

## GENOTYPE ENVIRONMENT INTERACTION

## FOR YIELD IN COTTON

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Four cotton breeding programs have been operating in Australia, three in New South Wales and one in Queensland. This is based on previous experience and limited evidence that cultivars different from those in the Namoi are required on the Darling Downs and central Queensland. In order to efficiently pursue all aspects of cotton cultivar improvement in eastern Australia, a critical examination is required of the adaptation patterns of cultivars and the effectiveness of locations to evaluate cultivar differences.

Fortunately, a large data set already exists for such a study. Beginning in 1974/75, the cotton breeders at CSIRO and QDPI have jointly been conducting the Australian Cotton Cultivar Trial (ACCT) at 6-11 locations per year throughout the major cotton growing districts in New South Wales and Queensland. Previous analyses of this data set (personal communications from Mungomery, Thomson, Reid and Williams) indicate that genotype-environment interactions for yield are sufficiently important to warrant consideration in a cotton breeding program.

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Genotype-environment interactions for yield occur if a group of genotypes or cultivars are tested at two or more locations and/or two or more years and the ranking of these cultivars by yield changes over the different locations and/or years. In our studies we have used a numerical classification analysis to summarize these genotype-environment interactions.

Figure 1 illustrates the relationship between locations, for the six years of results 1980/81 to 1985/86, to discriminate between genotype-environment interactions of the different genotypes. The interpretation of the graph can be best explained by an example. Boggabilla and Myall Vale give similar results for yield rankings of genotypes, whilst Darling Downs and Moomin Creek give dissimilar results.

The classification of locations obtain by this analysis (Fig 1) corresponds to the geographical spread of these locations. The locations in the Macquarie (Warren), Namoi (Myall Vale and West Namoi), Gwydir (Moree and Moomin Creek), MacIntyre (Boggabilla), and St George have produced the most similar genotype-environment effects in cotton genotypes compared to other locations used in the trials and are closely related geographically. Emerald, Biloela, and Theodore are central Queensland locations and are dissimilar in their effects to the NSW locations and to each other. Darling Downs produces the most dissimilar

response in the cotton cultivars as it is the last location to fuse with other locations.

Generalizing over the 12 years of trials from 1974/75 to 1985/86, it is possible to determine how locations contribute to the separation of genotype. West Namoi separates out the high yielding "Deltapine related" genotypes. Myall Vale, St George, Moomin Creek, Moree, and Boggabilla act similar to West Namoi but their genotype separation is not as significant. Darling Downs separates out the early maturity genotypes. Biloela separates out some specifically adapted genotypes such as "deltapine gl fr" or "Namcala related" genotypes. Warren is a contrasting environment in some years. Emerald separates out generally unadapted genotypes. Theodore separates out the Coker related genotypes.

These results will enable cotton breeders to decide the most appropriate locations to conduct their trials so that differences between genotypes in their yield response to environments can be measured. Trials of early generation breeding lines are grown at 2-3 locations. We recommend that it is best to choose 2-3 locations that give dissimilar genotype-environment interactions. For the trials of advanced breeding lines and cultivars there is a trade off between the cost of testing at another location and the extra information

obtained. Our results help the cotton breeder make these decisions.

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Figure 1. Relationships among locations for discriminating between genotype responses over environments.

