GENOTYPE-ENVIRONMENT INTERACTIONS FOR YIELD IN COTTON - CONTRIBUTION OF ENVIRONMENTS TO DIFFERENTIAL GENOTYPE RESPONSE

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AIMS

At present, four cotton breeding programs are operating in Australia, three in New South Wales (NSW) and one in Queensland (Qld). 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 Qld. 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[1] (ACCT) at 6-11 locations per year throughout the major cotton growing districts in NSW and Qld (Fig 1).

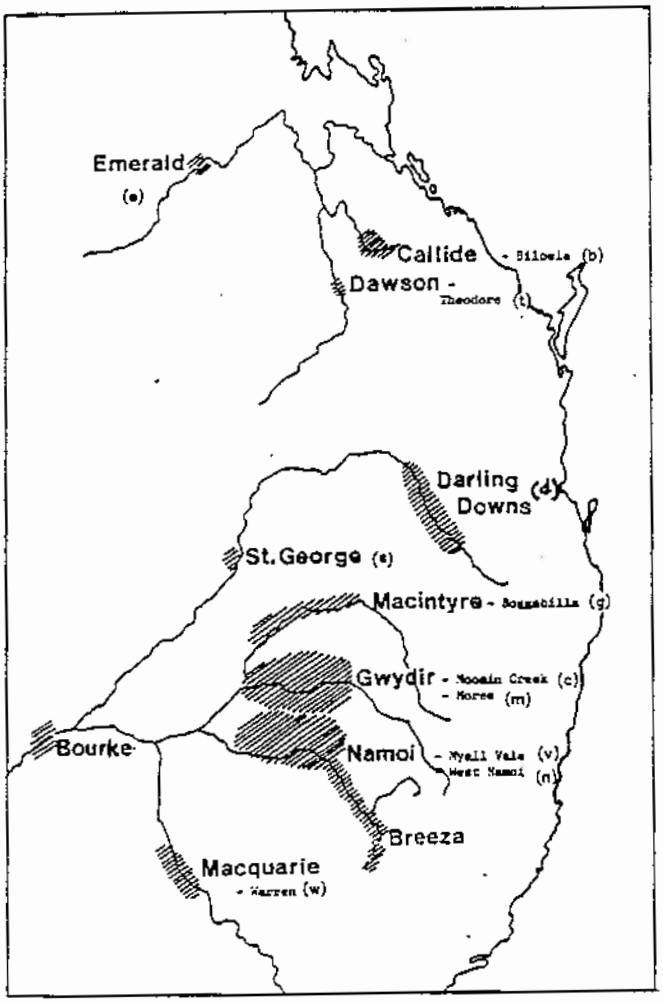

Figure 1: The 11 locations which represent the major cotton growing districts in eastern Australia used for the Australian Cotton Cultivar Trials (ACCT).

A contributions analysis[2] of this large data set (12 years x 6-11 locations x 16-30 genotypes per year) could provide information on the value of individual locations in differentiating among genotype group responses over environments.

RESULTS

The hierarchies of the genotype classifications on lint yield data for each year were truncated[3] at a level that retained 55% or more of the genotype by environment interactions (ge) sum of squares (SS) in the reduced matrix (Table 1). Contributions of locations (single member environments) were calculated for the specific truncation level in each hierarchy and were expressed as a percentage of the total contribution for each year (Table 2). These were summarized by averaging over years (Table 2) to give an unweighted measure of discriminating power for each location to the dissimilarity among genotype group responses.

Another method of examining the data, is to determine the single most important location or pair of contrasting locations for differentiating genotype groups at each fusion level in the classification down to the specified truncation level (Table 3). Results were summarized over years by calculating, for each location, the proportion of years that the location played an important role in classifying genotype responses (Table 4). Examination of Table 3 shows that some locations are more important than others. Further examination of the data revealed that for some fusion levels in so. ars, the most important location can be substituted for by another location with a similar contribution (Table 3), e.g. West Namoi can be substituted for by Myall Vale in the first split of 1980/81. By this process of substituting alter-

native locations it was possible to eliminate a number of locations as being non-essential in the classification of genotype groups (Table 4).

CONCLUSIONS

In the first six years of the trials most of the genotypes being evaluated were not adapted to the sub-tropical cotton growing region of eastern Australia. Consequently, the conclusions derived may not be relevant to cotton breeders in 1988. In contrast, the last six years of the trials included many advanced breeding selections developed by CSIRO, Narrabri, which were better adapted to the Australian cotton growing environments.

All locations played a role in discriminating between genotype groups (Table 2) though some locations were more important than others (Tables 2 and 4). West Namoi is obviously an important location in distinguishing between genotype performance. Darling Downs was not important in the early years of these trials (1974/75 to 79/80) but in latter years has become a very important location.

Table 1: Matrix size, truncation levels for hierarchies, and percentage ge SS retained in the reduced matrix for the 12 years of data from the ACCT[1].

Years	matrix size gen x env	reduced matrix	%ge SS retained
1974/75	18 x 7	4 x 7	57
1975/76	25 x 6	5 x 6	57
1976/77	25 x 7	5 x 7	56
1977/78	25 x 8	6 x 8	51
1978/79	16 x 6	4 x 6	63
1979/80	16 x 7	5 x 7	59
1980/81	25 x 9	6 x 9	54
1981/82	25 x 8	5 x 8	52
1982/83	25 x 11	7 x 11	54
1983/84	25 x 8	4 x 8	55
1984/85	30 x 10	5 x 10	57
1985/86	16 x 11	3 x 11	55

1 Australian cotton cultivar trials.

Table 2: Summarized contributions (%) to entry group classification at the specified truncation level for the 12 years of the ACCT[1].

years	locations											overall	
	e	b	t	d	s	g	c	m	v	n	w	main effects	ge effects
1974/75		32	9	0	13				5	37	3	43	57
1975/76		30	10		13				25	11	11	74	26
1976/77		39	15	9	15				2	12	6	66	34
1977/78	6	26	4	17	8				4	19	15	68	32
1978/79	30	19		4	5					28	14	55	45
1979/80	14	28		4	7				18	12	16	57	43
average	17	29	10	7	9				11	20	11	60	40
1980/81	8		8	10	16		8	16	17	16	8	71	29
1981/82		3	11	10	10			13	12	22	19	49	51
1982/83	5	7	7	12	13	10	3	9	13	15	5	59	41
1983/84		3		17		7	25	9	1	21	17	67	33
1984/85	7	7		30	8	9	7	7	4	16	5	42	58
1985/86	13	32	6	21	3	0	1	11	1	5	6	61	39
average	8	10	8	17	10	7	9	11	8	16	10	58	42

1 Australian cotton cultivar trials.

Table 3: Important locations contributing to the classification of entries at each split in the hierarchy for the 12 years of the ACCT[1].

years	split in hierarchy					
	1st	2nd	3rd	4th	5th	6th
1974/75	n	b/s	b			
1975/76	b	w	b	w		
1976/77	b	s	b/w	d		
1977/78	n	d	d	b/w	b/d	
1978/79	e,n	b/n	n			
1979/80	b	w	n	b/w		
1980/81	v,n	m,n	w/t	t	m,n/d	
1981/82	n	w	d/w	n/w		
1982/83	n	d/v,n	e	t	s,d	n/d
1983/84	d	c,n	b/n			
1984/85	n/d	d/b	e	d		
1985/86	b	d/w				

1 Australian cotton cultivar trials.
/ location with the opposite contribution due to ge effects.
, location with similar contribution.

Table 4: Proportion of years that locations played an important role in discriminating among cotton lines in ACCT[1].

years	location	proportion (%) of years location is important	
		no substitution of locations	preferential substitution of locations
74/75-79/80	Biloela	100	100
	West Namoi	67	67
	Warren	67	67
	Darling Downs	40	40
	St. George	33	33
	Emerald	33	0
	Theodore	0	0
	Myall Vale	0	0
80/81-85/86	Darling Downs	100	100
	West Namoi	67	83
	Warren	67	67
	Biloela	60	60
	Theodore	50	50
	Emerald	50	50
	Myall Vale	33	0
	St. George	20	0
	Moomin Creek	20	0
	Moree	17	0
	Boggabilla	0	0

1 Australian cotton cultivar trials.

Five locations, Myall Vale, St. George, Moomin Creek, Moree and Boggabilla are not essential for the classification of the genotype responses (Table 4) obtained in these trials. However, they do make some contribution to the classification of genotypes (Table 2). The six best locations, Darling Downs, West Namoi, Warren, Biloela, Theodore and Emerald basically cover the geographical diversity of cotton growing areas in eastern Australia. These are the main locations to be considered when deciding which are the best locations for preliminary testing of cotton breeding lines.

1 Reid, P.E., Thomson, N.J., Lawrence, P.K. and Luckett, D.J. 1988. This volume.
2 Shorter, R., DeLacy, I.H. and Eisemann, R.L. 1981. In 'Interpretation of Plant Response and Adaptation to Agricultural Environments' Eds. D.E. Byth and V.E. Mungomery.
3 DeLacy, I.H. 1981. In 'Interpretation of Plant Response and Adaptation to Agricultural Environments' Eds. D.E. B and V.E. Mungomery.