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Classing Merino fleeces into uniform lines with predicted adult fibre diameters

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ABSTRACT

The effectiveness of 3 wool classing methods, to separate fleeces into uniform lines of different mean fibre diameter (MFD) and to maximise net financial returns were compared. The methods were predictive (i.e. uses hogget MFD), objective (i.e. adult MFD) and subjective (i.e. visual). A flock of mixed-age Merino ewes, (n = 2,640; adult MFD = 19.9 ± SD 1.3 µm) were randomly drafted into predictive, objective and subjective groups for midside sampling and measurement of adult MFD pre-shearing. Predicted MFD was calculated from the correlation of hogget with adult MFD.

MFD of grab-samples of lines were, predictive 20.0 µm, objective 20.1 µm, and subjective 19.9 µm. The % CV of fibre diameter of grab-samples of objective lines was 0.4 and 0.9 less than predictive and subjective respectively. For a range of prices, premiums for the fine edge of the clip were generally insufficient to cover objective measurement costs.

Keywords: Merino; fleece classing; fibre diameter; prediction.

INTRODUCTION

Wool classing aims to separate wool with different processing characteristics and manufacturing uses into uniform lines. The dominance of fibre diameter (FD) in processing and end-product performance makes fleece midside mean fibre diameter (MFD) the trait of most economic importance for fleece classification. Studies have shown that MFD accounts for 80 to 90% of variation in prices of clean Merino fleece wool (Pattinson, 1981; Ford, 1989). An alternative to traditional subjective classing is objective classification of individual fleeces by MFD. This practice is encouraged by a curvilinear increase in price with reducing MFD. Interest in objective classing increased in the 1980's when wool prices were high (Andrews and Hawker, 1986; Charlton and David, 1987), but has declined along with price in recent years.

Another alternative is prediction of adult MFD from hogget MFD. Repeatabilities of MFD between years in wether trials were 0.86 to 0.88 (Cottle and Wilkinson, 1989) and 0.72 to 0.87 in fine wool ewes at 16 months and mature ages (K.G. Dodds, pers. comm.). Prediction of adult MFD may provide a cost-effective option for classing wool that is cheaper than annual objective tests and more accurate than annual subjective classing. This study examined that hypothesis by investigation of the effectiveness of 3 classing methods to produce lines of wool for a range of MFD classifications.

MATERIALS AND METHODS

The 2,640 hill-flock, mixed-age Merino ewes (MFD = 19.9 ± SD 1.3 µm) at AgResearch, Tara Hills Research Station, Omarama, were randomly allocated within ages to 3 groups of about 880 ewes, midside sampled and tested for MFD by airflow (IWTO 1990). Hogget (10 months age) midside samples were collected annually in August for MFD testing. Ewes were shorn in mid-September 1991, and fleeces were skirted, and classed by a registered classer. Classing methods (i.e. treatment groups) were: (1) FD10PRED – objective classing by prediction of adult MFD in 1991 from midside test at 10 months age. (2) FDACT – objective classing by the sheep's actual MFD measured before 1991 shearing. (3) FDVIS – traditional subjective classing of the 1991 fleeces. FD10PRED and FDACT micron groups were compiled from respective MFD rankings. Exactly 2,465 fleeces were in the trial, after 175 were excluded for fleece faults (e.g. discoloration, short/tender staples) and dubious identities. A few fleeces were visually assessed with clearly incorrect MFD in FD10PRED and FDACT and these were reclassed to the line of 'best visual fit'. The wool was accumulated at the Wrightson Wool Store, Dunedin, for core and grab-sampling and airflow FD testing, and then similar lines were merged (i.e. in accordance with the Code of Practice for FD, length, vegetable content etc.) into lots for auction selling with objective specifications and representative display samples. Grab-samples from the lines were measured for FD variability by Laserscan (IWTO 1993).

For prediction of MFD, it was assumed the genetic change of MFD between age groups was negligible. Yearly means of the hogget MFD's were adjusted for environ–mental variation across all 5 years. The MFD repeatability r = 0.7 was adopted from analysis of data from other fine wool flocks (K.G. Dodds, pers. comm.). A linear equation y = a + bx was developed, where y is the predicted MFD, x denotes the (adjusted) hogget MFD (with mean m_x). If m_y denotes the mean of the actual MFD, then coefficient b, may be calculated from the formula $b = rm_y/m_x$ where m_x is known, but m_y may be unknown, and can be approxi-

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mated. This formula assumes a constant CV for MFD. Thus $a = m_y - bm_x = (1 - r)m_y$, hence $y = m_y (1 - r + rx/m_x)$, giving the equation, predicted MFD = constant + 0.748 x MFD at 10 months.

Classing costs were calculated from typical on-farm inputs of staff, time and materials. Gross cost components per sheep for each classing method for a lifetime of 6 years were, FDVIS (classer fee $2.40), FD10PRED (classer fee $1.50; sampling and wool loss $1.02; MFD test $2.50; data handling $0.69; drafting $0.15) and FDACT (classer fee $1.50; sampling and wool loss $6.12; MFD test $15.00; data handling $2.76). Net costs were gross costs less benefits of hogget selection and fleece wool. Benefits were, FDVIS (nil), FD10PRED (selection $1.22; fleece $2.00); FDACT (selection $2.00). Net returns for a range of auction prices of sale lots, from different seasons and environments, rather than individual flocks, were calculated with net classing costs deducted.

RESULTS

All classing methods were effective in the separation of the wool into distinct lines. Core tests of finest and coarsest classed lines had differences of 2.1 µm in FDVIS, 2.2 µm, in FD10PRED and 2.9 µm in FDACT. In the 5 lines of both FD10PRED and FDACT, more finer wool was identified than with the 4 lines of FDVIS. The coefficient of variation of FD (FDcv) of grab-samples ranged from 16.9 to 21.5% across lines and classing methods (Table 1). The mean values for FDACT were 0.4 and 0.9 lower than for FD10PRED and FDVIS respectively.

Annual net costs per sheep were FDVIS $0.40, FD10PRED $0.44 and FDACT $3.90. Table 2 shows net returns per kg were highest with FD10PRED in 1991, FDVIS in moderate and high price years and nil classing in a poor year. FDVIS was always within $0.05/kg of the most profitable method. Net returns of classing methods for the 4 years were within 7% of the average net return ($/kg), with the greatest difference $2.09/kg between FDVIS and FDACT in a year of moderate prices.

Fleece MFD of ewes at 10 months and adult ages overall, were positively correlated r = 0.62, ($p<0.001$), with a range across birth years of 0.54 to 0.71. The overall MFD for adult ewes at 19.9 µm was 1.0 µm coarser than their hogget values. Except for the coarser lines, SD's of fleece midside MFD's in FD10PRED and FDVIS were clustered between 0.9 and 1.3 µm with FDACT lines grouped below 0.4 µm (Fig. 1). Reclassing fleeces in FDACT (1.3%) and FD10PRED (1.9%) into subjectively more appropriate lines (i.e. average shift was 1.8 lines or ± 1 µm) reduced the SD's of MFD's of affected lines in respective classing groups. There was a significant ($p<0.001$) linear relationship between actual MFD and predicted MFD (Fig. 2), with slope 1.05 (SE ± 0.03) and intercept -1.11 (± 0.57). Actual MFD was the most accurate predictor of core test FD, with a mean difference 0.09 (SE ± 0.07) µm, compared with 0.25 ± 0.09 µm and 0.13 ± 0.11 µm for predicted MFD and grab-sample FD respectively.

TABLE 1: Wool weight, fibre diameter and variability of lines within each classing method.

Line	MFD group or description	Wool weight[1] (kg)	Midside Actual MFD[2] (µm)	Midside Predicted MFD (µm)	Core test FD[2] (µm)	Grab sample FD (µm)	Grab sample FDsd[3] (µm)	Grab sample FDcv[4] (%)
FD10PRED (predictive)								
A	17.8-19.1	123	18.5	18.8	18.6	18.0	3.4	18.9
B	19.1-19.5	431	19.1	19.4	19.2	19.1	3.7	19.4
C	19.5-19.9	489	19.3	19.7	19.7	19.0	3.4	17.9
D	19.9-20.5	682	20.1	20.2	19.9	20.2	3.7	18.3
E	20.5+	687	21.0	21.0	20.8	21.3	4.1	19.2
Mean[5]		[2412]	19.9	20.1	19.9	20.0	3.7	18.7
FDACT (objective)								
F	15.9-18.0	153	17.7	19.5	17.9	18.3	3.2	17.5
G	18.1-18.9	387	18.6	19.6	18.8	18.9	3.2	16.9
H	19.0-19.5	533	19.3	19.9	19.6	19.6	3.5	17.9
I	19.6-20.4	581	20.0	20.2	19.9	20.5	3.8	18.5
J	20.5+	889	21.4	20.6	20.8	21.0	4.0	19.0
Mean[5]		[2543]	20.0	20.1	19.9	20.1	3.7	18.3
FDVIS (subjective)								
K	Extra Fine	229	19.1	19.8	18.9	19.0	3.3	17.4
L	Fine	1549	19.7	20.0	19.6	19.4	3.6	18.6
M	Medium	684	20.3	20.2	20.2	21.0	4.3	20.5
N	Strong	164	21.4	20.6	21.0	20.9	4.5	21.5
Mean[5]		[2626]	19.9	20.1	19.8	19.9	3.8	19.2
Overall[5]		[7581]	19.9	20.1	19.9	20.0	3.7	18.7

[1] Greasy, [2] Measured by airflow, [3] SD of FD, [4] CV of FD, [5] Weighted by wool weight.

TABLE 2: Net returns for three classing methods and a nil classing option, from lines described in Table 1 for a range of auction clean prices.

Year	1989 (high)		1994 (moderate)		1992 (poor)		1991 (actual)	
Classing method	Price[1] ($/kg)	Return ($/kg)	Price[1] ($/kg)	Return ($/kg)	Price[1] ($/kg)	Return ($/kg)	Price ($/kg)	Return ($/kg)
FD10PRED	18.45	18.24	14.74	14.53	8.10	7.89	12.34	12.13
FDACT	19.51	17.70	14.96	13.15	8.20	6.39	12.42	10.61
FDVIS	19.07	18.88	15.43	15.24	8.20	8.01	12.27	12.08
Nil classing	18.60	18.60	14.85	14.85	8.05	8.05	*	*

[1] Full fleece, BB/B style, combing length • 75 mm wool, courtesy of S. Britland, Wools of New Zealand.

FIGURE 1: Standard deviations of midside mean fibre diameters of lines for FD10PRED (predicted adult MFD), FDACT (actual MFD) and FDVIS (visual) classing methods. Included are the lines in FD10PRED that would have been obtained without reclassing.

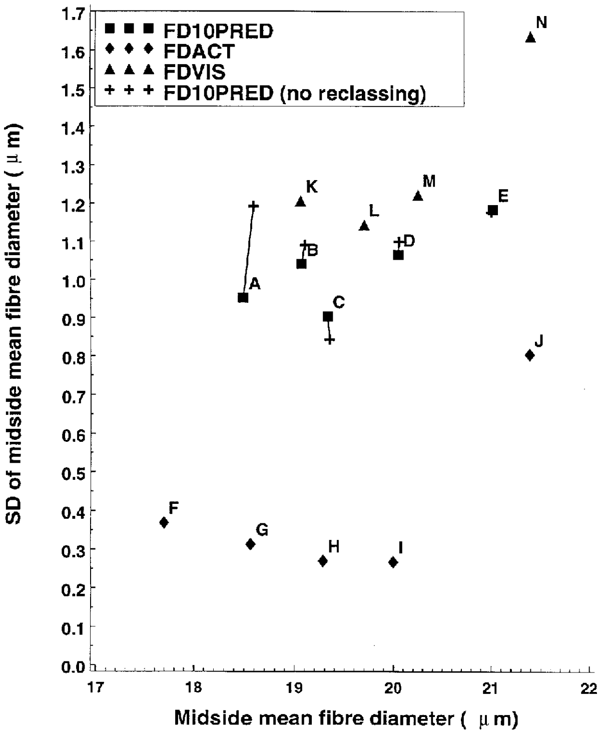
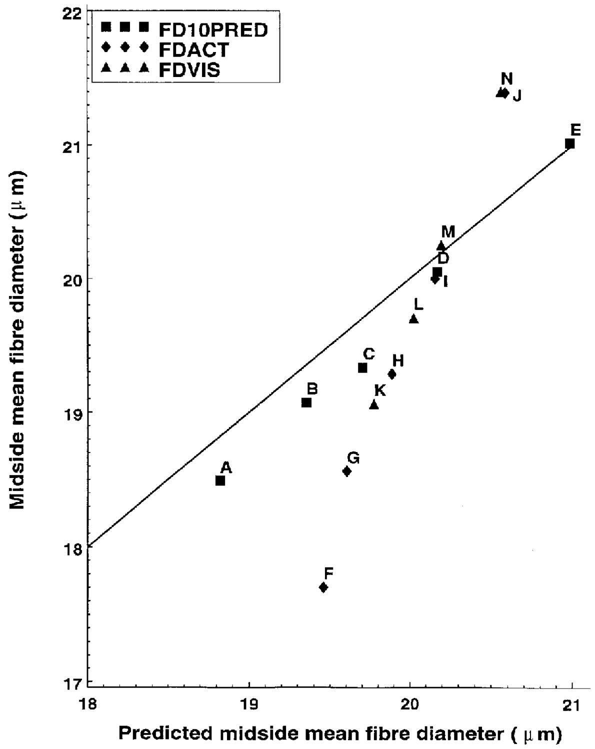


FIGURE 2: Relationships of average mean fibre diameter of lines of actual midside MFD with predicted MFD, for FD10PRED, FDACT and FDVIS classing methods. The line of equivalence is also shown.



DISCUSSION

All 3 classing methods separated the wool (without overlap of core test FD's) into distinct ranges of low to high FD lines. The 2 objective classing methods were able to differentiate more lines and finer lines than FDVIS, but the discrimination of the subjective method achieved consistent separations of 0.6 to 0.8 µm between lines. None of the classing methods were able to markedly reduce the variability of FD in individual lines, relative to the variability in the pool from which the lines were separated. This is not surprising given that 80% of the variation in FD occurs within the fleece (Whiteley, 1972; Baudinet and Jowsey, 1978), so that the classing methods had only 20% of the variation to improve upon. Variation was slightly less for FDACT than the other two methods and there was a suggestion that it was higher for higher FD lines, particularly with FDVIS. However, all 3 methods achieved the principal intention of separation of fleeces into lines differing in MFD, and any differences in variability within lines were secondary. It is unlikely that FD10PRED would have an adverse effect on processing or end uses. Reclassing outlier fleeces (Fig. 1) removed some of the variation in midside MFD's, reducing it further below the levels in FDVIS, and suggests there is a classer's role in quality management of objectively classed lines.

The economic analysis showed that FD10PRED gave slightly lower returns than FDVIS when compared across a range of price scenarios. The return with FDACT was best when prices were high, but as prices declined, classing methods of lower cost became more profitable and in the year of poorest prices, nil classing was the best option. In general, for FD10PRED and FDACT to be profitable would require increases in the fine edge (i.e. 25% of the clip) of about $2/kg and $8/kg respectively. Alternatively, for them to be profitable at current auction prices, clips would have to average less than 19.0 µm and 18.5 µm respectively, and have a fine edge under 18.5 µm

(FD10PRED) or 17.0 µm (FDACT). A repeat economic analysis with core test FD's reduced by 0.5 µm showed little advantage to FDVIS over FD10PRED, but FDACT had a slight advantage over both methods with the 1989 prices ($0.59/kg better than FDVIS). There is potential with objective methods to increase returns when a seasonal price trend is indicated, such as a buyer threshold for sale lots with an FD < 18.0 µm. This can be achieved by exploiting the close relationship of midside MFD with core test FD for separation of lines to order.

These analyses suggest that woolgrowers' can benefit from choice of classing method and precision according to anticipated wool price, increasing inputs when premiums for fine wools are high and decreasing them when premiums are not. The most cost effective method over the range of scenarios explored in this study was FDVIS. The extent to which these findings can be applied to the Merino industry depends on the FD and its variation in other flocks, and the skills of other woolclassers, and this needs further study.

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