COTTON RESEARCH AND DEVELOPMENT CORPORATION

FINAL REPORT

"Travel: to attend the 11th Biennial Conference of the Australasian Plant Pathology Society"

DAN115C

July 1997 to June 1998

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NSW AGRICULTURE

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Cotton Research and Development Corporation

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CONFERENCE TRAVEL

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TRAVEL DATES	**24 September - 3 October 1997**

OBJECTIVES OF TRAVEL

To attend the 11th Biennial Conference of the Australasian Plant Pathology Society (APPS), present a paper on recent research from CRDC Project DAN100C and attend a practical workshop on disease management at the conference. To meet and interact with leading pathologists and mycorrhizologists from the Australasian region.

ITINERARY

24 September	Narrabri - Sydney - Perth
25-26 September	Workshop on VAM fungi, University of WA
27 September	Transfer to conference venue
28 September	Workshop on Rhizoctonia
29 September - 2 October	APPS Conference
3 October	Perth - Sydney - Narrabri

HIGHLIGHTS

* Participation in a Workshop on VAM fungi held at the University of Western Australia and conducted by Dr Chris Walker from the UK.

* Participation in a Workshop on Rhizoctonia diseases.

* Participation in a Conference, with approximately 300 delegates from the Australasian region and elsewhere, addressing all aspects of plant pathology in the Australasian Region.

* Presentation of a paper (see attached) entitled "Plant-microbe-soil interactions in a soilborne disease of cotton" .

* Papers presented by, and opportunities for discussions with, other pathologists and mycorrhizologists.

FINANCIAL SUMMARY

Item	Expenditure
Air Fares (Economy Class)	
NBRI-SYD - PERTH (return)	911.40
Registration Fees	410.00
Subsistence	
9 days 11 hours @ 120.45 per day	1139.26
Other	
Workshop: disease resistance	70.00
TOTAL[z]	2530.66

[z]Attendance at an unplanned workshop on VAM at UWA required an extra day of subsistence. Consequently the total expenditure was $67.66 greater than the original budget estimate of $2463.00. The excess of $67.66 was charged to subsistence in Project DAN100C.

SIGNIFICANT ITEMS

1. The original itinerary included a one day visit to the VAM laboratory at the University of Western Australia for discussions with Dr Lynette Abbott. Dr Chris Walker from the UK happened to be visiting the VAM laboratory and kindly offered to run a two day workshop on isolation, culture and identification of VAM fungi, at no cost. This workshop provided valuable practical experience in working with VAM fungi and interaction with some leading VAM researchers from Australia and the UK. Useful discussions on the direction of VAM research in cotton were held with Dr Abbott.

2. Participation in the workshop on *Rhizoctonia* diseases at the APPS conference provided a greater understanding of the biology of *Rhizoctonia* diseases. The workshop included: the history of the disease; taxonomy of *Rhizoctonia* species; methods for isolation and culture of *Rhizoctonia*; and control of Rhizoctonia diseases, including rotation and tillage treatments, breeding and engineering host resistance, biological control, and host nutrition. Furthermore, contacts were established with leading *Rhizoctonia* researchers in Australia.

3. Participation in the APPS Conference provided an up to date overview of all aspects of plant pathology in the Australasian Region. The paper on bacterial stunt of cotton (see attached) was presented at the Conference and led to considerable discussion and evaluation by peer pathologists, including discussions outside of the allotted question time. Other papers presented in the same session were of relevance to the disease in cotton. In particular, Stephen Simpfendorfer presented a paper describing a disease of wheat with similarities to bacterial stunt of cotton. Discussions and exchange of information have continued with Mr Simpfendorfer during the time since the Conference.

In summary, the experience gained at the conference and workshops has enhanced the expertise of the plant pathology research effort in cotton, particulary as it relates to soilborne diseases affecting early season cotton growth.

PLANT-MICROBE-SOIL INTERACTIONS IN A SOILBORNE DISEASE OF COTTON

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INTRODUCTION

A soilborne disease occurs in cotton (*Gossypium hirsutum* L.) in northern NSW. The most obvious symptoms are stunted growth during at least the first half of the season and reduced yield (1). Initial fertiliser trials resulted in little improvement. There were no indications that the disease involved infectious agents and its causes were a mystery for many years. This paper recounts the holistic approach used to determine the contributions of biological and non-biological factors to the disease.

MATERIALS AND METHODS

Observations of soil characteristics, early season cotton growth and colonisation by mycorrhizal and pathogenic fungi were made at 35 sites across fields with gradients in severity of stunting. Soil was steamed in pots or fumigated in the field and inoculated with soil and roots to determine the influence of biological or non-biological factors on cotton growth. Mycorrhizal colonisation capacity of soil was measured over the period between successive crops using a pot bioassay. Relative field mycorrhizal dependency was estimated as the difference in dry mass between mycorrhizal and non-mycorrhizal plants, expressed as a percentage of the dry mass of mycorrhizal plants.

RESULTS AND DISCUSSION

Cotton-soil interaction Paradoxically, shoot growth decreased as the levels of available P, available Zn and exchangeable K and Mg increased, and as pH levels became more favourable for plant growth. Shoot growth decreased with increasing Mn availability, soil sodicity, clay content and water holding capacity. These observations suggested either Mn toxicity or anaerobic conditions in the soil as causes (1). The observed multiple correlations between symptoms and soil properties could not prove causal relationships. Seedlings whose growth was increased by soil sterilisation treatments contained more Mn than stunted seedlings, thus eliminating Mn toxicity as a cause.

Cotton-mycorrhizal fungi interaction Shoot growth in the field was closely related to mycorrhizal colonisation (1). The more stunted the plants, the lower the level of colonisation of their roots. Cotton was highly dependent (up to 92%) on mycorrhizal fungi for growth. Elimination of mycorrhizal fungi by sterilisation treatments halved P and Zn uptake by cotton. However, the bioassays in pots showed that at the start of the cotton season the colonisation capacity of soil from poor growth sites was no lower than in soil from anywhere else. Hence, slow mycorrhizal development at poor growth sites was determined by environmental conditions and not by a lack of mycorrhizal inoculum.

Mycorrhizal fungi-soil interaction Mycorrhizal dependency of cotton decreased as the level of available P in the soil increased. Mycorrhizal colonisation of cotton roots in affected fields declined as phosphorus availability increased. This snggested that the lack of mycorrhizal colonisation in stunted plants reflected their lower dependency on the fungi in the high P soils.

Cotton-pathogens interaction The elimination of root browning, a symptom of the disease (1), by soil sterilisation treatments indicated that browning was caused by microorganisms. Soil steaming and fumigation increased cotton growth consistently, even though the elimination of mycorrhizal colonisation led to reduced P and Zn uptake. Therefore, soilborne pathogens in unsterilised soil were inhibiting cotton growth.

Soil with stunted cotton was suppressive to fungal pathogens. Across fields, colonisation of roots by *Thielaviopsis basicola* (Berk. & Br.) Ferr. and chytrid fungi increased with increasing shoot growth. Verticillium wilt symptoms in mature plants increased as boll production increased across fields. Hence fungal pathogens were not causal in the disorder. Viruses and nematodes were also discounted as possible pathogens.

Several observations indicated that soilborne bacteria play a causal role in the disease. The application of bacterial antibiotics (penicillin, streptomycin) to unsterilised soil increased cotton growth. Under the microscope bacteria were observed inside browned root cells and streamed out from the cut surfaces of browned roots. Bacteria isolated from browned cotton roots caused root browning and stunted root growth in inoculation experiments. All the isolates of rhizobacteria that were pathogenic belonged to a species of *Pseudomonas*.

Pathogens-soil interaction The interactions between the pathogenic rhizobacteria and the soil are currently unknown. Some isolates antagonised fungi *in vitro* and, ironically, may simultaneously (2) contribute to the observed suppression of fungal pathogens in the field.

Pathogens-mycorrhizal fungi interaction Colonisation of roots inoculated with cultured mycorrhizal fungi in sterilised soil in pots was reduced by inoculation with the pathogenic *Pseudomonas* sp. and was 58% higher than colonisation of roots in unsterilised soil. Thus, the slow mycorrhizal development in the field was probably the result of both the activity of the bacteria and the lower mycorrhizal dependency of cotton in high P soils.

Conclusion The multidisciplinary approach reported here has increased our understanding of the causes of a previously intractable disease. Deleterious rhizobacteria (2) were inhibiting growth and mycorrhizal development of cotton, particularly in nutrient rich, heavy clay soils. Cotton growth should be viewed as the sum result of positive and negative soilborne factors, both biological and non-biological.

ACKNOWLEDGMENTS

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REFERENCES

1. Nehl, D.B., Allen, S.J. and Brown, J.F. (1996). Mycorrhizal colonisation, root browning, pathogens and soil properties associated with a growth disorder of cotton in Australia. *Plant and Soil* **179**: 171-182.
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