July 93 - June 94 FINREP94

Cotton Research and Development Corporation

Project title	**New PH1 glasshouse**
Project number	CSP62C
Research organisation	**CSIRO**
Principal researcher	**Dr G A Constable,** **CSIRO Cotton Research Unit,** **PO Box 59,** **Narrabri 2390** **ph 991500; fax 931186**
Supervisor	**as above**

Summary

A new glasshouse was constructed at Narrabri to enable an expansion of the backcrossing of genetically engineered characters into CSIRO cotton varieties. The glasshouse was constructed and in operation within three months.

A final report prepared for the Cotton research and Development Corporation

Introduction

Genetic engineering has great promise for improving the cotton crop and reducing problems with pests and diseases. In recent years the development of 'Bt' cotton has progressed rapidly, where a gene from the bacterium *Bacillus thuringiensis* has been transferred into cotton. The plant then produces a protein toxic to *Heliothis* and other lepidopterous insects. This technology has the potential to at least halve the insecticide applied to cotton. Such a development would have a concomitant reduction in environmental problems associated with pesticide use in the cotton industry.

Initially, the Bt gene is present in a USA Coker variety since it is easy to grow in tissue culture. However it is not suited to Australian conditions because of lower yield potential and agronomic adaptation, particularly pest and disease resistance and fibre quality. The gene therefore needs to be incorporated into elite Australian cotton varieties by traditional backcrossing techniques in a glasshouse that is approved for growing genetically modified organisms (PH1 standard).

The problem

At present there are up to seven separate Bt gene-constructs. Although the eventual commercial varieties will only contain up to two Bt genes, backcrossing to all seven genes needs to be done before the best Bt gene-construct can be identified. Since there are eight main commercial cotton varieties, the potential number of backcrossing combinations is 56. Even if only ten pots are used for each variety-gene combination, these numbers illustrate how quickly such a program can fill glasshouse space. The current PH1 glasshouse at Narrabri can only accommodate 42 backcrossing combinations. Therefore some gene-variety combinations have been delayed. We are also concerned about the limited number of plants in each backcrossing program for two reasons:

1 Inadequate sampling of the variety. The variability between plants means that we usually use 30 to 50 plants in crosses. The ten plants used at present in the Bt backcrossing program are barely sufficient.

2 Small amount of seed production. This is of particular concern in the generation before evaluation. Since it takes a number of generations to produce commercial quantities of seed, improved glasshouse facilities would decrease the amount of time to commercial seed production.

Furthermore, new high performing types from the traditional breeding program are not yet included in the backcrossing program because of the limited glasshouse space. Thus it is possible that the first Bt cottons released will be in varieties that could have been superseded. Extra glasshouse space would enable new lines to be included in the backcrossing program as soon as they are identified.

There are other genetically engineered characters soon to be ready for evaluation. They include two genes for herbicide resistance which will become available before the end of 1994. These characters will need to go into a backcrossing program, then be included into a further program which combines that gene with Bt.

The solution

A new PH1 glasshouse was required at Narrabri. This facility will enable the backcrossing program to be expanded and eliminate some of the problems specified above. The aim of the plant breeding program at Narrabri is to ensure that when Bt cotton is released, it is in a high performing background with no yield penalty. This aim can only be achieved by a program with a population size which is large enough to allow intensive selection for agronomic and fibre characteristics.

The glasshouse is 19m x 9m; built on the western end of the existing glasshouse mound area at Narrabri Research Station; cement foundation; steel frame covered by polycarbonate sheeting. This sheeting is hail resistant and is better insulated against temperature extremes than glass. The glasshouse has evaporative cooling and gas heating. PH1 standards will be strictly enforced.

Objective

Construct a new glasshouse at Narrabri to facilitate more rapid and larger amounts of backcrossing of genetically engineered characters into elite varieties.

Results and discussion

Construction of the glasshouse began in August 1994. The following photographs show exterior and interior details of the glasshouse. No major problems were encountered and the first plants were sown in October 1994. We are very pleased with the finish and operation of the new facility.

Conclusions

The new glasshouse has made a major change to our capacity for backcrossing genetically engineered traits into CSIRO varieties.

Appendix - budget

Item	Original submission $	Subsequent variation $
C OPERATING		
Concrete slab	15,000	14,000
Electrical fittings	4,000	4,000
Finalise mound	5,000	1,800
Bench materials and auto watering	5,000	5,000
Water and gas connection	1,200	1,200
TOTAL OPERATING	30,200	26,000
D CAPITAL		
Glasshouse	65,000	98,700
TOTAL CAPITAL	65,000	98,700
TOTAL REQUESTED	95,200	124,700

Figure 1.
View of new PH1 glasshouse at the Australian Cotton Research Institute.

Figure 2. Interior of the new glasshouse, showing the first cotton plants sown in October 1994. The benches were constructed by CSIRO staff. An automatic watering system has now been installed.