

HAIL RESPONSE IN COTTON

Karyl-Lee Capel (Contract Researcher)
Brent Demnar (Robins Agriculture Pty Ltd)

INTRODUCTION

Hail is an important source of economic loss to the Australian cotton industry. Hail insurance and damage assessment was prominent in the minds of many growers after the 1989/90 season when after heavy hail storms, insurance claims reached a figure of \$14 million whilst total loss to the industry was estimated at \$25 million when potential final yield, price and yield percentage payouts were taken into account.

In 1991/92, we saw it all again, with severe hail storms recorded in areas stretching from Emerald to the Macquarie Valley and 248 claims were lodged totalling \$9.5 million.

Financial losses are borne by individual growers who incur the crop loss and also by the industry as a whole through higher insurance premiums in the longer term.

In 1990, a C.R. & D.C. funded research project was begun, in co-operation with the Industry Hail Scheme Insurers, to investigate and evaluate the hail response of cotton varieties currently grown in the Australian cotton industry. While the research will increase our understanding of the cotton plant's response to hail damage and may also identify better management practices to maximise recovery potential, the information collected will also enable the current loss assessment procedures to be updated as necessary.

The procedures used for the Industry Hail Scheme have been in use for over ten years and are based on Acala lines grown under U.S. conditions. With the introduction of Australian bred varieties to the Australian industry, and well documented and observed varietal differences with respect to normal plant growth, it was considered an appropriate time to investigate hail response on the basis of those varieties.

Therefore, the aim of this work is to quantify and compare the regrowth characteristics of Australian cotton varieties following hail damage at various stages of plant development and in co-operation with the Industry Hail Loss Adjusters, modify the loss assessment procedures, if and where necessary, to ensure that growers losses are accurately reflected.

TRIAL PROGRESS

1991/92 represented the second year of the three year trial programme. Large scale trials were carried out at two Namoi Valley sites with the results validated through small scale trialling. Commercial scale trials were chosen to enable us to simulate damage by mechanical means and allow "commercial" crop loss assessment.

Varieties chosen for inclusion in the trial were selected on the basis of their representation of major lines of varieties in commercial production or development with Deltapine 90 as the standard given that this variety is the variety on which the U.S.-based loss procedures were designed.

As any grower who has had experience with hail damage and thus made a claim under the Industry Hail Scheme would appreciate, the loss assessment procedure is based on the growth stage at the time of damage. Part of our research has therefore been to cross check the performance of the assessment procedures against varieties and the date at which a particular variety is damaged. As it would be impractical to attempt to cross check damage levels at every stage of crop development, the research has been based on four critical stages, being early vegetative, late vegetative, mid-reproductive and late reproductive.

VEGETATIVE STAGE DAMAGE

Hail damage in the vegetative stage normally involves tipping out of plants and stand reduction where plants are killed by cutoffs below the cotyledon level. Simulated damage dramatically increased plant height. Plants as a whole were stronger, and in the case of V5/V6 damage were more strongly branched as a result of regrowth from a number of nodal ancillary buds.

Peak square production and hence peak flowering is delayed 7-10 days by damage at the V3 stage and 30-35 days by damage at the V5/V6 stages. This translates to similar delays in final maturity.

REPRODUCTIVE STAGE DAMAGE.

By the mid-reproductive stage (R9) the plant has attained much of its mature height. Regrowth occurs by meristem activity in branch axils and crop recovery in respect to height is limited. Simulated damage at the R9 stage reduced final plant height.

At stage R9, the plant is already in the reproductive phase and so the regrowth quickly produces squares. Seasonal conditions

and crop health will be the determinates of the rate of development and the degree of further development attained.

However, our 1991/92 trials showed limited maturation of squares initiated on regrowth after damage at the R9 stage due to the shortened season and Verticillium infection.

Late reproductive stage damage (R12+) involves primarily fruiting branch damage and damage/removal of bolls. The severity of damage is the major determinate of loss.

VARIETAL YIELD DIFFERENCES

Varietal differences in vegetative structure and fruiting patterns were not found to be significant with respect to the simulated damage we inflicted. Any varietal differences recorded tended to follow growth patterns we know to be inherently characteristic of the varieties.

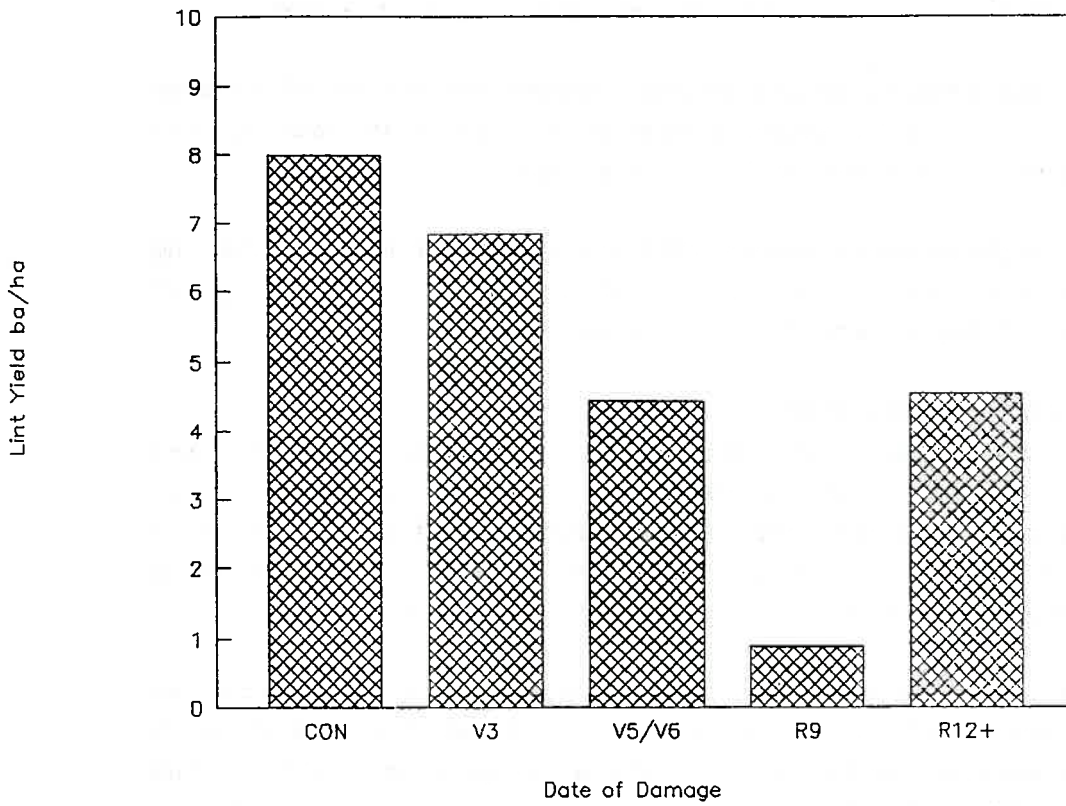
Obviously a key area of interest in terms of our research has been the potential for varietal differences as a result of hail damage at various growth stages. While our program still has one season to run, it would be fair to say that at this stage the data collected does not indicate that there is any yield difference between varieties following hail damage to any significant extent. Whilst our work has shown that date of damage, and thus the growth stage reached at time of damage, appears to be the overriding factor as recovery potential is concerned, mid-reproductive stage damage is shown to have the potential to cause the most significant yield loss. (Refer to Graph No.1)

If the yield data is sub-divided into the effect of date of damage on each variety, indications are at present that any differences in yield picked up in our data are not significantly related to damage but are specific to a site and represent the expected performance of a variety at that site. On this basis, date of damage remains the over-riding factor depleting yield. (Refer to Graph No.2)

At the time of undertaking this trial program, we were aware of growers frequent observations of perceived differences on a variety basis in regrowth after hail, and we acknowledge that the results of our work to date do not tend to support these observations. However, going back to the small scale trial data, we can support this observation to the extent that it is actually due to the inherent growth patterns of the respective varieties

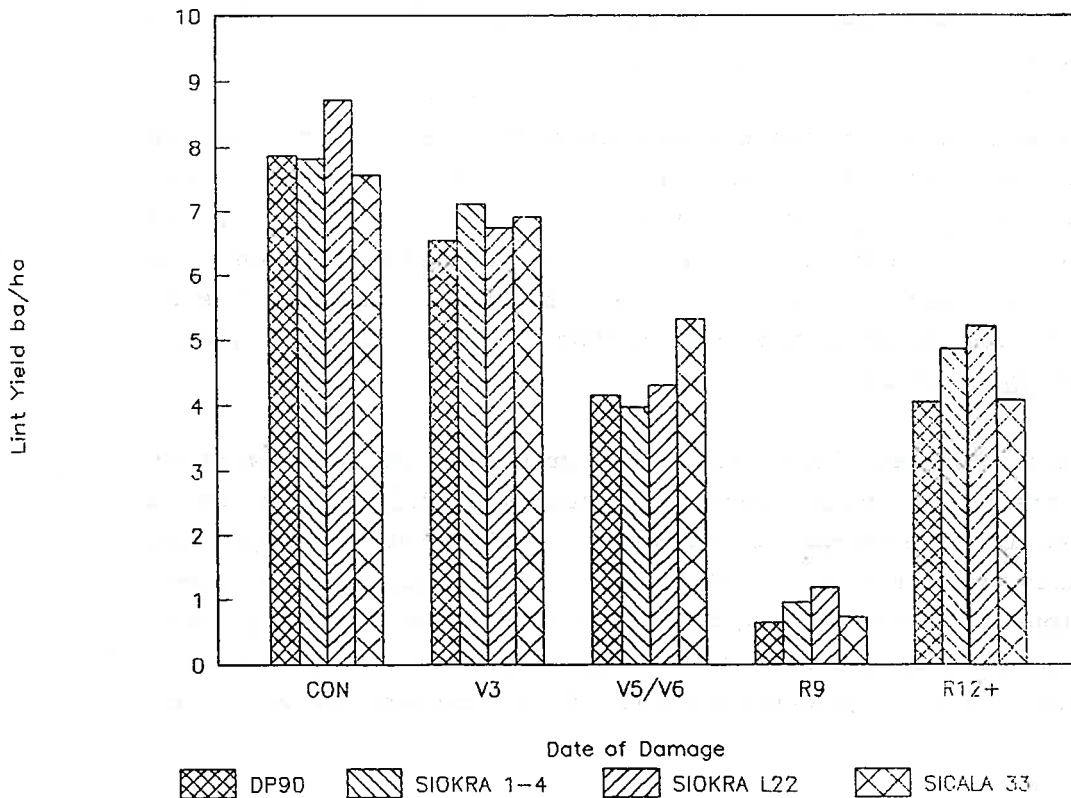
GRAPH No.1 EFFECT OF DAMAGE DATE ON LINT YIELD

Auscott Narrabri at 30% Damage Level



GRAPH No.2 EFFECT OF DAMAGE DATE ON VARIETAL YIELD

Auscott Narrabri at 30% Damage



in relation to vegetative and reproductive growth.

Under normal conditions vegetative growth, represented by height, is more rapid in the case of Siokra 1-4 than DP90, in the early part of the season (Graph No.3) At a date approximately 90 days from planting upward growth of Siokra 1-4 slows as the plant moves into it's reproductive phase. Growth of DP90, however, continues upward for a period of 20-25 days to produce the inherently taller plant. Hail damage does not change this characteristic. After damage, vegetative growth of Siokra 1-4 is also initially faster than DP90 as displayed in Graph No.4 which shows changes in plant height after damage at the V5/V6 stage. This mirrors the more rapid regrowth of Siokra types we see in the field.

Square production is also inherently more rapid in Siokra 1-4 than DP90. Square production and time to peak flowering are delayed by vegetative stage damage, but the same pattern of square production compared to that of DP90 is displayed after damage. i.e. Siokra 1-4 moves into it's reproductive phase earlier and produces squares more rapidly and reaches a peak earlier than DP90.

Graphs Nos.5 & 6 show square production of undamaged cotton in our 1991/92 small scale trial in comparison to cotton damaged at the V5/V6 stage.

Again in our trials, the differences have not translated through to yield. One hypothesis is that while Siokra 1-4 often produces much larger numbers of squares the inherent lower boll setting percentage of the variety brings it's final yield back closer to that of DP90 following damage.

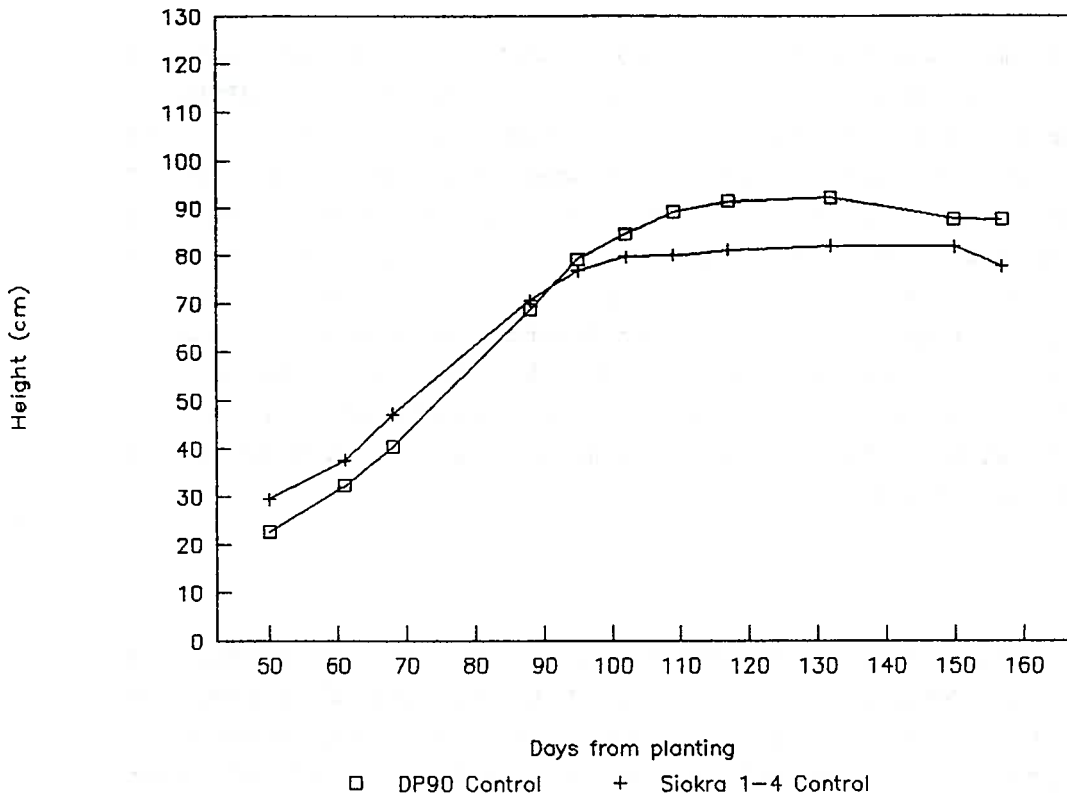
It must be kept in mind that in the field a number of problems can compound the effect of hail. Any type of stress such as waterlogging or nutrient deficiency reduce the ability of the cotton plant to recover from damage. Some stresses such as Bacterial Blight and Verticillium Wilt may produce a differential varietal response to damage due to varying susceptibilities of varieties.

Certainly our work is not yet complete and only at the conclusion of the trial programme, after all results have been analysed will we be in a position to make definite statements on the

GRAPH No.3

PLANT HEIGHT GROWTH IN UNDAMAGED COTTON

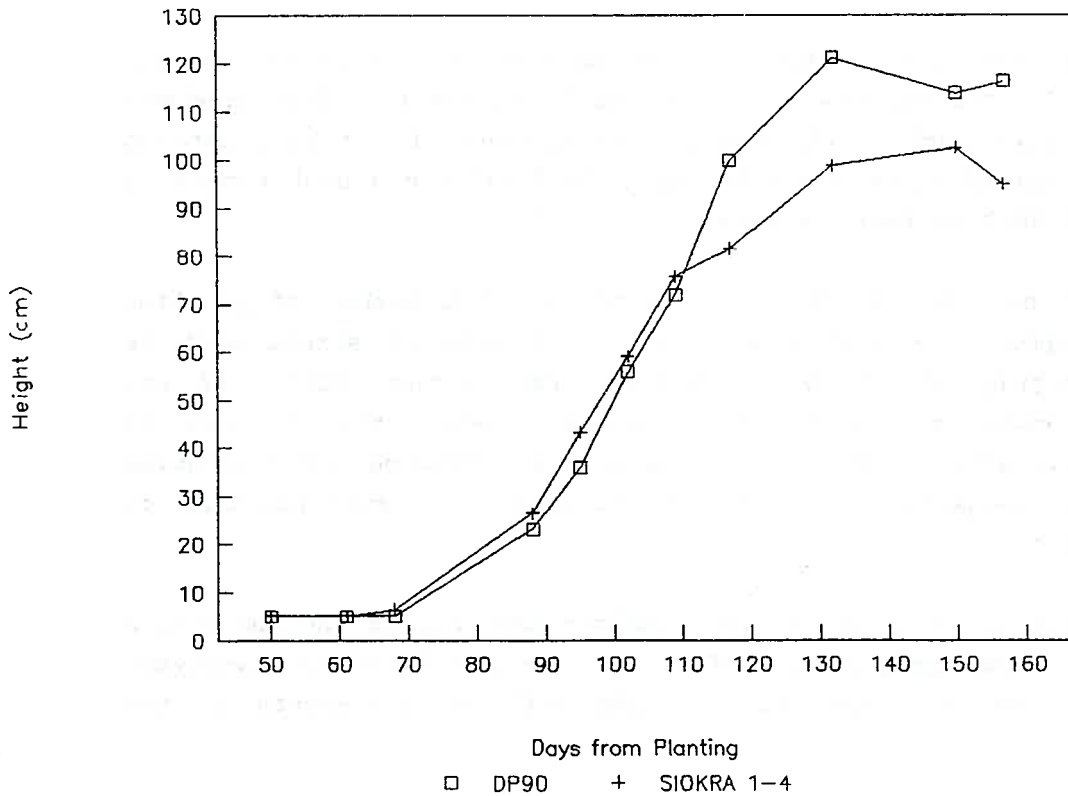
Narrabri Ag. Station 1991/92



GRAPH No.4

PLANT HEIGHT IN HAIL DAMAGED COTTON

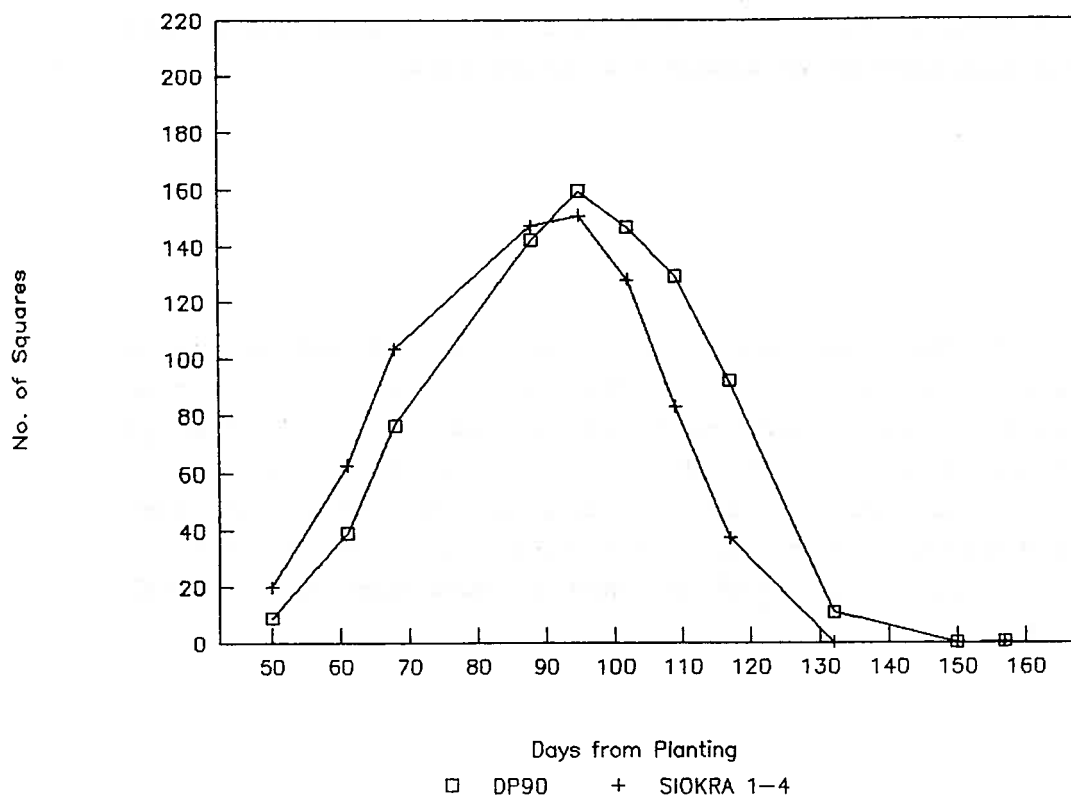
N.A.R.S. 1991/92 - DECEMBER DAMAGE



GRAPH No.5

SQUARE PRODUCTION IN UNDAMAGED COTTON

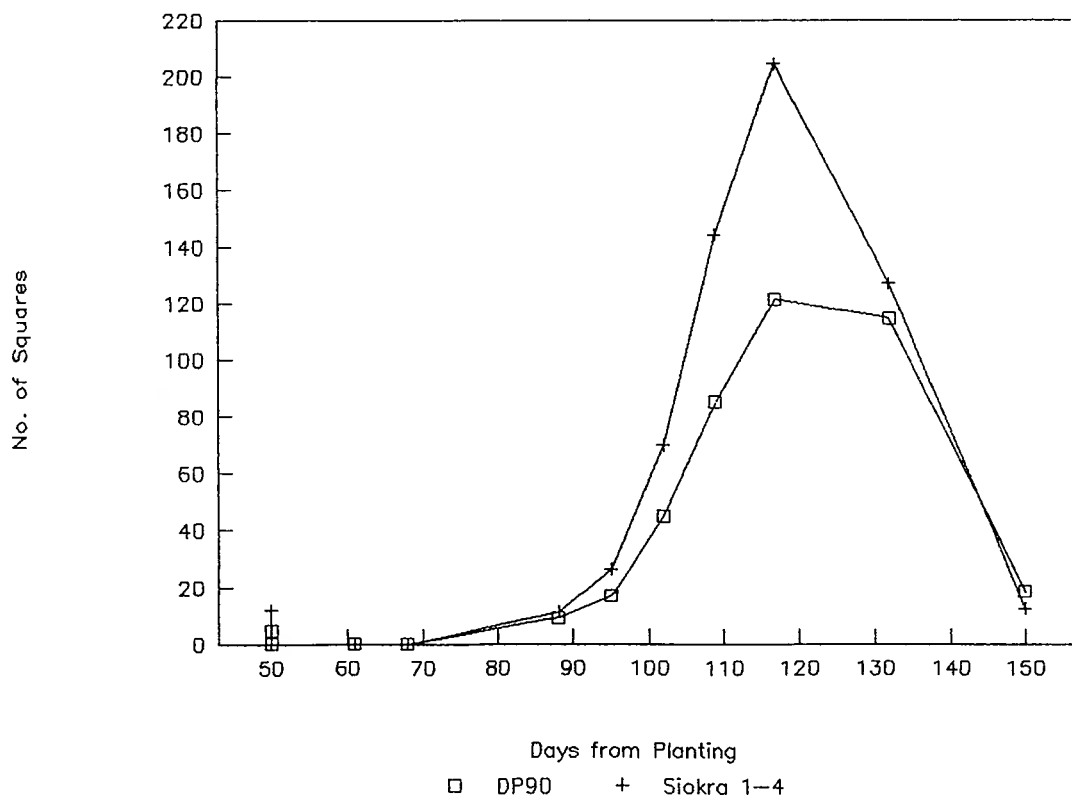
Narrabri Ag. Station 1991/92



GRAPH No.6

SQUARE PRODUCTION IN DAMAGED COTTON

N.A.R.S. 1991/92 - DECEMBER HAIL DAMAGE



subject of hail response. At this stage however, given that this is the first time research has been undertaken in this area, we are confident that conclusions will be possible which will provide a firm base of knowledge for future work.

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