GENETIC PARAMETERS OF GROWTH AND CARCASS QUALITY OF LAMBS AT THE FRENCH PROGENY-TEST STATION BERRYTEST

B. Bibé[1], J.C. Brunel[2], Y. Bourdillon[2], D. Loradoux[3], M.H. Gordy[3], J.L. Weisbecker[4] and J. Bouix[1]

[1] INRA, Station d'Amélioration Génétique des Animaux, Castanet-Tolosan 31326, France
[2] INRA, Domaine de la Sapinière, Osmoy 18390, France
[3] Berrytest, route de Villabon, Baugy 18800, France
[4] INRA, UEPSA, Domaine Duclos, Petit-Bourg 97170, Guadeloupe

INTRODUCTION

The Berrytest progeny-test station was created in year 1977. The program was defined in order to simultaneously index for meat qualities, the rams issued from breeding plans, and also estimate the required genetic parameters. First results on genetic parameters were published in 1986 by Bouix *et al*., based on anonymous rams' identification, and therefore considered as unrelated. These results come from the period 1989 - 2001, with known national identification.

MATERIAL AND METHODS

The Berrytest program. The station is a farm with 1300 INRA-401 ewes (Tchamitchian *et al*, 1986) that are artificially mated each 8 months, usually by 5 groups of 10 rams. Each group is composed by 10 of the better male lambs issued from the individual testing station of the Berrichon-du-Cher, Ile-de-France, Charmoise, Vendéen, Texel, Charollais, Rouge-de-l'Ouest and Suffolk breeds. The objective is to get 25 to 30 lambs by sire.

Lambs are weaned at 8 weeks of age and intensively fattened indoor. Live weights are recorded at birth (LWB), weaning and 70 days of age, considered as the effective beginning of fattening. Growth rate is estimated from birth to 70 days (ADG70), further during fattening till the departure (ADGfat), and an overall (ADGtot). Lambs are slaughtered once a week in a commercial abattoir at a fixed live weight of 39 kg for males, and 33 kg for females, requiring a by-week control. Cold carcasses are controlled after 24 hours. Dressing percentage (DR%) is the ratio between cold carcass and live weights. Size and shape are emphasized by the between tail and neck length (Len) and the largest width at hind legs (Wid) and the "blocky" ratio W/L. Expanded scores adapted for better accuracy from the French 5-levels grading system EUROP, are used for conformation (ConfS with 15 levels), external (EFS) and internal (IFS) fat with 9 levels. Better estimation of superficial fat is provided by the back fat depth on the 12th rib. Evaluation of the muscular development is improved by the eye-muscle area (EMA) after a transversal section at the 12th rib. Only 10 lambs by sire, among 20 to 30 are concerned. Bone (Bone) development is measured by the width of tarsian-metatarsian internal maleol.

Statistical analysis. Data from the 16th to the 34th progeny testing series are analyzed by a sire model with the Groeneveld's VCE software. Sires and two ancestors' generations are considered. Fixed effects are a combination between sex, litter-size and rearing type of lambs, a second one between testing series and within-series mating week, a third between age and genetic type of dams, and the last between sire breed and group within-breed. Groups depend on the sires' year of birth: a group is defined by a series of three years.

Animals. The total number of weaned lambs is 23770; among them 21121 carcasses and 7491 crosscuts were controlled. Lambs are sired by 832 rams. Among them, 338 are sons of 180 previously tested sires, 195 are sons of 67 non-tested sires; the 299 remaining rams are issued each from one non-tested sire. A total of 6345 individuals are involved in the sires' pedigree.

RESULTS

Performances. Results are typical of an intensive production of meat lambs with an overall daily gain near of 300 g from birth to slaughtering (Table 1), despite a very high litter size at birth (212 %), numerous double-suckling (54 %) and artificially reared (21 %) lambs. Age at slaughter of around 110 days is also typical of indoor meat lambs; the final weights of 39 and 33 kg were chosen in order to get similar ages and a high fat level for male and female lambs, for a good expression of the genetic rams' potentials. The mean values of 4.1 mm for back fat depth (BFD), and more than 6 for the 9-levels IFS and EFS, show that lambs were effectively reared beyond of the commercial optimal requirements for meat production.

Table 1. Means, heritabilities (h^2) and additive genetic standard deviation

	Analyzed traits		Mean	h^2	Genetic variability	
					SD[1]	CV[2] (%)
1	Live Weight at Birth (kg)	LWB	4.0	0.18	0.31	7.8
2	ADG 0-70 (g)	ADG70	281	0.18	24	8.4
3	Fattening ADG (g)	ADGfat	310	0.26	29	9.2
4	Overall ADG (g)	ADGtot	295	0.22	18	6.2
5	Dressing percentage (%)	DR%	46.9	0.35	1.22	2.6
6	Bone (mm)	Bone	29.4	0.23	0.67	2.3
7	Internal Fat Score (1-9)	IFS	6.5	0.24	0.32	4.9
8	External Fat Score (1-9)	EFS	6.4	0.26	0.30	4.8
9	Back Fat Depth (mm)	BFD	4.1	0.29	0.77	18.9
10	Carcass Length (cm)	Len	61.2	0.35	1.08	1.8
11	Carcass Width (cm)	Wid	21.0	0.30	0.33	1.6
12	"Blocky" ratio Wid/Len (%)	W/L	34.4	0.42	0.91	2.6
13	Conformation Score (1-15)	ConfS	10.8	0.30	0.68	6.3
14	Eye-Muscle Area (cm^2)	EMA	13.1	0.59	0.95	7.3

[1] Additive genetic standard deviation
[2] Additive genetic coefficient of variation

Heritabilities and additive genetic variability. Values of heritability are generally comprised between 0.25 and 0.35 (Table 1), except for LWB and ADG70 (0.18) and consequently for ADGtot (0.22). Greater values are found for the carcasses' "blocky" ratio W/L (0.42) and moreover for EMA (0.59). Beyond heritability values, additive genetic standard-deviation values indicate the potential of genetic improvement: around 20 g for ADG, 1.2 % for DR%, 0.77 mm for BFD and 0.20 to 0.25 level of the EUROP conformation grid. Expressed as coefficient of variation reported to the mean values, genetic variability is very high for fat (BFD: 18.9 %) and for growth (around 8 %), lower, but consistent for muscular development: 6.3 % and 7.3 % for ConfS and EMA. In the opposite, size and shape appear as very few variable at fixed weight: around of 2 % for Len, Wid, W/L and also for bone.

Genetic and phenotypic correlations within groups of traits. Homologous genetic and phenotypic correlations are generally very similar, slightly lower for the phenotypic ones (Table 2). Within-group relations of LWB and ADG traits are low (0.12 to 0.38), except obviously with overall ADGtot. Internal and external fat are not closely linked, with genetic and phenotypic correlation values of around 0.40 and 0.35 respectively. Correlations between carcasses' length (Len) and width (Wid) are nil for the phenotypic, and only –0.22 for the genetic one. Conformation is negatively related to Len with r_g = –0.40 and r_p = –0.15, respectively for genetic and phenotypic correlations, and positively to Wid: r_g = 0.37, r_p = 0.28. Consequently there is a strong genetic correlation of 0.50 between conformation and W/L. Conformation is positively related to EMA (r_g = 0.22, r_p = 0.20). Genetic and phenotypic correlations between EMA and Wid are equal to 0.30, but EMA is independent of Len.

Table 2. Heritabilities (bold on diagonal), genetic (above diagonal) and phenotypic correlations (under diagonal in italic)

		1 LWB	2 ADG 70	3 ADG fat	4 ADG tot	5 DR%	6 Bone	7 IFS	8 EFS	9 BFD	10 Len	11 Wid	12 W/L	13 Conf S	14 EMA
1	LWB	**.18**	.12	.13	.16	0	.48	-.15	-.21	-.24	.07	-.02	-.06	-.09	.01
2	ADG70	*.34*	**.18**	.38	.87	-.16	.21	-.05	.08	.01	.04	.11	.04	0	-.10
3	ADGfat	*.18*	*.23*	**.26**	.80	-.12	.24	-.10	-.07	-.04	.07	.06	-.01	-.04	.02
4	ADGtot	*.35*	*.86*	*.66*	**.22**	-.17	-.05	-.11	-.02	-.05	.08	.08	0	-.03	-.05
5	DR	*-.10*	*0*	*-.20*	*-.09*	**.35**	.05	.30	.12	.16	.08	.30	.12	.39	.47
6	Bone	*.34*	*.19*	*.18*	*.07*	*-.03*	**.23**	-.18	-.16	-.18	.13	.10	-.02	.02	-.02
7	IFS	*-.15*	*-.01*	*-.07*	*-.03*	*.25*	*-.18*	**.24**	.37	.43	-.08	.02	.07	.06	.10
8	EFS	*-.18*	*-.02*	*-.04*	*-.03*	*.21*	*-.16*	*.37*	**.26**	.92	-.10	.04	.10	.12	-.19
9	BFD	*-.23*	*-.08*	*-.06*	*.07*	*.26*	*-.18*	*.34*	*.70*	**.29**	-.09	.03	.09	.11	-.21
10	Len	*.08*	*.07*	*.01*	*.08*	*.06*	*.13*	*-.08*	*-.10*	*-.09*	**.35**	-.22	-.81	-.40	-.04
11	Wid	*.02*	*.08*	*.04*	*.08*	*.30*	*.10*	*.02*	*.04*	*.03*	*.05*	**.30**	.76	.37	.30
12	W/L	*-.05*	*.01*	*.02*	*.02*	*.21*	*-.02*	*.07*	*.10*	*.09*	*-.70*	*.67*	**.42**	.50	.22
13	ConfS	*-.07*	*.11*	*.06*	*.12*	*.30*	*.02*	*.06*	*.12*	*.11*	*-.15*	*.28*	*.31*	**.30**	.22
14	EMA	*-.03*	*-.01*	*.09*	*.07*	*.42*	*.04*	*.05*	*-.02*	*-.02*	*.01*	*.29*	*.20*	*.27*	**.59**

Genetic and phenotypic correlations between groups of traits. A main result is independence between growth, fat and conformation-muscle. DR% is firstly depending on muscular development with genetic correlations of 0.39 with ConfS and 0.47 with EMA, and secondly on fat. On an other hand, Bone is only related with LWB (r_g=0.48, r_p=0.34).

DISCUSSION AND CONCLUSIONS

Heritabilities of growth and fat traits agree with published literature (Fogarty, 1995). Oppositely, results on conformation-muscular development with heritabilities of 0.30 for ConfS and 0.59 for EMA, and their independence with fat are different (Pollott *et al*., 1994). A first cause is probably slaughtering at fixed live-weight, which avoids positive artificial correlation between fat and muscular development due to weight, and negative one due to an adjustment for carcass-weight. A second cause is the essential basis of the EUROP grading system: a separate evaluation of fat level and muscular thickness without reciprocal influence. So it is very important to clarify the meaning given to conformation (Nsoso *et al*., 2000).
Relation between DR% and conformation-muscle development is high because at a fixed live-weight more muscled lambs give heavier carcasses. A same remark is true for fatty animals, but with a lighter relationship, because a part of fat stays on the fifth quarter.
Heritability of EMA is higher than most of published values, except namely Moreno *et al*. (2001) in INRA-401 with the same protocol. It is likely due, beyond fixed live-weight, to a special cut at the 12th rib, with respect of the shape of *longisimus dorsi*. However, the genetic correlation value of 0.22 with ConfS is curiously smaller than the usual values of 0.30 to 0.50, estimated when verifying genetic parameter before each indexation' series, or by Moreno *et al*. (2001) with r_g = 0.33. Eye muscle (loin) is one of the 3 main sites considered for conformation grading. An other site is gigot that development can be evaluated by Wid (r_g = 0.37 with ConfS, and 0.50 with W/L), and also by the lateral profile; we are studying how to measure this important trait (Laville *et al*, 2002). Shoulder is the 3rd site, but without measurement today.
These parameters confirm previous results (Bouix *et al*., 1986) as basis of the French selection plan for lambs' qualities, with a progeny-test evaluation of rams following a previous individual test of the young males issued from the best evaluated sires.

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REFERENCES

Bouix, J., Bibé, B., Lefevre, C. and Eychenne, F., (1986) *Proc.11th J.R.O.C.* 115-145.
Fogarty, N.M., (1995) *Anim. Breed. Abstr*. **63** (3) : 101-143.
Laville, E., Bouix, J., Sayd, T., Eychenne, F., Marcq, F., Leroy, P.L., Elsen, J.M. and Bibé B. (2002) *INRA Prod. Anim.* (in press).
Moreno, C., Bouix, J., Brunel, J.C., Weisbecker, J.L., François, D., Lantier, F. and Elsen, J.M. (2001) *Livest. Prod.Sci.* **69** : 227-232.
Nsoso, J.S., Young, M.J. and Beatson, P.R. (2000) *Small Rumin. Res.* **35** : 89-96.
Pollott, G.E., (1994) *Anim. Prod.* **58** : 65-75.
Tchamitchian, L., Lefevre, C., Brunel J.C., Bibé B. and Ricordeau G. (1986) *Proc. 3rd WCGALP* **IX** *:* 535-540.