IMPROVING COTTON PRODUCTIVITY IN SOUTH AFRICA

Introduction

Cotton is regarded as one of the most versatile agricultural products in the world. In South Africa, relatively low prices, high input costs, exchange rates, cheap import of cotton fibre and international subsidies are all factors affecting cotton production negatively.

In South Africa, cotton production provides employment for 100 000 people. In 2003, the textile industry's local sales fetched R12.4 billion (a further R13 billion was obtained from the sale of garments/textile) and exports totaled R3.8 billion (Anonymous, 2005)

South African cotton is produced under both irrigated and dry land conditions. The second estimate for the 2008/2009 production year shows a total cotton harvest of 42 042 bales of fibre (Cotton SA, 2008). The estimated harvest will be the smallest in 40 years. This is mainly due to the perception that cotton farming is no longer a viable option, especially in the light of the favourable prices of other competitive summer crops. Cotton is getting strong competition from other crops, such as maize and sunflower, whose prices skyrocketed. These crops not only give farmers higher prices, but also need lower inputs (Cotton SA, 2008). Table 1 shows the hectares planted and yield for South Africa.

Possible solutions to overcome abovementioned limitations are addressed through research, and the following programs will give information on progress on South African research.

Breeding

In South Africa breeding was done from as early as the 1920's, where hairy cotton varieties were developed and exploited for their resistance to leafhoppers (Annecke &

Moran, 1982). In 1970 the South African textile industry favored an increase of fibre length and micronaire index of lint from certain areas. Emphasis later shifted to the improvement of fibre tenacity, and with the increased importance of rotor spinning, a lower micronaire index became increasingly desirable (van Heerden *et al*, 1987).

Table 1 Areas planted and yield in the Republic of South Africa (Cotton SA, 2008)

Marketing year	**Irrigation (ha)**	**Dry land (ha)**	**Total (ha)**	**Yield (Kg ha^{-1})**		
				Irrigation	**Dryland**	**Average**
1997/98	15954	67017	82971	2189	403	746
1998/99	20361	69578	89939	2724	580	1065
1999/00	31263	67356	98619	2680	545	1222
2000/01	10486	40282	50768	3107	777	1258
2001/02	18539	38153	56692	3455	593	1529
2002/03	9791	28897	38688	3538	515	1280
2003/04	10322	12252	22574	3482	475	1850
2004/05	18269	17450	35719	3455	492	2007
2005/06	12897	8866	21763	3791	521	2459
2006/07	9720	8394	18114	3633	485	2174
2007/08**	7920	3443	11363	3700	541	2844

* Seed cotton

** Estimates

In many parts of the world, an important aim of cotton breeding is earliness of crop maturity. Subsequently the then Tobacco and Cotton Research Institute (TCRI) initiated a breeding project in 1986 for the development of cotton cultivars adapted to a short growing season. The study investigated cultivar-environment interactions involving 15 short-season cultivars used in a programme at three different localities (de Kock, 1994).

In the breeding programme of 1987, the cultivar Acala 1517-70 was considered the standard as far as fibre characteristics were concerned. Acala 1517-70 then produced a better quality fibre than the other cultivars grown in South Africa but had a low yield potential. In the Vaalharts (Northern Cape Province) and Loskop (Mpumalanga Province) programmes improved yield and fibre properties equal to those of Acala 1517-70, were the breeding objectives. Resistance to *Xanthomonas* spp and *Altenaria* spp formed part of the screening process. In the Upington (Northern Cape Province) area, a prerequisite was resistance to *Verticilium* wilt, resistance to the physiological disorder called red leaf disease, and improvement of the spin ability of the locally grown OR3 (van Heerden *et al*, 1987).

Breeding after 1990

After 1990, the Agricultural Research Council undertook cotton breeding for yield and quality improvement-, at the Institute for Industrial Crops (ARC-IIC), in the North-West Province. The Plant Breeding Division at the Institute was responsible for developing new cultivars that would produce more efficiently under existing or potential environmental conditions, through manipulation of gene frequencies (Swanepoel, 2004). This division had various programmes aimed at improving genotypic backgrounds for improved production under dry land, irrigated and short growing season conditions, and resistance to Verticilium wilt and nematodes. The germplasm collection currently consists of 1726 accessions in 2004.

Cornellissen (2002) describes a program to develop jassid resistant varieties through incorporation of hairiness to adapted cultivars or breeding lines to address the problems of limited resource farmers in the Republic of South Africa.

Cultivar research

To obtain optimum yields when planting cotton instead of grain, cultivar selection is the most important aspect that the cotton grower has to take into consideration. A herbicide or insecticide that has been chosen can be changed during the season but cultivar selection is done only once and the selected cultivar dictates field management for the entire season. In order to give cotton producers recommendations regarding the adaptability and stability of cultivars, five cotton cultivars were planted at 6 sites in South Africa over the 2003 - 2006 period. Seed cotton yield, fibre percentage, fibre yield and fibre qualities were determined and cultivars were evaluated for performance and yield stability in the eight cotton production regions.

Cultivars planted under irrigated conditions in the National Cotton cultivar trials were NuOPAL, DeltaOPAL, DeltaOpal RR, LS9219 and SZ9314. The localities were Loskop (Mpumalanga Province), Makhathini (KwaZulu-Natal), Rustenburg (North-West Province), Vaalharts and Upington (Northern Cape) and Weipe (Limpopo Province). Results showed that although the cultivar, LS9219, outperformed NuOPAL with regard to fibre length and strength, it was second to NuOPAL in terms of seed cotton and fibre yields. Since no other cultivar matched the performance of NuOPAL regarding seed cotton or fibre yield (it was selected by the AMMI model as the best performer in respect of seed cotton yield and fibre yield (kg ha^{-1}) in fifteen out of eighteen environments), NuOPAL is recommended for planting in all of the different cotton-production areas of South Africa (Pretorius 2010).

The national cultivar trials are carried out annually to evaluate new cultivars against the standards.

Organic research

Yields of organically grown crops tend to be lower initially, because soils need to be build up first, and secondly, natural pesticides that prove to be effective must be found. In order for South African producers to be able to access this high value niche market recommendations need to be establish for local conditions, especially regarding fertility and pest and disease control.. Statistical research on organic cotton production is scarce, and therefore needed to be addressed.

Six different organic nutrient treatments were evaluated during the 2008/2009 season at the ARC-IIC- in Rustenburg. Treatments included mychorrhiza, cow manure, compost,

compost tea, a combination of compost plus compost tea and organic fertilizer. Soil analysis at the end of the season showed an increase in nitrogen only in the mychorrhiza treatment. The mychorrhiza, cow manure, compost, compost plus compost tea combination and the inorganic treatments resulted in a higher phosphorus contents in the soil at the end of the season. The soil potassium content at the end of the season was higher in the cow manure, compost plus compost tea combination and the inorganic treatments. Leaf analysis at 68 days after planting showed a higher nitrogen contents in the mychorrhiza, cow manure, organic and inorganic treatments. The cow manure treatment gave the highest potassium contents in the leaves at 150 days after planting. The inorganic treatment (1553 kg ha^{-1}) and compost and compost tea combination (1450 kg ha^{-1}) gave the highest seed cotton yields followed by the cow manure (1389 kg ha^{-1}) and compost treatments (1356 kg ha^{-1}) (ARC, Organic Nutrient Report, 2009).

Organic pesticides and nematicides

The input cost of small-scale cotton farming is high due to, amongst others, the cost of synthetic chemicals for insect- and nematode control. Some synthetic chemicals have the insecticidal and nematicidal properties but do not break down as easily as the natural chemicals and thus can build-up and damage the environment. This project is intended on lowering of input cost and increasing the profit margin in cotton production.

During the 2007/2008 season, the effect of tobacco, khaki Weed, thorn apple, garlic and garlic-onion-chilli sprays compared to Mospilan, Decis and an untreated control was investigated at Rustenburg in an irrigated cotton trial. Decis reduced the number of bollworms. Mospilan, Decis and tobacco treatments exhibited significantly less leafhopper damage. There was no significant difference on aphid and whitefly populations in all the treatments while Mospilan increased the spider mite population. In general the five organic insecticides were not as successful as the chemical treatments in the control of insect pests.

At Vaalharts tobacco, thorn apple, castor oil and marigold as an intercrop were compared to Temik and an untreated control. The thorn apple treatment showed some promise in controlling the nematodes at 12 weeks after planting. The other organic nematicide treatments and the Temik chemical treatment did not significantly reduce the nematode numbers during 2007/2008 season. The thorn apple treatment gave the highest seed cotton yield (ARC, Organic Pesticide Report, 2008).

Low input production systems on cotton

Due to the decrease in the cotton price and increase in tillage-, labour-, and chemical costs, very few small-scale farmers can make a profit planting cotton. Cotton is one of a few crops that can be cultivated successfully on the Makhathini flats in South Africa under dryland conditions, which mean that many of these farmers rely a great deal on this crop for an income. If a farmer can cut costs by planting a cultivar that can be cultivated with minimum input, he can produce cotton with a profit. The objective of this research is to train and support farmers in choosing the cotton cultivar that give the highest profit using the most economical input production system.

Previous results have shown that input costs can drastically be cut if a minimum soil cultivation practice (rip-on-row) is used instead of the conventional tillage practices (plough and rip) that are traditionally used. In spite of these reductions in input costs the small-scale farmers is still battling to make any profit by planting cotton. The possibility must be investigated that some cotton cultivars might be more economical to cultivate than others. Therefore the input costs of conventional cotton must be compared to that of genetically modified cotton.

Low input production systems on cotton (Conservation tillage)

The objective of this trial was to compare the profitability of the rip-on-row dryland cotton production method (1 meter inter-row spacing - Solid rows) with rip-on-row where two rows are planted and two skipped (Double skip row). The cotton cultivar DeltaOPAL was planted under dryland conditions at Makhathini. On a planted area basis the cotton in the double skip row treatment gave a significant higher yield than the solid row treatment. On a field area basis however, the yield of the cotton in the solid row treatment gave a significantly higher yield that the cotton in the double skip row treatment. The input costs using the solid row method were significantly higher than the input costs when using the double skip row method of planting. The gross income of the cotton in the solid row treatment was significant higher than the gross income of the cotton in the double skip row treatment. The cotton in the double skip row treatment gave a 25.8c profit per Rand invested while the cotton in the conventional spacing treatment showed a loss of 23.9c for each Rand invested (ARC, Low Input Production Systems Report, 2009).

Technology transfer

The cotton Industry together with the National Department of Agriculture has drawn up a National cotton strategy as part of the National Agricultural policy. This strategy envisages that by 2014, 30% of the South African cotton crop will be produced by the resource poor and developing farmers sector. Cotton is thus promoted as an alternative or rotation crop in climatically appropriate areas of the country.

Farmers are familiarized with cotton and the best production aspects by making use of demonstration plots at their homestead or their allocated portion of the tribal property. The local extension officer and staff members of the Agricultural Research Council – Institute for Industrial Crops (ARC-IIC) as a team visit these demonstration plots on a monthly basis and discuss the preceding as well as the future developmental aspects of the cotton plant, and or crop. They have also expanded this experience by supplying seed, fertilizer and if required pesticide and a knapsack sprayer to enable the participant(s) to experience the actual task of cotton crop management on an area between 0.5 to 1 ha. The area planted depends on the correctness of spacing in and between rows. The yield that is produced is then sold by the participant and partially used to acquire inputs for the following season. Once farmers have experienced these two activities they are able to make meaningful decisions about the inclusion of cotton in their standard practices (ARC, Technology Transfer Report, 2009).

Importance of the South African cotton industry: economic, social and environmental

Although the importance of domestically produced cotton, in terms of its gross value compared to other South African field crops is low, it is a crop highly suitable for small-scale farming as it is drought tolerant and non-perishable. Cotton production is also labour intensive, provides numerous job opportunities on farm level and production can be expanded without causing surpluses. Although cotton production may not always seem to be financially lucrative, it is often the most economic and viable crop in marginal dryland production areas. In the traditional cotton growing area of Makhathini in Northern KwaZulu-Natal for example, where more than 4000 small-scale cotton farmers reside, cotton is often the only commodity that can be planted due to the irregular rainfall in the region. In this region and in other marginal dryland production areas, cotton contributes to the social upliftment of people and assists in rural development and the elimination of poverty. As cotton is a cash crop it impacts positively on the households of rural communities in terms of food security and income levels. The cotton income of the estimated 4000 small-scale farmers in Makhathini is vital to the livelihood of about 20 000 people, roughly working on about 5 dependents per farmer (Bruwer, 2001 - Draft Cotton Strategy plan).

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