PROJECT NUMBER	**:**	TK 208/16 – Part A
PROJECT TITLE	**:**	Minimum input – Demonstration trials
REPORT YEAR	**:**	2013/2014
PROJECT MANAGER	**:**	HJ Steyn
CO-WORKERS	**:**	SJE Steyn MS Magwaza MC Mkhwanazi

ABSTRACT

The objective of these dryland cotton demonstration trials was to demonstrate to cotton farmers the difference between the rip-on-row production method (1 meter inter-row spacing and 30 cm intra-row spacing – Solid rows) and the double skip row production method where two rows are planted and two skipped. No cultivation is done except for ripping 25 – 30 cm deep on the plant rows only. The cotton cultivar PM3225B2RF from Monsanto/Deltapine was planted under dryland conditions in three different farmers' fields on the Makhathini Flats. These farmers are Amos Khumalo, Doris Nhlebela and Doris Gumbi. Half of the cotton demos on each of the farms were planted in the 1 meter inter-row spacing and the other half in the double skip row spacing. The intension was to harvest four rows of 30 meter each in the 1 meter inter-row spacing and the mass compared to that of two rows of 30 meter length in the skip row spacing. Calculations were to be made of seed cotton yield per hectare in kilogrammes. Unfortunately the planting at Doris Gumbi was destroyed by stray goats that entered the trial area through a hole in the fence over the Festive season and a hailstorm on 25 February 2014 severely damaged the two trials at Amos Khumalo and Doris Nhlebela.

OBJECTIVES

To plant on-farm demonstration trials for small scale farmers to teach and convince them of the benefits of the production methods proven to be the most profitable for them.

EXPERIMENTAL PROCEDURES

Three on-farm demonstration blocks were planted this season. One was planted on the farm of Amos Khumalo on 14/11/2013, a second on the farm of Doris Nhlabela on 13/11/2013, and a third at Doris Gumbi on 02/12/2013. The cultivar PM3225B2RF was planted in all three cases. The season started off very wet and weeds were very aggressive.

The demonstration block at Amos Khumalo was sprayed Roundup three times after plant on 20/11/2013, 17/12/2013 and 28/01/2014. Mospilan was sprayed twice against aphids and jassids. The trial was severely damaged by hail on 25/02/2014. One pick was done on 14 April 2014.

The demonstration block at Doris Nhlabela was sprayed Roundup on 19/11/2013, 17/12/2013 and 28/01/2014. Mospilan was sprayed once for aphids and jassids on 21/01/2014. The trial was also badly damaged by hail on 25/02/2014. The demo was harvested once on 14/04/2014.

The demonstration block at Doris Gumbi was planted on 02/12/2014. Roundup was sprayed twice on 02/12/2013 and on 18/12/2013. The trial was totally destroyed by goats on 01/01/2014.

The demonstration plot at Phineas Gumede was not planted as he communicated that he was not planning to plant cotton during the 2013/2014 season.

RESULTS AND DISCUSSION

Demonstration blocks

The two demo trials harvested were badly damaged by hail. Some cotton was harvested and the yields noted for interest sake.

In the cotton demonstration planting on the farm of Amos Khumalo, the 1 meter inter-row spacing gave 521 kg of seedcotton per hectare and the double skip row 599 kg/ha. In the demonstration planted at Doris Hlabelela the 1 meter inter-row spacing gave 613 kg/ha and the double skip row 471 kg/ha of seedcotton. The reason why the double skip row yield is lower than the 1 meter spacing at this locality is not clear and may be ascribed to the hail.

Table 1. The effect of the different cultivation practices on the seed cotton yield of dryland cotton at four different farms on the Makhathini Flats, 2013/14 growing season (kg/ha)

Localities	1 meter inter-row	Double skip row
Amos Khumalo	521	599
Doris Hlabela	613	471
Average	567	535

CONCLUSION

The reasoning behind the double skip row – rip on the row configuration, is that the average annual rainfall on the Makhathini Flats is too low to farm cotton successfully in the traditional way of ploughing and disking and planting in the 1 meter inter-row spacing. The cotton planted in the double skip rows where the planting rows have been ripped, has the advantage of using conserved moisture from the previous season. The ripping action also brakes up any compacted layers that may be present from previous bad cultivation practises. The seed is planted on the edges of these ripped rows resulting in moisture and cotton roots penetrating to deeper levels.

NEXT SEASON

A continuation with the on-farm demonstration blocks is recommended, but on different soil types on the Makhathini flats area to observe and promote this adapted planting pattern under small-scale farmers.

PROJECT NUMBER	**:**	TK 208/16 – Part B
PROJECT TITLE	**:**	Minimum input – N Fertilizing
REPORT YEAR	**:**	2013/2014
PROJECT MANAGER	**:**	HJ Steyn
CO-WORKERS	**:**	SJE Steyn MS Magwaza MC Mkhwanazi

ABSTRACT

The Makhathini Flats area of the Northern KwaZulu-Natal is very dry with an annual rainfall of 450 mm. The rainfall pattern is also very varied and erratic. Cotton is the only crop which can be grown successfully under these conditions without irrigation assistance. Research was done to determine which cultivation practice will be suitable for dryland cotton small holder farmers in this area. It was determined that the most profitable production method under these climatic conditions is the double skip row – rip on the row method. In this production method no ploughing or disking is done but only a shallow 25 to 30 cm deep ripping action on the plant row. Two rows are ripped one meter apart and two rows skipped. This allows for roots to penetrate deep on the planting line as well as utilize moisture sideways in the open spaces. This method results in more moisture being available to the crop and results in higher yields. It also reduces the input cost drastically. Ploughing and disking are very costly practices. Planting double skip row also uses only half the quantity of seed used in planting inter-row spacing of 1 meter resulting in a further reducing of Input costs. The fact that there are only half the usual amount of planted lines, also results in spraying only half the amount of pesticides. The question arose, that seeing that there is now more moisture available to the plants, will nitrogen topdressing result in a further economic benefit to the farmer and if so, at what quantity must it be applied?

OBJECTIVE

The objective of this dryland cotton, double skip row – rip on the row nitrogen trial is to determine if nitrogen applied as topdressing would have an economical benefit to the farmer.

EXPERIMENTAL PROCEDURES

The plant – furrows for the experiment was drawn on 19/11/2013 in the double skip row – rip on the row method. The trial was planted on the ripped furrows on 20/11/2013. A Youden Square Design was used with 6 treatments that were replicated 4 times.

Six different Nitrogen levels were applied on 07/01/2014. These levels were:

1. 0 kg N/ha
2. 10 kg N/ha
3. 20 kg N/ha
4. 30 kg N/ha
5. 40 kg N/ha
6. 50 kg N/ha

The cotton variety PM 3225 B2RF from Monsanto/Deltapine was used. A light manual weed control action was done on the planting rows on 06/12/2013 and again on 17/12/2013. On 09/12/2014 the gaps were filled to ensure a proper plant stand. The first spray of Roundup Power Max was done between the plant rows on 17/12/2013.

The second spray of Roundup Power Max was applied on 20/01/2014. A third manual weed control action on the rows was done on 05/02/2014. Mospilan was sprayed on 11/02/2014 to control aphids and jassids. A third spray of Roundup Power Max was done on 13/02/2014.

The trial was severely damaged by hail on 25/02/2014. In spite of the hail damage the surviving cotton was picked on 02/04/2014.

RESULTS AND DISCUSSION

Due to the hail damage no significant differences in yield and fibre quality were found. However some interesting observations were made.

Tabel 1. Average values for yield and fibre qualities, 2013/2014 season

Treatment	Yield (kg.ha)	Strength(g/tex)	Length (mm)	Micronaire
0	1268	32.05	27.80	3.46
10	1304	32.41	27.98 *	3.47
20	1384 *	32.67 *	27.58	3.44
30	1304	31.77	27.45	3.55
40	1375	32.54	27.90	3.56 *
50	1268	30.12	26.93	3.05
Average	**1317**	**31.93**	**27.60**	**3.42**

Yield

The average yield for the trial was 1317 kg of seed cotton per hectare with the highest treatment yield average coming from 20 kg of Nitrogen applied per hectare giving 1384 kg/ha.

FIBRE QUALITIES

Strength

The average strength measured was 31.93 with the treatment of 20 kg N/ha as the highest at 32.67.

Length

The average length was 27.6 which is on the low side with the longest fibre coming from the treatment of 10 kg N/ha that measured 27.97.

Micronaire

The average Micronaire measured was 3.42 which is low and could be a result of the hail. The treatments of 30 and 40 kg N/ha gave Micronaire values of more than 3.5 which is acceptable.

In spite of the hail damage the average trial yield was still very good for dryland produced cotton showing the higher yield potential of the applied production method. The fact that the treatment of 20 kg N/ha gave an average of 116 kg seedcotton per hectare more than the 0 kg N/ha treatment shows promise. At a price of R5.00 per kg of seed cotton it means the farmer gets an extra income of R580.00 per hectare. The cost of 20 kg of N in the form of

LAN (28%) is R370.00 and when deducted, results in an extra income of R206.00 per hectare. Unfortunately transport and application costs must still be deducted.

CONCLUSION

As a result of the hail damage no real conclusions can be made. Even if no hail damage occurred no confident conclusions can be made from only one season's results. There are however interesting observations that need to be investigated in another season.

NEXT SEASON

The trial will be repeated on the exact same location but on the skipped rows.

PROJECT NUMBER	**:**	TK 208/20
PROJECT TITLE	**:**	Heat tolerance in cotton
PERIOD	**:**	2013/14
PROJECT MANAGER	**:**	MM van der Westhuizen
CO-WORKER(S)	**:**	Prof DM Oosterhuis
PROJECT STATUS	**:**	Current
DURATION	**:**	2011 – 2016

STRATEGIC OBJECTIVE

Enhance the ability of the agricultural sector to manage and mitigate agricultural risks (Higher temperatures due to global warming)

DESCRIPTION OF THE PROBLEM

Cotton originates from hot climates, but does not necessarily yield best at excessively high temperatures. The optimum temperature range for cotton is 20 – 30°C (Reddy et al., 1996. However, the average maximum daily temperature in the US Cotton Belt is always above 32°C, i.e. well above the optimum for photosynthesis and reproductive development. In South Africa daytime temperatures during flowering (the most sensitive stage) also often exceed 30°C. This is considered a major reason for lowered and variable yields experienced in cotton production. Cotton yields in Arkansas are less than half of the theoretical maximum (Baker, 1965).

LONG-TERM OBJECTIVES

1. To use physiological measurements to quantify the effect of high temperature stress on reproductive development of cotton genotypes for screening for temperature tolerance.
2. To study the agronomic and physiological effects of high temperature stress on the growth and yield of cotton genotypes in the field.
3. To formulate and test methods of ameliorating the deleterious effects of high temperatures on boll development and yield.

FIELD TRIAL

PLANNED CHANGES TO PROCEDURES (from previous year)

The trial will be planted at Groblersdal and Rustenburg as the temperatures at Groblersdal are more often above 35°C.

MATERIALS AND METHODS

Two trials were planted at the Agricultural Research Council-Institute for Industrial Crops (ARC-IIC), Rustenburg, South Africa during November 2013. Planting 1 was done on 8 November 2013 and planting 2 on 26 November 2013. Cotton (*Gossypium hirsutum* L.) cultivars planted were VH260 and Arkot 9704 (two cultivars with heat tolerance), DP393 (a heat sensitive cultivar) and DP210 BRF, (a cultivar of unknown tolerance). The soil type was a black arcadia with 50% plus clay. The trial received total irrigation of 295 mm. Limestone Ammonium Nitrate was applied to supply 150 kg/ha in two split applications of 75 kg/ha N. The total rainfall was 759.3 mm. Plots were hand hoed to keep it clean from weeds. Temperatures and rainfall received during January to March 2014 are presented in Figure 1. The experimental design was a fully randomized block designs with six replications. Rows were 9 m in length and the inter-row spacing was 1 m and intra-row spacing 20 cm. Two to three seeds were planted by hand at each planting station and the seedlings was thinned to a single plant per station when they were approximately 15 cm tall. This resulted in a plant population of 70 000 plants/ha, the recommended plant population for cotton grown under irrigation. Data was collected from a net plot of 2 x 9 m. Data were analysed using SAS.

Measurements included:

a) Yield

- Total seed cotton yield (kg/ha)
- Fibre percentage (fibre will be removed from seeds with a mini gin)
- Fibre yield (kg/ha)

b) Quality

- Average fibre length (mm)
- Fibre strength (g/tex)
- Micronaire (Fiber fineness)

c) Physiological measurements

- Membrane leakage
- Carbohydrates
- Glutathione reductase (antioxidant activity)

d) Climatical data

- Daily minimum and maximum temperatures
- Rainfall

RESULTS

a) Yield parameters

Seed cotton yield (kg/ha)

Planting time and cultivars differed significantly. The first planting resulted in the highest seed cotton yield of 1826 kg/ha. Cultivar VH260 resulted in the highest seed cotton yield of 1849 kg/ha (Table 1). Seed cotton yield was low the past season due to a lot of cloudy weather that accompanied rain in February and March. The rain during mentioned two months resulted in no irrigation being applied during February and March. A lot of cloudy weather was also present during December which resulted in flowering to start two weeks late.

Fibre percentage (%)

Planting time and cultivars differed significantly. The first planting resulted in the highest fibre percentage of 41.9%. Cultivar VH260 resulted in the highest fibre percentage of 42.5% (Table 1).

Fibre yield (kg/ha)

Planting time and cultivars differed significantly. The first planting resulted in the highest fibre yield of 767 kg/ha. Cultivar VH260 resulted in the highest fibre yield of 789 kg/ha (Table 1).

b) Quality parameters

Length (mm)

Planting time and cultivars differed significantly. The first planting resulted in the longest fibres of 26.6 mm. Cultivar VH260 resulted in the longest fibres of 26.4 mm (Table 1).

Strength (g/tex)

Planting time and cultivars differed significantly. The first planting resulted in the strongest fibres of 24.0 g/tex. Cultivar DP393 resulted in the strongest fibres of 24.2 g/tex (Table 1).

Micronaire

Planting time differed significantly. The first planting resulted in the highest micronaire of 3.0 which is below the acceptable norm of 3.5. Arkot resulted in the highest micronaire value of 2.9 (Table 1).

c) Physiological parameters

The physiological measurements were made during two temperature regimes namely a high temperature regime, which was measured during a heat stress (35/17°C day/night temperatures) and a low temperature regime (31/14°C day/night temperature regime).

Membrane leakage (ML)

The mean membrane leakage was 80.9. Although cultivars did not differ significantly DP210 had the lowest electrolyte leakage of 77.6%. Temperature regimes differed significantly with the highest temperature regime (35/17°C day/night temperatures) resulting in the highest membrane leakage percentage of 88.8%. When temperatures were low (31/14°C day/night temperatures), membrane leakage was 73%. This is an increase of 16% in electrolyte leakages when a heat stress occurred (Figure 2 and 3).

Glutathione reductase

Cultivars did not differ significantly, but Arkot 9704 tended to give the highest antioxidant activity. Temperature regimes differed significantly. When the cotton was subjected to the high temperature regime (35/17°C day/night temperatures) the antioxidant activity increased significantly to be able to withstand the heat stress (Figures 4 and 5).

Carbohydrates

Starch

Significant differences were present at cultivars and temperature regimes. VH260 resulted in the highest starch content in the leaves (0.01643815 mg starch / mg Fresh weight). This differed significantly from DP393 (0.01399526) and DP210 (0.01065760), but not from Arkot 9704 (0.01497595). When the cotton was subjected to a heat wave on 17 January 2014 (35/17°C day/night temperatures) starch accumulated in plants (0.014 mg starch / mg Fresh weight) versus the lower content of (0.008 mg starch/mg Fresh weight) at the low temperature regime (31/17°C day/night temperature regime) (Figure 6).

Sucrose and total carbohydrates

For both sucrose and total carbohydrate contents cultivars and temperature regimes differed significantly. VH 260, Arkot 9704 and DP210 gave significantly higher sucrose and

carbohydrate contents than DP393. When subjected to the heat stress on 17 January 2014 (35/17°C day night temperatures) both sucrose and total carbohydrate contents were lower than the low temperature regime (31/17°C day/night temperature regime) (Figures 7 and 8).

CONCLUSION

In the current study different screening methods were used to evaluate heat tolerance in four cotton cultivars in a field study. The techniques included measurements of membrane leakage, glutathione reductase activity and carbohydrate content in response to two different temperature regimes. The cultivar VH260 gave the highest seed cotton yield, fibre percentage and fibre yields as well as the highest starch, sucrose and total carbohydrate content. The study will continue in 2014/2015 with field trials to be planted in Groblersdal and Rustenburg, South Africa. The cultivars to be planted will be (DP393 and Arkot 9704) select lines from Arkansas and Arizona, VH260 (A Pakistani cultivar), and Delta 210 BRF, a Monsanto variety that is planted commercially in South Africa. Measurements will include membrane leakage, glutathione reductase, pollen viability in different canopy positions and chlorophyll fluorescence (using the new Leaf Tech instrument).

Table 1. Yield and fibre characteristics of the heat tolerance trial planted under irrigation at Rustenburg, first planting, 2013/2014

Cultivar	VH260		Arkot		DP393		DP210 BRF	
Planting date	**Planting 1**	**Planting 2**	**Planting 1**	**Planting 2**	**Planting 1**	**Planting 2**	**Planting 1**	**Planting 2**
Seed cotton yield (kg/ha)	2052	1646	1784	1272	1711	954	1759	1034
Fibre %	44.4	40.6	41.2	36.4	41.3	38.3	40.8	37.3
Fibre Yield (kg/ha)	908	670	736	474	705	364	718	385
Length (mm)	27.1	25.7	24.7	24.1	26.6	26.0	27.9	26.4
Strength (g/tex)	24.2	22.7	22.3	21.5	24.7	23.6	24.7	22.8
Micronaire	3.1	2.5	2.9	2.8	3.3	2.4	2.7	2.2

Parameter	**Tukey's LSD p<0.05)**	**CV**
Yield (kg/ha)	414.8	22.3
Fibre %	2.6	5.4
Fibre yield (kg/ha)	169.9	22.5
Length (mm)	0.88	2.8
Strength (g/tex)	1.64	5.8
Micronaire	0.44	13.3

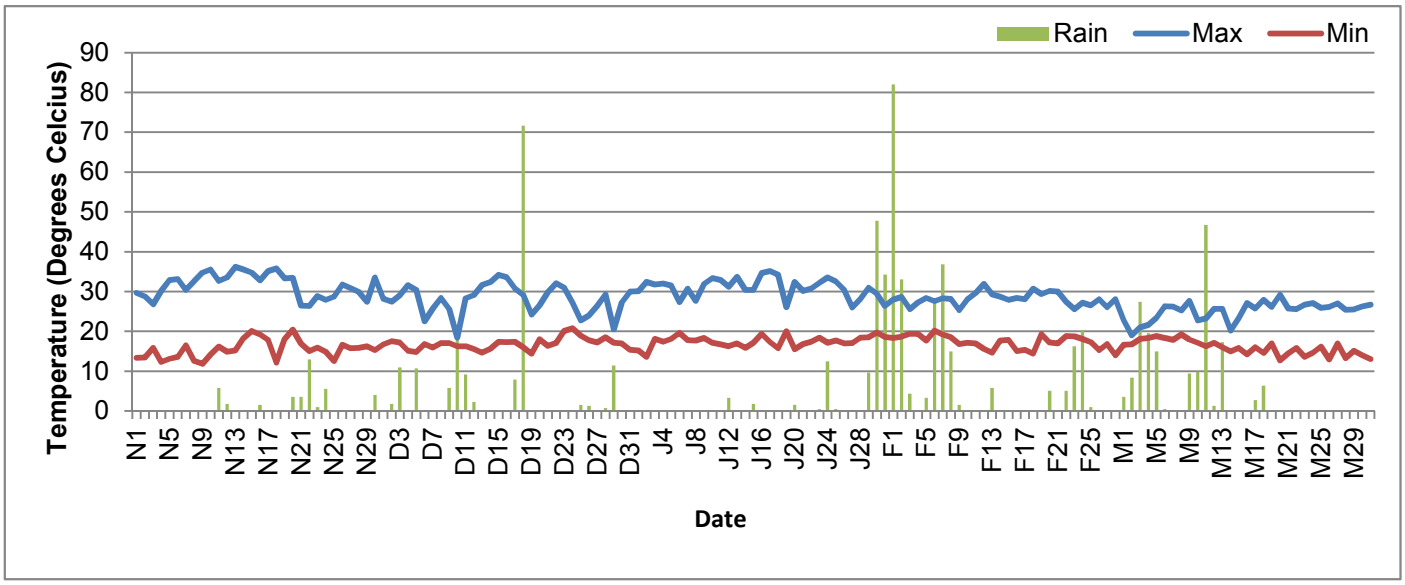

Figure 1. Maximum, minimum temperatures and rainfall data of the field study in Rustenburg, South Africa (2012/2013). Trials planted 8 and 26 November. Total irrigation was 295 mm. Irrigations of 25 mm was applied on 10 and 18 November 2013, 2 and 22 December, 5, 15 and 22 January 2014, 27 March and 4, 13, 20 and 27 April 2014.

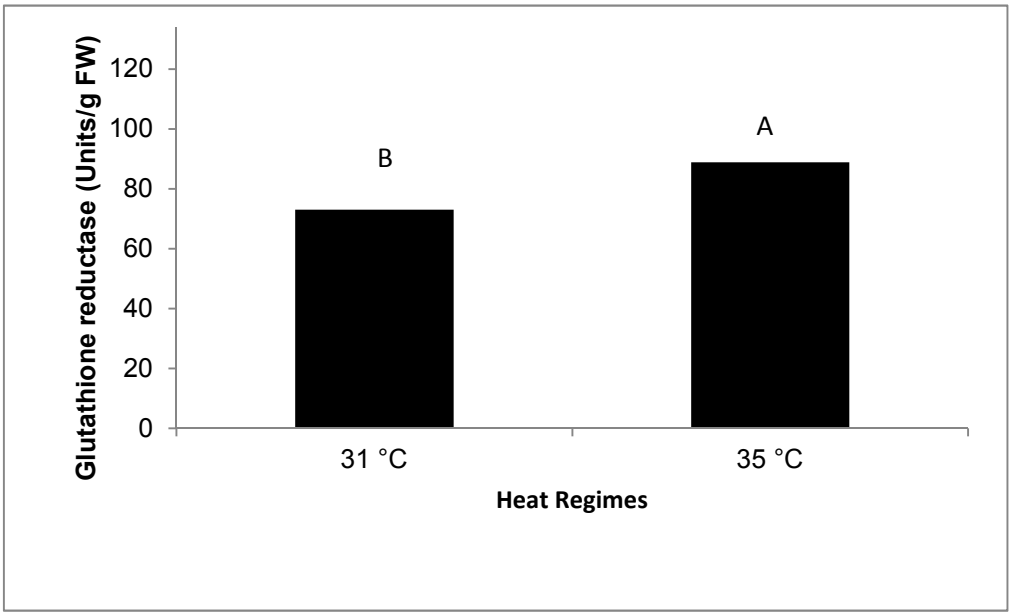

Figure 2. Membrane leakage (%) of two temperature regimes measured on 17 January 2014 (35/17°C day/night temperatures) and 18 February 2014 (31/14°C day/night temperatures) as an indication of the effect of heat stress on cell integrity in a field study in Rustenburg, South Africa 2013/14. Light bars with the same capital letters are not significantly different (*P*=0.05). Dark bars with the same lowercase letters are not significantly different (*P*=0.05).

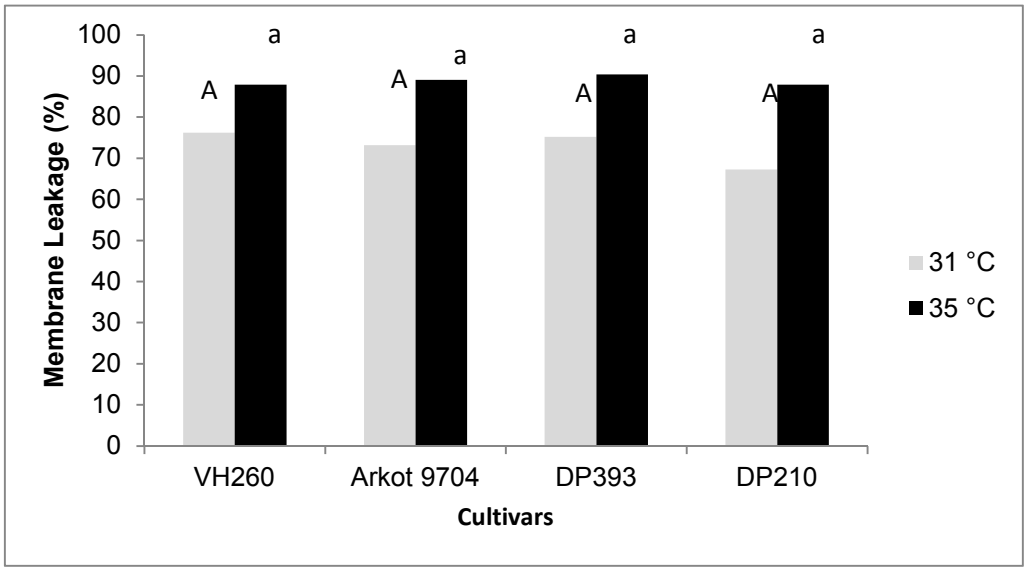

Figure 3. Membrane leakage (%) of four different cotton cultivars measured on 17 January 2014 (35/17°C day/night temperatures) and 18 February 2014 (31/14°C day/night temperatures) as an indication of the effect of heat stress on cell integrity in a field study in Rustenburg, South Africa 2013/14. Light bars with the same capital letters are not significantly different (*P*=0.05). Dark bars with the same lowercase letters are not significantly different (*P*=0.05).

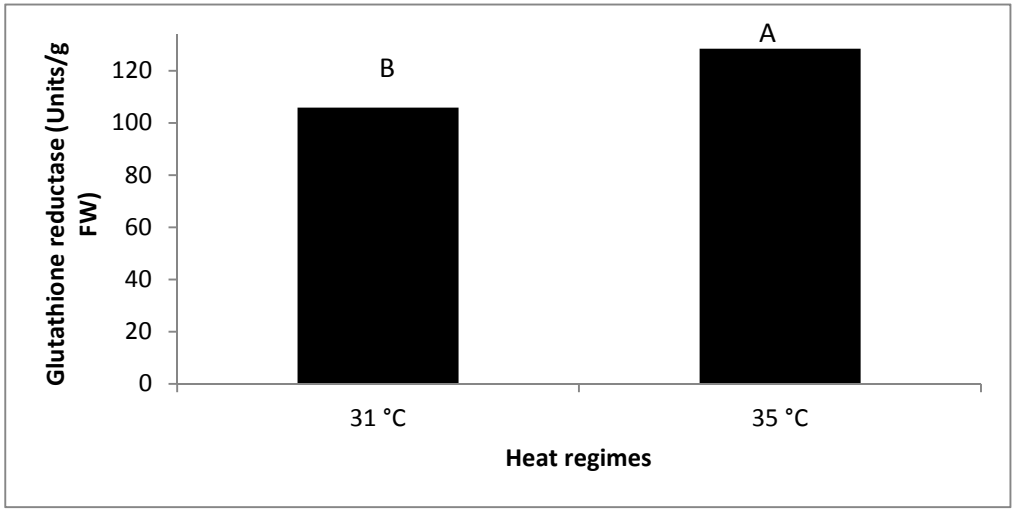

Figure 4. Glutathione reductase content (Units/g FW) of four different cotton cultivars measured at 35/17°C day/night temperatures (17 January 2014) and 31/14°C day/night temperatures (18 February 2014) on antioxidant activity in a field study in Rustenburg, South Africa 2013/14. Light bars with the same capital letters are not significantly different (*P*=0.05). Dark bars with the same capital letters are not significantly different (*P*=0.05).

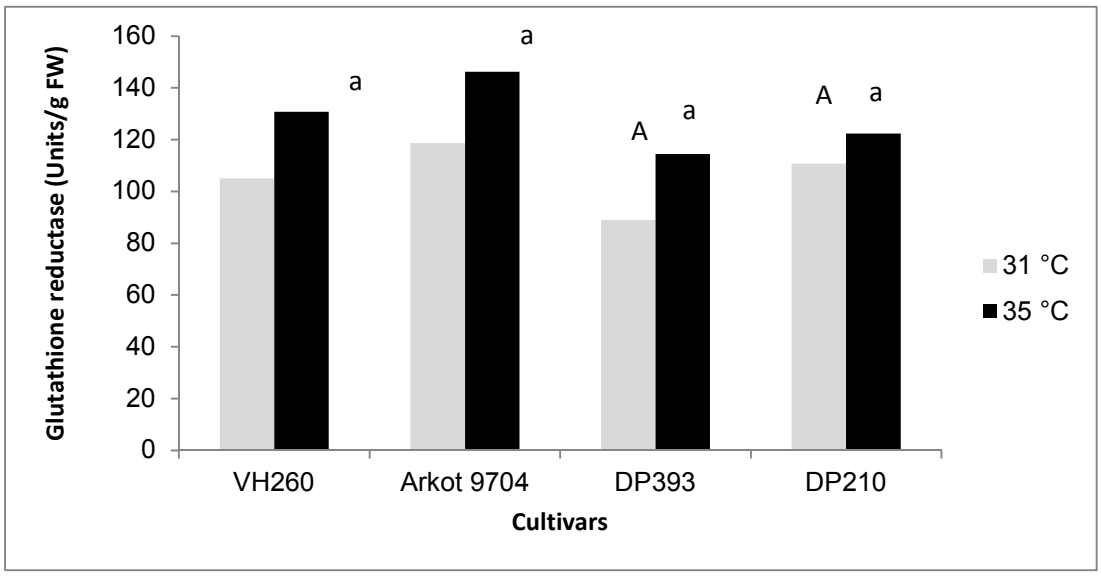

Figure 5. Glutathione reductase content (Units/g FW) of four different cotton cultivars measured at 35/17°C day/night temperatures (17 January 2014) and 31/14°C day/night temperatures (18 February 2014) as an indication of the effect of heat stress on antioxidant activity in a field study in Rustenburg, South Africa 2013/14. Light bars with the same capital letters are not significantly different (*P*=0.05). Dark bars with the same capital letters are not significantly different (*P*=0.05)

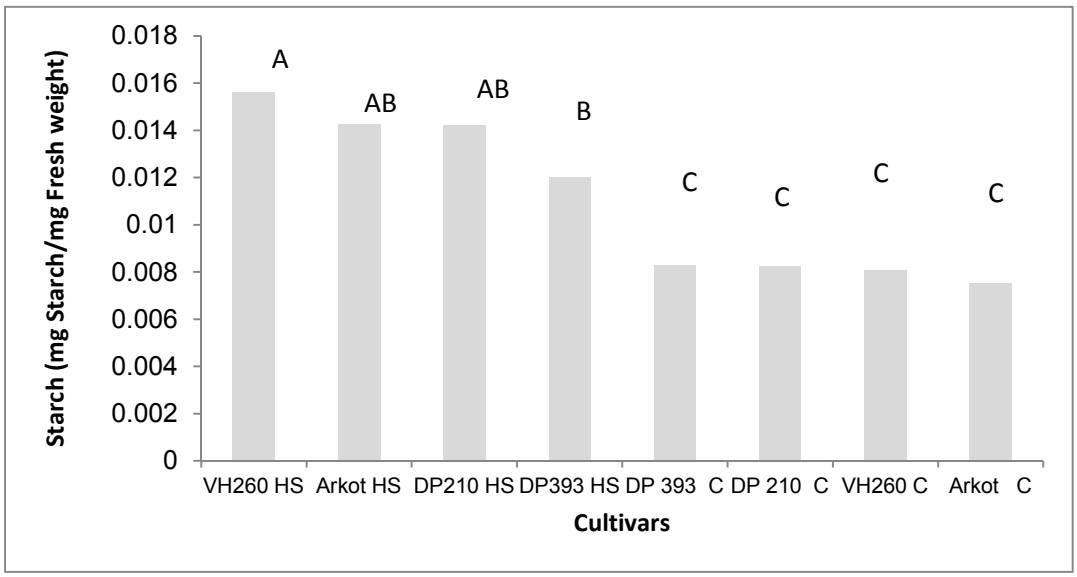

Figure 6. Starch content (mg starch/mg Fresh weight) of four different cotton cultivars from field study 2, Planting 1. Measured on 17 January (35/17°C day/night temperatures) and 22 January 2014 (31/17°C day/night temperatures, Rustenburg, 2013/2014

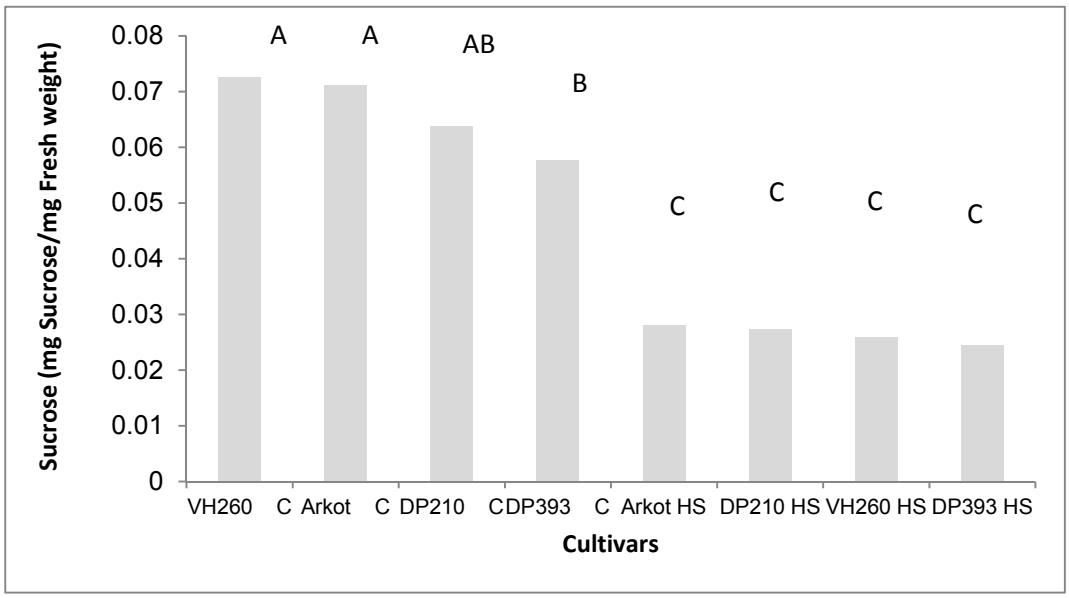

Figure 7. Sucrose content (mg sucrose/mg Fresh weight) of four different cotton cultivars from field study 2, Planting 1. Measured on 17 January (35°C day/night temperatures) and 22 January 2014 (31°C day/ night), Rustenburg, 2013/2014

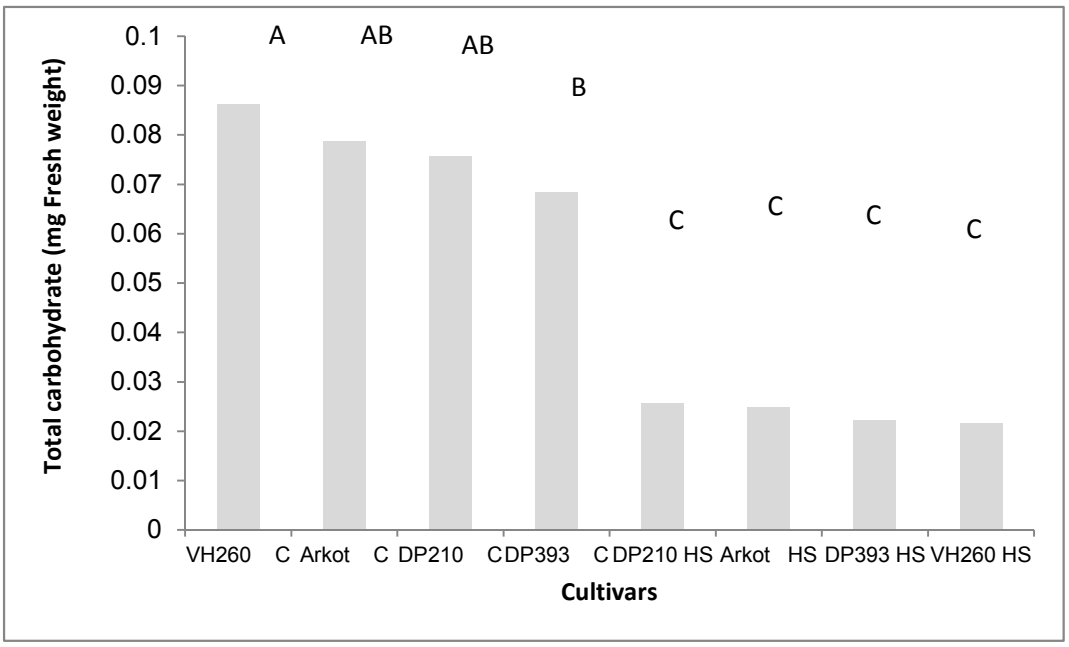

Figure 8. Total carbohydrate content (mg /mg Fresh weight) of four different cotton cultivars from field study 2, Planting 1. Measured on 17 January (35/17°C) and 22 January 2014 (31/17°C day/night temperatures), Rustenburg, 2013/2014.

Plate 1. Heat tolerant trial, Field study 2 (Planted 8 and 26 November 2013), Rustenburg, 2013/2014

Plate 2. Heat tolerant trial, Field study 2, (Planted 8 and 26 November 2013), Rustenburg, 2013/2014

LITERATURE CITED

Al-Khatib, K. and Paulsen, G.M. 1999. High-temperature effects on photosynthetic processes in temperate and tropical cereals. *Crop Sci*. 39:119-125.

Baker, D.N. 1965. Effects of certain environmental factors on net assimilation in cotton. *Crop Science.* Vol 5, pp 53-55

Boyer, J. S. 1982. Plant productivity and environment. *Science* Vol 218, pp 443-448.

Reddy, V. R., Hodges, H.F., McCarty, W.H. and McKinnon, J.M. 1996. Weather and cotton growth: Present and Future. Mississippi Agr & Forestry Exp Sta., Mississippi State University, Starkeville,

PROJECT NUMBER	**:**	TK 208/21
PROJECT TITLE	**:**	Evaluation of the effect of a particular planting date on production, fibre quality and colour of cotton (*Gossypium hirsutum* L.) cultivars produced in South Africa
REPORT YEAR	**:**	2013/2014
PROGRAMME MANAGER	**:**	Dr GJ Thompson
PROJECT LEADER	**:**	CE Fourie
CO-WORKERS	**:**	KC Phalane GV Matlala

INTRODUCTION

The cotton planting window for sowing becomes very narrow for optimal yield and fibre qualities. Finding the most suitable cultivar for a particular planting date can help to widen the window period for sowing.

Obtaining a vigorous stand is the first step for profitable cotton production. Soil temperature is one of the most important factors in determining the time of planting cotton. Cotton should not be planted before the top 30 mm of soil not maintained a temperature of 16 to 18°C or higher.

The results of the 2013/14 evaluation of cultivars that are most suitable for a particular planting date are presented in this report.

OBJECTIVE

The objective of the trial is to determine which cultivar is most suitable for a particular planting date. The effect on plant growth, yield, fibre qualities and the degree of whiteness (colour values) of the different cotton cultivars were determined at various planting dates.

LOCALITY

Groblersdal: ARC-Loskop Research Farm

The recommended locality presents one of the 8 different climatic zones experienced for cotton production in South Africa.

GENERAL PRODUCTION CONDITIONS

Maximum and Minimum temperatures

Cultivar adaptation and successful production are influenced by climatic conditions, especially temperatures during specific phases of the growing season. The minimum and maximum temperature data for October and November 2013 is given in Figures 1 and 2 below.

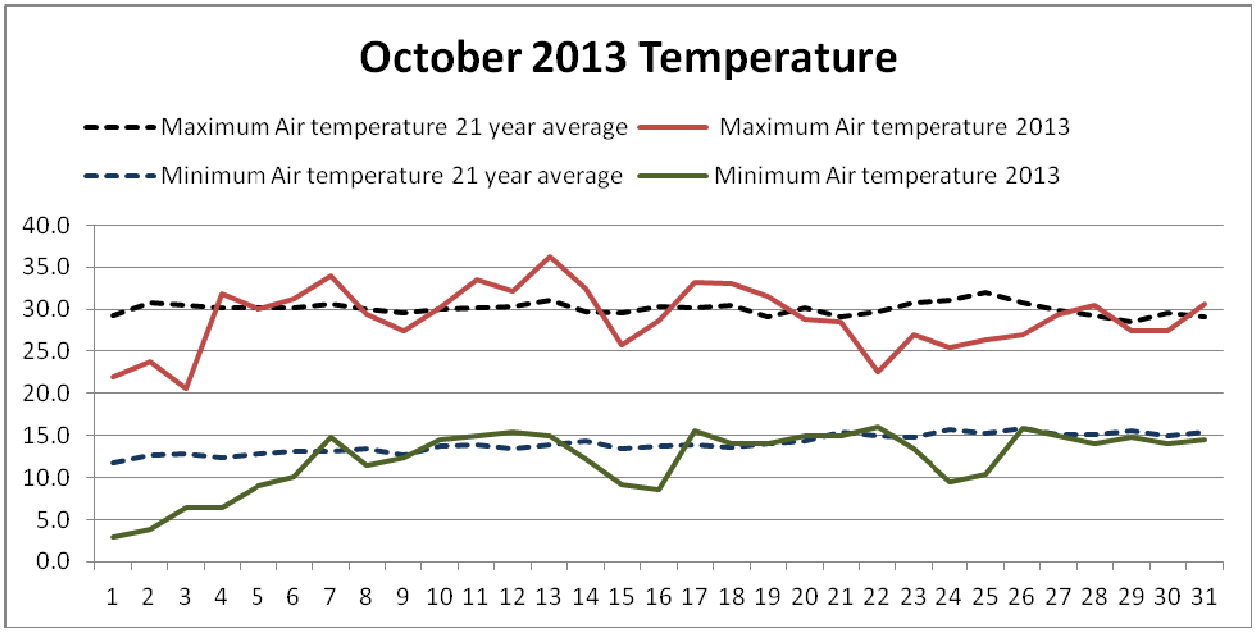

Figure 1. The minimum and maximum temperature data collected from the weather station at ARC-Loskop Research farm indicate that the maximum and minimum temperatures for October were lower than the long-term values. The minimum temperature was also lower during the first part of October 2013 than the long-term values.

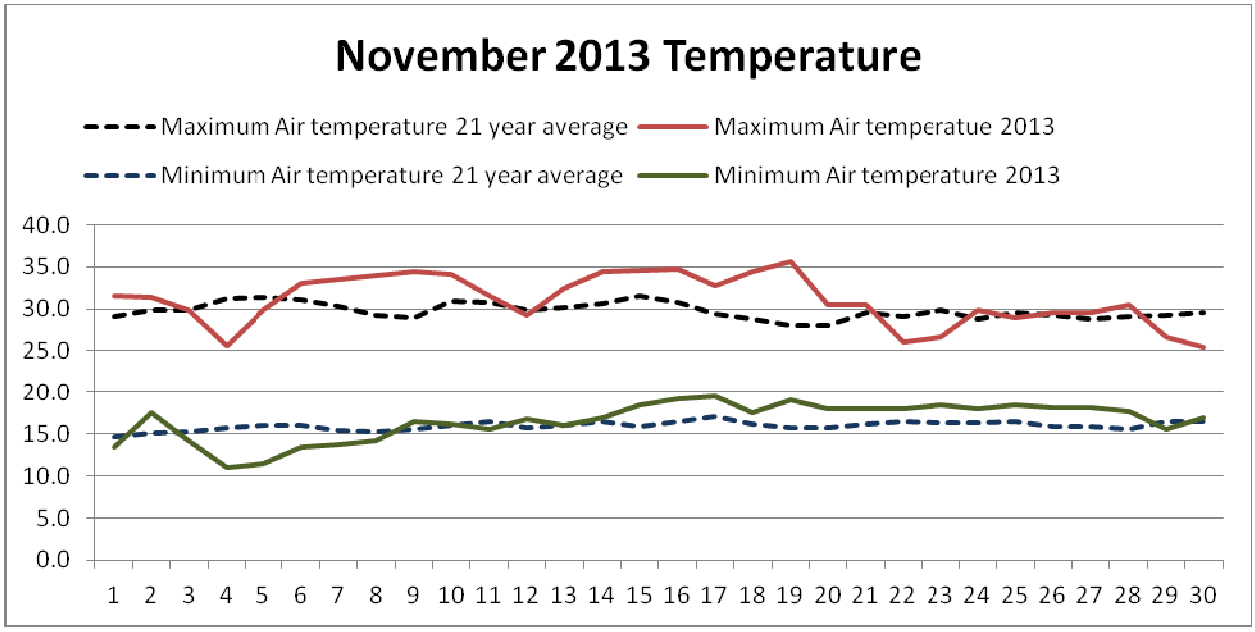

Figure 2. The minimum and maximum temperature data collected at the weather station for November 2013 indicated warmer temperatures than the long-term values.

Soil temperature

A soil temperature meter was installed the 30th of September 2013 to record soil temperatures during sowing season of the eight planting dates. A graph for the soil temperature is given in Figures 3 and 4 below.

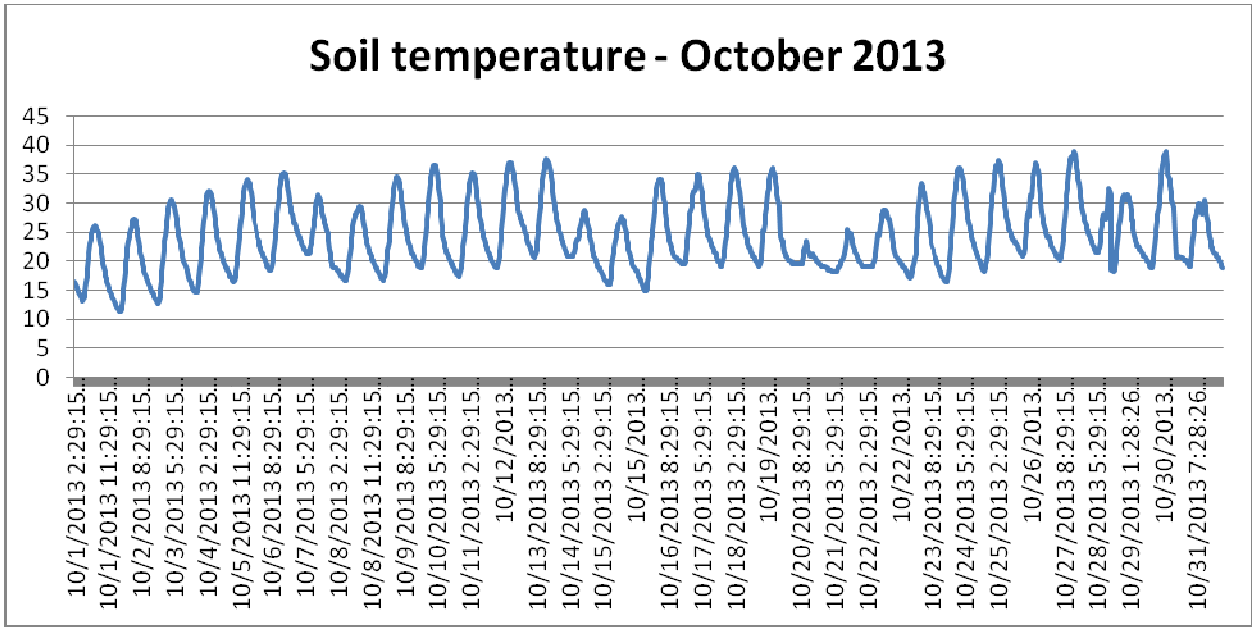

Figure 3. Cotton should not be planted before the top 30 mm of soil has not maintained a temperature of 16 to 18°C or higher. The soil temperature was beneath 16°C during the first part of October 2013

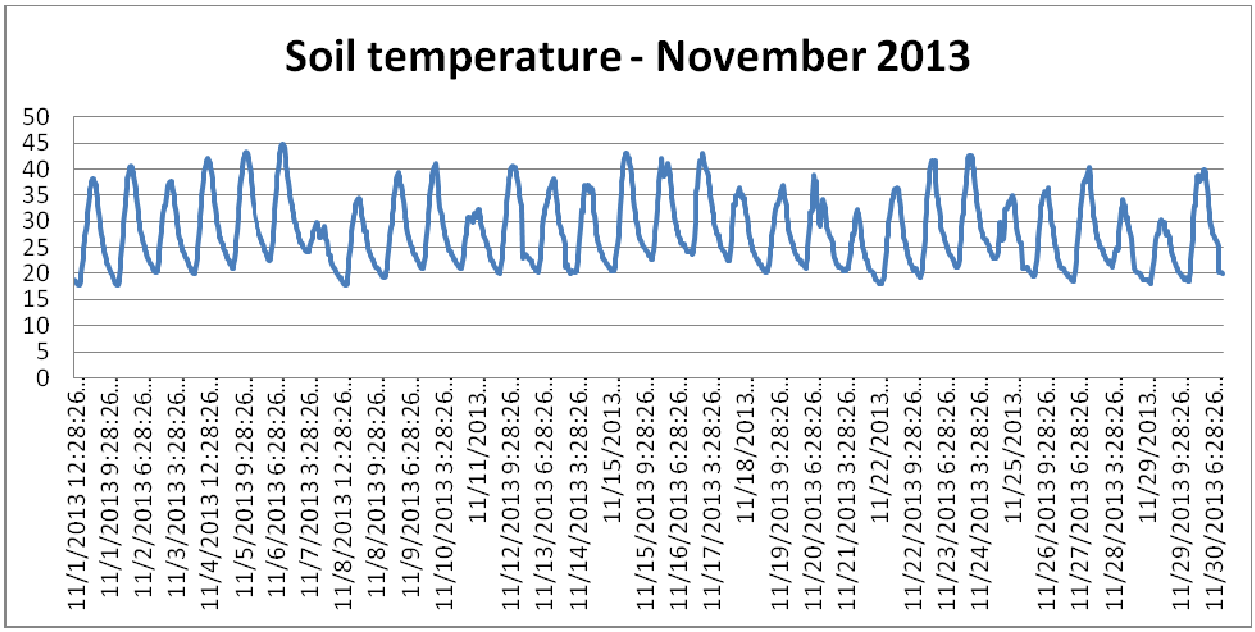

Figure 4. Soil temperatures for November 2013 were normal for sowing of cotton

Rainfall (mm)

A total of 927 mm rain was recorded during the growing season of the Plant Date Trials. Figure 5 indicates the rainfall for the 2013/14 cotton growing season with the highest rainfall for December 2013 (252 mm) and the first two weeks in March 2014 with (226 mm). A hailstorm and heavy rain (42 mm) just after planting on the 28th of October 2013 resulted in eroded soil and wash away of cotton seeds.

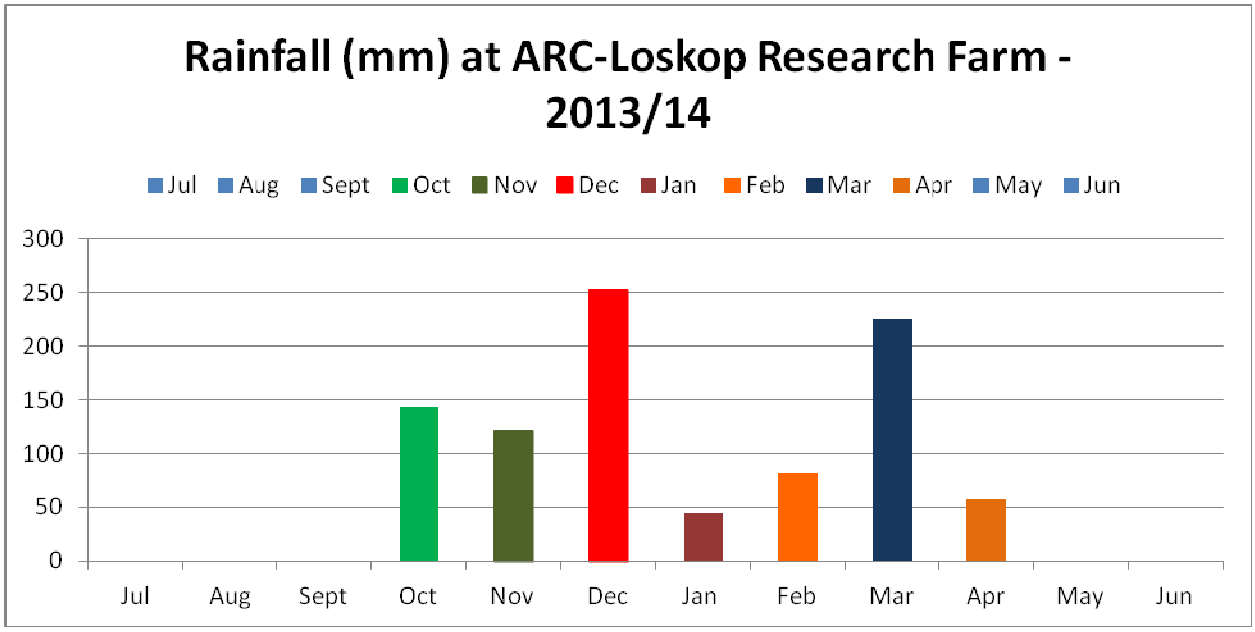

Figure 5. Rainfall for the 2013/14 cotton growing season at ARC-Loskop Research Farm

Planting Dates

In the field study eight planting dates were used. These planting dates are chosen to cover the available planting window for sowing cotton.

1. 7 October 2013,
2. 14 October 2013,
3. 22 October 2013,
4. 4 November 2013,
5. 11 November 2013,
6. 18 November 2013 and
7. 25 November 2013.

Cultivars

Cotton cultivars planted under irrigation consisted of 7 entries and these commercial cultivars that will be reported on are listed.

1. Delta12BRF (standard)
2. 13P3001B2RF
3. DP1240B2RF (new)
4. CandiaB2RF
5. 13P3005B2RF (new)
6. DP1441RF (Okra leaf)
7. DP210BRF (standard)

EXPERIMENTAL PROCEDURES

Trials were planted under commercial cotton production practices, where soil, climate and general production practices were used. All the planting date trials were handled in the same way through-out the sowing period. The planting date trials and cultivars were planted in a randomized block design with four replicates, and plots consisted of 2 rows of 5 m lengths, at an inter-row spacing of 90 cm and intra-row spacing of 15 cm.

All cultural practices, including fertilizer regimes, pest control and irrigation were treated the same. Target total fertilizer was 180 kg N/ha, 35 kg P/ha and 85 kg K/ha. Weed and insect control was applied as necessary.

Three application of 250 ml/ha each of the plant growth regulator, Mepiquat chloride (Pix), was applied with a knapsack on each planting date trial. The first application was spayed at 1st white flower, 2nd application was 3 weeks later and the 3rd application was again 3 weeks later. Plant establishments and any yield limiting factors were noted throughout. The plant height for each cultivar in a Planting Date was taken 150 days after planting.

Sub-samples of the harvested seed cotton were ginned for turnout data. Lint for samples was sent to Cotton SA for HVI fibre quality analysis.

STATISTICAL ANALYSIS

A randomized block design with four replications is used to accommodate treatments. Quantitative data was analysed using the program Gen Stat Release 11.1 (PC/Windows).

The empirical ranking of the entries are indicated in the tables, although this does not necessarily mean that the cultivars and planting dates differ significantly. For this purpose the LSD's (P0.05) are also included.

RESULTS

A cold front on the 1st of October 2013 kept soil temperatures below 13°C. From the compared analysis Plant date 1 resulted in very low average germination percentage of 10.8, and as the soil warmed, more seedlings emerge from the soil, but still the average germination percentage at 14 days was low at 49.9%. A hail storm and heavy rain on the 28th of October 2013 resulted in lower germination percentage in Plant dates 3 and 4 due to damage to the seedlings, eroded soil and wash away of seeds just after plant.

The average plant height that (measured 150 days after planting) was calculated over the different plant dates was 111.5 cm. The cultivar CandiaB2RF had the shortest significantly plant height of 99.3 cm. The cultivars 13P3001B2RF, DP1441RF, and 13P3005B2RF were strong growers with an average plant height of 116 cm or higher.

Average boll size over planting dates for cultivars was 6.12 grams. Boll sizes for the planting dates 5, 6 and 7 were small with a weight of 5.93 g and 5.82 g and 5.98 g respectively compared to the other planting dates that were above 6.0 grams per boll. The cultivar DP1441 RF average boll size of 6.89 g over planting dates weighing significantly more than the other cultivars.

A hailstorm on the 28th of October 2013 resulted in hail damage to seedlings and reduced reducing yields for planting date 1, 2, 3 and 4.

The average yield over planting dates for cultivars was 5334.1 kg/ha. From the combined analysis, the cultivars 13P3005B2RF, 13P3001B2RF and DP210BRF had the highest yields. The cultivar 13P3005B2RF had the highest significantly yield over seven of the eight planting dates with an average yield of 5941.0 kg/ha. The cultivar CandiaB2RF had the highest average yield for the eighth planting date with a yield of 5126.4 kg/ha.

The average fibre percentage over planting dates for cultivars was 41.7%. The planting date 7 had the highest significantly fibre percentage of 43.44%. From the combined analysis for planting dates over cultivars, cultivars, DP1441RF, CandiaB2RF and 13P3001B2RF at Planting Date 7 with fibre percentage of 45.62%, 45.60% and 45.40% respectively had significantly higher fibre percentage.

The cultivars, Delta12BRF had result the longest average fibre length of average 31.168 mm followed by CandiaB2RF with a fibre length of 31.07 mm. From the combined analysis for planting dates over planting dates, planting date 8 resulted in two cultivars, 13P3001B2RF and CandiaB2RF, with significantly higher fibre lengths of 32.07 mm and 32.00 mm respectively.

The cultivar Delta1240B2RF gave significantly the strongest fibres of 34.36 g/tex. From the combined analysis for planting dates over cultivars, Delta1240B2RF at planting date 2 and 6 resulted in significantly stronger fibres of 35.7 and 35.6 g/tex.

The uniformity index values of 83 to 85 indicates a high degree of uniformity and >85 indicates a very high degree of uniformity. Almost all the Cultivars over planting dates resulted in index values above 83 except for Delta12BRF and DP210BRF and DP1441RF which resulted index values below 83 at planting dates 7 and 8. Their uniformity index value classified them as intermediate.

When sowing cotton too early, very thick fibres with micronaires above 4.5 µgram was resulted. Planting Date 1, 2 and 3 resulted in average micronaires of 4.8 µgram, 4.5 µgram and 4.6 µgram respectively. The cultivar Candia B2RF had the best micronaire average over the planting dates with of 3.8 µgram.

Each planting date trial was hand pick when ready and cotton fibres were not exposed to too long to field weathering. Thus, the degree of Reflection (Rd ≥ 75) and yellowness (+b < 9) are in the respective norms.

CONCLUSION

It is very difficult to find a particular cultivar suited for planting early in the cotton growing season because environmental conditions such as hail and heavy rains had an influence on cultivar performance. Two cultivars, namely 13P3005B2RF and CandiaB2RF performed very

well in the yield, the latter cultivar especially for late planting. The results showed different cultivar parameters suited different planting dates.

PROPOSED RESEARCH FOR 2014/15

This trial was a first cotton season trial and a second season for this trial is needed because environmental conditions are unpredicted and not controllable. The trial will be planted at Groblersdal: ARC-Loskop Research Farm and Northern Cape Province.

Table 1. Germination percentage 7 days after planting

Cultivar		Planting dates								Average Plant height (cm)	Ranking
		PD 1 7/10/2013	PD 2 14/10/2013	PD 3 22/10/2013	PD 4 28/10/2013	PD 5 4/11/2013	PD 6 11/11/2013	PD 7 18/11/2013	PD 8 25/11/2013		
1	Delta 12 BRF	9.3	80.4	80.0	32.9	90.0	82.9	89.3	92.5	69.6	7
2	13P3001B2RF	12.1	85.4	85.7	42.1	94.3	88.6	96.1	94.6	74.9	2
3	DP 1240 B2RF	10.4	76.1	72.1	40.0	95.0	85.7	96.1	94.6	71.3	6
4	Candia B2RF	12.1	85.4	86.4	42.5	93.2	84.6	95.4	96.1	74.5	3
5	13P3005B2RF	3.9	83.2	83.9	46.1	97.9	84.6	90.4	93.6	72.9	5
6	DP1441RF	12.9	91.8	90.7	47.5	97.1	88.6	96.8	98.2	77.9	1
7	DP210BRF	15.0	85.0	87.1	42.9	92.9	85.4	90.0	90.4	73.6	4
Average		10.8	83.9	83.7	42.0	94.3	85.8	93.4	94.3		
Ranking		8	5	6	7	1	4	3	2		
CV %		1.15									
LSD_t(0.05)(PD x Cult)		3.39									
LSD_t(0.05)(Cult x PD)		2.13									

Table 2. Germination percentage 14 days after planting

Cultivar		Planting dates								Average Plant height (cm)	Ranking
		PD 1 7/10/2013	PD 2 14/10/2013	PD 3 22/10/2013	PD 4 28/10/2013	PD 5 4/11/2013	PD 6 11/11/2013	PD 7 18/11/2013	PD 8 25/11/2013		
1	Delta 12 BRF	31.1	83.2	59.3	38.6	90.0	96.4	95.0	97.9	73.9	7
2	13P3001B2RF	54.3	91.1	68.6	44.6	93.2	97.5	96.8	95.7	80.2	2
3	DP 1240 B2RF	52.5	84.6	58.9	47.9	95.0	95.0	98.6	96.1	78.6	5
4	Candia B2RF	48.9	90.4	66.1	50.0	93.9	96.4	97.5	96.1	79.9	3
5	13P3005B2RF	48.2	89.6	62.5	47.9	98.2	97.1	96.4	96.8	79.6	4
6	DP1441RF	47.9	91.1	75.0	55.0	96.4	95.4	97.5	98.2	82.1	1
7	DP210BRF	45.7	88.9	55.0	50.7	95.0	97.5	95.7	96.8	78.2	6
Average		46.9	88.4	63.6	47.8	94.5	96.5	96.8	96.8		
Ranking		8	5	6	7	4	3	2	1		
CV %		1.06									
LSD_t(0.05)(PD x Cult)		1.62									
LSD_t(0.05)(Cult x PD)		10.15									

Table 3. Plant height (cm) was taken 150 days after planting

Cultivar		Planting dates								Average Plant height (cm)	Ranking
		PD 1 7/10/2013	PD 2 14/10/2013	PD 3 22/10/2013	PD 4 28/10/2013	PD 5 4/11/2013	PD 6 11/11/2013	PD 7 18/11/2013	PD 8 25/11/2013		
1	Delta 12 BRF	102.9	109.5	104.3	112.9	120.8	111.3	108.9	112.2	110.3	5
2	13P3001B2RF	112.9	111.4	111.4	125.1	122.7	129.7	112.2	116.2	117.7	1
3	DP 1240 B2RF	103.6	108.5	106.7	116.2	113.6	118.2	111.5	112.1	111.3	4
4	Candia B2RF	92.8	94.7	89.8	105.4	106.6	117.8	102.2	96.6	100.7	7
5	13P3005B2RF	119.2	113.9	112.3	123.9	124.8	125.4	111.3	102.4	116.6	3
6	DP1441RF	108.2	116.3	108.2	123.3	122.1	117.2	117.7	119.6	116.6	2
7	DP210BRF	112.4	101.6	102.6	108.5	115.9	120.5	104.2	107.7	109.1	6
Average		107.4	108.0	105.0	116.4	118.0	120.0	109.7	109.5		
Ranking		8	7	6	3	2	1	5	4		
CV %		5.57									
LSD_t(0.05)(PD x Cult)		3.07									
LSD_t(0.05)(Cult x PD)		3.28									

Table 4. Boll size (g)

Cultivar		Planting dates								Average Plant height (cm)	Ranking
		PD 1 7/10/2013	PD 2 14/10/2013	PD 3 22/10/2013	PD 4 28/10/2013	PD 5 4/11/2013	PD 6 11/11/2013	PD 7 18/11/2013	PD 8 25/11/2013		
1	Delta 12 BRF	6.1	6.0	6.0	5.9	5.9	5.4	5.5	5.9	5.83	6
2	13P3001B2RF	6.2	6.4	6.2	6.2	5.8	5.8	5.9	6.8	6.17	2
3	DP 1240 B2RF	6.4	5.5	6.6	6.4	5.8	5.9	5.9	6.5	6.12	4
4	Candia B2RF	6.2	5.5	5.5	5.4	5.3	5.2	5.4	6.2	5.59	7
5	13P3005B2RF	6.2	6.0	6.0	6.3	6.1	5.8	6.2	6.5	6.14	3
6	DP1441RF	6.9	6.6	6.9	6.9	6.8	6.8	6.9	7.2	6.88	1
7	DP210BRF	6.5	6.3	6.4	6.2	5.3	5.7	6.0	6.2	6.09	5
Average		6.4	6.0	6.2	6.2	5.9	5.8	6.0	6.5		
Ranking		2	5	3	4	7	8	6	1		
CV %		5.13									
LSD_t(0.05)(PD x Cult)		0.155									
LSD_t(0.05)(Cult x PD)		0.1662									

Table 5. Yield (kg/ha)

Cultivar		Planting dates																Average yield (kg/ha)	Ranking
		PD 1 7/10/2013	Ranking	PD 2 14/10/2013	Ranking	PD 3 22/10/2013	Ranking	PD 4 28/10/2013	Ranking	PD 5 4/11/2013	Ranking	PD 6 11/11/2013	Ranking	PD 7 18/11/2013	Ranking	PD 8 25/11/2013	Ranking		
1	Delta 12 BRF	2607.7	7	4427.5	7	4536.8	2	4480.5	7	5533.1	5	4884.7	5	5287.0	7	4191.6	7	4498.6	7
2	13P3001B2RF	3553.7	5	6076.9	3	5795.7	2	5808.8	3	6168.9	3	6006.1	2	5693.8	4	4977.3	2	5512.9	2
3	DP 1240 B2RF	4610.3	2	4794.7	6	5116.7	4	5442.0	5	5856.7	4	5385.2	4	5984.2	2	4730.0	4	5243.3	4
4	Candia B2RF	3862.5	4	5176.3	5	4366.3	7	4515.9	6	5110.1	6	4659.0	7	5374.6	6	5126.4	1	4779.0	6
5	13P3005B2RF	5104.5	1	6338.8	1	6158.1	1	6126.9	1	6615.1	1	6075.3	1	6376.3	1	4726.1	5	5941.0	1
6	DP1441RF	4223.5	3	6151.0	2	4818.8	5	5525.4	4	5032.1	7	4790.3	6	5773.1	3	4666.6	6	5126.4	5
7	DP210BRF	3406.1	6	5237.5	4	5667.6	3	6062.0	2	6381.7	2	5905.0	3	5692.5	5	4843.1	3	5402.6	3
Average		3909.8		5457.5		5208.6		5423.1		5814.0		5386.5		5740.2		4751.6			
Ranking		8		3		6		4		1		5		2		7			
CV %		0.018																	
LSD_t(0.05)(PD x Cult)		427.9																	
LSD_t(0.05)(Cult x PD)		347.02																	
LSD_t(0.05)(Cult x PD)		347.02																	

Table 6. Fibre percentage (%)

Cultivar		Planting dates								Average Plant height (cm)	Ranking
		PD 1 7/10/2013	PD 2 14/10/2013	PD 3 22/10/2013	PD 4 28/10/2013	PD 5 4/11/2013	PD 6 11/11/2013	PD 7 18/11/2013	PD 8 25/11/2013		
1	Delta 12 BRF	37.4	37.5	41.4	38.8	38.0	38.8	40.0	38.3	38.8	7
2	13P3001B2RF	41.0	43.1	40.5	43.3	44.1	41.3	45.4	43.4	42.7	3
3	DP 1240 B2RF	39.8	38.6	40.0	40.4	39.6	40.2	41.4	40.0	40.0	6
4	Candia B2RF	43.2	42.7	42.8	43.4	43.4	41.6	45.6	43.7	43.3	2
5	13P3005B2RF	41.4	42.0	40.8	43.1	42.5	42.5	44.1	44.1	42.6	4
6	DP1441RF	42.7	42.8	42.0	44.4	43.3	44.6	45.6	44.1	43.7	1
7	DP210BRF	40.1	39.6	42.9	41.5	40.5	41.1	42.0	40.7	41.0	5
Average		40.8	40.9	41.5	42.1	41.6	41.7	43.5	42.1		
Ranking		8	7	6	2	5	4	1	3		
CV%		3.17									
LSD_t(0.05)(PD x Cult)		0.66									
LSD_t(0.05)(Cult x PD)		0.7									

Table 7. Fibre length (mm)

Cultivar		Planting dates								Average Plant height (cm)	Ranking
		PD 1 7/10/2013	PD 2 14/10/2013	PD 3 22/10/2013	PD 4 28/10/2013	PD 5 4/11/2013	PD 6 11/11/2014	PD 7 18/11/2013	PD 8 25/11/2013		
1	Delta 12 BRF	30.5	30.2	30.4	29.3	29.2	27.9	28.7	29.5	29.4	6
2	13P3001B2RF	30.3	30.5	30.6	30.9	29.6	30.5	30.1	32.1	30.6	4
3	DP 1240 B2RF	30.2	30.9	30.5	30.4	31.2	30.0	30.5	31.0	30.6	3
4	Candia B2RF	31.1	31.5	31.0	30.7	31.2	30.6	31.2	32.0	31.2	1
5	13P3005B2RF	30.1	29.8	29.8	30.1	31.1	31.1	30.3	30.1	30.3	5
6	DP1441RF	29.3	29.3	28.8	29.3	29.6	29.1	28.2	30.0	29.2	7
7	DP210BRF	31.1	31.4	31.6	31.8	31.3	30.4	30.1	31.7	31.2	2
Average		30.3	30.5	30.4	30.3	30.5	30.0	29.9	30.9		
Ranking		6	2	5	4	3	7	8	1		
CV %		3.749									
LSD_t(0.05)(PD x Cult)		0.439									
LSD_t(0.05)(Cult x PD)		0.41									

Table 8. Fibre Uniformity

Cultivar		Planting dates								Average Plant height (cm)	Ranking
		PD 1 7/10/2013	PD 2 14/10/2013	PD 3 22/10/2013	PD 4 28/10/2013	PD 5 4/11/2013	PD 6 11/11/2013	PD 7 18/11/2013	PD 8 25/11/2013		
1	Delta 12 BRF	86.1	85.3	85.9	83.8	83.8	83.1	82.4	83.1	84.2	6
2	13P3001B2RF	86.3	86.3	85.1	85.6	84.5	84.8	83.7	84.8	85.1	2
3	DP 1240 B2RF	86.7	87.0	85.9	84.9	86.3	85.0	84.5	85.0	85.6	1
4	Candia B2RF	85.0	86.7	85.4	83.5	84.0	84.2	84.1	84.2	84.6	4
5	13P3005B2RF	86.4	84.3	84.6	85.1	84.7	86.0	84.0	86.0	85.1	3
6	DP1441RF	86.4	86.2	84.6	85.2	85.0	83.9	82.3	83.9	84.7	5
7	DP210BRF	87.3	85.6	84.5	84.0	82.4	81.7	82.7	81.7	83.7	7
Average		86.3	85.9	85.1	84.6	84.4	84.1	83.4	84.1		
Ranking		1	2	3	4	5	7	8	6		
CV %		1.758									
LSD_t(0.05)(PD x Cult)		0.714									
LSD_t(0.05)(Cult x PD)		0.668									

Table 9. Fibre Strength (g/tex)

Cultivar		Planting dates								Average Plant height (cm)	Ranking
		PD 1 7/10/2013	PD 2 14/10/2013	PD 3 22/10/2013	PD 4 28/10/2013	PD 5 4/11/2013	PD 6 11/11/2013	PD 7 18/11/2013	PD 8 25/11/2013		
1	Delta 12 BRF	32.6	24.5	33.6	30.6	30.2	31.3	26.4	29.4	29.8	6
2	13P3001B2RF	34.5	33.9	33.7	33.5	31.1	31.9	27.6	30.2	32.1	4
3	DP 1240 B2RF	35.2	35.2	34.8	34.8	34.5	35.6	31.1	33.1	34.3	1
4	Candia B2RF	34.0	35.1	33.1	31.1	31.2	33.8	28.4	31.1	32.2	3
5	13P3005B2RF	35.2	33.8	34.4	33.0	32.8	34.7	29.3	30.1	32.9	2
6	DP1441RF	32.1	33.6	31.3	30.5	31.4	30.5	25.7	29.2	30.5	7
7	DP210BRF	34.6	33.6	32.6	31.7	29.8	31.7	28.3	30.3	31.6	5
Average		34.0	32.8	33.4	32.2	31.6	32.8	28.1	30.5		
Ranking		1	2	3	5	6	4	8	7		
CV %		6.076									
LSD_t(0.05)(PD x Cult)		0.741									
LSD_t(0.05)(Cult x PD)		1.977									

Table 10. Micronaire (µgram)

Cultivar		Planting dates								Average Plant height (cm)	Ranking
		PD 1 7/10/2013	PD 2 14/10/2013	PD 3 22/10/2013	PD 4 28/11/2013	PD 5 4/11/2013	PD 6 11/11/2013	PD 7 18/11/2013	PD 8 25/11/2013		
1	Delta 12 BRF	4.7	4.4	4.5	4.6	4.0	3.8	3.6	3.8	4.2	5
2	13P3001B2RF	4.7	4.9	4.5	4.4	4.3	4.0	4.5	3.9	4.4	3
3	DP 1240 B2RF	5.1	4.9	5.0	4.6	4.6	4.5	4.8	4.7	4.8	1
4	Candia B2RF	4.5	3.8	3.9	3.9	3.1	3.4	3.8	3.8	3.8	7
5	13P3005B2RF	4.9	4.7	5.1	4.8	4.4	4.2	4.7	4.7	4.7	2
6	DP1441RF	4.8	4.1	4.5	4.2	4.2	4.1	3.8	4.3	4.3	4
7	DP210BRF	4.6	4.4	4.6	4.0	3.8	3.7	4.1	3.7	4.1	6
Average		4.8	4.5	4.6	4.4	4.1	3.9	4.2	4.1		
Ranking		1	3	2	4	7	8	5	6		
CV %		10.754									
LSD_t(0.05)(PD x Cult)		0.161									
LSD_t(0.05)(Cult x PD)		0.151									

Table 11. Degree of reflectance (Rd ≥ 75)

Cultivar		Planting dates								Average Plant height (cm)	Ranking
		PD 1 7/10/2013	PD 2 14/10/2013	PD 3 22/10/2013	PD 4 28/11/2013	PD 5 4/11/2013	PD 6 11/11/2013	PD 7 18/11/2013	PD 8 25/11/2013		
1	Delta 12 BRF	76.9	78.6	77.8	79.6	80.0	80.1	80.4	82.8	79.5	4
2	13P3001B2RF	75.9	79.7	79.4	79.5	80.3	81.1	81.1	82.2	79.9	1
3	DP 1240 B2RF	74.6	75.7	75.7	76.1	77.3	78.2	79.0	81.9	77.3	7
4	Candia B2RF	76.2	80.4	79.0	79.5	81.0	81.3	80.0	82.4	80.0	2
5	13P3005B2RF	75.0	77.7	76.9	77.9	78.8	79.4	79.9	82.3	78.5	6
6	DP1441RF	76.9	78.9	77.6	79.0	80.0	79.9	80.2	81.5	79.2	5
7	DP210BRF	78.0	79.0	79.3	78.7	80.9	81.3	80.2	81.6	79.9	3
Average		76.2	78.6	77.9	78.6	79.7	80.2	80.1	82.1		
Ranking		8	6	7	5	4	2	3	1		
CV %		2.123									
LSD_t(0.05)(PD x Cult)		0.637									
LSD_t(0.05)(Cult x PD)		0.596									

Table 12. Yellowness (+b < 9)

Cultivar		Planting dates								Average Plant height (cm)	Ranking
		PD 1 7/10/2013	PD 2 14/10/2013	PD 3 22/10/2013	PD 4 28/10/2013	PD 5 4/11/2013	PD 6 11/11/2013	PD 7 18/11/2013	PD 8 25/11/2013		
1	Delta 12 BRF	8.8	8.3	8.0	7.3	7.3	7.0	7.2	7.4	7.6	7
2	13P3001B2RF	8.7	7.9	7.7	7.6	7.3	7.0	7.5	7.4	7.6	6
3	DP 1240 B2RF	9.7	9.1	9.2	8.7	8.6	8.5	8.1	7.8	8.7	1
4	Candia B2RF	8.6	7.9	7.7	7.8	7.8	7.1	7.9	7.8	7.8	4
5	13P3005B2RF	9.2	8.6	8.7	8.0	8.5	7.9	7.9	7.8	8.3	2
6	DP1441RF	9.0	8.4	8.5	7.9	8.2	7.6	7.8	7.9	8.2	3
7	DP210BRF	8.7	8.3	8.0	7.2	7.2	7.0	7.8	7.9	7.7	5
Average		8.9	8.3	8.3	7.8	7.8	7.4	7.7	7.7		
Ranking		1	2	3	5	4	8	7	6		
CV %		7.816									
LSD_t(0.05)(PD x Cult)		0.242									
LSD_t(0.05)(Cult x PD)		0.227									