THE INHERITANCE OF AND ASSOCIATIONS AMONG SOME PRODUCTION TRAITS IN YOUNG AUSTRALIAN ALPACAS

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SUMMARY

Phenotypic and genetic parameters for young Australian Alpacas are presented and compared with Alpaca reports in the literature, as well as with estimates for South Australian (SA) Merino sheep. The traits studied were greasy and clean fleece weight (GFW and CFW), fibre yield (YLD), mean fibre diameter (FD), coefficient of variation of FD (CVFD), staple length (SL) and live weight (LW). Most mean values fell within those found in the literature, except for YLD, which was greater in our study. YLD, FD, SL and LW were greater than for Merino sheep, whereas the opposite was true for GFW and CFW. The heritability was high (0.37 or greater) for all traits. The estimate for LW fell within the range in the literature, whereas for GFW and SL our values were greater. Relative to those for SA Merino sheep our estimates were greater for GFW, CFW, CVFD and LW, whereas they were lower for the remaining traits, except for SL, which had the same value. Phenotypic correlations from the literature were in broad agreement with ours. Those from SA Merino hoggets, except for some correlations involving YLD and SL, were in remarkable agreement with ours. The practical implications of the findings are discussed.

Keywords: Alpacas, phenotypic correlations, heritabilities

INTRODUCTION

Phenotypic and genetic parameters are part of the 'building blocks' required in the design of effective livestock genetic improvement programs. There is currently no published information dealing with this aspect of Alpacas in Australia, and very little worldwide.

In this paper we report results of a preliminary analysis of young Alpaca records, we compare them with other reports in the literature, and we comment on the likely implications of our findings. We also contrast the Alpaca phenotypic and genetic parameters with those derived from Merino sheep.

MATERIALS AND METHODS

The data were collected over four years (1994 to 1997) in five cooperating herds (two in South Australia and three in Victoria). The 1994 records were discarded because of uncertainty about the duration of the preceding period of fibre growth. The majority of the Alpacas recorded were of the Huacaya phenotype, although some properties had Suri as well. The latter were discarded for the present study. Animals included in the analysis were over one year old and less than two years old at shearing time (category usually called 'tuis').

Individual, sire and dam identities were known for most animals. An animal model was fitted using the computer program ASREML (Gilmour 1997), including property (1 to 5), year of record (1995 to 1997) and sex (female or male) as fixed effects. The data set used in the analysis consisted of 435 records, with 40 sires represented, six of which were used in more than one property.

Greasy fleece weight (GFW) was recorded during shearing, and a sample from the mid-side of each animal was taken for the measurement of mean fibre diameter (FD), coefficient of variation of FD (CVFD), fibre yield (YLD) and staple length (SL). Live weight (LW) was recorded off shears.

RESULTS AND DISCUSSION

Table 1 shows the means, phenotypic standard deviations and heritability estimates of the traits studied. For comparative purposes we show the corresponding range of values in the work reviewed by Chavez (1991) and in that reported by Wuliji *et al* (1992), as well as estimates from South Australian (SA) Merino sheep (ewe hoggets, 16 months old and 12 months of wool growth). We found no reports on CVFD for Alpacas in the work reviewed. Other mean values fell within those reported in the literature, with the exception of YLD, which was considerably greater in our study. Relative to SA Merino sheep the Alpaca means were greater for all traits, except GFW, CFW and CVFD. The phenotypic standard deviations were greater in Alpacas for all traits, except GFW, CFW and YLD. Note that YLD was about 20 per cent greater in Alpacas than in SA Merino sheep, but it had less phenotypic variation.

The heritability was high for all traits. Few estimates or suggested values were found in the literature. Our estimate for LW fell within the range reported in the literature, whereas for GFW and SL our values were greater. Relative to those for SA Merino sheep our estimates were greater for GFW, CFW, CVFD and LW, whereas they were lower for the remaining traits, except for SL, in which case we obtained the same value.

Overall one could suggest that in Australian Alpacas there is greater scope for selection for GFW and CFW than in SA Merino sheep, whereas the opposite may be true for YLD. With regards to other traits the opportunities would be comparable. Note however, that our estimates for Alpacas have large standard errors, and our 'preferred' or 'accepted' parameter values may change when more information becomes available. By contrast, the estimates for SA Merino sheep have much lower standard errors. Note also that because our Alpaca data were collected on private properties in which sires of different sources were used, and in which we had very limited control over the husbandry of the animals, there could be biases contributing to our parameter estimates.

Table 1. Means (μ), phenotypic standard deviations (σ_P) heritability estimates [h^2(s.e.)] and phenotypic correlations (s.e.)

	GFW	YLD	CFW	FD	CVFD	SL	LW
μ	3.12[A]	92.7	2.85	25.7	24.1	165	63.7
	1.7 - 3.64[B]	82.0 - 84.7	1.6 - 3.05	23.4 - 27.3	n.a.	124 - 215	40.6 - 67.8
	6.07[C]	71.9	4.36	22.2	24.1	115	49.2
σ_P	0.762	2.73	0.702	2.97	3.21	40.0	12.1
	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	0.935	5.01	0.736	1.93	2.92	11.8	5.53
h^2	0.83 (0.35)	0.37 (0.32)	0.79 (0.36)	0.67 (0.30)	0.90 (0.30)	0.63 (0.48)	0.56 (0.34)
	0.21–0.38	n.a.	n.a.	n.a.	n.a.	0.43	0.27–0.69
	0.41 (0.06)	0.66 (0.05)	0.42 (0.06)	0.72 (0.06)	0.71 (0.06)	0.63 (0.06)	0.43 (0.06)
GFW		-0.10 (0.11)	0.99 (0.01)	0.25 (0.11)	-0.03 (0.11)	0.58 (0.08)	0.32 (0.10)
		n.a.	n.a.	n.a.	n.a.	0.25 – 0.30	0.40 – 0.58
		-0.07 (0.02)	0.89 (0.01)	0.27 (0.02)	0.06 (0.02)	0.21 (0.02)	0.40 (0.02)
YLD			0.02 (0.11)	0.21 (0.09)	0.05 (0.09)	-0.08 (0.10)	-0.08 (0.10)
			n.a.	0.27	n.a.	n.a.	n.a.
			0.38 (0.02)	0.06 (0.03)	-0.16 (0.02)	0.23 (0.02)	0.05 (0.03)
CFW				0.29 (0.10)	-0.02 (0.11)	0.58 (0.08)	0.32 (0.10)
				n.a.	n.a.	n.a.	n.a.
				0.27 (0.02)	-0.01 (0.02)	0.30 (0.02)	0.40 (0.02)
FD					0.01 (0.10)	0.19 (0.11)	0.29 (0.09)
					n.a.	n.a.	n.a.
					-0.15 (0.03)	0.34 (0.02)	0.23 (0.02)
CVFD						0.20 (0.11)	-0.18 (0.10)
						n.a.	n.a.
						-0.24 (0.02)	-0.17 (0.02)
SL							0.12 (0.11)
							0.12
							0.23 (0.02)

[A] Estimates for Australian Alpacas; [B] Range of values from the literature; [C] Estimates from the SA Merino project described by Gifford *et al* (1993); n.a. = not available.

Table 1 also shows the phenotypic correlations among the traits studied. We also estimated genetic correlations, but with the limited size of our data set these had very large standard errors (often greater than the estimate itself). By contrast, phenotypic correlations can be estimated much more accurately, and may in the interim be interpreted as good indicators of the magnitude and sign of their genetic counterparts (Lynch and Walsh 1997, p.639). Consequently, we decided on presenting and discussing only phenotypic correlations. Very few estimates were available in the literature, but for the cases that there were, there was broad agreement with ours. Regarding the phenotypic correlations in SA Merino hoggets, with the exception of some correlations involving YLD and SL, there was remarkable agreement with our Alpaca estimates. The exceptions may be explained by the greater (and less variable) YLD in Alpacas (Table 1), and by a degree of uncertainty about the number of months of fibre growth associated with some SL records. The very high correlation between GFW and CFW suggests that there would be little justification for measuring YLD and CFW in genetic evaluation services for Alpacas (note that our estimate of the genetic correlation also was 0.99).

CONCLUDING REMARKS

In this paper we provide the first phenotypic and genetic parameters for Australian Alpacas. The data analysed were collected in a different set of environmental conditions from that experienced in the Alpaca studies found in the literature, and also from the SA Merino study. Although this reduces the certainty with which we can make comparative inferences about means and parameters there are some messages that may be safely drawn from our study, namely : *(i) Average production levels.* GFW (or CFW) and FD require attention if Australian Alpacas are to become competitive as fibre producing livestock. GFW and CFW were lower than for SA Merino, whereas the opposite was true for FD. By contrast, YLD and SL were at such high levels that further emphasis in those traits would not be justified (unless the shearing interval was less than 12 months, in the case of SL); *(ii) Heritabilities.* Even after allowing for possible sources of (positive) bias in some of the estimates, one may conclude that there is abundant genetic variation and hence scope for genetic improvement in fibre production and quality among Australian Alpacas; and *(iii) Correlations.* With few exceptions, the phenotypic correlatios in Alpacas showed a remarkable agreement with those in Merino sheep. An antagonism between GFW (and CFW) and FD was present, but it was not strong enough that it would prevent the simultaneous improvement of both traits.

It is concluded that our study provides sufficient pointers to confidently proceed with the development and implementation of scientifically based genetic improvement programs for Australian Alpacas.

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REFERENCES

Charry, A.A., Lawrie, J.W. and Johnson, D. (1997) "Technical Report for the Australian Alpaca Assoc." Aust. Alpaca Assoc. Inc., Victoria

Chavez, J.F. (1991) In: "Avances y Perspectivas del Conocimiento de los Cámelidos Sud Americanos" p. 149, Oficina Regional de lo FAO, Santiago, Chile

Gifford, D.R., Ponzoni, R.W., Ancell, P., Walkley, J. and Grimson, R. (1993) In: "Merino Resource Flocks in Australia" Proc. Natnl. Workshop, Turretfield Research Centre, Rosedale, SA p. 15, editors R.W.Ponzoni and D.R. Gifford

Gilmour, A.R. (1997) *Proc. Assoc. Advmt. Anim. Breed. Genet.* **12**:386

Lynch, M. and Walsh, B. (1997) "Genetic Analysis of Quantitative Traits" Sinauer Assoc. Inc. USA.

Wuliji, T., Davis, G.H., Andrews, R.N., Turner, P., Moore, G.H. and Dodds, K.G. (1992) *Proc. N Z Soc. Anim. Prod.* **52**:289