

ZIMBABWE'S AGRICULTURAL REVOLUTION REVISITED

Edited By:

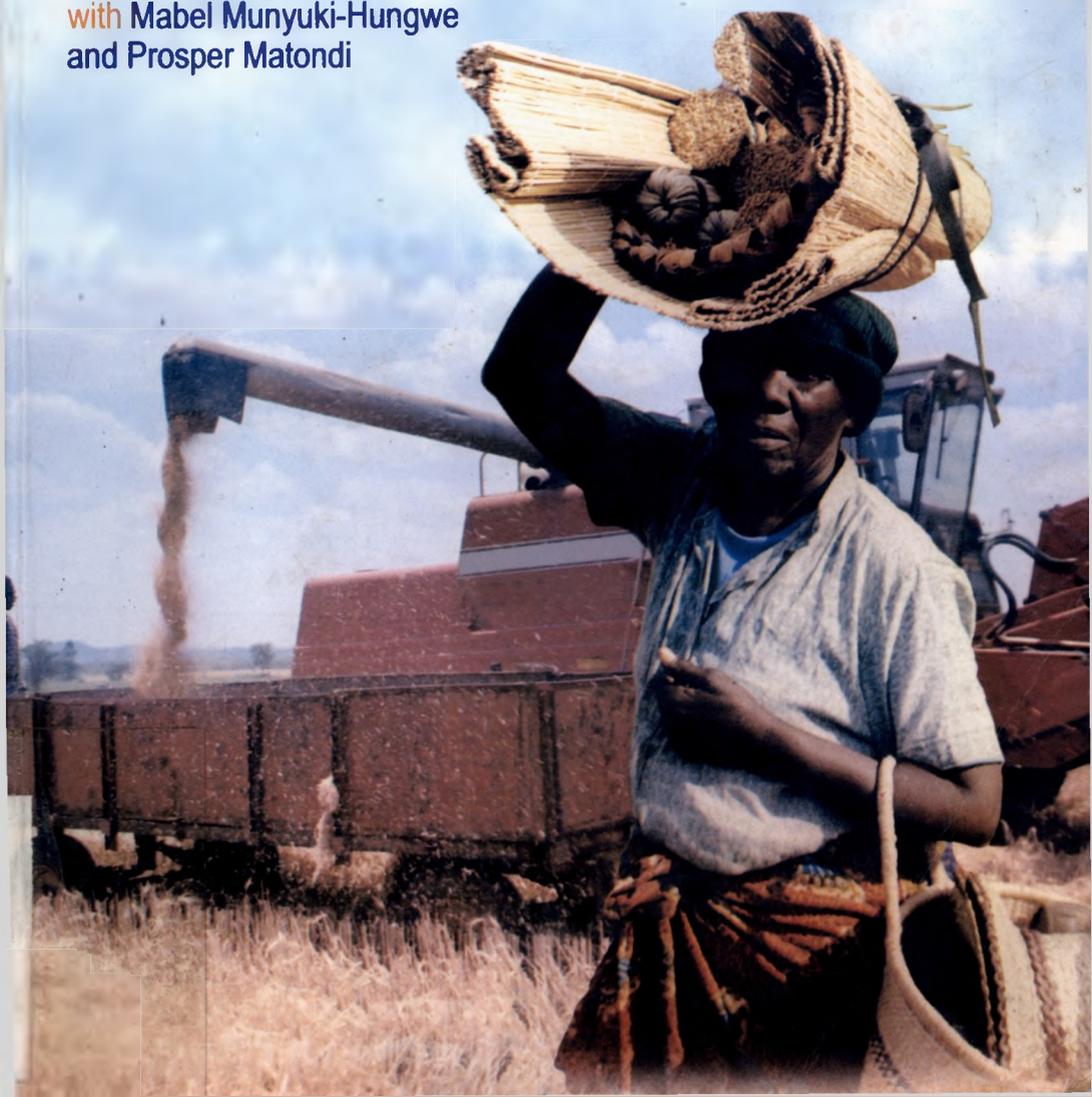
Mandivamba Rukuni,

Patrick Tawonezwi,

Carl Eicher

with Mabel Munyuki-Hungwe

and Prosper Matondi



ISBN 0-86924-141-9

Published by University of Zimbabwe Publications, P. O. Box MP 167,
Mt. Pleasant, Harare, Zimbabwe

First printed: 2006

Publishing consultant: Margo Bedingfield,

Cover and inside photographs supplied by Manfred Takaendesa, Centre for Rural
Development

© Editors – Mandivamba Rukuni, Patrick Tawonezvi and Carl Eicher with
Mabel Munyuki-Hungwe and Prosper Matondi, 2006

© Individual contributors, 2006

Printed by Sable Press Private Limited

Reproduction of this publication for educational or other non-commercial
purposes is authorized without prior written permission from the copyright
holder provided the source is fully acknowledged. Reproduction of the
publication for resale or other commercial purposes is prohibited without prior
permission of the copyright holder.

PART IV THE AGRICULTURAL REVOLUTIONS

Introduction to Part IV	357
16 Maize research and development	363
<i>Kingstone Mashingaidze</i>	
Maize production trends	363
The communal land maize production revolution	364
High-yielding cultivars (hybrids)	366
Support services	371
Issues facing the maize industry	373
Research needs	375
Conclusion	376
17 Cotton research and development: 1920 – 2004	381
<i>Irvine K. Mariga</i>	
Historical perspective	382
Laying the research foundation	385
Genetic modification	388
Entomology research	388
Cotton pathology research	390
Weed research	391
Agronomy and physiology research	391
Developing support services	392
Understanding the smallholder cotton success story	394
Current issues	396
Conclusion	398
18 Tobacco research and development	403
<i>Desirée L Cole and James S. Cole</i>	
Types of tobacco grown in Zimbabwe	404
Tobacco research	406
Information dissemination	412
Response to market opportunities	412
Stimulating smallholder production	412
Research and development: future needs	414
19 The growth and development of the horticultural sector	419
<i>Stanley Heri</i>	
Overview	419
The growth and development of the horticultural sector	420
Smallholder sector	421
Large-scale commercial sector	424
Investment in greenhouse production	429
Production and quality strategy	429
Research and crop development	431
Horticultural exports	432
Conclusion	435



Cotton has grown to be a key foreign currency earner – cotton grading in a communal setting (National Archives)

Cotton research and development: 1920–2004

Irvine K. Mariga

Cotton production occupies a special niche in Zimbabwe's agriculture. Cotton is a major cash crop and a source of rural employment. Furthermore, smallholders growing cotton have improved their housing, mechanized some of their farming operations and have invested in local business centres. Vaughan-Evans (1990) believes that cotton instils discipline in farmers because of its stringent husbandry requirements. The crop has also promoted infrastructural development in rural areas by the various players in the cotton industries, such as agro-chemical, fertilizer and cotton marketing companies.

Cotton became a strategic crop because it directly or indirectly employed over 500,000 people, including farmers, farmworkers and their families, and industrial workers (Agricultural Marketing Authority, 1990) and by 1990, it was the second largest agricultural foreign currency earner (Cotton Marketing Board, 1990b). The cotton industry earned Z\$57 million in foreign exchange in 1980 and Z\$233 million in 1990/91 (Agricultural Marketing Authority, 1991). In 1996, crop sales were Z\$1.656 billion and this increased to Z\$8.4 billion in the 2002/03 marketing season (Imani Development, 2003). The crop is a relatively drought-tolerant cash crop for communal and resettled farmers. Cotton is processed into various products that include lint, cotton wool, stockfeeds and cooking oil. Over half of the cooking oil in Zimbabwe comes from cotton seed.

Zimbabwe's cotton boom made it the fourth largest producer of seed cotton in Africa after Egypt, Sudan and the Ivory Coast. Cotton production continued to expand, for example from 274,000 hectares in the 1990/91 season to 330,450 hectares in the 1998/99 season. The area devoted to cotton increased to about 350,000 hectares during the fast track land reform programme as compared to the 1990s average area when 260,000 hectares were planted. The output also increased from 214,000 metric tonnes in the 1990s to over 286,000 metric tonnes in the 2001/02 marketing season. There has been, however, a drop in yield from 6.5 tonnes per hectare in the 1990s to 4.9 tonnes per hectare during the fast track period. Zimbabwe's cotton success is attributed mainly to its successful crop research programme which was supported by effective extension, marketing and economic policies. This chapter examines the sources of this boom and suggests how it can be sustained.

Historical perspective

Indigenous cotton was grown in some areas of Zimbabwe during the rule of the British South Africa Company (Wienmann, 1972). The first research trial was conducted in 1903 with seed from Egypt, Brazil and the United States of America but the crop was destroyed by frost. The second trial in 1904, which was conducted with American, Peruvian and Egyptian seed, suffered from drought and cutworm attack. A tobacco and cotton specialist was appointed in 1918 and a year later trials covering an area of over 1,000 acres were conducted on 91 farms in 12 districts. The results of these initial trials indicated that the greatest potential areas to grow cotton were in those below 1,200m above sea level.

Commercial production of cotton began in 1923 and increased for a few years until it declined because of bollworm attacks. Effective pest-control methods were developed and cotton extension services helped increase the area under cotton production from 4,800 hectares in 1964 to around 80,000 hectares in 1979 (table 17.1).¹⁸² Table 17.1 displays the rapid increase in cotton production by the communal farming sector after 1980 because of access to credit, better extension services, improved Cotton Marketing Board services and general upgrading of the infrastructure in rural Zimbabwe. The provision of market contracts based on cotton input provision to farmers improved the total production in both the small-scale and large-scale farming sectors. Besides the traditional cotton buyers, such as Cotton Company of Zimbabwe (Cottco), new market players emerged and provided the same services. The services provided contributed to cotton production through easy access to inputs (fertilizer, seed and chemicals) which improved pest control through provision of pest scouting services. In addition, the market guarantees, availability of reliable transportation and better prices were huge incentives for smallholder cotton producers.

However, table 17.2 also shows an overall decline in yield as the smallholder sector dominated cotton production, particularly after 1989/90. Seed cotton yields in the 1942 to 1950 period averaged 342kg per hectare on commercial farms (Metelerkamp, 1988).¹⁸³ The yields of seed cotton on communal farms have always been about half of those on commercial farms. Raising yields in communal areas is a major challenge.

The number of cotton growers in Zimbabwe in 1990/91 was as follows: 569 large-scale commercial; 1,790 small-scale commercial; 103,047 commu-

¹⁸² Research efforts in the 1940s and 1950s culminated in the development of effective pest-control recommendations in the early 1960s.

¹⁸³ The average seed cotton yields on commercial farms was 342kg per hectare in the 1940s; 614kg per hectare in the 1950s; 1,485kg per hectare in the 1960s, 1,715kg per hectare in the 1970s; and 2,057kg per hectare in the 1980s (Metelerkamp, 1988).

Table 17.1 Seed cotton production, area and yield: national, communal and commercial: 1970–2000

Growing Season	Communal sector			Commercial sector			National		
	Area (ha)	Yield (kg/ha)	Production (mt)	Area (ha)	Yield (kg/ha)	Production (mt)	Area (ha)	Yield (kg/ha)	Production (mt)
1969/74	30,400	809	24,594	78,533	1,321	103,742	108,933	1,178	128,336
1974/79	37,200	737	27,416	81,922	1,560	127,798	119,122	1,303	155,214
1979/84	58,000	658	38,164	69,424	1,855	128,782	127,424	1,310	166,946
1984/89	139,400	790	110,126	91,344	1,900	173,554	230,744	1,229	283,680
1989/90	153,000	673	102,960	64,486	1,586	102,281	217,486	944	205,241
1990/91	197,000	700	137,900	77,222	1,595	123,151	274,222	952	261,051
1991/92	183,000	195	35,700	52,777	768	40,532	235,777	323	76,232
1992/93	199,000	676	134,500	47,300	1,687	79,800	246,300	870	214,300
1993/94	181,150	612	110,805	40,150	1,760	70,675	221,300	820	181,480
1994/95	179,760	312	56,100	33,800	1,078	36,440	219,000	459	100,600
1995/96	217,620	724	157,584	40,000	1,827	73,070	264,120	396	104,700
1996/97	267,500	740	197,825	45,755	1,756	80,359	313,255	871	273,000
1997/98	239,000	764	182,550	47,000	1,921	90,300	295,000	925	272,850
1998/99	274,500	686	188,350	188,350	1,407	76,630	330,450	917	303,000
1999/2000	326,000	808	263,400	63,668	1,742	110,935	369,935	884	327,000

Source: CSO up to 1985/86; from 1986/87 Crop Forecasting Committee/NEWU

Note 1: Resettlement areas included in communal area totals from 1980/81 onwards

Note 2: Small-scale commercial areas in commercial area totals from 1980/81 onwards

Table 17.2 Cotton production patterns: 1995 to 2004 (in all sectors)

Year	1	2	3	4	5	6	7	8	9	10
1995	264,000	24,168	104,073	128,241	70,108	30,917	2,830	33,748	24,385	128,241
1996	313,000	24,385	101,025	125,410	63,141	30,917	2,395	33,312	28,958	125,410
1997	315,000	28,958	104,509	133,467	69,672	32,659	3,266	35,925	27,869	133,466
1998	320,000	27,869	114,960	142,829	69,672	38,102	3,266	41,368	31,788	142,828
1999	365,000	31,788	128,459	160,247	76,204	38,102	3,266	41,368	42,674	160,246
2000	390,000	42,674	119,750	162,424	81,647	32,659	3,266	35,925	44,852	162,424
2001	400,000	44,852	76,204	121,056	54,432	30,482	3,266	33,748	32,877	121,057
2002	330,000	32,877	84,913	117,790	59,875	28,304	3,266	31,570	26,345	117,790
2003	330,000	26,345	100,154	126,499	70,761	28,304	3,266	31,570	24,168	126,499
2004	400,000	24,168	108,863	133,031	76,204	26,127	0	26,127	30,699	133,030

Key

- | | |
|------------------------------------|---|
| 1 = Area harvested in hectares | 2 = Beginning stocks in metric tonnes |
| 3 = Production in metric tonnes | 4 = Total supply in metric tonnes |
| 5 = Exports in metric tonnes | 6 = Domestic consumption in metric tonnes |
| 7 = Losses in metric tonnes | 8 = Total domestic consumption in metric tonnes |
| 9 = Ending stocks in metric tonnes | 10 = Total |

Source: United States Department of Agriculture, (2004)

nal and 7,714 resettlement. In the 1988/89 season, Zimbabwe produced 247,671 hectares of cotton with an average seed cotton yield of 1,055 kg per hectare (Agricultural Marketing Authority, 1991). In 1999/2000 the country total was 370,000 hectares at an average yield of 884kg of seed cotton per hectare (table 17.2). The number of cotton farmers decreased in the large-scale commercial farming sector from 140 in 1997 to 12 in 2003, whilst the smallholder sector increased from 190,000 to 204,000 in the same period (Imani, 2003). Zimbabwe's cotton industry resembles that of the francophone countries (Cameroon and Senegal) which have attained higher average yields than anglophone countries because of a dynamic and productive cotton research programme.¹⁸⁴

The area under cotton production increased during the fast track land reform programme (table 17.2). Between 1999 and 2002 the stocks held increased and they were matched by an increase in exports. The number of small-scale cotton growers increased from 70 per cent to over 80 per cent following the land reform programme. Given that cotton was already grown mostly by smallholder farmers, it has not been negatively affected by the land reform programme.

The decontrolling of cotton marketing by the government in 1994 effectively ended the monopoly situation enjoyed by the parastatal, the Cotton Marketing Board, and paved the way for its privatization. It also made way for the producer cooperative, Cotpro, to enter the market in 1995 but this closed down and was absorbed by Cottco in 2001. Cargill began marketing cotton in 1996. From the late 1990s, some indigenous companies emerged in the marketing of cotton and these include Cabview Trading from Tanzania, Fleming Cotton Ginnery, Romsdal, Boka cotton auction sales floors, and FSI Agricom. These developments increased the competition for access to cotton leading to price wars. This competition has tended to bring prices offered to farmers close to export parity and generally reduced marketing costs to farmers. In the 2004 season cotton was expected to fetch over US\$150 million from exports (Cotton Growers' Association, 2004).

Laying the research foundation

Overview

Cotton research started in 1903. Imported varieties were tested on farms and experimental stations until the early 1920s when it was confirmed that cotton was best suited to elevations below 1,200m altitude. In 1925 a cotton breeding

¹⁸⁴ Cotton yields (kg per hectare) in anglophone countries are as follows: Nigeria, 250; Kenya, 350; Tanzania, 400; and Zimbabwe, 1,300 (communal) and 2,000 (commercial). In francophone countries average yields (kg per hectare) are Senegal, 1,012; and Cameroon, 1,300 (Lele, Van De Walle and Gbetibou, 1989; and Cotton Marketing Board, 1990a).

station was established at Kadoma, the present day home of the Cotton Research Institute. Research over the 1925 to 1950 period concentrated on selection for resistance to jassids and bollworms and on cultural practices. Significant breakthroughs in cotton production began in the early 1950s with the introduction of Albar stock from Uganda. The Albar lines had a high yield potential and they were hairy, hence resistant to jassid attacks and bacterial blight. Effective insecticide control of bollworms began in 1955 and by the late 1950s effective chemical control of red bollworm had been achieved. The 30-year gestation period in cotton research (1925–1955) was almost identical to the length of time it took (28 years from 1932–1960) to develop the famous SR52 hybrid maize variety.

New agronomic practices introduced in the early 1960s included pest scouting and spraying methods and pest control recommendations for bollworms and sucking pests. The breakthrough in pest control in the 1950s spearheaded the expansion in cotton production. Further pest control successes included the acaricide rotation scheme¹⁸⁵ in the early 1970s and the introduction of pyrethroids in the late 1970s. With the advent of independence in 1980, the Cotton Research Institute researchers introduced trials in communal lands focusing on moisture conservation, simpler pest scouting methods and performance of cotton varieties under low management.

The following sections will review the research achievements in breeding, agronomy, pathology, entomology and weed control for the period 1950 to 2000.

Cotton breeding research

Initial breeding work at Kadoma focused on the search for jassid-resistant material. This explains the introduction of the hairy U4 strains from South Africa in 1926. But heliothis and red bollworm soon emerged as major problems. Selection of U4 strains for improved fibre quality and for early crop formation helped to avoid mid to late season bollworm attacks. Breeding for pest control continued into the early 1950s. New germplasm, Albar 49 from Namulonge in Uganda, was introduced to Zimbabwe in 1952 as a source of bacterial blight resistance. More Albar 51 lines were introduced in 1953 and by 1954 the major part of the crossing and selection programme was using Albar 51 lines since they had resistance to jassids and bacterial blight and had quality advantages. Albar 637 breeding bulks gave a record yield of 2,087 kg per hectare at Kadoma and its first commercial seed issue was made for the 1959/60 season. These high yields of the Albar lines accounted for the rapid increase in cotton production in the mid-1960s. A cotton seed multiplication ginnery was built at the

¹⁸⁵ The scheme recommends rotation of three different chemical groups of acaricides to avoid build-up of resistance in red spider-mites.

Kadoma research station in 1965 using cotton growers' levy funds.

An external review of the cotton breeding programme by an expert from the Cotton Research Corporation in 1970 emphasized the need to broaden the genetic base. The research emphasis then shifted away from Albar progeny raw selection and the medium-staple (Albar) programme was subdivided into middleveld and lowveld sections to cater for the different conditions.

By the mid-1970s, there were four cotton breeding programmes. The medium-staple middleveld programme was targeted for areas in the altitude range 700–1,200m (middleveld) where about 80 per cent of the cotton is produced. Growers in this area included communal and commercial farmers and parastatal estates which had irrigation facilities. The cultivar for the area has to be broadly adapted. The medium-staple lowveld programme aimed at an earlier maturing and more determinate cultivar for the hot lowveld area (300–600 m) where most of the crop was grown under irrigation in rotation with wheat. This area produces 15 per cent of the country's cotton. The medium-staple highveld programme aimed to produce a short-season type of cotton tolerant to low temperatures that could be grown in areas between 1,250m and 1,400m above sea-level. The long staple programme aimed to develop cultivars with a long staple (up to 35mm long).

The cotton-breeding programme aimed to satisfy growers, ginners, oil expressers and spinners. The programme's objectives were to improve on yield, adaptability, boll size, earliness, pickability, disease-resistance, insect-resistance, high ginning percentage, seed size, low attachment forces, oil percentage and fibre –its length, uniformity, strength, maturity, elongation and fineness. Foreign introductions have been continuously imported for various desired traits. Emphasis in the 1990–1999 period was to improve jassid resistance, lint length and strength, and to select for resistance to verticillium wilt and less sensitivity to moisture stress. Several new cultivars of medium to long staple were released in the mid-1990s.

Zimbabwe's cotton breeding approach is to create variability, make single plant selections on field characters such as plant structure, yield, disease resistance and fibre quality, followed by a long testing stage. Variability is achieved by the following: formal hybridization using promising adaptable material and foreign introductions; population breeding involving cycles of intercrossing and selfing; and natural outcrossing and mutations in advanced and promising material (Mudzamiri, 1990). The material is then compared to the current commercial cultivar for 13 field and 9 fibre characters. The Cotton Research Institute has modern facilities for fibre testing. In keeping with changes in the spinning industry where there is a shift from ring to rotor and friction spinning, the cotton breeding research programme in the 1990s shifted to selections towards fine and strong cotton with satisfactory length, elongation and maturity.

Genetic modification

The use of genetically modified organisms has elicited debates in Africa and beyond. In South Africa more than 250,000 hectares was planted to genetically modified crops in 2001 and they accounted for 20 per cent of all cotton seed and 5 per cent of the maize with a variety of biotechnology (Bt) genes (Wilson, 2002). South Africans have further scaled up their biotechnology programmes into oil-seeds, rape, soyabeans, potatoes, tomatoes, apples and eucalyptus trees. In Zimbabwe, however, concerns have been raised by the beef and dairy industries which currently use large volumes of cottonseed cake byproducts from oil extraction. There would be serious ramifications for these industries in the European Union and Asian markets if genetically engineered cotton were grown extensively. This requires that strong labelling for ginned cotton seed is put in place to address market sensitivities in Europe.

The greatest challenge and reasons advanced for the use of biotechnology cotton is with respect to pest control. Trials on using biotechnology cotton were attempted by Monsanto in Zimbabwe but the field trials were destroyed by government because of the absence of a policy on biosafety; this was only concluded in 2001. Zimbabwe is closely following studies in neighbouring South Africa of the introduction of biotechnology cotton (Gregory, *et al.*, 2002) which is said to drastically reduce the use of pesticides thus reducing the exposure of farmworkers to hazardous chemicals and reducing labour losses through ill-health as reported by Maumbe (2001). This is important for farms that experience regular labour problems, especially with spraying that requires more labour hours. Experiments in India, however, showed that biotechnology cotton had numerous disadvantages and all the claims about what it could do proved false in the Indian context (Shiva, 2004). For instance, biotechnology cotton was put to field test on the following bases:

- Pest control – it was found to be susceptible to wild and root rot;
- High yields: – it was claimed it would give 15 quintals per acre but turned out to be just 1.2 quintal per acre;
- Farmers' income – poor yields meant the farmers did not earn enough to cover the costs of labour and the crop was a total failure in economic terms.

This warrants further studies on the potential impact of biotechnology cotton based on the above regimes within the Zimbabwean context.

Entomology research

As soon as cotton was introduced into Zimbabwe, it was apparent that pests were going to be a major constraint on production. This explains why most of the early breeding effort from 1925 to 1955 focused on breeding for insect pest

resistance. Metelerkamp (1988) asserted that the development of effective techniques for the control of insect pests was the most important ingredient for increasing cotton yields in Zimbabwe.¹⁸⁶ Five species of bollworms and several sucking pests are major cotton pests in Zimbabwe.¹⁸⁷

The effective control of red bollworms with chemicals was reported in the late 1950s. In the early 1960s, researchers studied crop damage by bollworms and developed scouting techniques that enabled the timing of sprays to be based on the threshold levels of pest damage (Brettell, 1986). By 1963, tail boom spraying methods and reliable pest control recommendations for red bollworms, spiny bollworms, heliothis and sucking pests had been developed. These developments explained the rapid increase in the cotton production area from the mid-1960s.¹⁸⁸

Red spider-mites can cause up to 40 per cent yield losses. Resistance to demethoate in the late 1960s led to wider testing of acaricides and the development of an acaricide rotation scheme. The acaricide rotation scheme has been in use since 1973/74. The pink bollworm is controlled through a legally-enforced closed season. There are legislated dates for destruction of cotton plants and earliest planting for the lowveld and middleveld.¹⁸⁹

The introduction of pyrethroids into the country in the 1979/80 season enhanced bollworm control as both heliothis and red bollworm could be controlled by one pyrethroid (Brettell, 1986). A strategy has been devised that alternates pyrethroids with organochlorines and carbamates during the season and restricts pyrethroid use to a maximum of nine weeks when both the heliothis and red bollworms are present in large numbers. Only pyrethroids that also suppress red spider-mite are recommended.

Since the early 1960s, recommended pesticide application rates have been conservative, varying quantities with crop growth stage, resulting in pesticide rates being considerably lower than those of other countries (Brettell, 1986). This approach may explain why carbaryl, first used in the late 1950s, is still effective today.

In the late 1980s the entomology research programme added trials on integrated pest control and the simplification of scouting and spray timing for communal farmers. In the 1990s, the research continued with integrated pest control focusing on spray timing and scouting methods for the control of whitefly,

¹⁸⁶ In the commercial farming sector, the average yield increased from 660kg per hectare in 1949/50 to 2110kg per hectare by the 1985/86 season.

¹⁸⁷ See Commercial Cotton Growers' Association (1985) and Brettell (1986) for details.

¹⁸⁸ The early achievements in pest research are reviewed by Gledhill (1979) while Brettell (1986) highlighted the achievements from 1971 to 1986.

¹⁸⁹ The regulations provide for a 65-day 'dead' period during which the pink bollworm should have no living host plants. See Commercial Cotton Growers' Association (1985) for dates and plant destruction details.

red spider-mite and aphids. Work was also initiated on termite control. Another notable addition was work on the leaf miner, covering insecticide evaluation, the effect of planting dates and study of its ecology.

These pest control programmes now need to be augmented by studies on the introduction of biotechnology cotton in neighbouring South Africa (Gregory *et al.*, 2002). Introducing biotechnology cotton could drastically reduce the use of pesticides thus reducing the exposure of farmworkers to hazardous chemicals and reducing labour losses through ill-health, as reported by Maumbe (2001).

Cotton pathology research

The first mention of cotton diseases concerned bacterial bollrot at Kadoma in the 1938/39 season.¹⁹⁰ In 1952, Albar 49 was introduced from Namulonge in Uganda, and was used as a source of bacterial blight (*Xanthomonas malvacearum*) resistance. Other Albar stocks were introduced up to 1954 for that purpose. Plant pathology research was done as part of the cotton breeding programme until 1974. In 1975, breeding programmes selected plants for bacterial blight and verticillium wilt resistance. In the 1976/77 season, *Xanthomonas* race identification work was added to the bacterial blight and verticillium wilt resistance screening programmes. A routine bacterial blight screening procedure had been established by the late 1970s.

In the early 1980s, research continued on verticillium wilt and bacterial blight screening. *Alternaria* leaf spot was becoming a serious cotton disease at this time. The programme expanded to include work on seedling diseases, verticillium wilt and *alternaria* leaf spot surveys by the mid-1980s. At this time verticillium wilt disease levels were increasing in the main cotton areas. This was worrying as K602, recommended for the lowveld, was susceptible to the disease. Attention was given to verticillium wilt following the severe outbreak in the Mazowe valley in the 1988/89 season. Cotton yields were adversely affected and the Cotton Marketing Board and the Cotton Research Institute jointly took steps to contain the problem (Hunting Technical Services, 1991). Strict cotton seed production procedures were put into force.

Cotton pathology research in the 1990–1999 period continued to focus on screening for resistance to verticillium wilt and bacterial blight and the effect of agronomic practices on the incidence of verticillium wilt.

¹⁹⁰ Gledhill (1979) described the early history of breeding for resistance to cotton diseases.

Weed research

Weed control research in cotton has always been conducted and coordinated by the weed research team. Herbicides have been used since the early 1960s to control rapoko grass (*Eleusine indica*) and shamva grass (*Rottboellia cochinchinensis*) (Chivinge, 1985). In 1965, the team concentrated on herbicide and weed biology studies on cotton and the most troublesome annual weeds (Thomas, 1969). By 1987, 16 herbicides were registered for use on cotton. Detailed weed competition studies were conducted in the late 1960s (Schwerzel and Thomas, 1971) and seed viability studies of important weeds were done in the early 1970s.

The weed research team programme consisted of weed biology, herbicide evaluation, systems of weed control and tillage investigations throughout the 1970s. The main challenge for the team was to develop weed control systems for communal farmers that were compatible with soil conservation, reduced labour and limited draught power.

In the 1991–2000 period, weed research at the Cotton Research Institute focused on wide testing of new herbicides and herbicide combinations for different soil types for the control of both grasses and broadleaf weeds. The Commercial Cotton Growers' Association was involved in testing new herbicides, focusing on rates of application and crop phytotoxicity.

Agronomy and physiology research

In the 1930s agronomy research concentrated on soil fertility and cultural control of heliothis bollworm, red bollworm and cotton stainer (Gledhill, 1979). Work on rotations, involving cotton, maize and grass leys, continued in the 1940s and in the late 1950s agronomic work included trials on spacing and fertilizer rates, herbicides and harvesting methods. In the mid-1960s, planting dates for the middleveld were established and work continued on herbicides, seedbed formation, water-planting and ratooning investigations. Research in the 1970s focused on cotton response to spacing, fertilizer levels and time of planting. The fertilizer trials concentrated on nitrogen and potassium application times and rates. Spacing and plant populations for different cotton types and for different planting times were established.

Starting in 1980, agronomy research was extended to the communal lands. It focused on herbicide trials, fertilizer rates, planting on ridges and on flat land, spacing, time of sowing and rotations. Moisture conservation techniques were tested for dryland crops in commercial areas and communal lands. In the 1983/84 season, tied ridges increased yields by up to 52 per cent and potholes by up to 26 per cent. On-station and communal area trials in 1986/87 showed that moisture conservation had the potential to increase seed cotton yields by

about 200kg per hectare. Further research is needed on water conservation techniques and the design of suitable installation equipment (Metelerkamp, 1988).

In the 1990s, the agronomy programme continued to emphasize work on moisture conservation and related tillage practices, including use of permanent structures. Work on manure involved rate and methods of application. Physiological investigations focused on the reproductive development of different cotton varieties and the effects of using the defoliant ethrel on crop yield and fibre quality. Most of the agronomy work was targeting smallholder producers, hence a lot of the trials were on-farm. The Commercial Cotton Growers' Association continued to collaborate with the Cotton Research Institute in agronomy research. Its work centred on drip irrigation, cotton root development studies and split application of a growth regulator, Pix.

Developing support services

Marketing

Almost all cotton produced in Zimbabwe is sold through Cottco and Cargill (a subsidiary of Monsanto) which then sell to the local textile industry and to the export market. Cottco was registered in 1994 as a private company and is the largest buyer, processor and marketer of cotton in southern Africa. Cottco operates depots throughout the cotton-growing areas (figure 17.1). It operates a network of 30 collection, grading and ginning facilities. Cottco has nine ginneries with a combined capacity of 265,000 tonnes in all major small-scale and commercial cotton-growing areas. Cargill is a much smaller company with a private ginnery depot at Triangle in the lowveld which serves as an agent of Cottco. Cargill also established another depot at Tafuna in Shamva district.

Seed cotton is graded for quality on a legislated basis. Grading is done by the Zimbabwe Cotton Corporation whose classifiers evaluate the seed cotton for length of fibre, fineness, strength and character. Seed cotton is downgraded for moisture, soil and leaf staining and for containing trash. After ginning, every bale of lint is sampled and analyzed at both the ginnery and the central quality control facilities in Harare to ensure that it meets the quality required by a particular client. About 90 to 95 per cent of the seed cotton grown in Zimbabwe is handpicked, thus making the lint attractive on the world market (Chavunduka, 1982). The ginned seed contains about 20 per cent edible oil and is sold to oil-expressing concerns for processing into cooking oil, margarine, cooking fats and other products. The residual meal is used in stockfeed manufacture.

There are two major types of cotton grown in Zimbabwe, namely, medium-staple (Albar K502 in the middleveld and Albar 603 in the lowveld) and long-staple (Delmac). Small amounts of middle-length staple (Seltapine) are also grown. Delmac commands higher prices on the world market (Albar – 85c per lb, Delmac – 130c per lb) but has lower yield potential than the Albar

cultivars. The Cotton Marketing Board offers a 25 per cent yield-loss premium on the producer price for Delmac to encourage production of this long-staple cotton (Agricultural Marketing Authority, 1991).

Cotton breeding by the Cotton Research Institute is undertaken to meet international market requirements. There is close liaison between the cotton marketing companies, cotton growers, research and extension services and the Zimbabwe Cotton Corporation in pre-release reviews of new varieties for fibre length and strength, maturity, fineness, spinning performance and uniformity. Selected growers undertake seed multiplication and production of certified seed for the Quton company, a subsidiary of Cottco.

More than 70 per cent of Zimbabwe's lint production is sold in international markets (Cotton Marketing Board, 1990b). About 60 per cent is sold to Eastern Europe (Italy, West Germany and Portugal being the main consumers), 28 per cent to South Africa and the balance to Japan, Hong Kong and Taiwan. The main competitors of Zimbabwe cotton are the United States of America, Uzbekistan, Syria, Pakistan, Sudan, Brazil, Australia and China. Zimbabwe's cotton often gets premium prices on the overseas market because of handpicking and the stringent standards for grading and ginning.

Extension and training

Cotton extension and training services are highly developed and effective. The Department of Agricultural, Technical and Extension Services, the Cotton Research Institute and the Commercial Cotton Growers' Association have an excellent track record of cooperation in extension and training. Starting in 1963, a cotton advisory officer was stationed at the Cotton Research Institute to facilitate liaison between researchers and extension workers (Gledhill, 1979). This arrangement was successful and ensured that extension information was up-to-date.

The main tool for cotton extension in Zimbabwe was the *Cotton handbook* published by the Commercial Cotton Growers' Association. The handbook was compiled by the relevant experts from the former Department of Agricultural, Technical and Extension Services (now the Department of Agricultural Research and Extension), Cottco, the Cotton Research Institute, the agro-chemical companies and the Commercial Cotton Growers' Association staff. Agro-chemical companies also provide technical back-up services to the cotton industry during promotion of their insecticides and herbicides.

The Commercial Cotton Growers' Association established a cotton training scheme at the Cotton Research Institute in the 1971/72 season in recognition of the importance of research, extension and training. Because of the rapid expansion of cotton production and subsequent demand for training, the Commercial Cotton Growers' Association bought a farm adjacent to the Cotton Research Institute in 1979 and established a residential cotton training centre. The

training centre has a commercial training side too and by 1989 the centre had trained 23,631 participants. The centre offers short courses in cotton scouting, picking, pest management and production for professionals, extension workers and farmers. The more advanced courses involve Cotton Research Institute staff in addition to the regular staff. The development of the training centre clearly demonstrates the dividends of coordinated efforts by the research, extension and private sectors.

Seed production

The Quton company is a seed certifying agency under the supervision of the seed services unit of the Department of Research and Specialist Services, which is the overall seed-certifying authority. The company has rights to commercialize varieties developed at the Cotton Research Institute and is mandated to multiply seeds of high quality. At Quton, seed is acid-delinted and fungicide-treated to reduce seed-borne pest and disease infection. Quton contracts growers to produce seed and aims at seed of at least 85 per cent germination (Cottco, 2000). Cottco has always had its own seed inspectors and seed processing plant at Glendale. Zimbabwe cotton growers have generally enjoyed the use of high quality seed except in 1989/90.¹⁹¹ Cotton seed multiplication is done in conjunction with the cotton breeding programme at the Cotton Research Institute.

Access to inputs

Agro-chemical and fertilizer companies have established depots at most growth points in the cotton producing areas and appointed agents at some rural business centres. Farmers can thus procure inputs, as well as get advice on their use, from nearby centres. The major problem for communal farmers has been the late marketing of seed cotton due to transport bottlenecks. This results in late purchase of inputs, late planting and reduced yield-potential.

Understanding the smallholder cotton success story

Zimbabwe has achieved a dramatic increase in cotton production since independence, particularly in the smallholder sector. The communal lands contributed 20 per cent of the national seed cotton production in the 1979/80 season and 80 per cent by 2000.

Areas and yields

The area under cotton in the communal lands increased steadily from 32,400 hectares in 1980 (29 per cent of the total) to 205,607 hectares in 1988 and

¹⁹¹ Poor seed quality resulted in poor crop performance in all sectors and widespread occurrence of verticillium wilt in the 1989/90 season.

326,000 hectares in 1999/2000 (80 per cent of the total). This increase was partly attributed to the resettlement programme which settled 51,000 families on 3.2 million hectares in the 1980s. Resettlement farmers had five hectares of arable land compared with an average of 3.5 hectares in communal lands. Also most of these resettlement schemes were in natural regions III, IV and V where cotton is the only dependable cash crop.

But seed cotton yields declined in the communal lands from 1.1 tonnes per hectare in 1980 to 0.7 tonnes per hectare in 1990. During the same period, the average yield of seed cotton on commercial farms ranged from 1.8 tonnes per hectare in 1980 to 2.6 tonnes per hectare in 1988, with an average of 2 tonnes per hectare. Thus communal land farmers had attained about 30 to 55 per cent of the commercial sector yield. Although most commercial farmers had irrigation facilities, which is critical in dry seasons, it is clear that cotton yields in the communal lands are low. These low yields can be attributed to low levels of inputs, late planting due to late delivery on inputs, poor management and poor growing areas in terms of soils and rainfall.

The marked increase in seed cotton production in the communal lands in the 1980s was a function of an increase in area under cultivation, not higher yields. Zimbabwe has the potential to double its cotton production if communal yields could be raised to those previously enjoyed by commercial farms. Further increases in area under cultivation are likely to be limited.

Support services

At independence, the government targeted cotton for expansion in communal lands for several reasons. Firstly, the crop was already established in these areas as a cash crop before independence and while commercial production of cotton had started to decline around 1978 due to reduced profitability, production was steadily increasing in communal lands. Furthermore, cotton was the only viable cash crop in most communal lands of marginal rainfall. Finally, the cotton industry, due to its diversity, had the potential to create many job opportunities and earn the country significant foreign exchange.

The government's 1980 'growth with equity' policy concentrated on the development of rural areas with emphasis on improving communal agriculture (Chavunduka, 1982). The implementation of the policy led to the expansion of infrastructure in rural areas including schools, clinics, roads, dams, rural business centres and 'growth points'. Communal farmers were given increased access to credit and the government and ruling party machinery mobilized people to increase agricultural production.

The development of the infrastructure attracted agro-chemical and fertilizer companies to open depots at rural business centres, in essence bringing inputs and technical advice nearer to the farmer. Several companies also developed one-acre (0.4 ha) packs of all required inputs for cotton production. The

Department of Agricultural and Technical Extension Services and the Cotton Training Centre played a significant role in cotton extension. The Department of Agricultural and Technical Extension Services sent its own staff on courses and selected growers with leadership ability and influence to attend cotton production courses at the training centre. These growers in turn passed the knowledge and skills on to their neighbours. Crop competitions were used by extension services and agro-chemical companies to improve production so the expanded extension effort created farmer confidence in cultivating an otherwise specialized and demanding crop.

Cottco is one of the key organizations responsible for the expansion of cotton production by communal farmers and provides seed and purchases, processes and markets most of the seed cotton. The company expanded its operations and opened nine transit depots in the main cotton-growing areas of the country in the 1980s. In the 1990s Cottco assisted 86,426 growers in the 1995/96 season with inputs worth Z\$165 million, of which Z\$105 million was allocated to smallholder farmers. Also in the 1995/96 season, the company started a farm-gate scheme to assist growers who had transport problems and also to protect them against unscrupulous middlemen. By 2000, the company had 26 depots in major cotton producing areas. In the 1997–2000 period, the company upgraded its ginning facilities and set up three new ginneries at Bindura, Muzarabani and Gokwe.

Prior to 1980, the Cotton Research Institute research was geared towards commercial farming area cotton production. Since independence, the institute has increased its emphasis on the communal sector. On-farm research was initiated in the Gokwe and Sanyati districts. Communal lands research has become a permanent feature of the Cotton Research Institute programme. It is focused on pest control and moisture conservation which are potential areas for raising cotton yields in communal lands.

Current issues

The government strengthened the prime movers for the cotton industry through improved rural infrastructure, expanded extension and research, liberalized cotton marketing activities, and increased access to credit by communal farmers. These activities stimulated interest in cotton and led to a dramatic increase in the area under cotton production by communal farmers in the 1980s. But cotton yields on communal farms have been about half those on former commercial farms. The challenge for the 1990s was to develop technologies that were simple and appropriate for smallholders and suitable for the marginal environments where cotton was being grown. The problem of low yields remains the challenge for the first decade of the twenty-first century. Specialized extension efforts are needed in pest control and moisture conservation to im-

prove farmer management levels and improve natural resource management.

The cotton industry faces some other major challenges (Hunting Technical Services, 1991). There is need for a levy on producers to increase funding for cotton research and training since, by 1990, only 569 commercial farmers belonging to the Commercial Cotton Growers' Association paid a levy of 1 per cent. This number has drastically reduced since most large-scale commercial farms were acquired for resettlement. Yet, since this represents only a fraction of the more than 200,000 registered growers, there is scope for raising significant revenue through a small blanket levy. Working out an effective mechanism to effect the collection, however, will be another challenge.

The availability of locally-produced polypropylene grain bags is of major concern to the cotton industry. If these bags are used for picking cotton, the plastic fibres may contaminate the cotton and eventually ruin lint produced from it (Modern Farming Publications, 1989). The presence of polypropylene fibres in the lint can threaten the export market so a major education campaign is necessary to alert farmers to this issue.

Shortage of transport affects the timeliness of input delivery and the sale of the seed cotton, often resulting in late planting and lower yield-potential. This affects communal farmers as they depend on seasonal sales to purchase inputs for the next season. Transport shortages have resulted in farmers being overcharged by as much as three to ten times the rates negotiated by the cotton marketing companies. Transport shortages also expose farmers to side marketing, which erodes their income. Transport availability is vital to maintain producer confidence in the communal farming sector as this sector has the greatest potential for further development of the cotton industry. The Cottco farm-gate collection scheme is a timely intervention and needs to be expanded.

Future breeding efforts must aim at germplasm that will improve yields and maintain the quality acceptable to the textile industry. There is need to develop cultivars that can be grown above 1,250m, varieties with higher ginning out-turns and perhaps shorter duration cultivars more suited to natural regions IV and V to avoid the risk of lint with short immature fibres. A long-staple cultivar with better yield and disease resistance than Delmac is needed. All cultivars need to be resistant to the major pests and diseases and entomology research must continue to develop simple pest scouting procedures to enhance insect control and reduce spraying costs in communal lands. Efforts to identify less poisonous chemicals must be made to safeguard the users and the environment.

There is need to develop cotton production systems that reduce soil erosion since most future expansion of cotton production by communal farmers is likely to be on sandy soil in the drier parts of the country (natural regions III, IV and V). Poor soil cover and rainfall in heavy falls, common in those ecologies, accelerate land degradation. More research is also needed to develop water

conservation techniques for natural regions IV and V.

Economic analysis should be made to evaluate current and future technologies while market research is necessary to identify new markets and ways of selling cotton lint to best advantage. The liberalization of cotton marketing through privatizing the Cotton Marketing Board and allowing competition have created room for more efficient marketing of cotton lint, thus addressing earlier concerns (Hunting Technical Services, 1991).

Conclusion

Zimbabwe's cotton success story is about the prime movers, enlightened government and private sector cooperation and coordination and hard work over five decades in creating the preconditions – technical, institutional and policy-related – to achieve an outstanding cotton success story. The period from 1920 to 1950 laid the technical foundation of the cotton industry through basic studies in breeding and agronomy studies to control pests and manage soil fertility. These achievements were spearheaded by researchers at the cotton breeding station in Kadoma over a period of three decades, much the same length of time that it took to develop the famous SR52 hybrid maize variety (1932–1960).

The starting point in the cotton industry, in terms of higher yields and increased production, started in the early 1950s with the introduction of the Albar germplasm from Uganda and the promotion of insecticide pest control methods in the early 1960s. Cotton production was further boosted with the formation of the Cotton Marketing Board in 1969 which facilitated seed production, cotton marketing and general coordination of the cotton subsector. Stringent cotton grading standards by the Cotton Marketing Board were responsible for Zimbabwe's strong position in the international market. These are still being maintained by the major marketing companies, Cottco and Cargill, since Zimbabwe's crop has to maintain its position in the international market on the basis of high quality.

Research advances in the 1970s included the control of major pests, notably the red spider-mite, with the development of the acaricide rotation scheme. Pyrethroids were introduced in the 1980s to improve the control of bollworm and red spider-mite. The 1980s also witnessed the establishment of the Cotton Training Centre which has been the cornerstone of cotton production training at multiple levels. The advent of independence in 1980 introduced changes in policy which brought communal farmers into cotton production as they gained access to credit, enjoyed expanded extension and marketing services, and improved infrastructure in rural areas.

The cotton industry in Zimbabwe is well served in the areas of crop research, marketing and producer training. The commodity research approach

has worked well and should be continued. The research work over the years has benefited from 'intelligent technology borrowing' by importing germplasm and interaction with visiting scientists. For example, the development of appropriate spraying systems was carried out by visiting scientists. A fairly sophisticated fertilizer and agro-chemical network exists in the country to provide the necessary inputs and advice. The major marketing organizations have also devised novel schemes of input supply and farm-gate collection which protects smallholder farmers from exploitation by middlemen.

Nevertheless, a number of important problems face Zimbabwe's cotton industry. The performance of the subsector could be enhanced by the creation of an independent cotton training research institute with both public and private sector funding. Farmers will continue to receive close to world prices if competition in the local market is encouraged as explained by Muir-Leresche and Muchopa (chapter 13). Adequate foreign currency should be allocated to the subsector and funding for research and extension should be increased through a levy imposed on all registered cotton growers. Adequate emphasis must be put on environmental conservation to avoid soil erosion and chemical pollution. Improved transport services are needed to facilitate timely planting and delivery of inputs and produce.

The local cotton industry and relevant government departments need to critically analyze the adoption and performance of biotechnology cotton in South Africa (Gregory, Stewart and Stravrous, 2002), with a view to possibly benefiting from increased yields and reduced environmental and health problems from heavy spraying of toxic pesticides. Maumbe (2001) also stresses the effect of indiscriminate use of pesticides on the health of the farmers, and has suggested strategies and solutions to this problem.

References

Agricultural Marketing Authority, *Cotton situation and outlook report 1989/90*, Harare, 1990.

– *Cotton situation and outlook report 1990/91*, Harare, 1991.

Brettell, J. H., 'Some aspects of cotton pest management in Zimbabwe', in *Zimbabwe Agricultural Journal*, 83(2):41–46, 1986.

Chavunduka, G. L. (chairperson), *Report of the commission of inquiry into the agricultural industry*, Government of Zimbabwe, Harare, 1982.

Chivinge, O. A., 'Weed control in cotton (*Gossypium lirsutum* L.) in Zimbabwe', paper presented to the '105th Biennial Weed Science Society of Eastern Africa' meeting, Nairobi, 1985.

Commercial Cotton Growers' Association, *Cotton handbook*, 1985.

– *Research report, 2000/2001*.

– *Annual reports, 1996, 1997, 2000/2001*.

- Cotton Company of Zimbabwe (Cottco), Information sheet, Harare, 2000.
- Cotton Marketing Board, *Cotton On*, Harare, 1990a.
– *The Cotton Marketing Board of Zimbabwe*, Harare, 1990b.
- Cotton Training Centre, *Cotton course handbook*, sixth edition, Harare, 1992.
- Cotton Research Institute, Annual reports 1990–1994, Department of Research and Specialist Services, Harare, 1990–1994.
- Gleahill, J. A., ‘The Cotton Research Institute of Gatooma’, in *Rhodesia Agricultural Journal*, 76(3): 103–118, 1979.
- Gregory, P., R. Stewart and S. Stravrous, ‘Adoption of Bt cotton by small-scale farmers in South Africa’, in *Pesticide Outlook* (February): 31–34, 2002.
- Hunting Technical Services Limited, *Cotton subsector study*, Ministry of Lands, Agriculture and Rural Resettlement, Harare, 1991.
- Imani Development, ‘Cotton marketing assessment and baseline marketing study for Zimbabwe’, report submitted to Rates Centre, Nairobi, Kenya, 2003.
- Lele, U., N. Van de Walle and M. Gbetibouli, *Cotton in Africa: an analysis of differences in performance*, MADIA discussion paper 7, World Bank, Washington DC, 1989.
- Maumbe, B. M., ‘Essays on the economics of cotton production in Zimbabwe: Policy implications for technology adoption, farmer health and market liberalization’, pages 157–163, PhD dissertation, Michigan State University, East Lansing, 2001.
- Metelerkamp, H. R. R., ‘Review of crop research relevant to the semi-arid areas of Zimbabwe’, pages 228–234 in *Cropping in the semi-arid areas of Zimbabwe*, proceedings of a workshop held in Harare 24–28 August 1987, Department of Agricultural and Technical Extension Services, Harare, 1988.
- Modern Farming Publication Trust, *Cotton in commercial agriculture in Zimbabwe*, Modern Farming, Harare, 1989.
- Mudzamiri, P., ‘Cotton breeding in Zimbabwe’, Cotton Training Centre, Kadoma, 1990.
- Schwerzel, P. J. and P. E. L. Thomas, ‘Weed competition in cotton’, in *PANS*, 17(1):30–34, 1971.
- Shiva V., ‘Force-feeding GMOs to the poor: Sending GMOs to starving people is ‘inhuman aid’, in *Humanitarian Review*, 2004, <http://www.humanitarian-review.org>.
- Shumba, E. M., ‘Crop production under marginal communal area environments’, in *Zimbabwe Science News*, 19(3/4): 39–43, 1985.
- Thomas, P. E. L., ‘Background to weed research and in particular weed biology studies at Henderson’, Weed Research Team, Mazowe, 1969.

Vaughan-Evans, R. H., 'Economics of cotton', handout, Cotton Training Centre, Kadoma, 1990.

Weinmann, H., *Agricultural research and development in Southern Rhodesia 1890–1923*, Occasional Paper No. 4, Department of Agriculture, University of Rhodesia, Salisbury, 1972.

– *Agricultural research and development in Southern Rhodesia, 1924–1950*, Series in Science No. 2., Department of Agriculture, University of Rhodesia, Salisbury, 1975.

Wilson, J., 'Country report on the organic cotton project in Zimbabwe within the context of the whole cotton industry', a report for PAN United Kingdom's Pesticides and Poverty project, Harare, 2002.



This work is licensed under a
Creative Commons
Attribution – NonCommercial - NoDerivs 3.0 License.

To view a copy of the license please see:
<http://creativecommons.org/licenses/by-nc-nd/3.0/>

This is a download from the BLDS Digital Library on OpenDocs
<http://opendocs.ids.ac.uk/opendocs/>