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COTTON RESEARCH & DEVELOPMENT CORPORATION

FINAL REPORT

OVERSEAS TRAVEL

ATTENDANCE AT BELTWIDE COTTON CONFERENCES & VISIT TO BELTSVILLE AGRICULTURAL RESEARCH CENTRE

DAN 65C

January, 1992

STEPHEN J. ALLEN

NSW AGRICULTURE

Cotton Research & Development Corporation
FINAL REPORT

OVERSEAS TRAVEL

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TRAVEL DATES	:	5-19th January, 1992

OBJECTIVES OF VISIT:

* To attend the 1992 Beltwide Cotton Production Research Conferences organised by the National Cotton Council of America which included the 52nd Cotton Disease Council.

* To review the latest developments in the biocontrol of seedling diseases and verticillium wilt of cotton with colleagues at the USDA 'Biocontrol of Plant Diseases' laboratory at Beltsville

ITINERARY

5 January	-	Brisbane - Los Angeles - Nashville
6-10 Jan	-	Beltwide Conferences
11 Jan	-	Nashville - Washington
13-14 Jan	-	Beltsville biocontrol Lab
17-19 Jan	-	Washington - Los Angeles - Brisbane

HIGHLIGHTS

* presentation of a paper entitled "The distribution, importance and control of diseases of cotton in Australia" to the 52nd Cotton Disease Council

* presentation of a seminar entitled "Seedling Diseases and Verticillium Wilt of Cotton in Australia - potential for biocontrol" to staff of the 'Biocontrol of Plant Diseases' laboratory at the Beltsville Agricultural Research Centre.

* participation in two days of presentations devoted entirely to cotton pathology at the Beltwide cotton conferences including papers on verticillium wilt (6), seedling diseases (10), biocontrol (4), nematodes (10), bacterial blight (2), fusarium wilt (2) and cotton rust (1).

FINANCIAL SUMMARY

All expenses were met from funds approved and allocated under the Cotton Research & Development Corporation Travel Grant - DAN 65C. No other funds were available and Departmental approval for travel was given on the condition that there would be "No cost to the state other than the Officer's salary".

ITEM	Budget estimate	Actual expenditure
Air fares (economy class)	$3156	$2583.00
Narrabri - Brisbane return	-------	$ 228.14
Sustenance (accom. +US$67/day)	$2300	$2198.56
Conference Registration & Dinner	$ 130	$ 125.70
Misc.(Insur., Med., Depart. tax, etc)	$ 250	$ 245.40
TOTAL	$5836	$5380.80

To be returned to Cotton R & D Corporation $455.20

RECOMMENDATIONS

1. More cultures of *Verticillium dahliae* should be sent to Dr Al Bell at the USDA, College Station, Texas to further confirm the unique cotton-verticillium strain situation that appears to exist in Australia.

2. Renewed emphasis should be made on the importance of Quarantine in preventing the introduction of the severe defoliating strains of *Verticillium dahliae*.

3. Methods of breeding/selecting for improved seed and seedling vigour should be considered as an effective means of reducing the incidence and importance of seedling diseases.

4. Low rates of fungicide could be considered in combination with biocontrol agents in order to improve efficacy and reliability.

5.The Beltwide Cotton Conferences provide an ideal opportunity to revue current research progress in cotton pathology. Participation in these conferences on a regular basis (every third or fourth year) would be advantageous.

6. Relevant sections of the Australian Cotton Industry should be made aware of the Beltwide Conferences and copies of the Proceedings should be made more widely available.

ATTENDANCE AT THE BELTWIDE COTTON CONFERENCES:

The Beltwide Cotton Conferences are held annually and bring together all people working on the various aspects of cotton production and processing from throughout the USA and also from overseas. The Cotton Disease Council meets for two days as part of the Beltwide conferences and receives reports from sub-committees including 'the Bacterial Blight Committee', 'the Seed Treatment Committee', 'the Soil Fungicide Committee', 'the Verticillium and Fusarium Wilt Committee',etc., etc. These reports summarise current research and provide a basis for the presentation of numerous research papers. The proceedings of the 1992 conferences have been published in three volumes totalling over 1500 pages. *A copy of the 'Table of Contents' is attached to this report.*

I presented a paper (*copy attached*) entitled "The distribution, importance and control of diseases of cotton in Australia" to the Cotton Disease Council and attended sessions on verticillium wilt of cotton, biocontrol of seedling diseases, breeding for disease resistance, nematodes, potassium deficiency syndrome etc.

PAPERS OF PARTICULAR INTEREST

Verticillium wilt

Neck, J. S. & Bell, A. A. Vegetative compatibility groups in *Verticillium dahliae*: Isozyme differences among groups. Vol.1 p195

Bell, A. A. Vegetative compatibility groups in *Verticillium dahliae*: Virulence to cotton. Vol.1 p195

Mace, M. E. & Stipanovic, R. D. Toxicity of terpenoid phytoalexins: effects on the plasmalemma of *Verticillium dahliae*. Vol.1 p196

Paplomatas, E. J.; Bassett, D. M.; Broome, J. C. & DeVay, J. E. Predictability of yield losses in cotton caused by verticillium wilt based on cultivar responses and inoculum density of *Verticillium dahliae* in field soils. Vol.1 p196

Oakley, S. R. Breeding for verticillium wilt resistance in California Acalas. Vol.3 pp1335-1336.

Bell, A.A.; Mace, M. E. & Stipanovic, R. D. Biochemical mechanisms of disease resistance in cotton: Applications to breeding. Vol.3 pp1337

Seedling Diseases

Bourland, F. M. Characterisation and improvement of seed and seedling vigour in cotton. Vol.3 pp1326-1329.

El-Zik, K. M. & Thaxton, P. M. Breeding for resistance to seed-seedling and bacterial blight diseases of cotton. Vol.3 pp1330-1334.

Baldwin, C. H. EXP10100D: a new fungicide for cotton seedling disease control. Vol.1 p47

Hagedorn, C.; Bourland, F. M. & Rothrock, C. S. Repression of seedling disease pathogens by amended bacteria and cotton genotypes. Vol.1 pp177-178.

Kaufman, H. W. & Supak, J. R. Effect of seed treatments and in-furrow fungicides on incidence of cotton seedling disease. Vol.1 pp179-180.

DeVay, J. E.; Garber, R. H.; Wakeman, R. J.; Paplomatas, E. J.; Weir, B. L.; Vargas, R.; Wright, S.; Munk, D. & Howell, C. R. Chemical and biological seed treatments and cotton cultivars for the management of seedling diseases. Vol.1 p197

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Sciumbato, G. L. & Ebelhar, M. W. Effects of starter fertiliser sources on cotton seedling diseases and in-furrow fungicide applications. Vol.1 p199

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Biocontrol

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Bacterial Blight

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Mueller, J. D. & Martin, S. B. Host suitability and yield losses associated with Columbia lance, reniform and root knot nematodes. Vol.1 p202

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VISIT TO BELTSVILLE AGRICULTURAL RESEARCH CENTRE - BIOCONTROL OF PLANT DISEASES LABORATORY:

The United States Department of Agriculture - Beltsville Agricultural Research Centre is internationally renowned and includes the 'Biocontrol of Plant Diseases Laboratory' formerly the 'Soil-borne Diseases Laboratory' now being directed by Dr Bob Lumsden. This group are actively working and publishing on the biocontrol of soil-borne diseases caused by Verticillium, Fusarium and Sclerotinia.

I presented a seminar entitled "Seedling Diseases and Verticillium Wilt of Cotton in Australia - potential for biocontrol" and had discussions with Dr Bob Lumsden and Dr Deborah Fravel who has worked extensively on the biocontrol of verticillium wilt in egg plants and potatoes.

Dr Bob Lumsden

* Dr Lumsden had just replaced Dr George Papavizas who had retired from the position of Director at the Biocontrol of Plant Diseases Laboratory.

* The most recent success of the Lab has been the registration of GL 21 for disease control in nursery horticultural crops. GL 21 is based on an isolate of the fungus - *Gliocladium virens*.

* Work with *Pseudomonas cepacia* for the biocontrol of seedling diseases was stopped as a result of the capacity of the organism for "opportunistic attack of humans" - despite encouraging results.

Dr Deborah Fravel

* *Talaromyces flavus* is still giving good results in biocoontrol of verticillium wilt of eggplant.

* Those who requested cultures of *Talaromyces flavus* from Dr Papavizas were sent cultures of the T4 strain - while those who requested cultures of *Talaromyces flavus* from Dr Fravel were sent cultures of the T1 strain. The T1 strain was much better than the T4 strain.

* There has been several years of work with *T. flavus* for the control of verticillium wilt of potato. Results have been encouraging but not significant.

* When *T. flavus* was applied with bran there was a huge increase in bacterial saprophytes resulting in lower disease suppression than in the untreated control treatments.

* Considerable interest now in the combination of a biocontrol agent and a sub-lethal application of Vapam (Vapam is a soil fumigant used in some crops in the USA).

* Kodak have dropped the development of the *Trichoderma harzianum* plus solid matrix priming for seedling disease control despite getting registration. No-one else has taken up the product.

THE DISTRIBUTION, IMPORTANCE AND CONTROL OF DISEASES OF COTTON IN AUSTRALIA.

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Abstract

Regular disease surveys of commercial crops in all cotton growing areas of New South Wales have monitored the relative importance and distribution of those diseases present. Bacterial blight, which was causing severe losses, has been controlled in susceptible cultivars by the development and implementation of a seed scheme to reduce the level of seed infestation. Blight resistant cultivars have also been released and widely adopted. The increased adoption of reduced tillage practices and the reliance on very susceptible cultivars coupled with conducive weather conditions have resulted in a significant increase in the incidence and importance of verticillium wilt. A cultivar with some resistance to verticillium wilt has just been released. The control of seedling diseases has relied on fungicide seed treatments with very little use of 'hopper-box' or 'in-furrow' treatments. Phytophthora boll rot and black root rot have only been reported in Australia in recent years.

Many of the diseases considered important in other cotton growing areas of the world are not present in Australia and the exclusion of these diseases by effective quarantine is important.

Introduction

Australian cotton growing areas are situated in association with inland river systems in the states of New South Wales (74%) and Queensland (26%). Approximately 84% of the 677,000 acres of cotton grown in Australia in the 1990/91 season was furrow irrigated. The crop is normally planted in late September and October and harvested in April and May. Monthly rainfall in excess of 4 inches is common during the cotton growing season.

Commercial crops in all cotton growing areas of New South Wales are inspected in November and March of each season and information on disease incidence, field history, ground preparation, cultivar, planting date, seed rate and trash carryover is collected for inclusion in a database. Between 80 and 100 fields are inspected in each survey. Such information provides an indication of the relative importance of the various diseases of cotton and the effects of various cultural practices on disease development.

The cotton pathology program at the Narrabri Agricultural Research Station services the entire Australian cotton industry. Current research projects are concentrating on cultural and biological methods for the control of verticillium wilt, stand establishment, bio-control of seedling diseases and the importance of mycorrhizas in early season plant growth.

Bacterial Blight

Bacterial blight of cotton caused by Xanthomonas campestris pv. malvacearum (Smith) Dye used to be recognised as the most widespread and important disease of cotton in Australia. The disease was present in all crops including all nursery and pure seed crops. The average incidence of blight on bolls was approximately 20% during the seasons from 1984/85 through to 1987/88 (Table 1) with up to 60% of bolls being infected in some crops. Growth chamber tests using standard differential cultivars showed that Race 18 of the pathogen was predominant (3). Results obtained from the disease surveys and from tests on commercial seed lots showed that infested seed was the major factor in the epidemiology of the disease (Table 1).

In 1985, in response to the severe losses being experienced by growers, Cotton Seed Distributors Ltd (a grower-controlled company that was responsible for the production of all cotton planting seed in Australia) co-ordinated the formation of the 'Blight Investigation Group' with the objective to "reduce the level of blight infestation of planting seed to less than 0.03% within 5 years". A seed scheme was developed and implemented in order to achieve this objective.

This scheme included the following:

(i) the isolation of cultivar nurseries from susceptible commercial crops,
(ii) the use of copper sprays in cultivar nurseries to reduce the spread of the disease early in the season,
(iii) the location of pure seed production areas in drier western areas,
(iv) blight assessments on pure seed crops and the use of blight incidence and severity as a criteria for rejection of crops from the pure seed production program,
(v) the processing of blight-immune cultivars through gins prior to the processing of seed cotton of susceptible cultivars for planting seed production ('gin sweeping'), and
(vi) the storage of seed for one season prior to planting.

The success of the scheme has been monitored by testing the level of seed infestation in commercial seed lots and by blight assessments during the disease surveys. The percentage of planting seed infested with the blight pathogen has decreased from 12.0% in 1985/86 to 0.016% in 1990/91. Consequently the mean incidence of blight on seedlings and bolls in commercial cotton crops has been reduced from 10.13% to 0.04% and from 19.56% to 0.29% respectively during the same period. The 'Blight Investigation Group' goal was achieved (Table 1) and the disease was not observed at all during the November 1991 survey.

Bacterial blight was a major factor in the rapid decline in popularity of the Deltapine cultivars which are susceptible to the disease. Australian cultivars with immunity to blight derived from Tamcot SP37 were released in the 1985/86 season and now account for approximately 80% of the Australian cotton growing area.

Verticillium Wilt

Verticillium wilt has been recognised as an important disease of cotton in Australia for many years, especially in the older established cotton growing areas. However, in recent years there has been an alarming increase in the incidence of this disease (Table 2). Possible reasons for this increase include: the increased adoption of reduced tillage practices and permanent bed systems; the use of very susceptible cultivars; a sequence of three wet winters which have prevented the early incorporation of crop debris and the occurrence of cool weather periods during summer.

The virulence of American and Australian isolates of the verticillium wilt pathogen have been compared previously (5) and all of the Australian isolates that were tested were found to be similar to what was described as the 'mild nondefoliating SS-4 strain'. Despite this 'mild' classification yield reductions of up to 20% have been observed.

A verticillium nursery has been established at the Narrabri Agricultural Research Station using gin trash from modules harvested from cotton fields with a high incidence of verticillium wilt. This site is now being used to (i) evaluate cultural control practices, (ii) compare the resistance of current commercial cultivars and (iii) screen new breeding lines for resistance to the disease. CSIRO (Commonwealth Scientific and Industrial Research Organisation) cotton breeders have just released the cultivar 'Sicala V1' which is significantly more resistant to verticillium wilt than the current commercial cultivars (Table 3). Sicala V1 has been shown to yield better than other commercial cultivars when the incidence of verticillium wilt is high. When the disease is not present Sicala V1 does not yield as well as other commercial cultivars.

Field experiments are currently evaluating stalk-pulling, raking and burning, cultivation to incorporate crop debris, a cereal-soybean double crop rotation and the use of the more resistant cultivar Sicala V1 in comparison with the standard practice of slashing followed by a cereal fallow rotation with reduced tillage on permanent beds and use of a susceptible cultivar. Stalk-pulling, raking and burning has become increasingly popular in recent years.

Seedling Diseases

The activity of seedling disease pathogens and soil-inhabiting insects often results in poor stand establishment. During a disease survey in commercial fields it is difficult to distinguish between the effects of this activity and losses due to seed that is not viable. Consequently, seed/seedling mortality has been estimated by comparing the seeding rate (seeds/ft) used by the grower with the number of plants established (plants/ft). A significant component (10-20%) of this mortality is related to the seed viability. The results indicate that seed/seedling losses have varied from 33.4% in the 1990/91 season to 49.7% during the 1987/88 season. Large areas of cotton needed to be replanted in the 1987/88 season. A recent study (4) has shown that Rhizoctonia solani Kuhn and Pythium ultimum Trow. are the pathogens most commonly involved in cotton seedling disease in Australia.

The standard seed treatment currently in use is a combination of pcnb, metalaxyl and thiodicarb. The application rate being used for pcnb as a seed treatment in Australia is approximately 60% of the recommended rate in the USA. Annual seed treatment evaluations have shown that triadimenol and tolclofos methyl are comparable in efficacy to pcnb. The use of fungicides as 'hopper-box' or 'in-furrow' treatments is not common although there has been an increased interest in these methods of application in the last two years.

Phytophthora Boll Rot

Phytophthora boll rot caused by Phytophthora nicotianae Breda de Haan var. parasitica (Dastur) Waterh. was first reported in Australia in 1986 (2). The disease develops when a period of wet weather coincides with the approaching maturity of low bolls (ie. rainfall in February). Soil containing the pathogen is splashed up onto the lower bolls and infection takes place. Losses of up to 26% have been observed under favorable conditions although the incidence of the disease is generally low (Table 4). Cultivars with bolls on low hanging branches are more prone to the disease than cultivars which produce bolls on shorter branches close to the stem. A dense, even crop canopy can minimise soil splash onto low bolls.

Minor Diseases of Local Importance

Black Root Rot

Black root rot of cotton caused by Thielaviopsis basicola (Berk. & Br.) Ferraris was first reported on cotton in Australia in 1990 (1). The disease has only been detected in cotton crops on eight farms in New South Wales and one farm in Queensland. Over 90% of plants were infected in two adjacent fields on a farm near Narrabri in the 1990/91 season. The efficacy of triadimenol as a fungicide seed treatment for the control of black root rot in Australia is being evaluated.

Alternaria Leaf Spot

Alternaria leaf spot (Alternaria macrospora Zimm.) causes severe defoliation in cotton grown on less fertile soils when the crop is exposed to extended periods of wet weather. These conditions occasionally occur in some Queensland cotton growing areas. Plants senescing prematurely as a result of Potassium deficiency appear to be most susceptible. The disease is rarely observed in New South Wales.

Nematodes

Soil and root samples were collected from irrigated cotton fields with a long history of cultivation so that nematodes, if present, could be detected. Collections were made in both the 1987/88 and 1988/89 seasons from all cotton growing regions of the state. Despite the common occurence of non-parasitic nematodes the numbers of parasitic nematodes were found to be insignificant.

Quarantine

The relative youthfulness of the Australian cotton industry and its isolation from other cotton growing areas has resulted in freedom from many of the diseases that cause concern in other parts of the world. Those diseases not present in Australia include: fusarium wilt, phymatotrichum root rot, rusts, virus diseases, the severe defoliating strains of V. dahliae and the African races of the bacterial blight pathogen. It is important that our quarantine precautions continue to exclude the pathogens that cause these diseases.

Acknowledgements

The financial support of the Australian Cotton Research & Development Corporation is gratefully acknowledged.

References

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Table 1. The percentage of planting seed infested with the blight pathogen and the incidence of blight(%) on seedlings and bolls in commercial Deltapine cotton crops 1984/85 - 1990/91 (NSW only).

Season	84/85	85/86	86/87	87/88	88/89	89/90	90/91
in planting seed	3.30	12.00	2.10	0.95	0.25	0.29	0.016
on seedlings	3.00	10.13	17.11	2.67	0.21	0.35	0.04
on bolls	23.76	19.56	19.68	22.66	7.96	8.02	0.29

Table 2. The mean incidence of verticillium wilt of cotton(%) in commercial fields for the seven seasons from 1984/85 through to 1990/91 as assessed prior to harvest in March of each season (NSW only).

	84/85	85/86	86/87	87/88	88/89	89/90	90/91
Incidence (%)	4.1	4.7	4.1	5.3	9.9	16.5	10.2

Table 3. The incidence of verticillium wilt(%) in five field experiments comparing the resistance and/or susceptibility of cotton cultivars to the disease.

	field experiment				
Cultivar	(i)	(ii)	(iii)	(iv)	(v)
DPL 90	57.7	73.4	92.9	44.3	46.6
Siokra 1-4	68.9	85.0	97.4	61.3	58.5
Sicala 33	48.0	84.8	98.0	63.2	57.3
Sicala V1	19.5	41.4	74.3	35.3	28.2
Acala 1517	-	-	83.0	-	-
L.S.D.	12.12	8.0	8.05	8.8	11.5

Table 4. The mean incidence of phytophthora boll rot in commercial cotton crops in New South Wales from 1987/88 to 1990/91.

Season	Mean incidence	Range	February rainfall[1]
1987/88	0.85%	0-10%	3.8 in.
1988/89	0.11%	0-3%	0.7 in.
1989/90	2.67%	0-26%	6.3 in.
1990/91	0.48%	0-11%	2.2 in.

[1] at Narrabri Agricultural Research Station

Price $50.00
per set

1992 PROCEEDINGS BELTWIDE COTTON CONFERENCES

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- Pictorial Highlights
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- New Developments from Industry
- Cotton Physiology Seminar
- Beltwide Cotton Production Conference
- 52nd Cotton Disease Council
- 16th Cotton Dust Research Conference
- 16th Cotton Economics and Marketing Conference
- 21st Cotton Engineering-Systems Conference

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- 44th Cotton Improvement Conference
- 45th Cotton Insect Research and Control Conference
- 4th Cotton Quality Measurement Conference

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- 9th Cotton Soil Management and Plant Nutrition Conference
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- 16th Cotton Weed Science Research Conference
- Joint Meeting: Cotton Disease Council and Cotton Improvement Conference
- Joint Meeting: Cotton Engineering-Systems Conference and Cotton Physiology Conference
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- Joint Meeting: Cotton Textile Processing and Cotton Quality Measurement Conference
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Editorial Coordinator: Douglas J. Herber
Asst. Editorial Coordinator: Deborah A. Richter

National Cotton Council of America

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