

CHALLENGES TO A PLANT BREEDER*N.J. THOMSON*

CSIRO COTTON RESEARCH UNIT

DIVISION OF PLANT INDUSTRY, NARRABRI

In addressing the theme of this talk I realize that I, as an individual, may well respond differently from other plant breeders, who, in turn, may perhaps differ considerably from each other. So be warned that my view is a very personal one and perhaps off-key compared to the majority perception. I say this because I suspect that most breeders, and seemingly what the organizing committee wanted me to do, was to delve into the classical technical problems associated with breeding, centering around the difficulties and opportunities resident in the breeding process itself, e.g. such matters as recombination, segregation, heterosis, linkage, genotypic interaction, competition and so on. These classical problems certainly continue to challenge the breeder and therefore have plenty of textbook coverage. But, to my thinking, discussion of such issues belongs more to specialized meetings of plant breeders and geneticists.

Okay, so what should I talk about? Well, for one thing, what better than what I see as the eternal, ever-increasing breeding dilemma - that is, what and how many attributes should a breeder aim to improve in any particular breeding project and what weight or selection pressure should be placed on each.

For example, it would seem that years ago a breeder might have had the luxury of being only concerned with one, or, at the worst, three or so parameters. His aim, say, in coping with the boll weevil invasion in the USA, might have been largely directed at earliness, or his project might have been concerned with one aspect of quality, e.g. length. Well, of course, it was probably never quite this simple but certainly early breeders living in a far slower, less technologically developed age often enunciated their objectives simply. But gradually as the world became more quantitative, the dilemma of just where one draws the line must have emerged (even if not always recognised) with for example, increased yield being sought not simply by breeding for heavier bolls or increased seed cotton yield but rather taking lint yield as the proper (although unfortunately more complex) parameter needing to be improved. Again quality parameters have inevitably grown over time from length alone to at least also include uniformity, strength and micronaire value.

Over time the "wish list" of desired improvements to be achieved by breeding has grown and grown so that now it looks like this (Table 1). Even a non-breeder might well say "wow" when confronted by such a list. Meanwhile don't bother looking for the breeder - he's probably quietly, (though admittedly messily) opting out of the system by disembowelling himself in a corner. Considerate chaps these breeders - don't make a fuss, just act decisively!

Well the point is that this is only a "wish list". The challenge to the breeder is to decide which of the wishes he will actively pursue, which he'll put on hold and which he'll well - ignore!

But hang on! Isn't there a challenge to the breeder, and to the non-breeder to first decide whether any particular solution to a problem is best sought by breeding or whether it is possible and preferable to go for the non-breeding solution. I say Yes, surely there is such a challenge, and I'll refer to compaction as an example. I believe that through the work of our soil researchers and through your own observations and experiences you know that compaction greatly impedes the growth and yield of your crop. Well you might call for a clod buster of a variety to counter this yield loss; and indeed we're pretty sure that varieties with a vigorous growth habit may have an advantage under compacted conditions. But I think that, in this example, most would agree that really a management solution is the way forward; and that we breeders, rather than giving priority to clod busting ability, should be employing our manifold talents to better advantage since a genetic solution will be, at best, a pretty limited one. But less obvious perhaps is the case for Verticillium Wilt. Most people I suspect are quite happy to see this problem dumped on our extremely broad backs, although the pathologists very gamely point out that there are also managerial practices to help alleviate the problem. However, as a plant breeder with a very bowed back, I'm always on the lookout to offload whatever I can, so imagine my delight on reading a recent (March 24) New Scientist article. Apparently a rare red fungus has been discovered in Western Australia which establishes itself in the roots of plants and then both protects and stimulates the growth of its host. Besides increasing yields it is also claimed that it prevents damaging diseases such as fungal infections that rot the roots by secreting a protein that has an antibiotic effect against other fungi. So here one sees the beginning of yet another breeding dilemma - are we wasting our time trying to combat Vert by breeding now that this red fungus is to hand!

Another very topical question and challenge is how much, and with what genes, should the plant breeder get involved in host plant resistance. We have had some heartening albeit necessarily limited success in this field, firstly with the development of our glabrous leaf, frego bract Sicot 3 that resulted in lower egg lay and larval survival of *Heliothis* than for normal cotton, and then with our Siokra varieties which are less susceptible to mites and *Heliothis*. But these types of traits only provide at best limited relief. So what else can be done? You will hear from Danny Llewellyn about genetic engineering with the B.T. gene so I won't go into that. There are, however, a host of genetically controlled chemicals in the plant such as the well known gossypol and tannins which could be used in a plant breeding program. But if so, and we move them to the forefront of our program, are we going to lose out on yield and/or quality? This is a subject that I've debated with myself and others for years since, on the evidence from the States particularly, it seemed that raising concentration of these chemicals was accompanied by yield loss. Recently the USA workers have been suggesting that they've overcome this problem so now we're evaluating their new "*Heliothis*-resistant" lines to see whether this is really so and thereby help us decide whether we should now pick this ball up and start running. But, in my case at least, there remains a nagging worry: is this really the best track to follow, since with the advent of genetic engineering, there are other intriguing possibilities, e.g. the idea of incorporating genes that produce a smell that the *Heliothis* find offputting, i.e. a "put-off" rather than a "come on". Intuitively this seems like a more satisfactory solution than working one's way through a slow, complex breeding program with the terpenoid genes and then ending, in the bargain, with the byproduct of high gossypol seed that the crushers don't want.

Besides the "BIG" questions and challenges so far discussed I would like to mention an evergreen technical-strategic challenge facing the breeder which may well make or break him. I am thinking about the question of aiming for hybrids rather than "straight" or fixed varieties. This siren has tantalized cotton breeders for years and years. In my own case I once caught the hybrid bug but in retrospect luckily, although it wasn't funny at the time, fell flat on my face before committing too much time or resources. Just after this, following the identification of new sources of cytoplasmic male sterility, many breeders and resources in the States were channelled into the quest for hybrids. Now I'm glad indeed that I didn't follow suit as that enormous effort has been unavailing. But still the question hasn't gone away, since although first generation F₁ hybrids have been dropped,

new techniques have allowed the commercial production of F₂ hybrids to be apparently feasible.

These sorts of questions that confront us breeders are the ones I find particularly interesting and challenging, Ladies and Gentlemen. I only trust that you in turn, if not confronted, were at least kept awake during this talk, but perhaps a bigger challenge in that regard would have been for my presentation to be made after lunch!

TABLE 1: BREEDING GOALS "WISH LIST"

AGRONOMIC	-	SEEDLING VIGOUR
	-	SMOOTH LEAVES/STEMS
	-	HIGH PLACED FIRST FR BRANCHES/BOLLS
	-	MEDIUM TO SHORT FRUITING BRANCHES
	-	ERECT NONLODGED PLANTS
	-	STORM RESISTANT BUT WELL FLUFFED BOLLS
	-	HIGH PICKING EFFICIENCY
	-	HIGH GINNING O/T
	-	GREAT YIELD (ALWAYS!)
	-	YIELD CONSISTENCY
	-	EARLINESS
RESISTANCE TO	-	HIGH CRUSHING VALUE SEED
	-	SEEDLING DISEASES
	-	BACTERIAL BLIGHT
	-	VERTICILLIUM WILT
	-	ALTERNARIA
	-	BOLL ROTS
	-	PREMATURE SENESCENCE
	-	MITES
QUALITY	-	HELIOTHIS
	-	SUCKING PESTS
	-	BRIGHTNESS/WHITENESS
	-	CLEANLINESS (ESP PIN TRASH)
	-	STRENGTH
	-	LENGTH
	-	LENGTH UNIFORMITY
	-	HIGH MATURITY
	-	FINENESS
	-	LOW SHORT FIBRE CONTENT
	-	LOW NEPPINESS
-	EASY DYEABILITY	
-	RESISTANCE TO WET HARVEST CONDITIONS	

