DRAFT SUMMARY FINAL REPORT: FACTORS AFFECTING DYE UPTAKE AND OTHER PROPERTIES OF AUSTRALIAN COTTONS – TEXSKILL, 1993-94

I have prepared these notes for our meeting of July 25. They describe some of the activity of many people who have given us insight into the processing characteristics of eight major cotton varieties grown at Narrabri and Merah North in the Namoi valley. As the industrial practice of blending bales into a mix always loses the varieties' identity, the trial provided a rare look at the pure varieties in yarn and fabric form, as well as their behaviour throughout spinning, knitting, preparation and dyeing. The possibility of converting them into varietal garments remains, but is beyond the present budget.

Related to this work is the parallel research of Schlafhorst, which received similar amounts – 100 kg of each of the 15 lots, donated by Cotton Seed Distributors -- and is processing them in Germany by both ring and rotor spinning. We have just received their processing results, on 13 of the lots, and have compared their earlier fibre results. Much comparable reserach appeared in the recent Ph.D. thesis of Stuart Gordon, funded likewise by the Cotton R. & D. Corporation at La Trobe University. For discussion: what information to send to Schlafhorst, immediately and finally?

We obtained CSD yield and gin turnout data, and distributed samples of the lint to co-operating labs, including our own, for fibre testing. Figure 1 shows the effect of variety and location on lint yield. Some tests continued during processing. We found, for instance, that fibre length distribution depends greatly on whether it was measured on lint, card sliver or drawframe sliver. The final report will discuss this, and other, findings in more detail.

To improve the database, we submitted selected samples to Texas Tech and Spinlab. We reported the results of these trials to participating labs on February 28. Wide variation in maturity results -- a range exceeding 30% -- led to one of the unexpected outcomes of the work: production and distribution of one batch of maturity calibration cotton that had been examined from many angles in Mr Gordon's project.

TexSkill, with direction and help from staff of Bonds Spinning Mills and Rocklea Spinning Mills, processed each lot into 30-tex knitting yarn, and engaged Melbourne College of Textiles to test yarn properties. The Rocklea lab supplemented yarn testing. Sportscraft provided facilities to knit into jersey fabrics, which Bonds then dyed in both hot exhaust and pad-batch to commercial quality.

Bonds and La Trobe then tested the fabrics colorimetrically, and for bursting strength. All this provided a spreadsheet from which we selected 42 properties of all 15 cottons. We discuss some of the derived information below. The analysis was limited by the number of samples (15) and even more by their close relationship to each other. We alleviated this problem by processing some of Mr Gordon's results. From a designed experiment, they referred to a much wider range of properties, the extremes of which do not apply to current Australian cotton. Fig. 2 shows how these data improved the correlation between yarn and fibre tenacity from +.45 to +.92.

Other correlations between comparable properties tested at different stages in the 15 TexSkill lots were:

Fibre and yarn elongation +.36
neppiness +.41
Reflectance of fibre and unbleached fabric +.24
Yellowness (+b) of the above +.82
Yarn tenacity and fabric burst strength +.65

The colour correlations mostly disappeared when the fabrics were bleached. The results raise the question of whether yarn or fibre tests can be substituted for each other. We also performed multiple linear regression analyses of the Engineered Fibre Selection type but, over the narrow range of properties in our survey, found only modest predictive power. For rotor yarn of 30 tex, 670 turns/m:

Yarn tenacity = 11.06 + .233 HVI Tenacity - .737 HVI Elongation. $r^*r = .40$, s = .32 g/tex

Yarn CV (Uster) = 6.79 + .020 Hair Weight + .304 HVI Elongation + .0019 AFIS Nep Count. $r^*r = .44$, s = .31 percentage points

Both point to a bad effect of fibre elongation, which we ascribe to a negative correlation (r = -.57) between extensibility and maturity.

The most important link between multiple properties came from Mr Gordon's work, where maturity and hair weight explained ($r^*r = .84$) 84% of the variation in colour depth of his 15 blue fabrics (Figure 3). Most of the remaining 16% was probably experimental variation.

We have also analysed the variances of all properties, and have identified those –yield, span length, elongation, AFIS dust and neps -- where there is an overall difference between Narrabri and Merah North; and those – gin turnout, maturity, coarseness, span length, fibre tenacity, fibre reflectance and yellowness, Schlafhorst utility value, yarn neps, yarn elongation, unbleached fabric yellowness, bleached fabric reflectance, and reflectance of navy fabric – where there seem to be some differences between the varieties. We have also examined significant differences between individual varieties.

Although processing trials of this kind are performed annually overseas, especially by USDA, we believe this work breaks new ground in Australia. To help monitor new developments in plant breeding, we expect to do further and improved processing of 15 lots in 1994-95, and look forward to ongoing collaboration.

Robert G. Steadman

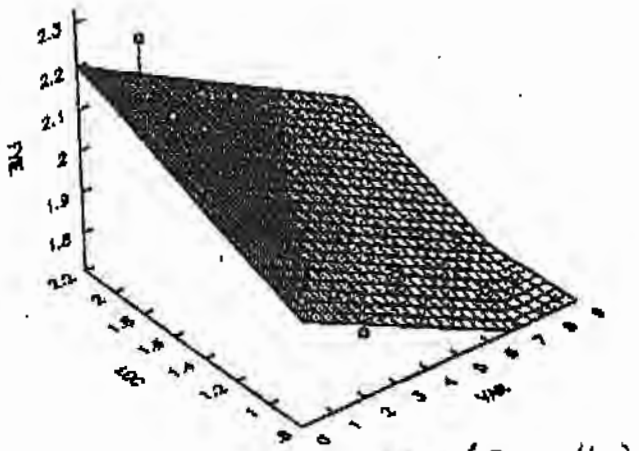

Fig. 1 Varieties ranked in order of yield (tonnes/ha)
Loc. 1 = Narrabri Loc. 2 = Merah North

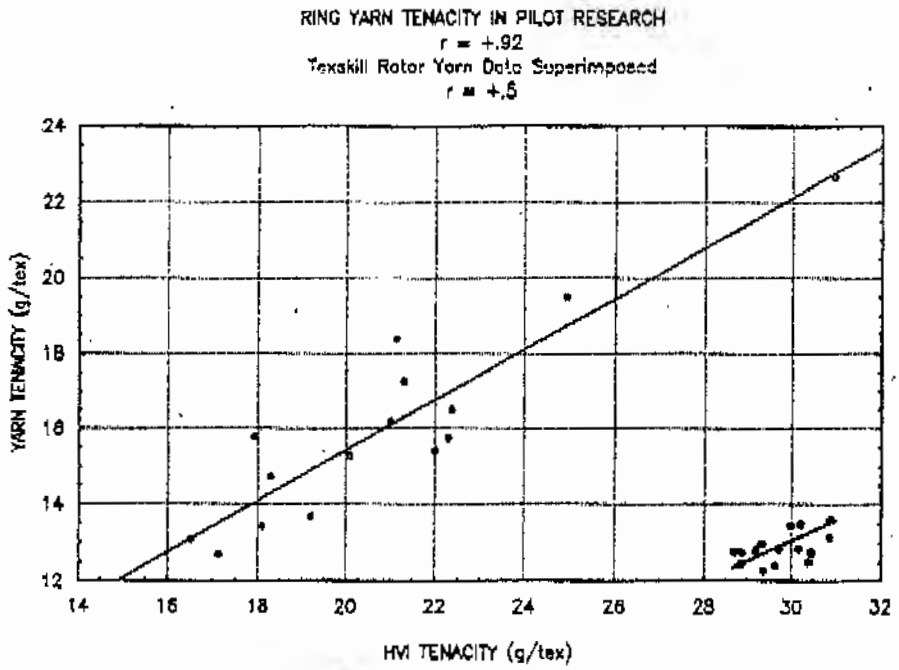

Fig. 2. Tenacity is one of the properties having a close link between fibre and yarn

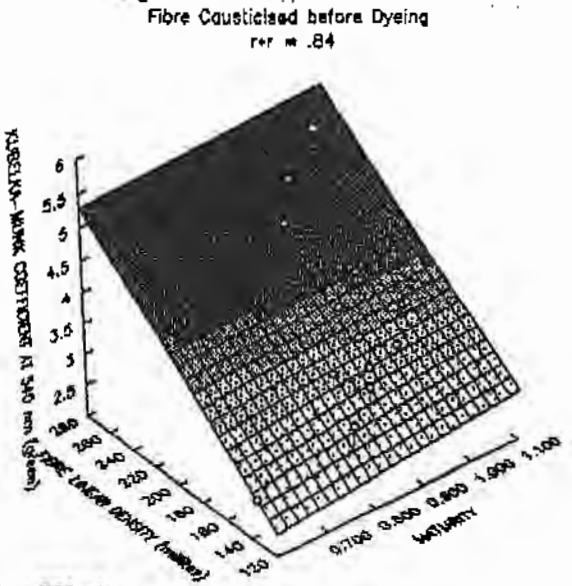

Fig. 3. Effect of Fibre Fineness and Maturity on Colour Depth