.30	5.00	34.40	4.53	22.90	9.20	13.70	118.37	0.67	29.72	22.64	2.77	49.80
PalalaxIrco	1136.85	39.08	478.93	16.43	40.49	41.20	4.98	9.33	6.49	31.00	4.13	16.87	10.47	6.40	130.60	49.33	28.45	20.78	3.60	52.47
OR27xIrco	975.42	28.87	409.94	12.15	39.28	42.01	6.45	11.00	7.25	35.10	4.27	17.53	7.33	10.47	143.73	46.33	27.60	21.30	3.67	53.73
2131-2-5xIrco	1184.84	37.17	508.18	15.96	40.85	42.91	5.98	10.14	7.01	34.80	4.47	14.53	7.40	7.13	125.93	37.00	27.69	21.17	3.73	53.23
DPAc90xIrco	928.57	35.58	403.22	15.43	42.48	42.90	4.78	8.49	6.26	31.87	4.13	17.07	11.20	5.87	110.90	27.33	26.67	21.30	3.87	52.90
SicalaxIrco	968.44	37.05	388.65	14.87	40.02	40.13	5.41	9.65	6.43	34.33	4.27	19.93	7.80	13.13	145.60	28.67	28.62	21.75	3.27	49.80
OR27xPalala	996.08	32.33	398.19	12.92	38.20	39.92	4.89	9.84	6.07	30.77	4.20	16.00	10.07	5.93	130.93	45.67	28.79	22.18	3.67	52.20
2131-2-5xPalala	2158.49	34.41	509.07	15.00	25.82	40.36	5.51	10.10	6.53	32.47	4.07	19.77	13.13	6.63	121.40	35.33	29.55	22.51	3.67	50.43
DPAc90xPalala	1099.41	35.43	455.42	14.56	39.95	41.31	4.82	9.29	6.01	33.10	4.13	20.53	12.93	7.60	131.07	17.33	29.47	20.26	3.67	51.60
SicalaxPalala	896.28	32.10	348.73	12.47	38.84	38.84	4.93	9.53	6.07	30.97	4.20	21.73	10.07	11.67	147.27	21.67	30.06	23.10	3.27	49.77
2131-2-5xPalala	903.25	29.25	376.20	12.19	39.21	41.63	5.85	10.95	6.89	32.60	4.53	13.53	5.20	8.33	128.93	29.33	29.13	23.98	3.30	51.10
DPAc90xOR27	1118.93	39.04	466.94	16.30	41.57	41.71	5.54	10.33	7.44	30.53	4.47	20.40	13.60	6.80	135.13	18.33	29.04	21.85	3.90	52.80
SicalaxOR27	889.72	42.33	356.22	16.96	38.69	40.20	5.74	10.65	6.72	33.17	4.33	19.53	8.87	10.67	138.47	21.33	30.14	22.93	3.43	51.40
DPAc90x2131-2-5	861.40	29.87	377.98	13.08	41.10	43.93	5.07	9.29	6.48	31.73	4.07	15.47	10.60	4.87	110.27	11.67	28.62	22.48	3.57	50.93
Sicalax2131-2-5	957.60	30.54	390.17	12.43	38.20	40.78	5.40	9.69	5.99	34.00	4.53	15.93	8.60	7.33	125.93	12.00	29.80	21.85	3.40	50.97
SicalaxDPAc90	911.82	31.08	378.87	12.92	40.71	41.59	5.20	9.35	6.41	31.23	4.07	20.20	11.87	8.33	129.13	1.33	29.80	22.21	3.30	51.50
Mean	865.39	32.24	357.24	13.31	39.24	40.90	5.19	9.54	6.34	32.33	4.19	18.40	9.58	8.88	126.35	25.29	28.69	22.10	3.44	51.36
LSD(0.05)	294.31	10.11	122.41	4.12	6.97	1.53	0.61	0.89	0.62	3.21	0.82	4.99	3.07	4.21	13.07	5.26	0.64	1.40	0.42	2.68
C.V.%	24.74	22.80	24.92	22.50	12.91	2.73	8.62	6.78	7.08	7.21	14.17	19.71	23.28	34.45	7.52	15.14	1.62	4.62	9.06	3.80
b	0.55	0.21	0.56	0.26	0.10	0.57	0.63	0.67	0.68	0.14	0.00	0.27	0.42	0.35	0.54	0.94	0.86	0.39	0.40	0.11

b = repeatability of results

4.2.2 Loskop EXPT2 1997/98 (Parents + F1 crosses)

Seed cotton yield

Means for SCYP are presented in Figure 4.2.2.1 (Appendix C) and Table 4.2.2. Significant differences were found between parents and crosses. Palala ranked highest among parents but there was no significant difference between it and OR27 and 2131-2-5. DPAc90 was significantly lower in ranking but did not differ significantly from Sicala. SicalaxIrco ranked highest among crosses, but 2131-2-5xIrco, OR27xPalala, DPAc90xIrco, OR27xIrco and PalalaxIrco were not significantly different from it. DPAc90xSicala ranked lowest but did not differ significantly from Sicalax2131-2-5, DPAc90x2131-2-5, 2131-2-5xOR27, SicalaxPalala and 2131-2-5xPalala. Figure 4.2.2.2 and Table 4.2.2 present means for SCYPLT. Significant differences were found. Irco ranked the highest and was significantly different from all other parents. DPAc90 ranked the lowest. It did not differ significantly from Sicala, but both were significantly different from Palala, OR27 and 2131-2-5.

SicalaxIrco ranked the highest among crosses, but there was no significant difference between it and the six crosses next in ranking. DPAc90xOR27 and DPAc90xPalala were intermediate and were not significantly different from each other. The transfer of superior effects from the parents to their offspring was evident in OR27xPalala and OR27xIrco.

Lint Yield

Means for LYP are presented in Figure 4.2.2.3 and Table 4.2.2. Palala ranked highest followed by OR27, 2131-2-5 and Irco, with no significant differences between them. DPAc90 and Sicala have the lowest lint yield which differed significantly from the rest of the parents.

Sicalaxlrco ranked the highest among the parents and were followed by the crosses 2131-2-5xlrco, DPA90xlrco, Palalaxlrco, OR27xlrco, and OR27xPalala, with no significant differences between them. SicalaxDPAc90 ranked the lowest but it was not significantly different from the other five crosses abovementioned.

In Figure 4.2.2.4 and Table 4.2.2 the means showed significant variability among parents and among crosses for LYPLT. Irco had the highest lint yield per plant which were significantly different from all other parents. 2131-2-5, Palala and OR27 were next with no significant difference between them. The lint yield of DPAc90 and Sicala were significantly lower than the rest of the parents.

Ginning Out Turn (GOT)

Figure 4.2.2.5 and Table 4.2.2 present the means for GOT1 (based on 5-boll sample). No significant differences were found by the anova and no mean separation could be done. Palala had the lowest GOT among parents and so had 2131-2-5xPalala, among the crosses. In Figure 4.2.2.6 and Table 4.2.2 some significant differences were found between parents and between crosses for GOT2. Irco ranked the highest, though not significantly different from 2131-2-5. Palala was significantly lower than the three best parents, but was not significantly different from Sicala and OR27. DPAc90clrco was the highest among crosses but did not differ significantly from six of the other crosses who followed. The cross with the lowest ranking was OR27XDPAc90. The parent Irco was present in five out of the seven crosses with high rankings, indicating that it was able to transfer its superiority to some extent to its offspring.

Boll Size (BS)

Means from Figure 4.2.2.7 and Table 4.2.2 show significant differences between parents and crosses.

OR27 ranked the highest and differed significantly from all the other parents. Palala differed significantly from Irco, Sicala and 2131-2-5, while DPAc90 was significantly lower than the rest of the parents.

Little variability existed between the crosses but OR27xIrco was significantly higher than the rest of the crosses.

Seed Index (SI)

The seed indexes of the parents and F1-crosses were illustrated in Figure 4.2.2.8 and shown in Table 4.2.2. Significant differences were found between parents and between crosses. OR27 ranked the highest; it seed index was significantly different from Palala and DPAc90, but not from Sicala, Irco and 2131-2-5.

SicalaxOR27 ranked the highest among crosses and differed significantly from the rest of the crosses. DPAc90x2131-2-5 ranked lowest but did not differ significantly from other crosses except 2131-2-5xIrco and SicalaxOR27.

Lint Index (LI)

The means for lint index in Figure 4.2.2.9 and Table 4.2.2 indicate significant differences among parents and among crosses. 2131-2-5, OR27 and Irco ranked highest among parents, with no significant differences between them. DPAc90 ranked the lowest but did not differ significantly from Sicala and Palala.

2131-2-5xIrco was the cross with the highest mean but was not significantly different from DPAc90xOR27, OR27xIrco and 2131-2-5xOR27. The lint index of SicalaxDPAc90 was significantly lower than the top ranked six crosses but was not significantly different from the eight crosses with lower lint indexes.

Seed per boll (SB)

Figure 4.2.2.10 and Table 4.2.2 show a lack of genetic variability for seed per boll. The anova did not show any significant differences between the different genotypes. Sicala had the highest number of seeds per boll of the parental lines. A cross with Sicala as parent, Sicalax2131-2-5 ranked the highest among the crosses.

Locules per boll (LB)

Significant differences were detected for locules per boll among the parents as well as the crosses. OR27 had the highest number of locules among the parents but was not significantly different from Sicala, Irco, Palala and 2131-2-5. DPAc90 was significantly lower and different from the rest of the parents (Fig. 4.2.2.11 and Table 4.2.2). The cross Sicalax2131-2-5 ranked highest and did not differ significantly from SicalaxPalala and DPAc90x2131-2-5. The cross with the lowest value was DPAc90xIrco which differed significantly from the highest seven crosses but not from the rest of the crosses.

Total bolls formed (TBF)

The means indicate significant differences among the total amount of bolls formed (Fig. 4.2.2.13 and Table 4.2.2). Irco had the highest number of bolls, which differed significantly from OR27, Sicala and DPAc90, but not from 2131-2-5 and Palala. DPAc90 and Sicala had the lowest values and differed significantly from OR27.

PalalaxIrco, 2131-2-5xIrco, 2131-2-5xPalala and OR27xPalala were not significantly different and ranked the highest among crosses. SicalaxPalala ranked the lowest, but was not significantly different from other crosses, except for SicalaxIrco.

Harvestable bolls (HB)

Significant differences are evident for harvestable bolls (Figure 4.2.2.13 and Table 4.2.2). Palala ranked highest among parents, but was not significantly different from 2131-2-5 and Irco. OR27 was significantly different from the top three parents, and also from the two, Sicala and DPAc90 which have the lowest number of harvestable bolls. 2131-2-5xPalala ranked highest among crosses but did not differ significantly from the other seven crosses following in rank. SicalaxDPAc90 ranked the lowest but did not significantly differ from the seven crosses with values closest to it.

Unharvestable bolls (UHB)

In Figure 4.2.2.14 and Table 4.2.2 significant differences among parents and among crosses are evident for unharvested number of bolls. Irco contains a significantly higher number of UHB than all the other parents. 2131-2-5, Sicala, OR27 and Palala did not differ significantly from one another. DPAc90 had consistently the lowest value, although it did not differ significantly from OR27, Sicala and Palala.

Palalaxlrco ranked the highest among crosses but was not significantly different from 2131-2-5xIrco, OR27xIrco and OR27xPalala. SicalaxPalala was the cross with the least number of unharvestable number of bolls. It did not differ significantly from Sicalaxlrco and the other seven crosses with similar values.

Hair count (HC)

Evidence of significant differences is apparent from the means (Figure 4.2.2.15 and Table 4.2.2). Irco and Palala ranked the highest among the parents, with no significant difference between them. OR27 and 2131-2-5 were not significantly different from each other. However, they differed significantly from the two parental lines with the highest hair count as well as the two lines, DPAc90 and Sicala with the lowest number of hairs..

Palalaxlrco ranked highest among the crosses, but did not differ significantly from OR27xIrco and OR27xPalala. DPAc90xPalala, DPAc90x2131-2-5 and Sicalax2131-2-5 have the lowest hair count values but did not differ significantly from one another.

Fibre Length (FL)

Significant differences were found among parents and among crosses for fibre length (Figure 4.2.2.17 and Table 4.2.2), though variability seemed limited. 2131-2-5, Sicala, OR27 and Palala ranked the highest, with no significant differences among them. DPAc90 and Irco significantly differed from the top four parents, but Irco was significantly lower than DPAc90. SicalaxPalala, SicalaxDPAc90, Sicalax2131-2-5, OR27xPalala and

DPAc90, rated the highest among the crosses, with no significant difference among them. All the crosses involving Irco as a parent ranked very low. These crosses were not significantly different from one another, except for SicalaxIrco.

Fibre Strength (FS)

Means for FS indicated limited variability (Fig. 4.2.2.17 and Table 4.2.2) but significant differences were detected among the parents and among the crosses. Irco ranked the lowest and was significantly different from the other five parents, which showed no significant difference among them.

Little variation for fibre strength existed among crosses. PalalaxIrco and DPAc90xIrco had significantly lower values than the rest of the crosses.

Micronaire (MC)

Significant differences were detected for the character, micronaire (Figure 4.2.2.18 and Table 4.2.2).

Irco had the highest micronaire units and did not differ significantly from OR27 and Palala. 2131-2-5 differed significantly from the top three parental lines and also from the two parents with the lowest values. DPAc90 and Sicala did not differ significantly from each other.

Fibre Uniformity (FU)

Very little variation existed among parents and among crosses for fibre uniformity. Significant differences were found among parents and among crosses (Figure 4.2.2.19 and Table 4.2.2). Palala and OR27 have the highest ratings with no significant difference between them. Irco, 2131-2-5 and DPAc90 were not significantly different. The parents with the lowest uniformity differed significantly from the rest of the parents.

OR27xIrco, DPAc90xIrco and OR27xPalala ranked the highest among crosses, with no significant differences among them. SicalaxDPAc90 ranked the lowest among crosses but did not differ significantly from SicalaxPalala and SicalaxIrco.

Discussion

Sufficient genetic variability was observed for most of the characteristics measured. Little variation existed for GOT and fibre quality characteristics. In some crosses such as OR27xPalala for SCYP (Fig. 4.2.2.1), it was evident that the parents transferred most of their superiority to its offspring. Most of the crosses surpassed their highest parent indicating some heterotic effects. Boll size had similar pattern as observed in Rustenburg, with OR27 having by far the most hairiest bolls. A cross between OR27 and Irco, OR27xIrco indicated transmission of its superiority to the offspring. Many of the crosses surpassed the highest parent, indicating some heterotic effects. The pattern for SI is similar to that of BS. OR27, characterised by large seeds produced some of the best crosses. In the case of LI the best parents, OR27 and 2131-2-5 again produced the best crosses. Sicala with high seeds per boll (SB) transmitted its superiority to the offspring as shown in most of its crosses. Little variation existed for locules per boll, but unlike in Rustenburg, OR27, characterised by large bolls, ranked the highest and DPAc90 characterised by small bolls ranked the lowest.

For TBF, Irco the best parent transfer this superiority to its offspring, as in PalalaxIrco and 2131-2-5xIrco. As in Rustenburg, Palala and 2131-2-5 produced the best cross with high HB and relatively few UHB. Irco produced high TBF but had high UHB, a characteristic manifested in its crosses. High TBF, HB and low UHB values would be a better choice.

For HC the most hairy parents Irco and Palala also producing the crosses with the highest hair count.

Limited variation exists for fibre quality characteristics. For FL and FS the best parental lines were also producing the best progenies. Sicala shown to be a very good parent to increase the quality characteristics of cotton.

Table 4.2.2 Means for various cotton agronomic and quality characteristics : Loskop 1997/98 (Parents + F1s)

GENOTYPES	SCYP	SCYPLT	LYP	LYPLT	GOT1	GOT2	BS	SI	LI	SB	LB	TB	HB	UHB	PH	HC	FLC	FSC	MC	FU
Irco	873.51	59.05	358.74	25.16	38.53	41.77	6.39	11.80	7.40	33.75	4.30	15.00	8.05	7.45	0.00	44.25	26.04	20.38	4.38	50.60
Palala	1268.22	40.19	455.12	14.46	35.49	36.25	5.46	11.10	6.11	31.20	4.25	13.35	8.90	4.45	0.00	43.25	28.96	22.15	4.28	52.95
OR27	1196.66	36.79	450.63	13.87	39.39	37.44	6.90	13.48	7.57	32.93	4.45	10.85	6.20	4.65	0.00	28.75	29.02	23.25	4.28	52.08
2131-2-5	1061.72	38.62	425.66	15.54	39.42	40.27	6.04	11.68	7.72	31.05	4.25	14.00	8.30	5.75	0.00	22.00	29.59	24.33	3.93	50.30
DPAc90	303.28	9.02	119.31	3.55	38.56	37.41	4.43	9.03	5.67	29.60	3.90	5.75	2.75	3.00	0.00	0.75	26.99	22.79	3.55	50.13
Sicala	412.82	14.62	155.45	5.49	36.07	37.43	6.30	11.84	6.12	37.25	4.40	7.90	3.45	4.43	0.00	3.50	29.15	22.93	3.35	48.93
PalalaxIrco	1604.66	48.83	636.57	19.38	38.08	39.77	6.35	11.33	6.97	35.05	4.20	15.50	8.80	6.70	0.00	49.75	28.13	20.75	4.40	51.95
OR27xIrco	1617.25	46.62	634.76	18.32	38.67	39.31	7.05	12.63	7.97	34.38	4.20	11.70	6.40	5.30	0.00	42.75	27.94	21.32	4.25	53.83
2131-2-5xIrco	1749.35	53.24	683.96	20.80	38.20	39.83	6.39	13.46	8.42	29.83	4.20	15.40	9.00	6.40	0.00	36.50	28.38	21.61	4.30	52.38
DPAc90xIrco	1633.72	47.77	680.37	19.89	38.36	40.72	6.05	11.40	7.11	33.03	4.05	12.25	9.30	2.95	0.00	29.50	27.24	20.53	4.58	53.03
SicalaxIrco	1811.95	54.91	708.88	21.51	37.67	39.18	6.48	11.69	7.07	34.60	4.25	12.90	8.60	4.30	0.00	31.25	28.83	21.51	4.08	50.73
OR27xPalala	1695.77	51.31	618.03	18.72	36.09	36.43	6.57	12.94	7.28	33.05	4.35	13.65	8.60	5.05	0.00	42.75	29.72	22.37	4.20	52.80
2131-2-5xPalala	1318.42	39.03	482.94	14.30	34.11	36.67	6.23	12.48	6.61	32.55	4.30	14.45	9.75	4.70	0.00	30.75	29.15	22.37	4.15	51.58
DPAc90xPalala	1448.92	43.49	555.14	16.65	37.23	38.24	6.50	11.92	6.98	34.25	4.20	12.00	8.50	3.50	0.00	21.00	29.72	22.10	4.28	51.70
SicalaxPalala	1322.87	40.41	475.73	14.54	35.14	37.23	6.66	12.77	6.44	34.25	4.50	9.93	7.18	2.70	0.00	21.25	30.42	22.34	4.18	51.18
2131-2-5xPalala	1209.14	36.93	488.03	14.90	37.42	40.13	6.48	13.02	7.76	31.45	4.35	10.45	6.55	3.93	0.00	26.50	29.59	22.59	4.10	51.40
DPAc90xOR27	1345.93	43.24	545.67	17.48	38.85	39.46	6.77	12.95	8.13	32.45	4.25	12.15	7.85	4.30	0.00	21.00	29.15	21.90	4.25	52.08
SicalaxOR27	1501.96	50.06	573.16	18.09	37.58	38.18	6.63	16.57	7.47	35.40	4.35	10.25	6.65	3.60	0.00	29.00	29.27	21.61	4.08	51.50
DPAc90x2131-2-5	1088.06	31.89	411.14	12.08	37.77	38.33	6.17	11.25	6.85	34.55	4.45	10.85	6.85	4.00	0.00	12.75	29.47	21.93	3.95	51.50
Sicalax2131-2-5	1143.34	32.98	437.54	12.63	37.83	38.57	6.57	11.67	7.03	35.45	4.60	10.50	6.45	4.05	0.00	13.50	29.97	22.52	3.85	51.48
SicalaxDPAc90	1049.88	31.20	410.81	12.20	36.27	38.93	6.16	11.73	6.52	35.25	4.35	10.45	5.60	4.88	0.00	12.00	30.04	22.39	3.75	50.08
Mean	1269.40	40.49	490.84	15.69	37.46	38.74	6.31	12.22	7.10	33.40	4.29	11.87	7.32	4.58	0.00	26.80	28.89	22.08	4.10	51.53
LSD(0.05)	309.49	9.83	120.53	4.38	2.88	1.73	0.63	2.09	0.67	3.66	0.25	2.32	2.18	1.80	0.00	8.76	0.73	1.16	0.22	1.24
C.V.%	30.64	20.55	20.79	23.62	6.50	3.79	8.41	14.44	7.98	9.27	4.907	16.57	25.23	33.31	0.00	27.66	2.13	4.46	4.61	2.04
b	0.67	0.66	0.68	0.61	0.09	0.43	0.45	0.28	0.57	0.14	0.22	0.57	0.42	0.28	0.00	0.76	0.75	0.38	0.68	0.49
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

b = repeatability of **b=repeatability of results**

4.2.3 RUSTENBURG EXPT3, 1998/99 (Parents + F1 crosses)

Seed Cotton Yield (SCYP)

The parental line Sicala ranked the highest among the parents (Figure 4.2.3.1 [Appendix D] and Table 4.2.3) for SCYP. It differed significantly from the rest of the five parents. DPAc90 had the lowest seed cotton yield and differed significantly from the rest of the parents. Palala, Irco, OR27 and 2131-2-5 yielded more or less in between and did not differ significantly from one another. The majority of the crosses have higher yields than most of the parents, except for Sicala. It is quite evident that the parental mission of superiority of parents like Sicala, transferred its superiority to most of its offspring. SicalaxOR27 was the cross with the highest yield but was not significantly different from eight other crosses which followed its ranking. A similar pattern was observed for seed cotton yield per plant. SCYPLT as illustrated in Figure 4.2.3.2 and shown in Table 4.2.3 showed that Palala and OR27 ranked the highest among the parents. SicalaxOR27 yielded again the highest among the crosses and outyielded the rest of the crosses, significantly.

Lint Yield (LYP)

Sicala ranked the highest for LYP (Figure 4.2.3.3 and Table 4.2.3) and differed significantly from the rest of the parents. The other four parents did not differ from one another significantly. SicalaxOR27 had the highest lint yield. However, it did not differ significantly from the following six crosses. SicalaxPalala ranked the lowest but did not differ significantly from five other crosses with almost similar means. Most crosses surpassed their best parent. Three of the lines, OR27, Sicala and Palala have similar means for LYPT. DPAc90 have the lowest lint yield but was not significantly different from 2131-2-5 and Irco. SicalaxOR27 had the highest lint yield among the crosses. The cross DPAc90xIrco had the lowest lint yield and did not significantly differ from SicalaxPalala, DPAc90x2131-2-5, DPAc90xOR27, DPAc90xPalala and 2131-2-5xOR27/

Ginning Out Turn (GOT)

GOTs did not show much variability. No significant differences were found in the anova for genotypes for GOT1 (based on 5-boll samples) but there were significant differences for GOT2 (based on 50 boll samples) (Figure 4.2.3.6 and Table 4.2.3). 2131-2-5 ranked highest among parents, but did not differ from DPAc90 and Irco. Palala was significantly the lowest and differed significantly from OR27. The best parents produced the best crosses as in 2131-2-5xIrco, DPAc90x2131-2-5 and DPAc90xIrco, indicating transferring its superiority to its offspring. OR27xPalala ranked the lowest and differed significantly from the rest of the crosses.

Boll Size (BS)

OR27 ranked the highest among the parents (Figure 4.2.3.7 and Table 4.2.3) but did not differ significantly from Sicala. No significant differences were found between Irco, Palala, 2131-2-5 and DPAc90. OR27 and Sicala produced the crosses with the highest boll size. It differed significantly from the rest of the crosses. The next three crosses had OR27 as a parent, indicating the superiority of OR27 as a parent for this characteristic, though they were not significantly different from the next two crosses in ranking. DPAc90xIrco was the lowest in ranking but did differ significantly from the four crosses with similar rankings. Nearly all the crosses with the parental line DPAc90 have on average very small boll size.

Seed Index (SI)

OR27 ranked the highest among parents (Figure 4.2.3.8 and Table 4.2.3) for seed index and was significantly different from the rest of the parents. DPAc90 ranked the lowest, but did not differ significantly from 2131-2-5 and Irco. The highest ranking, two parents, OR27 and Palala, produced the best cross, OR27xPalala. The four crosses which ranked next did not differ significantly from OR27xPalala. OR27 was represented in all four crosses. This indicates that OR27 transferred most of its superiority to its offspring. DPAc90xIrco again ranked the lowest as in BS, indicating that it is characterised by small seeds.

Lint Index (LI)

Palala ranked the highest among the parents though not significantly different from OR27, the next in ranking, Sicala and 2131-2-5 (Figure 4.2.3.9 and Table 4.2.3). Irco ranked the lowest but was not significantly different from DPAc90, 2131-2-5 and Sicala. The top two crosses were 2131-2-5xOR27 and SicalaxOR27. This indicates that OR27 transferred some of its superiority to its offsprings. Crosses involving Palala the highest parent, ranked high. DPAc90x2131-2-5 had the lowest lint index but did not differ significantly from 12 other crosses with similar lint indexes.

Seeds per boll (SB)

Sicala ranked highest among the parents for seeds per boll (Figure 4.2.3.10 and Table 4.2.3), but did not differ significantly from Irco and DPAc90. OR27 had the lowest seed number (expected with large seeds), but was not significantly different from Palala and 2131-2-5. The best parents were also involved in the top crosses, SicalaxOR27 and

OR27xSicala. Some of the crosses surpassed their best parent. The cross with the lowest seeds per boll was DPAc90x2131-2-5 which did not differ significantly from the rest of the crosses.

Locules per boll (LB)

Although Sicala ranked the highest among the parents, there was no significant variation among genotypes for LB (Figure 4.2.3.11 and Table 4.2.3).

Total bolls formed (TBF)

Sicala, OR27 and Palala had the highest TBF per plant and did not differ significantly from one another (Figure 4.2.3.12 and Table 4.2.3). 2131-2-5 had the lowest TBF ranking, but not significantly different from Irco and DPAc90. The best cross was from the lowest ranking parents 2131-2-5xIrco. However, Sicala and OR27 produced the second best cross, which indicates that some of their superiority was transferred to their offspring. DPAc90xIrco ranked the lowest but did not differ significantly from the six crosses with similar means. Some of the crosses also surpassed their best parents.

Harvestable bolls (HB)

Palala, Sicala, OR27 and DPAc90 had the highest number of harvestable bolls with no significant differences among them. 2131-2-5 and Irco ranked lowest and were not significantly different from each other (Figure 4.2.3.13 and Table 4.2.3). The highest crosses involved the highest parents as in the case of SicalaxDPAc90, SicalaxOR27 and OR27xPalala. 2131-2-5 xIrco is among the top crosses but its parents ranked among the lowest. DPAc90xIrco ranked low but was not significantly different from the five crosses with similar rankings.

Unharvestable bolls (UHB)

OR27 had the highest UHB among the parents while Palala had the lowest. OR27 was not significantly different from Sicala and Palala. Palala was not significantly different from DPAc90, 2131-2-5 and Irco. 2131-2-5xIrco, DPAc90xOR27, SicalaxDPAc90, OR27xIrco and Sicalax2131-2-5 ranked the highest for UHB and were not significantly different. UHB is a negative contribution to yield and preference would be given to a parent or cross with high TBF, HB and a low UHB values. Therefore Palala and its crosses, DPAc90xPalala and SicalaxPalala would be preferable (Figure 4.2.3.15 and Table 4.2.3).

Plant Height (PH)

Sicala and OR27 ranked the highest with no significant difference between the two. 2131-2-5 had the shortest plant height, though not significantly different from Irco and DPAc90. The tallest cross was from the tallest parents, SicalaxOR27, though not significantly different from the next ten crosses in ranking. The cross with the shortest plants is DPAc90xIrco, DPAc90 being characterised by small statured plants. Most crosses surpassed their high parents and there was evidence that some parents transferred their superiority to their offspring (Figure 4.2.3.15 and Table 4.2.3).

Hair Count (HC)

The variability in hair count was quite clear. Three categories emerged; the most hairy, medium and smooth parents. Irco and Palala, the most hairy types were not significantly different from each other, but differed significantly from the rest. The medium hairy parents, OR27 and 2131-2-5 differed significantly for hairiness, while the smooth parents, DPAc90 and Sicala, did not differ significantly (Figure 4.2.3.16 and Table 4.2.3). PalalaxIrco produced the cross with the largest hair count. It was significantly different from all other crosses. The next cross was between the most hairy parent and a smooth parent, SicalaxIrco which did not differ from two other crosses with similar rankings, OR27XIrco and 2131-2-5xIrco. Hairiness is highly transferable from the parents to their offspring.

Fibre Length (FL)

Very little variability exists among parents for fibre length. No significant differences were found among Sicala, Palala and OR27. Irco was the only parental line which fibre length was significantly shorter than the rest of the parents (Figure 4.2.3.17 and Table 4.2.3). Sicalax2131-2-5 ranked the highest among crosses but did not differ from 2131-2-5xPalala and OR27xPalala. DPAc90xIrco ranked the lowest and differed significantly from all other crosses. Crosses with Irco as a parent also ranked the lowest.

Fibre Strength (FS)

Little variability exist among the parents for fibre strength. The crosses showed very little variation. However, significant differences were observed. OR27 ranked the highest among parents (Figure 4.2.3.18 and Table 4.2.3), but was not significantly different from Sicala and Palala. Irco ranked the lowest and was significantly different from the rest of the parents. Sicalax2131-2-5 ranked the highest among the crosses, but did not differ significantly from OR27xPalala, SicalaxPalala and

2131-2-5xPalala. DPAc90xIrco ranked the lowest and differed significantly from the rest.

Micronaire (MC)

Micronaire like most of the quality characteristics, did not show too much genetic variability. Significant differences were, however, found among parents and among crosses. DPAc90 had the highest MC among parents, followed by OR27 and Irco. The three were not significantly different. Some of the crosses involving smooth parents, Sicala and DPAc90 ranked the highest for MC, SicalaxOR27, DPAc90xOR27, DPAc90x2131-2-5 and DPAc90xIrco - though they were not significantly different from eight other crosses with lower means. Sicalax2131-2-5xPalala ranked significantly lower than the rest of the crosses (Figure 4.2.3.19).

Fibre Uniformity (FU)

Variability for fibre uniformity was not high among the parents. However, some significant differences were found. Irco ranked the highest among the parents and differed significantly from the rest. Palala, Sicala, DPAc90 and OR27 were not significantly different from one another. 2131-2-5 ranked the lowest and its fibre uniformity was significantly lower than the rest of the parental lines.

DPAc90xIrco ranked the highest among crosses and did not differ significantly from seven other crosses with similar rankings. The five crosses involving Irco came on top of the ranking. Sicalax2131-2-5 ranked the lowest but was not significantly different from four crosses with similar means. (i.e. SicalaxOR27, DPAc90x2131-2-5, 2131-2-5xOR27 and 2131-2-5xPalala.

Discussion

Genetic variability was sufficient for most of the agronomic characteristics except GOT. The results showed limited variation for fibre quality characteristics but significant differences were still be found by the anova. For SCYP and SCYPLT most of the crosses ranked higher than the best parents indicating overdominance (heterotic effects). The same was observed for LYP and LYPLT. In GOT1 (5 boll sample) no significant differences were detected but GOT2 (50-boll sample) showed some significant differences among the crosses. With regard to boll size the parental line OR27 possessed of very large bolls, while the line DPAc90 had on average very small boll sizes. The parental line Sicala possessed of the largest (BS) value while OR27 ranked again the highest for SI. There was not much variability for LB since earlier selections may have preferred selections with more locules per boll (4 - 5). For TBF, HB and UHB, preference would be for a parent or line which combines a high TBF and HB, with low UHB, as the latter contributes negatively towards yield. Palala and its crosses, DPAc90xPalala and SicalaxPalala was close to this condition: some heterotic effects were indicated in this characteristics. Some crosses surpassed some of the high parents indicating some overdominance for both PH and HC.

For FL and FS, Irco ranked the lowest among parents and so its crosses. However for FU, Irco and most of its crosses ranked very high.

Table 4.2.3 **Means for various cotton agronomic and quality characteristics Rustenburg 1998/99 (Parents + F1s)**

GENOTYPES	SCYP	SCYPLT	LYP	LYPLT	GOT1	GOT2	BS	SI	LI	SB	LB	TBF	HB	UHB	PH	HC	FL	FS	MC	FU
Irco	1499.44	93.93	583.42	36.72	39.55	39.78	6.31	10.75	6.27	36.20	4.47	20.73	15.87	4.87	92.53	61.37	25.99	20.42	4.30	50.80
Palala	1673.14	135.09	583.16	46.68	41.21	35.78	5.93	11.55	8.73	33.20	4.27	27.93	24.07	4.00	98.87	61.33	29.38	21.82	4.10	49.20
OR27	1487.39	140.58	560.62	52.59	36.58	38.46	7.35	13.96	8.26	30.80	4.47	28.93	22.73	6.20	113.53	41.23	29.12	22.31	4.43	48.27
2131-2-5	1305.45	97.75	501.12	36.74	39.32	40.53	6.01	10.69	6.99	33.67	4.27	18.67	13.53	5.13	90.33	23.33	28.28	21.43	4.03	46.23
DPAc90	1804.79	71.00	696.80	27.52	38.95	39.98	6.00	10.23	6.59	35.73	4.33	23.47	19.27	4.20	95.53	4.53	27.52	21.37	4.47	48.30
Sicala	2511.34	122.04	988.80	49.14	38.01	39.01	7.22	11.76	7.35	37.47	4.73	29.27	23.27	6.00	114.47	5.67	29.55	22.01	4.20	49.13
PalalaxIrco	3303.35	130.32	1218.62	47.90	36.71	38.39	6.69	11.74	6.91	37.07	4.40	28.93	24.53	4.47	113.53	68.67	28.95	21.53	4.20	48.83
OR27xIrco	3008.80	124.33	1197.16	49.49	38.89	40.12	7.66	12.17	7.80	38.27	4.67	25.07	19.67	5.40	117.00	58.40	28.95	22.28	4.30	50.03
2131-2-5xIrco	3137.82	132.53	1277.98	54.23	40.32	40.91	6.68	10.92	7.46	36.53	4.40	32.27	25.07	7.20	118.20	51.60	29.21	21.69	4.30	49.53
DPAc90xIrco	2109.76	85.31	854.13	34.54	39.27	40.53	6.07	10.26	6.69	34.93	4.13	19.80	16.47	3.60	98.87	39.13	27.26	20.71	4.33	49.93
SicalaxIrco	2523.55	140.00	1010.96	56.06	38.33	40.01	7.44	12.13	8.01	35.27	3.00	28.13	23.33	4.80	116.60	58.67	29.46	22.28	4.13	49.57
OR27xPalala	3439.75	129.44	1253.19	47.30	35.01	36.56	6.98	13.10	7.11	33.93	4.53	27.47	24.73	4.20	117.13	43.60	30.23	22.70	4.23	48.67
2131-2-5xPalala	3193.84	124.54	1184.42	46.10	35.98	37.44	6.53	11.96	6.75	35.13	4.27	27.20	23.00	4.20	110.60	47.23	30.40	22.54	3.80	47.67
DPxPal	3058.75	132.11	1040.62	44.95	38.49	38.40	6.31	11.56	7.27	34.07	4.33	25.27	22.70	2.87	118.87	27.57	30.14	21.95	4.17	48.40
SicalaxPal	1994.46	95.34	779.01	37.30	37.47	38.20	6.94	11.62	7.03	37.27	4.60	20.33	18.00	2.33	104.47	28.20	29.38	22.61	4.17	48.27
2131xOR	2928.31	1180.00	1134.22	45.79	39.22	39.46	7.60	12.40	7.92	37.20	4.67	23.13	18.60	4.53	112.00	29.57	29.38	22.25	4.20	47.57
DPXOR0xOR27	3003.18	102.98	1195.23	41.04	38.28	39.96	7.61	12.66	7.92	37.40	4.73	26.87	20.47	6.40	118.73	24.23	29.72	22.31	4.37	48.73
SicalaxOR	3684.80	176.60	1457.14	69.91	37.77	38.63	8.33	13.25	8.17	38.27	4.73	29.80	24.80	5.00	119.27	34.03	30.06	22.18	4.37	47.43
DPx2131	2518.38	100.38	1021.32	40.79	34.93	40.77	6.39	11.73	6.45	33.00	4.13	23.27	18.73	4.53	110.27	16.27	29.80	21.95	4.37	47.47
Sicalax2131-2-5	2664.94	146.22	1034.84	56.81	37.93	39.16	7.43	12.32	7.57	37.53	4.60	26.53	23.13	5.33	114.73	14.17	30.99	22.93	3.97	49.37
SicalaxDPAc90	3142.03	137.38	1254.89	54.92	38.24	40.24	6.55	11.97	7.41	33.87	4.27	31.33	25.53	5.80	112.53	5.73	29.72	22.15	4.27	47.03
Mean	2571.11	120.76	991.79	46.50	38.12	39.60	6.87	11.85	7.45	35.56	4.38	25.92	21.31	4.81	109.91	35.45	29.21	21.97	4.22	48.59
LSD(0.05)	693.94	29.13	264.20	11.33	4.51	0.85	0.60	0.89	1.78	2.92	0.82	6.93	5.63	1.93	8.31	9.70	0.77	0.58	0.23	1.60
C.V.%	19.63	17.54	19.38	17.73	8.60	1.59	6.40	5.46	17.38	5.98	13.59	19.43	19.23	29.19	5.50	19.91	1.92	1.91	35.94	2.39
b	0.63	0.50	0.64	0.49		0.82	0.67	0.65	0.06	0.36	0.05	0.20	0.27	0.26	0.67	0.89	0.79	0.65	0.37	0.37

b=repeatability of results

4.2.4 LOSKOP EXPT4 1998/99 (Parents + F1 crosses)

Seed Cotton Yield (SCY)

OR27 ranked the highest among the parents for SCYP and was followed by Irco, Palala and Sicala. No significant differences exist among these parents. DPAc90 and 2131-2-5 ranked the lowest, with no significant difference between them (Fig. 4.2.4.1 [Appendix E] and Table 4.2.4). Crosses PalalaxIrco, OR27xIrco, OR27xPalala and DPAc90xOR27 yielded the highest with no significant differences among them. It seems quite clear that OR27 transferred its superiority to its offspring. 2131-2-5xPalala and the next eight crosses did not differ significantly among themselves. Sicalax2131-2-5 had the lowest SCY, though it did not differ significantly from four of the crosses with similar yields.

The parents showed a similar pattern with regard to SCYPLT. 2131-2-5 ranked the highest but was not significantly different from OR27, Irco, Sicala and Palala. DPAc90 differed significantly from the rest of the parents. OR27xIrco had again the highest SCYPLT, followed by SicalaxIrco, PalalaxIrco, OR27xPalala and SicalaxPalala. These crosss were not significant different from one another. Irco and OR27 transferred some of their superiority to their offspring. (Figure 4.2.4.2 and Table 4.2.4).

Lint Yield (LY)

For LYP (Figure 4.2.4.3 and Table 4.2.4), Irco and OR27 ranked the highest of the parents, with no significant differences between them and the third and fourth best parents, Palala and Sicala. 2131-2-5 and DPAc90 yielded significantly lower than the rest. OR27xIrco ranked the highest of the crosses, followed by PalalaxIrco, DPAc90xOR27 and

2131-2-5xOR27. These crosses did not differ significantly from one another. Irco and OR27 were again well represented in the crosses with the highest LYP, indicating that they transferred some of their superiority to their offspring. The cross Sicalax2131-2-5 ranked the lowest. Figure 4.2.4.4 illustrate and Table 4.2.4 shown that parent 2131-2-5 ranked the highest for LYPLT, but did not differ significantly from Irco and OR27. DPAc90 ranked the lowest, but did not differed significantly from Palala and Sicala. Sicalaxlrco ranked the highest among the crosses, followed by OR27xlrco and Palalaxlrco, with no significant differences among the three crosses.

Ginning Out Turn (GOT)

The results for GOT1 (based on 5-boll sample) indicated significant differences among parents and among crosses. 2131-2-5 ranked the highest among the parents but did not differ significantly from the rest of the parents, except Palala, which ranked significantly lower than the rest. (Figure 4.2.4.5 and Table 4.2.4). DPAc90x2131-2-5 ranked the highest among crosses though it did not differ significantly from seven other crosses with similar means. 2131-2-5xPalala ranked the lowest among the crosses. SicalaxPalala and SicalaxOR27 have similar values for GOT1. Irco again was well represented among the top crosses as a parent. For GOT2 (based on 50-bolls), DPAc90 ranked the highest among the parents, with no significant differences between it and 2131-2-5. (Figure 4.2.4.6 and Table 4.2.4). Irco, OR27 and Sicala did not differ significantly from one another and Palala had the lowest value and differed significantly from the rest. The crosses 2131-2-5xlrco, DPAc90x2131-2-5, SicalaxOR27 and DPAc90xOR27 ranked the highest, with no significant differences among them. The parents with the highest GOT2 values were well represented in the crosses with the larger GOT2 values.

Boll size (BS)

Sicala ranked the highest among the parents, but with no significant differences among it and four of the parents. The only line that differed significantly is DPAc90 which produced very small bolls. SicalaxOR27 and OR27xIrco were the highest in ranking but were not significantly different from eleven other crosses, with similar rankings. The parental line Sicala, Irco and OR27 which is characterised by very large bolls is also well represented in the best crosses (Figure 4.2.4.7 and Table 4.2.4).

Seed Index (SI)

The anova did not detect significant differences between the genotypes and separation of mean differences could not be done. However OR27 ranked the highest among the parents. All five crosses in which OR27 was involved as a parent, ranked first, indicating its superiority for this characteristics. It is characterised by large bolls and large seeds. Also DPAc90 which is characterised by small bolls, ranked last among the parents (Figure 4.2.4.8 and Table 4.2.4).

Lint Index (LI)

The parental line OR27 again ranked the highest for LI among the parents. It differed significantly from the rest of the parents. Sicala, 2131-2-5 and Irco did not differ significantly from one another while Palala and DPAc90 have the lowest lint in disc values. They did not differ significantly from each other. The cross 2131-2-5xOR27 ranked the highest among crosses, again indicating the superiority of OR27. Five other crosses had similar rankings (Fig 4.2.4.9 and Table 4.2.4). The cross 2131-2-5xPalala had the lowest SI but was not significantly different from six other crosses with similar lint indexes.

Seeds per boll (SB)

The anova did not detect any significant differences among genotypes. However, 2131-2-5 ranked the highest among the parents. The cross, 2131-2-5xIrco also ranked the highest among the crosses. OR27 was the parent with the lowest ranking, which is probably due to its characteristically large seed, but fewer seeds per boll. (Figure 4.2.4.10 and Table 4.2.4)

Locules per boll (LB)

No significant variability was found among the parents and among the crosses for locules per boll (Figure 4.2.4.11).

Total bolls formed (TBF)

The TBF values of the parents was clearly divided into three groups from which Palala and Irco ranked the highest. 2131-2-5 and OR27 were intermediate and DPAc90 and Sicala had the lowest number of bolls. Almost a similar pattern is observed for HC. However Palala did not differ significantly from 2131-2-5, nor did Irco differ from 2131-2-5 and OR27. Sicala was the lowest in ranking but did not differ significantly fro DPAc90 (Figure 4.2.4.12 and Table 4.2.4).

The crosses SicalaxIrco, PalalaxIrco, DPAc90xIrco and OR27cPalala did not differ significantly from one another and ranked the highest among crosses. Irco is seen to have exerted its superiority in its crosses as well as Palala. The five crosses with the highest TBF values involving Palala as a parent. SicalaxDPAc90 ranked the lowest of the crosses.

Harvestable bolls (HB)

The anova did not find significant differences among the parents and among the crosses for number of harvested bolls (Figure 4.2.4.13 and Table 4.2.4).

Unharvestable bolls (UHB)

Significant differences were found among parents and among crosses for UHB (Figure 4.2.4.14 and Table 4.2.4). Palala ranked the highest followed by Irco and OR27, which did not differ significantly from it. Sicala had the least UHB, but did not differ significantly from DPAc90 and 2131-2-5. Cross 2131-2-5xIrco ranked the highest for UHB, but did not differ significantly from seven other crosses, following in ranking. Crosses involving Irco ranked the highest for UHB.

Plant Height (PH)

OR27 ranked the highest among parents but did not differ significantly from Palala. Irco and Sicala were next with no significant difference between them. DPAc90 was the shortest but did not differ significantly from 2131-2-5 (Figure 4.2.4.15 and Table 4.2.4)

OR27xPalala ranked the highest, but without significant difference from the other four crosses next in ranking. OR27 was a common parent among the top five crosses indicating that it transferred its superiority to its offspring. All crosses involving DPAc90 ranked very low.

Hair Count (HC)

Significant differences were found among the parents and among the crosses for HC (Figure 4.2.4.16 and Table 4.2.4). Irco had the highest hair count followed by Palala. They did not differ significantly from each other. OR27 ranked third and differed significantly from the two parents with the highest hair count. 2131-2-5, DPAc90 and Sicala ranked the lowest with no significant difference among them.

PalalaxIrco ranked the highest among crosses and was significantly different from the rest. Some crosses surpassed their best parents while most of the other crosses have hair counts between best parent and the mid-parent.

Fibre Length (FL)

Variability was limiting for fibre length, but significant differences were found among parents and crosses. Sicala ranked the highest among the crosses and was significantly different from the rest of the parents. (Figure 4.2.4.17 and Table 4.2.4). Palala and OR27 were next with no significant difference among them. DPAc90, 2131-2-5 and Irco ranked the lowest but were significantly different from one another. 2131-2-5xPalala ranked the highest among crosses but was not significantly different from the eight other crosses following in ranking. DPAc90xIrco ranked the lowest. The other crosses involving Irco as a parent had very low FL values. Sicala and Palala indicated transmission of their superiority to their offspring.

Fibre Strength (FS)

Significant differences were found among the parents and among the crosses. Variability was, however, limited. Sicala ranked the highest among the parents followed by Palala and OR27. No significant differences were found among these three parents. Irco was the parent with the lowest value and differed significantly from the rest of the parents. 2131-2-5 and DPAc90 were intermediate and of equal strength. Ten of the crosses with the highest rankings did not differ significantly. Sicala, Palala and OR27 were common parents in those crosses indicating that their superiority was transferred to their offspring. The five crosses involving Irco as a parent also ranked the lowest (Figure 4.2.4.18).

Micronaire (MC)

Significant differences were not found among parents or among crosses in the anova. However, OR27 and Irco had the highest MC values among parents, though within acceptable range of 3.5 - 4.5 units (Figure 4.2.4.19 and Table 4.2.4). There was no clear pattern found in the offspring, although Irco and OR27 seemed to be common among the crosses with high MC units. It was not possible to separate the means of the offspring for significant differences.

Fibre Uniformity (FU)

Variability was limiting, but significant differences were found among parents and among crosses. (Figure 4.2.4.20 and Table 4.2.4). Palala ranked the highest among parents, but was not significantly different from OR27 and Irco. Sicala did not differ from 2131-2-5, and DPAc90, the lowest in ranking, did not differ significantly from 2131-2-5.

OR27xIrco ranked the highest among crosses, and did not differ significantly from five other crosses with similar means. The best three parents were present in the best five crosses.

Discussion

For yield characteristics, the best parents produced the best crosses. OR27 ranked the highest for BS, SI and LI as it is characterised by large bolls and large seeds.

Sufficient variability was observed for most of the agronomic characteristics measured except for GOT, SB and LB. Fibre quality characteristics had limited variability, but significant differences were found, except for MC.

The offspring which involved Irco as a parent had the highest number of TBF per plant. Probably due to the hairiness trait which protected them against some pests. They also had high UHB values which negatively contributes to yield. 2131-2-5 and DPAc90x2131-2-5 would be preferable; they combine high TBF and HB with low UHB. Tall parents give rise to tall offspring and vice verse. Crosses among hairy parents were very hairy even surpassing the best values parent (PalalaxIrco) while those crosses between smooth parents were less hairy.

Table 4.2.4 Means for various cotton agronomic and quality characteristics: Loskop 1998/99 (Parents + F1s)

GENOTYPES	SCYP	SCYPLT	LYP	LYPLT	GOT1	GOT2	BS	SI	LI	SB	LB	TBF	HB	UHB	PH	HC	FL	FS	MC	FU
Irco	2770.09	69.29	1118.68	27.99	38.20	38.00	7.34	11.10	7.06	36.67	4.60	24.67	15.53	9.13	133.13	72.07	26.16	20.25	4.30	50.73
Palala	2381.69	56.89	853.40	20.39	32.51	34.28	6.40	12.09	6.23	33.87	4.40	26.33	15.27	11.07	150.33	62.90	29.46	22.12	4.10	52.47
OR27	2882.63	70.07	1110.93	27.00	37.31	37.75	6.62	13.64	8.16	30.53	4.53	20.13	11.53	8.60	157.60	49.43	29.13	21.89	4.30	51.70
2131-2-5	1770.83	72.73	705.56	30.55	38.94	38.29	6.98	11.51	7.39	37.67	4.67	22.13	15.07	7.07	116.60	26.23	27.85	21.66	4.00	48.57
DPAc90	1606.65	43.84	657.43	17.94	37.73	39.16	5.29	9.55	5.90	34.13	4.33	15.40	10.93	4.47	104.13	8.57	28.70	21.66	4.07	47.97
Sicala	2337.45	59.07	894.64	22.60	38.18	37.09	7.38	11.98	7.52	37.20	4.60	10.07	11.27	3.87	127.27	14.20	30.14	22.44	4.03	50.37
PalalaxIrco	3800.04	88.96	1451.32	33.97	37.28	36.88	7.25	12.19	7.32	36.67	4.60	28.00	17.27	10.73	150.80	75.17	29.55	21.36	4.13	49.33
OR27xIrco	3704.67	95.24	1490.21	38.32	37.08	38.53	8.15	13.44	8.03	37.53	4.67		14.60	9.53	152.33	50.77	29.80	21.56	4.47	51.97
2131-2-5xIrco	2877.42	72.22	1200.76	30.13	38.88	40.10	8.02	11.98	7.82	39.93	4.47	24.47	12.00	12.47	150.13	59.40	29.72	21.72	4.17	48.60
DPAc90xIrco	2714.69	63.13	1102.66	25.64	39.65	38.85	7.49	11.76	7.77	38.27	4.47	25.87	15.27	10.60	137.40	46.90	28.02	20.91	4.33	50.37
SicalaxIrco	2469.62	94.07	1012.18	38.52	39.51	38.94	7.81	8.66	8.14	37.80	4.53	30.20	18.87	11.33	153.67	47.63	29.63	21.59	4.17	49.70
OR27xPalala	3315.37	78.27	1202.52	28.40	35.17	35.20	7.34	13.09	7.12	36.13	4.40	24.73	13.33	11.40	163.80	53.90	30.65	22.15	4.03	50.83
2131-2-5xPalala	3127.19	73.92	1170.10	27.66	35.51	37.04	6.82	12.57	7.03	33.27	4.53	22.60	14.07	8.53	140.07	39.40	30.65	22.35	3.97	47.53
DPAc90xPalala	3089.64	76.54	1186.03	29.37	37.82	37.28	7.67	11.84	7.25	39.20	4.47	23.93	16.67	7.27	137.40	21.93	29.80	21.79	4.20	49.53
SicalaxPalala	2609.22	78.08	976.03	29.24	35.51	35.85	6.76	12.57	7.04	34.00	4.33	22.53	14.40	8.20	149.20	32.10	30.23	22.24	4.07	50.03
2131-2-5xOR27	3092.72	73.75	1225.91	29.22	38.03	38.99	7.30	13.38	8.39	35.87	4.53	22.53	13.13	9.40	150.20	39.97	30.14	22.31	4.20	51.63
DPAc90xOR27	3180.24	73.96	1274.16	29.63	38.25	39.08	7.18	12.79	8.01	34.00	4.33	20.83	14.07	6.93	147.13	22.23	30.57	22.38	4.40	50.43
SicalaxOR27	2813.66	74.17	1081.21	28.48	37.03	36.73	8.19	13.38	7.89	38.40	4.87	21.80	14.00	7.80	151.07	25.53	30.39	22.38	4.07	50.60
DPAc90x2131-2-5	2679.67	67.92	1106.25	28.08	39.76	40.06	7.20	11.94	8.08	35.40	4.53	23.33	17.20	6.13	120.20	20.33	30.22	22.05	4.33	49.32
Sicalax2131-2-5	2055.17	62.98	811.45	24.87	38.10	38.21	7.71	12.15	7.65	37.80	4.60	22.93	13.47	9.47	143.47	21.93	30.65	22.34	4.00	47.93
SicalaxDPAc90	2786.45	72.21	1119.51	28.97	38.95	39.40	7.24	11.83	7.58	37.33	4.73	18.13	13.73	4.40	131.47	10.30	30.56	21.98	4.43	48.50
Mean	2765.01	72.25	1083.38	28.43	37.59	37.89	7.24	12.07	7.49	36.27	4.53	22.61	14.37	8.50	141.31	38.14	29.62	21.86	4.18	49.91
LSD(0.05)	660.85	18.70	266.87	7.36	1.88	1.10	1.16	2.34	0.62	4.80	0.31	5.64	4.02	3.58	13.60	10.05	0.64	0.61	0.30	1.76
C.V.%	17.38	18.82	17.92	18.82	3.65	2.12	11.64	14.13	6.02	9.64	4.96	18.16	20.37	30.68	7.00	19.17	1.58	2.04	5.13	2.56
b	0.50	0.30	0.47	0.33	0.56	0.77	0.21	0.15	0.62	0.09	0.04	0.43	0.14	0.35	0.66	0.88	0.85	0.53	0.52	0.47

b=repeatability of results

4.3. COMBINING ABILITY

4.3.1 Analysis of variance

At Rustenburg, EXPT1 1997/98, general combining ability effects (g.c.a.) were significant either at the $p<0.01$ or $p<0.05$ levels of significance for most of the characteristics measured. No significant g.c.a. were found for SCYPLT, LYPLT, SI, LB and FU. Most of the characteristics had significant specific combining abilities effects (s.c.a.) at $p<0.01$ or $p<0.05$ levels. Characteristics with no significant s.c.a. effects were GOT1, SI, SB, LB, UHB, FS and FU (Table 4.3.1.1). At Loskop, EXPT2, 1997/98, all the characteristics measured had highly significant ($p<0.01$) g.c.a. effects. Significant s.c.a. effects were found for most of the characteristics measured at both levels of significance, but not for GOT1, GOT2, SI, SB, LB, LYPLT, HC and FS (Table 4.3.1.2).

In EXPT3, planted at Rustenburg during 1998/99 significant g.c.a. were also found at both significant levels, for most of the characteristics measured. Characteristics that show no significant g.c.a. effects were SCYP, LYP, GOT1, LI, LB, TBF and PH. Significant s.c.a effects were also found for some of the characteristics measured at $p<0.01$ or $p<0.05$ levels. No significant s.c.a was found for GOT1, SI, LI, LB, TBF, UHB, PH, MC and FU (Table 4.3.1.3). At Loskop, EXPT4 1998/99, significant g.c.a. effects were recorded for most of the characteristics, except SB, LB, HB and UHB. Significant s.c.a. effect were also recorded for most of the characteristics. The only exceptions were GOT1, BS, SI, SB, LB, HB, UHB, HC, FS and MC (Table 4.3.1.4).

Table 4.3.1.1 ANOVA **Mean squares for combining ability for various cotton yield and quality characteristics for diallel experiment 1 Parents and F1s, Rustenburg 1997/98**

Source	D.F.	SCYP	SCYPLT	LYP	LYPLT	GOT1	GOT2	BS	SI	LI
GCA	5	38221.56*	15.8	7203.44**	2.77	16.12	4.62**	0.96**	60.26	1.09**
SCA	15	80713.08**	38.34*	14455.52**	7.25*	10.01	1.18**	0.21**	23.18	0.29**
Residual	40	15,273.41	18.02	2,642.47	2.99	8.56	0.14	1.07	33.87	0.07
GCA:SCA		0.47	0.41	0.5	0.38	0.56	1.77	4.5	2.6	3.84

Source	D.F.	SB	LB	TBF	HB	UHB	PH	HC	FL	FS	MC	FU
GCA	5	6.40**	0.13	11.45*	7.98**	15.83**	199.36**	877.74**	4.63**	2.59**	0.14**	1.75
SCA	15	1.5	0.12	8.60*	4.26**	5.65	115.30**	18.74**	0.32**	0.49	0.08*	1.71
Residual	40	1.81	0.12	4.39	1.66	3.12	30.11	4.89	0.07	0.35	0.03	1.27
GCA:SCA		4.26	1.13	1.33	1.87	2.8	1.72	46.84	14.43	5.28	1.79	1.71

*,**=significantly different at the 0.05 or 0.01 level of probability, respectively.

Table 4.3.1.2 ANOVA **Mean squares for combining ability for various cotton yield and quality characteristics for diallel experiment 2 Parents and F1s - Rustenburg 1997/98**

Source	D.F.	SCYP	SCYPLT	LYP	LYPLT	GOT1	GOT2	BS	SI	LI
GCA	5	199,985.06**	371.94**	29635.09**	66.88**	5.49**	6.92**	0.65**	4.27**	1.39**
SCA	15	142867.12**	76.64**	22375.58**	11.13**	0.91	0.59	0.19**	1.22	0.20**
Residual	60	17,159.25	17.31	2,602.67	3.43	1.48	0.54	0.07	0.78	0.08
GCA:SCA		1.4	4.85	1.32	6.01	6.02	11.75	3.47	3.5	6.99

Source	D.F.	SB	LB	TBF	HB	UHB	PH	HC	FL	FS	MC	FU
GCA	5	8.49**	0.05**	18.01**	7.89**	3.35**		685.73**	3.58**	2.43**	0.24**	3.01**
SCA	15	2.37	0.01	2.06*	1.82*	0.91		17.56	0.41**	0.32	0.03**	0.78**
Residual	40	2.4	0.01	0.97	0.85	0.58		13.74	0.09	0.24	0.01	0.28
GCA:SCA		3.59	3.71	8.75	4.34	3.7		39.05	8.69	7.73	7.24	3.88

*,**=significantly different at 0.05 or 0.01 level of probability, respectively.

Table 4.3.1.3 ANOVA **Mean squares for combining ability for various cotton yield and quality characteristics for diallel experiment 3 Parents and F1s - Rustenburg 1998/99**

Source	D.F.	SCYP	SCYPLT	LYP	LYPLT	GOT1	GOT2	BS	SI	LI
GCA	5	107,715.43	1,043.01**	18,828.06	164.13**	1.39	6.85**	1.28**	2.95**	1.09
SCA	15	643479.01**	441.73**	96761.39**	63.70**	2.96	0.25*	0.17**	0.23	0.51
Residual	40	84,920.44	149.61	12,309.05	22.65	3.59	0.13	0.06	0.14	0.56
GCA:SCA		0.17	2.36	0.19	2.58	0.47	27.38	7.37	12.95	2.12

Source	D.F.	SB	LB	TBF	HB	UHB	PH	HC	FL	FS	MC	FU
GCA	5	3.78*	0.1	12.47	15.27**	2.27*	6,210.31	1,460.31**	3.00**	0.94**	0.07**	3.25**
SCA	15	4.18**	0.15	15.74	10.78**	1.03	2,479.98	46.21**	0.76**	0.20**	0.01	0.57
Residual	40	1.51	0.12	8.46	5.6	0.66	3,851.2	16.6	0.11	0.06	0.01	0.45
GCA:SCA		0.9	0.67	0.79	1.42	2.22	2.5	31.6	3.96	4.68	7.2	5.69

*,**=significantly different at 0.05 or 0.01 level of probability, respectively.

Table 4.3.1.4 ANOVA **Mean squares for combining ability for various cotton yield and quality characteristics for diallel experiment 4 Parents and F1s - Loskop 1998/99**

Source	D.F.	SCYP	SCYPLT	LYP	LYPLT	GOT1	GOT2	BS	SI	LI
GCA	5	544,911.71**	183.11*	74189.13**	30.17*	9.98**	8.07**	0.66*	3.29*	0.89**
SCA	15	224,227.65**	125.81*	36007.41**	21.53*	0.71	0.47**	0.35	0.85	0.23**
Residual	40	77,013.42	61.64	12,559.16	9.54	0.63	0.22	0.24	0.97	0.07
GCA:SCA		2.43	1.46	2.06	1.4	14.02	17.25	1.89	3.86	3.87

Source	D.F.	SB	LB	TBF	HB	UHB	PH	HC	FL	FS	MC	FU
GCA	5	7.73	0.03	39.72**	4.77	69.97	642.15**	1490.44**	2.52**	0.99**	0.05*	4.64**
SCA	15	4.4	0.02	11.26**	4.05	20.17	79.36*	33.16	0.87**	0.06	0.02	1.08*
Residual	40	4.07	0.02	5.62	2.86	33.87	32.64	17.82	0.07	0.07	0.02	0.55
GCA:SCA		1.76	1.63	3.53	1.18	3.47	8.09	44.95	2.90	15.71	3.2	4.31

***,** = significantly different at 0.05 or 0.01 level of probability, respectively**

4.3.2 General Combining Ability (g.c.a.)

Effects are referred to as large or small when they are positive or negative respectively. Tenkouano *et al* (1998) referred to largest positive effects as largest effects and to largest negative effects as smallest effects.

<u>Seed cotton yield</u>

At Rustenburg, EXPT1 (P+F1s) 1997/98, Palala had the largest g.c.a. effect, while Sicala had the smallest effect for SCYP (Table 4.3.1.1). Palala was significantly different from Irco, OR27, DPAc90 and Sicala. 2131-2-5 was significantly different from Sicala. For SCYPLT, Sicala had comparatively the largest g.c.a. effects, but no significant differences were found for this character among the parents. Palala would appear to be a suitable choice for the improvement of SCYP under these conditions.

At Loskop, EXPT2 (P+F1s) 1997/98, Irco had the largest, and DPAc90 had the smallest g.c.a. effects for SCYP (Table 4.3.1.2). Palala was second, with no significant difference between them. Each of them differed significantly from DPAc90, Sicala and 2131-2-5. OR27 was significantly different from DPAc90 and Sicala. Irco had the largest g.c.a. effects for LYPLT, while DPAc90 had the smallest. Irco was significantly different from the other five parents. Palala and OR27 did not differ significantly from each other but were significant different from the line with the best g.c.a effect for seed cotton yield at Loskop.

In diallel experiment 3 planted at Rustenburg during 1998/99, OR27 had the largest and 2131-2-5 the smallest g.c.a. effects. No significant differences were found among the parents, for SCYP (Table 4.3.1.3). For SCYPLT, Sicala had the highest and DPAc90 the smallest g.c.a. effects. Sicala, OR27 and Palala were significantly different from DPAc90, Irco and 2131-2-5. Sicala and OR27 would therefore be useful for the improvement of seed cotton yield under the prevailing conditions.

At Loskop, EXPT4 (P+F1s) 1998/99, OR27 had the largest and 2131-2-5 the smallest g.c.a. effects for SCYP (Table 4.3.1.4). OR27 was significantly different from 2131-2-5, Sicala and DPAc90. Irco and Palala were not significantly different from OR27, but both of them were also significantly different from 2131-2-5, DPAc90 and Sicala The three, OR27, Irco and Palala were useful parents for yield improvement under these conditions. For SCYPLT, Irco had the largest and DPAc90 the smallest g.c.a. effects. Significant differences were detected only between Irco and DPAc90, making Irco again a very good choice for the improvement of seed cotton yield under these conditions.

General combining ability X environment interaction showed differences in rankings among parents across locations. This is an indication that interaction was significant. At Rustenburg Sicala appears to be consistently having larger g.c.a effects, while Irco appears to be the best cultivar for Loskop area.

Lint Yield

In diallel experiment 1 (P+F1s) planted at Rustenburg during 1997/98, Palala had the highest and OR27 the smallest g.c.a. effects for LYP. Palala differed significantly from OR27, but not from the rest of the parents. The effects for LYPLT were very small with no significant differences among the parental lines. Palala would be the best parent to use for the improvement of lint yield (Table 4.3.1.1).

At Loskop, EXPT2 (P+F1s) 1997/98, Irco had the highest and DPAc90 the smallest g.c.a. effects for LYP. Irco was significantly different from

DPAc90, Sicala and 2131-2-5 and did not differ significantly from Palala and OR27. OR27 and Palala were also significantly different from DPAc90 and Sicala. A similar pattern is repeated for LYPLT (Table 4.3.1.2). The three most hairy parents, Irco, Palala and OR27, had positive g.c.a. effects, and could be used for improvement of this characteristic, especially Irco with the highest g.c.a. effects.

At Rustenburg, EXPT3 (P+F1s) 1998/99, Sicala had the largest and Palala the smallest g.c.a. effects for SCYP. There were no significant differences among the parents. Sicala and OR27 had positive effects which would make them useful parents to use for the improvement of this characteristic (Table 4.3.1.3). A similar pattern was found for SCYPLT.

At Loskop, EXPT4 (P+F1s) 1998/99, OR27 and Irco had the largest g.c.a. effects while Sicala and 2131-2-5 had the smallest g.c.a. effects. OR27 and Irco were not significantly different from one another, but both of them differed significantly from Sicala, 2131-2-5 and DPAc90. For LYPLT, Irco had the largest and DPAc90 the smallest g.c.a. effects. The two differed significantly from one another. Irco appears to be a useful parent for the improvement of this characteristic. (Table 4.3.1.4).

It is clear that the environment had a significant effect on the g.c.a. effects of the parental lines . Irco and OR27 appear to be the most useful parents for the improvement of lint yield at Loskop. Sicala appears to be the best parental line to improve the lint yield at Rustenburg.

Ginning out turn (GOT)

In EXPT1 (P+F1s) planted at Rustenburg during 1997/98. DPAc90 had the largest and Palala had the smallest g.c.a. effects for GOT1. There was no significant difference between DPAc90 and Irco which also had positive g.c.a. effects. DPAc90 was significantly different from Palala (Table 4.3.1.1). 2131-2-5 and DPAc90 had the largest g.c.a. effects for GOT2 and Sicala had the smallest effects. Both DPAc90 and 2131-2-5 were significantly different from Sicala and Palala. DPAc90 appears to be the most suitable parent for the improvement of GOT.

The results of diallel experiment 2 planted at Loskop during 1997/98 showed that Irco had the largest g.c.a. effects and Palala the smallest effects for GOT2. OR27 also had large positive g.c.a effects which differed not significantly from Irco. Irco and OR27 were significantly different from Palala and Sicala. Irco again had the largest g.c.a. effects for GOT2 while Palala had the smallest effects. The two were significantly different. Irco is a suitable parent for the improvement of this characteristic in Loskop (Table 4.3.1.2).

At Rustenburg EXPT3, (P+F1s) 1998/99 no significant differences were among genotypes for GOT1. DPAc90 had the largest and Palala had the smallest g.c.a. effects for GOT2. The two were significantly different from each other (Table 4.3.1.3). DPAc90 is therefore the most suitable line for the improvement of this characteristic at Rustenburg area.

At Loskop, EXPT4 (P+F1s) 1998/99, DPAc90 had the largest g.c.a. effects for GOT1, though not significantly different from Irco. Palala had the smallest effects (Table 4.3.1.4). The same pattern is repeated with GOT2 suggesting that DPAc90 and Irco were excellent parents to be utilised to improve this characteristic.

All over, DPAc90 and Sicala appeared to be the most useful parents for the improving GOT at Rustenburg, while Irco appears to be the most useful to improve this characteristic at Loskop.

Boll size (BS)

At the Rustenburg diallel trial, OR27 had the largest g.c.a effects and was significantly different from the rest of the parents except 2131-2-5. As a parent, OR27 can therefore be successfully used to improve this characteristic (Table 4.3.1.1).

At Loskop EXPT2 (P+F1s) 1997/98, OR27 again had the largest g.c.a. effects which were significantly different from DPAc90 which had the largest negative effects. OR27 with the largest effects and DPAc90 with the smallest effects are characterised by large and small bolls respectively. OR27 is therefore the most suitable parent for the improvement of boll size (Table 4.3.1.2).

In diallel experiment 2, planted at Rustenburg during 1998/99, OR27 had the largest effects while DPAc90 had the largest negative effect. OR27 was significantly different from all the other parents except from Sicala. OR27 is again a very useful parent for the improvement of this characteristic. (Table 4.3.1.3).

In diallel experiment 4, planted at Loskop during 1998/99, Irco had the largest g.c.a. effects for BS followed by Sicala. There were no significant differences among the genotypes in the anova for the g.c.a. effects at Loskop.

The results indicated that the g.c.a. values for boll size were not very sensitive for different environmental effect. Secondly, it is quite clear that OR27 is the best local parent to improve boll size in cotton.

Seed Index (SI)

In diallel experiment 1 planted at Rustenburg during 1997/98 no significant differences were found for g.c.a. effects among genotypes. This is an indication that very little variation exists among the parents with regard to their g.c.a. effects.

At Loskop EXPT1 (P+F1s) 1997/98, OR27 had the largest g.c.a. effect. It was significantly different from DPAc90, and Palala with the smallest g.c.a. effects for seed index. (Table 4.3.1.2).

In diallel experiment 3 grown at Rustenburg during 1998/99, OR27 had the largest g.c.a. effect for seed index. It was significantly different from the rest of the parents. DPAc90 and Irco had again the least g.c.a. effects (Table 4.3.1.3). In EXPT4 grown at Loskop during 1998/99, OR27 had again the largest g.c.a. effects which differed significantly from DPAc90 and Irco, which had the large negative effects as seen in Table 4.3.1.4. Across the locations OR27 appears to have the largest g.c.a. effects for SB. It can therefore be successfully used to improve seed index across the two locations.

Lint Index (LI)

In diallel experiment 1 planted at Rustenburg during 1997/98. OR27 had the largest g.c.a. effects which was significantly different from the rest of the parents. 2131-2-5 had also a positive effects and differed significantly from the remaining four parents. Irco, Palala and Sicala had the same amount of negative g.c.a. effects. OR27 and 2131-2-5 could be used as parental lines to improve the lint increase. (Table 4.3.1.7).

In diallel experiment 2 planted at Loskop during 1997/98, OR27 and 2131-2-5 had the largest g.c.a effects for lint index with no significant difference between them. The two are significantly different from Palala, DPAc90 and Sicala, but not from Irco. Both parents, OR27 and 2131-2-5 can be used to improve this characteristics, and most preferably OR27 with the largest effects (Table 4.3.1.2).

In diallel experiment 3 planted at Rustenburg during 1998/99, OR27 had the largest g.c.a. effects for lint index. However the anova for combining abilities shown no significant differences among the genotypes (Table 4.3.1.3) at Rustenburg during 1998/99.

At Loskop EXPT4 (P+F1s), 1998/99 OR27 had the largest g.c.a. effects for lint yield. It differed significantly from Palala, which had the smallest effects as well as DPAc90. OR27 is again proved to be the choice for the improvement of this characteristic (Table 4.3.1.4).

It appears that the environment did not had a large effect on the g.c.a. values of cultivars with regard to lint yield.

<u>Seeds per boll</u> (SB)

Irco and Sicala had the largest g.c.a. effects at Rustenburg in diallel experiment 1 planted during 1997/1998. They did not differ significantly from each other. Both parents differed significantly from DPAc90, which had the lowest g.c.a. effects, as well as Palala (Table 4.3.1.1). Irco and Sicala can therefore be successfully utilised for the improvement of SB.

In diallel experiment 2 planted at Loskop during 1998/99 Sicala and Irco had the largest g.c.a. effects and was significantly different from the rest of the parents. Sicala and Irco with the largest g.c.a. effects could be used for the improvement of this characteristic in Loskop area.

In diallel experiment 3 planted at Rustenburg during 1998/99 Sicala had the largest g.c.a. effects for seeds per boll followed by Irco. However no significant differences exist among the parental lines.

In diallel experiment 4 planted at Rustenburg during 1998/99 Irco had the largest g.c.a. effects for seeds per boll followed by Sicala. Again no significant differences existed among the parental lines (Table 4.3.1.4).

The g.c.a. effects of the parental lines for this character appeared to be affected by the environment. Sicala appeared consistently suitable to use as a parent for Rustenburg while the cultivar Irco is the best (area) suited to enhance the seeds per boll at Loskop area.

Locules per boll (LB)

The diallel experiment 1 planted at Rustenburg during 1997/98 showed no significant differences among the parental lines with regard to their g.c.a. effects for locules per boll (Table 4.3.1.1).

Significant differences existed among the parental lines in diallel experiment 2 planted at Rustenburg during 1997/98. Sicala had the largest g.c.a. effects for LB and was significantly different from DPAc90 and Irco. Sicala can therefore be used as a parent to improve on LB (Table 4.3.1.2).

There were no significant differences among the parents for LB in diallel experiment 3 planted at Rustenburg during 1998/99 (Table 4.3.1.3).

At Loskop EXPT1 (P+F1s) 1998/99, no significant differences were found among parents.

Sicala appears not to be affected by the four different environments and can therefore be used as a parent to improve the number of locules per boll.

<u>Total bolls formed</u> (TBF)

At Rustenburg EXPT1 (P+F1s) 1997/98 Sicala had the largest g.c.a. effects for TBF. It differed significantly from OR27, which had the lowest g.c.a. effects. Irco also differed significantly from OR27 and 2131-2-5. Sicala and Irco can therefore be used for the improvement of the total number of bolls formed.

At Loskop EXPT2 (P+F1s) 1997/98, Irco had the largest g.c.a. effects while DPAc90 and Sicala had the smallest. Palala had the second largest effects with no significant difference between it and Irco. The two were significantly different from Sicala, DPAc90, 2131-2-5 and OR27.

At Rustenburg EXPT3 (P+F1s) 1998/99, Sicala had the largest g.c.a effects, while 2131-2-5 had the smallest. There were no significant differences among parents.

At Loskop EXPT4 (P+F1s) 1998/99, Irco had the largest effects with OR27 and Sicala having the lowest g.c.a. values. Irco was significantly different from Sicala, DPAc90 and OR27. Palala was also significantly different from OR27, Sicala and DPAc90 (Table 4.3.1.4). Irco and Palala can suitably be used as a parent for the improvement of this characteristic.

Across locations, the pattern appeared consistent with Irco and Palala being the favourites for the improvement of TBF.

Harvestable bolls (HB)

At Rustenburg EXPT1 (P+F1s) 1997/98, Palala and DPAc90 had the largest g.c.a. effects and were significantly different from OR27, with the smallest effects, Irco, 2131-2-5 and Sicala. These two parents are suitable for the improvement of this characteristic (Table 4.3.1.1).

At Loskop EXPT2 (P+F1s) 1997/98, the largest g.c.a. effects were from Palala with the smallest from Sicala. Palala was significantly different from Sicala, DPAc90 and OR27. Irco had positive g.c.a. effects and was significantly different from Sicala and DPAc90. Palala and Irco is suitable parents to be used for the improvement of HB (Table 4.3.1.2).

At Rustenburg EXPT3 (P+F1s) 1998/99, the largest g.c.a effects were from Sicala and Palala (Table 4.3.1.3). However no significant differences existed among the parental lines.

At Loskop EXPT4 (P+F1s) 1998/99, no significant differences were found among parents though Irco had the highest g.c.a. effect.

Across locations, it is quite clear that the environment had a much larger effect on the g.c.a. effects of the parental lines.

Unharvestable bolls (UHB)

UHB contributes negatively to yield. Preference would therefore be given to parents with low UHB. At Rustenburg EXPT1 (P+F1s) 1997/98, DPAc90 and Palala had the smallest g.c.a. effects. They were significantly different from Sicala and Irco with the largest effects. Palala and DPAc90 can be used to reduce the number of UHB per plant.

At Loskop EXPT2 (P+F1) 1997/98, DPAc90 had the smallest g.c.a. effects and differed significantly from Irco and 2131-2-5 with the largest effects. DPAc90 can therefore also be used to reduce UHB.

At Rustenburg EXPT3 (P+F1) 1998/99, Palala had the smallest effects and was significantly different from OR27, with the largest g.c.a. effects. Palala can be used to reduce UHB.

At Loskop EXPT4 (P+F1s) 1998/99, DPAc90 and Sicala had the smallest effects but no significant differences existed among the parents.

The different environments had an effect on the g.c.a. effects of the parents. Palala will be a reliable parent to use in the Rustenburg area.

Plant Height (PH)

At Rustenburg EXPT1 (P+F1) 1997/98, the largest g.c.a. effects were from Sicala and OR27 and both were significantly different from DPAc90 and 2131-2-5 with the smallest effects. Sicala and OR27 can therefore be used to increase plant height while DPAc90 is a suitable parent to reduce plant height, depending on the objectives of the breeding program.

At Loskop EXPT2 (P+F1s) 1997/98 no records were taken for plant height.

At Rustenburg EXPT3 (P+F1s) 1998/99, no significant differences exist among the parental lines with regard to their g.c.a. effects for plant height.

At Loskop EXPT4 (P+F1s) 1998/99, OR27 had the largest g.c.a. effects and 2131-2-5 the smallest. OR27 was significantly different from DPAc90, 2131-2-5 and Sicala. OR27 can also be used as a parent to increase plant height while DPAc90 can be used to reduce plant height.

Environment effects seem to influence plant height. However, both OR27 and Sicala seemed to be consistent for Rustenburg, while OR27 may be used successfully to increase plant height at Loskop.

Hair Count (HC)

Irco had the largest g.c.a. effects for Rustenburg EXPT1 (P+F1s) 1997/98, and differed significantly from the other parents except Palala. Palala was also significantly different from Sicala, DPAc90, 2131-2-5 and OR27. Irco and Palala can be used to increase hairiness, while Sicala and DPAc90 can be used to reduce hairiness.

At Loskop EXPT2 (P+F1s) 1997/98, Irco had the largest g.c.a. effects followed by Palala. Irco was significantly different from all the other parents, except Palala. The two should be useful in increasing hairiness while Sicala and Palala can be used to reduce hairiness (Table 4.3.1.2).

Irco had the largest g.c.a. effects for Rustenburg EXPT3 (P+F1s) 1998/99. It was significantly different from all the other parents. Palala was second and was significantly different from the rest. DPAc90 and Sicala had the smallest effects and were not significantly different from each other.

At Loskop EXPT4 (P+F1s) 1998/99, Irco had the largest g.c.a. effects followed by Palala. The two were significantly different and both were significantly different from the rest. DPAc90 and Sicala had the smallest effects without significant difference between them. Irco and Palala are again useful for increasing, while DPAc90 is useful for decreasing hairiness (Table 4.3.1.4).

Environment does not appear to have affected the g.c.a. effects for hairiness of the parents. Irco and Palala have the largest effects and DPAc90 and Sicala the smallest.

Fibre Length (FL)

At Rustenburg EXPT1 (P+F1s), 1997/98, Sicala had the largest effects for FL while Irco had the smallest. Sicala was significantly different from all the other parents and is a useful parent for the improvement of FL (Table 4.3.1.1).

At Loskop EXPT2 (P+F1) 1997/98, the largest g.c.a. effects were from Sicala, which differed significantly from Irco, with the smallest effects, and DPAc90. Sicala can be utilised to increase FL (Table 4.3.1.2).

At Rustenburg EXPT3 (P+F1s) 1998/99, Sicala had again the largest g.c.a. effects from the parents. It differed significantly from Irco and DPAc90, which had the smallest effects. Sicala would be a popular choice for the improvement of FL (Table 4.3.1.3).

At Loskop EXPT4 (P+F1s) 1998/99, Sicala had the largest g.c.a. effects and was significantly different from Irco, with the smallest effects. Sicala is again a choice for improvement of FL (Table 4.3.1.4).

From the results it appeared that the environment had a very small effect on the g.c.a. values of the parents. Sicala had the largest g.c.a. effect while Irco had the smallest g.c.a. effect consistently. Sicala can be used to improve FL across the two locations. The negative g.c.a. effects of Irco did not appear to be affected by the environment.

Fibre Strength (FS)

At Rustenburg EXPT1 (P+F1s) 1997/98, the largest g.c.a effects was from the parental line OR27. It differed significantly from Irco, with the smallest g.c.a. effects, Palala and DPAc90. OR27 is the choice for the improvement of FS. 2131-2-5 and Sicala also had large g.c.a. effects but were not significantly different from OR27 (Table 4.3.1.1.).

At Loskop EXPT2 (P+F1s) 1997/98 the largest g.c.a. effects were from 2131-2-5, which differed significantly from Irco, with the smallest effects. 2131-2-5 can therefore also be utilised for the improvement of FS. Again OR27 and Sicala also had large effects, but did not differ significantly from 2131-2-5 (Table 4.3.1.2).

At Rustenburg EXPT3 (P+F1s) 1998/99, OR27 and Sicala had the largest g.c.a. effects. They were significantly different from Irco with the smallest effects, and DPAc90 (Table 4.3.1.3). Again OR27 and Sicala can be used to improve FS.

Sicala had the largest g.c.a. effects at Loskop EXPT4 (P+F1s) 1998/99 and was significantly different from Irco with the smallest effects. Sicala will therefore be the best choice for the improvement of FS at Loskop (Table 4.3.1.4).

The environment had some effect on the g.c.a. effects of the parents. Generally Sicala and OR27 had the largest g.c.a. effects, consistently, across the locations and could therefore be used to improve FS at both locations. 21310205 is another choice, though it appeared to be location specific (Loskop).

Micronaire (MC)

At Rustenburg EXPT1 (P+F1s) 1997/98, the largest g.c.a. effects were from DPAc90 and it differed significantly from Sicala and Irco, which had the smallest effects (Table 4.3.1.1). DPAc90 could be used to improve the micronaire, depending on the level. Micronaire should not go beyond 4.5 units and Sicala could therefore be used to lower the MC to the right units.

At Loskop, EXPT2 (P+F1s) 1997/98, Irco had the largest effects and was significantly different from Sicala with the smallest effects, DPAc90 and 2131-2-5 (Table 4.3.1.2). Irco could be used to improve (raise) on the micronaire level, again depending on the level required. Sicala could also be used to improve (lower) the micronaire level.

At Rustenburg EXPT3 (P+F1s) 1998/99 DPAc90 and OR27 had larger g.c.a. effects and were significantly different from Palala and 2131-2-5, which had smaller effects. The parents with larger effects can be used interchangeably with those having smaller effects depending on the level of micronaire in the lines which one would like to improve (Table 4.3.1.3).

At Loskop EXPT4 (P+F1s) 1998/99, Irco had relatively larger g.c.a. effects for MC though there were no significant differences among the parents (Table 4.3.1.4).

The environment appears to have affected the g.c.a. effects of the parents as seen from the lack of consistency. Different parents can therefore be recommended for the improvement of this characteristic for each location depending on the MC level required.

Fibre Uniformity (FU)

At Rustenburg EXPT1, (P+F1) 1997/98, the largest g.c.a. effects were from OR27 and 2131-2-5 and both differed significantly from Sicala (Table 4.3.1.1). These two could be used to improve FU of other materials.

At Loskop EXPT3 (P+F1s) 1997/98, OR27 and Palala had the highest g.c.a. effects and were significantly different from Sicala with the smallest effects, DPAc90 and 2131-2-5. OR27 can be utilised to improve the FU in cotton. Irco had the largest g.c.a. effects and was significantly different from all the other parents (Table 4.3.1.3) at Rustenburg EXPT3 (P+F1s) 1998/99. It can successfully be utilised to improve the FU values of cotton germplasm.

OR27 had the largest g.c.a. effects at Loskop EXPT4 (P+F1s) 1998/99 (Table 4.3.1.4) and can be used as a parent for the improvement of this characteristic.

Environment appears to have some effect on g.c.a effects of the parents. OR27 appears to be least affected among those parents with positive g.c.a. effects and could be used to improve on this characteristic across locations. Irco, too appeared to be useful for the improvement of this characteristic.

Table 4.3.2.1 **GCA effects for various cotton agronomic and quality characteristics of diallel experiment 1**

Parents and F1s - Rustenburg 1997/98

GENOTYPES	SCYP	SCYPLT	LYP	LYPLT	GOT1	GOT2	BS	SI	LI	SB	LB	TBF	HB	UHB	PH	HC	FL	FS	MC	FU
Irco	-31.76	0.97	-8.77	0.46	1.18	0.23	0.02	-1.42	-0.35	0.85	0.03	0.77	-0.52	1.38	1.29	12.71	-1.27	-0.62	-0.06	0.01
Palala	101.85	0.22	36.09	0	-1.87	-0.55	-0.33	-1.34	-0.34	-0.72	-0.01	0	1.19	-1.24	1.74	9.13	0.43	-0.44	0.07	-0.23
OR27	-35.14	-1.84	-16.69	-0.86	0.24	-0.12	0.48	-0.14	0.62	-0.08	-0.22	-1.69	-1.38	-0.33	4.29	4	0.2	0.76	0.05	0.42
2131-2-5	67.75	0.99	33.73	0.77	-0.96	0.85	0.27	-0.78	0.23	0.54	0.09	-0.68	-0.25	-0.48	-4.63	-2.04	0.24	0.43	0.02	0.36
DPAc90	-24.82	-1.66	-3.17	-0.44	1.97	0.71	-0.44	-1.79	-0.12	-1.36	-0.04	-0.19	1.14	-1.38	-7.53	-12.46	-0.48	-0.43	0.16	0.27
Sicala	-77.88	1.33	-14.19	0.06	-0.57	-1.14	0	5.48	-0.34	0.77	0.14	1.76	-0.18	2.05	4.84	-11.33	0.88	0.3	-0.23	-0.81
LSD(0.05)	124.88	4.29	51.94	1.75	2.96	0.65	0.26	5.88	0.26	1.36	0.35	2.12	1.3	1.78	5.54	2.23	0.27	0.6	0.18	1.14

Table 4.3.2.2 **GCA effects for various cotton agronomic and quality characteristics of diallel experiment 2**

Parents and F1s - Loskop 1997/98

GENOTYPES	SCYP	SCYPLT	LYP	LYPLT	GOT1	GOT2	BS	SI	LI	SB	LB	TBF	HB	UHB	PH	HC	FL	FS	MC	FU
Irco	159.77	10.76	78.27	5.04	0.72	1.4	0.11	-0.18	0.33	0.08	-0.07	1.83	0.87	1.07	-	11.33	-1.21	-1.01	0.21	0.3
Palala	130.16	2.51	30.35	0.33	-1.33	-1.29	-0.12	-0.24	-0.4	-0.28	0	1.14	1.17	-0.06	-	8.05	0.35	-0.04	0.13	0.55
OR27	109.69	2.29	40.63	0.67	0.64	-0.35	0.39	1.19	0.5	-0.15	0.04	-0.4	-0.35	-0.07	-	3.99	0.18	0.22	0.09	0.63
2131-2-5	-31.76	-1.51	-10.12	-0.51	0.24	0.36	-0.03	-0.04	0.3	-0.98	0.04	0.82	-0.49	0.32	-	-2.95	0.44	0.64	-0.06	-0.22
DPAc90	-214.09	-8.47	-74.27	-3.06	0.42	0.41	-0.46	-1.03	-0.35	-0.63	-0.12	-1.74	-0.96	-0.8	-	-11.23	-0.33	-0.02	-0.1	-0.26
Sicala	-153.77	-5.58	-64.86	-2.49	-0.7	-0.53	0.11	0.32	-0.37	1.96	0.1	-1.66	-1.23	-0.46	-	-9.2	0.57	0.21	-0.26	-0.99
LSD(0.05)	130.99	4.16	51.02	1.85	1.22	0.73	0.27	0.88	0.28	1.55	0.11	0.98	0.92	0.76	-	3.71	0.31	0.49	0.09	0.53

Table 4.3.2.3 **GCA effects for various cotton agronomic and quality characteristics of diallel experiment 3**

Parents and F1s - Rustenburg 1998/99

GENOTYPES	SCYP	SCYPLT	LYP	LYPLT	GOT1	GOT2	BS	SI	LI	SB	LB		TBF	HB	UHB	PH	HC	FL	FS	MC	FU
Irco	-114.45	-5.62	-27.11	-1.23	0.72	0.68	-0.08	-0.52	-0.34	0.69	-0.14	-0.28	-0.73	-1.05	0.19	56.49	18.88	-1.08	-0.56	0.04	1.17
Palala	42.33	4.58	-37.55	-1.08	-0.09	-1.69	-0.32	0.02	0.05	-0.63	0	-0.32	0.45	1.49	-0.95	-12.68	11.22	0.42	0.15	-0.1	0.01
OR27	130.23	10.9	51.95	4.15	-0.56	-0.31	0.6	1.07	0.63	-0.28	0.21	-0.32	1.09	0.57	0.53	-6.57	3.02	0.26	0.32	0.1	-0.15
2131-2-5	-117.95	-3.57	-35.94	-1.04	0.03	0.59	-0.18	-0.28	-0.04	-0.28	-0.01	-0.65	-1.47	-1.7	0.3	-14.66	-5.33	0.23	0.05	-0.11	-0.76
DPAc90	-69.51	-18.51	-22.85	-6.78	0.04	0.72	-0.4	-0.54	-0.39	-0.53	-0.05	-2.89	-1	-0.84	-0.26	-14.18	-15.77	-0.35	-0.25	0.1	-0.24
Sicala	129.34	11.79	71.49	5.97	-0.13	0.02	0.38	0.24	0.1	1.03	0	1.32	1.65	1.52	0.2	-8.4	-12.01	0.53	0.3	-0.03	-0.03
LSD(0.05)	294.47	7.93	112.11	4.81	1.91	0.36	0.26	0.38	0.76	1.24	0.35	2.32	2.94	2.39	0.82	62.71	4.12	0.33	0.24	0.1	0.68

Table 4.3.2.4 **GCA effects for various cotton agronomic and quality characteristics of diallel experiment 4**

Parents and F1s - Loskop 1998/99

GENOTYPES	SCYP	SCYPLT	LYP	LYPLT	GOT1	GOT2	BS	SI	LI	SB	LB	TBF	HB	UHB	PH	HC	FL	FS	MC	FU
Irco	218.95	5.81	113.85	2.95	0.71	0.51	0.33	-0.53	0.09	1.21	0.03	2.97	1.06	0.63	2.68	19.63	-1.04	-0.67	0.08	0.26
Palala	168.73	0.47	13.65	-1.2	-2.1	-1.8	-0.26	0.24	-0.53	-0.86	-0.08	2.03	0.71	0.05	6.6	10.17	0.31	0.13	-0.08	0.35
OR27	314.61	3.72	114.02	1.13	-0.37	-0.15	0.09	1.11	0.41	-1.36	0.02	-4.49	-0.04	-0.7	11.33	3.04	0.31	0.19	0.06	1.19
2131-2-5	-247.65	-1.19	-82.26	0.26	0.63	0.72	0.04	0.07	0.16	0.46	0.03	0.23	-0.07	5.34	-6.48	-4.18	-0.03	0.13	-0.07	-0.9
DPAc90	-211.38	-8.04	-60.03	-2.68	0.84	0.97	-0.42	-0.65	-0.25	-0.18	-0.07	-1.92	-0.22	-2.95	-13.41	-16.02	-0.1	-0.08	0.07	-0.66
Sicala	-243.25	-0.77	-99.24	-0.46	0.29	-0.24	0.22	-0.24	0.11	0.73	-0.07	-2.82	-0.44	-2.37	-0.72	-12.63	0.55	0.3	-0.06	-0.23
LSD(0.05)	280.43	7.93	113.24	3.12	0.8	0.47	0.49	0.99	0.26	2.04	0.13	2.4	1.71	5.88	5.77	4.27	0.27	0.26	0.12	0.75

Table 4.3.2.5 **GCA effects on various cotton agronomic and quality characteristics**

Rustenburg, Parents and F1s - 1998/99

GENOTYPES	SCYP	SCYPLT	LYP	LYPLT	GOT1	GOT2	BS	SI	LI	SB	LB	TBF	HB	UHB	PH	HC	FL	FS	MC	FU
Irco	-121.36	-6.06	-36.33	-2.01	0.55	1.61	-0.03	-0.17	0.07	0.08	-0.04	-1.9	-1.51	-0.21	-1.85	11.88	-1.04	-0.87	-0.01	0.42
Palala	24.9	3.05	-29.12	-0.62	-1.38	-1.59	-0.08	0.1	-0.34	-0.03	0.02	1.77	2.2	-0.33	0.59	5.47	0.43	0.19	-0.02	-0.12
OR27	-61.69	6.58	-32.52	2.28	-0.26	-0.49	0.39	0.97	0.42	-0.56	0.01	-0.5	-0.68	0.2	2.1	5.46	0.28	0.34	0.12	0.34
2131-2-5	1.72	-6.58	13.93	-1.5	0.32	0.18	-0.04	-0.21	-0.08	0.36	0.03	-0.59	-0.91	0.36	-0.52	-1.8	0.11	0.1	-0.08	-0.42
DPAc90	68.39	-6.38	41.85	-1.96	0.09	0.71	-0.39	-0.7	-0.22	-0.31	-0.13	0.98	0.88	0.21	-2.33	-10.29	-0.29	-0.21	0.09	0.51
Sicala	88.04	9.39	45.2	3.81	0.68	-1.43	0.15	0.01	0.14	0.46	0.12	0.24	0.03	-0.23	2.02	-10.71	0.51	0.45	-0.1	0.29
LSD(0.05)	264.09	12.33	100.01	4.83	0.94	0.84	0.24	0.27	0.25	1.09	0.09	2.87	2.34	0.57	4	3.37	0.31	0.32	0.09	0.72

Table 4.3.2.6 **GCA effects on various cotton agronomic and quality characteristics**

Loskop, Parents and F1s - 1998/99

GENOTYPES	SCYP	SCYPLT	LYP	LYPLT	GOT1	GOT2	BS	SI	LI	SB	LB	TBF	HB	UHB	PH	HC	FL	FS	MC	FU
Irco	451.86	15.48	188.03	6.36	1	0.41	0.28	-0.29	0.15	1.57	-0.01	4.82	2.18	2.66	8.24	17.55	-0.73	-0.46	0.04	0.23
Palala	219.7	1.93	61.5	0.07	-1.62	-1.33	0	0.15	-0.38	0.21	0.07	0.19	1.17	-0.27	-1.03	6.54	0.2	0.1	0.11	0.69
OR27	-57.25	6.72	-24.39	2.54	0.06	-0.38	0.4	1.33	0.77	-1.34	0.03	0.52	-0.64	1.17	14.14	4.95	0.12	0.15	0.25	0.74
2131-2-5	-131.74	-6.15	-56.05	-2.62	0.09	0.57	-0.13	-0.05	-0.02	-0.26	-0.01	-1.92	-1.23	-0.69	-9.49	-3.01	0.33	0.24	-0.02	-0.23
DPAc90	-317.14	-14.53	-107.21	-5.1	0.88	0.79	-0.65	-1.1	-0.38	-0.74	-0.13	-2.66	-0.66	-1.9	-11.36	-12.07	-0.33	-0.18	-0.14	-1.33
Sicala	-165.43	-3.44	-61.88	-1.25	-0.42	-0.07	0.1	-0.04	0.14	0.56	0.04	-1.67	-0.82	-0.88	-0.5	-13.98	0.42	0.13	-0.24	-0.1
LSD(0.05)	244.87	9.48	103.19	3.86	0.66	0.92	0.36	0.43	0.31	1.66	0.12	2.36	1.73	1.43	7.15	4.98	0.39	0.22	0.24	0.88

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4.3.3 Specific Combining Ability

Seed cotton yield

At Rustenburg, EXPT1 (P+F1s) 1997/98 (Table 4.3.3.1) all crosses except DPAc90x2131-2-5, had positive s.c.a. effects for SCYP. The largest s.c.a. effects were from the cross DPAc90xOR27. It differed significantly from four of the fifteen crosses. The other crosses which differed significantly from it were OR27xPalala, SicalaxPalala, 2131-2-5xOR27 and DPAc90x2131-2-5. Most of the crosses with large s.c.a. effects had one or both parents with small (negative) g.c.a. effects. Both the parents of DPAc90xOR27 had small g.c.a. effects but had very large s.c.a. effects, although it did not differ significantly from 2131-2-5xPalala. This may be the result of non-allelic interaction effects.

Considering SCYPLT, nine out of fifteen crosses had positive s.c.a. effects. SicalaxOR27 had the largest effects, followed by DPAc90xOR27. The two were not significantly different from each other and both were significantly different from the other nine crosses. Sicala had the largest g.c.a. effects for SCYPLT and must have made a major contribution to this cross.

At Loskop, EXPT2 (P+F1s) 1997/98, two out of the fifteen crosses had negative g.c.a effects for SCYP. SicalaxIrco had the largest s.c.a. effects and was significantly different from twelve of the fifteen crosses (Table 4.3.3.2). DPAc90xIrco and 2131-2-5xIrco did not differ significantly from SicalaxIrco. Interestingly, Irco had the largest g.c.a effects and is present as a parent in all three crosses with large s.c.a. effects. Ten out of fifteen crosses had positive s.c.a. effects, with SicalaxOR27 having the largest s.c.a. effects for SCYPLT. It was significantly different from ten other crosses, but not from SicalaxIrco, DPAc90xPalala, DPAc90xOR27 and DPAc90xOR27. The parents in these crosses, again were the most hairy and also had large g.c.a effects. SicalaxIrco appears to be the most suited cross for selection under these conditions.

At Rustenburg, EXPT3 (P+F1) 1998/99, twelve of the fifteen crosses had positive s.c.a. effects for SCYP. SicalaxOR27 had the largest effects and was significantly different from five other crosses. It was not significantly different from PalalaxIrco, 2131-2-5xIrco, 2131-2-5xPalala, OR27xPalala, DPAc90xPalala, SicalaxDPAc90, OR27xIrco, DPAc90xOR27 and 2131-2-5XOR27. Both parents involved in the cross with large s.c.a. effects had large g.c.a. effects. This cross would be utilised in the breeding process for the improvement of seed cotton yield. For SCYPLT, nine out of fifteen crosses had positive s.c.a. effects. SicalaxOR27 had the largest effects and was significantly different from nine crosses. It was not significantly different from DPAc90xPalala, SicalaxDPAc90, 2131-2-5xIrco, SicalaxPalala and SicalaxIrco. SicalaxOR27 will again be a good choice for the improvement of SCYP at Rustenburg.

At Loskop, EXPT4 (P+F1) 1998/99, ten of the fifteen crosses had positive s.c.a for SCYP (Table 4.3.3.4). PalalaxIrco had the largest s.c.a. effects and was significantly different from seven other crosses. It was not significantly different from SicalaxDPAc90, 2131-2-5xPalala, OR27xIrco, DPAc90x2131-2-5, DPAc90xPalala, DPAc90xOR27 and 2131-2-5xOR27. The cross PalalaxIrco consists of the most hairy parents. They had also the largest g.c.a. effects, making it the most suitable cross for the improvement of SCYP. For SCYPLT, ten of the fifteen crosses had positive s.c.a. effects (Table 4.3.2.4). SicalaxIrco had the largest s.c.a. effects and differed significantly from seven other crosses. It did not differ significantly from OR27xIrco, DPAc90xPalala, PalalaxIrco, SicalaxDPAc90, DPAc90xOR27 and DPAc90x2131-2-5. Most of the crosses with large s.c.a. effects, involved hairy parents, Irco and Palala.

Palalaxlrco and Sicalaxlrco could be usefully utilised in a breeding programme to enhance SCYPLT.

The environment had a significant effect on the s.c.a. effects of the different crosses. This was observed from the inconsistency in the performance of the crosses at the two locations. Crosses involving Irco, the most hairy parent seemed to have larger s.c.a. effects at Loskop area, especially the cross, Sicalaxlrco.

Lint yield

At Rustenburg, EXPT1 (P+F1s) 1997/98, only two of the fifteen crosses had negative s.c.a. effects for LYP. DPAc90xOR27 had the largest s.c.a. effects and was significantly different from four other crosses, which were OR27xPalala, 2131-2-5xOR27, SicalaxPalala and DPAc90x2131-2-5, with the smallest effects. The only cross where both parents had positive g.c.a. effects was 2131-2-5xPalala. It ranked eighth. For LYPLT, SicalaxOR27 had the largest s.c.a. effects and was significantly different from nine out of fifteen crosses. DPAc90xOR27 appears to be the choice for a selection program, under the prevailing conditions. In EXPT2 (P+F1s) 1997/98 plant at Loskop the cross Sicalaxlrco had the largest s.c.a. effect while 2131-2-5xOR27 had the smallest effect. Only two out of fifteen crosses had negative s.c.a. effects. Sicalaxlrco did not differ significantly from DPAc90xlrco and 2131-2-5xlrco, but it differed significantly from twelve of the other crosses. The cross SicalaxOR27 had the largest s.c.a effect for LYPLT, though it did not differ significantly from seven of the other crosses. Six crosses had negative effects with OR27xlrco having the smallest (largest negative) effect. Sicalaxlrco and DPAc90xlrco appears to be the most consistent crosses and therefore useful for selection purposes.

At Rustenburg, EXPT3 (P+F1s) 1998/99, twelve of the fifteen crosses had positive s.c.a. effects for LYP. 2131-2-5xIrco had the largest effect and SicalaxPalala the smallest. For LYPLT SicalaxOR27 had the largest effect while SicalaxPalala had the smallest. The LYP of the cross 2131-2-5xIrco was significantly different from seven other crosses. For LYPLT, SicalaxOR27 differed significantly from nine of the other crosses. 2131-2-5xIrco and SicalaxOR27 ranked first and second respectively. The s.c.a. effects of these two crosses were very little affected by environmental variation (Table 4.3.1.3).

In the trial planted at Loskop, EXPT4 (P+F1s) 1998/99, nine of the fifteen crosses had positive s.c.a. effects for LYP. PalalaxIrco had the largest and Sicalax2131-2-5 had the smallest s.c.a effects. PalalaxIrco was significantly different from six other crosses. Both the parents involved in these crosses had large g.c.a effects. For LYPLT, ten from the fifteen crosses had positive s.c.a. effects. SicalaxIrco had the largest effect while SicalaxOR27 had the smallest effect.

Inconsistency in the performance of crosses at the two locations indicates a significant influence of environment on the s.c.a. effects.

The environment had a significant effect on lint yield. There was no consistency in the performance of the crosses across the two locations. The crosses DPAc90xOR27 and SicalaxOR27 appear to be the best suited for Rustenburg area, while SicalaxIrco appears to be suited for Loskop.

<u>Ginning Out Turn</u> (GOT)

In EXPT1 (P+F1s) at Rustenburg 1997/98, twelve of the fifteen crosses had positive s.c.a. effects for GOT1. SicalaxPalala had the largest s.c.a.

effect while 2131-2-5xPalala had the smallest effect. The s.c.a. effect of the cross 2131-2-5xPalala was significantly lower than the rest of the crosses. For GOT2, eleven from the fifteen crosses had positive s.c.a. effects (Table 4.3.2.1). DPAc90x2131-2-5 had the largest s.c.a. effects while 2131-2-5xPalala had the smallest. The s.c.a. effect of DPAc90x2131-2-5 was significantly higher than eight other crosses. For GOT, Irco appeared a good specific combiner as seen in crosses 2131-2-5xIrco and PalalaxIrco. This could be useful to enhance GOT under these conditions.

At Loskop, EXPT2 (P+F1s) 1997/98 only six from the fifteen crosses had positive s.c.a. effects (Table 4.3.2.2). PalalaxIrco had the largest and 2131-2-5xPalala had the smallest s.c.a. effects for GOT1. For GOT2, 2131-2-5xOR27 had the largest and 2131-2-5xPalala had the smallest s.c.a effects. In both cases 2131-2-5xPalala appeared to be the cross with the lowest specific combining ability. PalalaxIrco appeared to be well adapted to the Loskop area.

At Rustenburg, EXPT3 (P+F1s) 1998/99, eight of the fifteen crosses had positive s.c.a. effects for GOT1. 2131-2-5xOR27 had the largest s.c.a effect and DPAc90x2131-2-5 had the smallest (Table 4.3.2.3). 2131-2-5xOR27 differed significantly from four of the crosses. All four of them had negative s.c.a. effects. They are DPAc90x2131-2-5, OR27xPalala, 2131-2-5xPalala and PalalaxIrco. For GOT2, ten of the fifteen crosses had positive s.c.a. effects. The cross SicalaxPalala had the largest and 2131-2-5xPalala, the smallest effects. SicalaxPalala was significantly different from six other crosses. 2131-2-5xIrco and OR27xIrco appear to have consistently large s.c.a. values. These crosses could be successfully utilised in a breeding programme.

At Loskop EXPT4 (P+F1s) 1998/99, eight of the fifteen crosses had positive s.c.a. effects (Table 4.3.2.4), for GOT1. DPAc90xPalala had the largest s.c.a. effects and OR27xIrco had the smallest. DPAc90xPalala was significantly different from six other crosses. For GOT2, eleven crosses had positive s.c.a. effects. 2131-2-5xIrco had the largest effects while SicalaxOR27 had the smallest. 2131-2-5xIrco was significantly different from six other crosses. Crosses involving Irco as a parent gave rise to above average specific combining abilities. Irco could be successfully utilised in a breeding programme.

The results showed that the two locations had very little effect on the g.c.a. effects of cultivars. This is an indication that very little s.c.a. x environment interaction effects exists for GOT.

Boll size (BS)

At Rustenburg, EXPT1 (P+F1s) 1997/98, OR27xIrco had the largest s.c.a. effects and OR27XPalala the smallest. Twelve of the fifteen crosses had positive s.c.a. effects. OR27xIrco was significantly different from nine crosses. Under these conditions OR27xIrco would be a useful choice for the improvement of BS.

At Loskop, EXPT2 (P+F1) 1997/98, ten of the fifteen crosses had positive s.c.a. effects, with DPAc90xPalala and DPAc90xOR27 having the largest s.c.a. effects. 2131-2-5xOR27 and SicalaxOR27 had the smallest effects. DPAc90xPalala was significantly different from eleven crosses but not from DPAc90xOR27, SicalaxPalala and DPAc90x2131-2-5. Only one of the crosses involving a parent with characteristically large bolls. Both parents in this cross, DPAc90xOR27 had large g.c.a. effects, and could successfully be utilised to improve boll size in cotton.

At Rustenburg, EXPT3 (P+F1s) 1998/99, twelve crosses had positive s.c.a. effects. DPAc90xOR27 had the largest s.c.a. effect, while DPAc90xIrco and SicalaxDPAc90 had the smallest (Table 4.3.2.3). DPAc90xOR27 was significantly different from four crosses, namely SicalaxDPAc90, DPAc90xIrco, OR27xPalala and SicalaxPalala. The cross DPAc90xOR27 would be useful in the selection programme.

At Loskop, EXPT4 (P+F1s) 1998/99, eleven of the crosses had positive s.c.a. effects and DPAc90xPalala, had the largest effect. SicalaxPalala had the smallest effects. DPAc90xPalala was significantly different from five crosses, namely SicalaxPalala, 2131-2-5xOR27, PalalaxIrco, 2131-2-5xPalala and SicalaxIrco. Other crosses with large s.c.a. effects were SicalaxOR27 and OR27xIrco. These three crosses would be good for selection in improvement of boll size under the prevailing conditions. (Table 4.3.2.4).

The results showed that the environment had no significant effect on the s.c.a. effects for BS.

Seed Index (SI)

Ten of the fifteen crosses had positive s.c.a. effects for seed index in EXPT1 (P+F1s) at Rustenburg, 1997/98 season. OR27xIrco had the largest s.c.a. effect, with Sicalax2131-2-5 having the smallest effect. There were no significant differences among the crosses (Table 4.3.2.1).

At Loskop EXPT2 (P+F1s) 1997/98, nine crosses had positive s.c.a. effects, with SicalaxOR27 having the largest and Sicalax2131-2-5 the smallest s.c.a. effect. SicalaxOR27 was significantly different from twelve other crosses but did not differ from 2131-2-5xIrco and DPAc90xPalala.

SIcalaxOR27 together with these other two crosses could be utilised to improve SI under the prevailing conditions (Table 4.3.2.2).

EXPT3 (P+F1s) 1998/99 planted at Rustenburg had ten crosses with positive s.c.a. effects (Table 4.3.2.3). DPAc90x2131-2-5 had the largest effects and DPAc90xIrco the smallest. DPAc90x2131-2-5 was significantly different from six other crosses. Crosses with similar s.c.a. effects than the abovementioned cross were SicalaxIrco, Sicalax2131-2-5, SicalaxDPAc90 and PalalaxIrco. These crosses could be utilised in the selection programme to improve SI under these conditions.

In EXPT4 (P+F1s) 1998/99 at Loskop, thirteen crosses had positive s.c.a effects. DPAc90xIrco and OR27xIrco had the largest and SicalaxIrco the smallest s.c.a. effects. The two top crosses were significantly different from SicalaxIrco. The crosses DPAc90xIrco and OR27xIrco could be utilised in a selection programme to improve SI (Table 4.3.2.4).

There is a pattern of repeatability in the performance of some of the crosses for SB, which means that the environmental x s.c.a. interaction effects is of little importance for SB.

<u>Lint Index</u> (LI)

Ten out of fifteen crosses had positive s.c.a. effects for lint index at Rustenburg. DPAc90xOR27 had the largest s.c.a. effect and was significantly different from seven other crosses. OR27xPalala had the smallest effects. DPAc90xOR27 would appear to be a useful cross to use in a selection programme to improve LI under these conditions.

At Loskop, EXPT2 (P+F1s) 1997/98, there were 11 crosses with positive s.c.a. effects. DPAc90xOR27 had the largest s.c.a. effects and

DPAc90x2131-2-5 had the smallest. DPAc90xOR27 was significantly different from twelve of the crosses but not from DPAc90xPalala and 2131-2-5xIrco. These three crosses would be useful to improve lint index (Table 4.3.2.2).

In EXPT3 (P+F1s) 1998/99 at Rustenburg nine of the 15 crosses had positive s.c.a. effects. The largest effect was recorded from 2131-2-5xOR27 and the smallest from OR27xPalala. 2131-2-5xOR27 was significantly different from ten other crosses but not from SicalaxIrco, DPAc90xOR27 and 2131-2-5xIrco. These results have shown that 2131-2-5xOR27 together with these other three crosses could be utilised to improve LI in the local breeding programme (Table 4.3.2.3).

At Loskop, EXPT4 (P+F1s) 1998/99, ten crosses had positive s.c.a. effects. DPAc90x2131-2-5 had the largest and OR27xPalala had the smallest effects. DPAc90x2131-2-5 was significantly different from seven other crosses and could be successfully used to improve LI (Table 4.3.2.4).

The repeatability in the performance of the crosses across the location and years appears to indicate that the s.c.a. x environment interaction effects were not very large for SI.

<u>Seeds per boll</u> (SB)

In EXPT1 (P+F1s) at Rustenburg 1997/98 nine out of fifteen crosses had positive s.c.a. effects. DPAc90xPalala had the largest s.c.a. effects while PalalaxIrco had the smallest. DPAc90xPalala was significantly different from twelve other crosses but not from OR27xIrco and 2131-2-5xIrco, suggesting that these three with the largest s.c.a. effects, could be used for the improvement of SB (Table 4.3.2.1).

At Loskop, EXPT2 (P+F1s) 1997/98, ten crosses had positive s.c.a. effects. DPAc90x2131-2-5 had the largest and 2131-2-5xIrco the smallest effects. DPAc90x2131-2-5 was significantly different from five other crosses namely 2131-2-5xIrco, SicalaxIrco, SicalaxPalala, 2131-2-5xOR27 and DPAc90xOR27. Four crosses, DPAc90x2131-2-5, PalalaxIrco, Sicalax2131-2-5 and OR27xIrco could be utilised in a selection programme for the improvement of SB (Table 4.3.2.2).

At Rustenburg, EXPT3 (P+F1s) 1998/99, nine of the crosses had positive s.c.a. effects. DPAc90xOR27 had the largest and SicalaxDPAc90 the smallest effects. DPAc90xOR27 was significantly different from five other crosses; SicalaxDPAc90, SicalaxIrco, DPAc90x2131-2-5, DPAc90xIrco and DPAc90xPalala. DPAc90xOR27, OR27xIrco, 2131-2-5xOR27 and SicalaxOR27 could be used to improve SB under these conditions. (Table 4.3.2.3). At Loskop, EXPT4 (P+F1s) 1998/99, 10 of the crosses had positive s.c.a. effects. DPAc90xPalala had the largest and 2131-2-5xPalala the smallest s.c.a. effects. DPAc90xPalala was significantly different from 2131-2-5xPalala, SicalaxPalala, DPAc90xOR27, Sicalax2131-2-5 and PalalaxIrco. Crosses with similar s.c.a. effects as DPAc90xPalala could also be utilised together with DPAc90xPalala to improve SB. They were SicalaxOR27, OR27xPalala and 2131-2-5xIrco.

The environment had very little effect on the s.c.a. values of the different crosses for seeds per boll.

Locules per boll (LB)

The diallel trial planted at Rustenburg 1997/98 has shown that seven of the fifteen crosses had positive s.c.a. effects. DPAc90xOR27 had the largest and SicalaxOR27 had the smallest effects. DPAc90xOR27 was significantly different from six other crosses. In addition to DPAc90xOR27, 2131-2-5xOR27 could also be utilised in a selection programme for the improvement of LB, under these conditions. At Loskop, EXPT2 (P+F1s) 1997/98, seven crosses had positive s.c.a effects. DPAc90x2131-2-5 had the largest s.c.a. effects and SicalaxOR27 had the smallest. DPAc90x2131-2-5 was significantly different from eleven other crosses. The rest of the crosses which did not differ significantly were Sicalax2131-2-5, SicalaxPalala and SicalaxDPAc90. This suggests that DPAc90x2131-2-5 is a good cross to increase the number of locules per boll.

At Rustenburg, EXPT3 (P+F1s) 1998/99, eight of the crosses had positive s.c.a. effects with OR27xIrco and Sicalax2131-2-5 having the largest and SicalaxIrco the smallest effects. There were no significant differences between crosses except SicalaxIrco which was significantly different from the rest of the crosses. OR27xIrco, Sicalax2131-2-5, SicalaxPalala and DPAc90xOR27 would be useful in a selection programme to improve LB (Table 4.3.2.3). EXPT4 (P+F1s) 1998/99 at Loskop had seven crosses with positive s.c.a. effects with SicalaxOR27 having the largest and SicalaxPalala the lowest. SicalaxOR27 was significantly different from eight crosses. In addition to SicalaxOR27, SicalaxDPAc90 would be utilised in the improvement of LB under these conditions.

There was no consistence in the performance of the crosses across locations and years for locules per boll.

<u>Total bolls formed</u> (TBF)

Seven of the fifteen crosses had positive s.c.a. effects at Rustenburg, EXPT1 (P+F1s) 1997/98, with the largest effects from DPAc90xOR27 and smallest from 2131-2-5xIrco. DPAc90xOR27 was significantly different from nine other crosses. Crosses DPAc90xPalala and 2131-2-5xPalala would be useful in addition to DPAc90xOR27 to improve TBF under the prevailing conditions (Table 4.3.2.1).

At Loskop, EXPT2 (P+F1s) 1997/98, ten of the crosses had positive s.c.a. effects with DPAc90xOR27 having the largest effects and 2131-2-5xOR27 the smallest DPAc90xOR27. It was significantly different from eight other crosses. DPAc90xOR27, SicalaxDPAc90 and OR27xPalala would be regarded as one of the best crosses to improve TBF.

In EXPT3 (P+F1s) 1998/99 at Rustenburg, eight crosses had positive s.c.a. effects. 2131-2-5xIrco had the largest and SicalaxPalala the smallest effects. 2131-2-5xIrco was significantly different from the rest of the crosses, except SicalaxDPAc90. The two could be utilised for the improvement of TBF at this location. EXPT3 (P+F1s) 1998/99 at Loskop had twelve crosses with positive s.c.a. effects. SicalaxIrco had the largest s.c.a. effects and 2131-2-5x Palala the smallest effects. SicalaxIrco was significantly different from all the other crosses making it a suitable cross for the improvement of TBF (Table 4.3.2.4).

Environment x s.c.a. effects interaction appears significant, due to inconsistency in the performance of the hybrids.

<u>Harvestable bolls</u> (HB)

There were nine crosses with positive s.c.a. effects, in EXPT1 (P+F1s) 1997/98 planted at Rustenburg. DPAc90xOR27 had the largest s.c.a. effects and 2131-2-5xOR27 the smallest. DPAc90xOR27 differed significantly from all the crosses except 2131-2-5xPalala. These two crosses would be useful to select for increased HB under the prevailing conditions. (Table 4.3.2.1). At Loskop, EXPT1 (P+F1s) 1997/98, there were nine crosses with positive s.c.a. effects. DPAc90xIrco had the largest and OR27xIrco the smallest effects. Seven crosses were significantly different from DPAc90xIrco. In addition to DPAc90xIrco, DPAc90xOR27 could be used to improve HB, under the prevailing conditions (Table 4.3.2.2.).

At Rustenburg, EXPT2 (P+F1s) 1998/99, there were nine crosses with positive s.c.a. effects. SicalaxPalala had the largest and SicalaxPalala the smallest effects. Three crosses were significantly different from SicalaxPalala and they were; DPAc90xIrco, 2131-2-5xOR27 and OR27xIrco. SicalaxPalala, SicalaxDPAc90 and PalalaxIrco. They would be useful for the improvement of HB under the prevailing conditions (Table 4.3.2.3). In EXPT4 (P+F1s) 1998/99 at Loskop, nine crosses had positive s.c.a. effects, with SicalaxIrco having the largest and 2131-2-5xIrco the smallest effects. SicalaxIrco was significantly different from nine crosses. SicalaxIrco and DPAc90x2131-2-5 appear to be suitable for selection aimed to improve HB (Table 4.3.2.4).

There was no evidence of significant environment x s.c.a. interaction effects.

<u>Unharvestable bolls</u> (UHB)

In EXPT1 (P+F1s) 1997/98 at Rustenburg, six crosses had positive s.c.a. effects SicalaxPalala had the largest and Sicalax2131-2-5 had the smallest effects. Since UHB has a negative contribution to yield, the crosses with the smallest effects would be preferable, since they reduce the UHB. For this scenario Sicalax2131-2-5 is the choice, since it was significantly different from six other crosses. Sicalax2131-2-5, DPAc90xIrco, 2131-2-5xIrco and PalalaxIrco would be suitable to select in order to reduce UHB. In EXPT2 (P+F1s) 1997/98 at Loskop, five crosses had positive s.c.a. effects with SicalaxDPAc90 having the largest effects and DPAc90xIrco the smallest. DPAc90xIrco was significantly different from eleven crosses, but not from SicalaxIrco, 2131-2-5xOR27 and SicalaxPalala.

At Rustenburg, EXPT3 (P+F1s) 1998/99, there were six crosses with positive s.c.a. effects with the largest from 2131-2-5xIrco and the smallest from SicalaxPalala. To select for reduced UHB, SicalaxPalala would be the cross preferred. It was significantly different from 2131-2-5xIrco, DPAc90xOR27, and SicalaxDPAc90. SicalaxPalala and DPAc90xIrco are suitable crosses to reduce UHB (Table 4.3.2.3). In EXPT4 (P+F1s) 1997/98 at Loskop, nine crosses with positive s.c.a. effects were observed, with the largest s.c.a. effects from SicalaxIrco and the smallest from 2131-2-5xPalala. No significant differences were found between the crosses.

The environment had a significant effect on the s.c.a. values for UBS.

Plant Height (PH)

At Rustenburg, EXPT1 (P+F1s) 1997/98, eleven crosses had positive s.c.a. effects, with SicalaxPalala having the largest s.c.a. effect and DPAc90xIrco the smallest. SicalaxPalala was significantly different from nine crosses. SicalaxIrco is the cross with the second largest effect. It is not significantly different from SicalaxPalala but is significantly different from nine similar crosses. These two crosses could be utilised to increase PH. DPAc90xIrco would be the ideal cross to select for reduced height, depending on the objectives of the breeder. At Loskop, EXPT2 (P+F1s) 1997/98 no plant height records were taken.

In EXPT3 (P+F1s) 1998/99 at Rustenburg, there were ten crosses with positive s.c.a. effects. DPAc90xPalala had the largest and DPAc90xIrco the smallest effects. No significant differences were found between the crosses.

In EXPT4 (P+F1s) 1998/99 at Loskop, eleven crosses had positive s.c.a. effects with 2131-2-5xIrco having the largest and OR27xIrco the smallest effects. 2131-2-5xIrco was significantly different from six other crosses while SicalaxIrco, had the second largest s.c.a. effect. It differed significantly from five other crosses. The crosses, 2131-3-5xIrco and SicalaxIrco would be the choice to increase PH while OR27xIrco would be the choice to reduce PH (Table 4.3.2.4).

There was some inconsistency in the performance of the crosses. This indicates that the specific combining abilities of crosses were affected by the different environments.

Hair Count (HC)

At Rustenburg EXPT1 (P+F1s) 1997/98, there were twelve crosses with positive s.c.a. effects. OR27xPalala had the largest s.c.a. effects while DPAc90xPalala had the smallest. OR27xPalala was significantly different from twelve other crosses but not from OR27XIrco and SicalaxOR27. These three crosses would be useful in selecting for increased HC. DPAc90xPalala and SicalaxPalala would be useful in selecting for reduced HC. At Loskop, EXPT2 (P+F1s) 1997/98, positive s.c.a. effects were observed from ten crosses. The largest effect was from SicalaxOR27 and the smallest from SicalaxPalala. SicalaxOR27 was significantly different from eight other crosses. Selection for increased HC would be possible from the crosses SicalaxOR27 and PalalaxIrco.

Selection for reduced HC would be possible in SicalaxPalala (Table 4.3.2.2.).

EXPT3 (P+F1s) 1998/99 at Rustenburg had nine crosses with positive s.c.a. effects. SicalaxIrco had the largest effects and was significantly different from the rest of the crosses. (Table 4.3.2.3). Selections for increased HC could be made from this cross. OR27xPalala had the smallest effects. Plants with reduced HC could be selected within it. At Loskop, EXPT4 (P+F1s) 1998/99, positive s.c.a. effects were observed among nine crosses of which PalalaxIrco had the largest effects and DPAc90xPalala, the smallest effects. PalalaxIrco was significantly different from six crosses. The crosses OR27xIrco and 2131-2-5xIrco were the second and third in ranking and they too were significantly different from the six other crosses. These three crosses would be useful when selecting for increased HC. DPAc90xPalala and OR27xIrco would be suited for selecting for reduced HC (Table 4.3.2.4).

Environment appeared to have had significant influence on s.c.a. effects, due to inconsistent performance (s.c.a. effects) of the crosses across locations.

Fibre Length (FL)

Ten of the fifteen crosses had positive s.c.a. effects at Rustenburg EXPT1 (P+F1s) 1997/98. DPAc90xPalala had the largest effects and OR27xPalala had the smallest. DPAc90xPalala was significantly different from ten other crosses. SicalaxDPAc90 was next with the second largest s.c.a. effect. It was significantly different from eight other crosses. Selection of plants with improved FL could be made from these two crosses. OR27xPalala had the smallest effects. At Loskop, EXPT2 (P+F1s) 1997/98. SicalaxDPAc90 had the largest s.c.a. effects, and

2131-2-5xPalala had the smallest. Twelve of the fifteen crosses had positive effects. SicalaxDPAc90 was significantly different from nine crosses. DPAc90xPalala was the next with large s.c.a. effects and differed significantly from the same nine crosses. SicalaxPalala ranked third and was significantly different from three other crosses. SicalaxDPAc90, DPAc90xPalala and SicalaxPalala were suitable for selection to improve FL under these conditions.

In EXPT3 (P+F1s) 1998/99 at Rustenburg, twelve crosses had positive s.c.a. effects. Sicalax2131-2-5 had the largest s.c.a. effects while SicalaxPalala had the smallest. Sicalax2131-2-5 was significantly different from seven other crosses. DPAc90xPalala was next with large s.c.a. effects and was significantly different from four other crosses. 2131-2-5xIrco ranked third. The three crosses were not significantly different from each other and would be useful in selecting for improved FL under the prevailing conditions (Table 4.3.2.3). At Loskop, EXPT4 (P+F1s) 1998/99, eleven crosses had positive s.c.a. effects. 2131-2-5xIrco had the largest and DPAc90xIrco had the smallest effects. 2131-2-5xIrco was significantly different from nine other crosses. It was followed by OR27xIrco which was significantly different from eight other crosses. Selection for improved FL could be made from these two crosses for the prevailing conditions.

Ranking of crosses according to the size of their s.c.a. effects have shown some consistency, indicating little environment x s.c.a. interaction effects for FL.

Fibre Strength (FS)

At Rustenburg, EXPT1 (P+F1s) 1997/98, six crosses had positive s.c.a. effects. SicalaxPalala had the largest effects, while Sicalax2131-2-5 and

DPAc90xPalala had the smallest. DPAc90xPalala was significantly different from ten other crosses but not from 2131-2-5xPalala, DPAc90x2131-2-5, DPAc90xIrco and SicalaxDPAc90. SicalaxPalala could be useful in selecting for increased FS (Table 4.3.2.1).

At Loskop, EXPT3 (P+F1s) 1997/98, six of the crosses had positive s.c.a. effects. SicalaxIrco had the largest effects and DPAc90x2131-2-5 had the smallest. SicalaxIrco differed significantly only from DPAc90x2131-2-5. The second and third crosses, SicalaxDPAc90 and OR27xPalala, respectively, also differed significantly from DPAc90x2131-2-5. Selections to improve FS could be made from SicalaxIrco.

In EXPT3 (P+F1), Rustenburg 1998/99, ten crosses had positive s.c.a. effects. Sicalax2131-2-5 had the largest effects and DPAc90xIrco the smallest. Sicalax2131-2-5 was significantly different from six crosses. SicalaxIrco was second and was also significantly different from the same six crosses, Sicalax2131-2-5, SicalaxIrco and OR27xIrco were the best crosses which could be used in selecting for increased FS (Table 4.3.2.3). At Loskop, EXPT4 (P+F1s) 1998/99, ten of the crosses had positive s.c.a. effects. The largest effects were from 2131-2-5xIrco and DPAc90xOR27, while the smallest effects were from DPAc90xIrco. SicalaxIrco and DPAc90xOR27 were significantly different from three other crosses. Variability was limited, but the two crosses can be utilised in a selection program to improve FS (Table 4.3.2.4).

There appeared to be some consistency in the performance of the crosses across locations, indicating little environment x s.c.a. interaction effects.

Micronaire (MC)

The trial planted at Rustenburg, EXPT1, 1997/98 had 11 crosses with positive s.c.a. effects. 2131-2-5xIrco and DPAc90xIrco had the largest effects and were significantly different from five other crosses. 2131-2-5xOR27 had the smallest effect. The two crosses with the largest s.c.a. effects, could be successfully used in selecting for increased micronaire level. 2131-2-5xOR27 would also be useful in selecting for reduced MC. The sitae depends on the original levels so long as the intended improvement does not go beyond or below the acceptable range of 3.5 to 4.5 units. At Loskop, EXPT2, 1997/98, ten crosses had positive s.c.a effects, with SicalaxIrco having the largest effects and OR27xIrco the smallest. SicalaxIrco was significantly different from all the other crosses. SicalaxPalala was second in ranking for large effects and differed significantly from seven other crosses. SicalaxIrco and SicalaxPalala would be useful to increase MC and OR27xIrco to reduce MC.

In the trial planted at Rustenburg, EXPT3, 1998/99, there were seven crosses with positive s.c.a. effects. 2131-2-5xIrco had the largest effects and 2131-2-5xPalala had the smallest. 2131-2-5xIrco was second in ranking and was significantly different from eight other crosses, and DPAc90x2131-2-5, the second in ranking, was significantly different from seven other crosses (Table 4.3.2.3). These two would be useful in selecting for increased MC and 2131-2-5xPalala for reduced MC. In EXPT4, 1998/99 at Loskop, eight crosses had positive s.c.a. effects, with SicalaxDPAc90 having the largest and OR27xPalala the smallest. SicalaxDPAc90 was significantly different from eight crosses. DPAc90x2131-2-5 and OR27xIrco were second and third in ranking and both of them were significantly different from only two crosses.

SicalaxDPAc90 would be useful in selecting for increased MC while OR27xPalala would be useful for reducing MC (Table 4.3.2.4).

There was some inconsistency in the performance of crosses across location, suggesting significant environment x s.c.a. interaction effects.

Fibre Uniformity (FU)

At Rustenburg EXPT1, 1997/98, nine crosses had positive s.c.a. effects. OR27xIrco had the largest and two crosses, 2131-2-5xPalala and DPAc90x2131-2-5, had the smallest effects. OR27xIrco was significantly different from four other crosses which include 2131-2-5xPalala, DPAc90x2131-2-5, SicalaxIrco and SicalaxPalala (Table 4.3.2.1). The second cross was 2131-2-5xIrco and was also significantly different from the same four crosses. Selection of plants with increased FU could be made from these crosses. In EXPT2, 1997/98, nine crosses had positive s.c.a. effects. DPAc90xIrco had the largest and 2131-2-5xOR27 had the smallest effects. DPAc90xIrco differed significantly from 11 other crosses. OR27xIrco was next in ranking and was significantly different from 10 crosses. The third cross was Sicalax2131-2-5 and was significantly different from nine other crosses. Selection for increased FU could be done on these crosses. (Table 4.3.2.2).

At Rustenburg EXPT3, 1998/99, seven crosses had positive s.c.a. effects, among which Sicalax2131-2-5 had the largest effect. SicalaxDPAc90 had the smallest effect. Sicalax2131-2-5 was significantly different from 10 crosses. 2131-2-5xIrco was second and was significantly different from three crosses. Sicalax2131-2-5 and 2131-2-5xIrco would be useful to select for increased FU. In EXPT4, 1998/99 at Loskop, there were four crosses with positive effects. 2131-2-5xOR27 had the largest effects and was significantly different from eleven other crosses. The second best cross with large s.c.a. effects was DPAc90x2131-2-5 and it was significantly different from seven crosses. These two crosses could be used to increase FU. 2131-2-5xPalala had the lowest s.c.a. effects.

There were some consistencies in the performance of crosses, indicating little or no environment x s.c.a. interaction effects.

Table 4.3.3.1 **SCA effects for various cotton agronomic and quality characteristics for diallel experiments 1**

Parents and F1s - Rustenburg 1997/98

Crosses	SCYP	SCYPLT	LYP	LYPLT	GOT1	GOT2	BS	SI	LI	SB	LB	TBF	HB	UHB	PH	HC	FL	FS	MC	FU
PalalaxIrco	201.37	5.65	94.37	2.66	1.94	0.61	0.11	1.29	0.54	-1.46	-0.08	-2.3	0.23	-2.62	1.22	2.21	0.6	-0.26	0.16	1.33
OR27xIrco	176.93	-2.5	78.15	-0.76	-1.38	0.99	0.76	1.77	0.33	2.01	0.27	0.06	-0.34	0.53	11.8	4.34	-0.02	-0.94	0.25	1.94
2131-2-5xIrco	283.45	2.97	125.99	1.43	1.38	0.92	0.51	1.54	0.48	1.08	0.16	-3.95	-1.41	-2.65	2.92	1.05	0.03	-0.75	0.34	1.51
DPAc90xIrco	119.76	4.02	57.92	2.1	0.09	1.05	0.02	0.9	0.08	0.05	-0.04	-1.91	1	-3.01	-9.21	1.8	-0.27	0.25	0.34	1.26
SicalaxIrco	212.69	2.51	81.37	1.03	0.17	0.13	0.21	-5.21	0.47	0.38	-0.09	-1.03	-1.08	0.83	13.12	2.01	0.32	-0.03	0.12	-0.76
OR27xPalala	63.98	1.72	21.55	0.47	0.59	-0.31	-0.45	0.51	-0.53	-0.76	0.24	-0.71	0.68	-1.38	-1.45	7.26	-0.53	-0.24	0.11	0.65
2131-2-5xPalala	223.51	0.96	82.02	0.92	-10.6	-0.85	0.38	1.42	0.31	0.31	-0.21	2.05	2.62	-0.53	2.06	2.96	0.2	0.42	0.14	-1.05
DPAc90xPalala	157	4.63	65.26	1.69	0.61	0.24	0.4	1.06	0.14	2.85	-0.01	2.33	1.03	1.35	10.51	-4.62	0.84	-0.97	0.01	0.21
SicalaxPalala	6.92	-1.69	-3.41	-0.91	2.05	-0.38	0.07	-5.41	0.42	-1.42	-0.13	1.55	-0.52	1.98	14.35	-1.41	0.06	1.13	-0.01	-0.55
2131-2-5xOR27	5.25	-2.13	1.93	-1.07	0.69	0	-0.08	1.07	-0.29	-0.19	0.47	-2.5	-2.75	0.26	2.92	2.09	0	0.68	-0.2	-0.04
DPAc90xOR27	313.5	10.3	129.56	4.29	0.12	0.21	0.31	1.49	0.61	-0.35	0.54	3.88	4.26	-0.37	12.02	1.51	0.63	-0.58	0.26	0.75
SicalaxOR27	137.36	10.61	56.87	4.45	-0.22	0.56	0.07	-5.49	0.11	0.15	0.22	1.03	0.85	0.07	2.99	3.38	0.37	-0.23	0.18	0.43
DPAc90x2131-2-5	-46.92	-1.71	-9.82	-0.55	0.85	1.47	0.05	1.06	0.03	0.22	-0.18	-2.06	0.13	-2.15	-3.93	0.88	0.18	0.37	-0.04	-1.05
Sicalax2131-2-5	102.34	-4.02	40.4	-1.71	0.49	0.16	-0.05	-5.81	-0.23	0.35	0.11	-3.58	-0.55	-3.11	-0.62	0.09	0	-0.98	0.18	0.06
SicalaxDPAc90	149.13	-0.84	65.99	-0.02	0.08	1.11	0.45	-5.15	0.54	-0.51	-0.23	0.2	1.33	-1.21	5.47	-0.16	0.72	0.24	-0.06	0.69
LSD (0.05)	221.39	7.6	92.09	3.1	5.24	1.15	0.46	10.43	0.46	2.41	0.61	3.75	2.31	3.16	9.83	3.96	0.48	1.15	0.32	2.02

Table 4.3.3.2 **SCA effects for various cotton agronomic and quality characteristics for diallel experiment 2**

Parents and F1s - Loskop 1997/98

Crosses	SCYP	SCYPLT	LYP	LYPLT	GOT1	GOT2	BS	SI	LI	SB	LB	TBF	HB	UHB	PH	HC	FL	FS	MC	FU
Palalaxlrco	45.3	-4.92	37.12	-1.69	1.22	0.93	0.04	-0.47	-0.05	1.86	-0.02	0.66	-0.56	1.12	-	3.57	0.09	-0.28	-0.04	-0.43
OR27xlrco	78.4	-6.92	25.02	-3.09	-0.16	-0.48	0.23	-0.6	0.04	1.05	-0.07	-1.6	-1.44	-0.27	-	0.63	0.07	0.03	-0.15	1.37
2131-2-5xlrco	351.9	3.51	124.97	0.57	-0.23	-0.67	0	1.46	0.69	-2.67	-0.07	0.88	0.32	0.44	-	1.32	0.26	-0.1	0.06	0.77
DPAc90xlrco	418.6	4.99	185.52	2.21	-0.25	0.17	0.08	0.39	0.03	0.18	-0.06	0.28	2.07	-1.89	-	2.6	-0.11	-0.52	0.37	1.46
Sicalaxlrco	536.6	9.24	204.63	3.26	0.18	-0.43	-0.06	-0.67	0.01	-0.83	-0.07	0.86	1.64	-0.88	-	2.32	0.57	0.23	0.03	-0.11
OR27xPalala	186.5	6.02	56.21	2.02	-0.69	-0.67	-0.01	-0.22	0.08	0.08	0.01	1.04	0.46	0.6	-	3.91	0.29	0.11	*0.12	0.09
2131-2-5xPalala	-49.4	-2.46	-28.12	-1.21	-2.26	-1.14	0.07	0.54	-0.39	0.41	-0.04	0.62	0.76	-0.13	-	-1.15	-0.53	-0.31	-0.02	-0.28
DPAc90xPalala	263.5	8.97	108.22	3.68	0.67	0.38	0.77	0.97	0.63	1.76	0.03	0.73	0.96	-0.22	-	-2.62	0.81	0.08	0.14	-0.12
SicalaxPalala	77.1	2.99	19.4O	1.01	-0.29	0.31	0.35	0.47	0.11	-0.83	0.11	-1.43	-0.09	-1.36	-	-4.4	0.6	0.09	0.2	0.09
2131-2-5xOR27	-138.2	-4.33	-33.32	-0.96	-0.93	1.38	-0.19	-0.35	-0.14	-0.82	-0.03	-1.84	-0.92	-0.9	-	-1.34	0.08	-0.35	-0.03	-0.54
DPAc90xOR27	180.9	8.94	88.47	4.17	0.32	0.65	0.53	0.57	0.87	-0.17	0.03	2.42	1.83	0.59	-	1.44	0.4	-0.38	0.16	0.18
SicalaxOR27	276.6	12.86	106.55	4.21	0.18	0.32	-0.18	2.84	0.23	0.19	-0.09	0.44	0.91	-0.45	-	7.41	-0.38	-0.9	0.14	0.33
DPAc90x2131-2-5	64.5	1.39	4.68	-0.05	-0.35	-1.19	0.35	0.1	-0.2	2.77	0.23	-0.1	-0.01	-0.09	-	0.13	0.47	-0.77	0.01	0.45
Sicalax2131-2-5	59.5	-0.42	21.68	-0.07	0.82	0	0.18	-0.83	0	1.08	0.16	-0.53	-0.13	-0.39	-	-1.15	0.07	-0.41	0.07	1.16
SicalaxDPAc90	148.3	4.76	59.1	2.05	-0.91	0.31	0.2	0.22	0.13	0.53	0.08	1.98	0.47	1.56	-	5.63	0.91	0.12	0.01	-0.2
LSD (0.05)	232.23	7.38	90.44	3.28	2.16	1.3	0.47	1.56	0.5	2.74	0.19	1.74	1.64	1.35	-	6.57	0.54	0.87	0.17	0.93

Table 4.3.3.3 **SCA effects for various cotton agronomic and quality characteristics for diallel experiment 3**

Parents and F1s - Rustenburg 1998/99

Crosses	SCYP	SCYPLT	LYP	LYPLT	GOT1	GOT2	BS	SI	LI	SB	LB	TBF	HB	UHB	PH	HC	FL	FS	MC	FU
PalalaxIrco	804.4	10.6	291.5	3.7	-2.04	0.25	0.48	0.4	-0.25	1.45	0.16	3.29	2.78	0.42	-53.67	3.12	0.4	-0.03	0.04	-0.94
OR27xIrco	421.9	-1.71	180.5	0.07	0.61	0.59	0.27	-0.23	0.06	2.3	0.23	-1.22	-1.17	-0.13	-56.31	1.05	0.56	0.55	-0.06	0.42
2131-2-5xIrco	799.1	20.91	349.2	10	1.45	0.49	0.07	-0.13	0.39	0.56	0.17	8.54	6.5	1.9	-47.02	2.6	0.85	0.23	0.15	0.53
DPAc90xIrco	-277.4	-11.69	-87.7	-3.95	0.39	-0.02	-0.32	-0.53	-0.02	-0.8	-0.06	-4.4	-2.96	-1.14	-66.84	0.57	-0.52	-0.45	-0.04	0.42
SicalaxIrco	-62.4	13.07	-25.2	4.82	-0.38	0.16	0.27	0.56	0.81	-2.01	-1.24	1.29	1.55	-0.4	-54.88	16.34	0.81	0.57	-0.09	-0.17
OR27xPalala	696.1	-6.8	247	-2.27	-2.45	-0.6	-0.18	0.17	-1.01	-0.71	-0.05	0	1.36	-0.19	12.99	-6.09	0.33	0.27	0.01	0.21
2131-2-5xPalala	698.3	2.72	266.1	1.71	-2.07	-0.61	0.15	0.37	-0.71	0.48	-0.11	2.29	1.9	0.04	14.55	5.9	0.53	0.37	-0.22	-0.18
DPAc90xPalala	514.8	24.91	109.2	6.3	0.43	0.21	0.15	0.23	0.18	-0.34	0	-0.11	0.74	-0.73	22.33	-3.34	0.86	0.09	-0.07	0.04
SicalaxPalala	-748.3	-41.79	-246.7	-14.1	-0.43	0.72	0.01	-0.49	-0.56	1.31	0.22	-7.69	-6.32	-1.72	2.15	-6.47	-0.78	0.19	0.08	-0.31
2131-2-5xOR27	344.9	-10.14	126.4	-3.83	1.64	0.02	0.31	-0.24	1.57	2.2	0.09	-2.42	-1.59	-1.11	9.84	-3.57	-0.32	-0.09	0.01	-0.12
DPAc90xOR27	371.3	-10.53	174.3	-2.83	0.69	0.39	0.53	0.28	0.25	2.65	0.2	0.85	-0.57	1.32	16.09	1.54	0.6	0.27	-0.06	0.54
SicalaxOR27	854.1	33.15	341.9	13.29	0.34	-0.24	0.49	0.09	0.01	1.96	0.15	1.14	1.4	-0.54	10.85	7.57	0.06	-0.4	0.08	-0.99
DPAc90x2131-2-5	134.7	1.28	88.3	2.11	-3.25	0.3	0.09	0.7	-0.56	-1.76	-0.19	-0.19	-0.04	-0.32	15.71	1.92	0.71	0.18	0.14	-0.12
Sicalax2131-2-5	82.4	17.19	7.5	5.37	-0.08	-0.6	0.36	0.51	0.06	1.22	0.23	0.43	2	0.03	14.4	-3.95	1.02	0.61	-0.12	1.56
SicalaxDPAc90	511.1	22.98	214.5	9.22	0.22	0.35	-0.31	0.41	0.27	-2.2	-0.06	4.76	3.55	1.05	11.72	-1.94	0.33	0.13	-0.03	-1.29
LSD (0.05)	522.04	21.91	198.75	8.53	3.39	0.64	0.46	0.67	1.34	3.44	0.62	5.21	4.24	1.45	111.17	7.3	0.58	0.43	0.17	1.2

Table 4.3.3.4 **SCA effects for various cotton agronomic and quality characteristics**

Parents and F1s - Loskop 1998/99

Crosses	SCYP	SCYPLT	LYP	LYPLT	GOT1	GOT2	BS	SI	LI	SB	LB	TBF	HB	UHB	PH	HC	FL	FS	MC	FU
PalalaxIrco	647.4	10.43	240.44	3.79	1.08	0.28	-0.07	0.4	0.26	0.05	0.12	0.4	1.12	0.36	0.21	7.23	0.66	0.04	-0.04	-1.19
OR27xIrco	406.1	13.46	178.95	5.82	-0.85	0.28	0.48	0.79	0.03	1.42	0.09	-0.95	0.22	-0.09	-2.98	-10.04	0.91	0.18	0.15	0.61
2131-2-5xIrco	141.1	-4.65	85.79	-1.5	-0.04	0.99	0.4	0.37	0.08	1.99	-0.13	-1.34	-3.36	-3.2	12.63	5.82	1.17	0.4	-0.02	-0.67
DPAc90xIrco	-57.9	-6.88	-34.55	-3.05	0.51	-0.52	0.33	0.88	0.43	0.97	-0.03	2.21	0.06	3.22	6.82	5.15	-0.47	-0.2	0.01	0.86
SicalaxIrco	-271.1	16.78	-85.81	7.61	0.92	0.79	0.01	-2.63	0.44	-0.41	-0.09	7.44	3.88	3.37	10.4	2.5	0.5	0.1	-0.03	-0.23
OR27xPalala	67	1.82	-8.54	0.03	0.05	-0.73	0.27	-0.33	-0.26	2.09	-0.08	0.59	-0.7	2.36	4.57	2.56	0.41	-0.04	-0.13	-0.62
2131-2-5xPalala	441.1	2.39	155.33	0.17	-0.61	0.24	-0.21	0.19	-0.1	-2.61	0.04	-2.27	-0.94	-6.55	-1.36	-4.72	0.75	0.22	-0.06	-1.83
DPAc90xPalala	367.3	11.86	149.02	4.82	1.49	0.22	1.1	0.18	0.53	3.97	0.08	1.22	1.81	0.47	2.9	-10.35	-0.03	-0.13	0.03	-0.07
SicalaxPalala	-81.3	6.12	-21.66	2.47	-0.25	0	-0.44	0.5	-0.04	-2.14	-0.19	0.71	-0.24	0.82	2.01	-3.57	-0.25	-0.05	0.03	0
2131-2-5xOR27	260.8	-1.04	110.76	-0.6	0.18	0.53	-0.07	0.13	0.32	0.49	-0.05	0.19	-0.12	-4.94	4.05	2.97	0.24	0.13	0.03	1.44
DPAc90xOR27	312	6.03	136.78	2.75	0.18	0.37	0.27	0.26	0.35	-0.73	-0.15	0.64	0.97	0.89	7.91	-2.93	0.73	0.4	0.08	0
SicalaxOR27	-22.7	-1.04	-16.95	-0.61	-0.49	-0.77	0.64	0.44	-0.13	2.76	0.25	2.5	1.12	1.17	-0.85	-3.01	-0.08	0.03	-0.12	-0.26
DPAc90x2131-2-5	373.7	4.9	165.16	2.07	0.7	0.48	0.33	0.46	0.67	-1.16	0.03	2.41	3.12	-5.95	-1.21	2.4	0.73	0.13	0.16	0.98
Sicalax2131-2-5	-218.9	-7.31	-90.43	-3.35	-0.41	-0.16	0.21	0.26	-0.12	0.34	-0.03	2.91	-0.39	-3.2	9.36	0.61	0.51	0.05	-0.05	-0.84
SicalaxDPAc90	476.1	8.76	195.39	3.68	0.23	0.78	0.19	0.65	0.22	0.51	0.2	0.26	0.03	0.02	4.29	0.81	0.49	-0.1	0.24	-0.52
LSD (0.05)	497.14	14.07	200.76	5.53	1.42	0.83	0.87	1.76	0.47	3.61	0.23	4.25	3.03	10.43	10.23	7.56	0.48	0.46	0.22	1.32

4.3.4. GCA : SCA Ratios

The ratios were calculated for each trait measured, based on the g.c.a. and s.c.a. mean squares from the combining ability Anova tables (Table 4.3.4.). For purposes of discussion, the ratios can be grouped into low, medium, high or very high: Low values are considered to be below one; medium between one and two; high between two and ten and very high, above ten.

Diallel experiment 1 Rustenburg 1997/98

The ratios of g.c.a. to s.c.a. ranged from 0.38, the lowest for LYPLT to 46.84, the highest for HC. Very high ratios were recorded for HC (46.84) and FL (14.43). High values were also estimated for FS (5.28), BS (4.58), SB (4.26), LI (3.84) and UHB (2.80). In the very high to high ratio groups, additive genetic effects are more important. In the medium group there were characteristics like GOT2, SI, LB, TBF, HB, PH, MC and FU. For these characters the ratios are beyond unity (one) and additive effects as well as non-additive genetic effects may be considered important. The direct estimates of seed cotton and lint yields, SCYP, SCYPLT, LYP, LYPLT and GOT1, all had their ratios less than one. This implied that non-additive effects were more important than additive effects.

Diallel experiment 2 Loskop 1997/98

The characteristics measure had a range from very low (1.40) to very high (39.05). Very high ratios were observed for HC (39.05). The following characteristics had a high additive gene action SCYPLT, LYPLT, GOT1, GOT2, LI, TBF, HB, FL, FS and MC. For the characters SCYP and LYP a ratio of close to one were observed, indicating that for these two characters the contribution of additive and non-additive gene action were of equal importance.

The GCA : SCA ratio's for GOT2 (27.38) and HC (31,6) were extremely high, indicating that these characters were under the control of a few additive genes. For most of the remaining characteristics the additive gene component varies from two to four times the amount of the non-additive gene component. These characters were SCYPLT, LYPLT, LI, UHB, FL, FS and FU. The characters BS, SI and MC showed a higher additive gene component with ratio's that varies between (7.0) and (14.0). Characters for which the additive component is as important as the non-additive component were SCYP, LYP, GOT1, SB, LB, TBF and HB.

Diallel experiment 4 Loskop 1998/99

The GCA : SCA ratio is again extremely large for HC (44.95). Very high GCA : SCA ratio's were also recorded for GOT1 (14.02), GOT2 (17.25), PH (8.09) and FS (15.71), indication of the importance of additive gene action for these characteristics. The GCA : SCA ratio's for the remaining characteristics varies between one and four indicating that for most of the characters additive and non-additive genes were of equal importance.

The results in Table 4.3.4 showed that the environment had a significant effect on the GCA : SCA ratio's for some of the characteristics. Examples were LYPLT, GOT1, GOT2, BS, SI, LI, SB, TBF, PH, FL, FS, MC and FU.

Table 4.3.4 GCA: SCA Ratios for four diallel experiments

Characteristics	EXPT1 R97/98	EXPT2L 97/98	EXPT3R 98/99	EXPT4L 98/99
SCYP	0.47	1.4	0.17	2.43
SCYPLT	0.41	4.85	2.36	1.46
LYP	0.5	1.32	0.19	2.06
LYPLT	0.38	6.01	2.58	1.4
GOT1	0.56	6.02	0.47	14.02
GOT2	1.77	11.75	27.38	17.25
BS	4.5	3.47	7.37	1.89
SI	2.O	3.5	12.95	3.86
LI	3.84	6.99	2.12	3.87
SB	4.26	3.59	0.9	1.76
LB	1.13	3.71	0.67	1.63
TBF	1.33	8.75	0.79	3.53
HB	1.87	4.34	1.42	1.18
UHB	2.8	3.7	2.22	3.47
PH	1.72	-	1.5	8.09
HC	46.84	39.05	31.6	44.95
FL	14.43	8.69	3.96	2.9
FS	5.28	7.73	4.68	15.71
MC	1.79	7.24	7.2	3.27
FU	1.71	3.88	5.69	4.31

4.4 Heritability of characteristics

Broad sense (h^2_b) and narrow sense (h^2_n) heritabilities were calculated separately for each characteristic. The results are presented in Tables 4.4.1 to 4.4.4, for each experiment. For purposes of discussion, the values will be divided into four groups: low (0 to 0.25), moderate (0.26 to 0.50), high (0.51 to 0.74) and very high (0.74 and above). Heritability for some characteristics are not discussed due to the negative variance components obtained, as shown in the heritability tables.

4.4.1 Rustenburg 1997/98 (P+F1s)

Broad sense heritabilities were very high for HC (0.98), FL (0.95), LI (0.86), BS (0.83), GOT2 (0.80) and PH (0.78). Most of the remaining characteristics had heritability (broad sense) values categorised as high, except fibre uniformity (FU) which had a very low value (0.26). Two of the characteristics measured had very high values for heritability in the narrow sense. They were: HC (0.92) and FL (0.77). FS had also a highest narrow sense heritability (0.52) (Table 4.4.1). Low h^2_n values were observed for yield - SCYPLT (0.09) and LYPLT (0.01). Its components had moderate h^2_n values- BS (0.47) and LI (4.2). This is in line with what Zhang & Sun (1994) reported. FU also had a very low h^2_n-value (0.01).

4.4.2 Loskop 1997/98 (P+F1s)

Broad sense heritabilities were very high for nearly all the characteristics measured. The highest was HC (0.93), FL (0.92), MC (0.89), SCYP (0.89), LYP (0.89), SCYPLT (0.88), LYPLT (0.86), LI (0.84), TBF (0.84), FU (0.79), BS (0.77) and GOT1 (0.75). The lowest was LB (0.53) which also falls within the high category. Narrow sense heritabilities were relatively high for HC (0.87). Seven characteristics had high h^2_n-values.

These were GOT2 (0.73), FL (0.66), TBF (0.66), FS (0.63), MC (0.61), LI (0.60) and LYPLT (0.56). Apart from SCYP (0.09) and LYP (0.08), the remaining characteristics had moderate h^2_n-values (Table 4.4.2).

4.4.3 Rustenburg 1998/99 (P+F1)

Very high broad sense heritabilities were estimated for HC (0.96), FL. (0.92), GOT1 (0.87), BS (0.86), PH (0.86), SI (0.85), FS (0.85) and SCYPLT (0.75). The rest of the characteristics were categorised as high, the lowest being UHB (0.51). Very high narrow sense heritabilities (h^2_n) were estimated for GOT2 (0.93), HC (0.88) and SI (0.75). Low heritabilities were observed for PH (0.04), HB (0.09), UHB (0.23), SCYPLT (0.25) and LYPLT (0.28) - Table 4.4.3.

4.4.4 Loskop, 1998/99 (P+F1s)

Most of the characteristics measured had high to very high broad sense heritabilities (Table 4.4.4). Very high figures were estimated for HC (0.96), FL (0.94), GOT2 (0.91), SI (0.89), LI (0.83), GOT1 (0.79) and SCYP (0.75). Low h^2b was recorded for SB (0.22) and moderate for HB (0.33) and BS (0.44). Three characteristics had very high narrow sense heritabilities. They were HC (0.92), GOT2 (0.80) and GOT1 (0.76). Low h^2n values were recorded for HB (0.04), BS (0.18) and yield - SCYPLT (0.10), LYP (0.21) and LYPLT (0.09). However, one of the measurements of yield, SCYP had a moderate h^2n value (0.26). The rest of the characteristics were in the moderate and high categories.

Environment x heritability (h^2n), interaction effect was apparent for some characteristics. This is expected as Falconer *et al* (1996) pointed out that heritability is dependent on the characteristic, the type of population, the environmental circumstances and the method of measuring the phenotype. Direct measurements of yield - SCYP, SCYPLT, LYP and LYPLT - were visibly affected by environment. Heritability was higher at Loskop than at Rustenburg. For SCYP and LYP, estimates of genetic variances were negative at Rustenburg. Meredith (1984) quoted a similar situation, where some heritabilities were zero at some locations compared to others. The heritabilities for GOT was on average high to very high, especially from the larger sample (GOT2), with very little environmental influence. Additive effects were larger than dominance effects for most of the characters. This was also observed by other researchers. Components of yield, BS, SI and LI, had relatively higher heritabilities than yield per se. This was also observed by Zhang *et al* (1994). Heritability of boll size (BS) was slightly lower at Loskop than at Rustenburg. The inheritance of bolls per plant (TBF, HB and UHB) were rather low, especially harvestable bolls (HB). The error variance was high and therefore would not allow accurate estimation of h^2_n.

HC which had the highest heritability among all the characteristics was not much influenced by the environment.

Fibre qualities characteristics, especially FL and FS, were highly heritable. This was also observed by Tang *et al* (1996). The environmental interaction had no significant effect on these two characteristics. Again the additive genetic effects were larger than the dominance effects for these two characters. It appear that the environment had a significant effect on the heritability of MC and FU. Except for experiment 1 the h^2_n-values for MC and FU were very low. This could be the result of environmental effects. This could have been a result of duration of the growing season, which may not have permitted all the fibres to mature well.

Table 4.4.1 Estimates of heritabilities for various cotton agronomic and quality characteristics Rustenburg (Parents + F1s) - 1997/98 Season

	SCYP	SCYPLT	LYP	LYPLT	GOT1	GOT2	BS	SI	LI	SB
σ^2A	-10,622.88	30.83	-1,813.02	0.64	1.65	0.86	0.19	9.27	0.2	1.22
σ^2D	65,439.66	142.95	11,813.05	22.48	-0.03	0.77	0.15	-10.69	0.22	-0.31
σE	15,273.42	152.13	2,642.47	23.33	0.54	0.41	0.07	33.87	0.07	1.81
h^2b	-	0.53	-	0.48	-	0.8	0.83	-	0.86	-
h^2n	-	0.09	-	0.01	-	0.42	0.47	-	0.42	-

	TBF	HB	UHB	LB	PH	HC	FL	FS	MC	FU
σ^2A	0.71	0.83	2.55	0.01	21.01	214.75	1.08	0.53	0.02	0.01
σ^2D	4.21	2.6	2.53	0.01	85.19	13.85	0.25	0.14	0.05	0.44
σE	4.39	1.66	3.12	0.01	30.11	4.89	0.07	0.35	0.03	1.27
h^2b	0.53	0.68	0.62	0.67	0.78	0.98	0.95	0.66	0.66	0.26
h^2n	0.08	0.18	0.31	0.38	0.15	0.92	0.77	0.52	0.17	0.01

Table 4.4.2 **Estimates of heritabilities for various cotton agronomic and quality characteristics of diallel experiment 2 planted at Loskop (Parents + F1s) during 1997/98 Season**

	SCYP	SCYPLT	LYP	LYPLT	GOT1	GOT2	BS	SI	LI	SB
$\sigma^2 A$	14,279.49	73.82	1,814.88	13.94	1.14	1.58	0.12	0.76	0.3	1.53
$\sigma^2 D$	125,707.87	59.33	19,772.91	7.7	-0.57	0.05	0.12	0.44	0.12	-0.03
$\sigma^2 E$	17,159.25	17.31	2,602.67	3.43	1.48	0.54	0.07	0.78	0.08	2.4
$h^2 b$	0.89	0.88	0.89	0.86	-	0.75	0.77	0.61	0.84	-
$h^2 n$	0.09	0.49	0.08	0.56	-	0.73	0.38	0.38	0.6	-

	TBF	HB	UHB	LB	PH	HC	FL	FS	MC	FU
$\sigma^2 A$	3.99	1.58	0.61	0.01	-	167.04	0.79	0.53	0.51	0.56
$\sigma^2 D$	1.09	0.97	0.32	0	-	3.82	0.32	0.07	0.02	0.5
$\sigma^2 E$	0.97	0.85	0.58	0.01	-	13.74	0.09	0.24	0.01	0.28
$h^2 b$	0.84	0.74	0.62	0.53	-	0.93	0.92	0.71	0.89	0.79
$h^2 n$	0.66	0.46	0.4	0.41	-	0.91	0.66	0.63	0.61	0.42

Table 4.4.3 Estimates of heritabilities for various cotton agronomic and quality characteristics of diallel experiment 3 planted at Rustenburg (Parents + F1s) during 1998/99 Season

	SCYP	SCYPLT	LYP	LYPLT	GOT1	GOT2	BS	SI	LI	SB
$\sigma^2 A$	-133,940.9	150.32	-19,483.33	25.11	-0.39	1.65	0.28	0.68	0.14	-0.1
$\sigma^2 D$	558,558.57	292.12	84,452.34	41.05	-0.62	0.12	0.11	0.09	-0.04	2.67
$\sigma^2 E$	84,920.44	149.61	12,309.05	22.65	3.59	0.13	0.06	0.14	0.56	1.51
$h^2 b$	-	0.75	-	0.74	-	0.93	0.86	0.85	-	-
$h^2 n$	-	0.25	-	0.28	-	0.87	0.62	0.75	-	-

	TBF	HB	UHB	LB	PH	HC	FL	FS	MC	FU
$\sigma^2 A$	-0.93	1.12	0.31	-0.01	3.42	353.53	0.56	0.18	0.01	0.67
$\sigma^2 D$	7.28	5.18	0.37	0.03	69.86	29.61	0.65	0.14	0	0.12
$\sigma^2 E$	8.46	5.6	0.66	0.12	12.18	16.6	0.1	0.06	0	0.45
$h^2 b$	-	0.53	0.51	-	0.86	0.96	0.92	0.85	0.64	0.64
$h^2 n$	-	0.09	0.23	-	0.04	0.88	0.43	0.48	0.61	0.54

Table 4.4.4 Estimates of heritabilities for various cotton agronomic and quality characteristics of diallel experiments 4 planted at Loskop (Parents + F1s) during 1998/99 Season

	SCYP	SCYPLT	LYP	LYPLT	GOT1	GOT2	BS	SI	LI	SB
$\sigma^2 A$	80,171.02	14.33	9,545.43	2.16	2.32	1.9	0.08	0.57	0.17	0.83
$\sigma^2 D$	147,214.23	64.16	23,448.25	11.99	0.09	0.25	0.11	0.22	0.16	0.33
$\sigma^2 E$	77,013.42	61.64	12,559.16	9.54	0.63	0.21	0.24	0.09	0.07	0.07
$h^2 b$	0.75	0.56	0.72	0.6	0.79	0.91	0.44	0.89	0.83	0.22
$h^2 n$	0.26	0.1	0.21	0.09	0.76	0.8	0.18	0.64	0.42	0.16

	TBF	HB	UHB	LB	PH	HC	FL	FS	MC	FU
$\sigma^2 A$	7.11	0.18	3.11	0	140.7	364.32	0.41	0.23	0.01	0.89
$\sigma^2 D$	5.65	1.2	0.51	0	46.72	15.33	0.8	0	0	0.53
$\sigma^2 E$	5.62	2.85	2.26	0.01	32.64	17.82	0.07	0.06	0	0.55
$h^2 b$	0.69	0.33	0.62	-	0.85	0.96	0.94	-	-	0.72
$h^2 n$	0.39	0.04	0.53	-	0.64	0.92	0.32	-	-	0.45

4.5 Correlations between characteristics

4.5.1 Phenotypic correlations

The means all of the characteristics measured for each experiment, were subjected to linear-correlation analysis. The results are presented in correlation matrices - Tables 4.5.1.1. to 4.5.1.4.

4.5.1.1 Rustenburg 1997/98 (P+F1s)

Correlation coefficients are presented in Table 4.5.1.1. Most of the characteristics correlated had significant associations, either positive or negative.

Seed cotton yield

SCYP was highly and positively correlated with LYP (1.00), LYPLT (0.79), SCYPLT (0.75), MC (0.69), HB (0.53), BS (O.53), LI (0.49) and GOT 2 (0.45). It had significant negative correlation with UHB (-0.41) and FS (0.36). SCYPLT had significant positive correlation with SCYP (0.75), LYP (O.75), HB (0.58), MC (0.55), BS (0.48), LI (0.40), TBF (0.34), SB (0.29) and FU (O.28). It had significant negative correlation with FS (-0.34).

Lint yield

LYP had significant positive correlations with SCYP (1.00), LYPLT 0.79), SCYPLT (0.75), MC (0.71), BS (0.53), HB (0.53), GOT2 (0.52), SI (0.51), PH (0.42), FU (0.40) and HC (0.25). It had significant negative correlations with UHB (-0.4) and FS (-0.37). LYPLT was positively and significantly correlated with SCYPLT (0.99), SCYP (0.79), LYP (0.79), HB (0.60), MC (0.55), BS (0.50), PH (0.47), LI (0.44), GOT2 (0.42), SB (0.29), TBF (0.29) and FU (0.28).

Ginning out Turn (GOT)

GOT1 (based on small sample - five bolls) showed no significant correlations with all the characteristics measured. GOT2 (based on larger sample) showed significant positive correlations with MC (0.63), FU (0.60), LYP (0.52), LI (0.49), SCYP (0.45), LYPLT (O.42), BS (0.36) and SCYPLT (0.31). It was significantly negatively correlated with UHB (-0.43).

Boll size (BS)

Boll size was significantly and positively correlated with LI (0.71), SB (0.56), SCYP (0.53), LYP (0.53), PH (0.51), LYPLT (0.50), SCYPLT (0.48), MC (0.37), GOT2 (0.36) and FU (0.32). No significant negative correlations were found.

Seed Index (SI)

No positive or negative significant correlations were found.

Lint Index (LI)

LI had positive and significant correlations with BS (0.79), LYP (0.51), SCYP (0.49), GOT2 (0.49), MC (0.49), LYPLT (0.44), PH (0.42), SCYPLT (0.40) and FU (0.36). No significant negative correlations were found.

Seeds per boll (SB)

SB had significant positive correlations with BS (0.56), SCYPLT (0.29), LYPLT (0.29) and PH (0.26). No significant negative correlations were found.

Total bolls formed (TBF)

TBF had positive significant correlation with UHB (0.74), HB (0.41), SCYPLT (0.39) and LYPLT (0.29). It had significant negative correlation with MC (0.29) and FU (0.28).

Harvestable bolls (HB)

HB had significant positive correlation with LYPLT (0.60), SCYPLT (0.58), SCYP (0.53), LYP (0.53), TBF (0.53) and MC (0.36). It had a significant negative correlation with FS (-0.32).

Unharvestable bolls (UHB)

UHB was positively and significantly correlated with TBF (0.74), PH (0.36) and FS (0.32). It had significant negative correlations with MC (0.62), GOT2 (-0.43), FU (-0.43), LYP (-0.42) and SCYP (0.41).

Plant Height (PH)

PH had significant positive correlations with SCYPLT (0.51), BS (0.51), BS (0.51), LYPLT (O.47), SCYP (0.45), LYP (0.42), LI (0.42), TBF (0.41), UHB (0.36), FL (0.32), SB (0.26) and LB (0.25). No significant negative correlations were found.

Micronaire (MC)

MC was positively and significantly correlated with LYP (0.71), SCYP (0.69), GOT2 (0.63), FU (0.62), LYPLT (0.55), LI (0.49), SCYPLT (0.48), BS (0.37) and HB (0.36). It had significant negative correlation with FS (-0.53).

Fibre Uniformity (FU)

FU had significant positive correlations with GOT2 (0.66), MC (0.62), LYP (0.40), SCYP (0.36), LI (0.36) and LYPLT (0.28). It was significantly and negatively correlated with UHB (-0.43), FS (-0.29) and TBF (-0.28).

Hair count (HC)

HC was positively and significantly correlated with SCYP (0.26) and LYP (O.25). It was negatively and significantly correlated with FL.

Fibre Length (Fl)

Fibre length was positively and significantly correlated with PH and had significant negative correlation with HC (-0.31).

Fibre Strength (FS)

FS had a positive and significant correlation with UHB (O.32). Negative and positive correlations were found between FS and MC (-0.53), LYP (-0.37), SCYP (-0.36), HB (-0.32) and FU (-0.30).

4.5.1.2 Loskop 1997/98 (P+F1)

Correlations coefficients are presented in Table 4.5.1.2

Seed cotton yield

SCYP had significant positive correlation with LYP (0.99), SCYPLT (0.79), HB (0.66), MC (0.61), HC (0.58), TBF (0.53), FU (0.48), BS (0.36), LI (0.34) and SI (0.26). It had significant negative correlation with FS (-0.33).

SCYPLT had significant positive correlations with LYP (0.81), SCYP (0.79), MC (0.69), HC (0.69), HB (0.65), TBF (0.62), LI (0.43), FU (0.41), BS (0.35) and SI (0.28). It had significant negative correlation with FS (-0.37).

Lint yield

LYP had significant positive correlations with SCYP (0.99), SCYPLT (0.81), LYPLT (0.75), HB (0.66), MC (0.63), HC (0.59), TBF (0.54), FU (0.46), LI (0.40), BS (0.35) and SI (0.25). It had significant negative correlations with FS (-0.35). LYPLT had significant positive correlations with SCYPLT (0.98), LYP (0.75), SCYP (0.71), MC (0.68), HC (0.66), TBF (0.62), HB (0.61), LI (0.41), GOT2 (0.38), FU (0.36), BS (0.31), SI (0.25) and UHB (0.23). It had significant negative correlation with FS (-0.38).

Ginning Out Turn (GOT)

GOT1 had significant positive correlations with LI (0.44) and GOT2 (0.33). It had significant negative correlation with FL (-0.23). GOT2 had significant positive correlation with LYPLT (0.38), LI (0.37), GOT1 (0.33) and UHB (0.25). It had significant negative correlations with FL (-0.57) and LB (0.36).

Boll size (BS)

BS had significant positive correlations with SB (0.57), HB (0.51), LI (0.46), SCYP (0.36), LYP (0.35), SCYPLT (0.35), SI (0.34), LYPLT (0.31), MC (0.30), FL (0.28), HC (0.27). No significant negative correlations were found.

Seed Index (SI)

SI had significant positive correlation with LYP (0.79), LI (0.42), BS (0.34), SCYPLT (0.28), SCYP (0.26) and HC (0.23). No significant negative correlations were found.

Lint Index (LI)

LI was significantly and positively correlated with LYPLT (0.47), BS (0.46), GOT1 (0.44), SCYPLT (0.43), SI (0.42), MC (0.40), GOT2 (0.37), HC (0.35), SCYP (0.34), TBF (0.33), HB (0.26), UHB (0.23) and FU (0.23). It had a significant negative correlation with SB (-0.27).

Seeds per boll (SB)

SB had significant correlations with BS (O.57) and LB (0.45). It had significant negative correlation with LI (-0.27), HB (-0.26) and FS (-0.22).

Locules per boll (LB)

LB had significant positive correlations with BS (0.51), SB (0.45) and FL (0.24). It had significant negative correlation with GOT2 (-0.36).

Total bolls formed (TBF)

TBF had significant correlations with HB (0.80), HC (0.64), SCYPLT (0.62), LYPLT (0.62), UHB (0.61), LYP (0.54), SCYP (0.53), MC (0.49) and LI (0.34). It had significant negative correlation with FS (-0.28).

Harvestable bolls (HB)

HB had significant positive correlation with TBF (0.80), SCYP (0.66), LYP (0.66), SCYPLT (0.65), LYPLT (0.61), MC (0.54), HC (0.47) and LI (0.26). It was significantly and negatively correlated with LI (-0.24).

Unharvestable bolls (UHB)

UHB had significant positive correlations with TBF (0.61), HC (0.44), GOT2 (0.25), LYPLT (0.23) and LI (0.23). It was negatively and significantly correlated with FL (-0.34) and FS (-0.24).

Plant Height (PH)

No records were taken for plant height for this particular experiment.

Hair count (HC)

HC was positively and significantly correlated with MC (0.72), SCYPLT (0.69), LYPLT (0.66), TBF (0.64), LYP (0.59), SCYP (0.58), HB (0.47), FU (0.46), UHB (0.44), LI (0.35), BS (0.27) and SI (0.23). It was negatively and significantly correlated with FS (-0.37) and FL (-0.29).

Fibre Length (FL)

FL had significant and positive correlations with LB (O.44), FS (0.35) and BS (0.28). It was significantly and negatively correlated with GOT (-.57), UHB (-0.34), HC (-0.29), GOT1 (-0.23) and MC (0.22).

Fibre Strength (FS)

FS was significantly and positively correlated with FL (0.35). It has negative significant correlations with MC (-0.43), LYPLT (-0.38), HC (-0.37), SCYPLT (-0.37, LYP (-0.35), SCYP (-0.33), TBF (-0.28), UHB (-0.24) and SB (-0.22).

Micronaire (MC)

MC had positive and significant correlations with HC (0.72), SCYPLT (0.69), LYPLT (0.68), LYP (0.63), SCYP (0.61), FU (0.56), HB (0.54), TBF (0.49) and LI (0.40). It had negative and significant correlations with FS (-0.43) and FL (-0.22).

Fibre Uniformity (FU)

FU had positive and significant correlations with MC (0.56), SCYP (0.48), LYP (0.46), HC (0.46), SCYPLT (0.41), LYPLT (0.36) and LI (0.23). No significant negative correlations were found.

4.5.1.3 Rustenburg 1998/99 (P+F1)

Correlation coefficients are presented in Table 4.5.1.3.

Seed cotton yield

SCYP had significant positive correlations with LYP (0.98), PH (0.73), FL (0.54), BS (0.48), FS (0.41), LYPLT (0.41), SI (0.39), HB (0.39), SCYPLT (0.39), SB (0.33) and TBF (0.32). It had no significant negative correlations. SCYPLT had significant positive correlations with HB (0.75), TBF (0.71), FL (O.52), SI (0.49), PH (0.45), SCYP (0.39), BS (0.39), LYP

(0.38), LI (0.34), UHB (0.33) and FS (0.33). No significant negative correlations were found.

Lint Yield

LYP had significant positive correlations with SCYP (0.98), PH (0.75), BS (0.52), FS (0.50), LYPLT (0.44), SCYPLT (0.38), SB (0.37), HB (0.37), TBF (0.32) and SI (0.31). No significant negative correlations were found. LYPLT had significant positive correlations with HB (0.73), TBF (0.72), PH (0.50), FL (0.48), BS (0.47), SI (0.47), LYP (0.44), SCYP (0.42), UHB (0.38), LI (0.33) and FS (0.31).

Ginning Out Turn (GOT)

GOT1 (based on small sample - five bolls) was positively and significantly correlated with LI (0.63) and was significant negative correlated with SI (0.35). GOT2 (based on large sample - 50 bolls) was significantly positive correlated with MC (O.42) and significant negatively correlated with FS (-0,45), FL (-0.42), SI (-0.38) and HB (-0.27).

Boll size (BS)

BS had significant positive correlations with SI (0.74), PH (0.64), LYP (0.52), SB (0.51), FS (0.51), SCYP (0.48), LYPLT (0.47), SCYPLT (0.39), FL (0.39), LI (0.33) and TBF (0.26). No significant negative correlations were found.

Seed Index (SI)

SI had significant positive correlations with BS (0.74), PH (0.60), FS (0.60), FL (0.58), SCYPLT (0.49), LYPLT (0.47), SCYP (0.39), LI (0.33), HB (0.33), TBF (0.31). Negative correlations were significant for GOT2 (-0.38) and GOT1 (-0.35).

Lint Index (LI)

LI was positively and significantly correlated with GOT1 (0.63), LYPLT (0.47), SCYPLT (0.34), BS (0.33), SI (0.33) and PH (0.27). No negative significant correlations were found.

Seeds per boll (SB)

SB had significant positive correlations with BS (0.51), LYP (0.37), SCYP (0.33), PH (0.27) and LB (0.27).

Locules per boll (LB)

LB was significantly and positively correlated with SB (0.27).

Total Bolls Formed (TBF)

TBF had significant positive correlations with HB (O.95), LYPLT (0.72), SCYPLT (0.71), UHB (O.63), FL (0.40), PH (0.40), SCYP (0.32), LYP (0.32), SI (0.31), FS (0.29) and BS (0.26).

Harvestable bolls (HB)

HB had significant positive correlations with TBF (0.95), SCYPLT (0.75), LYPLT (0.73), FL (O.47), PH (0.44), UHB (0.41), SCYP (0.3(0, LYP (0.37), FS (0.34) and SI (0.33). It had a significant negative correlation with GOT2 (-0.27).

Unharvestable bolls (UHB)

UHB had significant positive correlations with TBF (0.63), HB (0.41), LYPLT (0.38) and SCYPLT (0.33).

Plant Height (PH)

PH had significant positive correlations with LYP (0.75), SCYP (0.73), BS (0.64), FL (0.62), SI (0.60), FS (0.57), LYPLT (0.50), SCYPLT (0.45), HB (0.44), TBF (0.40), LI (0.27) and SB (O.27). No significant negative correlations were found.

Hair count (HC)

Hair count had only one significant correlation with one characteristic and that was FU (0.41), which was also positive.

Fibre Length (FL)

FL had significant and positive correlations with FS (0.77), PH (0.62), SI (0.58), SCYP (0.54), SCYPLT (0.52), LYP (0.50), LYPLT (0.48), HB (0.47), TBF (0.40) and BS (0.39). It had significant negative correlations with GOT2 (0.42) and MC (0.33).

Fibre Strength (FS)

Significant positive correlations were found between FS and FL (0.77), SI (0.60), PH (0.57), BS (0.51), SCYP (0.41), LYP (0.39), HB (0.34), SCYPLT (0.33), LYPLT (0.31) and TBF (0.29). Significant negative correlations were also found between FS and GOT2 (0.45) and MC (0.37).

Micronaire (MC)

MC had only one positive significant correlation and that was with GOT2 (O.43). It had two significant negative correlations with FS (0.37) and FL (0.33).

Fibre Uniformity (FU)

FU had one positive significant correlation with MC (0.41).

4.5.1.4 Loskop 1998/99 (P+F1s)

Correlation coefficients are presented in Table 4.5.1.4

Seed cotton yield

Positive and significant correlations were found between SCYP and LYP (0.98), SCYPLT (0.69), LYPLT (0.64), SI (0.46), BS (0.42), PH (0.42), HC (0.4), MC (0.30), LI (0.28), LB (0.27) and HB (0.26). No significant negative correlations were found. SCYPLT had significant positive correlations with LYPLT (0.98), LYP (0.70), SCYP (0.69), HB (0.53), SI (0.44), BS (0.39), LI (0.33), LB (0.33), PH (0.32), TBF (0.30) and HC (0.29). No significant negative correlations were found.

Lint Yield

LYP had significant positive correlations with SCYP (0.98), SCYPLT (0.70), LYPLT (0.68), BS (0.46), SI (O.42), MC (0.37), HC (0.37), PH (0.36), LI (0.36), LB (0.29) and HB (0.28). No significant negative correlations were found. LYPLT had positive significant correlations with SCYPLT (0.98), LYP (0.68), SCYP (0.64), HB (0.54), BS (0.41), LI (0.39), SI (0.38), LB (0.34), SB (0.27) and HC (0.25). No significant negative correlations were found.

<u>Ginning Out Turn</u> (GOT)

GOT1 (based on small boll sample) had significant positive correlations with GOT2 (0.68), LI (0.57), SB (0.32) and MC (0.29). It had significant negtive correlations with PH (-0.28). GOT2 (based on larger boll sample) had significant positive correlations with GOT1 (0.68), LI (0.47) and MC (0.46). It had a significant negative correlation with PH (0.42).

<u>Boll size</u> (BS)

Positive significant correlations were found between BS and SB (0.73), LI (0.55), LB (0.54), LYP (0.46), SCYP (0.42), SI (0.41), LYPLT (0.41), SCYPLT (0.39), GOT1 (0.30), PH (0.28). No significant negative correlations were found.

<u>Seed Index</u> (SI)

SI had significant positive correlations with LI (0.67), PH (0.60), SCYP (0.46), SCYPLT (0.44), LYP (0.42), BS (0.41), FL (0.40), LYPLT (0.38), FU (0.35), UHB (0.32), FS (0.30) and HC (0.26). The negative correlations were not significant.

<u>Lint Index</u> (LI)

LI had significant positive correlations with SI (0.67), GOT1 (0.57), BS (0.55), GOT2 (0.47), MC (0.43), LYPLT (0.39), LYP (0.36), SCYPLT (0.33) and SCYP (0.28). No negative correlations were found with any degree of significance.

Seeds per boll (SB)

Significant and positive correlations were found between SB and BS (0.73), HB (0.28) and LYPLT (0.28). Significant negative correlations were not found.

Locules per boll (LB)

LB had positive and significant correlations with BS (0.54), LYPLT (0.34), SCYPLT (0.33), LYP (0.29), LI (0.29) and SCYP (0.27). No significant negative correlations were found.

Total bolls formed (TBF)

TBF had significant positive correlations with UHB (0.77), HB (0.62), HC (0.50), PH (0.31), LYPLT (0.31) and SCYPLT (0.30). A significant negative correlation was found for FS (-0.34).

Harvestable bolls (HB)

Positive and significant correlations were found between HB and TBF (0.62), LYPLT (0.54), SCYPLT (0.53), MC (0.30), LYP (0.28), SB (0.28) and SCYP (0.26). A significant negative correlation was found between HB and FS (-0.35).

Unharvestable bolls (UHB)

UHB had significant positive correlations with TBF (0.77), HC (0.57), PH (0.51) and SI (0.32). No significant negative correlations were found.

Plant Height (PH)

PH had significant positive correlation with SI (O.60), SCYP (0.42), HC (0.42), LYP (0.36), FL (0.35), SCYPLT (0.32), TBF (0.31) and BS (0.27). It was significantly negatively correlated with GOT2, (-0.42) and GOT1 (-0.28).

Hair count (HC)

HC had significant positive correlations with UHB (0.57), TBF (0.50), PH (0.42), SCYP (0.40), LYP (0.37), FU (0.29), SCYPLT (0.29), SI (0.26) and LYPLT (0.25). It had negative correlations with FL and FS, but only the latter was significant (0.43).

Fibre Length (FL)

FL was significantly positively correlated with FS (0.74), SI (0.40) and PH (0.35). No significant negative correlations were found.

Fibre Strength (FS)

FS was significantly positively correlated with only SI (0.30), but had significant negative correlations with HC (-0.43), HB (-0.35), TBF (-0.34) and HC (-0.29).

Micronaire (MC)

MC had significant positive correlations with GOT2 (0.46), LI (O.43), FU (0.40), LYP (0.37), SCYP (0.30), GOT1 (0.29), HB (0.29) and BS (0.28). It had significant negative correlations with FS (-0.29).

.Table. 4.5.1.1 **Phenotypic correlation coefficients for various cotton agronomic and quality characteristics**

Diallel Experiment 1, 1997/98, Rustenburg

	SCYP	SCYPLT	LYP	LYPLT	GOT1	GOT2	BS	SI	LI	SB	LB	TBF	HB	UHB	PH	HC	FL	FS	MC
Scyplt	0.7529**																		
Lyp	0.9958**	0.7462**																	
Lyplt	0.7878**	0.9872**	0.7904**																
GOT1	-0.1998	-0.1418	-0.1672	0.1089															
GOT2	0.4480**	0.3119*	0.5168**	0.4156**	0.1831														
BS	0.5276**	0.4779**	0.5290**	0.4974**	-0.1413	0.3550**													
SI	-0.0738	0.1078	-0.0835	0.0783	-0.0695	-0.1284	0.0817												
LI	0.4873**	0.4026**	0.5064**	0.4434**	-0.0072	0.4903**	0.7920**	-0.0715											
SB	0.2345	0.2917*	0.2294	0.2904*	-0.0509	0.1154	0.5564**	0.1613	0.0819										
LB	0.1760	0.2356	0.1696	0.2196	-0.0239	-0.0455	0.0030	0.0418	-0.0724	0.0894									
TBF	-0.0075	0.3446**	-0.0241	0.2912*	-0.2198	-0.2226	0.0101	0.0932	-0.0831	0.146	0.2084								
HB	0.5316**	0.5817**	0.5276**	0.5991**	-0.1399	0.2237	0.028	-0.0253	0.076	-0.0138	0.1244	0.5260**							
UHB	-0.4074**	-0.0383	-0.4249**	-0.1148	-0.1419	-0.4329**	-0.0013	0.1257	-0.1450	0.1944	0.1452	0.7443**	-0.1699						
PH	0.4458**	0.5097**	0.4200	0.4657**	-0.2345	0.0273	0.5082**	0.0559	0.4206**	0.2573*	0.2548*	0.4176**	0.1693	0.3607**					
HC	0.2610*	0.1276	0.2532**	0.1371	-0.0975	0.0512	0.1809	-0.1794	0.1403	0.1257	-0.0145	-0.145	-0.0547	-0.1200	0.1967				
FL	0.2510	0.1801	0.2111	0.1475	-0.2395	-0.1891	0.2282	0.126	0.1045	0.0660	0.1413	0.0629	0.1579	-0.0508	0.3202*	-0.3137			
FS	-0.3613	-0.3413**	-0.3718**	-0.3506**	-0.0955	-0.2996	0.0826	-0.081	0.0241	-0.0681	-0.0854	0.0733	-0.3162	-0.3172*	-0.0785	-0.2334	0.245		
MC	0.6912**	0.4848**	0.7110**	0.5518**	0.0512	0.6309**	0.3669**	-0.1190	0.4925**	0.0334	-0.0878	-0.2907*	0.3598**	-0.6173**	0.102	0.1799	-0.0479	-0.5252**	
FU	0.3614**	0.5152	0.3953**	0.2776*	0.1934	0.6018**	0.3199**	-0.1257	0.3582**	0.1301	-0.1637	-0.2810*	0.1210	-0.4289**	-0.0338	0.1589	-0.0404	-0.2875*	0.6159**

** = P (0,01)

* = P (0,05)

Table 4.5.1.2 **Phenotypic correlation coefficients for various cotton agronomic and quality characteristics Diallel Experiment 2, 1997/98, Loskop**

	SCYP	SCYPLT	LYP	LYPLT	GOT1	GOT2	BS	SI	LI	SB	LB	TBF	HB	UHB	PH	HC	FL	FS	MC
Scyplt	0.7929**																		
Lyp	0.9870**	0.8050**																	
Lyplt	0.7084**	0.9768**	0.7483**																
GOT1	-0.1118	-0.0007	-0.0601	0.0646															
GOT2	-0.1143	0.2085	-0.0245	0.3779**	0.3283**														
BS	0.3637**	0.3511**	0.3699*	0.3081**	0.0757	-0.0776													
SI	0.2576*	0.2821*	0.2464*	0.2478*	-0.1033	-0.0802	0.3413**												
LI	0.3430**	0.4333**	0.3953**	0.4071**	0.4431**	0.3701**	0.4563**	0.4229**											
SB	-0.0107	-0.05	-0.0356	-0.0783	0.0115	-0.2021	0.5666**	-0.1041	-0.2701*										
LB	0.0090	-0.0316	-0.0467	-0.082	-0.1442	-0.3627**	0.5062**	0.1719	0.0375	0.4453**									
TBF	0.5315**	0.6205**	0.5416**	0.6182**	0.0157	0.1187	0.1007	0.1283	0.3380**	-0.151	-0.1051								
HB	0.6610**	0.6525**	0.6552**	0.6114**	-0.0713	-0.0262	0.0308	0.1730	0.2626*	-0.2366**	-0.1276	0.7983**							
UHB	-0.0074	0.1749	0.0195	0.2288**	0.1469	0.2544	0.123	-0.0207	0.2348*	0.0544	-0.0120	0.6130**	0.0192						
PH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
HC	0.5807**	0.6862**	0.5852**	0.6624**	-0.0661	0.1120	0.2661*	0.2268*	0.3455**	-0.099	-0.0652	0.6376**	0.4727**	0.4411**	-				
FL	0.1857	-0.0929	0.1092	-0.2093	-0.2332*	-0.5695	0.2818*	0.1862	-0.0828	0.1932	0.4382**	-0.1564	0.0335	-0.3383**	-	-0.2913**			
FS	-0.3305**	-0.3729**	-0.3485*	-0.3798**	0.0803	-0.0995	-0.1942	0.362	-0.0312	-0.2182	0.0249	-0.2780*	-0.1764	-0.2360*	-	-0.3703**	0.3464**		
MC	0.6096**	0.6860**	0.6319**	0.684**	0.0062	0.1835	0.3003**	0.1284	0.3993**	-0.1349	-0.0696	0.4933**	0.5399**	0.1133	-	0.7232**	-0.2178*	-0.1842	
FU	0.4764**	0.4111**	0.4554**	0.3619**	-0.0725	-0.1283	0.1541	0.1175	0.2338*	-0.1544	-0.0289	0.1546	0.2165	-0.0377	-	0.4564**	0.0777	-0.4333**	0.5635**

** = P (0,01)

* = P (0,05)

4.5.1.3 Phenotypic correlation coefficients of various cotton agronomic and quality characteristics Diallel Experiment 3, 1998/99, Rustenburg

	SCYP	SCYPLT	LYP	LYPLT	GOT1	GOT2	BS	SI	LI	SB	LB	TBF	HB	UHB	PH	HC	FL	FS	MC
Scyplt	0.3938**																		
Lyp	0.9832**	0.3774**																	
Lyplt	0.4100**	0.9692**	0.4359**																
GOT1	-0.1066	0.0177	-0.0907	-0.0295															
GOT2	-0.1591	-0.2214	-0.0618	-0.0797	0.1259														
BS	0.4750**	0.3944**	0.5170**	0.4667**	-0.1798	-0.0706													
SI	0.3916**	0.4873**	0.3828**	0.4740**	-0.3502**	-0.3822**	0.7363**												
LI	0.1794	0.3362**	0.1799	0.3261**	0.6283**	-0.1173	0.3300	0.3277**											
SB	0.3280**	-0.0437	0.3726**	0.0493	0.0141	0.0984	0.5064	-0.0806	-0.0345										
LB	0.1859	0.1121	0.1903	0.1219	-0.007	-0.0836	0.2508	0.1582	0.0965	0.2710*									
TBF	0.3153**	0.7083**	0.3169*	0.7175**	-0.0715	-0.1364	0.2631*	0.3086*	0.1775	0.0132	0.0894								
HB	0.3919**	0.7481**	0.3744**	0.7272**	-0.1167	-0.2699*	0.2302	0.3257*	0.1316	0.0081	0.0787	0.9520**							
UHB	*0.0033	0.3336**	0.0414	0.3777**	0.0614	0.2383	0.2286	0.1655	0.2187	-0.0139	0.0643	0.6325**	0.4119**						
PH	*0.1883	0.3332**	*0.1880	0.3133*	-0.0309	0.0316	-0.0903	-0.0514	0.0576	-0.0195	0.368	-0.078	-0.1246	0.0952					
HC	0.0284	0.2455	0.0043	0.202	0.1503	-0.2072	0.3942**	0.0089	0.1028	-0.0216	-0.1651	0.1669	-0.1821	0.0187	0.1071				
FL	0.5364**	0.5197**	0.5034**	0.4794**	-0.2344	-0.4193	0.5103**	0.5810**	0.2169	-0.0216	0.0996	0.4031**	0.4712**	0.1074	-0.232	-0.2151			
FS	0.4134**	0.3325**	0.3947**	0.3325**	-0.1957	-0.4470**	0.014	0.5989**	0.2276	0.1631	0.0367	0.2876*	0.2876*	0.1173	-0.2332	-0.1828	0.7667**		
MC	*0.0311	-0.0283	0.0143	0.0428	0.1000	0.4206**	0.0864	0.032	0.0694	-0.0576	0.1113	0.0154	-0.0149	0.0495	0.0801	-0.0672	*0.3339**	-0.3672**	
FU	0.0104	0.0180	0.0160	0.0449	0.2269	0.0236	0.0562	-0.0820	0.0731	0.1233	0.0982	0.1441	0.156	0.0599	-0.1649	0.4088**	-0.2286	-0.2313	0.1792

** = P (0,01)

* = P (0,05)

Table 4.5.1.4 **Phenotypic correlation coefficients of various cotton agronomic and quality characteristics Diallel Experiment 4, 1998/99, Loskop**

	SCYP	SCYPLT	LYP	LYPLT	GOT1	GOT2	BS	SI	LI	SB	LB	TBF	HB	UHB	PH	HC	FL	FS	MC
Scyplt	0.6928**																		
Lyp	0.9839**	0.6993**																	
Lyplt	0.6421**	0.9791**	0.6813**																
GOT1	-0.0974	0.0482	0.265	0.1762															
GOT2	-0.0949	0.0072	0.0562	0.1593	0.6770**														
BS	0.4215**	0.3871	0.4560**	0.4095**	0.3046*	0.179													
SI	0.4577**	0.4354**	0.4185**	0.3794**	-0.1357	-0.1137	0.4071**												
LI	0.2838*	0.3285**	0.3555**	0.3876**	0.5677**	0.4722**	0.5529**	0.6681**											
SB	0.1773	0.2316	0.2139	0.2674*	0.3176*	0.1473	0.7268**	-0.1353	0.0831										
LB	0.2734*	0.3300**	0.2905*	0.3428**	0.2084	0.0549	0.5391**	0.1850	0.2887*	0.4291**									
TBF	0.2008	0.3018*	0.2114	0.3071*	0.287	-0.0378	0.2239	0.2215	0.2154	0.0907	0.0468								
HB	0.2629*	0.5333**	0.2772	0.5390**	0.1649	0.0522	0.2487	0.0562	0.1696	0.2815*	0.1343	0.6234**							
UHB	-0.0635	-0.0604	-0.0515**	-0.0482	0.1092	0.0036	0.1344	0.0107	0.1207	0.0991	0.1520	0.2058	-0.0552						
PH	0.4193**	0.3169*	0.3574	0.2310	-0.2792*	-0.4183**	0.2711*	0.5990**	0.2136	-0.0044	0.1195	0.3066*	-0.0207	0.0466					
HC	0.3993**	0.2913*	0.3718**	0.2541*	-0.2264	-0.2258	0.1062	0.2616*	0.256	-0.0299	-0.0241	0.5037**	0.1985	0.1057	0.4210**				
FL	0.1971	0.1098	0.1511	0.0429	-0.1958	-0.1203	0.1379	0.4040**	0.1436	-0.0278	0.0238	-0.0638	-0.1858	-0.1702	0.3541**	-0.3682**			
FS	-0.0442	-0.1432	-0.0963	-0.1849	-0.2436	-0.1852	-0.0619	0.2971*	0.0574	-0.1535	-0.0391	-0.3449**	-0.3504	-0.1021	0.0999	-0.4295**	0.7442**		
MC	0.3021*	0.164	0.3741**	0.2333	0.2884*	0.4576**	0.2842*	0.1802	0.4254**	0.0574	-0.0239	0.2073	0.2973*	0.0811	-0.1648	0.0922	-0.1108	-0.2852*	
FU	0.0791	-0.0488	0.0589	-0.0713	-0.1760	-0.2059	0.0364	0.3466**	0.1437	-0.1599	-0.2180	0.1376	-0.0070	-0.0477	0.2410	0.2881	-0.0421	-0.0911	0.3995**

** = P (0,01)

* = P (0,05)

Fibre Uniformity (FU)

Fibre uniformity was positively and significantly correlated with MC (0.40), SI (0.35) and HC (0.29). Significant negative correlations were not found.

4.5.2 Genetic Correlations

Significant genetic correlations were not found for most of the characteristics measured. This could be the result of the size of the sample used in the correlation analysis. The sample was too small compared to the sample used in phenotypic correlations. In phenotypic correlation analysis, significance was found from values as low as 0.2, where as none could be detected from values even as high as 0.95 for genetic correlations. Correlations values which are relatively high will therefore be discussed:

4.5.2.1 Rustenburg 1997/98 (P+F1s)

Genetic correlation coefficients are presented in Table 4.5.2.1.

Seed cotton yield

In SCYP, there was only one significant correlation found with LYP (0.98). Positive correlations of high degree though not significant statistically, were observed with GOT1 (0.62), MC (0.49) and HB (0.45). High negative correlations were also observed with UHB (-0.65) and SI (-0.55). For SCYPLT high correlations though not statistically significant were with LYPLT (0.87), LB (0.88), SB (0.74) and TBF (0.70). High negative correlations were with MC (-0.73) and FU (-0.66). Table 4.5.2.1 presents the correlation coefficients.

Lint yield

LYP was significantly and positively correlated with SCYP (0.98) and had high correlations, though not statistically significant with MC (0.59), GOT2 (0.47) and HB (0.44). It was negatively correlated with UHB (-0.70) and SI (-0.68). LYPLT had high positive correlations with SCYPLT (0.87), LB (0.80) and SB (0.59).

Ginning Out Turn (GOT)

GOT1 was highly significant correlated with FL (0.64) and SCYP (0.62). GOT2 had high positive correlation with FU (0.84) and MC (0.65). It had also high negative correlation with PH (-0.84), SI (-0.74), TBF (-0.52) and UHB (-0.50).

Boll size (BS)

Boll size had relatively high positive correlation with FL (0.88), LI (0.81) and SB (0.61). It had a high negative correlation with HB (-0.94).

Seed Index (SI)

SI had significantly high positive correlations with UHB (0.72), TBF (0.60), FL (0.53), PH (0.52), SB (0.49), LB (0.45), FS (0.44) and SCYPLT (0.42). It had relatively high negative correlation with MC (-0.85), FU (-0.78), GOT2 (-0.74), LYP (-0.68) and SCYP (-0.55).

Lint Index (LI)

LI had significantly high positive correlations with BS (0.81), FU (0.78) and FS (0.65). It had high negative correlations with TBF (-0.81), HB (-0.74), LB (-0.67) and SCYPLT (-0.49).

Seeds per boll (SB)

SB had significantly high positive correlations with UHB (0.84), SCYPLT (0.74), BS (0.61), LYPLT (0.58), SI (0.49), PH (0.49) and LB (0.46). It had high negative correlations with MC (-0.82) and HB (-0.67).

Locules per boll (LB)

LB had significantly high positive correlations with SCYPLT (0.88), LYPLT (0.81), TBF (0.79) and SI (0.45). It had high negative correlations with LI (-0.67), FU (-0.62) and MC (-0.59).

Total bolls formed (TBF)

TBF showed significantly high positive correlations with LB (0.79), SCYPLT (0.70), UHB (0.70), SI (0.60) and high negative correlations with FU (-0.88), LI (-0.82), MC (-0.74) and GOT2 (-0.52).

Harvestable bolls (HB)

HB had significantly high positive correlations with SCYP (0.45) and LYP (0.44). It showed high negative correlations with BS (-0.94), LI (-0.74), FS (-0.67), PH (-0.52) and UHB (-0.51).

Unharvestable bolls (UHB)

UHB was significantly, positively correlated with SB (0.84), SI (0.72), TBF (0.70), SCYPLT (0.63) and PH (0.59). High negative correlations were found with MC (-0.94), LYP (-0.70), SCYP (-0.65), FU (-0.62), HB (-0.51) and GOT2 (-0.50).

Plant Height (PH)

PH had significantly high positive correlations with UHB (0.59), SI (0.57), SB (0.49), and BS (0.41). It had also high negative correlations with GOT2 (-0.84), MC (-0.64), FU (-0.53), HB (-0.52) and LYP (-0.47).

Hair count (HC)

Hair count had negative correlation with FL (-0.49) and LI (0.48).

Fibre Length (FL)

FL had significantly high positive correlations with FS (0.61) and SI (0.53). Strong negative correlation was found with GOT1 (-0.64), HC (-0.49) and GOT2 (-0.45).

Fibre Strength (FS)

Fibre strength had significant high positive correlations with BS (0.88), LI (0.65), FL (0.61) and SI (0.44). It was highly negatively correlated with HB (-0.67) and TBF (-0.42).

Micronaire (MC)

MC had significant high positive correlations with GOT2 (0.65), LYP (0.59) and SCYP (0.49). It had high negative correlation with UHB (-0.94), SI (-0.85), SB (-0.82), TBF (-0.74), SCYPLT (-0.73), PH (-0.64) and LB (-0.59).

Fibre Uniformity (FU)

FU had significant high positive correlation with GOT2 (0.84), LI (0.77), MC (0.77), LYP (0.42). Negative correlations were found with TBF (-0.88), SI (-0.78), UHB (-0.62), SCYPLT (0.60) and PH (-0.53).

4.5.2.2 Loskop 1997/98 (P+F1)

Genetic correlation coefficients are presented in Table 4.5.2.2

Seed cotton yield

SCYP had significant positive correlations with LYP (0.98), HC (0.98) and SCYPLT (0.93). Also high positive correlations were found with MC (0.90), LYPLT (0.86), TBF (0.84), FU (0.83), HB (0.80), UHB (0.76), BS (0.57), LI (0.54) and SI (0.42). Negative correlations was found between SCYP and FS (-0.44). SCYPLT had significant positive correlations with LYPLT (0.99), LYP (0.97) and HC (0.96). It also had high positive correlations with UHB (0.91), TBF (0.87), MC (0.87), HB (0.76), LI (0.58) and BS (0.53).

Lint yield

LYP had significant positive correlations with SCYP 90.98), HC (0.98) and SCYPLT (0.97). Non-significant but high positive correlations were also found for LYPLT (0.94), MC (0.93), TBF (0.85), UHB (0.84), FU (0.83), HB (0.78), LI (0.64) and BS (0.56). It had also negative correlation with FS (-0.57) and FL (-0.46) in LYPLT. A significant correlation was found with SCYPLT (0.99). Other high positive correlations were found with LYP (0.94), UHB (0.93), HC (0.91), SCYP (0.86), MC (0.85), TBF (0.85), HB (0.72), FU (0.62), LI (0.61), BS (0.47) and GOT2 (0.46). High negative correlations were found with FS (0.72) and FL (0.67).

Ginning Out Turn (GOT)

GOT1 had significant high positive correlation with GOT2 (0.81) and LI (0.74) and high negative correlation with FL (0.60). GOT2 had high positive correlations with GOT1 (0.81), UHB (0.54) and LI (0.49). It had high negative correlations with FL (-.80), LB (-0.53) and FS (-0.51).

Boll size (BS)

BS had significant high positive correlation with SI (0.94), LI (0.66), LB (0.64), SCYP (0.57), LYP (0.56), SCYPLT (0.53), LYPLT (0.47) and HC (0.46).

Seed Index (SI)

SI had significant high positive correlations with BS (0.94), LB (0.74), LI (0.57) and SCYP (0.42). No significant negative correlations were found.

Lint Index (LI)

LI had high positive correlation with GOT1 (0.74), BS (0.66), LYP (0.64), LYPLT (0.61), SCYPLT (0.58), SI (0.57), SCYP (0.54) and GOT2 (0.49). No significant negative correlations were found.

Seeds per boll (SB)

Relatively high significant correlations were found with LB (0.52) and negative correlations with FU (-0.56), HB (-0.49) and MC (-0.46). None of them were significant.

Locules per boll (LB)

LB had significant positive correlation with FL (0.77), SI (0.74), BS (0.64), FS (0.58) and SB (0.52). A high negative correlation was found with GOT2 (-0.53).

Total bolls formed (TBF)

TBF was significantly correlated with HB (0.96) and shown high positive correlations with UHB (0.89), SCYPLT (0.87), HC (0.87), LYPLT (0.85), LYP (0.85), SCYP (0.84), MOO (0.80), FU (0.67) and LI (0.45). Negative correlation was found for FS (-0.43).

Harvestable bolls (HB)

Relatively significant positive correlations were found with HC (0.84), SCYP (0.80), MC (0.80), LYP (0.78), SCYPLT (0.76), UHB (0.74), LYPLT (0.72) and FU (0.67). Negative correlation was found with SB (-0.49).

Unharvestable bolls (UHB)

UHB had significant positive correlation with LYPLT (0.93), SCYPLT (0.91), TBF (0.89), LYP (0.84), HC (0.79), SCYP (0.76), HB (O.74), FU (0.69), LI (0.65), GOT2 (0.53), BS (0.42) and FU (0.42). It had high negative correlation with FL (-0.54) and FS (-0.54).

Plant Height (PH)

No records were taken for this characteristic.

Hair count (HC)

HC was significantly correlated with SCYP (0.98), LYP (0.98), SCYPLT (0.96), MC (0.93), LYPLT (0.91), TBF (0.87), FU (0.81), UHB (0.79), BS (0.46) and LI (0.46). It had relatively high negative correlations with FS (-0.57) and FL (-0.42).

Fibre Length (FL)

FL had significant positive correlations with FS (0.89), LB (0.77) and LYP (0.46). It had high negative correlations with GOT2 (-0.80), LYPLT (-0.67), GOT1 (-0.60), MC (-0.57), SCYPLT (-0.56), UHB (-0.54) and HC (-0.42)

Fibre Strength (FS)

FS had significant positive correlations with FL (0.89), LB (0.58) and LYP (0.54). It had negative correlations with LYPLT (-0.72), SCYPLT (-0.66), MC (-0.6)), UHB (-0.54), GOT2 (-0.51), SCYP (-0.44) and TBF (-0.43)

Micronaire (MC)

MC had significant positive correlations with LYP (0.93), HC (0.93), FU (0.92), SCYP (0.90), SCYPLT (0.87), LYPLT (0.85), TBF (0.80), HB (0.80), UHB (0.69) and LI (0.47). It had high negative correlations with FS (-0.60), FL (-0.57) and SB (-0.47).

Fibre Uniformity (FU)

FU had significant positive correlations with MC (0.92), SCYP (0.83), LYP (0.81), HC (0.81), SCYPLT (0.67), HB (0.67), LYPLT (0.62), TBF (0.61), LI (0.45) and UHB (0.42). It was negatively correlated with SB (0.56).

4.5.2.3 Rustenburg 1998/99 (P+F1)

Genetic correlation coefficients are presented in Table 4.5.2.3.

Seed cotton yield

SCYP was significantly and positively correlated with TBF (0.97) and had also had significant positive correlation with PH (0.93), HB (0.89), SI (0.86), LYP (0.83), SCYPLT (0.82), FS (0.81), LI (0.78), LYPLT (0.76), BS (0.74), LB (0.72) and FL (0.68). It had high negative correlation with GOT1 (-0.76) and GOT2 (-0.57). For SCYPLT, high positive correlations were found with LYPLT (0.94), TBF (0.85), LI (0.85), LI (0.83), SCYP (0.82), SI (0.81), PH (0.8), BS (0.78), FS (0.77), HB (0.74), LYP (0.70), FL (0.65) and LB (0.61). It had high negative correlations with GOT2 (-0.56) and GOT1 (-0.54).

Lint yield

LYP had high positive correlations with PH (0.92), BS (0.91), TBF (0.84), SCYP (0.83), LYPLT (0.83), SI (0.74), SCYPLT (0.70), LI (0.64), FS (0.61), LB (0.58), HB (0.57), UHB (0.52), SB (0.51) and FL (0.44). High negative correlations was also found with GOT1 (-0.54). For LYPLT high positive correlations were found with SCYPLT (0.94), BS (0.89), LYP (0.83), PH (0.83), TBF (0.82), SCYP (0.76), SI (0.76), LI (0.75), FS (0.68), HB (0.59), SB (0.55), LB (0.53) and FL (0.52). It was negatively correlated with GOT1 (-0.44).

Ginning Out Turn (GOT)

GOT1 had significant positive correlation with FU (0.68) and GOT1 (0.44). It had strong negative correlations with LB (-0.93), FS (-0.90), SI (-0.82), LI (-0.82), FL (-0.82), SCYP (-0.76), PH (-0.73), TBF (-0.57), LYP (-0.56), SCYPLT (-0.54), BS (-0.53), HB (-0.52), and LYPLT (-0.44). GOT2 had positive correlation with UHB (0.64), GOT1 (0.44) and MC (0.41). It had high negative correlations with HB (-0.78), FL (-0.58), SCYP (-0.57), TBF (-0.57), SCYPLT (-0.56), FS (-0.55), LI (-0.48) and SI (-0.45).

Boll size (BS)

BS had significant positive correlation with PH (0.92), LYP (0.91), LYP (0.89), SI (0.85), LI (0.80), SCYPLT (0.78), TBF (0.75), SCYP (0.74), LB (0.68), UHB (0.68), FS (0.57), SB (0.45) and HB (0.43). It was negatively correlated with GOT1 (-0.53).

Seed Index (SI)

SI had one significant positive correlation with LI (0.98). However, there were also strong positive correlations found with PH (0.93), LB (0.93), SCYP (0.86), BS (0.85), SCYPLT (0.81). Some negative correlation were found with GOT1 (-0.82) and GOT2 (-0.45).

Lint Index (LI)

LI was significantly correlated with SI (0.98) and also had high positive correlations, though not statistically significant, with LB (0.94), PH (0.86), FS (0.83), SCYPLT (0.82), BS (0.80), SCYP (0.78), LYPLT (0.75), TBF (0.68), FL (0.65), LYP (0.64), HB (0.53). It had also negative correlations with GOT1 (-0.82) and GOT2 (-0.45).

Seed per boll (SB)

Significant high correlations were found with LYPLT (0.55), FU (0.53), LYP (0.51), UHB (0.46), BS (0.45), GOT1 (0.39), TBF (0.36), GOT2 (0.35) and SCYPLT (0.32). It was negatively correlated with SB (-0.33).

Locules per boll (LB)

There were significant positive correlation with LI (0.94), SI (0.93), FS (0.81), PH (0.80), SCYP (0.72), BS (0.68), FL (0.65), SCYPLT (0.61), LYP (0.58), TBF (0.55), LYPLT (0.53), HB (0.41). It had also high negative correlations with GOT1 (-0.93) and FU (-0.50).

Total bolls formed (TBF)

TBF had significant correlations with SCYP (0.97) and had also high positive correlations with HB (0.92), PH (0.89), SCYPLT (0.85), LYP (0.84), LYPLT (0.82), SI (0.76), BS (0.75), FS (0.69), LI (0.68), FL (0.56) and LB (0.55). It had strong negative correlations with GOT1 (-0.57) and GOT2 (-0.54).

Harvestable bolls (HB)

HB had significant positive correlations with TBF (0.92), SCYP (0.89), SCYPLT (0.74), PH (0.68), FS (0.66), FL (0.62), LYPLT (0.59), SI 0.59), LYP (0.57), LI (0.52), BS (0.43) and LB (0.41). Negative correlations were found with GOT2 (-0.78) and GOT1 (0.52).

Unharvestable bolls (UHB)

UHB had no outstanding genetic correlation with most of the characteristics except with GOT2 (0.68), LYP (0.52), SB (0.46), and LYPLT (0.47).

Plant Height (PH)

PH had significant positive correlations with SCYP (0.93), SI (0.93), LYP (0.92), BS (0.92), TBF (0.89), LI (0.86), LYPLT (0.83), SCYPLT (0.81), LB (0.80), HB (0.68), FL (0.54). It had a high negative correlation with GOT1 (-0.73).

Hair count (HC)

HC had low correlations with most of the characteristics. However, it had relatively high correlations with FU (0.70) and GOT1 (0.42) positively and FL (-0.41) and FS (-0.34) negatively.

Fibre Length (FL)

FL had significant positive correlations with FS (0.96), SCYP (0.68), SCYPLT (0.65), SI (0.65), LB (0.65), HB (0.62), TBF (0.56), PH (0.54) and LYPLT (0.52). It had also high negative correlations with GOT1 (-0.82), FU 0.72), GOT2 (-0.58) and MC (-0.48).

Fibre Strength (FS)

FS was significantly positively correlated with FL (0.96), LI (0.81), SCYP (0.81), LB (0.81), SI (0.79), SCYPLT (0.77), PH (0.74), TBF (0.69), LYPLT (0.68), HB (0.66) and LYP (0.61). High negative correlations were also found for GOT1 (-0.90), FU (-0.63) and GOT2 (-0.55).

Micronaire (MC)

MC had low correlation coefficients with most of the characteristics measured. However, some had relatively high correlations. This includes a positive correlation with GOT2 (0.41), and a negative correlation with FL (-0.48).

Fibre Uniformity (FU)

FU had also low correlation coefficients with the characteristics measured. Some had relatively high correlations found with it and they included: HC

(0.70), GOT1 (0.68) and SB (0.53) for positive correlations and FL (-0.72), FS (-0.63) and LB (-0.50) for negative correlations.

4.5.2.4 Loskop 1998/99 (P+F1s)

Genetic correlation coefficients are presented in Table 4.5.2.4.

Seed cotton yield

SCYP had a significant correlation with LYP (0.96). Other characteristics had large correlation coefficients with SCYP, though not statistically significant. The positive ones were FU (0.91), PH (0.84), HC (0.81), SCYPLT (0.75), TBF (0.65), LYPLT (0.56) and SI (0.54). Those with negative correlations were GOT1 (-0.49), SB (-0.44) and GOT2 (-0.42). SCYPLT had relatively high correlations with LYPLT (0.91), HC (0.84), PH (0.83), BS (0.77), LYP (0.76), SCYP (0.75), FU (0.69), TBF (0.61), LB (0.45), LI (0.44) and SI (0.42). Some negative correlations were found with FL (-0.32) and FS (-0.35).

Lint yield

LYP had significant correlations with SCYP (0.96), FU (0.84), HC (0.80), SCYPLT (0.76), PH (0.72), LYPLT (0.68), TBF (0.63), MC (0.59), and SI (0.41). Negative but relatively high correlations were found for FS (-0.52) and FL (-0.46). LYPLT had high positive correlations with SCYPLT (0.91), BS (0.87), HC (0.73), LYP (0.68), TBF (0.64), LI (0.62), LB (0.61), SCYP (0.56), PH (0.54) and FU (0.45). It had negative correlations with FL (-0.57) and FS (-0.54).

Ginning Out Turn (GOT)

GOT1 had significant positive correlation with GOT2 (0.96) and high positive correlation with SB (0.64), LI (0.51), LB (0.47) and MC (0.46). It had relatively high negative correlations with PH (-0.63), SI (-0.52), FU (-0.50), SCYP (-0.49), FL (-0.46) and FS (-0.37). GOT2 was significantly correlated with GOT1 (0.96) and were high positively correlated with MC (0.53), SB (0.48) and LI (0.47). It also had relative high negative correlations with PH (-0.60), FL (-0.49), SCYP (-0.43), SI (-0.43) and FS (-0.38).

Boll size (BS)

BS had relatively significant positive correlation with LB (0.89), LYPLT (0.87), SCYPLT (0.77), LI (0.70), SB (0.54), PH (0.42) and HC (0.41). No negative correlations were observed.

Seed Index (SI)

SI had relatively high positive correlations with PH (0.74), FU (0.69), SCYP (0.54), FS (0.52), FL (0.50), SCYPLT (0.42) and LYP (0.41). Relatively high negative correlation were found for SB (-0.76), GOT1 (-0.53), HB (-0.53) and GOT2 (-0.43).

Lint Index (LI)

LI had significant positive correlation with LB (0.81), BS (0.70), LYPLT (0.62), GOT1 (0.51), GOT2 (0.47) and SCYPLT (0.44). It was negatively correlated with HB (-0.56).

Seeds per boll (SB)

SB had relatively high significant positive correlations with GOT1 (0.64), BS (0.54), LB (0.52), GOT2 (0.48) and HB (0.47). Negative correlations were found for SI (-0.76), FU (-0.56), FL (-0.55), SCYP (-0.44), PH (-0.43) and FS (0.42).

Locules per boll (LB)

LB had significant high correlation with BS (0.89), LI (0.81), LYPLT (0.61), SB (0.52), GOT1 (0.47) and SCYPLT (0.45). No relatively high negative correlations were observed.

Total bolls formed (TBF)

TBF had significant high correlations with HC (0.94), HB (0.79), SCYP (0.64), LYP (0.64), SCYPLT (0.61), LYPLT (0.57), UHB (0.48) and PH (0.42). Relatively high negative correlations were observed for FL (-0.64) and FS (-0.63).

Harvestable bolls (HB)

HB had low correlation values with most of the characteristics. It had relatively positive correlations with TBF (0.79) and HC (0.65). Relatively high negative correlations were found for FS (-0.69), FL (-0.66), LI (-0.56), SI (-0.53) and SB (-0.47).

Unharvestable bolls (UHB)

UHB had low correlation values with all the characteristics measured, except with TBF (0.48).

Plant Height (PH)

PH had significant high positive correlations with FU (0.92), SCYP (0.84), SCYPLT (0.82), SI (0.74), LYP (0.72), HC (0.66), LYPLT (0.54), BS (0.42) and TBF (0.42).

Hair count (HC)

Significant high correlations were found with TBF (0.94), SCYPLT (0.84), SCYP (0.81), LYP (0.80), LYPLT (0.73), PH (0.66), HB (0.65), FU (0.57) and BS (0.41). It also had relatively high negative correlations with FS (-0.60), FL (-0.56), GOT1 (-0.37) and GOT2 (-0.35).

Fibre Length (FL)

Two of the characteristics measured had relatively high positive correlations with FL and those were FS (0.98), which was significant and SI (0.50). Some characters with relatively high negative correlations with FL included TBF (-0.66), MC (-0.60), LYPLT (-0.57), HC (-0.56), SB (-0.55), GOT2 (-0.49), LYP (-0.46) and GOT1 (-0.46).

Fibre Strength (FS)

FS was significantly correlated with FL (0.98) and highly correlated with SI. It had relatively high negative correlations with HB (-0.69), TBF (-0.63), HC (-0.60), MC (-0.60), LYPLT (-0.54), LYP (-0.52) and SB (-0.42).

Micronaire (MC)

MC had significant positive correlation with LYPLT (0.59), GOT2 (0.53) and GOT1 (0.46). It had relatively high negative correlations with FS (-0.60), FL (-0.55) and UHB (-0.41).

Fibre Uniformity (FU)

FU had significant high positive correlation with PH (0.92), SCYP (0.91), LYP (0.84), SCYPLT (0.69), SI (0.69), HC (0.57) and LYPLT (0.45). It had relatively high negative correlations with SB (-0.56), GOT1 (-0.51) and GOT2 (-0.50).

Table 4.5.2.1 **Genetic correlation coefficients for various cotton agronomic and quality characteristics Diallel Experiment 1, 1997/98, Rustenburg**

	SCYP	SCYPLT	LYP	LYPLT	GOT1	GOT2	BS	SI	LI	SB	LB	TBF	HB	UHB	PH	HC	FL	FS	MC
Scyplt	0.1246																		
Lyp	0.9751*	0.0660																	
Lyplt	0.3614	0.8703	0.3957																
GOT1	0.6227	-0.4674	-0.4542	-0.3102															
GOT2	0.2844	-0.2852	0.4684	0.2115	0.466														
BS	-0.1813	0.0209	-0.1835	-0.0098	-0.1499	0.0305													
SI	-0.5499	0.4170	-0.6798	-0.0003	-0.2632	-0.7431	0.1912												
LI	-0.0859	-0.4910	-0.0067	-0.3142	0.1935	0.4321	0.8130	-0.281											
SB	-0.2804	0.7404	-0.3067	0.5789	-0.2086	-0.2328	0.6141	0.4901	0.1145										
LB	0.0550	0.8753	0.0316	0.8055	-0.2859	-0.1559	-0.2812	0.4489	-0.6747	0.4611									
TBF	-0.3535	0.7003	-0.4165	0.4223	-0.0292	-0.5207	-0.4318	0.5998	-0.8183	0.388	0.7852								
HB	0.4486	-0.0123	0.4399	0.0853	-0.0811	0.0546	-0.9401	-0.2544	-0.7444	-0.6744	0.3000	0.2602							
UHB	-0.6507	0.6290	-0.6993	0.3096	0.0431	-0.5026	0.3077	0.7155	-0.1777	0.8430	0.4711	0.6985	-0.509						
PH	-0.3006	0.2288	-0.4698	-0.2072	-0.3908	-0.8411	0.4137	0.5662	0.0196	0.4916	-0.1173	0.2334	-0.5169	0.5920					
HC	0.3974	0.1435	0.3745	0.1809	-0.2305	-0.006	0.2264	-0.4809	0.1961	0.2350	-0.2884	-0.2170	-0.2491	-0.0004	0.3742				
FL	0.1748	-0.0368	0.0330	0.2339	-0.6439	-0.4548	0.0976	0.5298	-0.0693	-0.1556	0.0739	-0.0857	0.1140	-0.1735	0.1969	-0.4872			
FS	-0.1825	-0.1404	-0.2319	-0.2401	-0.2846	-0.1269	0.8818	0.4418	0.6519	0.3074	-0.2271	-0.4192	-0.6698	0.1129	0.3079	-0.2638	0.6108		
MC	0.4910	-0.7288	0.5920	-0.3561	0.2427	0.653	-0.2746	-0.8541	0.2958	-0.8195	-0.5941	-0.7355	0.3953	-0.9447	-0.6401	0.0906	-0.1211	-0.2171	
FU	0.2609	-0.6040	0.4166	-0.1838	0.3607	0.8435	0.3186	-0.7751	0.7738	-0.3151	-0.6229	-0.8782	-0.2137	-0.6214	-0.5304	0.1968	-0.3032	0.1602	0.7684

Table 4.5.2.2 **Genetic correlation coefficients for various cotton agronomic and quality characteristics Diallel Experiment 2, 1997/98, Loskop**

	SCYP	SCYPLT	LYP	LYPLT	GOT1	GOT2	BS	SI	LI	SB	LB	TBF	HB	UHB	PH	HC	FL	FS	MC
Scyplt	0.9306																		
Lyp	0.9760*	0.9723*																	
Lyplt	0.8465	0.9859*	0.9385																
GOT1	0.0364	0.2099	0.2159	0.3327															
GOT2	-0.0036	0.3107	0.1965	0.4639	0.8145														
BS	0.5672	0.5309	0.5583	0.4731	0.1804	-0.0619													
SI	0.4207	0.2884	0.3735	0.2064	0.0942	-0.2854	0.9446												
LI	0.5365	0.5783	0.6351	0.6113	0.7413	0.4949	0.6596	0.569o											
SB	-0.2157	-0.1233	-0.2518	-0.153	-0.3636	-0.2377	0.3615	0.3165	-0.3402										
LB	0.0391	-0.0933	-0.069	-0.193	-0.391	-0.5258	0.6405	0.7358	0.104	0.518									
TBF	0.8416	0.8675	-0.8542	0.8468	-0.0299	0.2396	0.2357	0.0268	0.4468	-0.3982	-0.1102								
HB	0.8046	0.7596	0.7788	0.7159	-0.1382	0.055	0.0756	-0.0781	0.2751	-0.4902	-0.1593	0.9638*							
UHB	0.7551	0.9064	0.8357	0.9329	0.3235	0.5357	0.4446	0.1711	0.652o	-0.1785	-0.0494	0.8897	0.7363						
PH	-	-	-	-	-	-	-	-	-	-	-	-	-	-					
HC	0.9849*	0.9573	0.9774*	0.9058	0.0289	0.073	0.4642	0.2812	0.4607	-0.2103	-0.0853	0.8739	0.8378	0.7867	-				
FL	-0.2972	-0.5564	-0.456	-0.6684	-0.5972	-0.7975	0.0983	0.3524	-0.2911	0.1989	0.7652	-0.3766	-0.2622	-0.5415	-	-0.4167			
FS	0.4405	-0.6631	0.5664	-0.7222	-0.2348	-0.5134	-0.0222	0.2526	-0.0741	-0.106	0.5835	-0.4299	-0.3394	-0.542	-	-0.5697	0.8928		
MC	0.9029	0.8737	0.9265	0.8522	0.2216	0.1982	0.253o	0.0987	0.4771	0.4693	-0.3861	0.8049	0.799	0.6869	-	0.9317	-0.5679	-0.6027	
FU	0.8313	0.674	0.8108	0.6184	0.1667	-0.0624	0.2617	0.2342	0.4547	-0.5627	-0.2839	0.6153	0.6701	0.4187	-	0.8098	-0.3059	-0.3159	0.9198

*,** **Significant at 0.05 and 0.01 levels of probability, respectively**

Table 4.5.2.3 Genetic correlation coefficients for various cotton agronomic and qualityi characteristics Diallel Experiment 3, 1998/99, Rustenburg

	SCYP	SCYPLT	LYP	LYPLT	GOT1	GOT2	BS	SI	LI	SB	LB	TBF	HB	UHB	PH	HC	FL	FS	MC
Scyplt	0.8238																		
Lyp	0.8297	0.6970																	
Lyplt	0.7618	0.9446	0.8269																
GOT1	-0.7557	-0.5442	-0.5602	-0.4447															
GOT2	-0.5696	-0.5636	-0.0305	-0.2697	0.4449														
BS	0.7426	0.7823	0.9067	0.8912	-0.5256	-0.0489													
SI	0.8556	0.8149	0.7369	0.7584	-0.8242	-0.4486	0.8506												
LI	0.7817	0.8299	0.6396	0.7521	-0.8202	-0.4777	0.7994	0.9803*											
SB	0.1471	0.3238	0.5126	0.5538	0.385	0.3487	0.4512	-0.0356	-0.0986										
LB	0.7189	0.6120	0.5768	0.533	-0.9309	-0.3825	0.6825	0.9342	0.9378	-0.3284									
TBF	0.9665*	0.8528	0.8354	0.8168	-0.5664	-0.5427	0.746	0.7645	0.6808	0.3552	0.5478								
HB	0.8889	0.7366	0.5697	0.5946	-0.5183	-0.7792	0.4266	0.5906	0.5242	0.1343	0.4115	0.9150							
UHB	0.0510	0.2095	0.5229	0.4665	-0.0920	0.6362	0.6821	0.3432	0.3380	0.4591	0.3016	0.0494	-0.3532						
PH	0.9336	0.8121	0.9211	0.8314	-0.733	-0.3212	0.9214	0.9318	0.8579	0.2402	0.7974	0.8946	0.6832	0.3883					
HC	-0.1429	0.1834	-0.3303	0.0587	0.4200	-0.3492	-0.0234	0.0133	0.0576	0.0549	-0.1647	-0.0185	0.0298	-0.1487	-0.1262				
FL	0.6794	0.6487	0.435	0.5241	-0.8213	-0.5772	0.3365	0.5976	0.6498	-0.2035	0.6474	0.5610	0.6188	-0.1239	0.5373	-0.4092			
FS	0.8093	0.7717	0.6148	-0.6765	-0.9015	-0.5467	0.5715	0.7942	0.8239	-0.1265	0.8063	0.6910	0.6573	0.0677	0.7392	-0.3398	-0.9595		
MC	0.0886	-0.294	0.2939	-0.1663	-0.0582	0.4080	0.2645	0.1552	0.0020	0.0049	0.1743	0.0477	-0.1404	0.3425	0.2647	-0.1319	-0.4767	-0.2945	
FU	-0.1327	-0.0351	-0.056	-0.0172	0.6808	0.0661	0.0298	-0.2255	-0.3070	0.5281	-0.4962	0.0795	0.038	-0.200	-0.0945	0.6976	-0.7191	-0.6275	0.2827

** = P (0,05)

* = P (0,01)

Table 4.5.2.4 Genetic correlation coefficients for various cotton agronomic and qualityi characteristics
Diallel Experiment 4, 1998/99, Loskop

	SCYP	SCYPLT	LYP	LYPLT	GOT1	GOT2	BS	SI	LI	SB	LB	TBF	HB	UHB	PH	HC	FL	FS	MC
Scyplt	0.7533																		
Lyp	0.9573*	0.759																	
Lyplt	0.558	0.9114	0.6777																
GOT1	-0.4946	-0.2252	-0.2262	0.1798															
GOT2	-0.4304	-0.2878	-0.1595	0.1225	0.9626*														
BS	0.2185	0.7703	0.3217	0.8694	0.3036	0.1359													
SI	0.5414	0.4242	0.4104	0.2051	-0.5231	-0.4348	0.0837												
LI	0.1046	0.4391	0.2535	0.6233	0.5101	0.472O	0.7026	0.3963											
SB	-0.4402	0.0786	-0.274O	0.3459	0.6412	0.4775	0.5411	-0.757	0.1235										
LB	-0.1614	0.4504	-0.057O	0.6072	0.4746	0.3045	0.8873	0.0925	0.8119	0.5219									
TBF	0.6427	0.6135	0.638	0.5668	0.3428	-0.2752	0.1922	0.0448	-0.2175	0.0822	-0.2156								
HB	0.1947	0.2605	0.201	0.2495	-0.1667	-0.1916	0.0643	-0.5256	-0.5576	0.4669	-0.2789	0.7875							
UHB	0.7586	0.2605	0.7293	0.7284	-0.4132	-0.3813	0.4114	0.2998	0.0211	0.003O	0.0184	0.2385	0.6018						
PH	0.8449	0.8256	0.7177	0.5448	-0.0343	-0.6602	0.4169	0.7382	0.2397	-0.4317	0.1553	0.4305	-0.016O	0.6735					
HC	0.812	0.8377	0.8033	0.7301	-0.3728	-0.354O	0.4053	0.1975	-0.0213	0.0367	-0.0344	0.9383	0.6523	0.9772	0.6625				
FL	-0.2509	-0.3235	-0.4619	-0.5654	-0.4565	-0.4879	-0.2983	0.4959	-0.0548	-0.5546	-0.0098	-0.6364	-0.658O	-0.4766	0.1521	-0.5632			
FS	-0.3347	0.3456	-0.524	-0.5357	-0.3691	-0.3773	-0.2803	0.5203	0.0303	-0.4173	0.0554	-0.6319	-0.6932	-0.4751	0.0757	-0.5973	0.9762*		
MC	0.3916	0.1035	0.5917	0.2757	0.458	0.5282	0.0604	-0.1106	0.3142	-0.0356	-0.0865	0.0376	-0.099O	-0.0144	-0.0164	0.1367	0.5472	-0.5991	
FU	0.9144	0.6935	0.8355	0.4492	0.5148	-0.5004	0.2619	0.6916	0.2492	-0.5559	-0.0052	0.3075	-0.0366	-0.5187	0.9178	0.5685	0.0796	-0.0288	0.333O

** = P (0,05)

* = P (0,01)

4.5.3 Correlated response to selection

Narrow sense heritabilities, additive variances and genetic correlations were used in the calculation of the correlated response to selection, for all the characteristics measured and for each experiment. Calculated values are presented in appropriate tables for each experiment. Missing values in the tables are due to negative heritabilities obtained for some of the characteristics. Characteristics listed horisontal in the table are assumed to be those to which selection is applied.

4.5.3.1 Rustenburg 1997/98 (Parents + F1s)

The correlated responses are presented in Table 4.5.3.1.

Seed cotton yield

When selection is applied to SCYPLT, favourable response is obtained from TBF (5.85), LB (4.49), GOT2 (1.53) and HC (1.15). Selection for SCYPLT would increase these characteristics. When selection is applied for SCYPLT it would cause a decrease in all the fibre quality characteristics (FL, FS, MC and FU) and LI. UHB (2.92) shows a high correlated response with seed cotton yield. It will therefore be very difficult to increase yield without an increase in number of unharvested bolls.

Lint yield

Selection for LYPLT would have very little effect on characters like LB (0.59) and SCYPLT (0.31). Selection for lint yield would cause a decrease in most quality characteristics.

Ginning Out Turn (GOT)

No reasonable correlated response was found between GOT and the rest of the characters measured.

Boll size (BS)

Selecting for increased BS will also increase FL (0.41) and LI (0.34). HB (-0.25) will decrease with an increase in boll size.

Seed Index (SI)

Selecting for a higher SI will respond favourable with FL (2.12), MC (1.59), FS (1.45), LB (1.26), TBF (0.76), BS (0.59) and SCYPLT (0.57). This however will result in a decrease in GOT (-2.19) and HC (-2.10). Reduction in HC would be preferable depending on the initial level of hairiness, prevalence of insect pests, especially jassids, and the need for high grade cotton in case of machine harvesting.

Lint Index (LI)

Selection for LI did not appear to have favourable response with the other characteristics except some relatively low response it had with BS (0.37) and FS (0.31). The rest of the responses were either very low or negative.

Seeds per boll (SB)

The correlated response for SB was relatively low for BS (0.66), MC (0.55), LB (0.47), FS (0.38), HC (0.37) and SCYPLT (0.37). It had a decreasing effect on FL (-0.23).

Locules per boll (LB)

There was no significant response with the rest of the characteristics.

Total bolls formed (TBF)

TBF had a relatively low response with LB (0.61), FS (0.38), BS (0.38) and SCYPLT (0.26). It will also cause a reduction in FU (0.94), GOT (-0.60) and MC (-0.38).

Harvestable bolls (HB)

No significant correlated response was found between HB and the rest of the characters measured. It had a large negative response with BS (-0.92), probably with the implication that the less the number of bolls per plant, the larger the size of the boll.

Unharvestable bolls (UHB)

UHB had a moderate response with GOT (0.78), LB (0.70), HB (0.59) and PH (0.55).

Plant height (PH)

Plant height had a large correlated response with LB (4.58), HC (2.46), UHB (2.27), BS (1.93), FS (1.52), HB (1.49) and also some reasonable response with SCYPLT (0.47). The large response with UHB implies late prolification of bolls at the top sympodia which do not mature within the growing season. There is also an improvement on HB which will improve the yield. The negative response for GOT (-3.74) implies that selection for reduced PH would improve GOT.

Hair count (HC)

HC had a large correlated response with FL (9.37), BS (3.36), PH (3.19), and LI (2.74). It also had a moderate response with SCYPLT (0.95) and MC (0.82). Large negative responses were observed for FS (-4.16), LB (-3.90) and HB (-2.29). The negative response for HB appears to cancel the positive response for BS, again implying that the larger the bolls, the fewer the HB.

Fibre Length (FL)

The correlated response between FL and the rest of the characteristics was very low. The only exceptions were HC (0.72) and FS (0.68). Therefore selection for FL will not affect most of the other characters.

Fibre strength (FS)

Most of the characters have low responses with FS. The only exceptions were BS (0.65), FL (0.58) and LI (0.45).

Micronaire (MC)

The correlated response between MC and the rest of the characters measured was non-significant.

Fibre Uniformity (FU)

Selection for FU had low correlated response for almost all the characteristics measured.

Table 4.5.3.1 Correlated response (CRY) among various cotton agronomic and quality characteristics

Diallel Experiment 1 Rustenburg 1997/98

	SCYP	SCYPLT	LYP	LYPLT	GOT1	GOT2	BS	SI	LI	SB	LB	TBF	HB	UHB	PH	HC	FL	FS	MC	FU
Scyp	1	x	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Scyplt	x	1	X	0.31	-0.27	-0.12	X	0.57	-0.1	0.37	0.04	0.26	-0.01	0.45	. 0.47	0.95	-0.02	-0.05	-0.04	-0.02
Lyp	x		1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Lyplt	x	0.72	X	1	-0.06	0.03	X	X	-0.02	0.1	0.01	0.05	0.01	0.07	-0.14	0.4	0.04	-0.03	-0.01	0
GOT1	x		X	X	1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
GOT2	x	1.53	X	0.16	0.58	1	0.01	-2.19	0.19	-0.25	0.01	-0.6	0.05	0.78	-3.74	-0.09	-0.46	-0.09	0.08	0.07
BS	x	0.12	X	-0.01	-0.2	0.03	1	0.59	0.37	0.66	-0.03	0.37	-0.92	0.5	1.93	3.36	0.1	0.65	-0.04	0.03
SI	x		X	X	X	X	X	1	X	X	X	X	X	X	X	X	X	X	X	X
LI	x	-2.6	X	-0.24	0.24	0.38	0.34	-0.82	1	0.12	-0.04	-0.66	-0.69	-0.27	0.09	2.74	-0.07	0.45	0.04	0.07
SB	x	x	X	X	X	X	X	X	X	1	X	X	X	X	X	X	X	X	X	X
LB	x	4.49	X	0.59	-0.34	-0.13	-0.4	1.26	-0.28	0.47	1	0.61	0.27	0.7	4.58	-3.9	0.08	-0.15	-0.07	-0.05
TBF	x	5.85	X	0.14	-0.02	0.2	-0.08	0.76	-0.15	0.18	0.03	1	0.1	0.47	0.45	-1.33	-0.04	0.13	-0.04	-0.03
HB	x	-0.04	X	0.04	-0.07	0.03	-0.25	-0.48	-0.21	-0.47	0.02	0.14	1	0.59	1.49	-2.29	0.07	-0.3	0.03	-0.01
UHB	x	2.92	X	0.21	0.05	-0.39	0.11	1.82	-0.07	0.78	0.04	0.49	-0.41	1	2.27	X	-0.15	0.07	-0.1	-0.05
PH	x	0.74	X	-0.1	-0.29	0.45	0.1	1	0.01	0.32	-0.01	0.11	-0.29	0.55	1	3.19	0.12	0.13	-0.05	-0.03
HC	x	1.15	X	0.21	-0.42	-0.01	0.14	-2.1	0.13	0.37	-0.04	-0.26	-0.34	X	2.46	1	-0.72	-0.21	0.02	0.03
FL	x	-1.28	X	0.25	-1.09	-0.55	0.06	2.12	-0.04	-0.23	0.01	-0.1	0.01	-0.36	1.19	9.37	1	0.58	0.02	-0.04
FS	x	-0.84	X	-0.21	-0.39	-0.13	0.41	1.45	0.31	0.38	-0.02	0.38	-0.69	0.19	1.52	-4.16	0.68	1	-0.03	0.02
MC	x	-0.25	X	-0.17	0.19	0.37	-0.07	1.59	0.08	0.55	-0.02	-0.38	0.23	-0.92	-1.79	0.82	-0.08	-0.1	1	0.04
FU	x	-0.35	X	-0.02	0.05	0.08	0.01	0.25	0.04	0.04	-0.01	-0.94	-0.02	-0.1	-0.25	0.3	-0.03	0.01	0.01	1

4.5.3.2 Loskop 1997/98 (Parents | F1s)

Correlated responses are presented in Table 4.5.3.2.

Seed cotton yield

Selection for SCYP shown a positive response for most of the characteristics except FS (-O.62), FL (-42,89) and GOT (0.61). The largest correlated response was for MC (125.58), TBF (121.60), PH (116.83), SCYPLT (116.19), LYPLT (115.67), HB (96.16), LI (73.72) and BS (62.68). Selection for SCYPLT had a favourable response for HC (11.65), LYPLT (9.48), TBF (9.01), MC (8.74), UHB (7.52), HB (6.53), LI (-5.71) and FU (5.53). An increase in SCYPLT cause a decrease in FL.

Lint yield

Selection for LYP will cause a large response for HC (58.90), SCYPLT (48.25), MC (45.96), TBF (43.97), UHB (33.48), HB (33.17), LI (31.08) and BS (21.99). Large increases for these characteristics can be achieved through indirect selection for LYP. Negative correlated responses were only recorded for FL (-23.53) and LB (-0.69). Selection for LYPLT caused an increase in HC (4.79), SCYPLT (3.84), TBF (3.82), MC (3.70), UHB (3.27), FL (3.01), HB (2.67), LI (2.62) and GOT (2.20). Appreciable increases were also recorded for BS (1.63), LYP (1.46) and SCYP (1.45).

Ginning Out Turn (GOT)

GOT was highly correlated with LI (0.91) and FL (0.77). GOT2 was highly correlated with FL (1.21) and moderately correlated with LI (0.72), LYPLT (0.65) and TBF (0.36). Selecting for increased GOT will have a decreasing effect on FS (-0.76).

Boll size (BS)

The correlated response between boll size and the rest of the characters were relatively low.

Seed Index (SI)

Selection for SI did not have a large correlated response with most of the characteristics. There was, however, relatively moderate responses for some boll components. The largest was BS (0.76) followed by LB (0.61), LI (0.57) and FL (0.37).

Lint Index (LI)

Selection for LI generally had a low correlated response but a notable response came from LYPLT (0.56), HC (0.36), GOT (0.34) and BS (0.33).

Seed per boll (SB)

Applying selection for SB had relatively moderately correlated response from mainly within - boll components, such as LB (0.61), LI (0.48), BS (0.41), GOT (0.37) and SI (0.35).

Locules per boll (LB)

LB showed very low correlated responses with the remaining characteristics.

Total bolls formed (TBF)

TBF had relatively high correlated response with most of the characteristics. The highest responses was with HC (2.47) followed by LYPLT (1.89), MC (1.87), SCYPLT (1.81), UHB (1.67) and LI (1.03). TBF was negatively correlated with fibre quality characteristics; FS (-0.01) and FL (-0.09), TBF had a large positive response from UHB and a negative one for HB (-0.77). This implies that selection against high UHB would improve HB.

Harvestable bolls (HB)

Harvestable bolls had good correlated responses with HC (1.46), HC (1.15), LYPLT (0.99), SCYPLT (0.94), UHB (0.85) and FU (0.79). There was a negative response for TBF (-0.57), FS (-0.49) and FL (-0.39).

Unharvestable bolls (UHB)

UHB had very moderate correlated responses with HC (0.87), TBF (0.84), LYPLT (0.82), SCYPLT (0.74) and MC (0.70). It was negatively correlated with FL (0.57) and FS (0.56).

Hair count (HC)

Applying selection on hair count had relatively large positive correlated response from most of the characteristics measured, except FS (-8.68) and FL (6.5). Extremely large positive correlated responses were obtained for MC (14.02), TBF (13.65), LYPLT (13.10), SCYPLT (12.91), HB (10.82).

Fibre Length (FL)

Selection for increased FL shown moderate correlation response with FS (0.94), GOT (0.90), LYPLT (0.67) and LB (0.65). Responses for the other characteristics were either very low or negative.

Fibre strength (FS)

Like FL, most of the characteristics had either a low or negative correlated response. Relatively moderate responses were recorded for FL (0.79), SCYPLT (0.50) and LB (0.41).

Micronaire (MC)

MC had low correlated response for most of the characteristics. Appreciable responses was recorded for HC (0.30), LYPLT (0.22) and SCYPLT (0.21).

Fibre Uniformity (FU)

FU was moderate correlated with MC (0.80), TBF (0.56), SCYPLT (0.53), LYPLT (0.52) and HB (0.50). An increase in FU resulted in a reduction of FL (-0.28) and FS (-0.28).

Table 4.5.3.2 Correlated response (CRY) among various cotton agronomic and quality characteristics

Diallel Experiment 2 Loskop 1997/98

	SCYP	SCYPLT	LYP	`LYPLT	GOT1	GOT2	BS	SI	LI	SB	LB	TBF	HB	UHB	HC	FL	FS	MC	FU
Scyp	1	.3.58	18.67	1.45	0.02	-	0.09	0.16	0.13	-0.12	-	0.75	0.04	0.26	5.7	-0.12	0.1	0.09	0.28
Scyplt	116.19	1	48.25	3.84	0.23	0.41	0.19	0.26	0.33	-0.16	-0.01	1.81	0.94	0.74	12.91	-0.52	0.5	0.21	0.53
Lyp	48.87	3.49	1	1.46	0.1	0.1	0.08	0.14	0.14	-0.13	0	0.71	0.4	0.27	5.27	-0.17	0.16	0.09	0.25
Lyplt	115.67	9.48	4.48	1	0.4	0.65	0.18	0.2	0.56	-0.21	-0.02	1.89	0.99	0.82	13.1	0.67	-0.59	0.22	0.52
GOT1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOT2	-0.61	3.39	10.64	2.2	1.11	1	-0.03	0.23	0.34	-0.37	-0.07	0.61	0.09	0.53	1.2	0.9	-0.47	0.06	-0.06
BS	62.68	.4.42	.21.99	-1.63	0.1	-0.07	1	0.76	0.33	0.41	0.1	0.43	-0.09	0.32	5.55	0.08	-0.01	0.02	0.18
SI	46.54	2.29	14.74	0.69	0.09	0.23	0.3	1	0.29	0.36	0.07	0.05	0.09	0.12	3.36	0.29	0.17	0.02	0.16
LI	73.72	5.71	31.08	2.62	0.91	0.72	0.26	0.57	1	0.48	0.01	1.03	1.39	0.59	6.84	-0.3	-0.84	0.12	0.39
SB	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
LB	4.45	-0.76	-0.27	-0.69	-0.4	-0.63	0.21	0.61	0.05	0.61	1	0.21	-0.18	0.04	-1.05	0.65	0.41	-0.08	-0.2
TBF	121.6	9.01	43.97	3.82	0.04	0.36	0.1	0.03	-0.29	-0.59	-0.01	1	-0.57	0.84	13.65	-0.41	-0.38	0.22	0.56
HB	96.16	6.53	33.17	2.67	-0.15	0.01	0.03	0.07	0.15	-0.61	-0.02	-0.77	1	0.57	10.82	-0.23	-0.25	0.18	0.5
UHB	84.8	7.52	33.48	3.27	0.33	0.63	0.14	0.14	0.33	-0.21	0	1.67	0.85	1	9.56	-0.46	-0.37	0.15	0.29
PH	116.83	11.65	58.9	4.79	0.04	0.13	0.22	0.35	0.36	0.37	-0.01	2.47	1.46	0.87	1	-0.53	-0.59	0.3	0.44
HC	-42.89	-5.77	-23.53	3.01	0.77	1.21	0.04	0.37	-0.19	0.3	0.09	-0.09	-0.39	-0.57	-6.51	1	0.79	-0.16	-0.28
FL	-62.11	0.71	27.01	-2.18	-0.3	-0.76	-0.01	0.26	-0.05	-0.15	0.07	-1.01	-0.49	-0..56	-8.68	0.94	1	-0.16	-0.28
FS	125.58	8.74	45.96	3.7	0.28	0.29	0.1	0.1	0.3	-0.68	-0.04	1.87	1.15	0.7	14.02	-0.59	-0.51	1	0.8
MC											-	-							1
FU	94.82	5.53	32.99	2.2	0.02	-0.07	0.08	0.2	0.24	-0.67	-0.63	1.17	0.79	0.35	10	-0.26	-0.22	0.2	

4.5.3.3 Rustenburg 1998/99 (Parents + F1s)

Correlated responses are presented in Table 4.5.3.3

Seed cotton yield

The correlated response between SCYPLT and SI (12.97), BS (11.16), LYPLT (9.16), FL (8.07) and FS (6.78) were very large. SCYPLT had a negative response with GOT (-9.60) and MC (-4.20).

Lint Yield

Lint yield had positive responses with BS (5.20), SI (4.93), SCYPLT (3.53), FL (3.15), FS (2.43), UHB (1.63), HB (1.38) and PH (1.24). It had negative responses with GOT (-1.88) and MC (-0.97).

Ginning Out Turn (GOT)

Selection for GOT did not have positive response with other characteristics. Relatively small and positive response was obtained for MC (0.61) and UHB (0.58). It had a negative response with SI (-0.75), HC (-0.63) and SCYPLT (-0.54).

Boll size (BS)

Selecting for BS had a positive response with SI (0.58), LYPLT (0.37) and SCYPLT (0.31). The response between BS and the remaining characteristics was very low.

Seed Index (SI)

A relatively small positive response was found between SI and BS (0.82), GOT (0.51), SCYPLT (0.5), LYPLT (0.49) and FL (0.48). The rest of the responses were even lower,

Lint Index (LI)

Lint index had a low correlated response with most of the characteristics. Only BS (0.48), SI (0.35), SCYPLT (0.23) and LYPLT (0.23) had a relatively moderate correlated response. FS (0.22) and FL (0.21) have shown very low correlated response. A small negative response was observed between LI and GOT (-0.25).

Harvestable bolls (HB)

A relatively large positive correlated response, was found between HB and SI (0.81), LYPLT (0.69), FL (0.64), SCYPLT (0.58), BS (0.53), FS (0.50). An increase in HB caused a decrease in UHB (-0.27), which was relevant to increasing yield indirectly. It also decreases GOT (-1.15) and MC (-0.17).

Unharvestable bolls (UHB)

Low correlated response was obtained for most of the characteristics when selection was on the higher side of UHB. Since UHB has a negative contribution to yield, selection for reduced UHB would be appropriate.

Plant Height (PH)

Selection for PH had large correlated response with most of the characteristics measured. The largest response was with SI (2.24) followed by BS (1.98), LYPLT (1.22), SCYPLT (1.12), FS (0.97), FL (0.96), HB (0.58) and MC (0.57).

Hair count (HC)

A large correlated response was found between HC and FU (14.29), SCYPLT (2.57), UHB (2.01) and LYPLT (0.58). It had a negative correlated response with GOT (-9.11), FL (-7.46), FS (-4.58), which implies selecting for low MC will improve these characteristics.

Fibre Length (FL)

Selection for FL had generally low correlated response with most of the characteristics. Relatively moderate and positive response was observed with GOT (0.60), SI (0.58), FS (0.51). Selection for FL caused a decrease FU (-0.59), HC (-0.43) and MC (-0.42).

Fibre Strength (FS)

A generally low correlated response was found between FS and the other characteristics. Positive response was observed for SI (0.4), FL (0.40), and BS (0.26). An increase in FS causes a decrease in GOT (-0.33), FU (-0.29) and MC (-0.15).

Micronaire (MC)

Very low correlated response was found between MC and the remaining characteristics.

Fibre Uniformity (FU)

A low response was found between FU and the remaining characteristics.

.Table 4.5.3.3 Correlated response (CRY) among various cotton agronomic and quality characteristics

Diallel Experiment 3 Rustenburg 1998/99

	SCYP	SCYPLT	LYP	LYPLT	GOT1	GOT2	BS	SI	LI	SB	LB	TBF	HB	UHB	PH	HC	FL	FS	MC	FU
Scyp	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Scyplt	-	1	-	3.53	-	-0.54	0.31	0.5	0.23	-	-	-	0.58	0.09	1.12	2.57	0.38	0.25	-0.03	-0.02
Lyp	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lyplt	-	9.16	-	1	-	-0.27	0.37	0.49	0.23	-	-	-	0.69	0.21	1.22	0.59	0.38	0.23	-0.02	0.01
GOT1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOT2	-	-9.6	-	-1.88	-	1	-0.04	-0.51	-0.25	-	-	-	-1.15	0.49	-0.82	-9.11	0.6	-0.33	0.07	0.07
BS	-	11.16	-	5.2	-	-0.07	1	0.82	0.35	-	-	-	0.53	0.44	1.98	-0.5	0.29	0.26	0.04	0.03
SI	-	12.97	-	4.93	-	-0.75	0.58	1	0.48	-	-	-	0.81	0.25	2.24	-0.32	0.58	0.44	0.03	-0.24
LI	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
SB	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
LB	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
TBF	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
HB	-	2.18	-	1.38	-	-0.46	0.1	0.23	0.09	-	-	-	1	-0.09	0.58	0.26	0.21	0.13	0.01	0.01
UHB	-	1.84	-	1.68	-	0.58	0.26	0.2	0.09	-	-	-	-0.27	1	0.51	2.01	0.02	0.02	0.25	-0.01
PH	-	2.97	-	1.24	-	-0.12	0.14	0.23	0.1	-	-	-	0.22	0.06	1	-0.71	0.12	0.09	0.01	-0.02
HC	-	3.15	-	0.41	-	-0.63	-0.02	-0.02	0.03	-	-	-	0.04	-0.12	-0.33	1	-0.43	-0.21	-0.02	0.8
FL	-	8.07	-	3.15	-	0.07	0.17	0.48	0.21	-	-	-	0.64	0.07	0.96	-7.42	1	0.4	-0.06	-0.57
FS	-	6.78	-	2.43	-	-0.5	0.21	0.27	0.22	-	-	-	0.5	0.03	0.97	-4.58	0.51	1	-0.03	-0.37
MC	-	-4.2	-	-0.97	-	0.61	0.16	0.15	0	-	-	-	-0.17	0.22	0.57	-2.89	-0.42	-0.15	1	0.27
FU	-	-0.47	-	0.09	-	0.09	0.02	-0.2	-0.13	-	-	-	0.04	-0.01	-0.19	14.29	-0.59	-0.29	0.04	1

4.5.3.4 Loskop 1998/99 (Parents & F1)

Correlated responses are presented in Table 4.5.3.4

Seed cotton yield

Large correlated responses were found between SCYP and the other characteristics. Those with the largest response were PH (285.54), FU (258.81), UHB (233.94), HC (213.01), LYP (187.03), SI (182.97), TBF (168.34) and SCYPLT (101.83). There was negative response (decrease) of GOT (-181.78) for GOT1 and (163.64) for GOT2 and SB (-74.39). When selection is applied to SCYPLT, the largest correlated response will be found with TBF (21.48), HC (4.54), PH (3.73), FU (2.62), SCYP (2.17), SI (1.92), BS (1.87), LYP (1.66), LI (1.61), LYPLT (1.54). it causes a decrease in GOT, (-1.46) for GOT2 and (-1.11) for GOT1. Selection for SCYPLT appears to have been more effective then selection for SCYP.

Lint yield

Selection for LYP had large correlated response with HC (112.41), PH (83.69), FU (81.60), UHB (77.61), SCYP (71.17), TBF (57.66), SI (47.86), FL (38.38). A decrease in response to selection for high LYP, was recorded for GOT, (-28.69) for GOT1 and (-20.16) for GOT2. When selection will be applied on LYPLT, large correlated response will be found for HC (1.54), UHB (1.17), PH (0.95), LI (0.89), BS (0.82), TBF (0.77), FL (0.71) and FU (0.66). Response from GOT was positive though low. Selection for LYPLT appears to be more effective then selection for LYP.

Ginning Out Turn (GOT)

Selection for GOT1 will have an increasing effect on FU (0.78), LI (0.75), BS (0.69), FL (0.59) and SB (0.58). Response with most of the characteristics were negative. GOT2 was negatively correlated with all the characteristics except with LI (0.63), BS (0.12) and LYPLT (0.08). Selection for GOT did not appear to be effective.

Boll size (BS)

Boll size had a positive response with all the characteristics. The largest responses was with HC (0.16), LI (0.13), UHB (0.12) and GOT (0.11).

Seed Index (SI)

The correlated response between SI and the remaining characteristics was very low.

Lint Index (LI)

Very low correlated responses was found between lint index and the other characteristics.

Seeds per boll

Possitive correlated response was found between SB and FL (0.92), LI (0.88) and GOT1 (0.76). It had a negative correlated response with SI (-0.82).

Locules per boll (LB)

There were very low correlated responses for most of the characteristics, except for SCYPLT (0.23).

Total bolls formed (TBF)

TBF was positively correlated with HC (3.58), UHB (2.73), FL (1.44), PH (1.34), SCYP (1.30) and LYP (1.17). There was a negative response with GOT, (-1.19) for GOT1 and (-0.99) for GOT2.

Harvestable bolls (HB)

Low response was found for all the other characteristics. Moderate response was found with HC (0.40) and PH (0.28).

Unharvestable bolls (UHB)

High correlated response was found with HC (20.32), PH (8.70, TBF (3.06), SCYP (2.04), LYP (0.77) and LYPLT (1.15). There was high negative correlation with GOT (-10.51) for GOT2 and (-1.59) for GOT1.

Plant Height (PH)

PH had a high positive correlated response with HC (71.26), FU (10.88), SI (10.45), SCYP (7.62), LYP (5.84), SCYPLT (4.67), TBF (4.61), BS (3.17) and SB (3.06). A large negative response was also found with GOT, (-10.51) for GOT2 and (-9.79) for GOT1.

Hair count (HC)

HC had a positive correlated response with PH (18.11), TBF (16.57), SCYP (11.80), FU (10.85), LYP (10.52), FL (9.14), SCYPLT (7.64), LYPLT (6.58), BS (4.96), SI (4.56) and HB (3.90). A large negative response was found with GOT (-9.97) for GOT2 and (-9.24) for GOT1.

Fibre Length (FL)

Very low correlated response was found between fibre length and the rest of the characteristics.

Fibre Strength (FS)

The response between fibre strength and the rest of the characters was very low.

Micronaire (MC)

There were very low responses between MC and the rest of the characters.

Fibre Uniformity (FU)

A high positive correlated response was found between FU and PH (1.03), UHB (0.92), SI (0.78), HC (0.76), SCYP (0.65), GOT (0.55) for GOT1 and (0.63) for GOT2 and LYP (0.54).

There is evidence that correlated response to selection can be used to improve several characteristics simultaneously by applying selection on one characteristic. Cotton yield can, for example be improved or increased when one selects for SI, TBF, HB, LI, BS and HC. Generally fibre quality characteristics had low or negative response when selection was applied to yield or yield components. They were: SCYPLT, LYPLT, GOT, BS, LI, SB, TBF and HB. Environmental effects was also evident as responses varied from location to location, as well as from year to year.

Table 4.5.3.4 Correlated response (CRY) among various cotton agronomic and quality characteristics

Diallel Experiment 4 Loskop 1998/99

	SCYP	SCYPLT	LYP	LYPLT	GOT1	GOT2	BS	SI	LI	SB	LB	TBF	HB	UHB	PH	HC	FL	FS	MC	FU
Scyp	1	2.17	71.17	0.62	-0.57	-0.45	0.05	0.31	-0.08	-0.31	0.01	1.3	0.06	2.04	7.62	11.8	0.12	0.12	0.03	0.65
Scyplt	101.58	1	35.4	0.64	-0.16	-0.19	0.1	0.15	0.09	0.03	0.23	0.78	0.05	0.14	4.67	7.64	0.1	0.08	0	0.31
Lyp	187.03	1.66	1	0.68	-0.24	-0.15	0.06	0.21	0.07	0.17	-0.01	1.17	0.06	1.77	5.84	10.52	0.2	0.17	0.04	0.54
Lyplt	70.72	1.54	29.64	1	0.12	0.08	0.11	0.07	0.12	0.14	0.02	0.58	0.05	1.15	2.89	6.58	0.16	0.12	0.01	0.2
GOT1	-181.78	-1.11	-28.69	0.34	1	1.72	0.11	-0.51	0.27	0.76	0.03	-1.19	-0.09	-1.59	-9.79	-9.24	0.38	0.23	0.05	0.55
GOT2	-163.64	-1.46	-20.93	0.25	1.97	1	0.05	-0.24	0.26	-0.58	-0.02	0.99	-0.11	-10.51	-10.51	-9.07	-0.42	-0.24	0.07	-0.63
BS	39.64	1.87	20.16	0.82	0.69	0.12	1	0.04	0.12	0.32	0.03	0.32	0.04	0.93	3.17	4.96	0.12	0.09	0	0.16
SI	182.97	1.92	47.86	0.36	-0.95	-0.72	0.03	1	0.19	-0.82	0.01	0.14	-0.26	1.26	10.45	4.5	0.38	0.3	0.01	0.78
LI	28.72	1.61	24.02	0.89	0.75	0.63	0.13	0.29	1	0.88	0.04	-0.56	0.1	0.02	2.76	0.39	0.03	0.01	0.03	0.23
SB	-74.39	1.18	-15.98	0.3	0.58	-0.39	0.09	-0.34	0.03	1	0.02	0.13	0.12	0.01	3.06	0.42	0.21	0.12	0	-0.31
LB	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
TBF	168.34	21.48	57.66	0.77	-0.48	-0.35	0.05	0.03	-0.08	0.07	-0.01	1	0.01	3.06	4.61	16.57	-0.38	0.03	0	0.27
HB	17.29	0.31	6.15	0.11	-0.08	-0.08	0.01	-0.12	-0.07	0.13	0	0.03	1	0.67	0.06	3.9	-0.13	0.1	0	-0.01
UHB	233.94	1.07	77.61	1.17	-0.68	-0.57	0.12	0.25	0.01	0	-0.06	2.73	0.28	1	1.42	2.47	-0.71	-	-	0.92
PH	285.54	3.73	83.69	0.95	-1.15	-1.09	0.11	0.66	0.12	0.47	0.01	1.34	0.01	8.7	1	18.11	0.12	0.09	0	1.03
HC	213.01	4.54	112.41	1.54	-0.81	-0.7	0.16	0.21	0.01	0.04	0.01	3.57	0.4	20.32	71.26	1	0.52	0.41	0.02	0.76
FL	60.02	1.04	38.38	0.71	0.59	-0.57	0.07	0.32	0.02	0.92	-	1.44	-0.24	-0.46	1.53	9.14	1	1.31	0.04	0.06
FS	-	-	-	-	-	-	-	-	-	-	-	-	-	-0.25	-	-	-	1	-	-
MC	-	-	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	-	1	-
FU	258.81	2.62	81.6	0.66	0.78	-0.69	0.07	0.1	0.1	-0.51	-	0.82	-0.02	0.53	10.88	10.85	0.05	-0.01	0.03	1

4.6 Heterosis

Mid-parent and high parent heterosis were calculated for all the characteristics measured. Estimated values are presented in Tables 4.6.1. to 4.6.4.

4.6.1 Rustenburg 1997/98 (P+F1s)

Estimated values for all the characteristics are presented in Table 4.6.1.

Seed cotton yield

Heterosis for SCYP was positive for all the crosses, both based on mid-parent and higher parent means. Eight crosses had values for mid-parent heterosis, over 100% with the best being SicalaxIrco (172.69%) and followed by OR27XIrco (159.63%), DPAc90xIrco (139.85%), 2131-2-5xIrco (131.90%), PalalaxIrco (117.00%), DPAc90xOR27 (114.28%), SicalaxDPAc90 and SicalaxOR27 (108.83%).

Nine of the crosses had over 50% higher parent heterosis, the highest being from SicalaxIrco (138.83%). This was followed by DPAc90xOR27 (138.31%), OR27xIrco (118.41%), SicalaxOR27 (99.22%), DPAc90xIrco (97.99%), DPAc90xSicala (94.20%), 2131-2-5xPalala (69.45%), 2131-2-5xIrco (65.23%) and PalalaxIrco (53.07%).

Heterosis for SCYPLT mid-parent values were positive except for two of the crosses which had negative values. The best cross was DPAc90xOR27 (93.75%) and was followed by SicalaxOR27 (65.42%), DPAc90xPalala (48.30%) DPAc90xIrco (46,42%), PalalaxIrco (42,32%) and OR27xPalala (37.76%). Ten out of 15 crosses had positive higher parent heterosis for SCYPLT. The highest was for DPAc90xOR27

(88.33%) followed by PalalaxIrco (40.22%), SicalaxOR27 (33.91%) and DPAc90xPalala (31.03%).

For both SCYP and SCYPLT, the best cross for mid-parent heterosis was also the best for higher parent heterosis.

Lint yield

Mid-parent heterosis values for LYP were all positive. Eight of the crosses had values well over 100% and the highest was SicalaxIrco (182.59%) followed by OR27xIrco (172.71%), PalalaxIrco (167.99%), DPAc90xIrco (154.19%), DPAc90xOR27 (148.19%), 2131-2-5xIrco (139.01%), SicalaxDPAc90 (116.07%) and SicalaxOR27 (113.25%). High parent heterosis values were also all positive. SicalaxIrco had again the highest high parent heterosis (151.98%) followed by DPAc90xOR27 (137.69%), OR27xIrco (127.96%), DPAc90xIrco (105.25%), SicalaxOR27 (98.81%) and SicalaxDPAc90 (92.86%).

Mid-parent heterosis for LYPLT had only one negative value for cross SicalaxDPAc90 (-9.00%). The best cross was DPAc90xOR27 (96.86%) followed by SicalaxOR27 (70.05%), DPAc90xIrco (56.81%), PalalaxIrco (50.05%) and DPAc90xPalala (48.72%). Eleven crosses had positive higher parent heterosis. The highest was DPAc90xOR27 (87.79%) followed by PalalaxIrco (49.36%) and DPAc90xIrco (40.27%).

SicalaxIrco was the best for both SCYP and LYP, considering both mid-parent and high parent heterosis. Similarly DPAc90xOR27 was the best for SCYPLT and LYPLT again considering both mid-parent and high parent heterosis.

Ginning Out Turn (GOT)

Values for GOT1 heterosis were small for both mid-parent and higher parent. Values for mid-parent heterosis were nearly all positive, except for six crosses. SicalaxPalala recorded the highest mid-parent value (3.55%) followed by SicalaxIrco (3.52%), SicalaxDPAc90 (2.91%) and PalalaxIrco (2.87%). Higher parent heterosis was generally small and negative except for SicalaxPalala (1.65%) and DPAc90xPalala (0.42%). Mid-parent heterosis values for GOT2 were larger and positive compared to those for GOT1. Three of the crosses had negative values. DPAc90x2131-2-5 had the highest mid-parent value (9.77%) followed by DPAc90xIrco (7.52%), SicalaxDPAc90 (6.45%), OR27xIrco (5.74%) and 2131-2-5xIrco (5.61%). Most of the values for high parent heterosis were also positive and larger compared to GOT1. DPAc90xIrco had the highest value (6.48%) followed by DPAc90x2131-2-5 and OR27xIrco (5.18%).

Generally heterosis for GOT was low. This was also observed by Meredith (1984). However, there was good indication that useful heterosis was available.

Boll size (BS)

Mid-parent heterosis values were mainly positive except for OR27xPalala (-3.36%). The largest heterosis was recorded in cross DPAc90xIrco (74.21%), a cross between a characteristically large-bolled parent (OR27) and a characteristically small-bolled parent DPAc90. Other crosses with relatively high mid-parent heterosis were: OR27xIrco (25.73%), 2131-2-5xIrco (22.79%), SicalaxDPAc90 (22.35%) and DPAc90xPalala (21.11%). High parent heterosis was also relatively high with most values positive. The highest value was from DPAc90xPalala (12.88%) followed by Palalaxlrco (12.67%), 2131-2-5xlrco (12.62%), Sicalaxlrco (12.47%) and OR27xlrco (10.45%).

Seed index (SI)

Relatively high mid-parent heterosis was found for SI and all the values were positive. DPAc90xPalala had the largest value (18.19%) and was followed by OR27xlrco (17.77%), SicalaxDPAc90 (17.41%), Sicalaxlrco (17.46%), 2131-2-5xlrco (16.42%) and Palalaxlrco (14.90%). Higher parent heterosis showed mostly positive values. Sicalaxlrco had the highest (11.95%) followed by Palalaxlrco (10.81%), SicalaxPalala (10.56%), DPAc90xPalala (10.33%). The lowest higher parent heterosis was found for OR27xPalala (-9.31%) which also had the lowest mid-parent heterosis (2.07%).

Lint index (LI)

Most of the mid-parent heterosis was positive, except 2131-2-5xOR27 (-3.5%) and OR27xPalala (-4.11%). The highest mid-parent heterosis was found for Sicalaxlrco (24.27%) and followed by SicalaxDPAc90 (23.27%), Palalaxlrco (23.15%), SicalaxPalala (19.02%), 2131-2-5xlrco (17.03%), DPAc90xlrco (16.57%) and DPAc90xOR27 (15.71%). High parent heterosis was mostly negative. Positive heterosis was found for Palalaxlrco (21.76%), Sicalaxlrco (20.64%), Sicala (18.70%), SicalaxPalala (16.73%) and DPAc90xlrco (15.93%). The lowest high parent heterosis was found from Sicalax2131-2-5 (-19.71%) and OR27xPalala (18.43%).

Seed per boll (SB)

Ten of the fifteen crosses had positive mid-parent heterosis, with DPAc90xPalala (11.07%) recording the highest. This was followed by OR27xIrco (8.43%), 2131-3-5xIrco (6.19%) and DPAc90x2131-2-5 (4.03%). High parent heterosis was negative for nearly all the crosses. Crosses with positive and relatively large heterosis were: OR27xIrco (6.36%), DPAc90xPalala (6.33%) and 2131-2-5xIrco (5.45%). SicalaxPalala had both the lowest mid-parent (-5.49%) and high parent (-9.97%) heterosis.

Locules per boll (LB)

Seven of the crosses had positive mid-parent heterosis. Relatively large heterosis was found from DPAc90xOR27 (28.82%), 2131-2-5xOR27 (27.97%), OR27xIrco (22.00%), OR27xPalala (17.65%) and SicalaxOR27 (17.03%). SicalaxDPAc90 (-5.35%) and SicalaxPalala (-4.55%) had the lowest values. High parent heterosis was mostly negative. Positive and relatively large heterosis was recorded for DPAc90xOR27 (9.83%), 2131-2-5xOR27 (7.86%) and 2131-2-5xIrco (6.43%). Lowest values were recorded for SicalaxDPAc90 (-10.15%) and SicalaxPalala (-7.28%).

Total bolls formed (TBF)

Positive and relatively large mid-parent heterosis was recorded for DPAc90xOR27 (31.87%) and DPAc90xPalala (21.70%). Large negative mid-parent heterosis was recorded for 2131-2-5xIrco (-37.61%), Sicalax2131-2-5 (-29.17%), 2131-2-5xOR27 (25.52%) and DPAc90x2131-2-5 (20.42%). High parent heterosis was mostly negative. Only two of the crosses, which also had the largest positive mid-parent heterosis, had positive higher parent heterosis. These were

DPAc90xPalala (21.20%) and DPAc90xOR27 (20.50%). Large negative heterosis was found for 2131-2-5xIrco (-40.69%), 2131-2-5 (-38,70%) and Sicalax2131-2-5 (30.44%).

Harvestable bolls (HB)

Mid-parent heterosis was relatively large. The highest was found for the cross DPAc90xOR27 (101.78%). This was followed by DPAc90xPalala (44.15%), SicalaxDPAc90 (38.02%), 2131-2-5xPalala (31.30%) and DPAc90xIrco (29.18%). The lowest was found for 2131-2-5xOR27 (-33.08%) and 2131-2-5xIrco (-23.71%). High parent heterosis was relatively large and positive. The largest was found from DPAc90xOR27 (70,00%), which had also the largest mid-parent heterosis. Others with large positive heterosis were: 2131-2-5xPalala (30.39%), DPAc90xPalala (30.21%), SicalaxDPAc90 (29.02%) and DPAc90xIrco (12.79%). The lowest high parent heterosis was found from 2131-2-5OR27 (-48.36%) and 2131-2-5xIrco (-26.51%). These had the lowest mid-parent heterosis as well.

Unharvestable bolls (UHB)

Most of the crosses had negative heterosis for both mid- and high parent heterosis. Only two crosses showed positive mid-parent heterosis and these were: SicalaxPalala (12.75%) and SicalaxIrco (8.82%). Large negative mid-parent heterosis was found from DPAc90x2131-2-5 (-53.17%), DPAc90xIrco (-50.88%), 2131-2-5xIrco (-47.38%), Sicalax2131-2-5 (42.96%) and PalalaxIrco (42.08%). Largest negative high parent heterosis was recorded from the same crosses. DPAc90xIrco (-61.13%), DPAc90x2131-2-5 (-59.42%), PalalaxIrco (57.62%), 2131-2-5xIrco (-52.78%).

Plant height (PH)

Mid-parent and high parent heterosis were almost similar in magnitude and direction (positive and negative). SicalaxPalala had the largest mid-parent heterosis (24.33%) as well as the highest higher parent heterosis (24.25%). SicalaxIrco was next in ranking both in mid-parent heterosis (22.67%) and higher parent heterosis (22.35%). Other crosses with large mid-parent heterosis were DPAc90xOR27 (20.29%), OR27xIrco (19.87%), OR27xPalala (17.87%) and SicalaxDPAc90 (16.73%). Others with relatively large higher parent heterosis were: OR27xIrco (18.98%), SicalaxOR27 (14.63%), DPAc90xOR27 (11.86%) and DPAc90xPalala (10.58%).

Hair count (HC)

All crosses had positive mid-parent heterosis except DPAc90xPalala (-12.61%). The largest heterosis was recorded from SicalaxDPAc90 (98.51%), SicalaxOR27 (78.85%), DPAc90xOR27 (48.54%), OR27xPalala (41.96%), 2131-2-5xOR27 (40.74%), OR27xIrco (34.29%) and Sicalax2131-2-5 (30.86%). All the crosses, except four showed negative higher parent heterosis. The largest positive heterosis was recorded in the cross SicalaxDPAc90 (98.51%) and these two parents are smooth cultivars. The other three crosses were PalalaxIrco (9.62%), OR27xIrco (2.96%) and OR27xPalala (1.32%). There was large negative high parent heterosis in the crosses with DPAc90xPalala recording the largest (-57.03%), SicalaxPalala (-46.27%), DPAc90 (-39.27%) and SicalaxIrco (36.29%).

Fibre length (FL)

All crosses except OR27xPalala (-0.00), had positive mid-parent heterosis. Crosses with relatively large heterosis were DPAc90xPalala (5.93%), SicalaxDPAc90 (5.67%), DPAc90xOR27 (4.66%) and PalalaxIrco (3.87%). Higher parent heterosis was very low. 2131-2-5xPalala recorded the highest amount of heterosis (2.04%). It was followed by DPAc90xPalala (1.74%) and SicalaxIrco (1.41%). Small amounts of heterosis for fibre length was expected Meredith (1984).

Fibre strength (FS)

Three of the crosses had positive mid-parent heterosis. All the other crosses had negative heterosis. Relatively large heterosis was recorded for SicalaxPalala (4.97%), 2131-2-5xPalala (1.71%) and 2131-2-5xOR27 (1.27%). Only one cross, which also had the largest mid-parent heterosis, had positive high parent heterosis and this was for SicalaxPalala (2.03%).

Micronaire (MC)

All crosses had positive mid-parent heterosis with the largest coming from DPAc90xOR27 (24.84%), 2131-2-5xIrco (24.75%), OR27xIrco (23.57%) and SicalaxIrco (19.34%). Nearly all the crosses had positive high parent heterosis as well, except SicalaxDPAc90 (-5.71%) and SicalaxPalala (-2.97%). The largest higher parent heterosis was from SicalaxIrco (18.05%), 2131-2-5xIrco (14.07%), OR27xIrco (13.63%) and DPAc90xIrco (10.57%).

The lowest mid-parent heterosis was for 2131-2-5xOR27 (1.54%) and SicalaxDPAc90 (-5,71%) for high parent heterosis.

Fibre uniformity (FU)

Ten of the crosses had positive mid-parent heterosis. The largest amount was found for OR27xIrco (10.15%) and DPAc90xIrco (6.12%), PalalaxIrco (5.64%) and 2131-2-5 (4.78%). High parent heterosis was relatively small. OR27xIrco (5.71%) again recording the largest amount of heterosis and was followed by DPAc90xIrco (3.79%). PalalaxIrco (3.70%) and DPAc90xIrco (3.59%).

Table. 4.6.1 **Heterosis (%) estimates for various cotton yield and quality characteristics Rustenburg, EXPT1 (1997/98)**

CROSS	SCYP		SCYPLT		LYP		LYPLT		GOT1		GOT2		BS		SI		LI		SB		LB		TBF	
	MP	HP	MP	HP	MP	HP	MP	HP	MP	HP	MP	HP	MP	HP	MP	HP	MP	HP	MP	HP	MP	HP	MP	HP
PalalaXIrco	117	53.07	42.32	40.22	167.99	59.9	50.05	49.36	2.87	-2.47	3.44	2.62	14.48	12.67	14.9	10.81	23.15	21.76	--3.34	-6.06	-1.67	-3.28	-18.58	-31.11
OR27xIrco	159.63	118.41	17.5	3.59	172.99	127.96	28.71	10.45	-2.22	-3.01	5.74	5.18	25.73	10.45	17.77	1.29	13.28	-2.82	8.43	6.36	22	3.39	-9.27	-28.45
2131-2-5xIrco	131.9	65.23	16.05	2.74	139.01	66.93	21.28	4.25	0.34	-0.17	5.61	2.8	22.79	12.62	16.42	5.63	17.03	5.57	6.19	5.45	7.19	6.43	-37.61	-40.69
DPAc90xIrco	139.85	97.77	46.42	27.66	154.19	105.25	56.81	40.27	2.61	0.43	7.52	6.48	17.73	8.14	12.3	8.57	16.57	15.73	3.68	-3.42	-0.73	0	-17.34	-27.02
SicalaxIrco	172.69	138.83	24.58	17.21	182.59	151.98	29.19	23.81	3.52	-1.79	3.75	1.57	17.1	12.47	17.4	11.95	24.37	20.64	1.87	0	-1.39	-5.74	-15.91	-18.65
OR27xPalala	67.5	34.12	36.76	19.56	66.13	32.94	37.59	18.53	-2.1	-4.09	-0.32	-0.57	-3.36	-16.27	2.07	-9.39	-4.11	-18.63	-2.1	-3.03	17.65	-1.64	3.03	-5.49
2131-2-5xPalala	72.42	69.45	8.86	-4.89	68.56	67.23	14.43	-2.02	-34.75	-36.9	-1.44	-3.31	15.03	3.77	12.1	5.21	10.3	-1.66	2.01	0	-4	-4.68	1.38	-10.42
DOAc90xPalala	81.39	48.03	48.3	31.03	83.64	52.2	48.72	33.36	-0.77	-0.06	2.71	2.53	21.11	12.88	18.19	10.33	13.4	11.3	11.07	6.33	-0.96	-3.28	21.7	21.26
SicalaxPalala	56.12	20.68	9.44	1.55	53.71	16.43	8.81	3.83	3.55	1.65	-0.41	-3.25	0.59	2.49	11.85	10.56	19.02	16.73	-5.49	-9.97	-4.45	-7.28	9.09	-5.11
2131-2-5xOR27	55.24	26.96	4.95	-19.15	55.37	23.58	5.09	-20.38	-2.9	-4.11	1.83	-0.26	4.84	-0.17	7.04	0.83	-3.5	-9.82	1.46	0	27.97	7.86	-25.52	-38.7
DPAc90xOR27	114.28	138.31	93.75	88.33	148.19	137.69	96.86	87.79	1.22	-1.73	3.95	3.52	74.21	-5.14	13.77	-4.88	15.71	-0.27	1.43	-3.78	28.82	9.83	31.87	20.5
SicalaxOR27	108.83	99.22	65.42	33.91	113.25	98.81	70.05	41.22	0.97	-2.86	3.37	0.65	7.69	-1.71	9.34	-1.93	6.33	-12.04	0	-3.58	17.03	-4.42	5.45	-14.72
DPAc90x2131-2-5	45.19	20.13	4.95	-17.44	50.93	24.16	9	-14.57	-1.23	-2.84	9.77	5.25	12.67	-4.52	9.94	-3.23	7.64	-2.41	4.03	-2.46	-1.69	-3.1	-20.42	-29.9
Sicalax2131-2-5	70.61	33.54	-9.91	-15.59	70.13	28.17	-9	-18.81	-1.02	-0.66	2.49	-2.3	6.72	1.69	6.37	0.94	2.92	-19.71	1.58	-1.16	3.66	0	-29.17	-30.47
SicalaxDPAc90	108.41	94.2	18.76	-0.53	116.67	92.86	24.83	7.58	2.91	-3.76	6.45	3.23	22.35	8.11	17.46	8.47	23.27	18.7	-0.01	-9.22	-5.35	-10.15	1.76	-11.79

MP = mid-parent
HP = high parent

Table. 4.6.1 (Continued)

CROSS	HB		UHB		PH		HC		FL		FS		MC		FU	
	MP	HP	MP	HP	MP	HP	MP	HP	MP	HP	MP	HP	MP	HP	MP	HP
PalalaxIrco	8.72	3.97	-42.08	-57.62	9.96	9.75	15.61	9.62	3.87	-1.76	-3.12	-4.37	18.42	6.82	5.64	3.7
OR27xIrco	-0.01	-21.14	-15.5	-30.66	19.87	18.98	41.96	1.32	0	0	-7.39	-12.24	23.57	13.63	10.15	5.71
2131-2-5xIrco	-28.71	-26.51	-47.38	-52.78	6.1	5.82	18.06	-17.78	1.1	-4.39	-5.53	-8.32	24.75	14.07	4.78	0.01
DPAc90xIrco	29.18	12.79	-50.88	61.13	0	-6.81	16.13	-39.27	0.01	0	-0.01	-1.98	24.84	10.57	6.12	3.79
SicalaxIrco	-15.86	-16.4	8.82	-13.05	22.67	22.35	25.53	-36.29	2.69	-3.7	-1.98	-3.93	19.34	18.05	1.08	0
OR27xPalala	30.78	1.41	-20.36	-31.6	13.19	8.39	41.96	1.32	0	0	-2.38	-8.61	11.21	8.9	2.92	2.7
2131-2-5xPalala	31.3	30.39	-30.21	-44.75	2.88	2.56	21.83	-12.12	2.04	2.04	1.72	-2.51	10.54	8.9	-2.53	-4.62
DPAc90xPalala	44.15	30.21	-3.8	-13.64	17.87	10.58	-12.61	-57.03	5.93	1.76	-5.24	-6.16	6.69	4.86	1.59	1.24
SicalaxPalala	5.22	1.41	12.75	-14.82	24.33	24.25	5.71	-46.27	2.45	1.14	4.97	2.03	6.51	-2.97	-0.01	-1.64
2131-2-5xOR27	-33.08	-48.36	-19.44	-27.75	8.22	6.73	40.74	-27.27	0.01	0.05	1.27	-1.19	1.54	0.01	-1.45	-3.35
DPAc90xOR27	101.78	70	-20	-22.73	20.29	11.86	48.54	-23.63	4.66	0.01	-4.71	-9.97	15.73	11.43	3.73	3.59
SicalaxOR27	20.84	-3.59	-4.37	-22.12	15.79	14.63	78.85	-11.13	2.97	1.41	-2.26	-5.52	14.33	6.19	2.15	1.12
DPAc90x2131-2-5	17.26	5.26	-53.17	-59.42	0	-6.13	27.26	-33.96	2.88	-1.17	0.01	-2.64	5.31	2	-1.91	-3.67
Sicalax2131-2-5	-10.79	-14.6	-42.96	-46.5	6.79	6.39	30.86	-32.09	1.57	0	-4.38	-5.37	12.58	3.98	-0.01	-3.59
SicalaxDPAc90	38.02	29.02	-25.96	-39.2	16.73	9.09	98.51	98.51	5.67	0	0	-11.9	5.1	-5.71	2.03	1.04

MP = mid-parent
HP = high parent

4.6.2 Loskop, 1997/98 (P+F1s)

Estimated values are presented in Table 4.6.2.

Seed cotton yield

All the values calculated were positive for both mid-parent and high parent heterosis. Eleven of the fifteen crosses recorded over 50% heterosis for SCYP and three of these had over 100%. The best crosses for mid-parent heterosis were SicalaxDPAc90 (193.22%), SicalaxIrco (187%), DPAc90xIrco (177.65%), SicalaxOR27 (86,64%), DPAc90xPalala (84.40%), 2131-2-5xIrco (80.79%) and DPAc90xOR27 (79.46%). Three of the crosses had less than 50% heterosis, they were 2131-2-5xOR27 (7.08%) - the lowest, 2131-2-5xPalala (13.17%) and OR27xPalala (37.59%). For high parent heterosis, only four of the crosses recorded over 50%. The largest amount of heterosis was recorded for SicalaxDPAc90 (193.22%), SicalaxIrco (107.43%), DPAc90xIrco (87.03%), 2131-2-5xIrco (60.79%) and SicalaxPalala (43.09%).

Mid-parent heterosis for SCYPLT was positive for most of the crosses. The largest amount of heterosis was found in SicalaxDPAc90 (163.96%), SicalaxOR27 (94.71%), DPAc90xOR27 (88.74%), DPAc90xPalala (76.72%), SicalaxIrco (49.05%) and SicalaxPalala (47.43%). Most of the crosses showed negative high parent heterosis for SCYPLT. Six of the crosses expressed positive high parent heterosis and those with relatively large amounts were SicalaxDPAc90 (163.96%), SicalaxOR27 (36.07%), OR27xPalala (27.67%) and DPAc90xOR27 (17.53%).

Lint yield

Mid-parent heterosis for LYP was relatively large and positive with only three of the fifteen crosses recording heterosis below 50%. SicalaxDPAc90 (199.01%) was the highest. DPAc90xIrco (184.64%) was next, followed by SicalaxIrco (175.72%), DPAc90xPalala (93.28%), DPAc90xOR27 (91.48%), SicalaxOR27 (89.14%) and 2131-2-5xIrco (74.39%). Highest parent heterosis was also positive for all the crosses, except one. SicalaxDPAc90 (164.27%) recorded the largest amount of heterosis and was followed by SicalaxIrco (97.60%), DPAc90xIrco (89.66%), 2131-2-5xIrco (60.68%) and OR27xIrco (40.87%).

Twelve of the 15 crosses had positive mid-parent heterosis for LYPLT. Large amounts of heterosis was found from SicalaxDPAc90 (169.9%), DPAc90xOR27 (100.6%), SicalaxOR27 (86.88%), DPAc90xPalala (84.79%) and SicalaxPalala (45.69%). Crosses with large high parent heterosis were SicalaxDPAc90 (122.22%), DPAc90xIrco (34.76%), SicalaxIrco (30.43%), OR27xPalala (29.46%) and DPAc90xOR27 (26.03%).

Ginning Out Turn (GOT)

GOT1 recorded low or negative heterosis. Four of the crosses had positive mid-parent heterosis, they were PalalaxIrco (2.89%), SicalaxIrco (0.99%), DPAc90xPalala (0.54%) and Sicalax2131-2-5 (0.21%). All crosses recorded negative high parent heterosis.

GOT2 recorded low mid-parent heterosis with half of the crosses having negative heterosis. Relatively large amounts of heterosis were found for 2131-2-5xOR27 (3.27%), DPAc90xOR27 (2.68%), SicalaxOR27 (1.98%) and PalalaxIrco (1.95%). High parent heterosis was negative for nearly all the crosses except SicalaxOR27 (1.98%) and DPAc90xOR27 (0.13%).

Boll size

Mid-parent heterosis was positive for all the crosses, DPAc90xPalala (31.31%) recorded the largest amount of heterosis. This was followed by DPAc90xOR27 (19.40%), DPAc90x2131-2-5 (17.75%), OR27xIrco

(16.17%), SicalaxDPAc90 (14.71%) and Sicala (13.27%). Ten of the crosses shown positive high parent heterosis. They are DPAc90xPalala (19.05%), Sicalax2131-2-5 (4.29%), SicalaxPalala (3.48%), 2131-2-5xPalala (3.15%) and OR27xIrco (2.17%).

Seed index ((SI)

Mid-parent heterosis was positive for nearly all the crosses except four, which had negative heterosis. SicalaxOR27 (30.88%) ranked the highest and was followed by DPAc90xPalala (18.37%), DPAc90xOR27 (15.01%) and 2131-2-5xIrco (14.65%). Five of the crosses recorded positive high parent heterosis and they were SicalaxIrco (22.92%), 2131-2-5xIrco (14.07%), SicalaxPalala (7.85), DPAc90xPalala (7.85), DPAc90xPalala (7.30%) and 2131-2-5xPalala (6.85%).

Lint index (LI)

Mid-parent heterosis was positive for all the crosses, except 2131-2-5xPalala (-4.48%). The largest amount of heterosis was found from DPAc90xOR27 (22.81%), DPAc90xPalala (18.51), 2131-2-5xIrco (11.38%) and SicalaxDPAc90 (10.51%). Seven of the crosses had positive high parent heterosis with the largest amount found in DPAc90xPalala (14.24%), 2131-2-5xIrco (9.07), DPAc90xOR27 (7.46%), SicalaxDPAc90 (6.54%), OR27xIrco (5.23%).

Seeds per boll (SB)

Twelve out of 15 crosses had positive mid-parent heterosis. DPAc90x2131-2-5 (13.91%) recorded the largest amount of heterosis. This was followed by DPAc90xPalala (12.66%), PalalaxIrco (7.91%) and Sicala (5.44%). High parent heterosis was positive for six crosses. Relatively large amount was recorded for DPAc90x2131-2-5 (11.27%), DPAc90xPalala (9.78%) and 2131-2-5xPalala (4.33%).

Locules per boll (LB)

Seven of the crosses had positive mid-parent heterosis, with DPAc90x2131-2-5 (9.07%) ranking the highest. This was followed by Sicalax2131-2-5 (6.24%), SicalaxDPAc90 (4.82%), SicalaxPalala (3.93%) and DPAc90xPalala (2.94%). Positive high parent heterosis was recorded in four of the crosses. They were DPAc90x2131-2-5 (5.95%), Sicalax2131-2-5 (4.55%), SicalaxPalala (2.27%) and 2131-2-5 (1.18%).

Total bolls formed (TBF)

Eleven of the crosses had positive mid-parent heterosis. SicalaxDPAc90 (53.00%), DPAc90xOR27 (46.39%) and DPAc90xPalala (25.65%) recorded the largest amounts. Some of the other crosses with relatively large amounts of heterosis were DPAc90xIrco (18.02%), OR27xPalala (12.81%) and SicalaxIrco (12.66%). Six of the crosses recorded positive high parent heterosis, with relatively large amount recorded for SicalaxDPAc90 (32.28%), and DPAc90xOR27 (11.98%).

Harvestable bolls (HB)

Mid-parent heterosis was relatively large and positive. Crosses with large amounts of heterosis were SicalaxDPAc90 (80.65%), DPAc90xOR27 (75.22%), DPAc90xIrco (72.22%), SicalaxIrco (49.57) and DPAc90xPalala (45.80%). Seven crosses shown positive high parent heterosis. They were SicalaxDPAc90 (62.32%) ranked the highest. Other crosses with relatively large high parent heterosis were DPAc90xOR27 (26.21%), DPAc90xIrco (15.53%), 2131-2-5xIrco (11.80% and 2131-2-5xPalala (9.55%).

Unharvestable bolls (UHB)

Most of the crosses had negative heterosis. The exceptions for mid-parent heterosis were SicalaxDPAc90 (31.18%), Palalaxlrco (12.60%) and OR27xPalala (10.99%). SicalaxDPAc90 (10.16%) and OR27xPalala (8.60%) were the only two crosses which expressed positive high parent heterosis.

Hair count (HC)

Mid-parent heterosis was positive for thirteen of the crosses. Relatively large heterosis was recorded from Sicalaxlrco (79.79%), DPAc90xOR27 (42.37%), DPAc90xlrco (31.11%) and Sicalaxlrco (30.86%). SicalaxDPAc90 (463.38%) a cross between smooth parents, recorded an excessively large amount of heterosis.

High parent heterosis was mainly negative, except for crosses SicalaxDPAc90 (97.96%), Palalaxlrco (12.43%) and SicalaxOR27 (0.87%).

Fibre length (FL)

Mid-parent heterosis was positive for all the crosses except one. Crosses with the highest ranking were Sicalax2131-2-5 (8.85%), SicalaxDPAc90 (7.02%), DPAc90xPalala (6.22%) and SicalaxPalala (4.68%). Eight of the crosses had positive high parent heterosis. SicalaxPalala (4.36%) ranked the highest and was followed by SicalaxDPAc90 (3.05%), DPAc90xPalala (2.62%) and OR27xPalala (2.41%).

Fibre strength (FS)

All the crosses expressed negative heterosis for FS.

Micronaire (MC)

Mid-parent heterosis was positive for most of the crosses except OR27xPalala (-1.87%) and OR27xIrco (-1.85%). DPAc90xIrco (15.37%) ranked the highest and was followed by SicalaxPalala (9.42%), DPAc90xPalala (9.18%), SicalaxDPAc90 (8.70%), DPAc90xOR27 (8.42%) and SicalaxOR27 (6.81%). Six crosses had positive high parent heterosis, with SicalaxDPAc90 (5.63%) and DPAc90xIrco (4.57%) ranking the highest. They were followed by SicalaxOR27 (4.67%) and SicalaxPalala (4.34%).

Fibre uniformity (FU)

Positive values for mid-parent heterosis were found for all the crosses except 2131-2-5xPalala (-0.10%). DPAc90xIrco (5.28%) ranked highest and was followed by OR27xIrco (4.85%), 2131-2-5xIrco (3.83%) and Sicalax2131-2-5 (3.75%). Ten of the crosses recorded positive high parent heterosis, while DPAc90xIrco (4.80%) had the highest ranking.

Table. 4.6.2 **Heterosis (%) estimates for various cotton yield and quality characteristics**

Loskop, EXPT2 (1997/98)

CROSS	SCYP		SCYPLT		LYP		LYPLT		GOT1		GOT2		BS		SI		LI		SB		LB		TBF	
	MP	HP	MP	HP	MP	HP	MP	HP	MP	HP	MP	HP	MP	HP	MP	HP	MP	HP	MP	HP	MP	HP	MP	HP
PalalaXIrco	49.84	26.52	-1.59	-17.31	56.43	39.87	-2.17	-22.97	2.89	-1.18	1.95	-4.79	7.08	-0.63	-1.05	-3.98	3.11	-5.81	7.91	3.85	-1.87	-2.33	9.31	3.33
OR27xIrco	56.24	35.15	-2.71	-21.5	56.85	40.86	-6.15	-27.19	-0.74	-1.83	-0.76	-5.89	16.17	2.17	-0.08	-6.31	6.41	5.28	3.12	1.87	-4.11	-5.62	-9.51	-22
2131-2-Irco	80.79	64.76	9.01	-9.84	74.39	60.68	2.21	-17.33	-2	-3.09	-2.9	-4.64	2.73	0	14.65	14.07	11.38	9.07	-7.93	-11.64	-1.87	-2.33	6.21	2.67
DPAc90xIrco	177.65	87.03	-1.59	-17.31	184.64	89.66	38.51	-34.76	-0.49	-0.52	0.32	-2.51	11.83	-5.32	9.4	-3.38	8.72	-3.92	4.26	-2.13	-1.22	-5.81	18.02	-18.33
SicalaxIrco	181.72	107.43	49.05	-7.01	175.72	97.6	40.31	-17.25	0.99	-2.23	-1.06	-6.2	2.05	1.41	-1.1	-1.27	4.59	-4.46	-2.54	-7.11	-2.3	-3.41	12.66	-14
OR27xPalala	37.59	33.71	33.31	27.67	36.47	35.79	32.11	29.46	-3.61	-8.38	-1.14	-2.7	6.31	-4.78	5.29	-4.01	6.43	-3.83	3.06	0.36	0	-2.25	12.81	2.25
2131-2-5xPalala	13.17	3.96	-0.96	-2.89	9.66	6.11	-4.67	-7.98	-8.94	-13.47	-4.16	-8.94	8.35	3.15	9.57	6.85	-4.48	-14.38	4.56	4.33	1.18	1.18	5.63	3.21
DOAc90xPalala	84.4	14.25	76.72	8.21	93.28	21.98	84.79	15.15	0.54	-3.45	1.08	-2.97	31.31	19.05	18.37	7.3	18.51	14.24	12.66	9.78	2.94	-1.18	25.65	-10.21
SicalaxPalala	57.39	43.09	47.43	0.55	55.83	4.53	45.69	0.55	-1.79	-2.58	1.06	-0.53	13.27	3.48	11.33	7.85	5.23	5.23	0.06	-2.08	3.93	2.27	-6.59	-25.62
2131-2-5xOR27	7.08	1.04	-2.07	-4.38	11.38	8.3	1.29	-4.12	-5.05	-5.07	3.27	-0.35	2.73	0	3.5	-3.41	1.44	0.52	-4.43	-4.49	0	-2.25	-15.93	-25.36
DPAc90xOR27	79.46	12.47	88.74	17.53	91.48	21.09	100.69	26.03	-0.33	-1.37	2.68	0.13	19.4	1.88	15.01	-3.93	22.81	7.4	3.71	-1.46	1.67	-4.49	46.39	11.98
SicalaxOR27	86.64	25.51	94.71	36.07	89.14	27.19	86.88	30.43	-0.42	-4.6	1.98	1.98	0.45	-3.91	30.88	22.92	9.05	-1.32	0.88	-4.97	-1.81	-2.25	9.28	-5.53
DPAc90x2131-2-5	59.42	2.48	33.88	-17.43	50.88	-3.41	26.49	-22.27	-3.13	-4.19	-3.79	-4.82	17.75	2.15	8.59	-3.68	2.24	-11.27	13.91	11.27	9.07	5.95	9.82	-22.5
Sicalax2131-2-5	55.08	7.69	23.89	-14.6	50.4	2.79	20.06	-18.73	0.21	-4.03	-0.72	-4.22	6.48	4.29	-0.77	-1.44	1.59	-8.94	3.81	-4.83	6.24	4.55	-4.11	-25
SicalaxDPAc90	193.22	154.32	163.96	113.41	199.01	164.27	169.91	122.22	-2.81	-5.94	1.33	-1.22	14.71	1.99	12.36	-0.93	10.51	6.54	5.44	-5.37	4.82	-1.14	53	32.28

MP = mid-parent
HP = high parent

Table. 4.6.2 (Continued)

CROSS	HB		UHB		PH		HC		FL		FS		MC		FU	
	MP	HP	MP	HP	MP	HP	MP	HP	MP	HP	MP	HP	MP	HP	MP	HP
Palalaxlrco	3.77	-1.12	12.61	-10.07	-	-	13.71	12.43	2.29	-2.87	-2.24	-6.32	1.62	0.46	0.33	-1.89
OR27xlrco	-10.24	-20.5	-12.4	-28.8	-	-	17.12	-3.39	1.49	-3.72	-2.29	-8.3	-1.85	-2.97	4.85	3.36
2131-2-5xlrco	10.02	8.43	-3.03	-14.09	-	-	10.17	-17.51	2.01	-4.09	-3.35	-11.18	3.37	-1.83	3.83	3.52
DPAc90xlrco	72.22	15.53	-43.59	-60.4	-	-	31.11	-33.33	2.71	0.93	-4.91	-9.92	15.37	4.57	5.28	4.8
Sicalaxlrco	49.57	6.83	-29.61	-42.28	-	-	30.76	-29.38	4.46	-1.09	-0.37	-6.19	5.43	-6.85	1.93	0.26
OR27xPalala	13.91	-3.37	10.99	8.6	-	-	18.75	-1.16	2.52	2.41	-1.45	-3.78	-1.87	-1.87	0.53	0.28
2131-2-5xPalala	13.37	9.55	-7.84	-18.26	-	-	-5.76	-28.9	-0.44	-1.49	-3.74	-8.06	0.97	-3.04	-0.1	-2.59
DPAc90xPalala	45.8	-4.49	-6.17	-21.35	-	-	4.55	-51.45	6.22	2.62	-1.65	-3.03	9.18	0	0.31	-2.36
SicalaxPalala	16.18	-19.33	-39.19	-39.33	-	-	-9.11	-5.09	4.68	4.36	-0.89	-2.57	9.42	2.34	0.47	-3.34
2131-2-5xOR27	-9.66	-21.08	-24.44	-31.65	-	-	4.41	-7.82	0.96	0	-5.04	-7.15	0.97	-3.04	0.41	-1.31
DPAc90xOR27	75.22	26.61	-12.27	-7.53	-	-	42.37	-26.96	4.07	0.45	-4.91	-5.81	8.42	-0.7	1.9	0
SicalaxOR27	37.68	7.26	-20.7	-22.58	-	-	79.79	0.87	0.62	0.41	-6.41	-7.05	6.81	4.67	1.96	1.11
DPAc90x2131-2-5	23.39	-17.47	-8.66	-30.43	-	-	12.04	-42.05	4.17	-0.41	-6.92	-9.86	5.61	0.51	2.55	2.39
Sicalax2131-2-5	9.69	-22.29	-20.43	-29.57	-	-	5.88	-38.64	8.85	1.28	-2.47	-3.14	5.77	-2.04	3.75	2.35
SicalaxDPAc90	80.65	62.32	31.18	10.16	-	-	463.38	97.96	7.02	3.05	-2.06	-2.35	8.7	5.63	1.11	-0.1

MP = mid-parent
HP = high parent

4.6.3 Rustenburg 1998/99 (P+F1)

Estimated values for both mid- and high parent heterosis are presented in Table 4.6.3.

Seed cotton yield (CY)

Mid-parent and high parent heterosis were positive for nearly all the crosses, except for SicalaxPalala. Most of the crosses had large amounts of mid-parent heterosis, well over 50%. 2131-2-5xIrco (123.74%) ranked the highest. This was followed by OR27xPalala (117.67%), 2131-2-5xPalala (14.45%), 2131-2-5xOR27 (109.70%), PalalaxIrco (108.24%) and OR27xIrco (101.47%). Large and positive high parent heterosis was found for the crosses 2131-2-5xIrco (109.27%), OR27xPalala (105.59%), OR27xIrco (100.66%), PalalaxIrco (97.43%), 2131-2-5xOR27 (96.88%) and 2131-2-5xPalala (90.89%).

Eleven of the crosses had positive mid-parent heterosis for SCYPLT. SicalaxDPAc90 (42.33%) had the highest ranking and was followed by 2131-2-5xIrco (38.28%), SicalaxOR27 (34.68%), Sicalax2131-2-5 (33.05%), SicalaxIrco (29.64%) and DPAc90xPalala (28.20%). Six of the crosses had positive high parent heterosis. Those with relatively large amounts of heterosis were 2131-2-5xIrco (35.58%), SicalaxOR27 (25.62%), Sicalax2131-2-5 (19.81%), SicalaxIrco (14.72%) and SicalaxDPAc90 (12.57%).

Lint yield (LY)

Mid-parent and high parent heterosis were positive for all the crosses, for LYP, except SicalaxPalala. Heterosis was relatively large. Six of the crosses recording over 100% mid-parent heterosis. 2131-2-5xIrco (135.52%) ranked the highest. It was followed by OR27xPalala (119.13%), 2131-2-5xPalala (118.47%), 2131-2-5xOR27 (113.65%), OR27xIrco (109.29%) and PalalaxIrco (108.92%). Five of the crosses recorded high parent heterosis above 100%. They were 2131-2-5xIrco (118.91%), OR27xPalala (114.90%), PalalaxIrco (108.88%), OR27xIrco (105.20%) and 2131-2-5x OR27 (102.32%).

Mid-parent heterosis for LYPLT was positive for all the crosses, except SicalaxPalala and OR27xPalala. 2131-2-5xIrco (47.60%) ranked the highest and was followed by SicalaxDPAc90 (43.28%), SicalaxOR27 (37.42%), Sicalax2131-2-5 (32.30%) and SicalaxIrco (30.58%). Seven of the crosses recorded positive high parent heterosis for LYPLT. Relatively large amounts of heterosis was recorded from 2131-2-5xIrco (47.60%), SicalaxOR27 (32.93%), Sicalax2131-2-5 (15.61%) and SicalaxDPAc90 (14.08%).

Ginning out turn (GOT)

Generally heterosis for GOT was low and mostly negative for high parent heterosis. The low heterosis for GOT had also been observed by earlier workers (Meredith, 1984). For GOT1, six of the crosses had positive mid-parent heterosis, they were 2131-2-5xOR27 (3.35%), 2131-2-5xIrco (2.23%), OR27xIrco (2.15%), DPAc90xOR27 (1.35%), SicalaxOR27 (1.25%) and DPAc90xIrco (0.05%). 2131-2-5xIrco (1.95%) was the only cross with positive high parent heterosis for GOT1. Eight of the crosses had positive mid-parent heterosis for GOT2. Those with a relatively small amount of heterosis were OR27xIrco (2.56%), SicalaxPalala (2.14%), DPAc90x2131-2-5 (2.03%), DPAc90xOR27 (1.89%), 2131-2-5xIrco (1.87) and SicalaxDPAc90 (1.87%). Six of the crosses expressed positive high parent heterosis for GOT2. Relatively small amount of heterosis were recorded for DPAc90xIrco (1.38%), 2131-2-5xIrco (0.96%), OR27xIrco (0.85%), SicalaxDPAc90 (0.65%), DPAc90x2131-2-5 (0.59%) and SicalaxIrco (0.58%).

Boll size (BS)

Most of the crosses expressed positive mid-parent heterosis, except DPAc90xIrco (-1.46%) and SicalaxDPAc90 (-0.91%). SicalaxOR27 (14.27%) ranked the highest and was followed by DPAc90xOR27 (13.92%), 2131-2-5xOR27 (13.77%), PalalaxIrco (13.73), Sicalax2131-2-5 (12.24%) and OR27xIrco (12.15%). Most of the crosses expressed positive high parent heterosis although it was generally low. SicalaxOR27 (13.33%) recorded relative large amount of high parent heterosis. Other crosses with relatively large amounts of heterosis were PalalaxIrco (10.30%), 2131-2-5xPalala (8.65%), 2131-2-5xIrco (5.86%) and DPAc90xPalala (5.17%).

Seed Index (SI)

Mid-parent heterosis was positive for most of the crosses. A relatively large amount of heterosis was recorded for DPAc90x2131-2-5 (12.14%), Sicalax2131-2-5 (9.32%), SicalaxDPAc90 (18.72%), SicalaxIrco (7.63%), 2131-2-5xPalala (7.55%), DPAc90xPalala (6.15%) and PalalaxIrco (5.29%). The largest amount of high parent heterosis was found in DPAc90x2131-2-5 (9.44%), Sicalax2131-2-5 (4.50%), 2131-2-5xPalala (3.55%) and SicalaxIrco (2.88%).

Lint index (LI)

Positive mid-parent heterosis was found in nine of the crosses. 2131-2-5xOR27 (25.82%) had the largest amount of heterosis and was followed by SicalaxIrco (17.62%), 2131-2-5xIrco (12.52%), OR27xIrco (7.29%), DPAc90xOR27 (6.59%) and SicalaxDPAc90 (6.31%). High parent heterosis was relatively low for 2131-2-5xOR27 (16.22%), SicalaxIrco (8.98%), and 2131-2-5xIrco (6.72%).

Seed per boll (SB)

Ten crosses expressed positive heterosis and relatively moderate amount was found in 2131-2-5xOR27 (15.38%), OR27xIrco (14.24%), SicalaxPalala (12.41%), SicalaxOR27 (12.09%) and PalalaxIrco (6.83%). 2131-2-5xOR27 (10.48%) recorded the largest amount of high parent heterosis. Other crosses with relatively small amounts of heterosis were OR27xIrco (4.76%), DPAc90xOR27 (4.67%) and 2131-2-5xPalala (4.34%).

Locules per boll (LB)

Positive mid-parent heterosis was found in 10 of the crosses. DPAc90xOR27 (7.50%) ranked the highest and was followed by 2131-2-5xOR27 (6.86%) and OR27xIrco (4.47%). A relatively small amount of high parent heterosis was found in DPAc90xOR27 (5.82%), OR27xIrco (4.47%) and 2131-2-5xOR27 (4.47%).

Total bolls formed (TBF)

Mid-parent heterosis was relatively large. 2131-2-5xIrco (63.81%) had the highest ranking. This was followed by SicalaxDPAc90 (21.22%), PalalaxIrco (18.91%), 2131-2-5xPalala (16.74%), SicalaxIrco (12.52%), Sicalax2131-2-5 (10.68%) and DPAc90x2131-2-5 (10.44%). Four of the crosses recorded positive high parent heterosis, with 2131-2-5xIrco

(55.67%) ranking the highest. This was followed by SicalaxDPAc90 (7.03%), Palalaxlrco (3.58%) and SicalaxOR27 (1.81%).

Harvestable bolls (HB)

Mid-parent heterosis was positive for 12 of the crosses. 2131-2-5xlrco (70.54%) ranked the highest and was followed by Sicalax2131-2-5 (25.71%), Palalaxlrco (22.83%), 2131-2-5xPalala (22.34%) and SicalaxDPAc90 (20.03%). 2131-2-5xlrco (57.97%) had the highest ranking for high parent heterosis. It was followed by SicalaxDPAc90 (9.71%) and SicalaxOR27 (6.57%).

Unharvestable bolls (UHB)

Mid-parent and high parent heterosis were negative for most of the crosses. Positive heterosis was found for 2131-2-5xlrco (44.00%), DPAc90xOR27 (23.08%), SicalaxDPAc90 (13.73%), OR27xlrco (3.85%) and Palalaxlrco (0.68%). High parent heterosis was positive only in 2131-2-5xlrco (40.35%) and DPAc90xOR27 (3.23%).

Plant height (PH)

Mid-parent heterosis was positive for all the crosses except SicalaxPalala (-2.06%). 2131-2-5xlrco (29.28%) ranked the highest. Other crosses with relatively large heterosis were DPAc90xPalala (22.29%), DPAc90x2131-2-5 (18.66%), Palalaxlrco (18.63%), 2131-2-5xPalala (16.91%) and DPAc90xOR27 (13.36%). Most of the crosses recorded positive high parent heterosis as well. 2131-2-5xlrco (27.74%) ranked the highest and was followed by DPAc90xPalala (20.23%), DPAc90x2131-2-5 (15.43%), Palalaxlrco (14.83%) and 2131-2-5xPalala (11.86%).

Hair count (HC)

Nine of the crosses recorded positive mid-parent heterosis with Sicalaxlrco ranking the highest (75.03%). This was followed by SicalaxOR27 (45.12%), 2131-2-5xlrco (21.84%), DPAc90x?, DPAc90x2131-2-5 (16.80%), OR27xlrco (13.84%), SicalaxDPAc90 (12.35%), Palalaxlrco (11.93%) and 2131-2-5xPalala (11.16%). Most of the crosses recorded negative high parent heterosis except Palalaxlrco (11.90%) and SicalaxDPAc90 (1.06%).

Fibre length (FL)

All crosses, except SicalaxPalala (-0.31), recorded positive mid-parent heterosis. Sicalaxlrco (7.63%) ranked the highest and was followed by Sicalax2131-2-5 (7.16%), DPAc90x2131-2-5 (6.81%), Sicalaxlrco (6.09%), DPAc90xPalala (5.94%), 2131-2-5xPalala (5.45%) and OR27xlrco (5.04%). Ten of the crosses recorded positive high parent heterosis. Crosses with relatively moderate amounts of heterosis were DPAc90x2131-2-5 (5.37%), Sicalax2131-2-5 (4.89%), 2131-2-5xPalala (3.47%), OR27xPalala (2.89%) and DPAc90xPalala (2.59%).

Fibre strength (FS)

All the crosses, except DPAc90xlrco (-0.91) recorded positive mid-parent heterosis. Relatively large amount of heterosis was recorded for Sicalax2131-2-5 (5.57%), Sicalaxlrco (5.00%), OR27xlrco (4.76%), 2131-2-5xPalala (4.21%), 2131-2-5xlrco (3.63%) and SicalaxPalala (3.15%). Nine of the crosses recorded positive high parent heterosis. Sicalax2131-2-5 (4.18%) had relatively large amount of heterosis and it was followed by 2131-2-5xPalala (3.30%), SicalaxPalala (2.73%) and DPAc90x2131-2-5 (2.43%).

Micronaire (MC)

The amount of mid-parent heterosis was small and only four of the crosses recorded positive values. These crosses were SicalaxPalala (4.82%), 2131-2-5xIrco (3.12%), DPAc90x2131-2-5 (2.82%) and SicalaxOR27 (1.16%). High parent heterosis was negative for all the crosses.

Fibre uniformity (FU)

Seven of the crosses recorded positive mid-parent heterosis. Relatively small amounts of heterosis was recorded for Sicalax2131-2-5 (2.54%), 2131-2-5xIrco (2.06%), OR27xIrco (0.99%), DPAc90xOR27 (0.91%), DPAc90xIrco (0.77%) and 2131-2-5xOR27 (0.68%). All crosses, except DPAc90xOR27 (0.89%), recorded negative high parent heterosis.

Table. 4.6.3 **Heterosis (%) estimates for various cotton yield and quality characteristics**

Rustenburg, EXPT3

CROSS	SCYP		SCYPLT		LYP		LYPLT		GOT1		GOT2		BS		SI		LI		SB		LB		TBF	
	MP	HP	MP	HP	MP	HP	MP	HP	MP	HP	MP	HP	MP	HP	MP	HP	MP	HP	MP	HP	MP	HP	MP	HP
PalalaXIrco	108.24	97.43	13.81	-3.53	108.92	108.88	11.87	2.61	-9.09	-10.92	1.61	-3.49	13.73	10.3	5.29	1.65	-7.87	-12.85	6.83	2.4	0.69	-1.57	18.91	3.58
OR27xIrco	101.47	100.66	6.03	-1.16	109.29	105.2	10.82	-5.81	2.15	-1.17	2.56	0.85	12.15	4.22	-1.54	-12.82	7.29	-5.57	14.24	4.76	4.47	4.47	0.97	-13.34
2131-2-Irco	123.74	109.27	38.28	35.58	135.52	118.91	47.64	47.6	2.23	1.95	1.87	0.96	8.44	5.86	1.87	1.58	12.52	6.72	4.55	0.91	0.69	-1.57	63.81	55.67
DPAc90xIrco	27.7	16.9	3.44	-9.18	57.51	22.58	7.53	-5.94	0.05	-0.71	1.63	1.38	-1.46	-3.8	-2.19	-4.56	4.04	1.52	-2.89	-3.51	-6.14	-7.61	-10.41	-15.64
SicalaxIrco	25.84	0.49	29.64	14.72	28.6	2.24	30.58	14.08	-1.16	-6.99	1.55	0.58	9.9	3.05	7.63	2.88	17.62	8.98	-4.26	-5.85	-3.48	-3.66	12.52	-3.89
OR27xPalala	117.67	105.59	-6.09	-7.92	119.13	114.9	-4.71	-10.06	-10	-15.04	-1.51	-4.94	5.12	-5.03	2.66	-6.16	22.46	-25.94	6.03	2.2	3.66	1.34	-3.38	-5.05
2131-2-5xPalala	114.45	90.89	6.97	-7.81	118.47	69.98	10.53	-1.24	-10.65	-12.27	-1.89	-7.62	9.38	8.65	7.55	3.55	-14.12	-22.68	5.05	4.34	0	0	16.74	-2.61
DOAc90xPalala	76.07	69.48	28.2	-2.21	62.6	49.34	21.16	-3.71	-3.97	-6.6	1.37	-3.95	5.7	5.15	6.15	0.09	-5.09	-16.72	-1.16	-4.65	0.7	0	-1.29	-9.52
SicalaxPalala	-4.67	-20.58	25.88	-29.43	-0.89	-21.22	-22.15	-24.09	-5.4	-9.08	2.14	-2.08	5.47	-3.88	-0.43	-1.44	-12.56	-19.47	5.46	-0.53	2.22	-2.75	-28.92	-30.54
2131-2-5xOR27	109.7	96.88	-0.98	-16.06	113.65	102.32	2.51	-12.93	3.35	-0.25	-0.1	-2.64	13.77	3.4	0.57	-11.17	25.82	16.22	15.38	0.48	6.86	4.47	-2.82	-20.05
DPAc90xOR27	82.44	66.4	-2.66	-26.75	90.11	71.53	2.45	-21.96	1.35	-1.72	1.89	-0.05	13.92	3.54	4.63	-9.31	6.59	-4.12	12.41	4.67	7.5	5.82	2.56	-7.12
SicalaxOR27	84.3	140.73	34.68	25.62	88.09	47.36	37.43	32.93	1.26	-0.63	-0.28	-0.97	14.27	13.33	2.87	-5.09	4.61	-1.09	12.09	2.14	2.83	0	2.41	1.81
DPAc90x2131-2-5	61.94	39.54	18.96	2.69	70.51	46.57	26.99	11.02	-10.76	-11.16	2.03	0.59	6.32	6.32	12.14	9.64	-5.01	-7.73	-4.9	-7.64	-3.95	-4.62	10.44	-0.85
Sicalax2131-2-5	39.64	6.12	33.05	19.81	38.91	4.66	32.4	15.61	-1.91	-3.54	-1.53	-3.38	12.24	2.91	9.32	4.52	5.58	2.99	5.51	0.16	2.22	-2.75	10.68	-9.36
SicalaxDPAc90	45.59	25.11	42.33	12.57	48.9	26.91	43.28	11.76	-0.62	-1.82	2.56	0.85	-0.91	-9.28	8.72	1.53	6.31	0.82	-7.19	-9.61	-5.74	-9.73	21.22	7.03

MP = mid-parent
HP = high parent

Table. 4.6.3 (Continued)

CROSS	HB		UHB		PH		HC		FL		FS		MC		FU	
	MP	HP	MP	HP	MP	HP	MP	HP	MP	HP	MP	HP	MP	HP	MP	HP
Palalaxlrco	22.83	1.91	0.68	-8.21	18.63	14.83	11.93	11.9	4.55	-1.46	1.94	-1.33	0	-2.33	-2.34	-3.88
OR27xlrco	1.92	-13.46	3.85	-12.9	13.56	3	13.84	-4.84	5.04	-0.58	4.26	-0.13	-1.6	-2.93	0.99	-1.52
2131-2-5xlrco	70.5	57.97	44	40.35	29.28	27.74	21.84	-15.92	7.63	3.29	3.63	1.21	3.12	0	2.06	-2.5
DPAc90xlrco	-6.26	-14.53	-12.2	-26.08	5.15	3.5	18.76	-36.23	1.87	-0.94	-0.91	-3.09	-1.37	-3.13	0.77	-1.71
Sicalaxlrco	19.21	0.26	-11.76	-20	12.66	1.86	75.03	-4.4	6.09	-0.3	5	1.23	-2.82	-3.95	-0.8	-2.42
OR27xPalala	5.68	2.74	-17.65	-32.26	10.29	3.17	-14.98	-28.91	3.35	2.89	2.85	1.75	-0.94	-4.51	-0.14	-1.08
2131-2-5xPalala	22.34	-4.45	-8.1	-18.13	16.91	11.86	11.16	-22.99	5.45	3.47	4.21	3.3	-6.63	-7.32	-0.1	-3.11
DPAc90xPalala	4.75	-5.69	-30	-31.67	22.29	20.23	-16.28	-55.05	5.94	2.59	1.62	0.6	-2.8	-6.71	-0.72	-1.63
SicalaxPalala	-23.95	-25.22	-53.4	-61.17	-2.06	-8.74	-15.82	-54.02	-0.31	-0.58	3.15	2.73	4.82	-0.71	-1.83	-1.89
2131-2-5xOR27	2.42	-18.17	-20.11	-26.94	9.88	-1.35	-8.4	-28.28	2.37	0.89	7.74	-0.27	-0.71	-5.19	0.68	-1.45
DPAc90xOR27	-4.79	-9.94	23.08	3.23	13.36	4.58	5.9	-41.23	4.94	2.06	2.15	0	-1.8	-2.24	0.91	0.89
SicalaxOR27	7.83	6.57	-18.03	-19.35	4.62	4.19	45.12	-17.46	2.45	1.73	0.09	-5.83	1.16	-1.35	-2.61	-3.46
DPAc90x2131-2-5	14.21	-2.8	-3	-11.96	18.66	15.43	16.8	-30.26	6.81	5.37	2.57	2.43	2.82	-2.24	0.47	-1.72
Sicalax2131-2-5	25.71	-0.6	-4.31	-11.17	12.04	0.23	-2.28	-39.26	7.16	4.89	5.57	4.18	-3.64	-5.48	3.54	-2.95
SicalaxDPAc90	20.03	9.71	13.73	-3.33	7.17	-1.69	12.35	1.06	4.13	0.58	2.12	0.64	-1.61	-4.47	-3.47	-4.27

MP = mid-parent
HP = high parent

4.6.4 Loskop 1998/99 (P+F1)

Calculated values of mid-parent and high parent heterosis are presented in Table 4.6.3

Seed cotton yield (SCY)

Positive mid-parent heterosis for SCYP was found in all the crosses, except Sicalaxlrco (-3.30%). DPAc90x2131-2-5 ranked the highest and was followed by 2131-2-5xPalala (50.62%), DPAc90xPalala (48.81%), Palalaxlrco (47.52%), DPAc90xOR27 (41.68%) and SicalaxDPAc90 (41.30%). Eleven of the crosses recorded positive high parent heterosis. DPAc90x2131-2-5 (51.32%) had the highest ranking and was followed by Palalaxlrco (37.18%), 2131-2-5xPalala (31.30%), DPAc90xPalala (29.72%) and OR27xlrco (28.52%).

Mid-parent heterosis for SCYPLT was positive for all the crosses except Sicalax2131-2-5 (-4.43%). DPAc90xPalala (51.97%) had the highest ranking and was followed by Sicalaxlrco (46.56%), Palalaxlrco (41.00%), SicalaxDPAc90 (40.32%), OR27xlrco (36.68%), SicalaxPalala (34.67%) and 2131-2-5xOR27 (32.91%). Eleven crosses had positive high parent heterosis for SCYPLT. OR27xlrco (35.92%) had the highest ranking and was followed by Sicalaxlrco (35.76%), SicalaxPalala (32.18%), DPAc90xPalala (29.58%) and Palalaxlrco (28.39%).

Lint yield (LY)

Mid-parent heterosis was positive for LYP for all the crosses. Palalaxlrco (85.67%) ranked the highest, and was followed by DPAc90x2131-2-5 (62.33%), DPAc90xPalala (57.00%), 2131-2-5xPalala (50.11%), SicalaxDPAc90 (44.26%) and DPAc90xOR27 (44.12%). Twelve of the crosses recorded positive high parent heterosis for LYP. Those with relatively large amount of heterosis were DPAc90x2131-2-5 (56.79%), DPAc90xPalala (38.98%), 2131-2-5xPalala (37.11%), OR27xIrco (33.21%), PalalaxIrco (29.74%) and SicalaxDPAc90 (25.14%). For LYPLT, all the crosses, except Sicalax2131-2-5 (-6.43%), recorded positive mid-parent heterosis. DPAc90xPalala (53.21%) ranked the highest, and was followed by SicalaxIrco (52.25%), SicalaxDPAc90 (42.92%) and PalalaxIrco (40.43%). Positive high parent heterosis for LYPLT was found in nine of the crosses. DPAc90xPalala (44.04%) ranked the highest, followed by SicalaxIrco (37.62%), OR27xIrco (36.91%), SicalaxPalala (29.38%) and SicalaxDPAc90 (28.19%).

Ginning out turn (GOT)

Twelve of the crosses recorded positive mid-parent heterosis for GOT1. DPAc90xPalala (7.69%) ranked the highest and was followed by PalalaxIrco (5.43%), DPAc90x2131-2-5 (4.63%), and DPAc90xIrco (4.42%). Five of the crosses had positive high parent heterosis for GOT1. Relatively small amounts of heterosis was recorded for DPAc90x2131-2-5 (4.08%), DPAc90xIrco (3.80%) and SicalaxIrco (3.43%).

Thirteen crosses had positive mid-parent heterosis for GOT2. 2131-2-5xIrco (5.11%) ranked the highest followed by SicalaxIrco (3.70%), DPAc90 (3.43%), SicalaxDPAc90 (3.33%) and 2131-2-5xOR27 (2.55%). Six crosses had positive high parent heterosis, though it was generally low. 2131-2-5xIrco (4.73%) ranked the highest, followed by SicalaxIrco (2.47%) and DPAc90x2131-2-5 (2.30%).

Boll size (BS)

All crosses, except SicalaxPalala (-1.89%), recorded positive mid-parent heterosis. DPAc90xPalala (31.11%) ranked the highest and was followed by OR27xIrco (21.06%), DPAc90xOR27 (20.47%), 2131-2-5xPalala (19.43%), DPAc90xIrco (18.51%), DPAc90x2131-2-5 (17.26%) and SicalaxOR27 (17.00%). High parent heterosis was positive for 11 crosses. DPAc90xPalala (19.84%) ranked the highest and was followed by OR27xIrco (11.04%), SicalaxOR27 (10.98%) and OR27xPalala (10.88%).

Seed index (SI)

SicalaxIrco (-24.50) was the only crosses with negative mid-parent heterosis. DPAc90xIrco (13.84%) ranked the highest and was followed by DPAc90x2131-2-5 (13.39%), DPAc90xOR27 (10.26%), SicalaxDPAc90 (9.84%), DPAc90xPalala (9.43%) and OR27xIrco (8.65%). High parent heterosis was positive for seven crosses. The crosses with relatively moderate amount of heterosis were DPAc90xIrco (6.95%), 2131-2-5xIrco (4.08%), SicalaxPalala (3.97%) and 2131-2-5xPalala (3.97%).

Lint index (LI)

Mid-parent heterosis was positive for all the crosses except OR27xPalala (-1.11%). DPAc90x2131-2-5 (21.50%) ranked the highest. It was followed by DPAc90xIrco (19.91%), DPAc90xPalala (19.44%), DPAc90xOR27 (13.94%), SicalaxDPAc90 (12.97%), SicalaxIrco (11.66%) and PalalaxIrco (10.08%). Nine of the crosses had positive high parent heterosis. DPAc90xPalala (16.37%) ranked the highest. It was followed by OR27XPalala (12.75%), DPAc90xIrco (-10.06%) and DPAc90x2131-2-5 (9.34%).

Seed per boll (SB)

There was positive mid-parent heterosis for 12 of the crosses. DPAc90xPalala (15.29%) ranked the highest. It was followed by SicalaxOR27 (13.37%), OR27xPalala (12.20%) and OR27xIrco (11.70%). Positive high parent heterosis was found in 11 crosses. DPAc90xPalala (14.89%) had the highest ranking. It was followed by OR27xPalala (6.67%), 2131-2-5xIrco (6.00%) and DPAc90xIrco (4.36%).

Locules per boll (LB)

Seven of the crosses had positive mid-parent heterosis. SicalaxOR27 (6.56%), SicalaxDPAc90 (5.82%), DPAc90xPalala (2.29%), PalalaxIrco (2.22.%) and OR27xIrco (2.18%) had a relatively small amount of positive heterosis. Positive high parent heterosis was found in four of the crosses. SicalaxOR27 (5.87%) was the highest ranking. It was followed by SicalaxDPAc90 (2.83%), DPAc90xPalala (1.59%) and OR27xIrco (1.52%).

Total bolls formed (TBF)

All the crosses, except SicalaxPalala (-6.73%) recorded positive mid-parent heterosis. SicalaxIrco (73.86%) ranked the highest. It was followed by SicalaxOR27 (44.37%), Sicalax2131-2-5 (42.42%), SicalaxDPAc90 (42.31%), DPAc90xIrco (29.09%), DPAc90x2131-2-5 (24.29%) and SicalaxPalala (23.79%). High parent heterosis was positive for nine crosses. SicalaxIrco (22.42%) ranked the highest and was followed by SicalaxDPAc90 (17.73%), SicalaxOR27 (8.30%), PalalaxIrco (6.34%) and DPAc90x2131-2-5 (5.42%).

Harvestable bolls (HB)

Twelve of the crosses had positive mid-parent heterosis. SicalaxIrco (40.82%) had the largest amount of heterosis and was followed by DPAc90x2131-2-5 (32.31%), DPAc90xPalala (27.25%), DPAc90xOR27 (25.29%), SicalaxDPAc90 (24.14%) and SicalaxOR27 (22.81%). High parent heterosis was positive for seven of the crosses. 2131-2-5xIrco (22.73%) ranked highest and was followed by DPAc90xOR27 (22.03%), SicalaxDPAc90 (21.83%), SicalaxIrco (21.51%) and SicalaxOR27 (21.42%).

Unharvestable bolls (UHB)

Thirteen of the crosses expressed positive mid-parent heterosis. SicalaxIrco (74.31%) ranked the highest, and was followed by Sicalax2131-2-5 (73.13%), DPAc90xIrco (55.88%) and 2131-2-5xIrco (53.95%). Seven of the crosses expressed positive high parent heterosis. 2131-2-5xIrco (36.58%) had the highest ranking. This was followed by Sicalax2131-2-5 (33.95%) and SicalaxIrco (24.10%).

Plant height (PH)

All the crosses expressed positive mid-parent heterosis. 2131-2-5xIrco (20.23%) had the highest ranking and was followed by SicalaxIrco (18.03%), Sicalax2131-2-5 (17.66%), DPAc90xIrco (15.82%), SicalaxDPAc90 (13.63%) and DPAc90xOR27 (12.42%). Eight of the crosses had positive high parent heterosis. SicalaxIrco (15.43%) ranked the highest and was followed by 2131-2-5xIrco (12.77%) and Sicalax2131-2-5 (12.73%).

Hair count (HC)

Seven of the crosses expressed positive mid-parent heterosis. The cross with the highest ranking was 2131-2-5xIrco (20.85%). It was followed by DPAc90x2131-2-5 (16.84%), DPAc90xIrco (16.43%), DPAc90xIrco (16.32%), PalalaxIrco (11.39%) and SicalaxIrco (10.41%). High parent heterosis was negative for all the crosses except PalalaxIrco (4.30%).

Fibre length (FL)

All the crosses expressed positive mid-parent heterosis. DPAc90xPalala (24.76%) had the highest amount of heterosis. It was followed by 2131-2-5xPalala (19.45%), 2131-2-5xIrco (10.04%), OR27xIrco (7.78%), DPAc90x2131-2-5 (6.86%) and PalalaxIrco (6.26%). Positive high parent heterosis was also found for all the other crosses except 2131-2-5xOR27 (-3.47%), DPAc90xIrco (-2.37%) and SicalaxIrco (-1.69%). DPAc90xPalala (11.545) ranked the highest and was followed by 2131-2-5xIrco (6.71%), DPAc90x2131-2-5 (5.30%) and DPAc90xOR27 (4.94%).

Fibre strength (FS)

Eleven of the crosses had positive mid-parent heterosis. Relatively large amounts of heterosis was found in 2131-2-5xIrco (3.63%), DPAc90xOR27 (2.75%), 2131-2-5xOR27 (2.43%), OR27xIrco (2.33%) and 2131-2-5xPalala (2.10%). Six of the crosses had positive high parent heterosis. DPAc90xOR27 (2.24%) ranked the highest and was followed by 2131-2-5xOR27 (1.92%), DPAc90x2131-2-5 (1.80%) and 2131-2-5xPalala (1.04%).

Micronaire (MC)

Positive mid-parent heterosis was recorded for eleven of the the crosses. SicalaxDPAc90 (9.38%) ranked the highest and was followed by DPAc90x2131-2-5 (7.18%), DPAc90xOR27 (5.01%), OR27xIrco (3.95%) and DPAc90xIrco (3.34%). Six of the crosses had positive high parent heterosis. SicalaxDPAc90 (8.85%) ranked the highest and was followed by DPAc90x2131-2-5 (6.39%), OR27xIrco (3.95%) and DPAc90xOR27 (2.33%).

Fibre uniformity

Six crosses recorded positive mid-parent heterosis. OR27xIrco (14.64%) ranked the highest. It was followed by DPAc90xOR27 (11.84%) and 2131-2-5xPalala (5.92%). Positive high parent heterosis was recorded for only two crosses. They were OR27xIrco (0.52) and DPAc90x2131-2-5 (1.56%)

Discussion

Most crosses expressed large and positive amounts of both mid-parent and high parent heterosis for yield (SCYP, SCYPLT, LYP and LYPLT), indicating the presence of some overdominance effects. Some crosses in Experiment 2 had negative high parent heterosis for SCYPLT and LYPLT. GOT has generally shown low levels or negative high parent heterosis in most of the crosses. These results agree with observations made by Tang *et al* (1993a) and Meredith (1999), and prove that heterosis will not improve GOT. Positive and relatively large amounts of heterosis were observed for most of the crosses, for BS. This is also in agreement with Gencer & Kaynak (1994). Similar levels of heterosis were found for SI and LI. Harvestable bolls (HB) per plant had fairly large amounts of heterosis for most of the crosses at most locations. Gencer & Kaynak (1994), Meredith (1999) and Tang *et al* (1993a) reported similar results. There were however many crosses with negative high parent heterosis.

PH had fairly large amounts of heterosis for all the crosses. Positive high parent heterosis was observed for most of the crosses in experiments one and three while most crosses in experiment four had negative high parent heterosis. This indicates the effect of the environment. HC mid-parent heterosis was positive and large for most of the crosses at all four locations.

FL mid-parent heterosis was relatively small, but positive for most of the crosses across locations. High parent heterosis was also positive for most of the crosses across locations. For FS, most of the crosses, specially those in Experiment 2, had negative heterosis. The levels of heterosis were very low in magnitude.

MC mid-parent heterosis was positive for most of the crosses, except those in Experiment 3. Most crosses had negative high parent heterosis except those in Experiment 1. For FU, mid-parent heterosis was positive for most of the crosses except those in Experiment 3. Most of the crosses had negative high parent heterosis except those in Experiment 1, most of which had positive high parent heterosis.

Fibre quality characteristics, except MC, had generally low levels of heterosis. Gencer & Kaynak (1994) also reported similar findings. This is probably due to the fact that these characteristic is largely under the control of additive genes.

Table. 4.6.4 **Heterosis (%) estimates for various cotton yield and quality characteristics**

Loskop Recittel EXPT4 (1998/99

CROSS	SCYP		SCYPLT		LYP		LYPLT		GOT1		GOT2		BS		SI		LI		SB		LB		TBF	
	MP	HP	MP	HP	MP	HP	MP	HP	MP	HP	MP	HP	MP	HP	MP	HP	MP	HP	MP	HP	MP	HP	MP	HP
PalalaXIrco	47.52	37.18	41	28.39	85.67	29.74	40.43	21.36	5.43	-2.41	2.05	-2.95	5.53	-1.23	2	0.83	10.08	3.68	4.86	0	2.22	0	9.8	6.34
OR27xIrco	31.11	28.52	36.68	35.92	33.67	33.21	39.35	36.91	-1.8	-2.93	1.72	1.39	21.06	11.04	8.65	-1.47	5.52	-1.59	11.7	2.35	2.18	1.52	7.72	-2.19
2131-2-Irco	26.76	20.81	1.7	-0.7	31.64	7.34	2.94	-1.37	0.8	-0.15	5.11	4.73	12.01	9.26	5.92	4.08	8.16	5.82	7.43	6	-3.66	-4.28	4.57	-0.81
DPAc90xIrco	24.06	-2	11.6	-8.89	24.17	-1.43	11.62	-8.4	4.42	3.8	0.7	-0.79	18.51	2.04	13.84	5.95	19.91	10.06	8.11	4.36	0	-2.83	29.09	4.86
SicalaxIrco	-3.3	-10.85	46.56	35.76	0.55	-9.52	52.25	37.62	3.46	3.43	3.7	2.47	6.11	5.82	-24.5	-27.71	11.66	8.24	2.33	1.61	-1.52	-1.52	73.86	22.42
OR27xPalala	25.96	15.01	23.3	11.7	22.44	8.24	19.83	5.19	0.77	-5.28	-2.28	-6.75	12.75	10.88	1.87	-4.03	-1.11	-12.95	12.2	6.67	-1.57	-2.87	6.46	-6.08
2131-2-5xPalala	50.62	31.3	14.06	1.64	50.11	37.11	8.6	-9.46	-0.62	-7	2.07	-3.26	19.43	-11.17	6.53	3.97	3.23	-4.87	-6.99	-11.68	-0.22	-3	-6.73	-14.17
DOAc90xPalala	48.81	29.72	51.96	29.58	57	38.98	53.21	44.04	7.69	-0.24	1.49	-4.8	31.11	19.84	9.43	-2.07	19.44	16.37	15.29	14.87	2.29	1.59	14.46	-9.12
SicalaxPalala	10.58	9.55	34.67	32.18	11.68	9.11	36	29.38	0.51	-6.94	0.45	-3.34	-1.89	-8.4	4.4	3.97	2.33	-6.38	-4.33	-8.6	-3.78	-5.87	23.79	-14.43
2131-2-5xOR27	32.92	7.29	32.91	1.4	35.12	10.34	1.53	-4.35	0.26	-2.34	2.55	1.83	7.35	4.58	6.36	-1.91	7.84	2.82	5.19	-4.78	-1.52	-3	6.63	1.81
DPAc90xOR27	41.68	10.32	29.85	5.55	44.12	14.69	31.86	9.74	1.95	1.38	1.61	-0.2	20.47	8.46	10.26	-6.23	13.94	-1.84	5.17	0.38	-2.26	-4.42	17.62	3.48
SicalaxOR27	7.8	-2.39	14.87	5.85	7.82	-2.68	14.84	5.48	-1.91	-6.94	-1.84	-2.7	17	10.98	4.71	-1.91	0.64	-3.31	13.37	-3.23	6.56	5.87	44.37	8.3
DPAc90x2131-2-5	58.68	51.22	16.52	-6.61	62.33	56.79	15.79	-8.09	4.63	4.08	3.43	2.3	17.26	3.15	13.39	3.74	21.5	9.34	-1.39	-6.03	0.67	-3	24.29	5.42
Sicalax2131-2-5	0.05	-12.07	-4.43	-13.41	14.19	-9.3	-6.43	-18.59	1.19	-2.16	1.38	-0.21	7.38	4.47	3.4	1.42	2.55	1.73	0.96	0.35	-0.86	-1.5	42.42	3.61
SicalaxDPAc90	41.3	19.21	40.32	22.45	44.26	25.14	42.92	22.19	2.61	2.02	3.33	0.61	14.2	-1.9	9.84	-1.25	12.97	0.8	4.65	0.35	5.82	2.83	42.31	17.73

MP = mid-parent
HP = high parent

Table. 4.6.4 (Continued)

CROSS	HB		UHB		PH		HC		FL		FS		MC		FU	
	MP	HP	MP	HP	MP	HP	MP	HP	MP	HP	MP	HP	MP	HP	MP	HP
PalalaxIrco	12.14	11.2	6.24	-3.07	6.4	0.31	11.39	4.3	6.26	0.31	0.8	-3.44	-1.67	-3.95	-4.4	-5.98
OR27xIrco	7.91	-5.99	7.44	4.38	4.79	-3.34	-16.43	-29.55	7.78	2.3	2.33	-1.51	3.95	3.95	14.64	0.52
2131-2-5xIrco	-21.57	-22.73	53.95	36.58	20.23	12.77	20.85	-17.58	10.03	6.71	3.63	0.28	0.48	-3.02	-2.11	-4.2
DPAc90xIrco	15.43	-1.67	55.88	16.1	15.82	3.21	16.32	-34.49	2.15	-2.37	-0.24	-3.46	3.34	0.7	2.08	-0.71
SicalaxIrco	40.82	21.51	74.31	24.1	18.03	15.43	10.41	-33.45	5.26	-1.69	1.12	-3.79	0	-3.02	-1.68	-2.03
OR27xPalala	-0.52	-12.7	15.85	52.98	6.38	3.98	-4.41	-14.31	4.61	4.04	0.64	0.14	-4.05	-6.28	-1.47	-3.13
2131-2-5xPalala	6.03	-7.86	-5.95	-22.94	4.94	-6.82	-11.6	-37.36	19.45	4.04	2.1	1.04	-1.98	-3.17	5.92	-5.7
DPAc90xPalala	27.25	0.92	-6.44	-34.33	7.99	-8.6	-38.64	-65.14	24.76	11.54	-0.46	-1.49	2.69	0.24	-1.37	-5.6
SicalaxPalala	8.51	-5.7	9.77	-25.93	7.49	-0.75	-15.56	-48.97	3.87	1.39	-0.18	-0.89	0	-0.73	-2.7	-4.65
2131-2-5xOR27	-1.28	-12.87	19.9	9.3	9.56	-4.7	5.66	-19.14	5.79	3.47	2.43	1.92	1.2	-2.33	2.97	-0.14
DPAc90xOR27	25.29	22.03	5.96	-19.42	12.42	-6.64	-23.34	-55.03	5.71	4.94	2.75	2.24	5.01	2.33	11.84	-2.46
SicalaxOR27	22.81	21.42	20.03	-9.3	6.06	-4.14	-19.77	-48.35	2.53	0.83	0.95	-0.27	-2.4	-5.35	-0.86	-2.13
DPAc90x2131-2-5	32.31	14.13	6.24	-13.3	8.91	3.09	16.84	-22.49	6.86	5.3	1.8	1.8	7.18	6.39	2.2	1.56
Sicalax2131-2-5	2.28	-10.62	73.13	33.95	17.66	12.73	8.46	-16.39	5.69	1.69	1.32	-0.45	0.5	-0.74	-3.11	-4.84
SicalaxDPAc90	24.14	21.83	5.52	15.66	13.63	3.3	-9.7	-27.46	3.87	1.39	-0.32	-2.05	9.38	8.85	-1.36	-3.71

MP = mid-parent
HP = high parent

CHAPTER FIVE

SUMMARY

Key words: *Genetic variability, yield, fibre, quality, cotton*

1 The objective of this research was to study the genetic variability in South African cotton germplasm and to identify superior parental lines for the improvement of yield and quality characteristics.

2 Six parental lines (Irco, Palala, OR27, 2131-2-5, DPAc90 and Sicala) were crossed in diallel fashion. The parents and their F1-offspring were planted in four experiments at two locations, Rustenburg and Loskop, in two successive years, 1997/1998 and 1998/1999. Twenty agronomic and yield characteristics were measured. The data for each characteristic were subjected to a diallel analysis, using the computer program "Agrobase".

3 Significant mean differences were found among the parental lines and their F1-offspring for most of the characteristics measured at both locations, during the two successive years. The only exceptions were SI and LB. On average, Palala and Sicala proved to be the best yielders at Rustenburg, while Irco yielded the best at Loskop. Sicala proved to be the best for FL in both environments, while OR27 was on average the best for FS at both Rustenburg and Loskop. Palala was the best for FU at Loskop, while both Irco and 2131-2-5 ranked the best at Rustenburg. For the character MC, all the parents were within the acceptable range of 3.5 - 4.5.

4 OR27 proved to be the best combiner for yield and most of the yield components, at both Rustenburg and Loskop. The parental line Sicala proved to

be the best general combiner for fibre length, while OR27 was the best general combiner for fibre strength and fibre uniformity at both locations. Parental lines DPAc90 and Irco were the best general combiners for MC at Rustenburg and Loskop respectively.

5 The G.C.A.:S.C.A. ratios were close to unity for most of the characteristics, including yield. Some of the characteristics, such as HC (31.6 - 46.8), GOT2 (1.7 - 17.3), FS (4.6 - 15.7) and FL (2.9 - 14.4) had relatively high G.C.A.:S.C.A. ratios.

6 Extremely high broad sense heritabilities were found for HC (0.92 - 0.98), FL (0.92 - 0.95) and GOT2 (0.77 - 0.93). Extremely high narrow sense heritability was found for HC (0.88 - 0.92), and relatively high values were also computed for FL (0.32 - 0.77), GOT2 (0.42 - 0.87), and FS (0.48 - 0.63).

7 Extremely high significant genetic correlations were computed between SCYP and LYP (0.97), SCYPLT and LYP (0.97), SCYPLT and LYPLT (0.98), SCYP and HC (0.98), LYP and HC (0.97), SCYP and TBF (0.96), SI and LI (0.98) and FL and FS (0.97).

8 Relatively high positive correlated response was found between SCYPLT and GOT2, LI, LB, TBF and UHB in both trials at Rustenburg. In the trials planted at Loskop characteristics like SCYP, SCYPLT, LYP and HC, had relatively high, positive correlated response with most of the other characteristics. High negative correlated response was found between SCYP and GOT, BS, HC and FL in the Loskop trials, while LYP had a negative response with GOT and BS.

9 Mid-parent as well as high or best parent heterosis were highly positive for SCYP and LYP, in most of the crosses. The cross SicalaxIrco, showed on average the highest amount of heterosis at Rustenburg and Loskop during 1997/98 season.

The amount of heterosis for SCYPLT and LYPLT varies from large negative to large positive values.

HOOFSTUK 5

OPSOMMING

1 Die doel van die navorsing is om die genetiese variabiliteit in die Suid-Afrikaanse katoen kiemplasma te bestudeer en om meerderwaardige ouerlyne vir die verbetering van opbrengs en kwaliteit te identifiseer.

2 Ses ouerlyne (Irco, Palala, OR27, 2131-2-5, DPAc90 en Sicala) is op diallele wyse gekruis. Die ouers en hul F1-nageslagte is op twee lokaliteite, Rustenburg en Loskop, in twee opeenvolgende jare 1997/98 en 1998/99 aangeplant. Twintig agronomiese en kwaliteits-eienskappe is gemeet. Die data van elke eienskap is op diallele wyse met behulp van die "Agrobase" rekenaarprogram geanaliseer.

3 Betekenisvolle gemiddelde verskille is tussen die ouerlyne sowel as hul F1-nageslagte gevind vir meeste van die gemete eienskappe, op beide lokaliteite, gedurende die twee opeenvolgende jare. Die enigste uitsonderings was SI en LB. Gemiddeld het Palala en Sicala die hoogste opbrengste by Rustenburg gehad, terwyl Irco die hoogste opbrengs by Loskop toon. Sicala was die beste ouer vir FL in beide omgewings, terwyl OR27 gemiddeld die beste ouer was vir FS op Rustenburg en Loskop. Palala was die beste ouer vir FU by Loskop, terwyl Irco en 2131-2-5 die hoogste waardes vir FU toon op Rustenburg. Vir die eienskap MV val al die ouers binne die aanvaarbare grense van tussen 3.5 en 4.5.

4 OR27 is die beste kombineerder vir opbrengs en meeste van die opbrengskomponente by Rustenburg sowel as Loskop. Die ouerlyn Sicala is die beste algemene kombineerder vir vesellengte terwyl OR27 die beste kombineerder is vir veselsterkte en veseluniformiteit by beide lokaliteite.

Ouerlyne DPAc90 is die beste kombineerder vir MC by Rustenburg en Loskop, onderskeidelik.

5 Die G.C.A.: S.C.A verhoudings is baie na aan een vir meeste eienskappe insluitend opbrengs. Sekere van die eienskappe soos HC (31.6 - 46.8), GOT2 (12.7 - 17.3), FS (4.6 - 15.7) en FL (2.9 - 14.4) het relatief hoë G.C.A.:S.C.A verhoudings.

6 Uitermate hoë breë-sin oorerflikhede is verkry vir HC (0.92 - 0.98), FL (0.92 - 0.95) en GOT2 (0.77 - 0.93). Uitermate hoë nou-sin oorerflikheid is verkry vir HC (0.88 - 0.92). Relatief hoë nou-sin oorerflikhede is bereken vir FL (0.32 - 0.77), GOT (0.42 - 0.87) en FS (0.48 - 0.63).

7 Uitermate hoë genetiese korrelasie koëffisiente is bereken tussen SCYP en LYP (0.97), SCYPLT en LYP (0.97), SCYPLT en LYPLT (0.98), SCYP en HC (0.98), LYP en HC (0.97), SCYP en TBF (0.96), SI en LI (90.98) en FL en FS (0.97).

8 Relatief hoë gekorreleerde responsies is verkry tussen SCYPLT en GOT2, LI, LB, TBF en UHB, in beide proewe by Rustenburg. In die proewe wat op Loskop geplant is, toon die eienskappe SCYP, SCYPLT, LYP en HC relatiewe hoë positiewe responsies met meeste van die ander eienskappe. Hoë negatiewe gekorreleerde responsies is waargeneem tussen SCYP en GOT, SB, HC en FL, terwyl LYP ook 'n hoë negatiewe responsie met GOT en SB toon.

9 Middel-ouer sowel as beste ouer heterose is hoog positief vir SCYP en LYP in meeste van die kruisings. Die kruis Sicalaxlrco toon gemiddeld die grootste hoeveelheid heterose by Rustenburg gedurende 1997/98. Die hoeveelheid heterose vir SCYPLT and LYPLT varieer van hoog negatief tot hoog positief.

CHAPTER SIX

CONCLUSIONS and RECOMMENDATIONS

Results of the analyses performed on the data, have shown that a relatively large amount of genetic variability exists among the genotypes for most of the characteristics measured. Heritability of most of the characteristics measured was relatively high and the correlated responses among some of them were also positive. These observations indicate that further improvements in yield and quality are possible, within the existing germplasm and that early generation selection among segregating populations will enhance most characteristics. Continued exploitation of genetic variability existing elsewhere is, however, necessary to make up for any of the shortfalls in the current germplasm. This can be done through introductions of both exotic germplasm and locally available material within the region and especially within the countries of the recently formed Cotton Forum for Southern and Eastern Africa Countries (SEACF).

Correlated responses among characteristics have shown that it is possible to apply indirect selection for simultaneous improvement of a wide range of characteristics. Breeders should, however, be aware of the strong negative correlated responses between yield and some of the characteristics. This may lead to an improvement of some characteristics at the expense of a reduction in yield components. In this study, SCYP had strong negative correlated responses from GOT, SB and FL, while LYP had strong negative correlated responses from GOT and SB.

Large positive g.c.a. effects gave an indication of availability of parent lines in the germplasm, which have good general combining ability for some of the characteristics measured. These can be utilised for the improvement of yield and quality characteristics. In this study, OR27 proved to be a good general combiner for SCYP, most of the yield components, as well as some of the fibre quality characteristics like FS and FU, at both locations. Sicala proved to be a good general combiner for FL at both locations as well as TBF at Rustenburg. Irco was a good general combiner, at both locations, for HC and for TBF at Loskop. Introduced germplasm, both exotic and local, should be evaluated extensively for good performance and adaptability, and crossed with identified lines having good general combining abilities. Other useful and beneficial morphological traits like okra leaf for earliness, frego brack and hairiness for insect resistance should be studied further and introduced into these combinations. These characteristics are already in the breeding program at TCRI and their beneficial uses should be further exploited.

Heterosis values calculated in this study were positive and relatively high and do justify studies on the possibility of a hybrid cotton breeding programme. There was relatively high positive useful heterosis for SCYP. This would make hybrid cotton production beneficial and more especially, when the hybrids carry some genes for insect and disease resistance. For some characteristics, the location effects on the genotypes were extremely high indicating the specific adaptation needs of cotton. For the best response it would be worthwhile to split the F_2-germplasm into two groups and run two early generations programs simultaneously, one at Rustenburg and the other at Loskop. If such a program is too costly, the breeder can delay the whole process until the breeding material reaches homozygosity before testing it for adaptation at different locations.

ABBREVIATION LIST

A or a	Additive
ACB	Analysis of Complete (Balanced) Blocks
ANOVA	Analysis of Variance
ARC	Agricultural Research Council
b	Repeatability (of results)
BS	Boll size
Ca	Calcium
CL	Chloride
cN/tex	Units of measurement for fibre strength
COV	Coefficient of variance
Covp	Phenotypic coefficient of variance
CR	Correlated response
CV	Coefficient of variance
EMS	Expected Mean Squares
EXPT	Experiment
F1	Filial one
FL	Fibre length
FS	Fibre strength
FU	Fibre uniformity
GCA (or g.c.a.)	General Combining Ability
G x E	Genotype by Environment interaction
G x L	Genotype by Location interaction
GOT	Ginning Out Turn
G. spp.	Gossypium species
g/tex	Units of measurements for fibre strength
h^2	Heritability
HB	Harvestable bolls (per plant)
h^2_b	Heritability in broad sense
h^2_n	Heritability in narrow sense
HC	Hair Count
Hp	High Parent
HVI	High Volume Instrument
i	Intensity of selection
K	Potassium
L.	Linneus
LB	Locules per Boll
LI	Lint Index
LYP	Lint Yield per plot
LYPLT	Lint Yield per plant
MC	Micronaire
mse	mean squares for error
Mg	Magnesium
mg	mean squares for general combining ability

MS	Mean Squares
ms	mean squares for specific combining ability
N	Nitrogen
P or p	Phenotype or probability or Phosphorous
PH	Plant Height
pH	Measure of soil acidity or alkalinity
R or r	Correlation coefficient
SB	Seeds per Boll
SCYP	Seed Cotton Yield per Plot
SCYPLT	Seed Cotton Yield per Plant
se	sum of squares for error
sg	sum of squares for general combining ability
SI	Seed Index
SS	Sum of Squares
ss	sum of squares for specific combining ability
TBF	Total Bolls Formed (per plant)
TCRI	Tobacco and Cotton Research Institute
UHB	Unharvestable Bolls (per plant)
Zn	Zinc

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APPENDIX : A

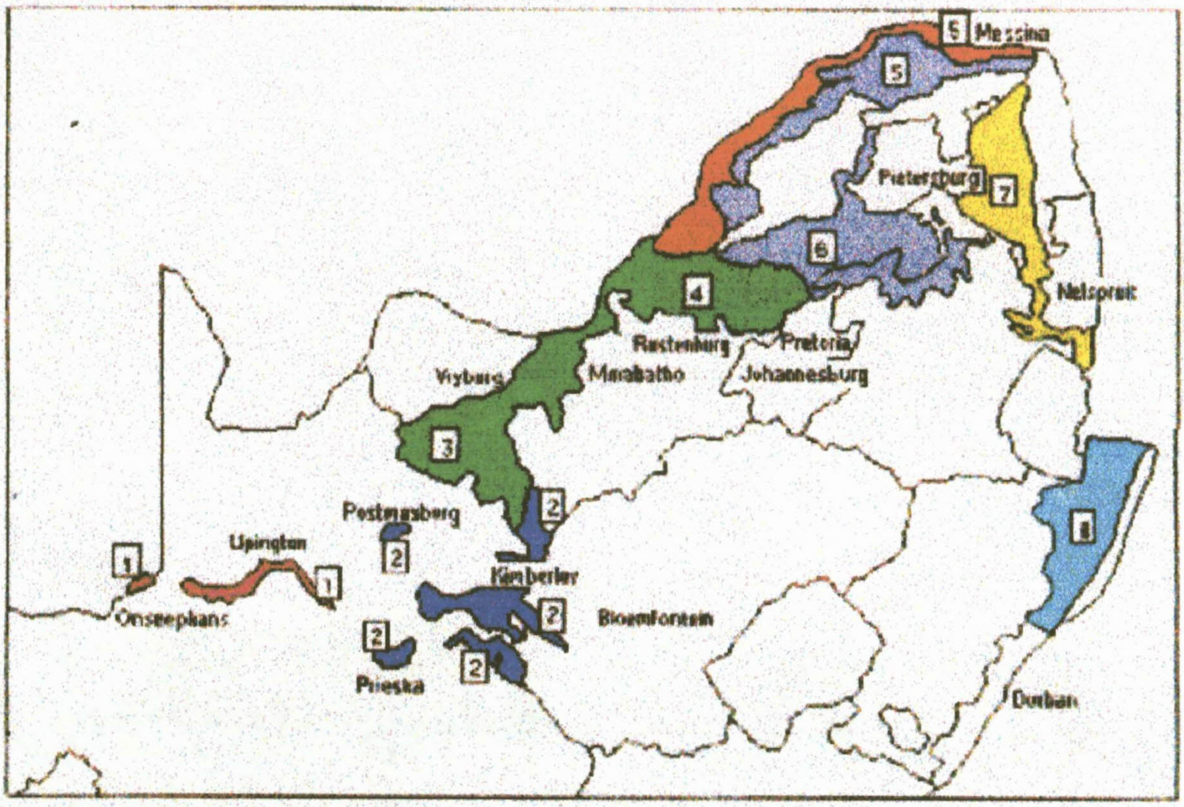

FIG. 1. Cotton Areas in the RSA (areas 1 to 8)

1. **Lower Orange River (Irrigation)**
2. **Griekwaland-West (Irrigation)**
3. **North-West Vryburg**
4. **North-West Rustenburg**
5. **Limpopo Valley**
6. **Loskop - Springbok Flats**
7. **Lowveld (Irrigation)**
8. **Kwazulu-Natal**

Appendix B

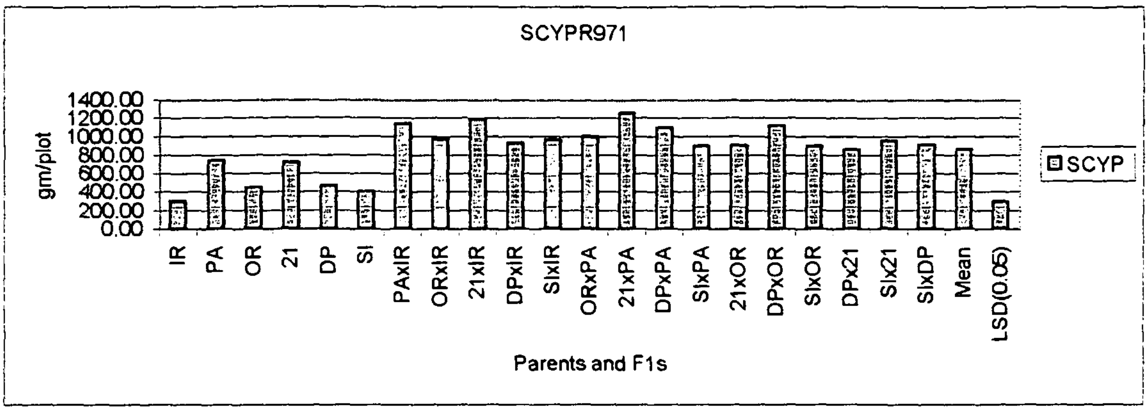

Fig. 4.2.1.1 Seed cotton yield per plot, Rusternburg 1997/98

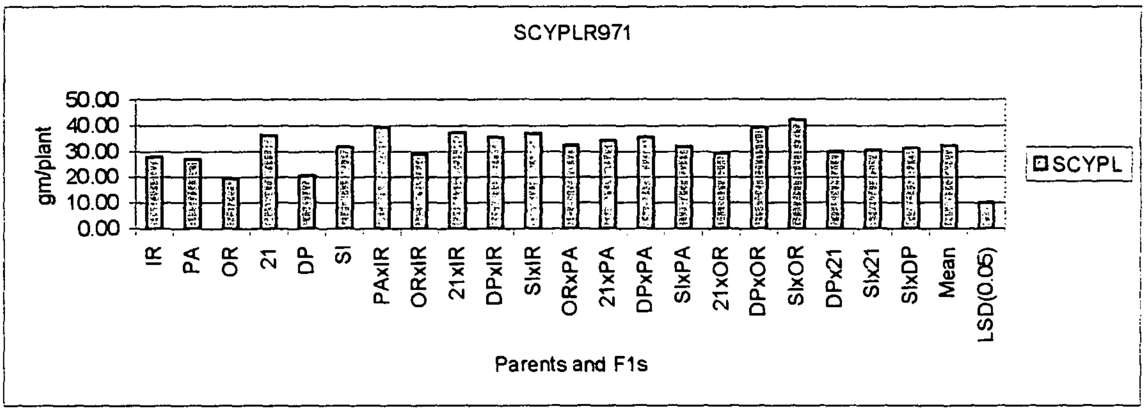

Fig. 4.2.1.2 Seed cotton yield per plant, Rusternburg 1997/98

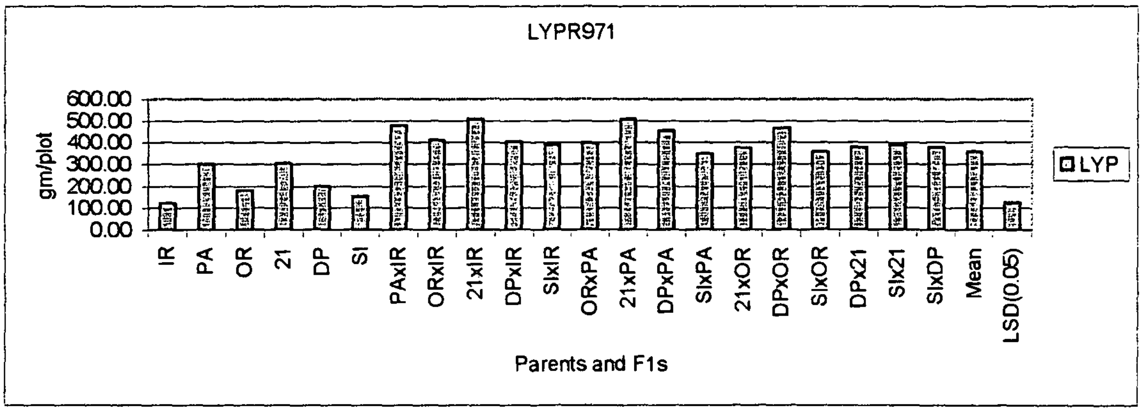

Fig. 4.2.1.3 Lint yield per plot, Rusternburg 1997/98

Appendix B

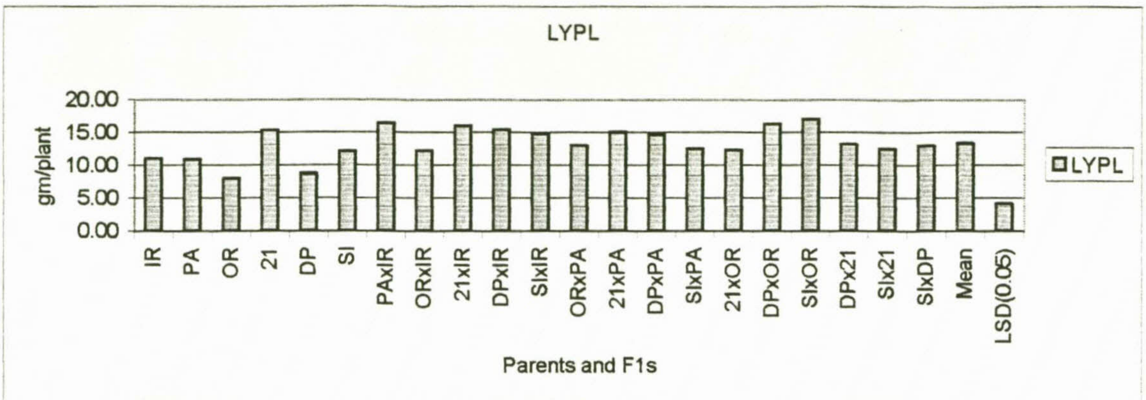

Fig. 4.2.1.4 Lint yield per plant, Rusternburg 1997/98

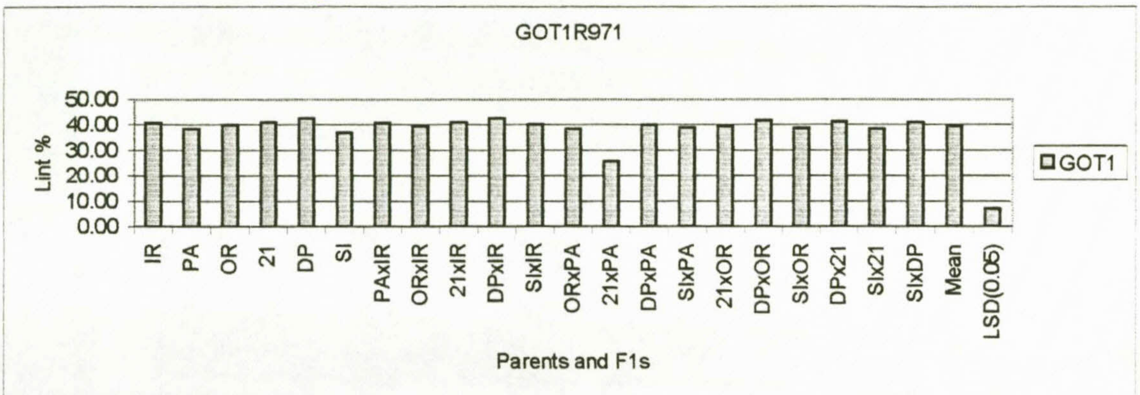

Fig. 4.2.1.5 Ginning out turn 1, Rusternburg 1997/98

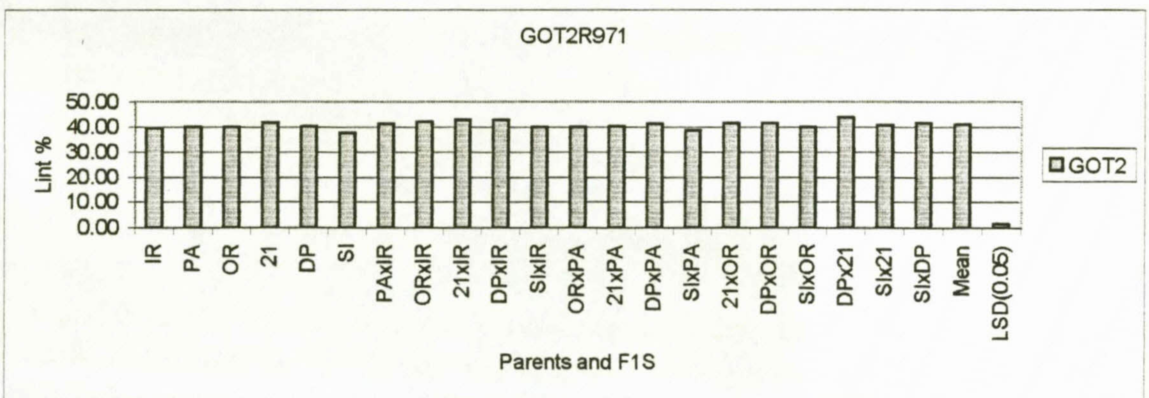

Fig. 4.2.1.6 Ginning out turn 2, Rusternburg 1997/98

Appendix B

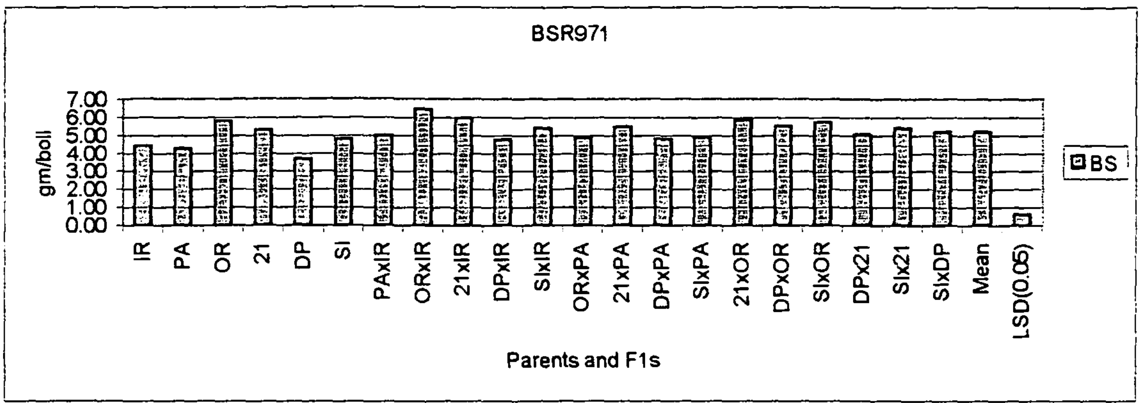

Fig. 4.2.1.7 Boll size, Rusternburg 1997/98

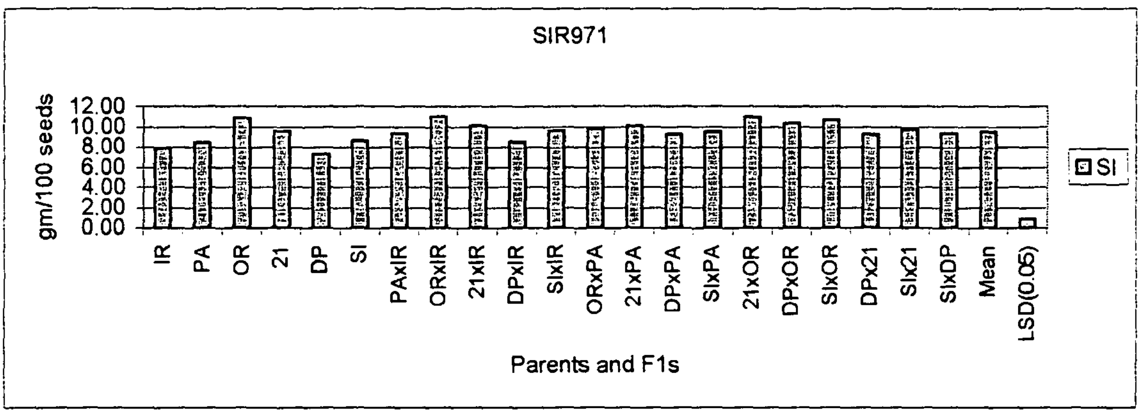

Fig. 4.2.1.8 Seed index, Rusternburg 1997/98

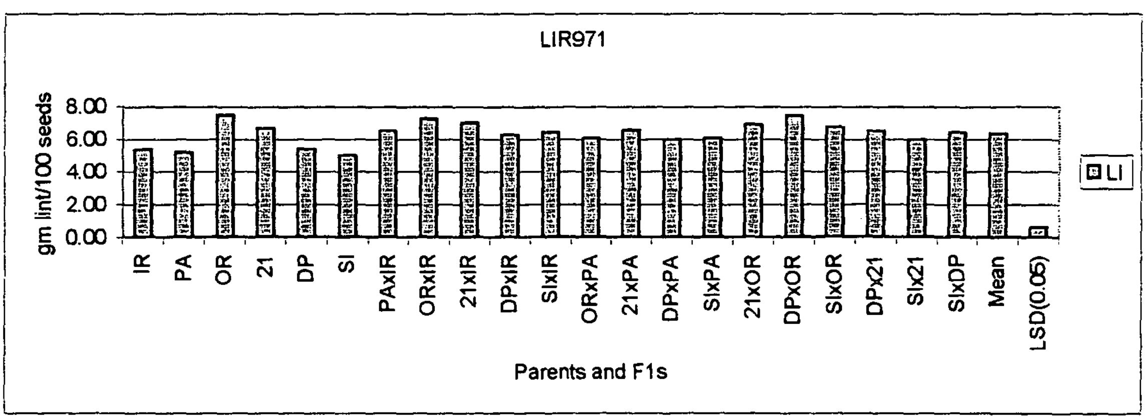

Fig. 4.2.1.9 Lint index, Rusternburg 1997/98

Appendix B

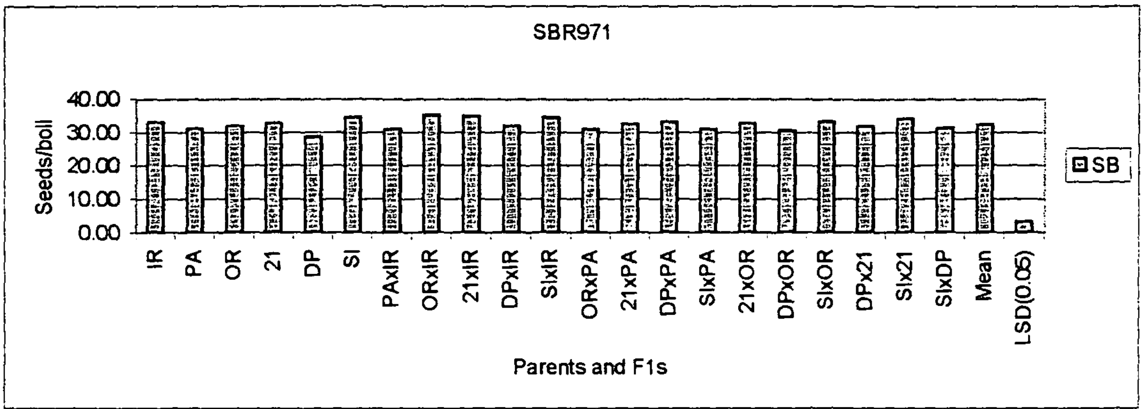

Fig. 4.2.1.10 Seeds per boll, Rusternburg 1997/98

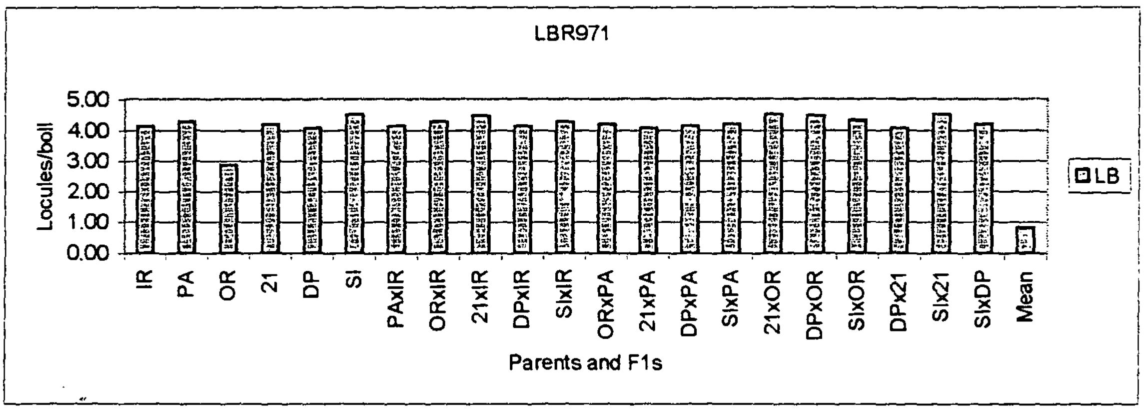

Fig. 4.2.1.11 Locules per boll, Rusternburg 1997/98

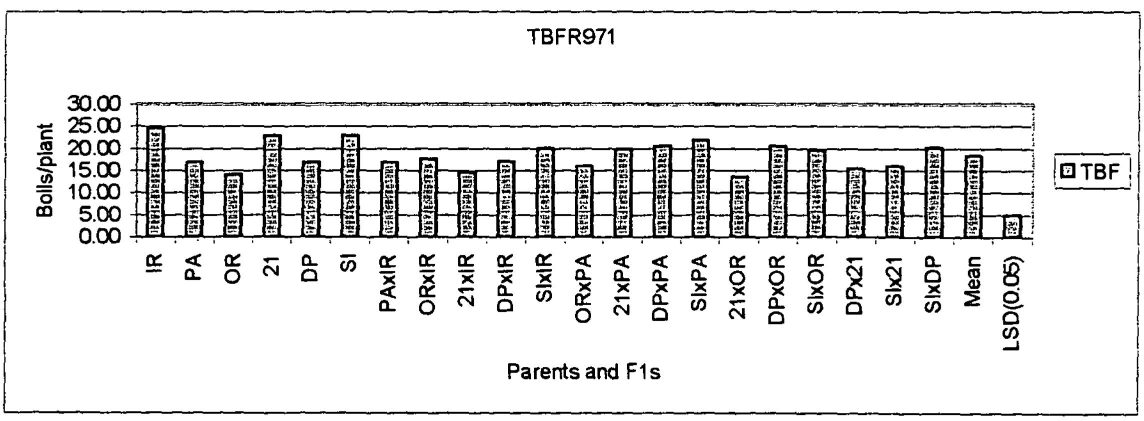

Fig. 4.2.1.12 Total bolls formed per plant, Rusternburg 1997/98

Appendix B

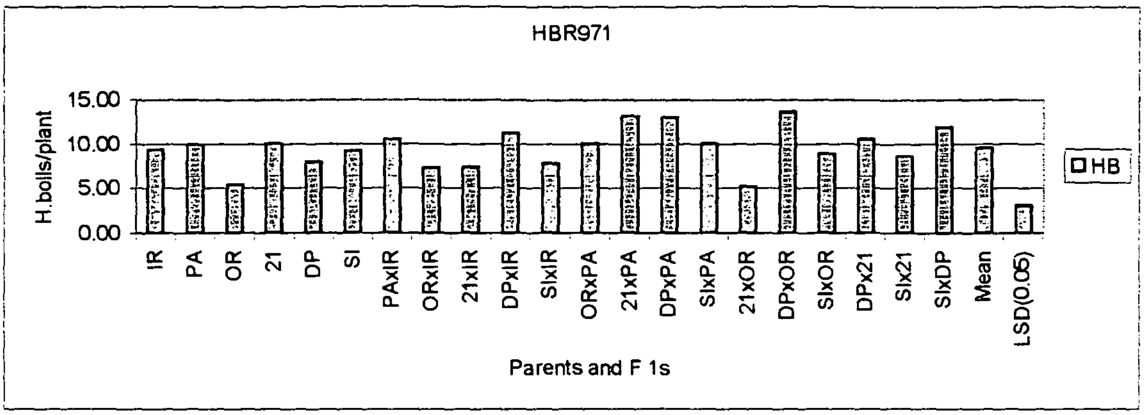

Fig. 4.2.1.13 Harvestable bolls per plant, Rusternburg 1997/98

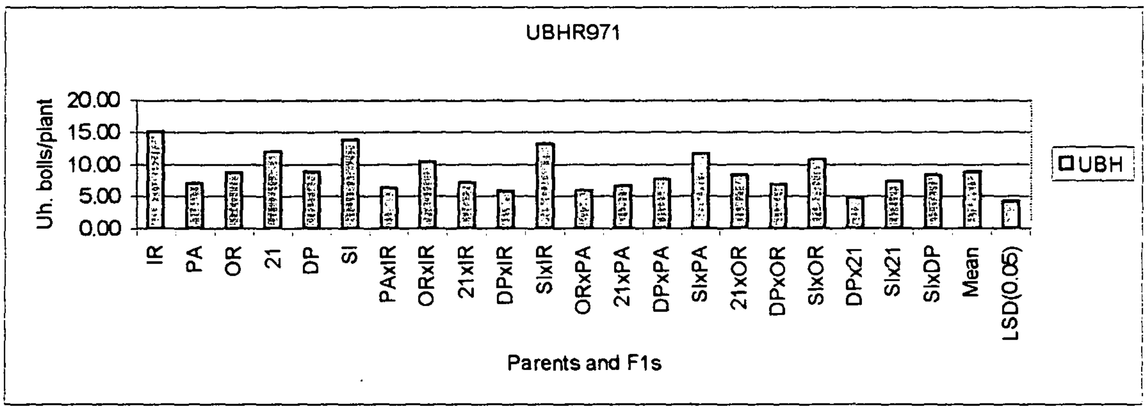

Fig. 4.2.14 Unharvestable bolls per plant, Rusternburg 1997/98

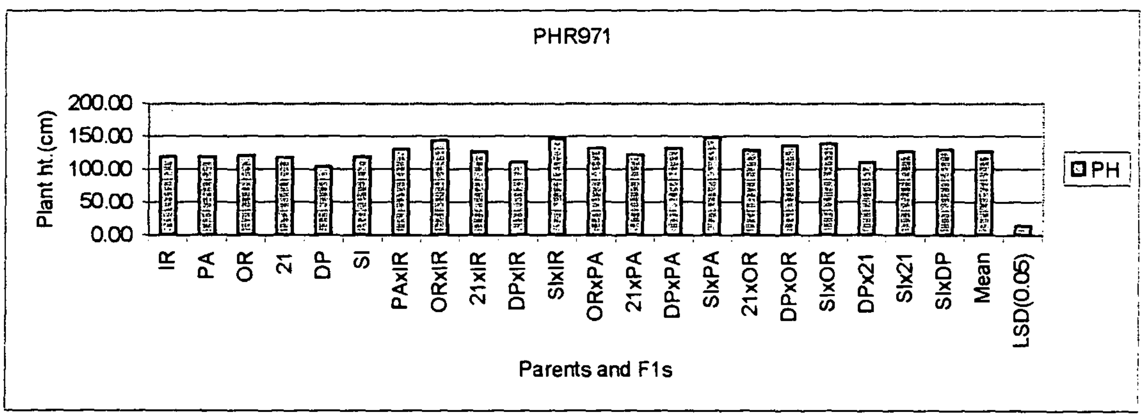

Fig. 4.2.1.15 Plant height, Rusternburg 1997/98

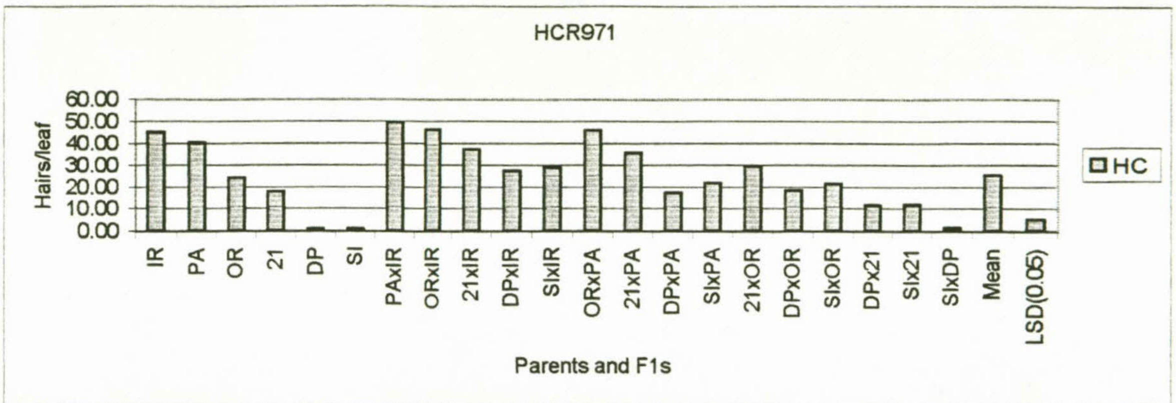

Fig. 4.2.1.16 Hair count per leaf, Rusternburg 1997/98

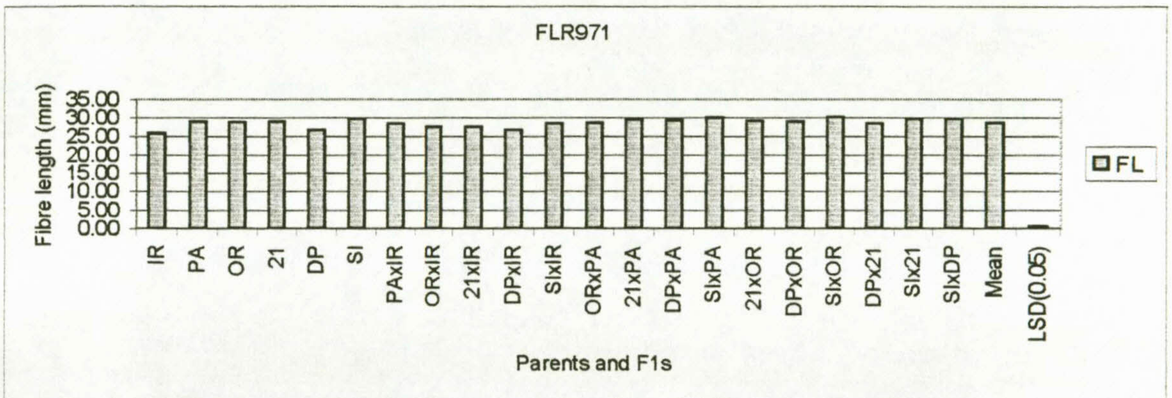

Fig. 4.2.1.17 Fibre length, Rusternburg 1997/98

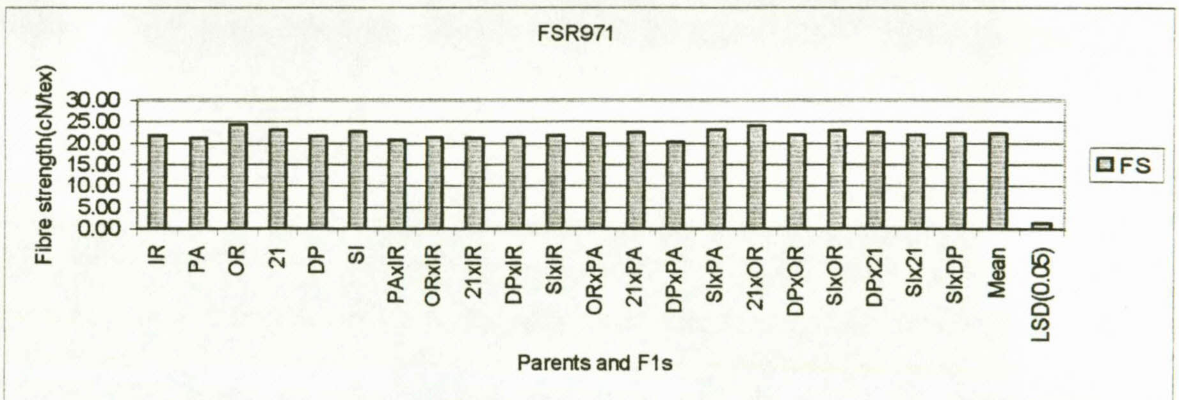

Fig. 4.2.1.18 Fibre strength, Rusternburg 1997/98

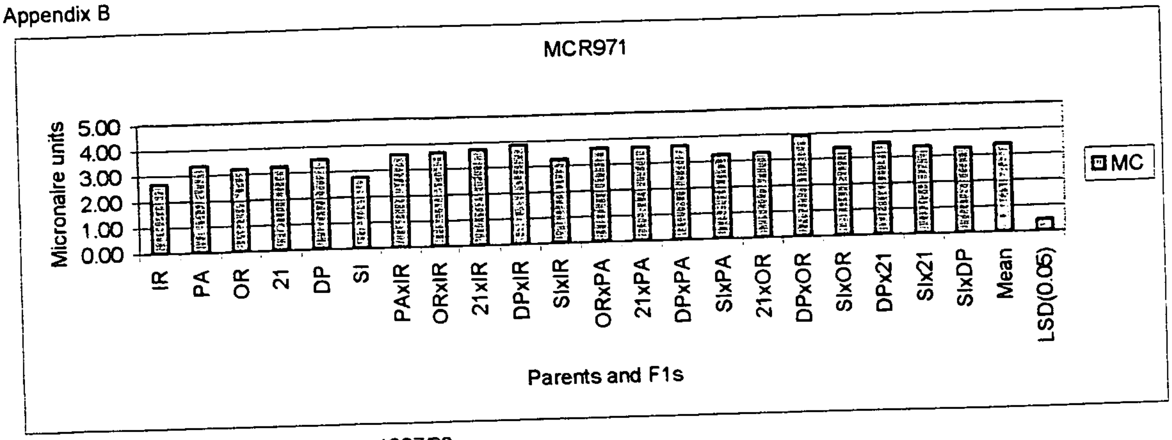

Fig. 4.2.1.19 Micronaire, Rusternburg 1997/98

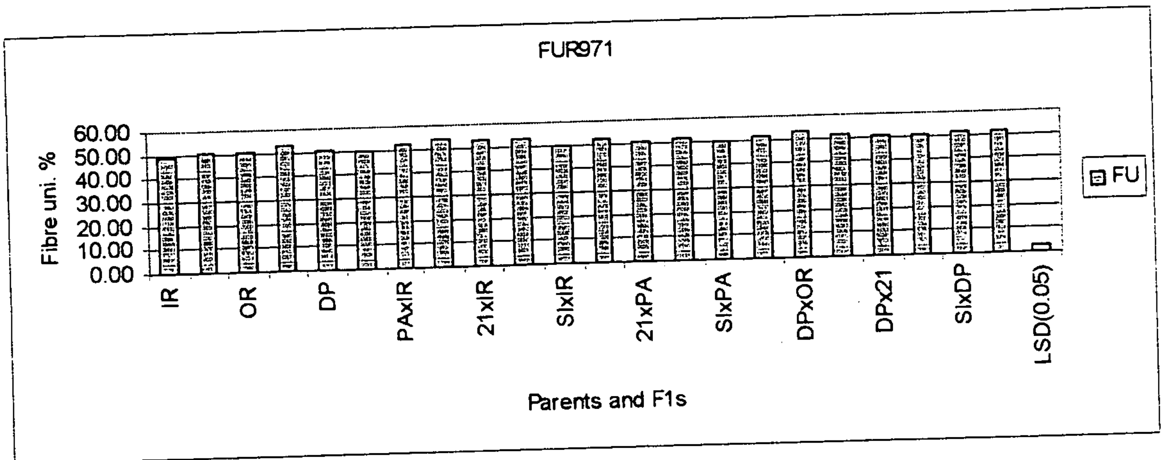

Fig. 4.2.1.20 Fibre uniformity, Rusternburg 1997/98

Appendix C

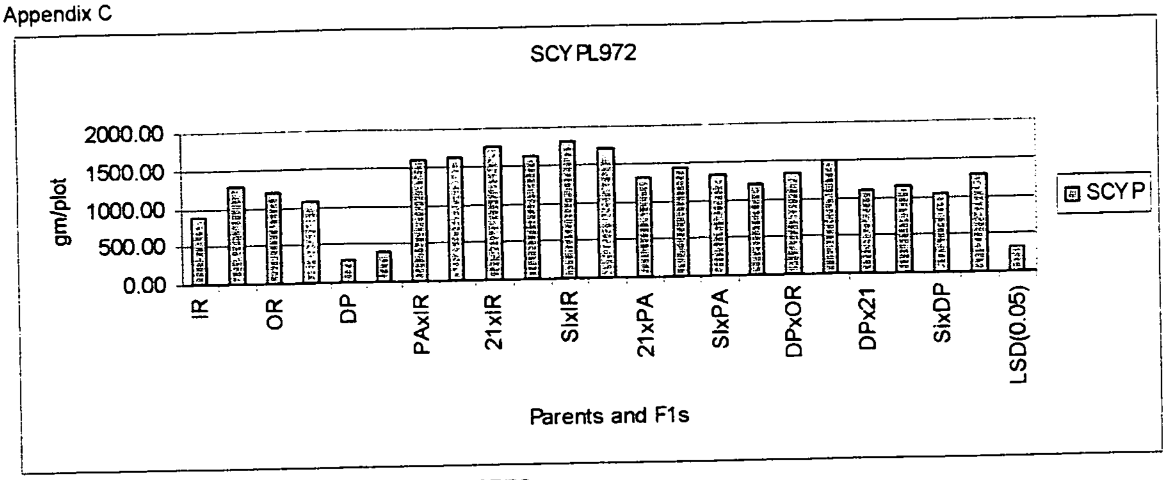

Fig. 4.2.2.1 Seed cotton yield per plot, Loskop 1997/98

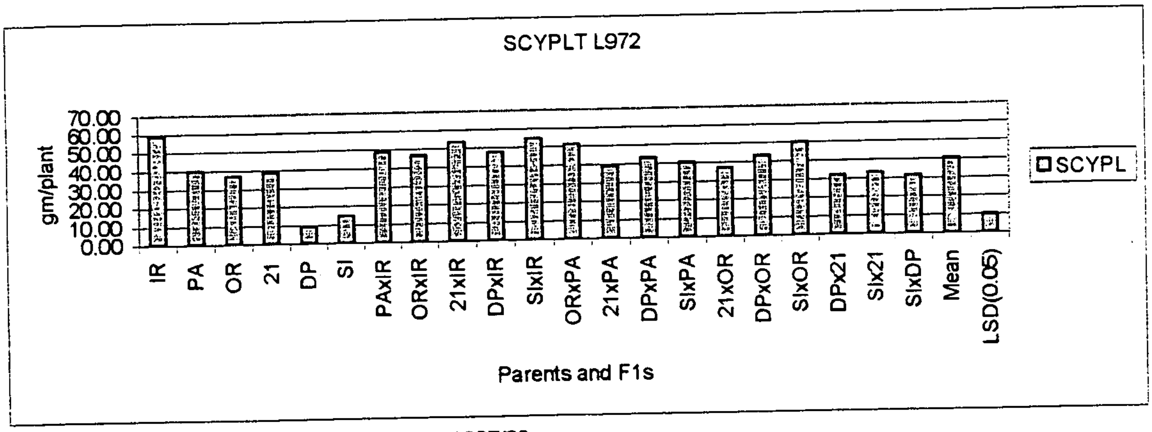

Fig. 4.2.2.2 Seed cotton yield per plant, Loskop 1997/98

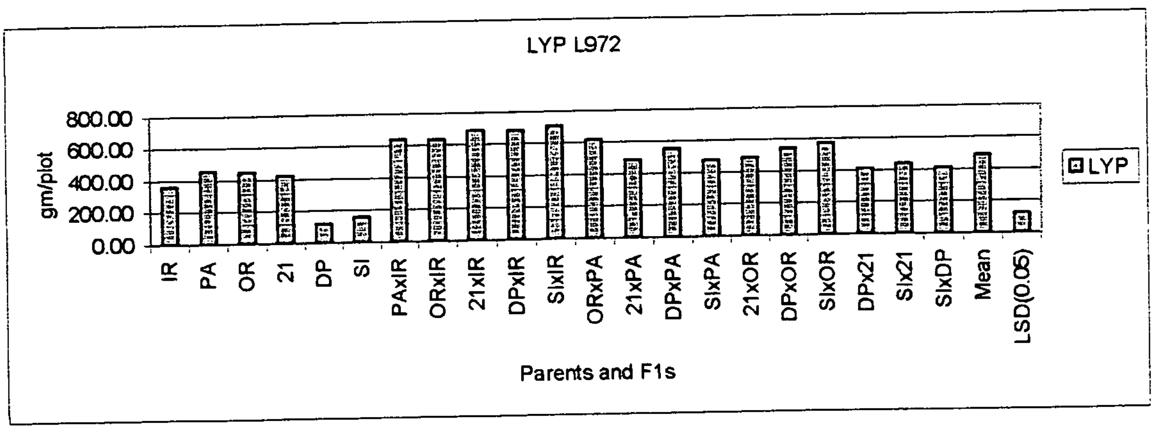

Fig. 4.2.2.3 Lint yield per plot, Loskop 1997/98

Appendix C

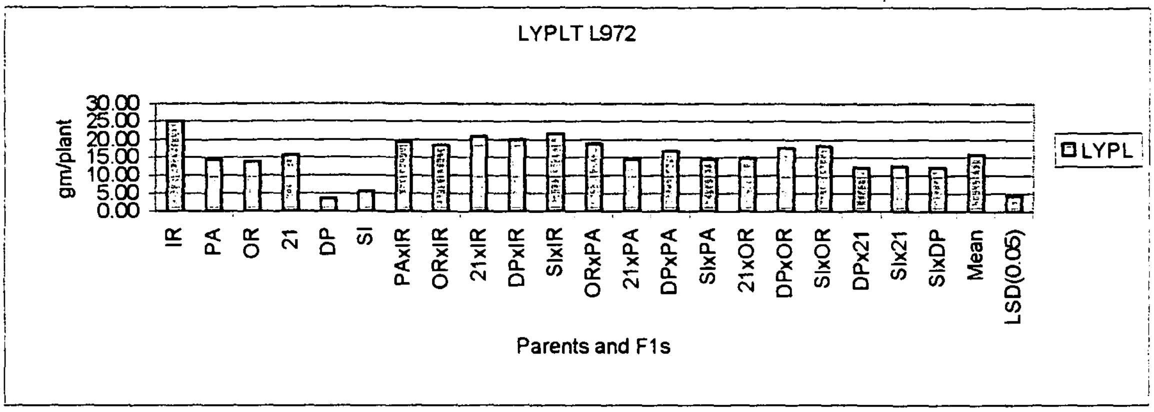

Fig. 4.2.2.4 Lint yield per plant, Loskop 1997/98

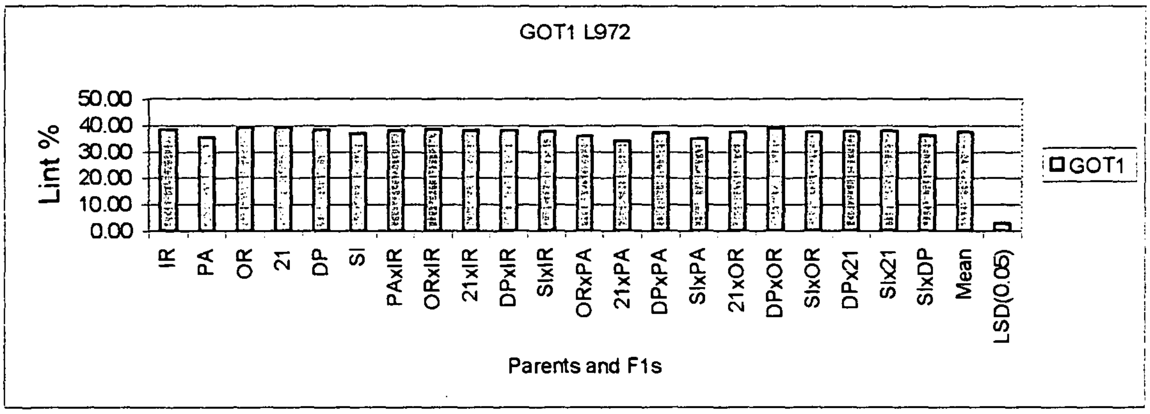

Fig. 4.2.2.5 Ginning out turn 1, Loskop 1997/98

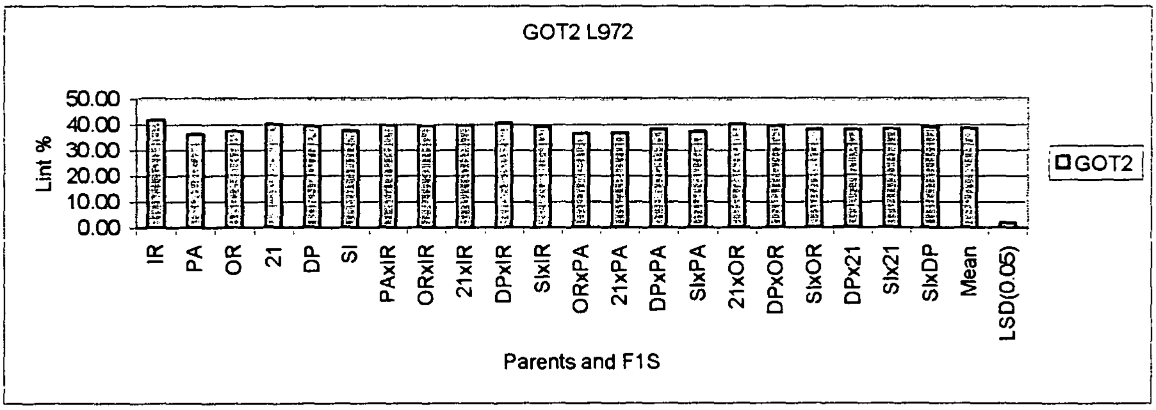

Fig. 4.2.2.6 Ginning out turn 2, Loskop 1997/98

Appendix C

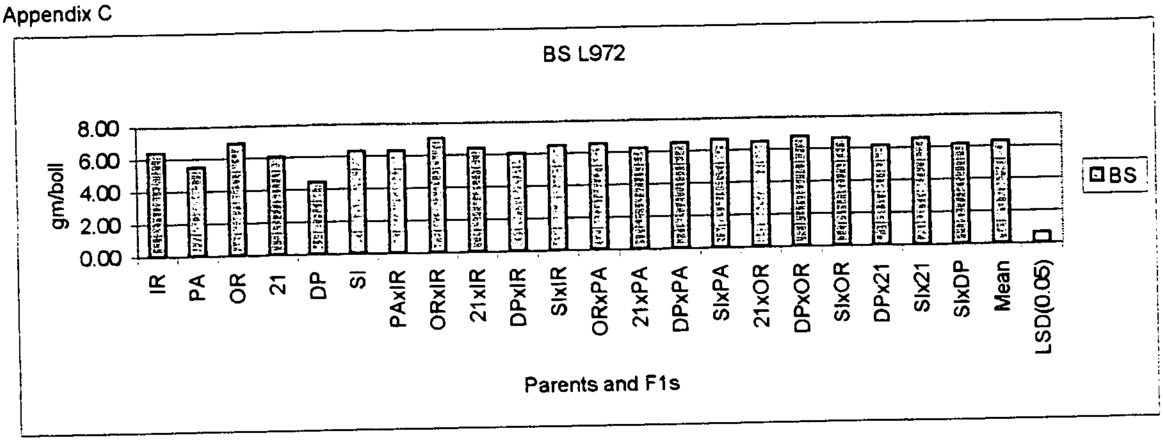

Fig. 4.2.2.7 Boll size, Loskop 1997/98

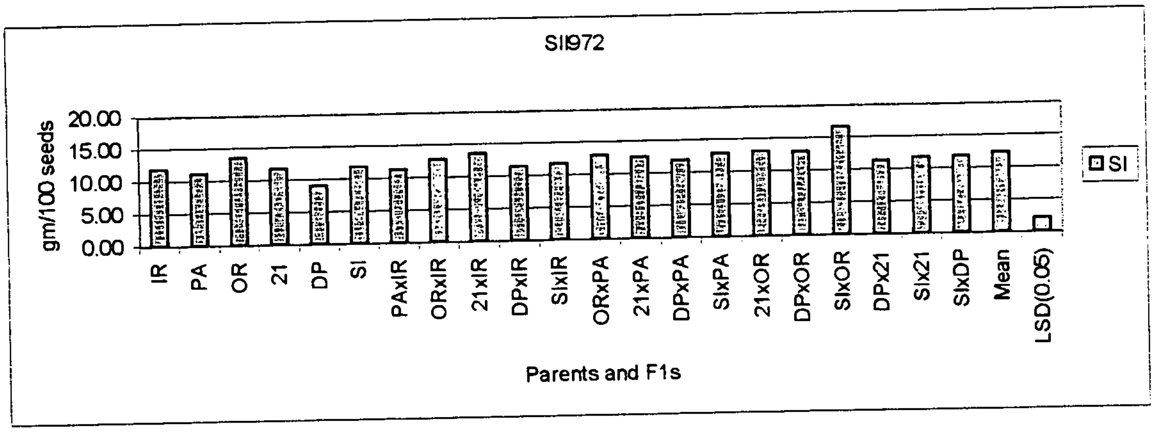

Fig. 4.2.2.8 Seed index, Loskop 1997/98

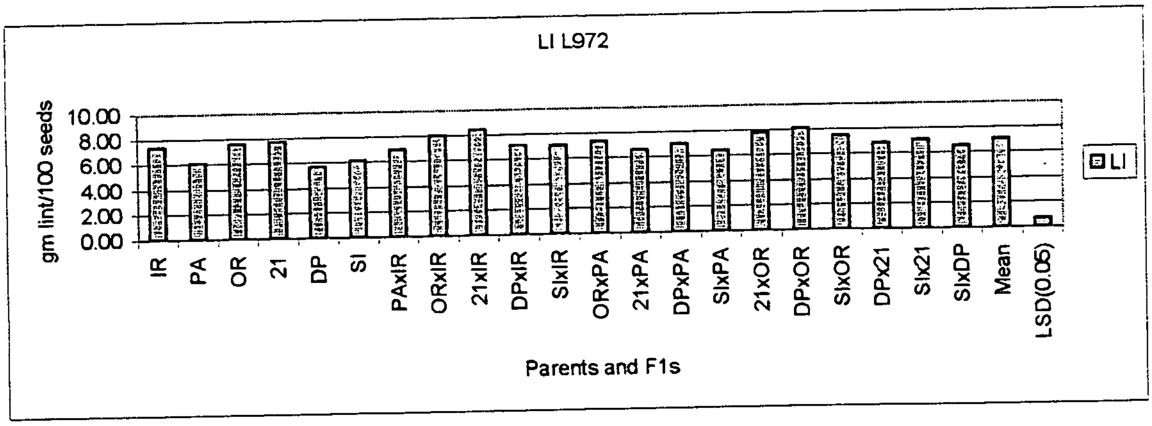

Fig. 4.2.2.9 Lint index, Loskop 1997/98

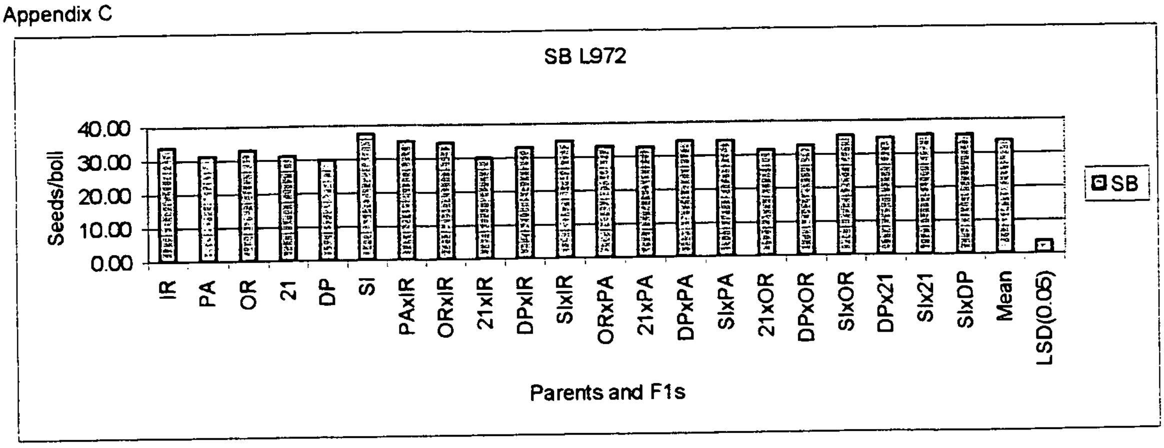

Fig. 4.2.2.10 Seeds per boll, Loskop 1997/98

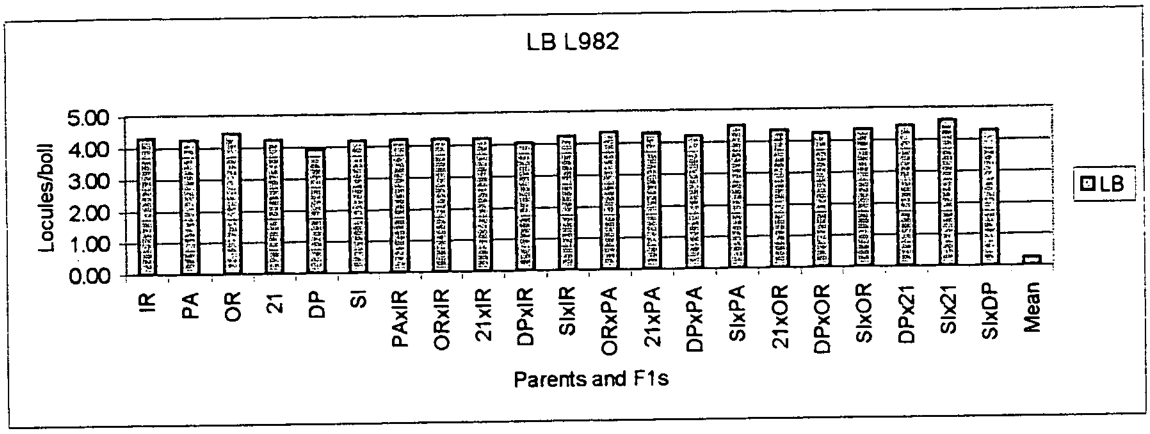

Fig. 4.2.2.11 Locules per boll, Loskop 1997/98

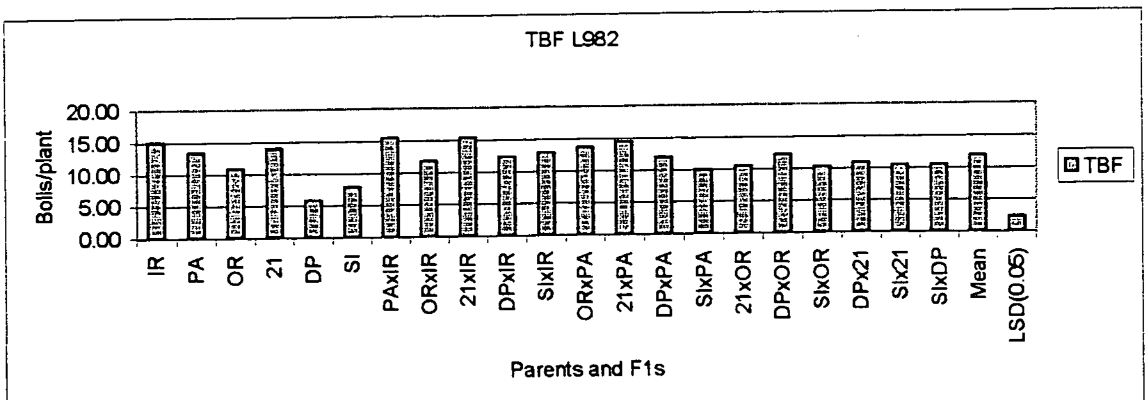

Fig. 4.2.2.12 Total bolls formed per plant, Loskop 1997/98

Appendix C

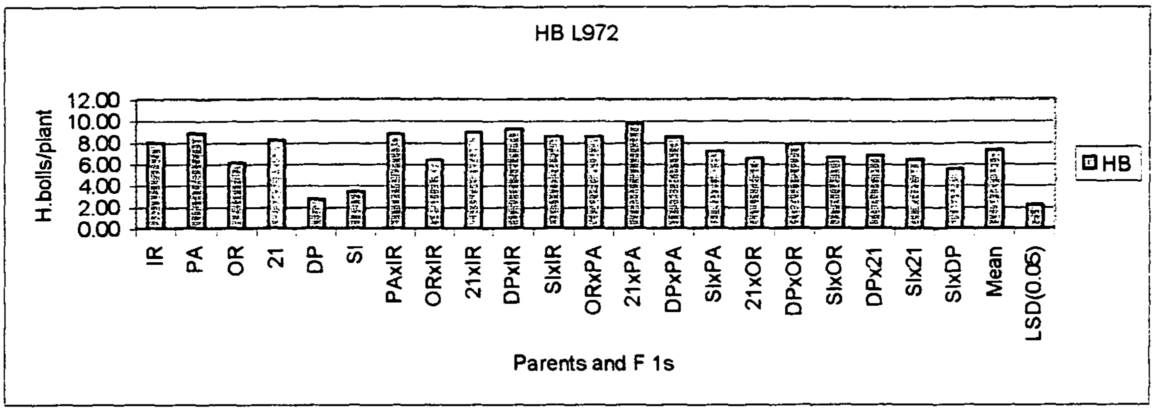

Fig. 4.2.2.13 Harvestable bolls per plant, Loskop 1997/98

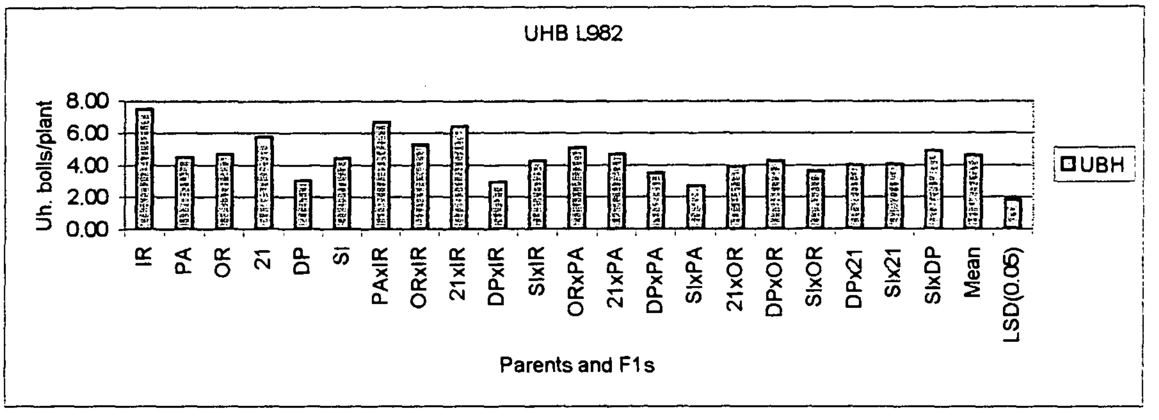

Fig. 4.2.2.14 Unharvestable bolls per plant, Loskop 1997/98

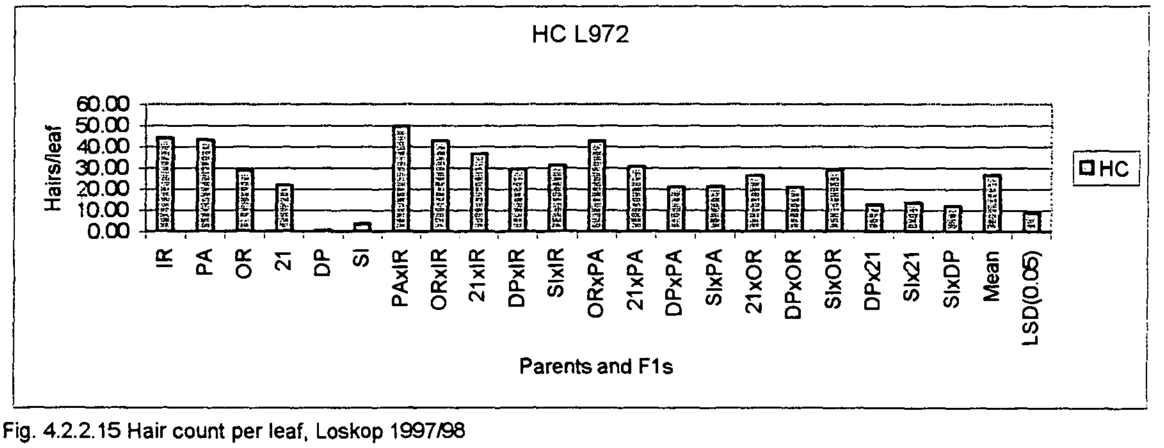

Fig. 4.2.2.15 Hair count per leaf, Loskop 1997/98

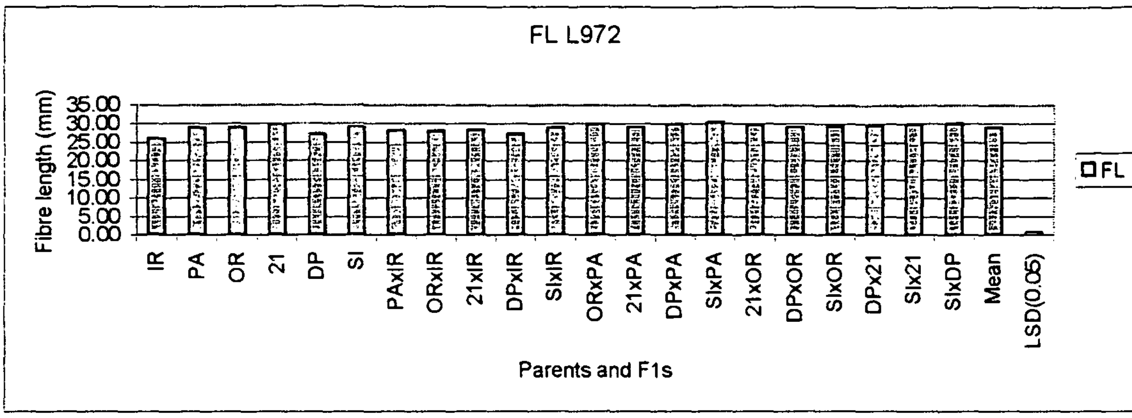

Fig. 4.2.2.16 Fibre length, Loskop 1997/98

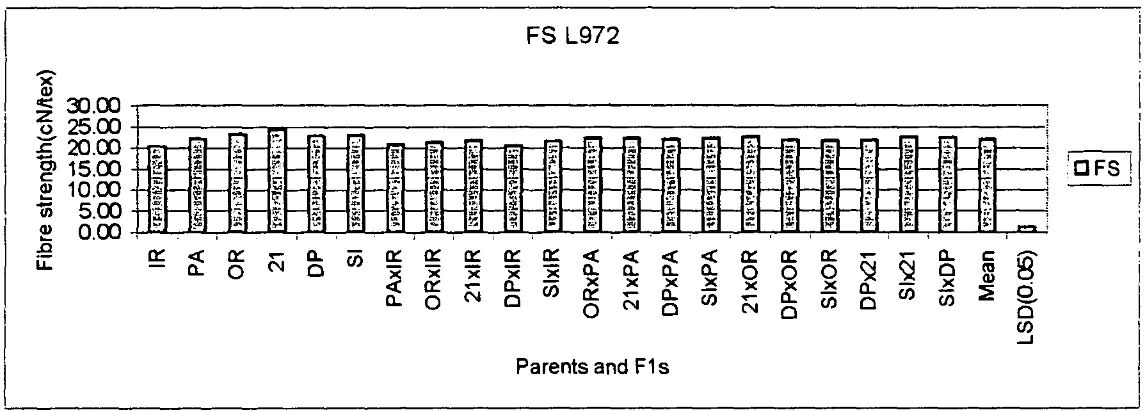

Fig. 4.2.2.17 Fibre strength, Loskop 1997/98

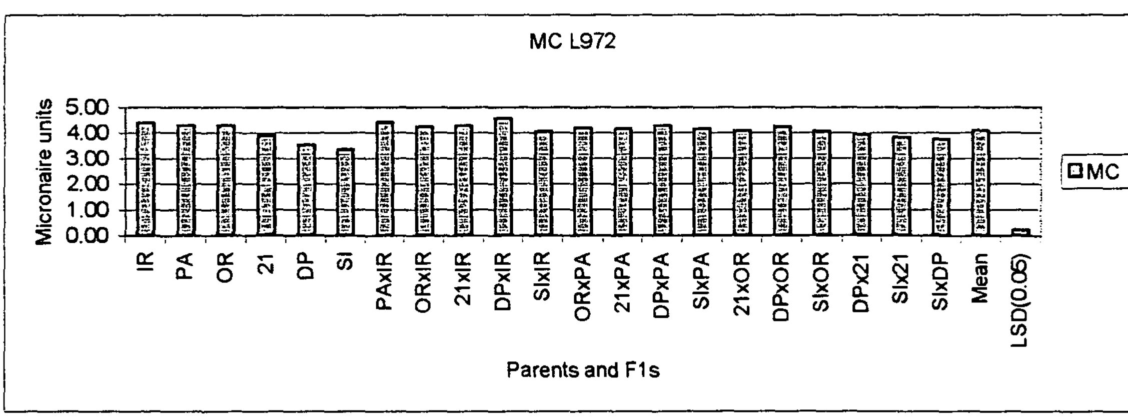

Fig. 4.2.2.18 Micronaire, Loskop 1997/98

Appendix C

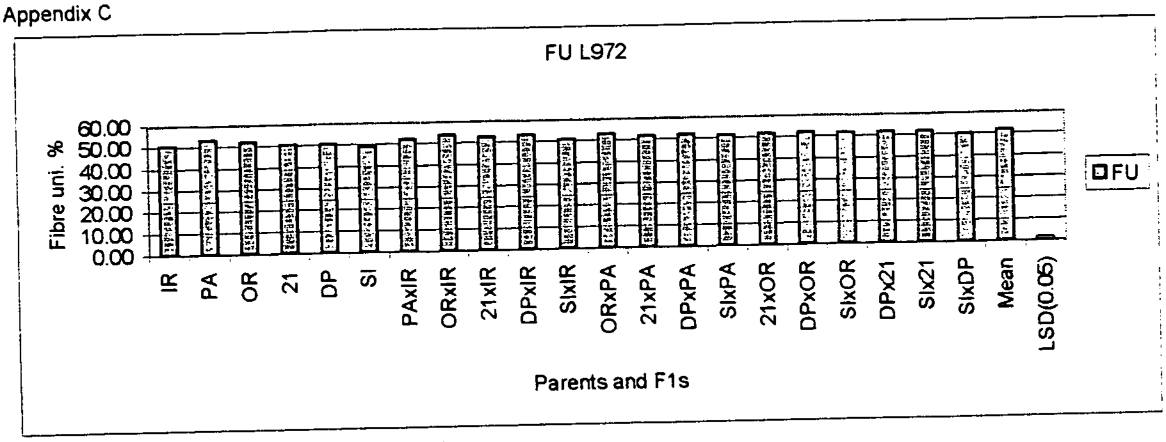

Fig. 4.2.2.19 Fibre uniformity, Loskop 1997/98

Appendix D

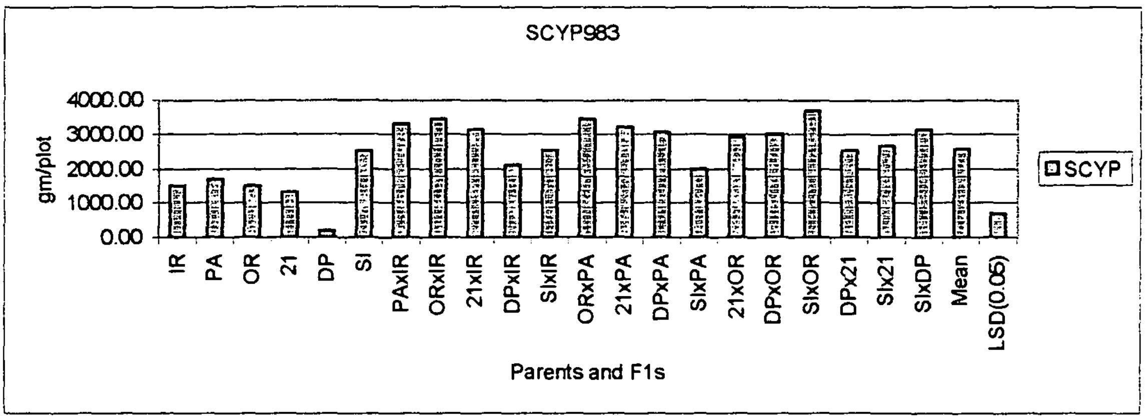

Fig. 4.2.3.1 Seed cotton yield per plot, Rusternburg 1998/99

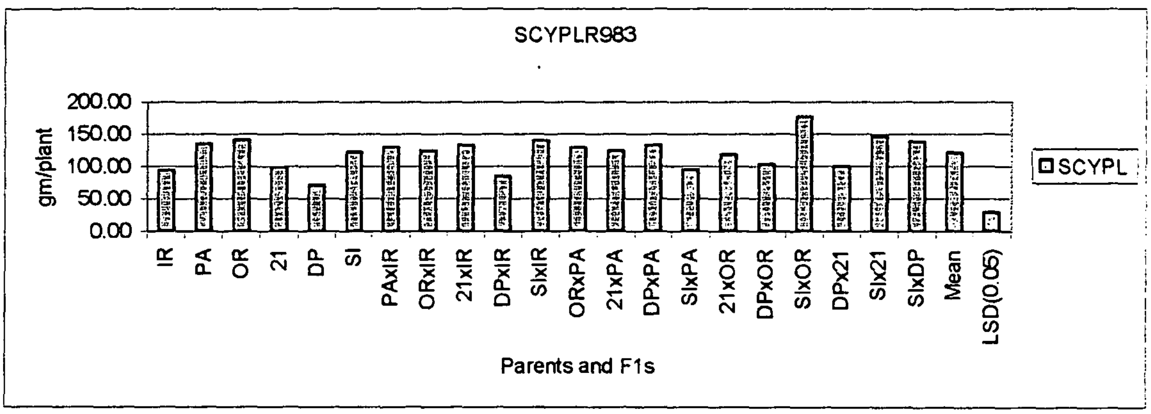

Fig. 4.2.3.2 Seed cotton yield per plant, Rusternburg 1998/99

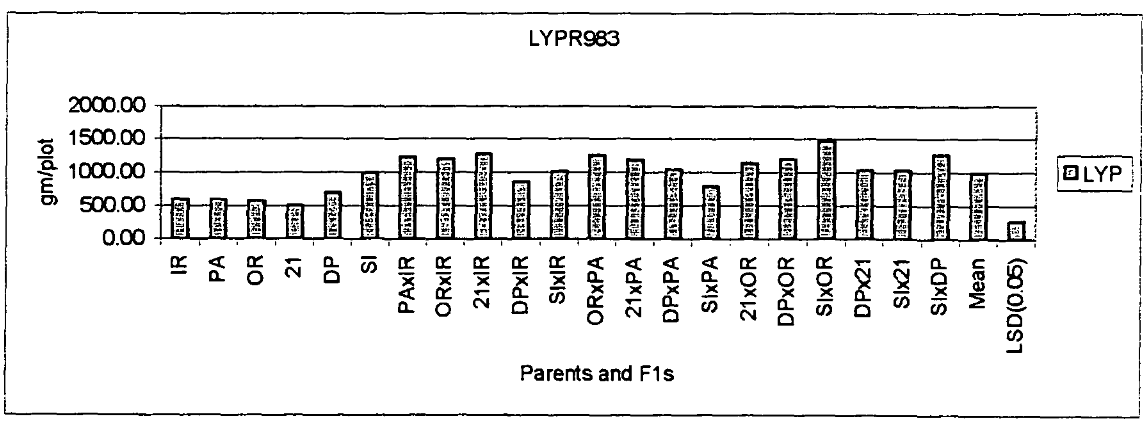

Fig. 4.2.3.3 Lint yield per plot, Rusternburg 1998/99

Appendix D

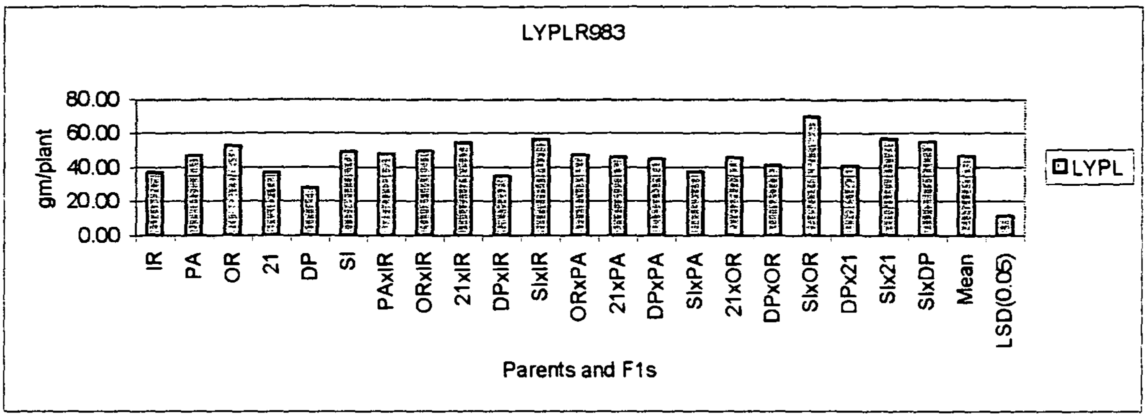

Fig. 4.2.3.4 Lint yield per plant, Rusternburg 1998/99

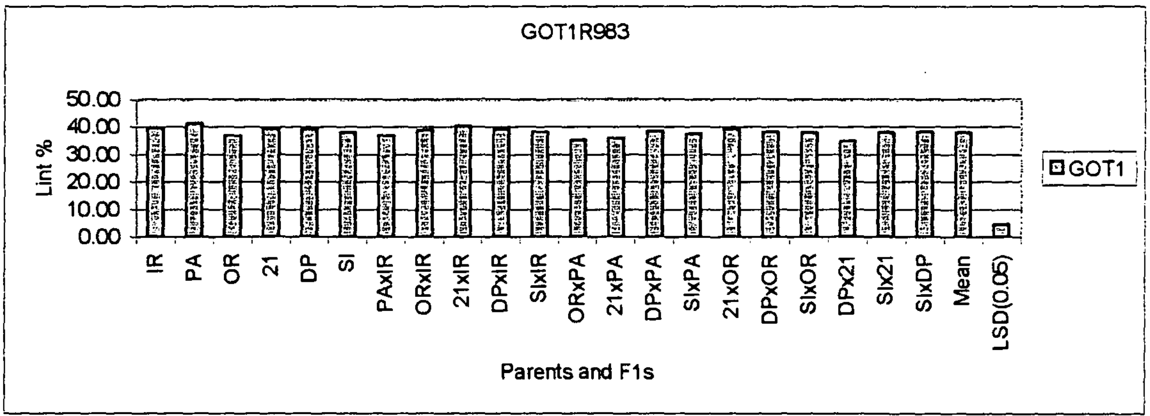

Fig 4.2.3.5 Ginning out turn 1, Rusternburg 1998/99

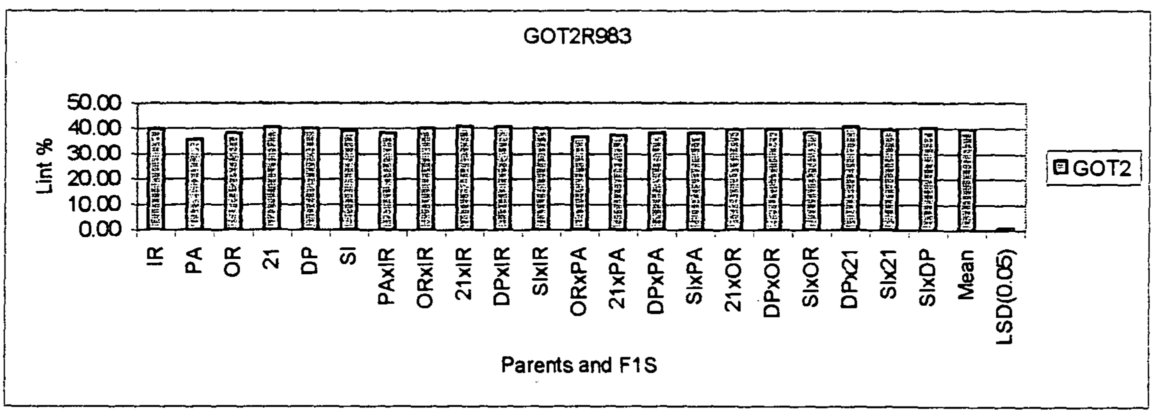

Fig. 4.2.3.6 Ginning out turn 2, Rusternburg 1998/99

Appendix D

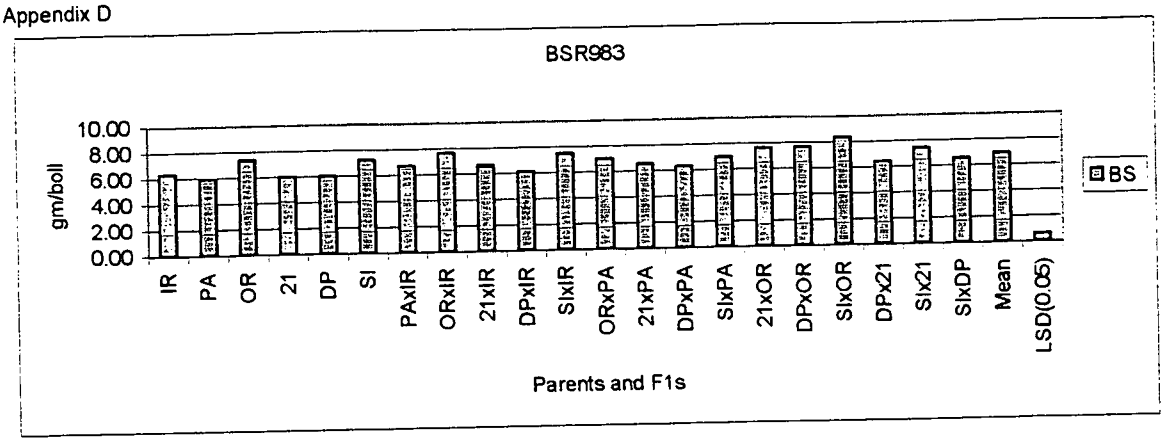

Fig. 4.2.3.7 Boll size, Rusternburg 1998/99

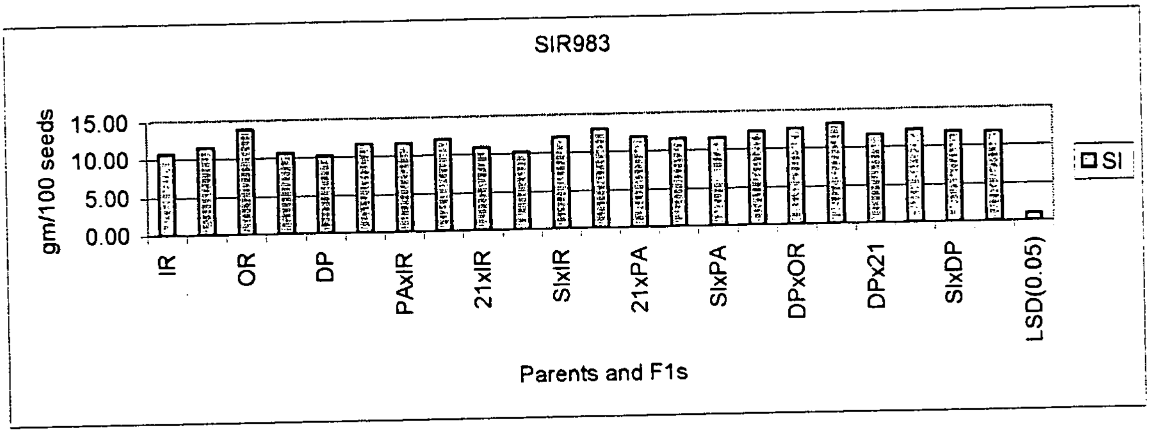

Fig. 4.2.3.8 Seed index, Rusternburg 1998/99

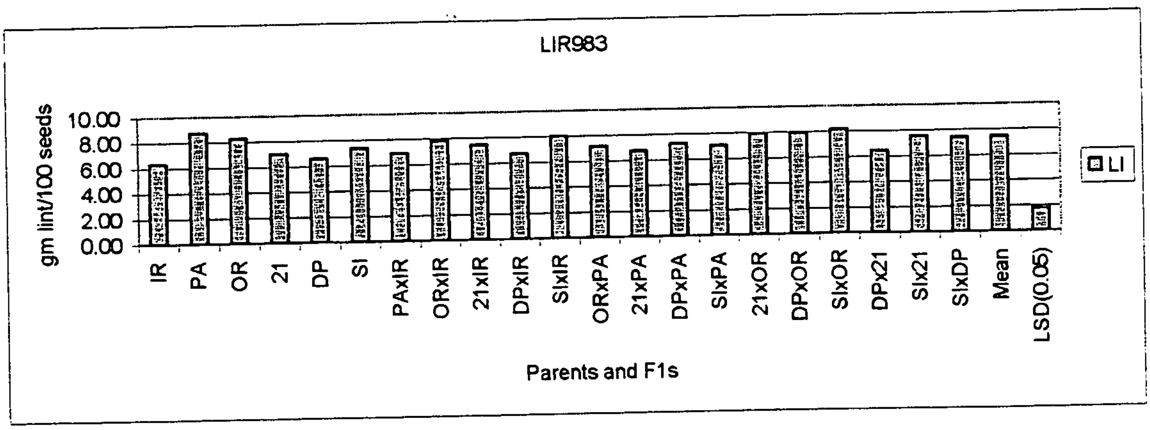

Fig. 4.2.3.9 Lint index, Rusternburg 1998/99

Appendix D

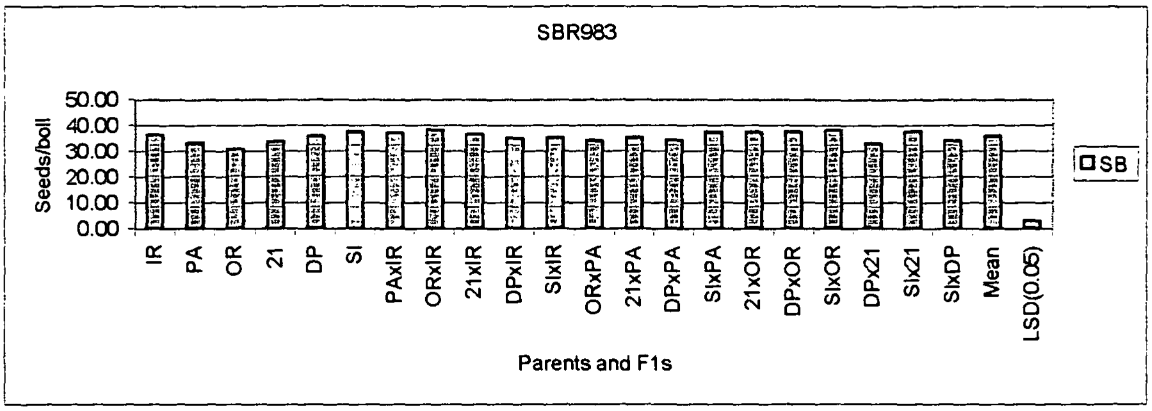

Fig. 4.2.3.10 Seeds per boll, Rusternburg 1998/99

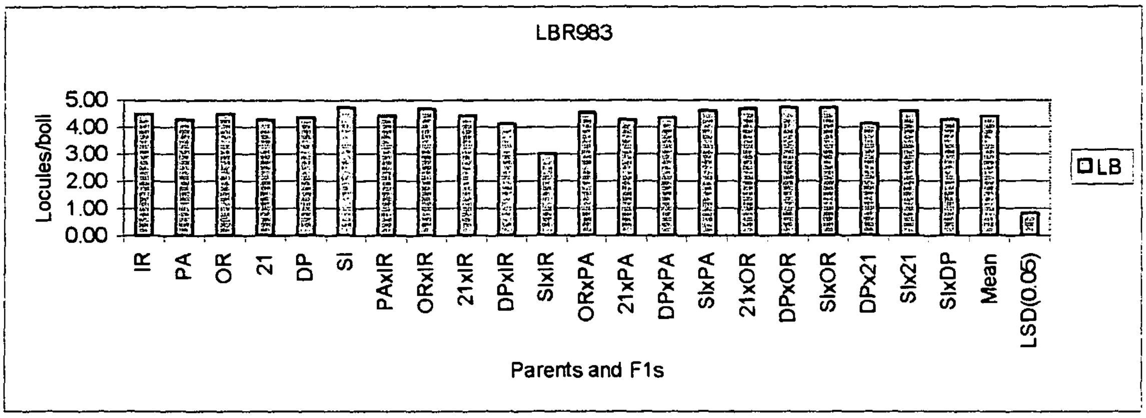

Fig. 4.2.3.11 Locules per boll, Rusternburg 1998/99

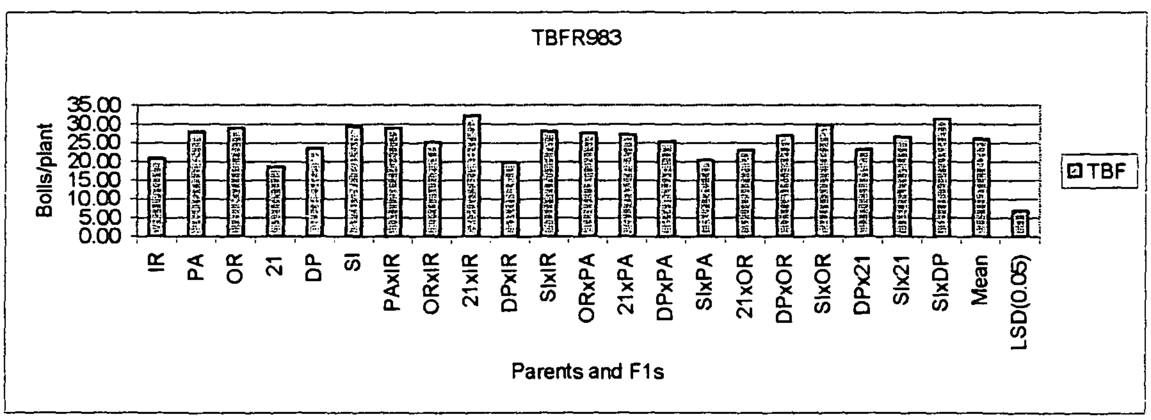

Fig. 4.2.3.12 Total bolls formed per plant, Rusternburg 1998/99

Appendix D

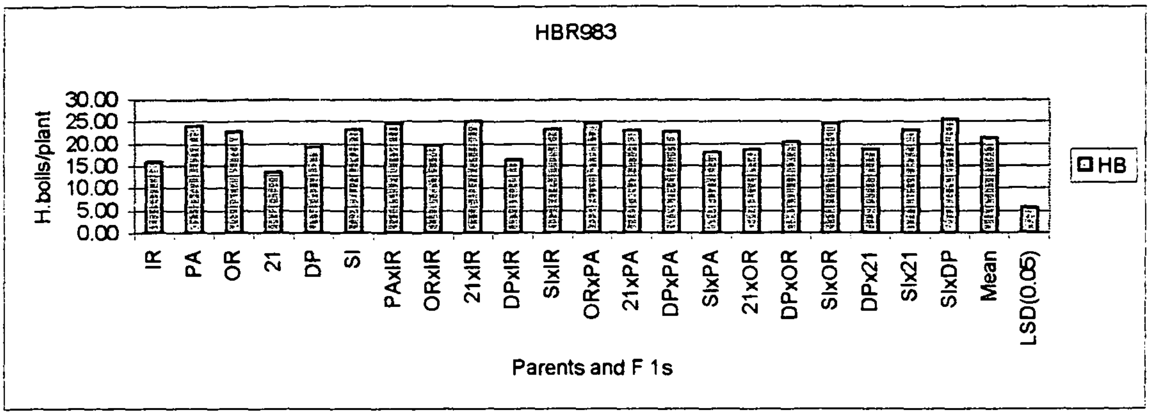

Fig. 4.2.3.13 Harvestable bolls per plant, Rusternburg 1998/99

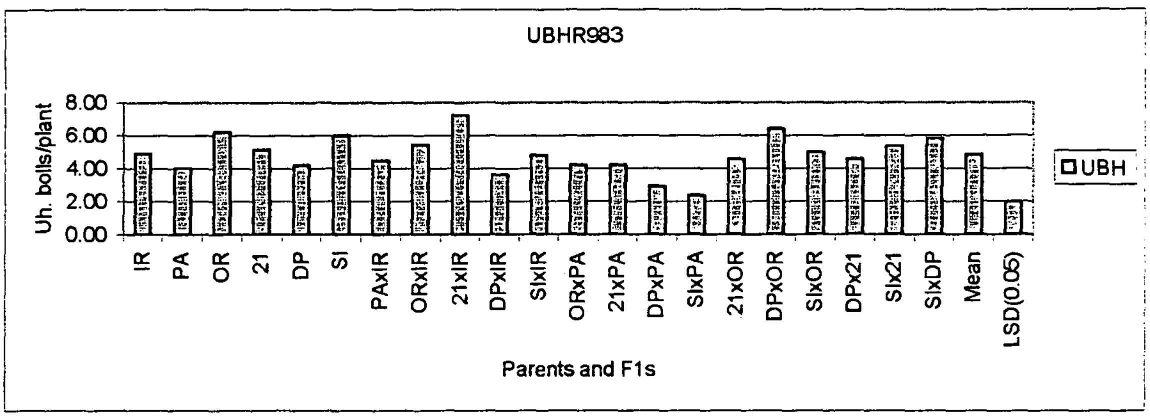

Fig. 4.2.3.14 Unharvestable bolls per plant, Rusternburg 1998/99

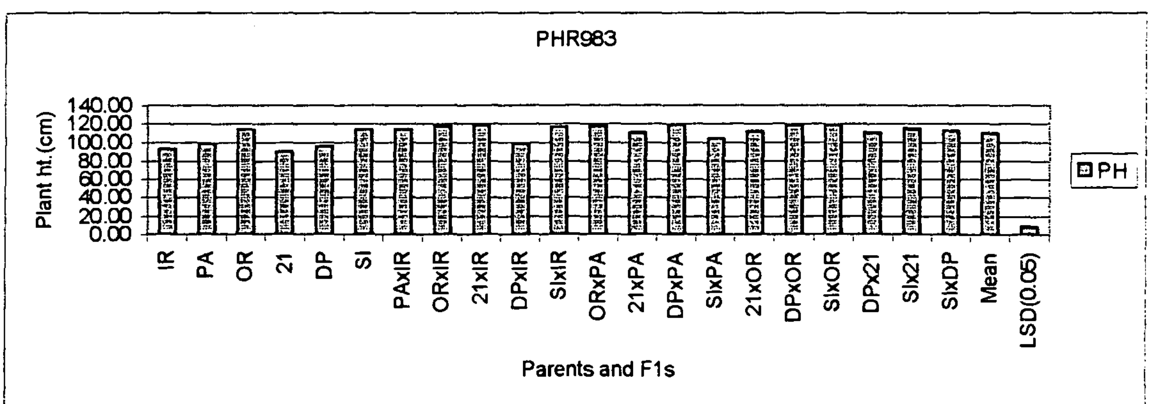

Fig. 4.2.3.15 Plant height, Rusternburg 1998/99

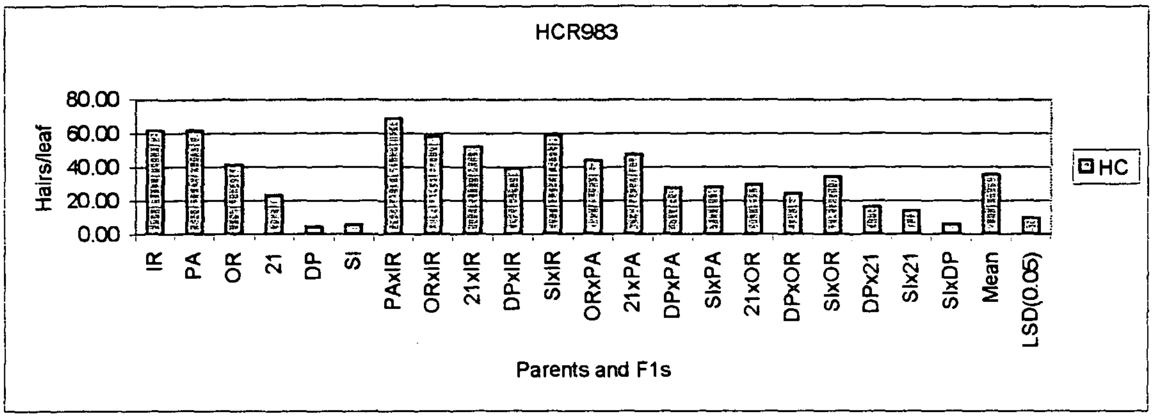

Fig. 4.2.3.16 Hair count per leaf, Rusternburg 1998/99

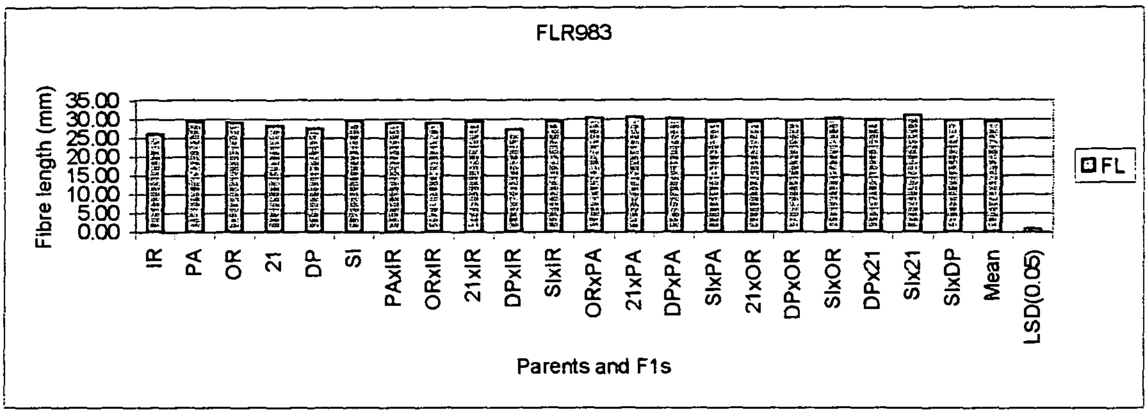

Fig. 4.2.3.17 Fibre length, Rusternburg 1998/99

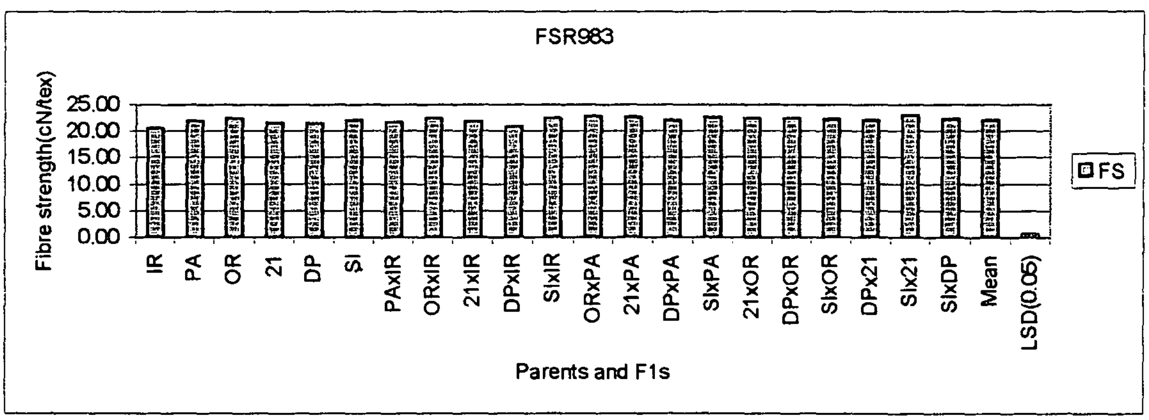

Fig. 4.2.3.18 Fibre strength, Rusternburg 1998/99

Appendix D

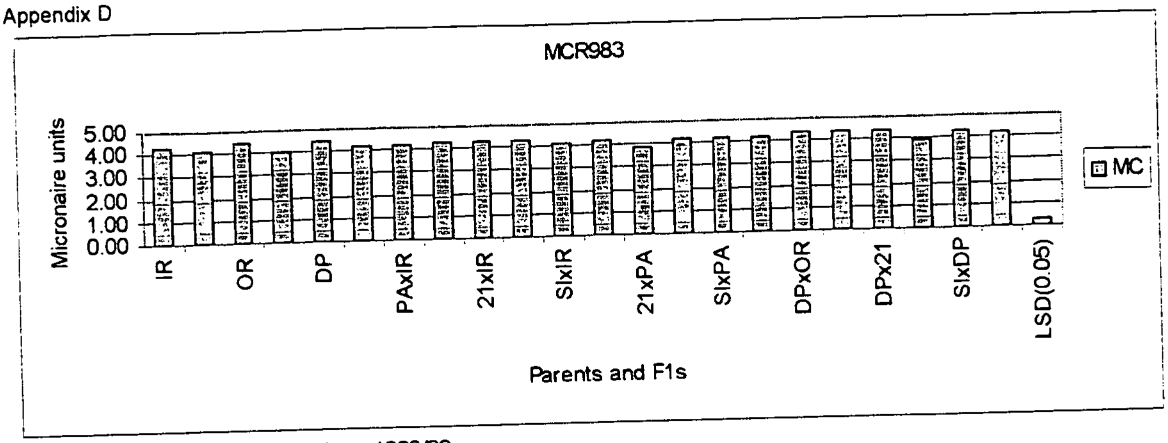

Fig. 4.2.3.19 Micronaire, Rusternburg 1998/99

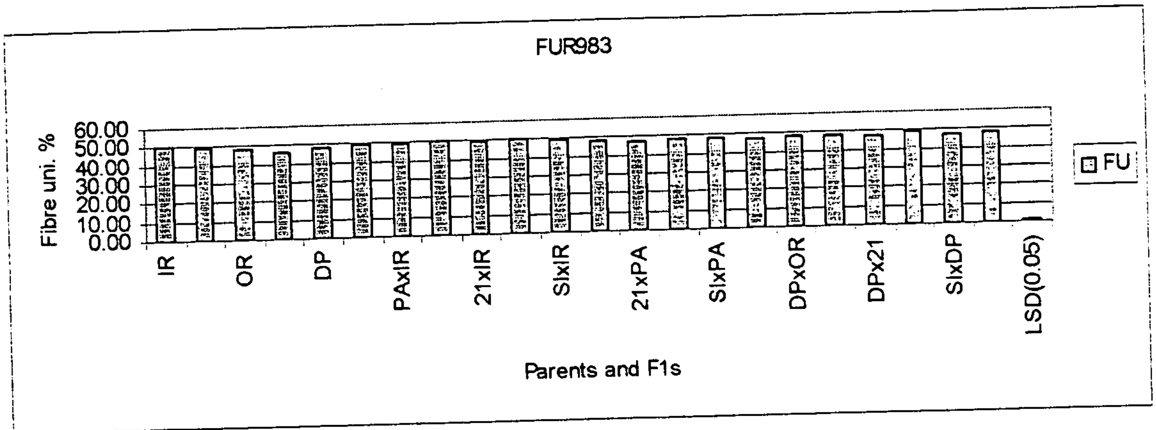

Fig. 4.2.3.20 Fibre uniformity, Rusternburg 1998/99

Appendix E

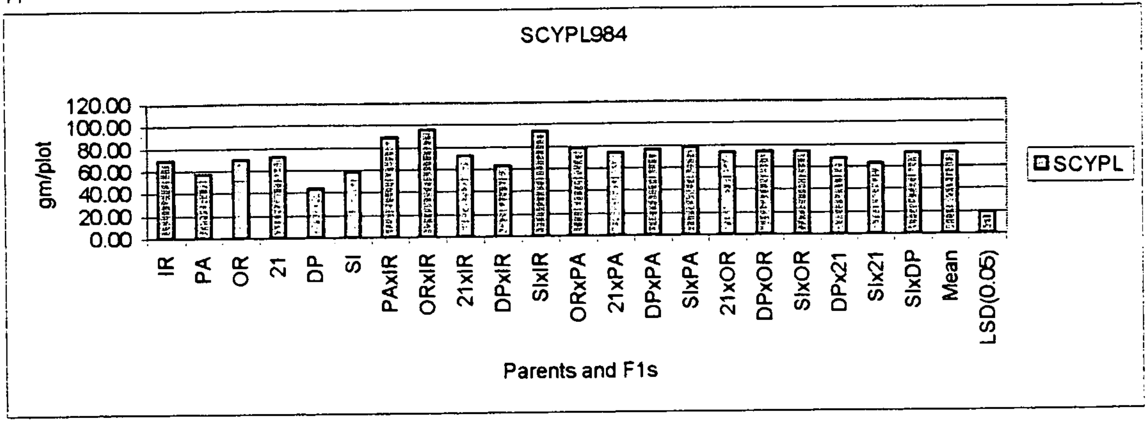

Fig. 4.2.4.1 Seed cotton yield per plot, Loskop 1998/99

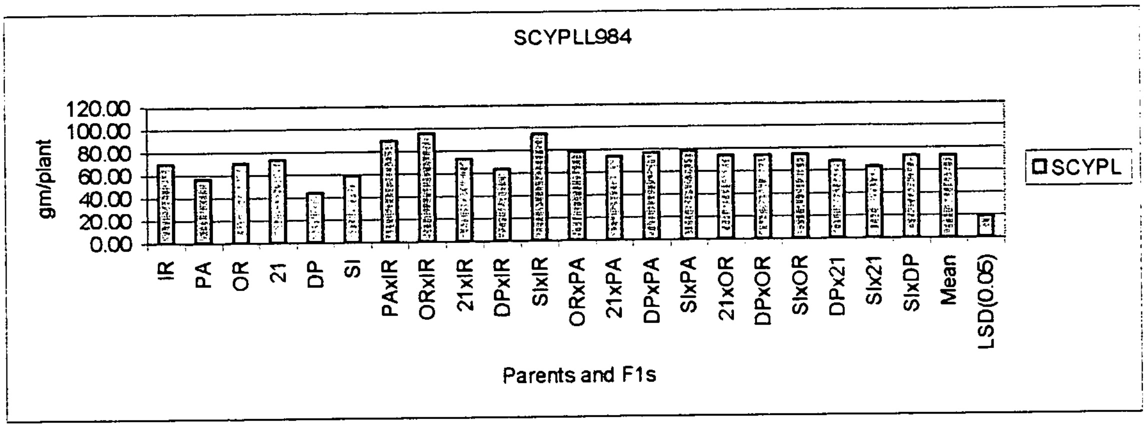

Fig. 4.2.4.2 Seed cotton yield per plant, Loskop 1998/99

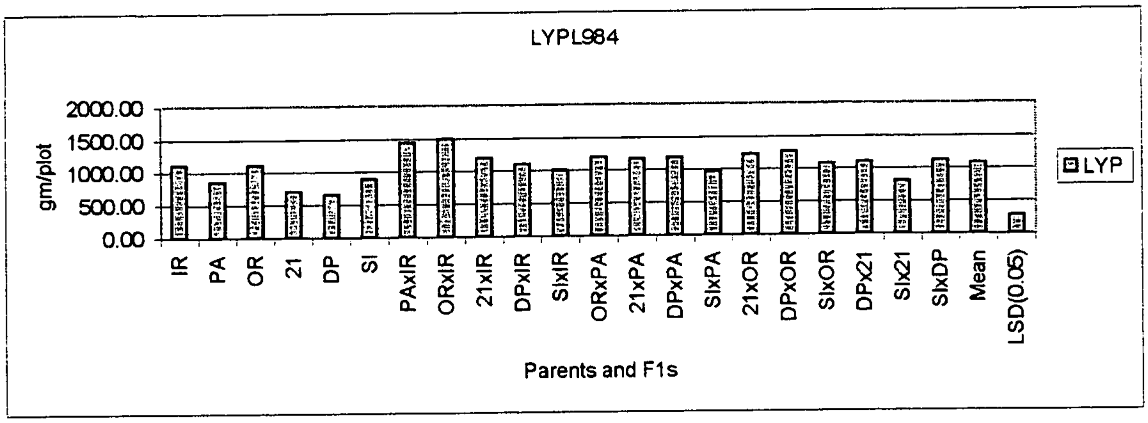

Fig. 4.2.4.3 Lint yield per plot, Loskop 1998/99

Appendix E

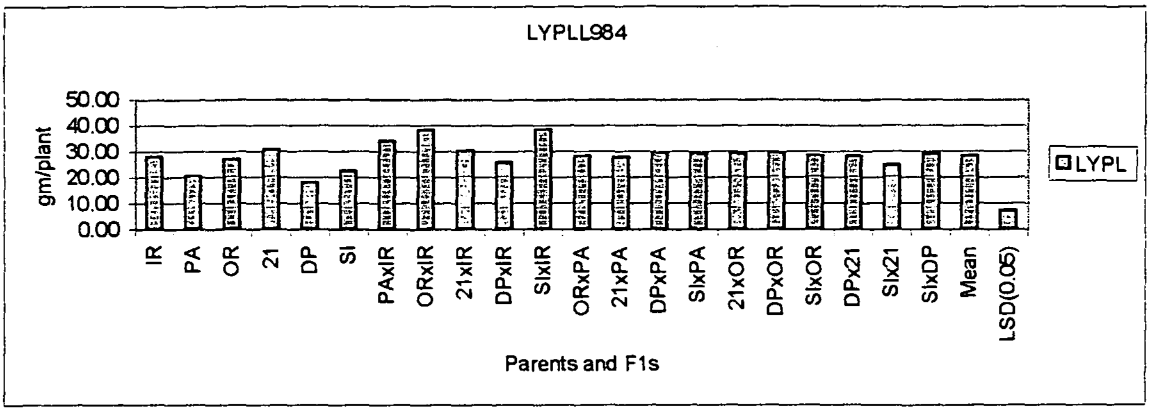

Fig. 4.2.4.4 Lint yield per plant, Loskop 1998/99

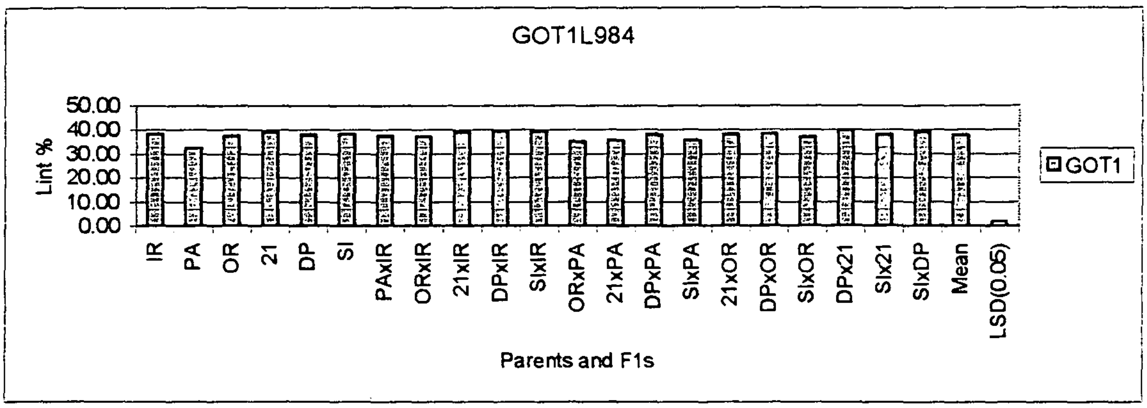

Fig. 4.2.4.5 Ginning out turn 1, Loskop 1998/99

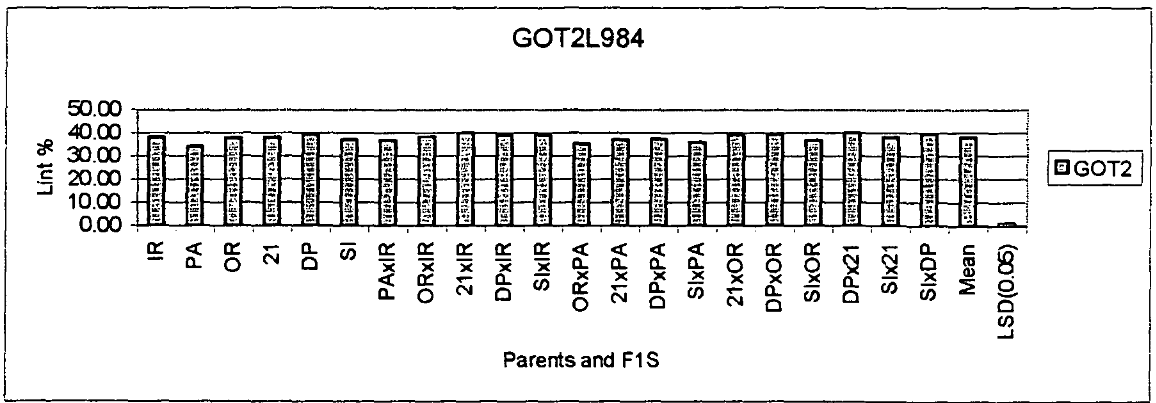

Fig. 4.2.4.6 Ginning out turn 2, Loskop 1998/99

Appendix E

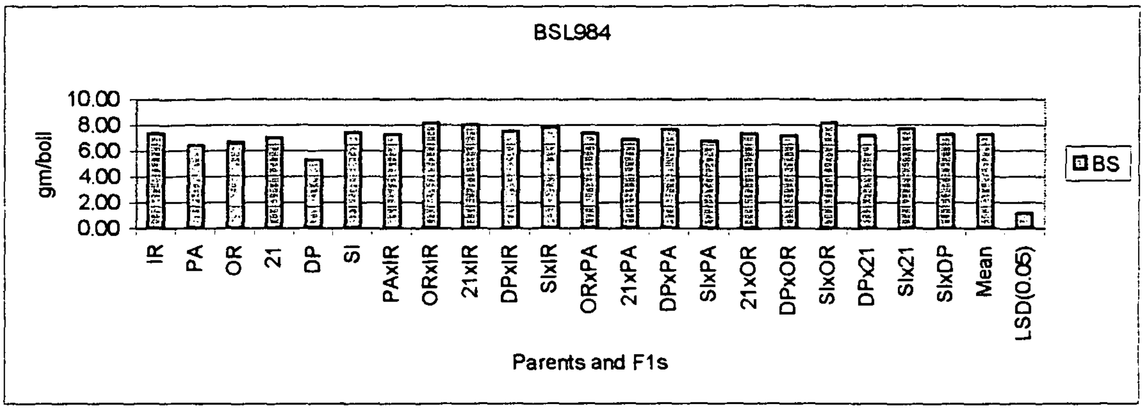

Fig. 4.2.4.7 Boll size, Loskop 1998/99

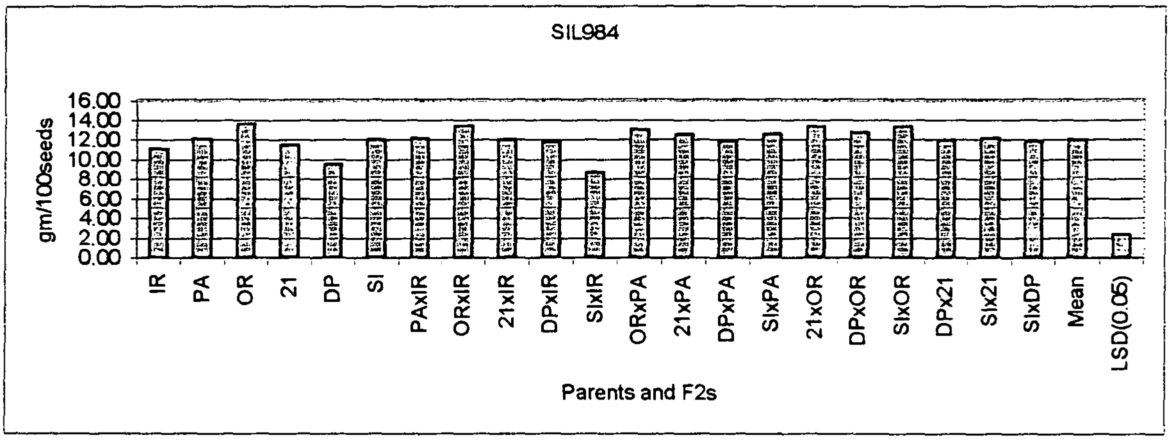

Fig. 4.2.4.8 Seed index, Loskop 1998/99

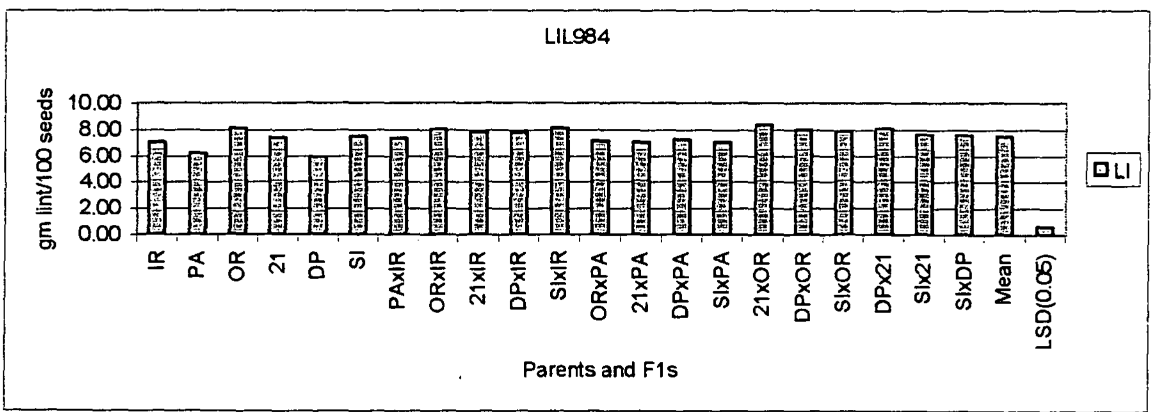

Fig. 4.2.4.9 Lint index, Loskop 1998/99

Appendix E

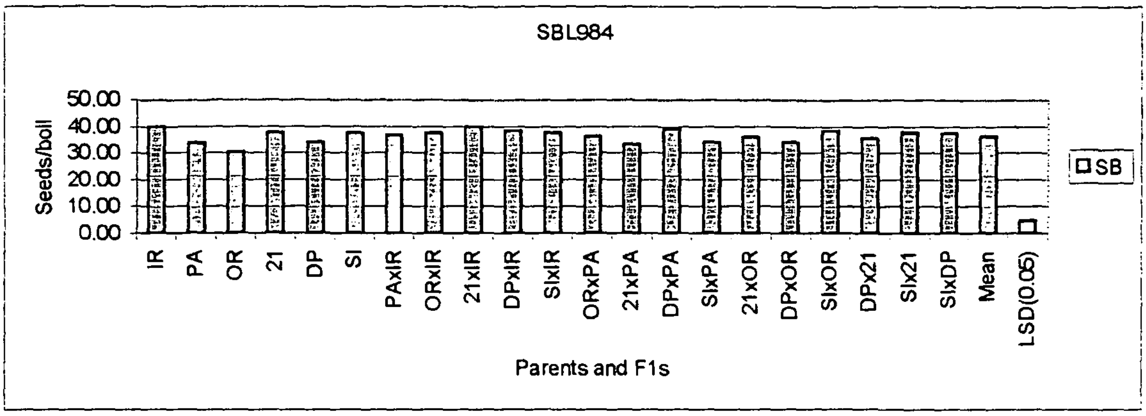

Fig. 4.2.4.10 Seeds per boll, Loskop 1998/99

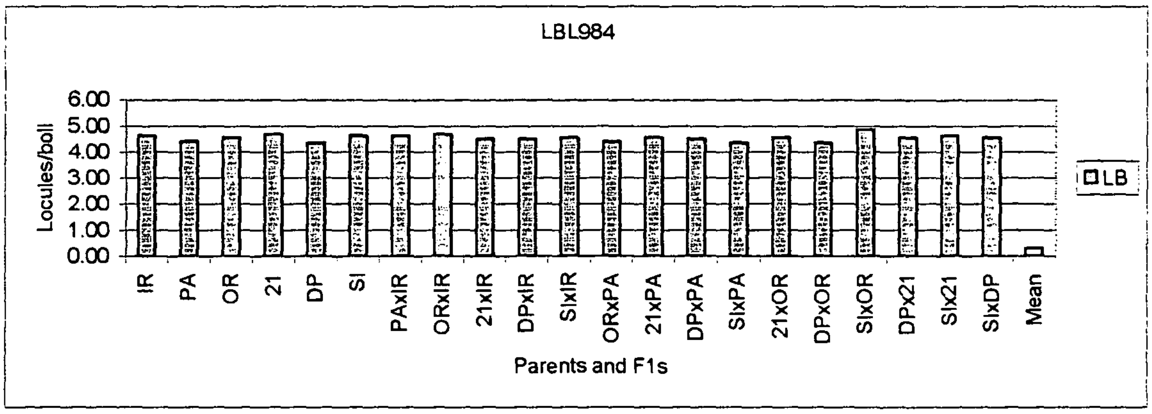

Fig. 4.3.4.11 Locules per boll, Loskop 1998/99

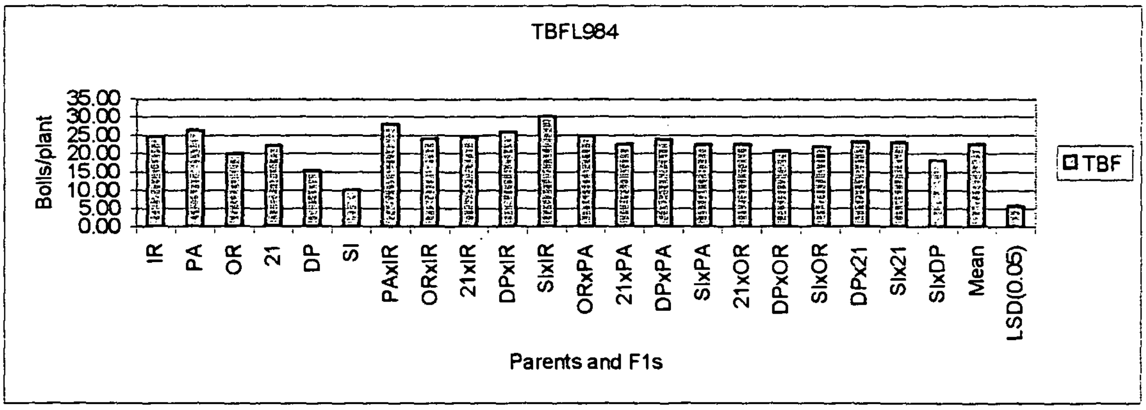

Fig. 4.2.4.12 Total bolls formed per plant, Loskop 1998/99

Appendix E

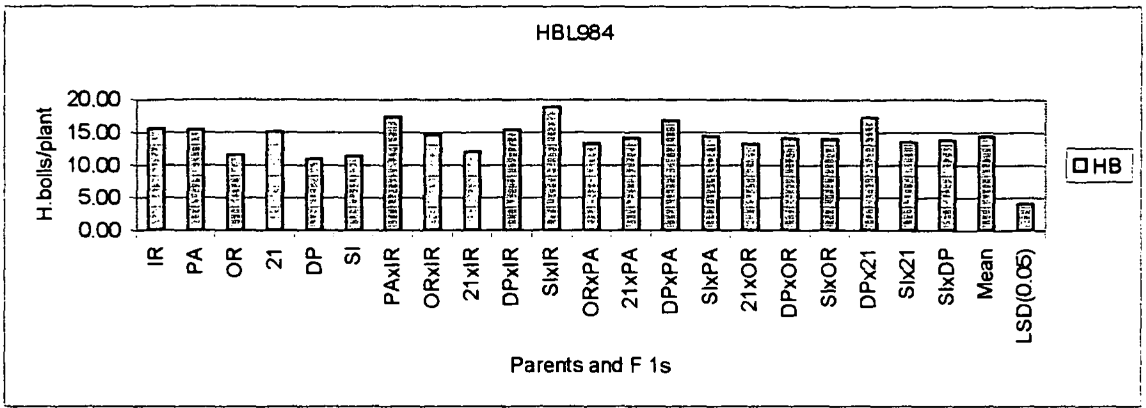

Fig. 4.2.4.13 Harvestable bolls per plant, Loskop 1998/99

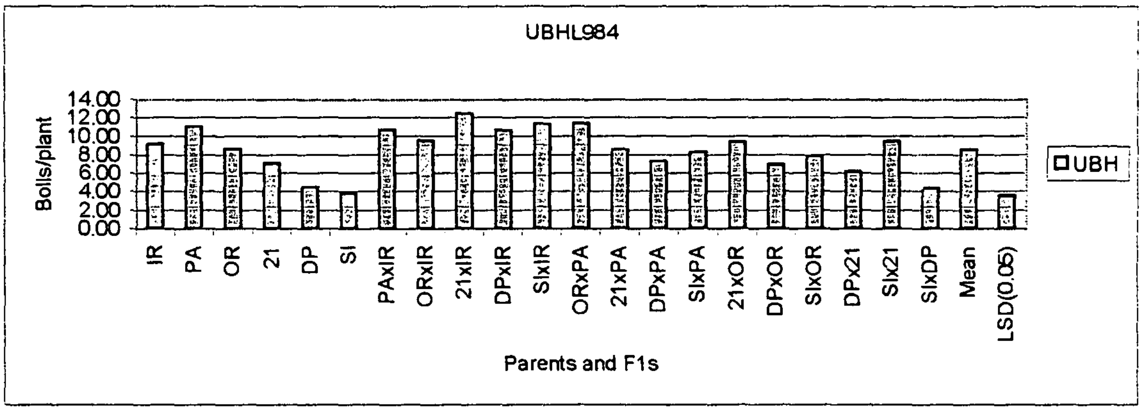

Fig. 4.2.4.14 Unharvestable bolls per plant, Loskop 1998/99

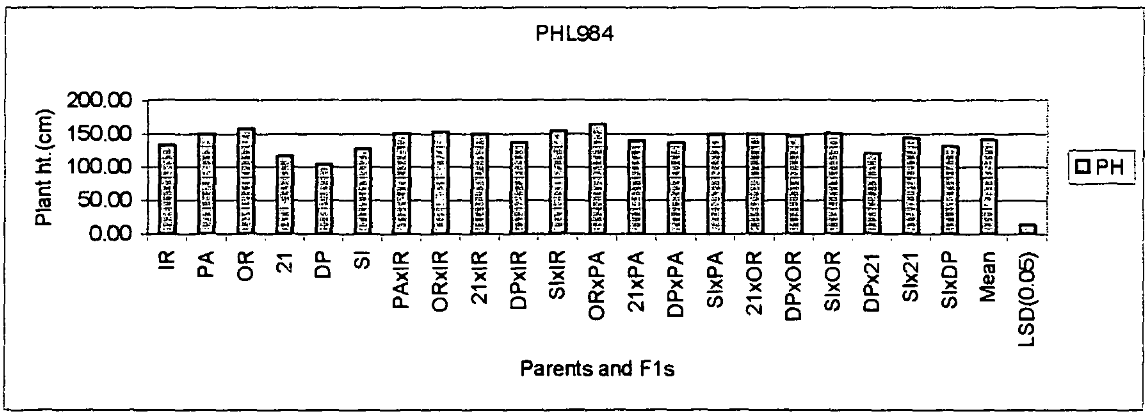

Fig. 4.2.4.15 Plant height, Loskop 1998/99

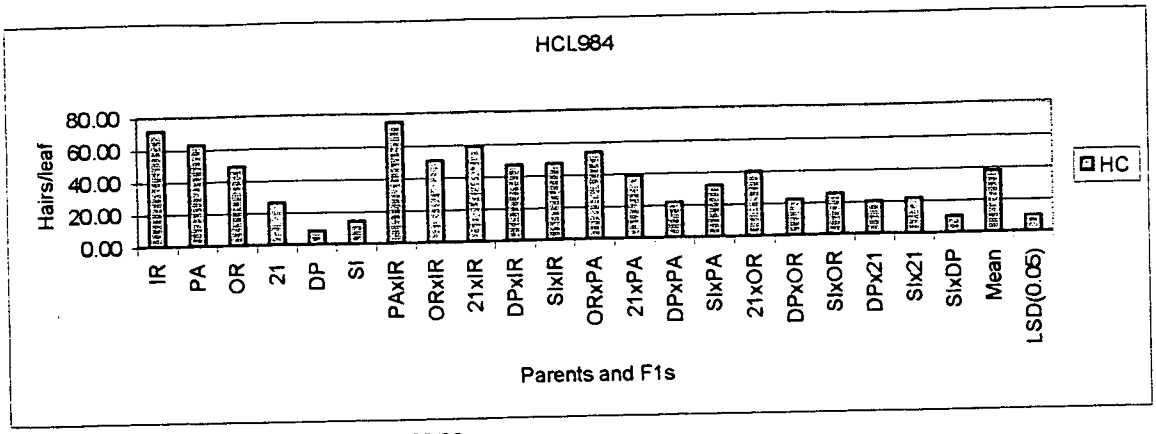

Fig. 4.2.4.16 Hair count per leaf, Loskop 1998/99

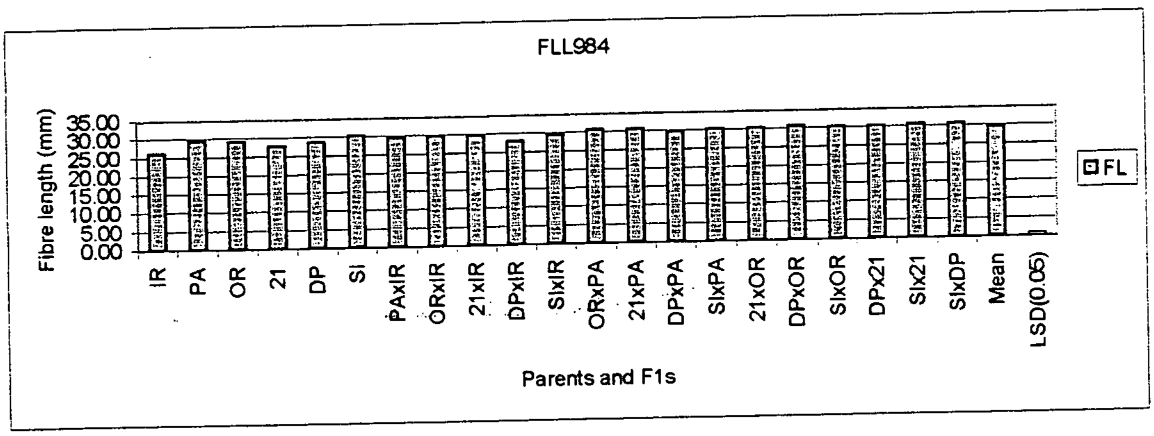

Fig. 4.2.4.17 Fibre length, Loskop 1998/99

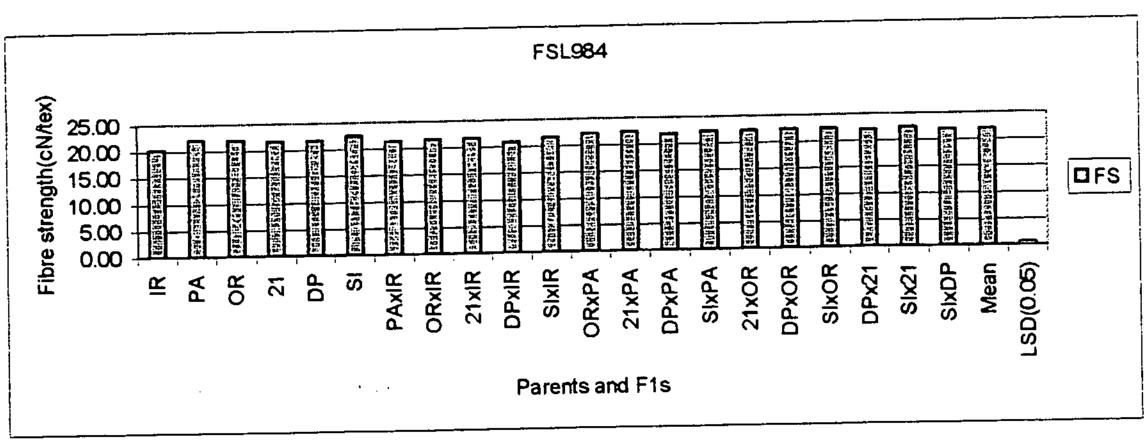

Fig. 4.2.4.18 Fibre strength, Loskop 1998/99

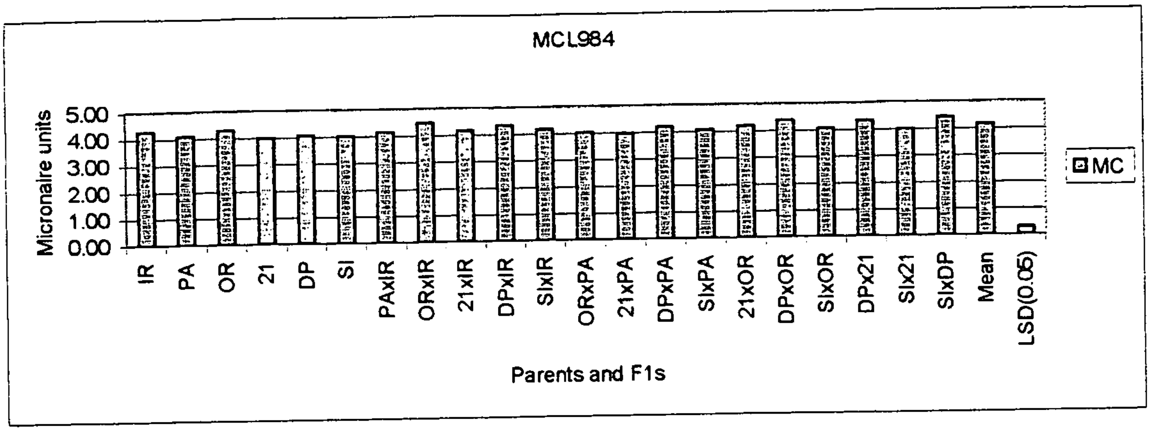

Fig. 4.2.4.19 Micronaire, Loskop 1998/99

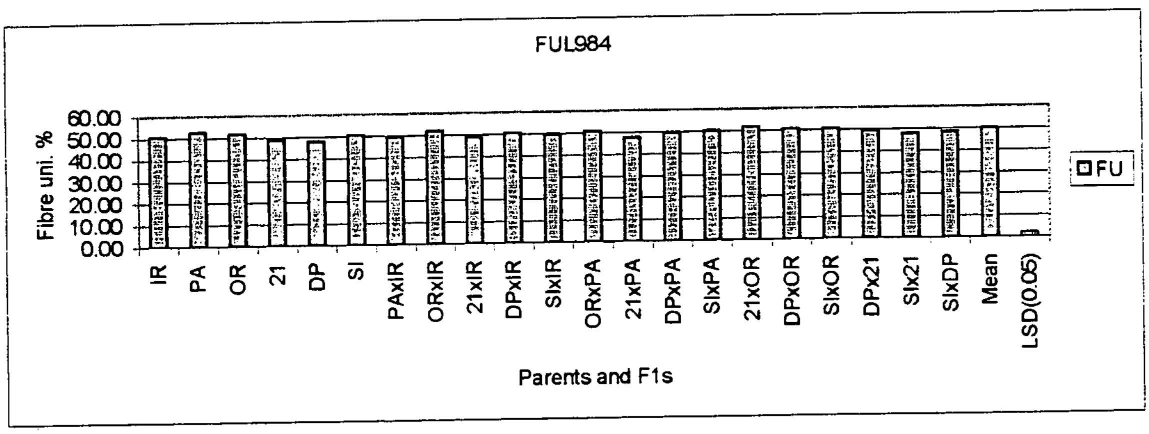

Fig. 4.2.4.20 Fibre strength, Loskop 1998/99