ARC-Institute for Industrial Crops

Cotton Project Annual Progress Report

2017/2018

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Excellence in Research and Development

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PROJECT NUMBER	**:**	P08000011
PROJECT TITLE	**:**	Minimum input
REPORT YEAR	**:**	2017/2018
PROJECT MANAGER	**:**	HJ Steyn (Resigned) Dr T van der Westhuizen

OBJECTIVE

To evaluate five different Nitrogen dosages on cotton planted with the Rip on Row method.

LOCALITY

Makhathini

CULTIVAR

DP1531 B2RF

N DOSAGES

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

RESULTS

Yield parameters

The highest seedcotton yield was obtained when 30 kg N/ha (1894 kg/ha) was applied, followed by the 50 kg N/ha (1773 kg/ha). The highest fibre percentage of 40.2 % was obtained when 30 kg N/ha was applied. The highest fibre yield was obtained when 30 kg N/ha (764 kg/ha) was applied, followed by the 50 kg N/ha (684 kg/ha).

Fibre parameters

The longest fibre was obtain when zero nitrogen was applied (31.1 mm). The strongest fibres was obtained when 40 kg N/ha was applied. Micronaires was in the acceptable range of 3.5 to 4.9 except when 20 and 50 kg/ha was applied.

Table 1. Yield parameters of the Minimum Input Trial at Makhathini, 2017/2018

N dosages	Seed cotton yield	Fibre %	Fibre yield
0 kg N/ha	1726	39.4	680
10 kg N/ha	1644	38.9	638
20 kg N/ha	1523	40.1	607
30 kg N/ha	1894	40.2	764
40 kg N/ha	1702	38.6	657
50 kg N/ha	1773	38.6	684

Table 2. Fibre characteristics of the Minimum Input Trial at Makhathini, 2017/2018

N dosages	0 kg N/ha	10 kg N/ha	20 kg N/ha	30 kg N/ha	40 kg N/ha	50 kg N/ha
Length (mm)	31.1	30.2	30.5	30.0	30.8	30.0
Uniformity	84.0	84.8	84.7	83.1	84.8	84.9
Strength (g/tex)	29.8	29.8	31.6	31.1	32.4	31.9
Maturity	0.83	0.82	0.83	0.82	0.83	0.83
Micronaire	3.5	3.5	**3.3**	3.5	3.6	**3.2**
PlusB	8.6	8.2	9.3	8.5	7.8	9.0
Rd	77.0	77.1	77.1	75.0	78.2	76.4
Color Grade	31-2	31-2	21-4	41-1	31-2	31-3

CONCLUSION

Higher seed cotton yields, fibre percentages and fibre yields were obtained when 30 kg/ha nitrogen was applied at the Rip on Row Trial in Makhathini. The highest and best micronaire was also obtained by the 30 kg/ha nitrogen application. Advantages in fibre yield plus fibre characteristics exists when 30 kg/ha are applied on dryland Rip on Row cotton.

PROJECT NUMBER	:	P08000016
PROJECT TITLE	:	Evaluation of planting date on production of cotton cultivar
REPORT YEAR	:	2017/2018
PROJECT LEADER	:	CE Fourie
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CO-WORKERS	:	KC Phalane RS Phalamohlaka

INTRODUCTION

Obtaining a vigorous and optimal stand is the first step for profitable cotton production. The use of appropriate cultivars and agronomic practices in suitable environments is a prerequisite for such success. Environmental factors such as soil temperature determines the time of planting cotton.

In South Africa, the window for sowing cotton is very narrow and has a major influence on the yield and fibre qualities. Finding the most suitable cultivar for a particular planting date can help to widen the window period for sowing and ultimately optimize the total yield and quality of fibre.

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 was determined at various planting dates.

TREATMENTS

Locality

Groblersdal: ARC-Loskop Research Farm

Planting Dates

1. 03 October 2017 (PD1)
2. 09 October 2017 (PD 2)
3. 16 October 2017 (PD 3)
4. 23 October 2017 (PD 4)
5. 30 October 2017 (PD 5)
6. 06 November 2017 (PD 6)
7. 13 November 2017 (PD 7)
8. 20 November 2017 (PD 8)
9. 27 November 2017 (PD 9)
10. 04 December 2017 (PD 10)

Cultivars

Cotton cultivars planted under irrigation consisted of five entries namely:

1. Delta 12BRF (standard)
2. DP1541 B2RF
3. DP1240 B2RF
4. Candia B2RF
5. DP1531 B2RF

MATERIAL AND METHODS

The trial was conducted under irrigation conditions, following practices that are commonly used in commercial cotton production systems. An additional 450 mm was irrigated during the season.

The effect on planting time on plant growth, yield, fibre qualities and the degree of whiteness (colour values) of the different cotton cultivars was determined.

Each planting date trial were planted in a randomized block design with four replicates. Plots consisted of four rows of 5m lengths, at an inter-row spacing of 90cm and intra-row spacing of 15cm. Each plot was split into two where two rows were harvest on time and two rows were harvested 6 weeks after the first harvest. This procedure was done to assess fibre weathering. One soil temperature meter was installed, 3 cm deep into the soil, on 30 September 2017 to record soil temperatures during sowing season. The planting date trials had been handpicked as soon as all the bolls were opened.

Final Plant Mapping data

Final Plant mapping data were made to assist in explaining the influence of the cultivar adaptation and climatic conditions. The growth of the cotton plant is temperature dependent.

For every Planting Date trial five plants per cultivar in each replication were evaluated.

The Final Plant Mapping data included the following:

a. Plant height
b. Number of vegetative nodes
c. Number of fruit branches
d. Height-to-node ratio
e. Bolls/plant
f. Boll Retention at 95 % zone

ENVIRONMENTAL CONDITIONS

Temperatures

Warm and consistence air- and soil temperatures did benefit all the cotton cultivars in the 2017-18 growing season. However, low rainfall measurements of 202 mm during the growing season.

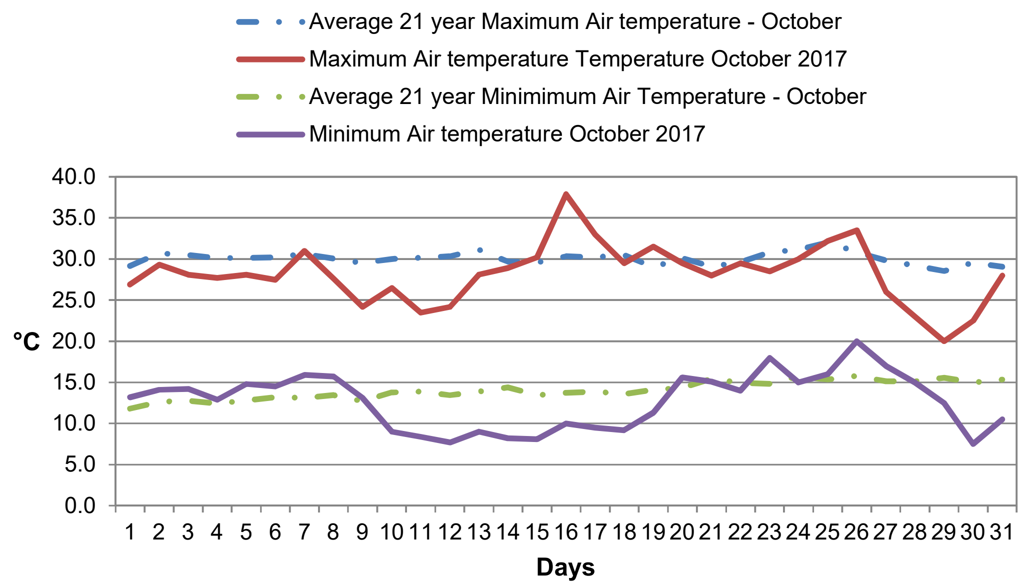

Figure 1. Air Temperature – October 2017 (°C)

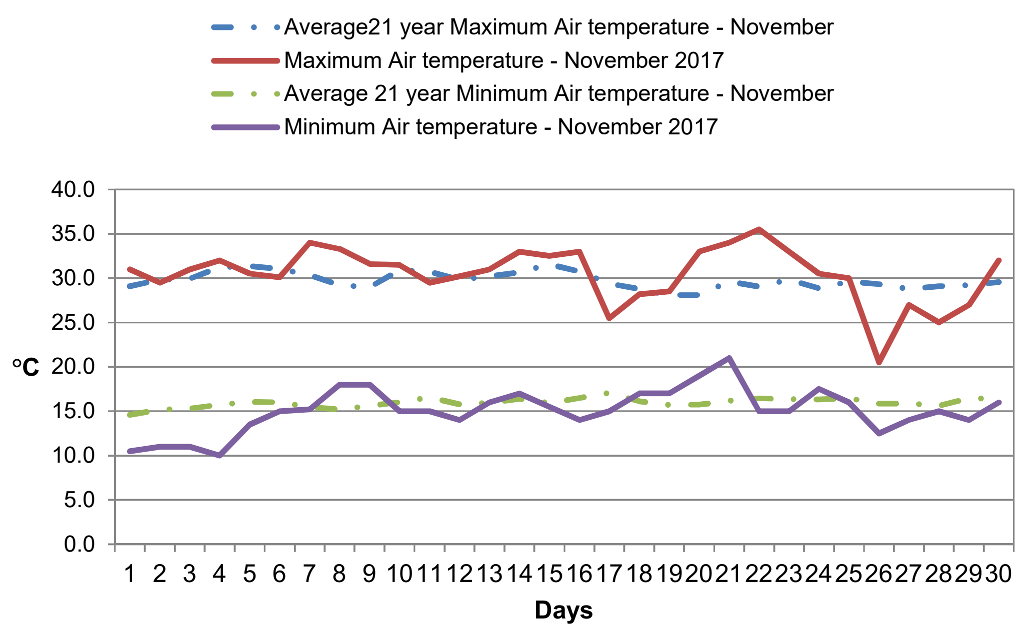

Figure 2. Air temperature – November 2017 (°C)

Soil temperature

October 2017 - Soil temperatures

The soil temperature between 9 October to 18 October 2017 dropped below the required 16 °C.

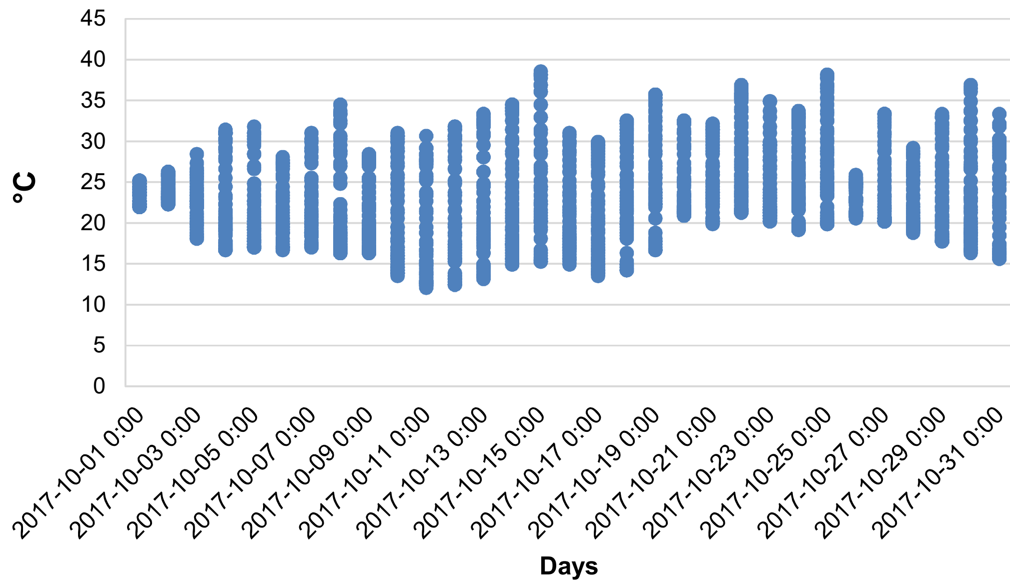

Figure 3. October 2017 - Soil temperatures (°C)

November 2017 - Soil temperatures

Soil temperatures for November 2017 were sufficiently for sowing of cotton.

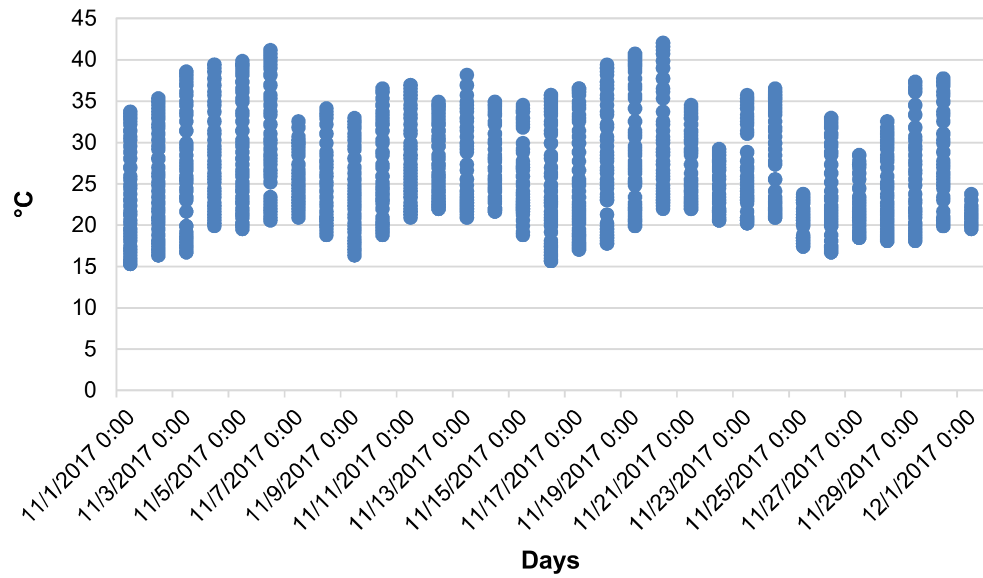

Figure 4. November 2017 Soil temperatures (°C)

Day Degree (base 15.6 °C)

The growth of the cotton plant is temperature dependent. If daily temperatures fall below the critical threshold of 15.6 °C, growth ceased. As temperature rise above the critical threshold, growth-rate of the plant increase again.

The relationship between growth and temperature is used to predict the timing of various development stages of the cotton plant. Day degree accumulation evolved to monitor crop development because it took accumulation of heat over time. One degree-day is defined as the amount of heat that accumulates during a 24-hour period when the average temperature is 16.6 or 1° above the development threshold. The formula used to calculate degree-days:

Degree days = [(Maximum temperature + Minimum temperature) ÷ 2] - 15.6 °C

(Cotton Production Manual, University of California, Division of Agriculture and Natural resources, p.22)

If cottonseed does not experience favourable temperature within 5 days of planting, seedling emergence will be delayed, plant stand reduced and yield loss will have occurred.

From the day of planting, a cottonseed needs 50 degree-days to emerge from an optimum depth. If cotton emerges from the soil in less than 10 days, the plant has experience ideal soil and daily temperatures of five of more degree-days. When more than 10 days are required for seedlings to emerge, this indicates less-than-ideal temperatures has occurred.

PD 1 (2/10/2017), PD 2 (9/10/2017), PD3 (16/10/2017) and PD 7 (13/11/2017) resulted in low germination percentages which were caused by low soil, (≤ 16 °C) and low daily temperatures of 28.4 degree-days. The November planting date resulted in degree-days higher than 50 and thus resulted in good germination percentages.

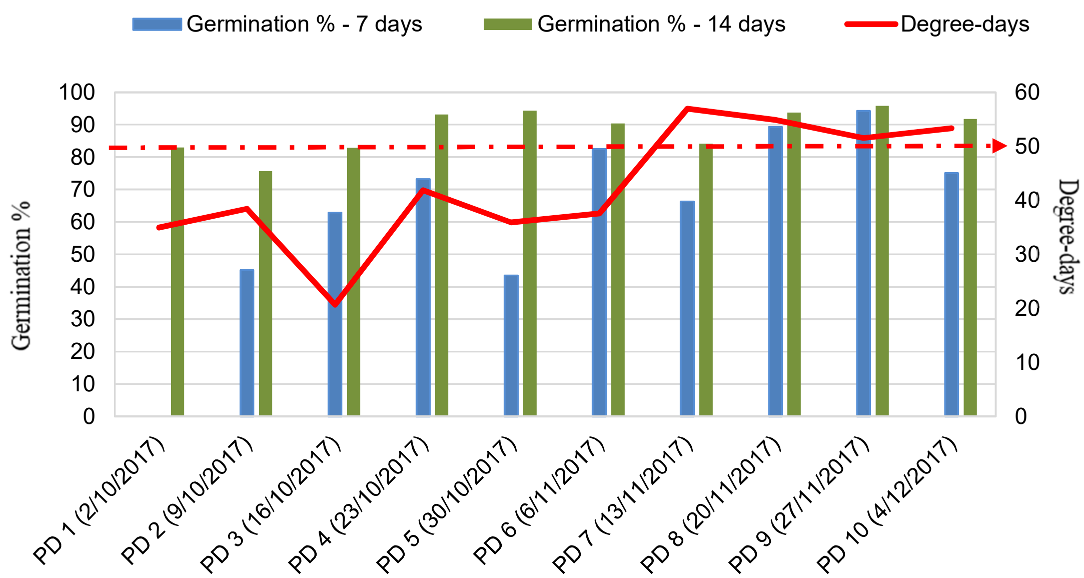

Figure 5. Germination percentage compared to Degree-days

2017-18 Rainfall (mm) compared to 2016-17 Rainfall (mm)

A total of 202 mm rainfall was measured for the 2016-17 cotton-growing period.

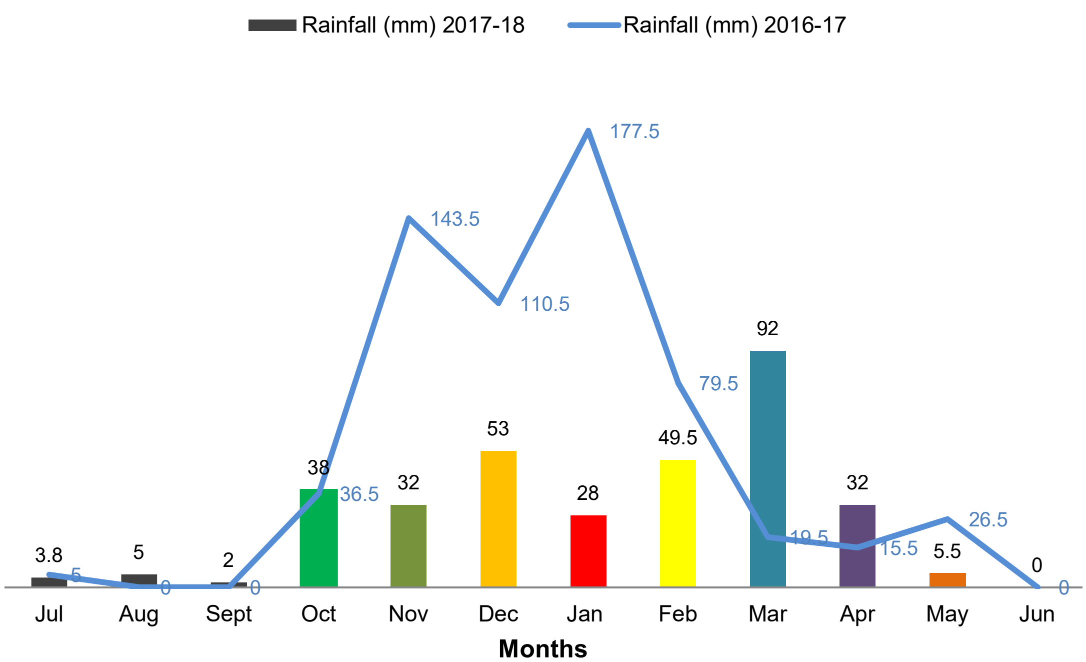

Figure 6. Rainfall (mm)

PLANT GROWTH

Germination percentage

Cool soil temperatures below 16 °C and low daily temperatures of less than 50 degree-days resulted in less than acceptable germination percentages for the October plantings.

Soil temperatures indicated that the soil was cold and germination percentages for October 2017 stayed low even after 14 days after plant.

Table 1. Germination percentage 7 days after planting

Cultivar		Planting dates										Average Germination % - 7 Days after plant	Ranking
		PD 1 02/10/17	PD 2 09/10/17	PD 3 16/10/17	PD 4 23/10/17	PD 5 30/10/17	PD 6 06/11/17	PD 7 13/11/17	PD 8 20/11/17	PD 9 27/11/17	PD 10 04/12/17		
1	Delta 12 BRF	0.0	35.4	50.4	59.3	40.5	77.3	66.1	87.9	92.1	67.9	57.7	5
2	DP1541 B2RF	0.0	48.9	66.6	81.3	43.6	85.0	57.0	91.1	96.1	81.6	65.1	3
3	DP 1240 B2RF	0.0	39.6	72.5	78.0	45.2	87.1	73.9	88.2	95.9	71.1	65.2	2
4	Candia BGRF	0.0	54.3	63.0	75.7	45.5	80.0	76.1	89.5	93.0	77.5	65.5	1
5	DP1531 B2RF	0.0	47.1	62.1	71.8	42.7	83.2	59.8	90.0	93.9	77.5	62.8	4
Average		0.0	45.1	62.9	73.2	43.5	82.5	66.6	89.3	94.2	75.1		
Ranking		10	8	7	5	9	3	6	2	1	4		
CV %		17.6											
LSD_t(0.05)(Cult x PD)		15.582											

Table 2. Germination percentage 14 days after planting

Cultivar		Planting dates										Average Germination % - 14 Days after plant	Ranking
		PD 1 02/10/17	PD 2 09/10/17	PD 3 16/10/17	PD 4 23/10/17	PD 5 30/10/17	PD 6 06/11/17	PD 7 13/11/17	PD 8 20/11/17	PD 9 27/11/17	PD 10 04/12/17		
1	Delta 12 BRF	56	71.1	71.4	93.0	72.1	87.7	81.1	89.1	94.8	92.3	80.8	5
2	DP1541 B2RF	86	71.8	88.0	95.0	72.0	93.6	86.1	96.1	97.5	92.7	87.9	3
3	DP 1240 B2RF	89	75.5	91.1	94.6	90.4	94.1	90.9	96.6	96.8	90.2	90.9	1
4	Candia BGRF	93	84.3	83.6	90.9	88.2	89.3	83.8	93.0	94.3	91.3	89.1	2
5	DP1531 B2RF	91	75.9	80.5	92.0	78.0	88.0	79.1	94.1	95.7	93.0	86.8	4
Average		83.0	75.7	82.9	93.1	80.1	90.5	84.2	93.8	95.8	91.9		
Ranking		7	10	8	2	9	5	6	3	1	4		
CV %		9.6											
LSD_t(0.05)(Cult x PD)		11.662											

Plant height at Final Plant Mapping

The cultivars DP1541 B2RF and DP1531 B2RF resulted in significantly taller plants at the fourth Planting Date with heights of 140.0 cm and 145.5cm respectively. The cultivar Candia BGRF resulted in significant shorter plants over all the planting dates with an average plant height of 102.0 cm. The shorter plants of Candia B2RF could be cultivar related.

Table 3. Plant Height at Final Plant Mapping

Cultivar		Planting dates										Average Plant height (cm)	Significant level
		PD 1 02/10/17	PD 2 09/10/17	PD 3 16/10/17	PD 4 23/10/17	PD 5 30/10/17	PD 6 06/11/17	PD 7 13/11/17	PD 8 20/11/17	PD 9 27/11/17	PD 10 04/12/17		
1	Delta 12 BRF	84.0	84.5	119.8	121.6	117.1	115.5	121.5	116.8	115.3	110.5	110.6	4
2	DP1541 B2RF	92.7	84.8	119.8	140.0	135.3	136.8	145.5	137.3	123.8	122.5	123.8	2
3	DP 1240 B2RF	91.3	90.5	106.3	137.1	118.0	133.3	136.3	123.5	105.3	109.0	115.0	3
4	Candia BGRF	78.5	86.8	95.3	115.8	107.3	110.8	114.0	107.8	99.8	104.5	102.0	5
5	DP1531 B2RF	97.5	97.3	132.3	145.5	131.8	145.8	139.8	130.3	117.0	126.3	126.3	1
	Average	88.8	88.8	114.7	132.0	121.9	128.4	131.4	123.1	112.2	114.6		
Significant level		9	9	6	1	5	3	2	4	8	7		
CV %		1											
$LSD_t(0.05)$(PD x Cult)		3.24											
$LSD_t(0.05)$(Cult x PD)		4.582											

Number of vegetative nodes

The number of vegetative nodes produced before the first fruiting branches are formed depends on the variety and the environment.

Candia BGRF and DP1541 B2RF resulted in a lower number of vegetative nodes of 4.8 per plant.

Table 4. Number of vegetative nodes

Cultivar		Planting dates										Average Number of Vegetative nodes above cotyledons (count)	Ranking
		PD 1 02/10/17	PD 2 09/10/17	PD 3 16/10/17	PD 4 23/10/17	PD 5 30/10/17	PD 6 06/11/17	PD 7 13/11/17	PD 8 20/11/17	PD 9 27/11/17	PD 10 04/12/17		
1	Delta 12 BRF	4.6	5.0	5.0	4.8	5.3	4.8	5.3	4.8	5.0	5.3	5.0	1
2	DP1541 B2RF	4.3	5.5	5.0	4.5	4.3	4.5	5.0	5.0	5.8	4.3	4.8	3
3	DP 1240 B2RF	4.8	5.0	5.0	4.3	4.8	5.3	5.0	5.0	5.0	4.8	4.9	2
4	Candia BGRF	4.0	4.8	5.3	5.0	5.0	5.5	4.5	4.0	5.3	5.0	4.8	3
5	DP1531 B2RF	4.5	4.8	5.0	5.3	5.0	5.5	5.0	4.5	5.0	4.5	4.9	2
Average		4.4	5.0	5.1	4.8	4.9	5.1	5.0	4.7	5.2	4.8		
Ranking		8	3	2	5	4	2	3	6	1	5		
CV %		0.7											
$LSD_t(0.05)$(PD x Cult)		0.2119											
$LSD_t(0.05)$(Cult x PD)		0.2997											

Fruit Branches

The number of fruit branches decreased significantly in the end of the November plantings (Table 5). This may be related to the fact that later plantings develop during warmer weather, resulting in faster vegetative growth. The cultivar, Candia BGRF, resulted in significantly lower fruiting branches over all the planting dates. Plant dating seven (30 October 2017) resulted in the highest number for fruit branches of 17.5 fruit branches per plant.

Table 5. Number of fruit branches

Cultivar		Planting dates										Average Number of fruit nodes (count)	Ranking
		PD 1 02/10/17	PD 2 09/10/17	PD 3 16/10/17	PD 4 23/10/17	PD 5 30/10/17	PD 6 06/11/17	PD 7 13/11/17	PD 8 20/11/17	PD 9 27/11/17	PD 10 04/12/17		
1	Delta 12 BRF	17.5	16.0	18.8	17.0	16.5	16.3	14.5	16.5	14.3	13.5	16.1	4
2	DP1541 B2RF	15.2	15.0	17.3	16.3	18.0	18.0	17.5	16.0	16.0	15.3	16.4	3
3	DP 1240 B2RF	16.3	16.0	17.3	18.3	18.0	18.0	15.5	16.5	15.8	14.3	16.6	2
4	Candia BGRF	16.5	14.0	14.5	17.3	16.3	14.3	15.8	14.5	13.5	14.3	15.1	5
5	DP1531 B2RF	15.8	16.0	19.0	17.0	18.5	18.0	16.3	16.8	15.0	15.0	16.7	1
Average		16.2	15.4	17.4	17.2	17.5	16.9	15.9	16.1	14.9	14.5		
Ranking		5	8	2	3	1	4	7	6	9	10		
CV %		11.58056											
$LSD_t(0.05)$(PD x Cult)		1.036											
$LSD_t(0.05)$(Cult x PD)		1.2744											

Height-to-node ratio (HNR)

The height-to-node ratio is a simple determination of the plant's vigour or growth potential. It reflects the degree of stress that plants experience throughout the season. This is the numeric equivalent to the average distance between nodes and is called internode length. The formula used:

Height-to-node ratio = Plant height (cm) ÷ total number of nodes on main stem (vegetative nodes and fruit branch nodes)

Cooler temperatures and good rainfall patterns during March 2018 benefitted Planting Dates 7 and 8. Plants were growing more vigorously and the internode lengths (cm) were all longer (>5.0 cm).

Cultivars DP1541 B2RF and DP1531 B2RF had the longest internode of 5.8 cm. The two cultivars are both strong growers and it is recommended that improved management of these cultivars is needed. Candia BGRF had the shortest internode length of 5.1 cm.

Table 6. Height-to-node ratio of cotton cultivars planted at different dates

Cultivar		Planting dates										Average HNR (Calculated)	Ranking
		PD 1 02/10/17	PD 2 09/10/17	PD 3 16/10/17	PD 4 23/10/17	PD 5 30/10/17	PD 6 06/11/17	PD 7 13/11/17	PD 8 20/11/17	PD 9 27/11/17	PD 10 04/12/17		
1	Delta 12 BRF	3.8	4.1	5.1	5.1	5.3	5.5	6.2	5.5	6.0	6.0	5.2	3
2	DP1541 B2RF	4.8	4.1	5.4	6.1	6.1	6.1	6.5	6.5	5.7	6.3	5.8	1
3	DP 1240 B2RF	4.3	4.3	4.8	5.2	5.2	5.8	6.7	5.8	5.1	5.7	5.3	2
4	Candia BGRF	3.9	4.7	4.8	4.9	5.1	5.7	5.6	5.8	5.4	5.4	5.1	4
5	DP1531 B2RF	4.8	4.7	5.5	5.6	5.6	6.2	6.6	6.1	5.9	6.5	5.8	1
Average		4.3	4.4	5.1	5.4	5.4	5.9	6.3	6.0	5.6	6.0		
Ranking		8	7	6	5	5	3	1	2	4	2		
CV %		0.6											
LSD_t(0.05)(PD x Cult)		0.2249											
LSD_t(0.05)(Cult x PD)		0.318											

Bolls per plant

Stress to plants reduces early leaf area, resulting in a smaller and older leaf area during boll set. Cultivar Candia BGRF had the highest average bolls per plant with 25.2 bolls per plant. Plant date 5 had the highest average number of boll per plant of 30.6.

Table 7. Number of boll per plant

Cultivar		Planting dates										Average Bolls per plant (count)	Ranking
		PD 1 02/10/17	PD 2 09/10/17	PD 3 16/10/17	PD 4 23/10/17	PD 5 30/10/17	PD 6 06/11/17	PD 7 13/11/17	PD 8 20/11/17	PD 9 27/11/17	PD 10 04/12/17		
1	Delta 12 BRF	25.9	20.8	34.0	26.8	25.3	24.0	19.3	19.3	14.5	21.3	23.1	3
2	DP1541 B2RF	22.6	18.5	26.8	20.0	30.0	25.3	26.8	19.8	21.0	16.0	22.7	4
3	DP 1240 B2RF	24.8	23.8	25.0	25.3	30.3	30.3	18.5	21.5	12.0	15.0	22.6	5
4	Candia BGRF	27.0	22.5	28.8	32.0	35.8	25.8	29.3	17.3	15.5	18.3	25.2	1
5	DP1531 B2RF	25.3	26.5	21.8	22.5	31.8	31.3	30.0	18.3	18.0	20.3	24.6	2
Average		25.1	22.4	27.3	25.3	30.6	27.3	24.8	19.2	16.2	18.2		
Ranking		4	6	2	3	1	2	5	7	9	8		
CV %		4.0											
LSD_t(0.05)(PD x Cult)		2.672											
LSD_t(0.05)(Cult x PD)		3.779											

Boll retention 95% zone

Cut-out occurs when the boll load consumes all the carbohydrates produced by the leaves. Both the early boll load and the quantity of leaf area to sustain the boll load affect this. Final plant mapping data was used to determine when cut-out occurred. Plants were considered to reach cut-out when 95 percent of the harvested bolls at the first position have already been set.

Planting Date 5, (30 October 2017) significantly retained more bolls at the 95 percent zone of 90.9 %. The cultivar Candia BGRF retained the highest number of bolls at the 95 percent zone of 88.3 %.

Table 8. Boll retention 95 % zone

Cultivar		Planting dates										Average retention 95 % bolls (calculated)	Ranking
		PD 1 02/10/17	PD 2 09/10/17	PD 3 16/10/17	PD 4 23/10/17	PD 5 30/10/17	PD 6 06/11/17	PD 7 13/11/17	PD 8 20/11/17	PD 9 27/11/17	PD 10 04/12/17		
1	Delta 12 BRF	77.1	77.1	87.1	80.7	91.3	79.8	88.0	76.8	72.2	79.3	80.9	5
2	DP1541 B2RF	76.6	83.3	87.0	93.6	92.3	88.7	72.1	84.2	76.1	83.8	83.8	3
3	DP 1240 B2RF	76.2	78.3	93.7	92.7	92.7	87.2	83.0	87.7	61.0	81.1	83.4	4
4	Candia BGRF	84.5	87.6	86.7	93.3	83.7	98.2	80.6	90.6	87.2	90.8	88.3	1
5	DP1531 B2RF	82.7	81.0	83.6	89.9	94.8	89.4	89.6	78.7	80.8	89.0	86.0	2
Average		79.4	81.4	87.6	90.1	90.9	88.7	82.7	83.6	75.5	84.8		
Ranking		9	8	4	2	1	3	7	6	10	5		
CV %		0.8											
$LSD_t(0.05)$(PD x Cult)		4.863											
$LSD_t(0.05)$(Cult x PD)		6.877											

YIELD AND FIBRE QUALITIES

Seed Cotton Yield

All the Planting Dates resulted in good seed cotton yield, except for Plant Date 8, 9 and 10 that obtained a yield < 4000 kg/ha.

Planting date 4 (23 October 2017) resulted in the highest yield of 6617.6 kg/ha followed by planting date 3 (16 October 2017) with a yield of 6168.7 kg/ha. According to the 2017/18 results, the recommended plant date for cotton to obtain optimum yields is 23 October 2017.

The cultivars DP1541 B2RF and DP1531 B2RF resulted in the highest yields per hectare of 5171.0 kg/ha and 4979.4 kg/a respectively.

Table 9. Yield kg/ha

Cultivar		Planting dates										Average yield (kg/ha)	Ranking
		PD 1 02/10/17	PD 2 09/10/17	PD 3 16/10/17	PD 4 23/10/17	PD 5 30/10/17	PD 6 06/11/17	PD 7 13/11/17	PD 8 20/11/17	PD 9 27/11/17	PD 10 04/12/17		
1	Delta 12 BRF	3913.8	5371.6	5650.6	6182.9	4343.2	4775.9	3742.3	3645.9	3378.3	2657.0	4366.1	5
2	DP1541 B2RF	5120.3	4518.5	6770.2	7323.9	5771.3	5799.6	4531.3	4627.1	3825.2	3432.1	5171.9	1
3	DP 1240 B2RF	5584.1	4852.8	6142.0	6819.3	4765.4	4921.3	4315.1	3228.8	3055.9	2795.3	4648.0	3
4	Candia BGRF	4809.6	5102.7	6768.5	6414.2	4615.0	4109.0	3336.2	3312.1	2699.9	2764.3	4393.2	4
5	DP1531 B2RF	5039.6	5691.8	5512.1	6347.7	5238.3	5745.7	4480.6	4386.8	4103.4	3248.4	4979.4	2
Average		4893.5	5107.5	6168.7	6617.6	4946.6	5070.3	4081.1	3840.1	3412.6	2979.4		
Ranking		6	3	2	1	5	4	7	8	9	10		
CV %		2.4											
LSD_t(0.05)(PD x Cult)		273.9											
LSD_t(0.05)(Cult x PD)		387.4											

Fibre percentage

Fibre percentages were not greatly influenced by the planting dates. Fibre percentages are cultivar related. The cultivars DP1531 B2RF, Candia BGRF and DP1541 B2RF resulted in the highest fibre percentages of 45.3, 45.1 and 45.0 respectively.

Table 10. Fibre percentage

Cultivar		Planting dates										Average Fibre %	Ranking
		PD 1 02/10/17	PD 2 09/10/17	PD 3 16/10/17	PD 4 23/10/17	PD 5 30/10/17	PD 6 06/11/17	PD 7 13/11/17	PD 8 20/11/17	PD 9 27/11/17	PD 10 04/12/17		
1	Delta 12 BRF	40.9	41.0	41.3	40.6	40.7	40.9	40.9	40.2	40.1	39.5	40.6	5
2	DP1541 B2RF	45.1	44.5	46.2	46.0	44.7	45.0	45.7	44.2	44.0	44.7	45.0	3
3	DP 1240 B2RF	43.1	42.5	46.2	43.0	42.3	43.2	41.1	41.0	40.1	41.3	42.4	4
4	Candia BGRF	45.7	44.0	46.3	43.0	45.4	45.2	46.0	45.6	45.5	44.4	45.1	2
5	DP1531 B2RF	46.1	45.1	44.9	46.8	46.1	45.0	45.1	45.1	44.7	43.6	45.3	1
Average		44.2	43.4	45.0	43.9	43.8	43.8	43.8	43.2	42.9	42.7		
Ranking		2	5	1	3	4	4	4	6	7	8		
CV%		3.8											
LSD_t(0.05)(PD x Cult)		0.729											
LSD_t(0.05)(Cult x PD)		1.031											

Boll size

All the planting dates resulted in boll sizes greater than 5 grams per boll. The smallest bolls were obtained from Plant date 10. Cultivars DP1531 B2RF and DP1240 B2RF resulted in the heaviest bolls of 5.6 g.

Table 11. Boll size (g)

Cultivar		Planting dates										Average Boll size (g)	Ranking
		PD 1 02/10/17	PD 2 09/10/17	PD 3 16/10/17	PD 4 23/10/17	PD 5 30/10/17	PD 6 06/11/17	PD 7 13/11/17	PD 8 20/11/17	PD 9 27/11/17	PD 10 04/12/17		
1	Delta 12 BRF	5.3	5.5	6.9	5.4	5.5	5.7	5.0	4.9	5.1	4.7	5.4	2
2	DP1541 B2RF	5.2	5.7	5.4	5.6	5.8	5.8	5.2	5.4	5.6	5.1	5.5	3
3	DP 1240 B2RF	5.8	5.4	7.1	5.7	5.7	6.0	5.4	5.2	5.0	5.0	5.6	1
4	Candia BGRF	4.7	5.2	4.9	4.7	5.1	5.1	4.7	4.5	4.8	4.6	4.8	4
5	DP1531 B2RF	5.5	5.7	5.5	5.2	5.6	5.7	5.9	5.7	5.9	5.6	5.6	1
Average		5.3	5.5	6.0	5.3	5.5	5.7	5.2	5.1	5.3	5.0		
Ranking		4	3	1	4	3	2	5	6	4	7		
CV %		7.5											
LSD_t(0.05)(PD x Cult)		0.1766											
LSD_t(0.05)(Cult x PD)		0.2497											

Fibre length

Fibre length is largely controlled by variety, although weather and management can also influence the final fibre length. Length and length uniformity are two of the most important fibre qualities. A good yarn could not be spun without a sufficient fibre length. The acceptable fibre lengths are 26.9 to 29 mm or longer.

The cultivar, DP1541 B2RF resulted in the longest average fibre length of 29.0 mm followed by Candia BGRF with a fibre length of 28.8 mm. From the combined analysis for planting dates over planting dates, in planting date 2 the cultivar DP1541 B2RF resulted in a significantly higher fibre length of 30.0 mm.

Table 14. Fibre length (mm)

Cultivar		Planting dates										Average Length (mm)	Ranking
		PD 1 02/10/17	PD 2 09/10/17	PD 3 16/10/17	PD 4 23/10/17	PD 5 30/10/17	PD 6 06/11/17	PD 7 13/11/17	PD 8 20/11/17	PD 9 27/11/17	PD 10 04/12/17		
1	Delta 12 BRF	28.6	27.7	28.0	28.9	29.0	29.5	28.5	28.5	29.1	28.4	28.6	4
2	DP1541 B2RF	29.8	28.0	28.6	30.1	29.6	29.8	29.4	29.4	29.0	29.0	29.3	2
3	DP 1240 B2RF	28.5	28.3	29.3	29.7	29.3	30.0	29.2	29.2	29.1	29.8	29.2	3
4	Candia BGRF	28.3	28.6	29.4	29.4	30.0	30.7	29.2	29.2	29.2	29.7	29.4	1
5	DP1531 B2RF	28.5	28.6	29.0	28.9	29.4	30.3	28.9	28.9	29.5	29.7	29.2	3
Average		28.8	28.2	28.9	29.4	29.5	30.0	29.1	29.1	29.2	29.3		
Ranking		8	9	7	3	2	1	6	6	5	4		
CV %		0.5											
LSD_t(0.05)(PD x Cult)		0.2679											
LSD_t(0.05)(Cult x PD)		0.3789											

Uniformity index

Uniformity index is minimally affected by cotton variety. Fibre weathering and ginning have a more dramatic effect on uniformity.

The acceptable uniformity index values are in the range of 83 to 85 or higher. Planting date 6 resulted in the highest uniformity index value of 85.2. The cultivar DP1240 B2RF resulted in the highest mean uniformity of 84.8. Planting date 6, (6 November 2017) resulted in the highest uniformity of 85.2.

Table 15. Uniformity index

Cultivar		Planting dates										Average Uniformity	Ranking
		PD 1 02/10/17	PD 2 09/10/17	PD 3 16/10/17	PD 4 23/10/17	PD 5 30/10/17	PD 6 06/11/17	PD 7 13/11/17	PD 8 20/11/17	PD 9 27/11/17	PD 10 04/12/17		
1	Delta 12 BRF	84.3	83.2	83.8	83.8	84.0	84.5	83.4	83.4	83.4	83.3	83.7	2
2	DP1541 B2RF	85.3	83.6	84.4	85.5	85.1	85.3	84.4	84.4	84.4	84.9	84.7	2
3	DP 1240 B2RF	84.4	85.0	84.9	85.7	85.1	86.0	84.0	84.0	84.4	85.0	84.8	1
4	Candia BGRF	82.8	84.3	84.5	83.2	84.3	84.9	83.0	83.0	84.4	83.4	83.8	1
5	DP1531 B2RF	84.5	84.5	85.2	84.7	85.4	85.3	84.0	84.0	84.6	84.4	84.7	2
Average		84.3	84.1	84.6	84.6	84.8	85.2	83.7	83.7	84.2	84.2		
Ranking		1	2	3	4	2	1	9	10	6	7		
CV %		0.2											
$LSD_t(0.05)$(PD x Cult)		0.3458											
$LSD_t(0.05)$(Cult x PD)		0.489											

Fibre strength

Cotton fibres need to have a certain strength to withstand the spinning process. Acceptable strengths are 27g/tex or higher.

All the Planting Dates and Cultivars were in the acceptable strength values. The cultivar Delta1240B2RF significantly gave the strongest fibres of 32.1 g/tex. From the combined analysis for planting dates over cultivars, no significant differences were obtained. Planting Date 6 resulted in the strongest fibres of 31.6 g/tex.

Table 16. Fibre strength (g/tex)

Cultivar		Planting dates										Average Fibre Strength (g/tex)	Ranking
		PD 1 02/10/17	PD 2 09/10/17	PD 3 16/10/17	PD 4 23/10/17	PD 5 30/10/17	PD 6 06/11/17	PD 7 13/11/17	PD 8 20/11/17	PD 9 27/11/17	PD 10 04/12/17		
1	Delta 12 BRF	28.8	28.0	29.3	29.1	29.3	30.7	28.7	27.8	29.0	28.5	28.9	5
2	DP1541 B2RF	30.0	30.5	31.1	31.6	31.3	31.1	29.7	30.1	30.9	30.9	30.7	2
3	DP 1240 B2RF	31.9	31.5	33.3	32.4	33.2	33.4	31.2	31.1	31.2	31.3	32.1	1
4	Candia BGRF	28.8	29.4	29.7	28.8	30.9	30.5	29.2	28.5	30.9	30.1	29.7	4
5	DP1531 B2RF	30.7	30.0	30.9	30.5	31.6	32.3	30.4	29.0	29.9	29.8	30.5	3
Average		30.0	29.9	30.8	30.5	31.3	31.6	29.8	29.3	30.4	30.1		
Ranking		7	8	3	4	2	1	9	10	5	6		
CV %		0.7											
LSD_t(0.05)(PD x Cult)		0.509											
LSD_t(0.05)(Cult x PD)		0.7198											

Elongation

Elongation and fibre strength are directly correlated to yarn strength and elongation. Planting Date 9 and 10 resulted in significantly higher fibre elongation of 8.3 and 8.2, respectively. The cultivar DP1531 B2RF resulted in the highest fibre elongation of 8.2.

Table 17. Elongation

Cultivar		Planting dates										Average fibre elongation	Ranking
		PD 1 02/10/17	PD 2 09/10/17	PD 3 16/10/17	PD 4 23/10/17	PD 5 30/10/17	PD 6 06/11/17	PD 7 13/11/17	PD 8 20/11/17	PD 9 27/11/17	PD 10 04/12/17		
1	Delta 12 BRF	7.1	7.2	7.0	7.2	7.2	8.0	7.7	7.8	7.8	8.1	7.5	3
2	DP1541 B2RF	7.4	7.6	7.5	7.7	7.9	8.4	8.1	8.4	8.2	8.6	8.0	2
3	DP 1240 B2RF	7.8	7.9	7.5	7.7	7.8	8.3	8.3	8.1	8.4	8.5	8.0	2
4	Candia BGRF	6.9	6.9	6.7	6.7	6.9	7.4	7.5	7.7	7.9	7.6	7.2	4
5	DP1531 B2RF	7.8	8.3	7.6	7.6	7.7	8.1	8.4	8.5	8.6	8.9	8.2	1
Average		7.4	7.6	7.3	7.4	7.5	8.0	8.0	8.1	8.2	8.3		
Ranking		7	5	8	7	6	4	4	3	2	1		
CV %		0.9											
LSD_t(0.05)(PD x Cult)		0.1273											
LSD_t(0.05)(Cult x PD)		0.18											

Micronaire

Planting cotton too early resulted in very thick fibres with micronaires above 4.5 µgram. The November plantings resulted in significantly finer fibres compared to the October plantings. The cultivar Candia BGRF resulted in thin fibres of 3.9.

Table 18. Micronaire (µgrams)

Cultivar		Planting dates										Average Micronaire (µg)	Ranking
		PD 1 02/10/17	PD 2 09/10/17	PD 3 16/10/17	PD 4 23/10/17	PD 5 30/10/17	PD 6 06/11/17	PD 7 13/11/17	PD 8 20/11/17	PD 9 27/11/17	PD 10 04/12/17		
1	Delta 12 BRF	5.0	5.1	4.9	4.7	4.5	4.3	4.2	4.1	4.3	3.9	4.5	2
2	DP1541 B2RF	4.9	5.3	5.0	4.9	4.7	4.5	4.9	4.9	4.8	4.6	4.8	4
3	DP 1240 B2RF	5.2	5.3	4.9	4.8	4.7	4.7	4.6	4.2	4.4	4.3	4.7	3
4	Candia BGRF	4.3	4.5	4.3	4.0	3.6	3.9	3.6	3.4	3.7	3.3	3.9	1
5	DP1531 B2RF	5.1	5.2	4.9	4.9	4.9	4.7	4.7	4.6	4.5	4.2	4.8	4
Average		4.9	5.1	4.8	4.7	4.5	4.4	4.4	4.2	4.4	4.1		
Ranking		7	8	6	5	4	3	3	2	3	1		
CV %		0.5											
LSD_t(0.05)(PD x Cult)		0.1031											
LSD_t(0.05)(Cult x PD)		0.1457											

Yellowness and Degree of reflectance

Each planting date trial was hand pick when ready and cotton fibres were not exposed too long to field weathering. The degree yellowness (+b < 9) is in the respective norms but the degree of reflectance (RD ≥ 75) for planting date 1 and 2 were below the respective norms.

Table 19. Yellowness (+b < 9)

Cultivar		Planting dates										Average Yellowness (+b < 9)	Ranking
		PD 1 02/10/17	PD 2 09/10/17	PD 3 16/10/17	PD 4 23/10/17	PD 5 30/10/17	PD 6 06/11/17	PD 7 13/11/17	PD 8 20/11/17	PD 9 27/11/17	PD 10 04/12/17		
1	Delta 12 BRF	7.1	6.9	6.6	6.9	7.1	7.2	5.9	6.2	6.5	6.6	6.7	1
2	DP1541 B2RF	6.9	7.4	7.4	6.9	7.0	7.4	7.0	7.3	7.4	7.6	7.2	4
3	DP 1240 B2RF	8.1	8.0	7.9	8.0	8.4	8.4	7.2	7.5	7.8	7.8	7.9	5
4	Candia BGRF	7.1	6.7	6.7	6.8	6.9	7.3	6.4	6.6	6.6	7.1	6.8	2
5	DP1531 B2RF	7.3	6.6	6.8	7.7	7.8	7.5	6.1	6.3	6.6	6.8	7.0	3
Average		7.3	7.1	7.1	7.2	7.4	7.6	6.5	6.8	7.0	7.2		
Ranking		8	5	4	7	9	10	1	2	3	6		
CV %		0.5											
LSD_t(0.05)(PD x Cult)		0.1114											
LSD_t(0.05)(Cult x PD)		0.1575											

Table 20. Degree of reflectance (RD ≥75)

Cultivar		Planting dates										Average Degree of reflectance (RD ≥ 75)	Ranking
		PD 1 02/10/17	PD 2 09/10/17	PD 3 16/10/17	PD 4 23/10/17	PD 5 30/10/17	PD 6 06/11/17	PD 7 13/11/17	PD 8 20/11/17	PD 9 27/11/17	PD 10 04/12/17		
1	Delta 12 BRF	74.0	73.6	81.0	83.1	84.0	84.2	81.8	82.3	82.3	82.7	80.9	2
2	DP1541 B2RF	75.2	75.8	81.6	83.3	84.0	84.2	80.7	81.6	81.6	81.2	80.9	3
3	DP 1240 B2RF	72.3	73.7	79.9	81.1	80.5	80.7	80.4	80.6	80.6	80.2	79.0	5
4	Candia BGRF	73.3	74.0	82.4	83.9	85.6	84.8	82.6	83.5	83.5	83.6	81.7	1
5	DP1531 B2RF	74.5	75.2	80.9	82.1	82.6	83.6	81.8	82.6	82.6	82.7	80.8	4
Average		73.9	74.5	81.2	82.7	83.3	83.5	81.4	82.1	82.1	82.1		
Ranking		10	9	8	3	2	1	4	5	7	6		
CV %		0.4											
LSD_t(0.05)(PD x Cult)		0.486											
LSD_t(0.05)(Cult x PD)		0.6873											

FIBRE WEATHERING

The cotton fibre is an epidermal cell with a thin waxy cuticle on the outside. Just below the cuticle is a very thin primary wall, composed of cellulose and protein. Inside the primary wall is the thick secondary wall, which is 95% cellulose. Cellulose is built from plant sugars that are moved to the fibres form the leaves. As bolls matured and open, these plant sugars in the fibre disappear.

When the mature cotton bolls first open, the lint is white and clean due to the highly reflective nature of the cellulose and lack of microbial degradation. Immediately after the boll opens, exposure to the environment allows bacteria and fungi to rapidly multiply on the fibre.

Fibre weathering is described as a series of processes, usually deteriorative, that occurred between the times of boll opening to harvesting.

Seed Cotton Yield

When bolls opened, the fibres continue to fluff outwards ad high winds could blow cotton to the ground. Cotton locks could fall to the ground. Loss in weight due to microbial degradation (boll rot) and ginning loss of weathered fibres can be significant.

Yield decreased with average 9 % per hectare when the harvest process was delayed with 6 weeks. Planting Date 6 resulted in the highest loss in weight of 15.4 %.

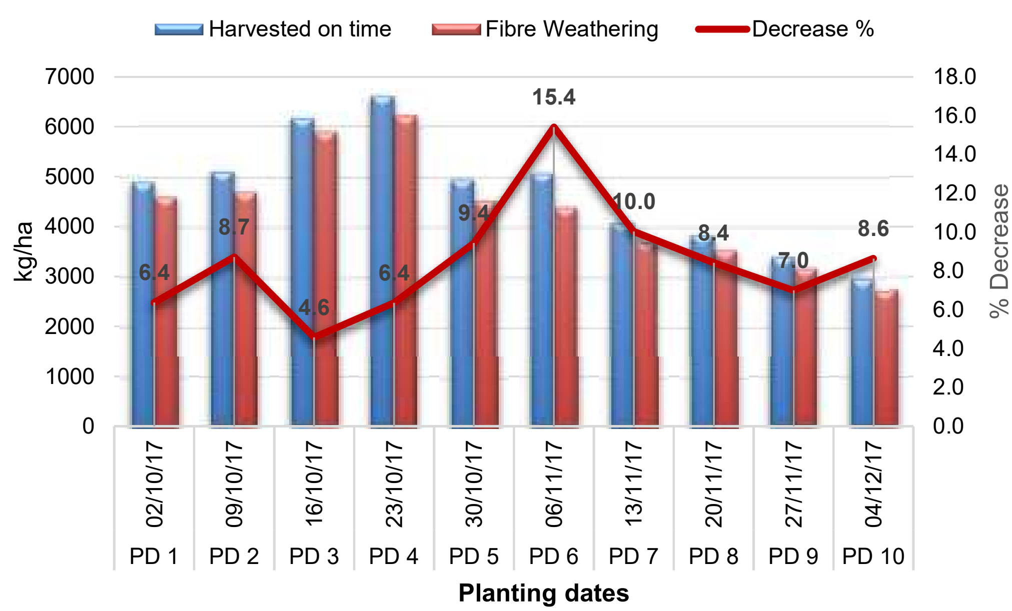

Figure 7. Yield kg/ha

Fibre percentage

Fibre percentages were not greatly influenced by fibre weathering because it is cultivar related.

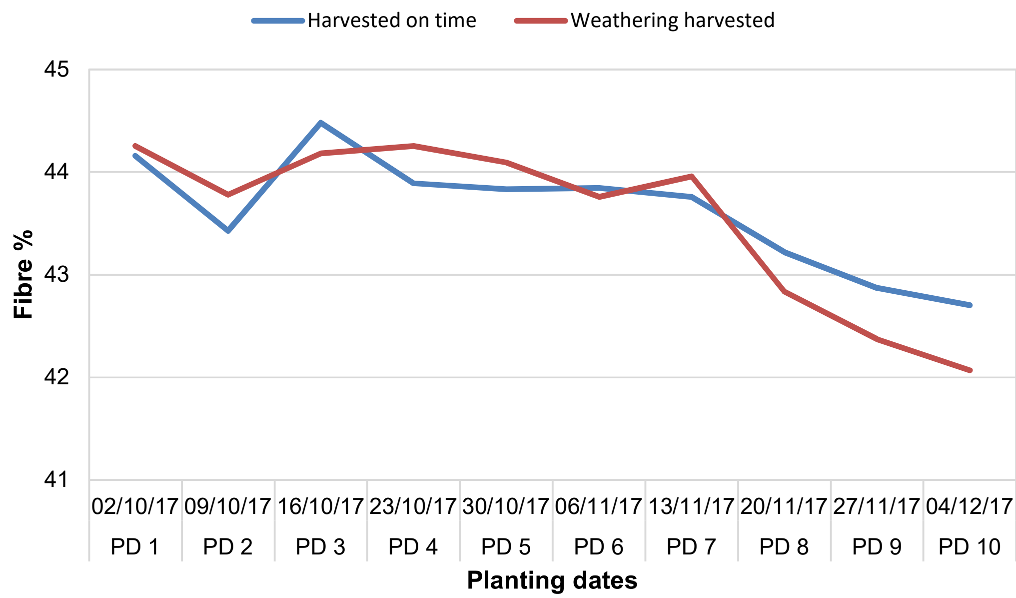

Figure 8. Fibre percentage

Boll size (gram)

A boll weighed 0.4 grams less when the harvest processed was delayed for 6 weeks. Planting date 6, however, weighed 0.8 gram less per boll compared to the other planting dates.

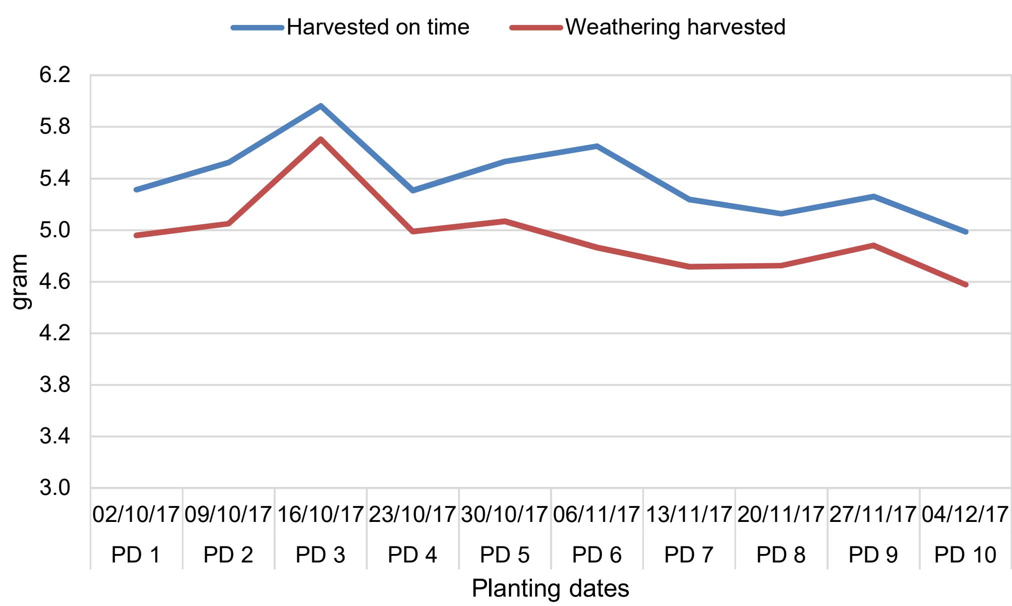

Figure 9. Boll size (gram)

Fibre length (mm)

Fibre length is largely controlled by variety, although weather and management can also influence the final fibre length. No significant effect of fibre weathering was noticed.

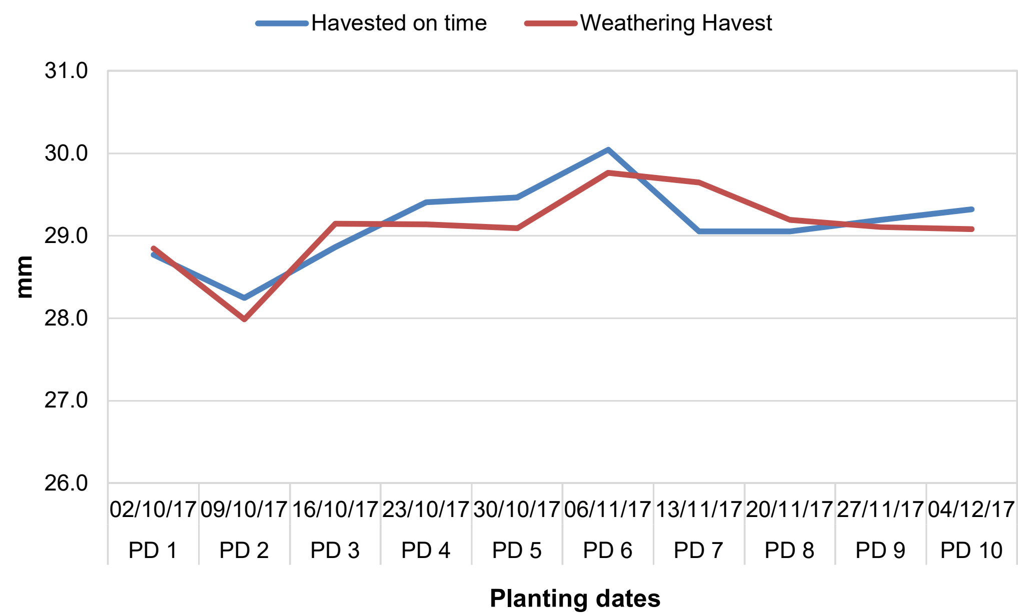

Figure 10. Length (mm)

Uniformity index

Field weathering and ginning had a dramatic effect on the uniformity index. Open bolls has weathered, deteriorates and is more susceptible to fibre breakage during processing. Plant dating 7 to 10 showed less deteriorating of fibres.

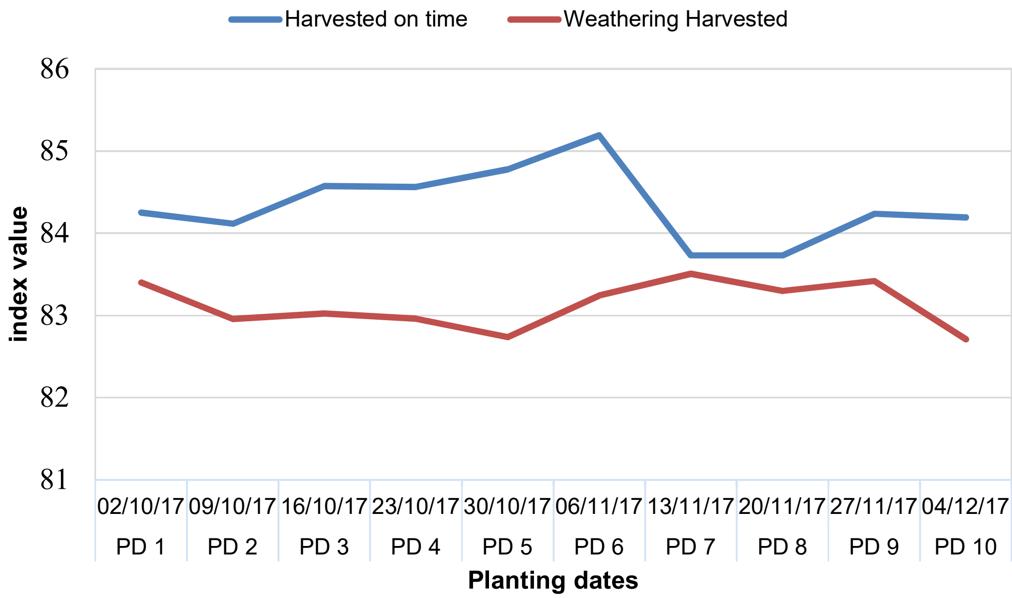

Figure 11. Uniformity index

Fibre Strength (g/tex)

Longer exposure to environmental conditions weakened the strength of the fibres over all the planting dates.

The average reduction of fibre strength for all the planting dates was 10 %. Planting date 6 fibre strength was weakened with 14.2 %.

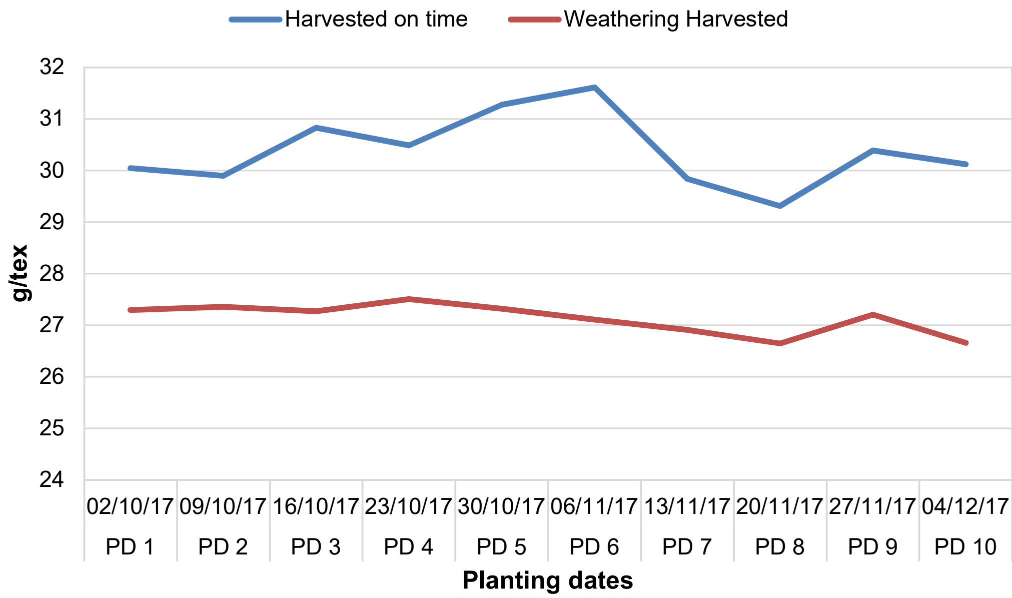

Figure 12. Fibre Strength (g/tex)

Elongation

No effect of fibre weathering was noticed.

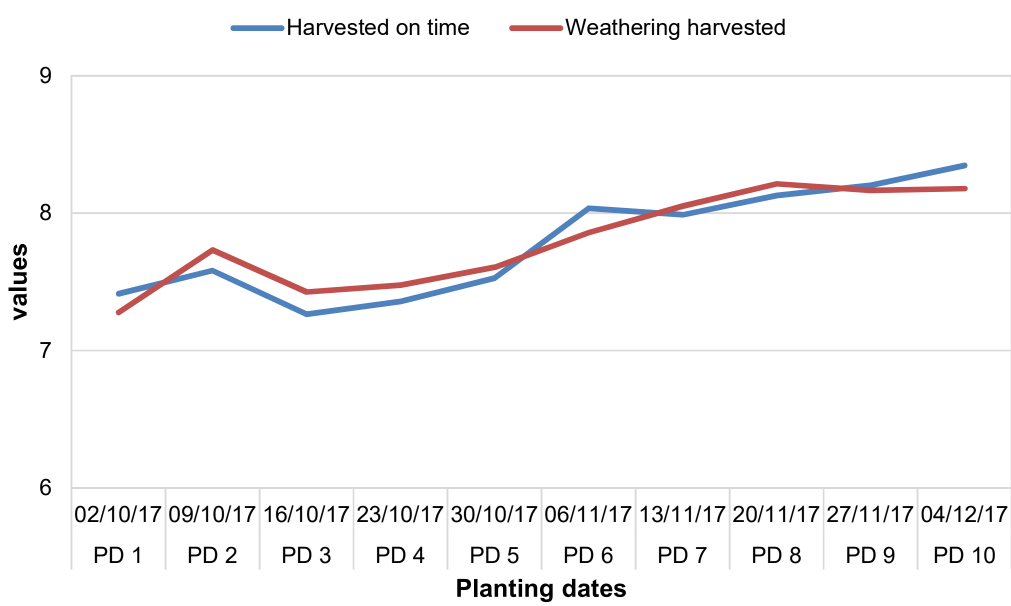

Figure 13. Elongation

Micronaire (µgram)

A reduction in micronaire due to fibre weathering did not occur over the planting dates.

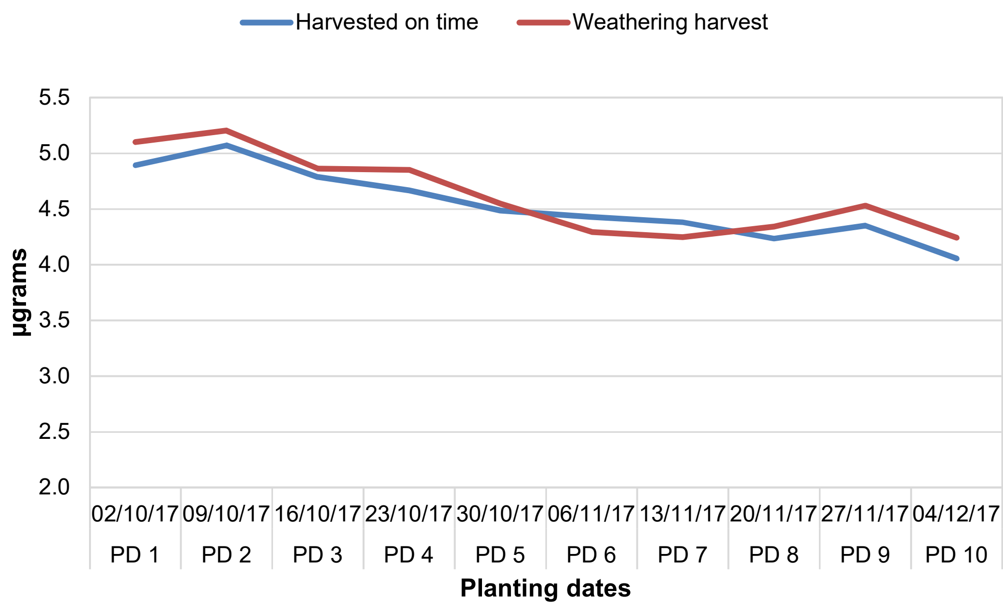

Figure 14. Micronaire (µgram)

Degree of whiteness (colour values)

The degree of whiteness is determined by two factors, yellowness (+b) and degree of reflectance (RD). By delaying the harvest process, the +b value increased for all the planting dates but the RD value decreased and fibres became greyish.

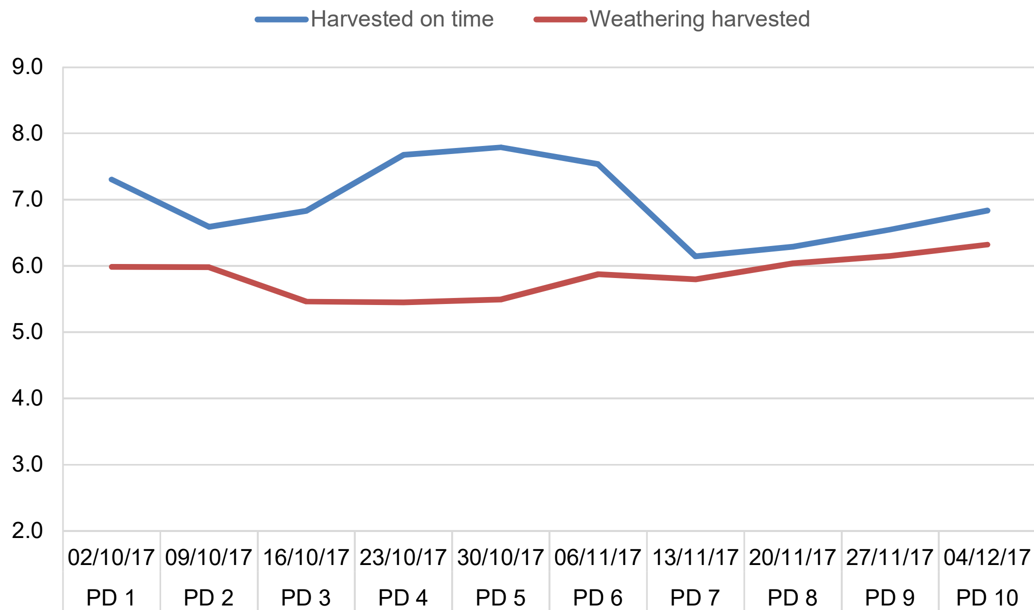

Figure 15. Yellowness (+b < 9)

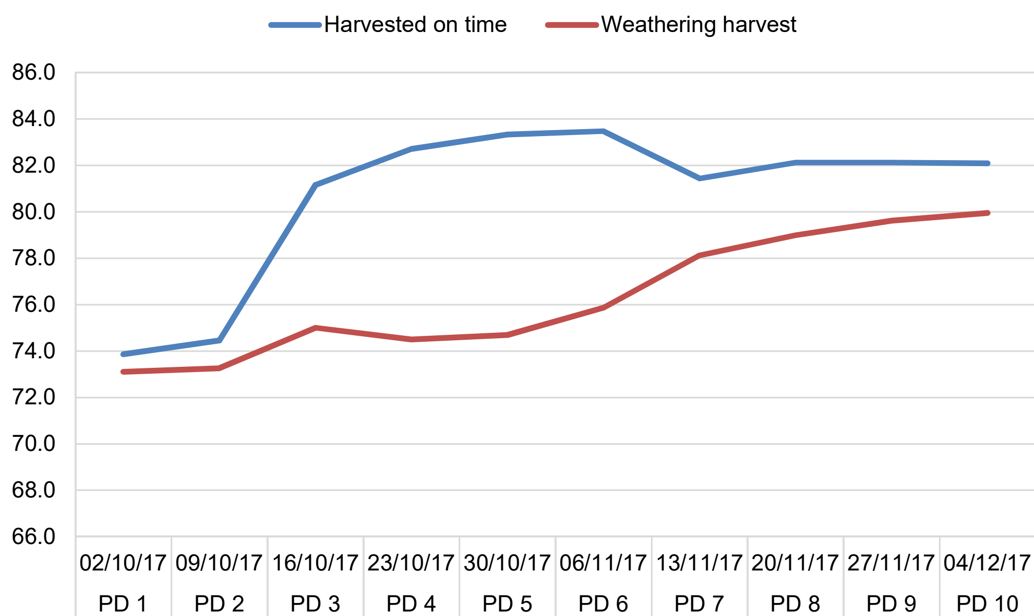

Figure 16. Degree of reflectance (RD ≥75)

CONCLUSION

Planting cotton before or after the best recommended date will resulted in lower yields and fibre quality.

Heat units increase from 1 November 2017 resulted in higher germination percentages at 7 and 14 days after plant. Clear differences were recorded between the October and November plantings. The cultivars DP1541 B2RF, DP1531 B2RF and Candia BGRF performed good during the growing season and resulted in high yields and good fibre qualities.

The results obtained from the field weather assessments showed that yield, boll size, uniformity index, fibre strength and degree of whiteness were effected when the harvest processed was delayed. By delaying the harvest process with 6 weeks, yield decreased with average 9 % per hectare, bolls weighed 0.4 grams less, cotton fibres weaken with 11% and the degree of reflectance become greyish. Weathering of fibre could thus be described as a series of processes, usually deteriorative, that occurred between the times of boll opening to harvesting.

Farmers have to manage cotton fields for high yields and good fibre quality taken in consideration that environment is not always predictable or manageable.

PROJECT NUMBER : P08000018

PROJECT TITLE : Biological control of nematodes on cotton

SUBPROJECT TITLE : Evaluation of environmental friendly products for control of *Meloidogyne* sp. on cotton in South Africa

REPORT YEAR : 2017/2018

PROJECT LEADER : SC Khuzwayo

CO-WORKERS : LN Malinga

ABSTRACT

Cotton is currently the leading fibre crop worldwide and it is grown commercially in more than 50 countries. Root knot nematodes, *Meloidogyne javanica* and *Meloidogyne incognita* (race 4) are one of the serious parasitic nematodes that causes root knots on cotton roots. Despite the expense, farmers use high volume of chemicals to control the nematodes with the objective to increase crop yield. Integration of biological agents on the control of nematodes may reduce the production costs and soil contamination.

Two trials were conducted during the 2017/18 season to evaluate the efficacy of biological agents in reducing *Meloidogyne* spp populations in cotton. A field trial was conducted at Douglas in the Northern Cape Province while the glasshouse trial was done at IC in Rustenburg, North West Province. Standard nematicides Nemacur, Vydate and Poncho Votivo, which are registered on cotton, were compared to Velum prime Avicta 500S seed treatment and biological agents FirstBase, Vertigo, Crop Biolife and Transformer. Root and soil samples were collected at different cotton growing stages to determine the populations of *Meloidogyne* spp. Seed cotton yield was also determined at the end of the season.

The results revealed that all applications had significantly lower number of *Meloidogyne* spp. populations in the soil compared to the untreated control. Plots that were treated with Nemacur showed a significantly lower number of *Meloidogyne spp.* population in the roots compared to the untreated control. The Untreated control had the lowest yield of 2,7 t/ha compared to other treatments. The Transformer and Nemacur had the highest significant yield of 5.8 t/ha, compared to the untreated control, Avicta500 and Velum Prime.

INTRODUCTION

Cotton is currently the leading fibre crop worldwide and is grown commercially in the temperate and tropical regions of more than 50 countries, with a total coverage of 34 million ha (Khadi, B.M,. 2010). South Africa alone had estimated for the 2017/18 production year a cotton crop of 187 528-lint bales, an increase by 142% over the previous season, Cotton SA. Dryland and irrigation hectares show increases of 67% and 168% respectively over the previous year mainly due to the more favorable prices of cotton in relation to competitive crops but also due to renewed interest in cotton production reported by Cotton SA, 2018. Farmers use chemicals to increase crop values per hectare, that is, to increase profits. Increase in crop value may be due to a larger yield, usually there is also an increase in quality and a larger percentage of the produce can be sold. Nematodes are killed in the process, though not always immediately. (Taylor, A.L. and Sasser, J.N., 1978).

The importance of plant-parasitic nematodes as yield-limiting pathogens of cotton has received increased recognition and attention in the South African cotton producing arears in the recent past. The root-knot nematode (RKN), especially Meloidogyne javanica, is by far the most important nematode pest of cotton worldwide. Root-knot nematodes, in particular *Meloidogyne incognita* race 4 is the predominant nematode species and race that adversely affects the production of cotton in South Africa and thus result in substantial yield losses (De Beer, 2010). Nematodes, such as *Pratylenchus spp* and *trichodorus spp* are widely found but not of economic importance in cotton. *Meloidogyne spp*., are widespread and attack a wide range of hosts, both cultivated and uncultivated. Although the usefulness of synthetic chemicals cannot be denied, the negative environmental and human health effects cannot be ignored (Quinn, *et al*., 2011). Government restrictions on the use of chemicals by farmers and the increasing cost and hazards of the application have stimulated research towards the development of a cheaper and more effective control measures that can be recommended. The use of biological control agents to manage plant parasitic nematodes may provide the best alternative to pesticides. The objective of the study was to evaluate efficacy of bio and synthetic nematicides in controlling plant-parasitic nematode species on cotton under field and glasshouse conditions.

MATERIALS AND METHODS

A field and glasshouse experiment were conducted in Douglas, Northern Cape and Rustenburg, North West, respectively. The trials were conducted during the 2017/18 season. A commercially available cotton cultivar, Candia BGRF was used for the experiments. The following treatments were evaluated in the study:

I. Untreated control
II. Vydate® - Active ingredient: Oxamyl – carbamate @ 3-5L/ha @ 500L water/ha. 1st application @ 3L/ha first true leaf, 2nd @ 4L/ha first square, 3rd @ 5L/ha first flower
III. Velum® Prime - Active ingredient: Fluopyram Pyridinylethylbenzamide @ 500 g/l. Seed coating
IV. AVICTA® 500FS: Active ingredients: Abamectin 0.02 mg/m^3. Seed coating
V. Nemacur® - Active ingredient: Fenamiphos – organophosphate. Dosage rate: 7.5L/ha @ 250 litres water per ha. Applied at planting
VI. Vertigo® - Active ingredient: Bacillus ameloliquifacens 5×10^8 @ 1L/ha. 200ml @ 3L/ha water. Applied at planting, first true leaf, first square, first flower
VII. Transformer® + Nemacur - Active ingredient: Cold-Pressed Orange Oil at a rate of one ml/m^2 (five - 10 ℓ/ha in a dilution of one litre/1000 litres + Fenamiphos – organophosphate. Applied at planting time and first square
VIII. Transformer® + Crop Biolife® - Active ingredients: Cold-Pressed Orange Oil + bioflavinoid
IX. First Base® - Active ingredients & strengths: three x Bacillus sp. at 5×10^9 1ml / 1kg seed. Seed coating
X. Ponch Votivo + Velum Prime - Active ingredient: Clothianidin 0.424 mg total ai/seed + Fluopyram Pyridinylethylbenzamide @ 500 g/l Seed coating
XI. Poncho votivo Seed treatment - Active ingredient: Clothianidin 0.424 mg total ai/seed

Glasshouse experiment

A glasshouse trial was conducted to investigate the efficacy of biological agents and nematicides on the population of *M. incognita* (race 4). The trial was planted on 13 February 2017. Mass production of *M. incognita* race 4*,* grown in sterile tomato plants, was used in the cotton trial. Mixed growth medium and sand soil were sterilised to remove any pathogens in the soil. The soil was transferred to pots in glasshouse. Tomato roots infested with the root knot nematodes were incorporated to the soil to establish nematode population. Soil samples were taken for analysis of nutrients. During the trial, foliar 20g/l cypermethrin were sprayed to control aphids.

Extraction of RKN eggs and second stage juveniles (J2) were done by using the adapted NaOCl-method of Riekert (1995), while PPN were extracted from 5g-root samples using the adapted sugar-flotation method as adapted and described by (De Waele., *et al*., 1987). Galled roots were collected from the culture of plants and washed gently with water to remove soil particles. The roots were cut into 1–2 cm segments and placed in a jar containing 200 ml of 0.5% NaOCl solution. The jar was shaken vigorously for 2 to 4 minutes. The suspension was passed through 60 and 325 mesh sieves nested over the 500 mm mesh sieve, which collected the eggs. The eggs in the sieve were placed quickly under a stream of cold water to remove the residual NaOCl. The eggs were then transferred into a beaker with the aid of a wash bottle. The number of eggs per unit volume was standardized and the desired number of eggs (approximately 500 eggs/pot) were placed in separate vials. The egg suspension was introduced by pouring it into the sterilized potted soil.

Pots filled with sterilized soil were randomly arranged in the glasshouse. Each treatment was replicated 3 times. The desired concentrations of +200 (J2), *M. incognita* race 4 was prepared and placed in separate vials.

Galling index was determined using the following rating scale: 1 – no galling; 2 – trace (1–25% galling); 3 – slight (26–50% galling); 4 – moderate (51–75% galling) and 5 – severe (76–100% galling). Population density of nematodes in roots, number of galls and egg masses were determined in one gram root sample. Counting was done with the aid of a dissecting microscope and a hand tally counter. Percentage reduction in gall number was computed.
A completely randomized design was used in this experiment. Data were subjected to analysis of variance (ANOVA) using the GenStat Software.

Figure 1. Glasshouse trial conducted at ARC-IC in Rustenburg, to evaluate different treatments in reducing Meloidogyne incognita race 4 in cotton. B: rearing of *M. incoginita* on tomatoes Photo: SC Khuzwayo

Figure 2. Soil and root sampling of cotton in glasshouse. Photo: SC Khuzwayo

Field Experiment

The trial was planted on 25 October 2017 under irrigation. The trial site was selected at a locality where cotton is grown in sandy soils that have high infestations of *Meloidogyne* spp. The experiment comprised of a randomized block design with 11 treatments, replicated 4 times, three rows each block, which are 3m long and an inter row spacing of 20cm. Each treatment was replicated four times. Two plant were chosen randomly per plot and used for nematode assessments during the season. Soil samples were taken before the onset of this trial to determine values of parameters that are used as an indication of soil fertility and structure. Soil and root samples were also taken for analysis of nematode populations. Ninety five percent of the seedlings develop sufficient root/stem systems that ensured adequate number of test plants per plot.

Nematodes were extracted according to the procedure of Jenkins (1964) from one 250-ml sub-sample taken from the composite sample from each plot for identification and quantification of all plant parasitic nematodes (PPN) present. The five nematode sampling intervals represented the first true leaf 22 DAP and inoculation (Sampling 1), first square 50 DAP and inoculation (Sampling 2), first flower 67 DAP and inoculation (Sampling 3), first boll opening 91 DAP and inoculation (Sampling 4) and 50% boll opening 106 DAP and inoculation (Sampling 5). During each of these sampling intervals, counts were done for each of the respective growth stage parameters. Nematodes were extracted from the excised roots by maceration and sugar-centrifugal flotation (Coolen and D'Herde, 1972) for identification and quantification of all PPN present.

For disease rating, galling index was determined using the following rating scale: 1 – no galling; 2 – trace (1–25% galling); 3 – slight (26–50% galling); 4 – moderate (51–75% galling) and 5 – severe (76–100% galling). Population density of nematodes in roots, number of galls and egg masses were determined in one-gram root sample. Counting was done with the aid of a dissecting microscope and a hand tally counter. Percentage reduction in gall number was computed. The nematode data will be loge (no. + 1) transformed for analysis (Van Ark, 1981). Data will be analysed using Genstat and subjected to an analysis of variance. Means were compared by Tukey's multiple range test ($P \leq 0.05$).

Figure 3. Shows the field trial planted in Douglas, Northern Cape. Photo: SC Khuzwayo

Figure 4. Soils samples taken in the field for nematodes counts. Photo: SC Khuzwayo

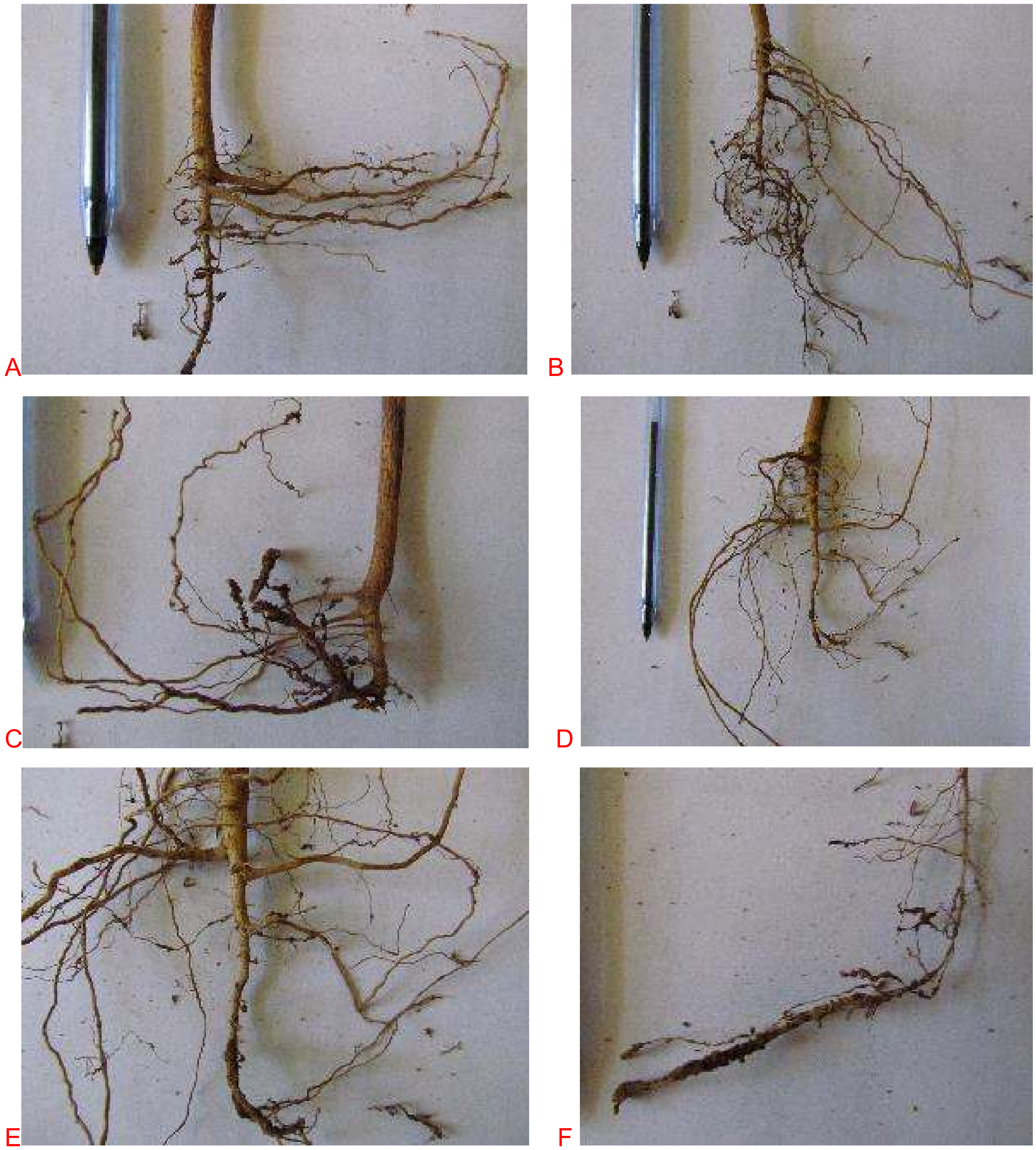

Figure 5. Impact of nematode on roots in field trials from early stage to harvest end of season. A:Poncho votivo seed coat, B: Crop Biolife treatment, C: Vertigo. D: Tranformer and Nemacur, E: Nemacur and F: Untreated Control first flower of cotton growth stage. Photo : SC Khuzwayo

RESULTS AND DISCUSSION

Glasshouse trial

The initial population of nematodes in soil showed significant difference in each pot for each treatment at planting compared to harvest (Table 1). Untreated control had high number of nematodes counted in the soil compared to other treatments statistical Nemacur had the lowest count of nematodes on soil statistically. Vertigo also had high number of nematode count statistically slight less then untreated control statistical but it had no significant difference with other treatments except for Nemacur, which had the lowest significant number of nematodes in each pot.

Nemacur at the end of season showed lower number of nematodes in the soil, which was significantly difference to untreated controlled that had the highest number of nematodes count present in the soil at harvest. The rest of the treat showed no significant difference with the exception of Avicta 500FS which was not different to untreated control statistical. Moreover, at planting all treatment had same number of nematodes on all the treatment statistically and on first emergence of square. At first Boll number of counts increased significantly the highest being control and lowest Nemacur and Transformer_Nemacur

The number of nematodes found at planting were significantly different from planting to harvest, where PonchVotivo_VelumPrime was planted on plots with highest number nematodes compared to PonchoVotivo and Transformer_CropBiolife (Table 2). Poncho Votivo had lowest count of nematodes in the soil compared to untreated control at planting statistical. During the second stage of cotton growth, the nematode counts in the soil showed a decline in the number of nematodes on Nemacur, compared to at planting. It was significant lower than Control treatment, seed treatments showed no different in number of nematodes found at First Square of cotton comparing to standard nematicide Nemacur and Vydate. Untreated control showed gradual increase in number of nematode through growth stages of cotton lowest number at planting and the highest at harvest. Nemacur show a decline over the season the lowest number counted at Harvest and highest at planting.

Roots sample were taken at first square of cotton plants in the field (Table 3). At first square nematode present on roots showed no significant difference in all the treatments and at Harvest nemacur had the lowest count of nematodes present in the roots statistical compared to all the treatments in the study.

At first square emergence on cotton plant untreated control had highest number of nematodes present in the pot compared to Transformer_Nemacur which had the lowest statistical but not different to other treatments (Table 4). First base showed a decline in nematode counting on the pot at harvest compared to untreated control and it was not different from Nemacur, Transformer_Nemacur, and Avicta500FS statistical.

Root assessments (Table 4), untreated control had highest count of nematodes present compared to other treatments statically. Nemacur and Vydate showed lowest significant number of nematodes that penetrated the roots, and it was not significant different to combination of transformer and Nemacur.

Table 1. Overall analysis of variance for the effects of each treatment on *Meloidogyne* spp. population in the soil

	Stages					
Treatments	**Planting[a]**	**First Square**	**First-boll**	**50%-boll**	**Harvest**	**LSD**
Transformer_Nemacur	3.0 **a**	2.5 **b**	1.3 **b**	4.0 **ab**	9.0 **a**	6.2305
Nemacur	4.3 **a**	2.0 **a**	1.5 **a**	1.3 **a**	1.0 **a**	4.2183
Vydate	3.3 **a**	4.5 a	3.8 **a**	2.0 **a**	3.3 **a**	3.1668
FirstBase	4.3 **a**	3.3 **a**	1.5 **a**	5.8 **a**	6.5 **a**	5.9686
Vertigo	3.7 **a**	3.8 **a**	3.5 **a**	9.3 **a**	5.5 **a**	6.4955
PonchVotivo_VelumPrime	5.3 **a**	2.3 **a**	4.3 **a**	5.3 **a**	2.7 **a**	4.8107
PonchoVotivo	1.5 **b**	2.5 **ab**	3.8 **ab**	5.3 **ab**	7.0 **a**	5.2250
Transformer_CropBiolife	3.3 **a**	3.3 **a**	2.0 **a**	3.3 **a**	4.0 **a**	2.4562
VelumPrime	3.7 **ab**	3.3 **ab**	4.0 **ab**	2.3 **b**	4.8 **a**	1.8431
AVICTA500FS	3.3 **b**	2.8 **b**	2.8 **b**	2.8 **b**	10.3 **a**	3.7743
UntreatedControl	4.0 **b**	3.5 **b**	5.0 **b**	16.5 **a**	16.5 **a**	4.9090

[a] Values followed by the same letter do not differ significantly at the 5% test level according to Student's t-LSD test.

Table 2. Showing nematode population on soil over a period

	Stages					Overall population
Treatments	**Planting[a]**	**First Square**	**First-boll**	**50%-boll**	**Harvest**	**Mean**
Transformer_Nemacur	3.0 **a**	2.5 **a**	1.3 **d**	4.0 **c**	9.0 **bc**	3.6 **bc**
Nemacur	4.3 **a**	2.0 **a**	1.3 **d**	1.0 **c**	1.5 **d**	4.1 **bc**
Vydate	3.3 **a**	4.5 **a**	3.8 **abc**	2.0 **c**	3.3 **bcd**	8.3 **a**
FirstBase	4.3 **a**	3.3 **a**	1.5 **cd**	5.8 **bc**	6.5 **bcd**	3.4 **bc**
Vertigo	3.7 **a**	3.8 **a**	3.5 **abcd**	9.3 **b**	5.5 **bcd**	2.3 **c**
PonchVotivo_VelumPrime	5.3 **a**	2.3 **a**	4.3 **ab**	5.3 **bc**	2.7 **cd**	3.4 **bc**
PonchoVotivo	1.5 **a**	2.5 **a**	3.8 **abc**	5.3 **bc**	7.0 **bcd**	4.3 **bc**
Transformer_CropBiolife	3.3 **a**	3.3 **a**	2.0 **bcd**	3.3 **c**	4.0 **bcd**	5.2 **b**
VelumPrime	3.7 **a**	3.3 **a**	4.0 **ab**	2.3 **c**	4.8 **bcd**	4.0 **bc**
AVICTA500FS	3.3 **a**	2.8 **a**	2.8 **abcd**	2.8 **c**	10.3 **ab**	3.8 **bc**
UntreatedControl	4.0 **a**	3.5 **a**	5.0 **a**	16.5 **a**	16.5 **a**	2.3312
LSD	3.8511	3.282	2.3884	4.791	7.3621	2.3312

[a] Values followed by the same letter do not differ significantly at the 5% test level according to Student's t-LSD test.

Table 3. Effects of each treatment for each sample in nematode population on roots *Meloidogyne spp***.**

	Stages		
Treatments	**First Square**[a]	**Harvest**	**LSD**
Transformer_Nemacur	1.0 **a**	0.7 **a**	1.4342
Nemacur	1.3 **a**	1.0 **b**	0
Vydate	2.5 **a**	2.3 **a**	22.008
FirstBase	2.3 **a**	1.0 **a**	6.7079
Vertigo	3.0 **a**	2.0 **a**	6.9711
PonchVotivo_VelumPrime	2.7 **a**	2.3 **a**	3.5495
PonchoVotivo	2.3 **a**	2.0 **a**	2.7175
Transformer_CropBiolife	2.5 **a**	2.3 **a**	2.3237
VelumPrime	3.8 **a**	2.0 **a**	3.5495
AVICTA500FS	2.3 **a**	1.3 **a**	15.562
UntreatedControl	3.8 **a**	3.3 **a**	2.0543

[a] Values followed by the same letter do not differ significantly at the 5% test level according to Student's t-LSD test.

Table 4. Effects of each treatment for in nematode population on roots *Meloidogyne spp per* growth stages

	Stages		Overall population
Treatments	**First Square[a]**	**Mean**	**Mean**
Transformer_Nemacur	0.7 **b**	1.0 **b**	9.3**cd**
Nemacur	1.3 **b**	1.0 **b**	2.5 **d**
Vydate	2.3 **ab**	2.5 **ab**	2.8 **d**
FirstBase	2.3 **ab**	1.0 **b**	16.7 **bc**
Vertigo	3.0 **ab**	2.**0 ab**	2.8 **d**
PonchVotivo_VelumPrime	2.7 **ab**	2.3 **ab**	9.0 **cd**
PonchoVotivo	2.3 **ab**	2.0 **ab**	29.2**b**
Transformer_CropBiolife	2.3 **ab**	2.5 **ab**	7.0 **cd**
VelumPrime	3.8 **a**	2.0 **ab**	6.5 **cd**
AVICTA500FS	2.3 **ab**	1.3 **b**	3.5 **d**
UntreatedControl	3.8 **a**	3.3 **a**	146.0 **a**
LSD	2.486	1.7579	13.989

[a] Values followed by the same letter do not differ significantly at the 5% test level according to Student's t-LSD test.

Field trial

Population for *M. incognita* and *M. Javanica* showed significant difference among counts in each plot for each treatment at Harvest compared to planting to first ball. (Table 7) Although the number was high in untreated control compared to Nemacur (Table 7). Nemacur plots showed a lower number counts which was significantly different compared to untreated control which had highest number of nematodes counted in soil, and no significant difference with other treatments. Although there was an increase in number of nematode present in the soil from planting to Harvest, which had highest number of nematodes.

Vydate, Nemacur, Vertigo, PonchoVotivo_VelumPrime at planting had highest number of nematodes at planting compared to FirstBase and Transfomer_Nemacur statistical and it was not different from rest of the treatments (Table 6). At first true leaf and first square Nemacur was reduces significantly compared to at planting. Untreated control increase number of nematodes present from planting to harvest.

Nematodes present in the roots were higher at first square compared to other growth stages of cotton the highest recorded on untreated control and lowest being Poncho votivo statistically not lower than Nemacur, Vydate and Nemacur_Transformer (Table 7).

Untreated control had the highest number of nematodes present at harvest compared to PonchoVotivo_VelumPrime statistically which had the lowest, but it was not different from FirstBase, Vertigo that had lowest count of nematodes at harvest statistically (Table 7).

Root assessments of cotton showed significant difference among counts in each plot for each treatment although the number was high in untreated control compared to Nemacur and combination of Transformer and Nemacur (Table 8). Nemacur plots showed a lower number of counts of nematodes which was significantly different compared to untreated control which had highest number of nematodes counted in roots, and some significant difference first base bio-agent and vertigo seed treatment. Poncho Votivo showed no significant difference with other treatment and was significant different from untreated control.

Cotton was harvested at the end of the season. Seed cotton yield for each treatment showed significant differences (Table 9). The untreated control had the lowest yield compared to other treatments and Transformer had the highest yield, which was not significantly different from Nemacur treatment, Vydate a nematicide, poncho Votivo combined with Velum Prime a seeds treatment and first base.

Table 5. Showing nematode population on soil over 7 cotton growth stages

	Stages							
Treatments	**Planting**[a]	**First true leaf**	**Firstsquare**	**First flower**	**First-boll opening**	**50%-boll opening**	**Harvest**	**LSD**
Transformer_Nemacur	1.0 **b**	1.5 **b**	1.5 **b**	16.3 **ab**	5.5 **b**	10.5 **b**	49.3 **a**	37.919
Nemacur	3.8 **a**	2.0 **a**	*	3.0 **a**	4.0 **a**	3.0 **a**	5.5 **a**	6.6241
Vydate	50.5 **a**	2.5 **b**	*	2.3 **b**	4.0 **b**	17.3 **b**	6.8 **b**	32.115
FirstBase	7.0 **b**	7.5 **b**	56.0 **a**	7.0 **b**	6.0 **b**	13.8 **b**	11.8 **b**	20.741
Vertigo	5.7 **a**	8.8 **a**	1.0 **a**	8.8 **a**	4.3 **a**	16.3 **a**	17.3 **a**	27.194
PonchVotivo_VelumPrime	8.0**a**	3.5 **a**	2.0**a**	5.3 **a**	8.0 **a**	5.8**a**	20.5 **a**	21.39
PonchoVotivo	*	7.0 **a**	9.5 **a**	2.0 **a**	7.0 **a**	1.8 **a**	14.25 **a**	20.698
Transformer_CropBiolife	3.0 **ab**	5.3 **ab**	1.5 **b**	1.5 **b**	4.0 **ab**	1.8 **ab**	6.3 **a**	4.5835
VelumPrime	*	2.3**a**	1.0 **a**	2.3 **a**	4.0 **a**	5.0 **a**	7.0 **a**	11.486
AVICTA500FS	9.7 **ab**	2.3 **b**	1.0 **b**	2.7 **b**	8.0 **ab**	12.8 **a**	4.8 **ab**	9.3502
UntreatedControl	27.3 **a**	18.3 **a**	9.0 **a**	3.5 **a**	109.7 **a**	50.3 **a**	12.8 **a**	150.51

[a] Values followed by the same letter do not differ significantly at the 5% test level according to Student's t-LSD test.

Table 6. Effects of treatments in nematode population on soil *Meloidogyne spp*. On 5 growth stages

	Stages							Overall population
Treatments	**Planting[a]**	**First-**	**First**	**First**	**First-boll**	**50%-boll**	**Harvest**	**Mean**
Transformer_Nemacur	1.0 **b**	1.5 **b**	1.5 **b**	16.3 **a**	5.5 **b**	10.5 **b**	49.3 **b**	14,5 **b**
Nemacur	3.8 **b**	2.0 **b**	*	3.0 **b**	4.0 **b**	3.0 **b**	5.5 **b**	3,6 **b**
Vydate	50.5 **a**	2.5 **b**	*	2.3 **b**	4.0 **b**	17.3 **b**	6.8 **b**	10,9 **b**
FirstBase	7.0 **b**	7.5 **b**	56.0 **a**	7.0 **ab**	6.0 **b**	13.8 **b**	11.8 **b**	11,4 **b**
Vertigo	5.6 **b**	8.8 **b**	1.0 **b**	8.8 **ab**	4.3 **b**	16.3 **b**	17.3 **b**	10,2 **b**
PonchVotivo_VelumPrime	8.0 **b**	3.5 **b**	2.0 **b**	5.3 **b**	8.0 **b**	5.8 **b**	20.5 **b**	7,8 **b**
PonchoVotivo	*	7.0 **b**	9.5 **b**	2.0 **b**	7.0 **b**	1.8 **b**	14.3 **b**	7,1 **b**
Transformer_CropBiolife	3.0 **b**	5.3 **b**	1.5 **b**	1.5 **b**	4.0 **b**	1.8 **b**	6.3 **b**	3,6 **b**
VelumPrime	10.0 **b**	2.3 **b**	1.0 **b**	2.3 **b**	4.0 **b**	5.0 **b**	7.0 **b**	4,6 **b**
AVICTA500FS	9.7 **b**	2.3 **b**	1.0 **b**	2.7 **b**	8.0 **b**	12.8 **b**	4.8 **b**	6,5 **b**
UntreatedControl	27.3**ab**	18.3 **a**	9.0 **b**	3.5 **b**	109.7 **a**	50.3 **a**	123.8 **a**	56,9 **a**
LSD	34.069	7.3782	28.051	10.541	41.333	32.198	58.704	14.159

[a] Values followed by the same letter do not differ significantly at the 5% test level according to Student's t-LSD test.

Table 7. Effects of each treatment for in nematode population on roots *Meloidogyne spp per* week

	Stages					
Treatments	**First square[a]**	**First flower**	**First boll opening**	**50% boll opening**	**Harvest**	**LSD**
Transformer_Nemacur	9.0 **a**	1.5 **b**	1.8 **b**	2.8 **ab**	5.0 **ab**	7.2534
Nemacur	1.7 **a**	1.3 **a**	3.0 **a**	3.0 **a**	2.3 **a**	2.1933
Vydate	1.8 **a**	1.3 **a**	7.8 **a**	1.8 **a**	2.3 a	8.7243
FirstBase	11.5 **b**	12.8 **b**	54.5 **a**	28.5 **b**	12.7 **b**	23.894
Vertigo	18.7 **ab**	7.8 **b**	23.5 **ab**	36.3 **a**	3.5 **b**	26.827
PonchVotivo_VelumPrime	2.7 **a**	26.0 **a**	13.8 **a**	9.8 **a**	14 **a**	27.885
PonchoVotivo	2.0 **a**	12.5 **a**	18.3 **a**	23.3 **a**	20.0 **a**	32.026
Transformer_CropBiolife	15.5 **a**	3.8 **a**	9.0 **a**	6.7 **a**	10.5 **a**	14.009
VelumPrime	3.0 **b**	9.7 **ab**	11.0 **b**	5.3 **ab**	6.8 **ab**	6.9
AVICTA500FS	3.0 **b**	3.8 **b**	23.5 **ab**	7.0 **b**	30.0 **a**	21.407
UntreatedControl	37.0 **b**	152.0 **a**	18.8 **a**	123.5 **a**	149.0 **a**	61.909

[a] Values followed by the same letter do not differ significantly at the 5% test level according to Student's t-LSD test.

Table 8. Effects of each treatment for in nematode population on roots *Meloidogyne spp per* week

	Stages					Overall population
Treatments	**First square**[a]	**First flower**	**First boll opening**	**50% boll opening**	**Harvest**	**Mean**
Transformer_Nemacur	9.0 **c**	1.5 **b**	1.8 **c**	2.8 **c**	2.3 **c**	3.4 **de**
Nemacur	1.7 **c**	1.3 **b**	3.0 **c**	1.3 **c**	2.3 **c**	1.9 **e**
Vydate	1.8 **c**	7.3 **b**	7.8 **c**	1.8 **c**	2.3 **c**	4.1 **cde**
FirstBase	11.5 **bc**	12.8 **b**	54.20 **b**	28.5 **bc**	12.7 **bc**	24.6 **b**
Vertigo	18.7 **b**	7.8 **b**	23.5 **c**	36.3 **b**	3.5 **c**	17.9 **bc**
PonchVotivo_VelumPrime	2.7 **bc**	26.0 **b**	13.8 **c**	9.8 **bc**	14.0 **bc**	13.9 **bcde**
PonchoVotivo	2.0 **c**	12.5 **b**	18.3 **c**	23.3 **bc**	20.0 **bc**	16.6 **bcd**
Transformer_CropBiolife	15.5 **bc**	3.8 **b**	9.0 **c**	6.8 **c**	10.5 **bc**	9.1 **cde**
VelumPrime	3.0 **bc**	9.7 **b**	11.0 **c**	5.3 **c**	6.8 **c**	7.0 **cde**
AVICTA500FS	3.0 **bc**	3.8 **b**	23.5 **c**	7.0 **bc**	30.0 **b**	13.5 **bcde**
UntreatedControl	37.0 **a**	152.0 **a**	180.75 **a**	123.5 **a**	149.0 **a**	128.5 **a**
LSD	16.358	33.347	26.929	29.443	23.086	13.989

[a] Values followed by the same letter do not differ significantly at the 5% test level according to Student's t-LSD test.

Table 9. Effects of each treatment in cotton yield

Treatments	**Mean[a]**
Transformer_Nemacur	5,8 **a**
Nemacur	5,1 **ab**
Vydate	4,5 **abc**
FirstBase	4,3 **abc**
Vertigo	4,3 **abcd**
PonchVotivo_VelumPrime	4,2 **abcd**
PonchoVotivo	4,0 **bcd**
Transformer_CropBiolife	3,9 **bcd**
VelumPrime	3,8 **bcd**
AVICTA500FS	3,3 **cd**
UntreatedControl	2,7 **d**
LSD	1.624

[a] Values followed by the same letter do not differ significantly at the 5% test level according to Student's t-LSD test.

CONCLUSION

Plant parasitic nematodes are important cotton pests. They can be equally damaging in sandy soils and warm regions, yet the damage inflicted by nematodes is easily confused with damage from other pests and pathogens. Examining soil and root systems provided the confirmation of nematode presence and damage. Population counts were important in determining efficacy of treatments for management of nematodes. Although few nematicides are available and registered for the control of *Meloidogyne spp* nematodes on cotton, Nemacur performed best compared to other environmental friendly product currently available. These treatments used in the study showed slight control at early stages of cotton and bio agents showed some degree of controlling nematodes. More research needs to done in order to enhance these products for efficacy on cotton and any other crops.

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PROJECT NUMBER	:	P08000025
PROJECT TITLE	:	Evaluation of different Pix dosages on diverse cultivars in South Africa
REPORT YEAR	:	2017/2018
PROJECT LEADER	:	Dr T van der Westhuizen
CO-WORKERS	:	C Fourie
EXTERNAL CO-WORKER	:	Evert Genis

MOTIVATION

Monsanto have Pix recommendations for their cultivars, but we found in literature that soaking of seed before planting in Pix have advantages. We want to statistically proof this, as well as test different dosages. Treatment with Pix accelerated root growth and increased water absorption, especially at greater soil depths. Seedlings treated with Pix were turgid longer and wilted less than the drought controls. In another experiment, seed treatment with 500 mg/kg Pix, gave shorter and more compact shoots, did not affect leaf area, but increased specific leaf weight and chlorophyll content (Xu and Taylor, 1992). Zhang *et al*., (1990) found increased nutrients in leaves, stems and roots, namely calcium, magnesium, phosphorus and nitrogen. We want to test if potassium will also increase and maybe these higher concentrations of nutrients will combat leaf reddening.

OBJECTIVES

To evaluate different Pix dosages of diverse cotton cultivars.

EXPERIMENTAL DESIGN

A two-factor experiment was conducted. The factors studied was cultivars and Pix dosages. The experiment was arranged according to a randomized complete block design (RCB) with four replications. Quantitative data was analyzed as factorial factors, using the program Genstat 5. The LSD of Tukey at p =0.05 was calculated to compare means.

Plots size and spacing

Four rows of 5 m in length were planted with a row width of 1m and inter-row spacing of 20cm. There were four replications.

Treatments

Cultivars

1. DP1240 B2RF
2. DP1531 B2RF
3. DP1541 B2RF
4. Candia BG2RF

Dosages

1. Control
2. 120 ml/ha x 4 (total = 480 ml)
3. 360 ml/ha x 3 (total = 1080 ml)
4. Pix ruler x 3 (total = 450 ml)

Treatment	Date	Dosage
Low dosage	14 December 3 January 22 January and 5 February	120 ml/ha x 4 (total = 480 ml/ha)
High dosage	3 January 22 January 5 February	360 ml/ha x 3 (total = 1080 ml/ha)
Pix ruler	11 January 22 January 5 February	Pix ruler x 3 (total = 450 ml/ha)

Locality

Marblehall

Measurements

1. Plant height
2. Boll counts
3. Cotton seed yield (kg/ha), fibre percentage and fibre yield (k/ha)
4. Fibre length (mm), strength (g/tex) and micronaire

Project risks

1. Extreme climatic conditions (Hail)
2. Insect and disease infestation

RESULTS

Significant differences were not present regarding seed cotton yield. Although significant differences were not present, Candia BGRF gave the highest seedcotton yield of 4083 kg/ ha, followed by DP1541 B2RF with 4004 kg/ha. The only cultivar that obtained yield increases after spraying with Pix at a low and high dosage was DP1240 B2RF. When sprayed at the low dosage, a yield increase of 658 t/ha was obtained. When sprayed at the high Pix dosage, a yield increase of 717 t/ha was obtained. Both DP 1531 B2RF and DP1541 B2RF resulted in decreased yields when sprayed with Pix. The reason for this is that a higher dosage is needed at cutout (80 days after planting) to stop these two rank growing cultivars from pushing growth into top branches instead of into bolls.

Both Candia and DP1240 B2RF are shorter in plant height than DP 1531 B2RF and DP1541 B2RF. Candia is sensitive for Pix sprayings and resulted in yield decreases when sprayed with the low and high dosage of Pix,as well as the Pix ruler method.

Fibre lengths of all cultivars and Pix dosages were in the accepted range of fibre lengths of 26.9 – 28.9 mm. The longest fibres were obtained from Candia BGRF (32.6 mm) when sprayed with Pix according to the Pix Ruler Method. The most uniform fibres were obtained with DP 1240 B2RF when sprayed according to the Pix ruler method (87.0). Fibre strengths were within the acceptable range of 27 – 32 g/tex. The stongest fibres were obtained from DP 1240 B2RF when sprayed according to the Pix ruler method (32.1 g/tex). When DP1240 B2RF was sprayed with Pix, higher micronaires of 5.2 (Control) and 5.3 (Low dosage) and 5.2 (Pix ruler) was obtained.

Table 1. Plant height (cm) at the 2017/2018 Pix trial at Marblehall

Cultivar	**DP1531 B2RF**	**DP1541 B2RF**	**DP1240 B2RF**	**Candia BGRF**	
	89.8	106.0	108.5	94.2	
Dosage	**0**	**120 ml/ha**	**360 ml/ha**	**Ruler**	
	108.1	103.7	99.7	86.9	
Interaction	**0**	**120 ml/ha**	**360 ml/ha**	**Ruler**	
Candia BGRF	96.1	97.7	91.6	73.6	94.2
DP1541 B2RF	116.2	111.5	106.6	89.6	106.0
DP1531 B2RF	118.3	109.9	106.5	99.3	89.8
DP1240 B2RF	101.7	95.6	94.2	85.2	108.5
	108.1	103.7	99.7	86.9	
CV %	9.5				
Tukey's LSD (p<0.05) Cult	5.5				
LSD (Dosage)	5.5				

Table 2. Boll counts at the 2017/2018 Pix trial at Marblehall

Cultivar	**DP1531 B2RF**	**DP1541 B2RF**	**DP1240 B2RF**	**Candia BGRF**	
	20.9	23.2	19.5	20.7	
Dosage	**0**	**120 ml/ha**	**360 ml/ha**	**Ruler**	
	22.8	19.8	22.1	19.6	
Interaction	**0**	**120 ml/ha**	**360 ml/ha**	**Ruler**	
Candia BGRF	24.9	18.9	19.0	20.7	20.9
DP1541 B2RF	23.9	22.7	23.2	23.1	23.2
DP1531 B2RF	21.1	16.7	23.8	16.3	19.5
DP1240 B2RF	21.1	20.9	22.3	18.3	20.7
	22.8	19.8	22.1	19.6	
CV %	18.4				
Tukey's LSD (p<0.05)	NS				

Table 3. Seed cotton yield (kg/ha) of the 2017/2018 Pix trial at Marblehall

Cultivar	**DP1531 B2RF**	**DP1541 B2RF**	**DP1240 B2RF**	**Candia BGRF**	
	3919	4004	3969	4083	
Dosage	**0**	**120 ml/ha**	**360 ml/ha**	**Ruler**	
	4235	3946	4070	3724	
Interaction	**0**	**120 ml/ha**	**360 ml/ha**	**Ruler**	
Candia BGRF	4438	4103	4163	3628	4083
DP1541 B2RF	4385	3955	3826	3850	4004
DP1531 B2RF	4491	3443	3948	3795	3919
DP1240 B2RF	3626	4284	4343	3621	3969
	4235	3946	4070	3724	
CV %	13.5				
Tukey's LSD (p<0.05) Yield	NS				

Table 4. Fibre characteristics of the 2017/2018 Pix trial at Marblehall

Cultivar	Pix dosage	Length (mm)	Uniformity	Strength (g/tex)	Maturity	Micronaire	Rd	PlusB	Colour Grade
1240 BG2RF	Control	30,4	85,4	31,4	0,87	**5,2**	77,2	7,6	41-1
1240 BG2RF	120 ml/ha	30,2	86,1	30,3	0,86	4,8	78,7	8,1	31-1
1240 BG2RF	360 ml/ha	29,5	85,4	31,8	0,87	**5,3**	78,3	8,1	31-1
1240 BG2RF	Pix Ruler	31,2	87.0	32,1	0,87	**5,2**	78,0	6,8	41-1
1531 BG2RF	Control	30,5	85,1	30,1	0,85	4,6	80,7	6,1	31-2
1531 BG2RF	120 ml/ha	30,2	84,7	28,5	0,85	4,7	80,9	5,8	41-1
1531 BG2RF	360 ml/ha	30.0	85,1	27,7	0,85	4,4	80,9	6,6	31-2
1531 BG2RF	Pix Ruler	30,5	86.0	27,4	0,85	4,7	80,9	6,7	31-1
1541 BG2RF	Control	30,7	85,5	31.0	0,86	4,6	80.0	7,0	31-2
1541 BG2RF	120 ml/ha	28,9	84,6	29,3	0,87	**5,2**	80,5	7,5	31-1
1541 BG2RF	360 ml/ha	30,2	85,0	29,9	0,87	**5,2**	80,3	6,9	31-2
1541 BG2RF	Pix Ruler	30,9	85,4	30,8	0,86	4,8	80,8	6,9	31-1
Candia BGRF	Control	31,9	84,9	30,7	0,85	3,8	80,9	6,3	31-2
Candia BGRF	120 ml/ha	29,9	84.0	28,7	0,85	4,0	81,2	7,0	31-1
Candia BGRF	360 ml/ha	31,4	84,6	28,9	0,85	4,3	80,9	6,2	31-2
Candia BGRF	Pix Ruler	32,6	86,3	29,5	0,87	4,6	81,1	7,1	31-1

PROJECT NUMBER : P08000023

PROJECT TITLE : Evaluation of water harvesting methods in dryland cotton

REPORT YEAR : 2017/2018

PROJECT LEADER : Dr T van der Westhuizen

CO-WORKERS : C Fourie
P Maja

MOTIVATION

South Africa is a water scarce country and as such, water conservation is a necessity. Dryland cotton needs to be cultivated with specific production practices to enhance yield. Previous research by Brough, Kruger and Dippenaar (2003) showed promising results and yield increases where organic mulching and ploughing (leave the soil coarse) were applied. This is because of improved water infiltration and less evaporation. These practices were however not fully adapted by small-scale or commercial farmers. The aim of the demonstration blocks is to have a farmer's day to visually persuade farmers that conservation agriculture leads to higher yields.

OBJECTIVE

To evaluate different water harvesting methods on cotton yield and fibre properties in South Africa.

EXPERIMENTAL DESIGN

This dryland trial was planted with eight rows of 9 m in length with cultivar DP1240 B2RF. Interrow spacing was 30cm. Weed control was done manually.

Treatments

1. Control
2. Mulch (Scattered straw)
3. Plough (leave soil coarse after ploughing)
4. Hills (Ridges)
5. Basins (Small basins of 10 x 10 m x 1 m to be constructed)

Locality

Loskop

Measurements

1. Plant height (cm).
2. Boll counts.
3. Seed cotton yield (kg/ha), fibre percentage and fibre yield (kg/ha).
4. Fibre length (mm), strength (g/tex) and micronaire.
5. Rainfall and other climatic conditions.
6. Soil moisture content.

RESULTS

Soil moisture percentage

When ridges were used as a water harvesting method, the greatest moisture percentage of 13 % was obtained, followed by Straw (12.0 %) and Rip on Row double skip with 10.8 %.

Yield parameters

The Rip on row double skip method gave significantly higher yields (more than double) (3956 kg/ha) than the control plots (1718 kg/ha). The highest fibre percentage was obtained with the plots where straw was applied as mulch (43.4 %) as well as the control plots (43.4 %). Significantly, higher fibre yields of 1706 kg/ha was obtained from the rip on row double skip water harvesting method. The second highest fibre yield was obtained where straw was applied as mulch.

Quality parameters

All the water-harvesting methods resulted in acceptable lengths except the ploughed plots with lengths of 26.5 mm. The straw plots obtained the longest fibre of 28.6 mm where straw was applied as mulching. The strongest fibre (31.0 g/tax) was obtained with the rip on the row double skip water harvesting method. All micronaires of this trial was too high, except the ploughed plots with an acceptable micronaire of 4.6. The Rip on row double skip and Zeba plots resulted in micronaires of 5.1.

Table 1. Yield and quality parameters of the Water Harvesting Method Trial, Loskop, 2017/2018

	Control	Zeba	Plough	Ridges	Straw	Rip	CV%	LSD
Moisture %	6.1	8.0	7.7	13.0	12.2	7.7		
Plant height (cm)	84.0	82.9	85.0	77.1	77.2	94.1	15.9	NS
Boll count	13.0	17.3	13.6	13.2	14.87	20.1	14.6	4.1
Seed cotton yield (kg/ha)	1718	2028	1851	1614	2358	3956	16.0	656.1
Fibre %	43.4	41.5	43.3	40.9	43.4	43.2	0.7	0.53
Fibre yield (kg/ha)	746	842	801	660	1025	1706	15.8	276.3
Length (mm)	28.1	28.4	26.5	27.4	28.6	28.1		
Uniformity	82.6	84.2	82.2	83.8	84.0	85.0		
Strength (g/tex)	30.6	29.6	29.2	30.0	28.0	31.0		
Maturity	0.88	0.87	0.86	0.87	0.88	0.87		
Micronaire	**5.3**	**5.1**	4.6	5.2	5.5	5.1		
Rd	68.1	70.1	69.1	73.9	76.3	72.4		
PlusB	6.3	6.1	6.4	6.4	6.3	6.7		
Colour	51-2	51-2	51-2	51-1	41-2	51-1		

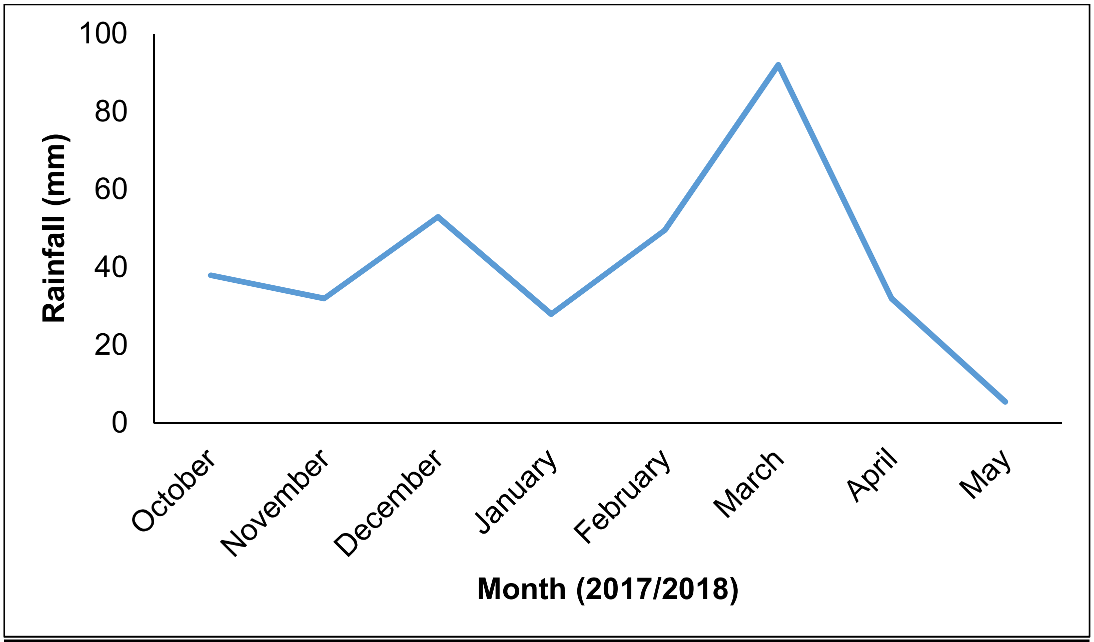

Figure 1. Rainfall (mm) during the 2017/18 season at the water harvesting methods trial

CONCLUSION

The higher yields that was obtained with the rip on row double skip method, makes this water harvesting strategy economically worth the while for dryland cotton producers.

PROJECT NUMBER	**:**	P08000026
PROJECT TITLE	**:**	Evaluation of different cultivars for drought tolerance in South Africa
REPORT YEAR	**:**	2017/2018
PROJECT LEADER	**:**	Dr T van der Westhuizen
CO-WORKERS	**:**	J Steyn C Fourie P Maja

MOTIVATION

Drought is a common occurrence in South Africa and likely to increase with climate change. With the increased demand for production under dryland conditions there is now a great need for cultivars with greater drought tolerance. There is currently a major focus on drought/ heat tolerant germplasm development programmes in other major cotton producing countries and it would be the quickest to tap into these programmes. Not all this material will be genetically modified but the most promising lines can then be included in a programme to incorporate the GM traits needed.

OBJECTIVES

To evaluate drought tolerance of cotton cultivars at three localities under dryland conditions.

EXPERIMENTAL DESIGN

A one-factor experiment was conducted. The factor studied was cultivars. The experiment was arranged according to a randomized complete block design (RCB) with four replications. Quantitative data was analyzed as factorial factors, using the program Genstat 5. The LSD of Tukey at p =0.05 was calculated to compare means.

Plots size and spacing

Six rows of 9 m in length was planted with a row width of 1m and inter-row spacing of 20 cm.

There were four replications.

Cultivars

Hybrid (C567)
Hybrid (C569)
Hybrid (C570)
Hybrid (C571)
Hybrid (C608)
DP1531 B2RF
VH260
Gariep 1
Gariep 2

Localities

Loskop
Makhathini
Rustenburg

Measurements

1. Plant height and boll counts.
2. Seed cotton yield (t/ha), fibre percentage and fibre yield (t/ha)
3. Fibre length (mm), strength (g/tex) and micronaire

RESULTS

LOSKOP

Yield parameter

Seedcotton yield (t/ha)

Mean seed cotton yield harvested at the drought tolerant trial was 1.8 t/ha. The highest seed cotton yield was obtained from DP1531 B2RF with 1.9 ton/ha. The highest fibre percentage was obtained from DP1531 B2RF with 43.4 %. The highest fibre yields was obtained from

DP1531 B2RF and VH260 with 0.8 ton/ha. The highest boll count was with Hybrid C608 (18.2). The tallest plants were also obtained from C608 with 97.1 cm.

Fibre quality parameters

All nine cultivars gave acceptable lengths. Hybrid C608 gave the longest fibre of 30.3 mm. The most uniform cultivar was hybrid C571 with 84.5. All nine hybrids gave acceptable strengths. Hybrid C608 gave the strongest fibre of 30.9 g/tex. The most mature cultivars were Gariep 1 and 2. All cultivars gave acceptable micronaires except hybrid C569 with 3.2.

Table 1. Seed cotton yield (t/ha, fibre %, Fibre yield (t/ha), boll count and plant height (cm) of the drought tolerant trial at Loskop 2017/2018

Cultivar	Seed cotton yield (t/ha)	Fibre %	Fibre Yield (t/ha)	Boll count	Plant height (cm)
C567	1.7	35.4	0.6	11.0	99.1
C569	1.8	33.7	0.6	11.6	92.5
C570	1.8	32.9	0.6	9.7	95.3
C571	1.7	34.7	0.6	11.6	89.5
C608	1.7	34.4	0.6	18.2	97.1
DP1531 B2RF	1.9	43.4	0.8	11.5	87.8
VH260	1.8	43.1	0.8	15.2	77.1
Gariep 1	1.8	40.9	0.7	11.9	93.5
Gariep 2	1.8	40.4	0.7	11.7	90.6

Table 2. Fibre characteristics of the drought tolerant trial at Loskop, 2017/2018

Cultivar	Length	Uniformity	Strength	Maturity	Micronaire	Rd	Plus B	Colour
Hybrid C567	28.9	83.9	29.8	0.85	3.8	71.7	7.0	51-1
Hybrid C569	30.0	83.6	27.2	0.83	3.2	73.9	7.1	41-2
Hybrid C570	29.3	84.1	31.5	0.84	3.5	71.0	7.1	51-1
Hybrid C571	29.3	84.5	28.9	0.85	3.9	73.4	6.6	51-1
Hybrid C608	30.3	83.9	30.9	0.85	4.0	73.0	7.8	41-2
DP1531 B2RF	28.9	83.1	28.7	0.85	4.3	75.5	6.1	41-2
VH260	26.0	82.0	26.6	0.84	4.0	73.0	6.8	51-1
Gariep 1	26.9	83.8	27.5	0.86	4.5	74.2	7.5	41-2
Gariep 2	25.8	82.6	26.4	0.86	4.4	72.9	6.8	51-1

MAKHATHINI

Seedcotton yield (t/ha)

Mean seed cotton yield harvested at the drought tolerant trial was 1.8 t/ha. The highest seed cotton yield was obtained from hybrid C608 with 2.6 ton/ha. The highest fibr percentage was obtained from DP1531 B2RF with 40.5 %. The higest seed cotton yield was the highest at Hybrid C608 with 0.8 t/ha. The highest boll count was with Hybrid C608. The tallest plants was also obtained from C608 with 139.7 cm (Table 2).

Fibre quality parameters

All nine cultivars gave acceptable lengths. Hybrid C608 gave the longest fibre of 33.5 mm. The most uniform cultivars was hybrids C567 and C571 (86.6). All nine cultivars gave acceptable strengths. Hybrid C567 gave the strongest fibre of 36.0 g/tex. The most mature cultivar was Hybrid C608 (0.84). The only two cultivars with acceptable micronaires was DP1531 B2RF (3.7) and VH260 with 3.6. Hybrid C608 gave a micronaire of 3.42.

Table 3. Seed cotton yield (t/ha, fibre %, Fibre yield (t/ha), boll count and plant height (cm) of the drought tolerant trial at Makhathini, 2017/2018

Cultivar	Seed cotton yield (t/ha)	Fibre %	Fibre yield (t/ha)	Boll count	Plant height (cm)
C567	2.0	24.0	0.7	16.2	116.5
C569	2.3	32.0	0.7	21.9	126.8
C570	1.9	28.7	0.5	20.4	127.1
C571	2.3	29.7	0.7	21.2	118.4
C608	2.6	29.4	0.8	18.0	139.7
DP1531 B2RF	1.8	40.5	0.7	23.0	110.1
VH260	1.5	35.6	0.6	17.7	93.4
Gariep 1	1.0	35.6	0.4	16.1	117.7
Gariep 2	1.3	35.7	0.5	19.5	136.0

Table 4. Fibre characteristics of the drought tolerant trial at Makhathini, 2017/2018

Cultivar	Length	Uniformity	Strength	Maturity	Micronaire	Rd	Plus B	Colour
Hybrid C567	32,5	86,6	32,4	0,83	**2,97**	82,9	7,3	21-1
Hybrid C569	31,9	86,2	30,6	0,82	**3,00**	83,1	7,8	21-1
Hybrid C570	31,9	85,9	36,0	0,83	**2,80**	83,4	7,2	21-1
Hybrid C571	32,5	86,6	32.0	0,82	**2,99**	83,6	7,6	11-2
Hybrid C608	33,5	85,5	34,7	0,84	**3,42**	81,3	8,3	21-1
DP1531 B2RF	30,7	85,5	31,5	0,83	3,70	82,2	7.0	31-1
VH260	29,7	84,2	30,2	0,83	3,63	80,2	7,6	31-1
Gariep 1	28,4	84,1	31,3	0,82	**3,00**	79,4	8.0	31-1
Gariep 2	27,3	84,7	30,7	0,83	**3,19**	80,2	8,2	21-2

RUSTENBURG

Seedcotton yield (t/ha)

Mean seed cotton yield harvested at the drought tolerant trial was 2.1 t/ha. The highest seed cotton yield was obtained from Gariep 2 with 2.3 ton/ha. Fibre percentages of the hybrids were very low. The highest fibre percentage was obtained with DP1531 B2RF with 40.3 %. The highest fibre yield was obtained from DP1531 B2RF with 0.9 t/ha. The highest boll count was with Gariep 2 (16.4) and the tallest plants was obtained from DP1531 B2RF with 91.2 cm (Table 3).

Fibre quality parameters

All nine cultivars gave acceptable lengths. Hybrid C608 gave the longest fibre of 33.5 mm. The most uniform cultivar was C567 (86.3). All nine cultivars gave acceptable strengths. Hybrid C569 gave the strongest fibre of 33.4 g/tex. The most mature cultivar was Gariep 1 (0.87). All nine cultivars had acceptable micronaires of between 3.5 and 4.9.

Table 5. Seed cotton yield (t/ha, fibre %, Fibre yield (t/ha), boll count and plant height (cm) of the drought tolerant trial at Rustenburg, 2017/2018

Cultivar	Seed cotton yield (t/ha)	Fibre %	Fibre yield (t/ha)	Boll count	Plant height cm)
C567	2.2	26.4	0.6	12.7	84.2
C569	2.2	29.8	0.7	11.6	75.9
C570	1.7	28.9	0.5	10.5	87.0
C571	2.1	28.9	0.6	15.7	85.4
C608	2.2	29.9	0.7	11.2	85.6
DP1531 B2RF	2.1	40.3	0.9	12.7	91.2
VH260	2.0	36.5	0.7	14.5	78.2
Gariep 1	1.9	37.8	0.5	14.2	87.2
Gariep 2	**2.3**	36.9	0.6	**16.4**	89.9

Table 6. Rustenburg fibre characteristics of the drought tolerant trial

Cultivar	Length	Uniformity	Strength	Maturity	Micronaire	Rd	Plus B	Colour
Hybrid C567	30.5	86.3	30.5	0.86	4.5	83.0	5.9	31-1
Hybrid C569	31.1	86.1	29.6	0.84	4.0	84.5	6.1	21-2
Hybrid C570	30.0	85.3	33.4	0.86	4.4	79.5	5.6	41-1
Hybrid C571	30.8	85.9	31.6	0.86	4.3	79.9	6.0	41-1
Hybrid C608	33.5	84.7	33.2	0.85	4.0	83.1	6.0	31-1
DP1531 B2RF	28.2	84.6	28.2	0.85	4.3	81.7	6.8	31-1
VH260	29.1	84.9	28.6	0.85	4.5	82.9	7.3	21-1
Gariep 1	28.2	85.5	31.8	0.87	4.8	78.5	7.1	31-2
Gariep 2	27.8	85.1	29.5	0.85	4.2	80.0	7.1	31-2

CONCLUSION

As expected, different cultivars performed different at the different cotton production areas. At Loskop DP1531 B2RF gave the highest yield of 1.9 t/ha. At Makhathini, Hybrid C608 gave the highest seed cotton yield of 2.6 t/ha. At Rustenburg, Gariep 2 performed the best with 2.3 t/ha. The drought tolerant trials did excellent overall with 2.6 t/ha for a late January planting.

Rainfall were advantages with totals of 365.6, 635 and 482.8 mm for Loskop, Makhathini and Rustenburg respectively.

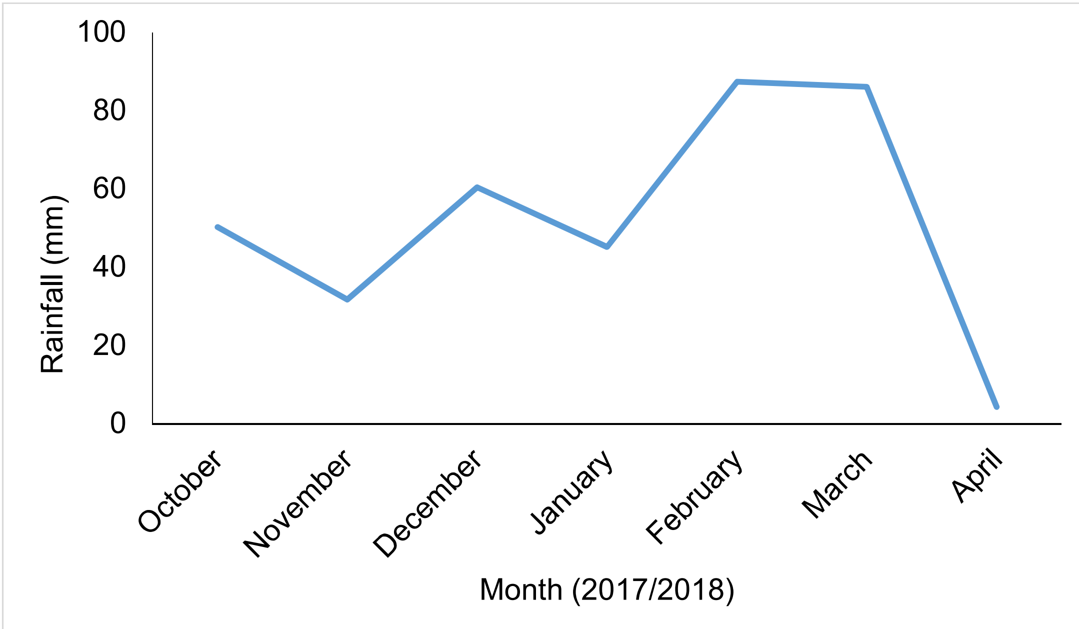

Figure 1. Rainfall at Loskop drought tolerant trial (2017/2018)

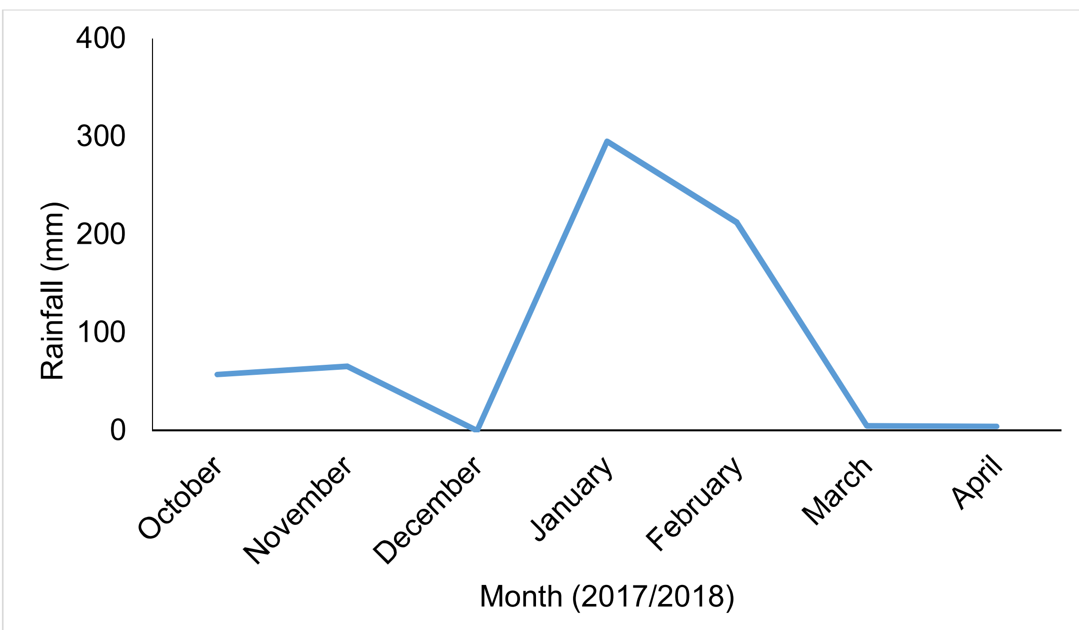

Figure 1. Rainfall at Makhathini drought tolerant trial (2017/2018)

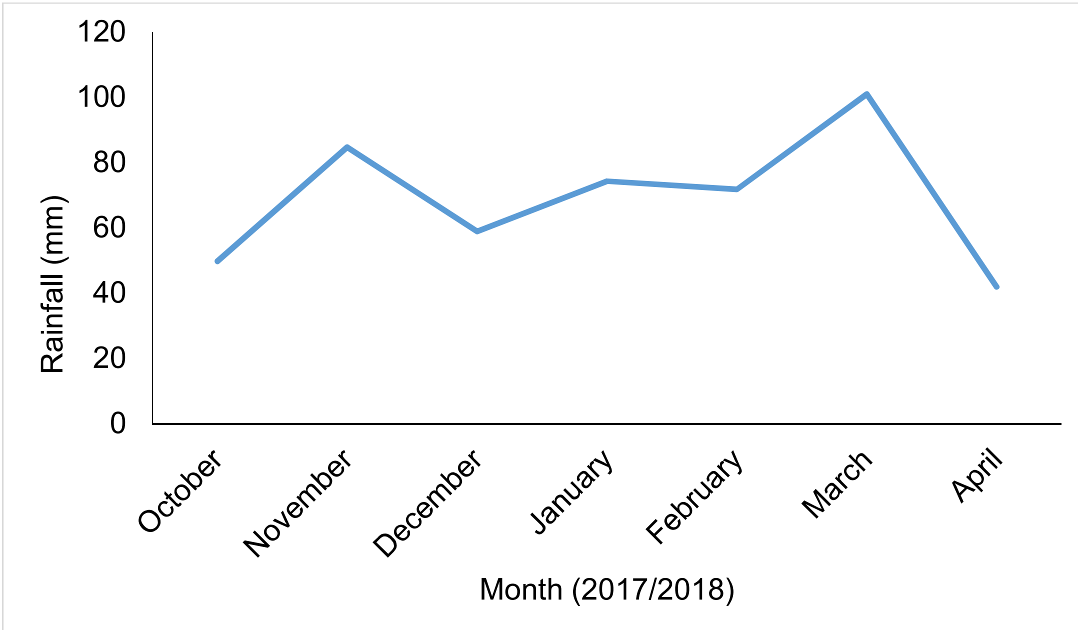

Figure 1. Rainfall at Loskop drought tolerant trial (2017/2018)