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Conference paper

INHERITANCE OF PRODUCTION AND LINEAR TYPE TRAITS IN PERFORMANCE-TESTED BELGIAN BLUE BULLS

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Summary

Data on 2139 Belgan Blue bulls having completed the performance test in station were analyzed. The traits observed (production traits) were: weight, height and chest girth at 7 and 13 months, daily gain from 7 to 13 months, feed conversion ratio, price per kilogram of live weight. Among these bulls, 1673 were classified for 20 linear traits. Multiple-trait derivative-free restricted maximum likelihood (MTDFREML) estimates of (co)variance components were obtained for these traits. For the nine production traits, estimates of heritabilities range from 0.14 (Feed Conversion Ratio) to 0.51 (height at 13 months). For the linear traits, the heritabilities range from 0.06 (forelegs) to 0.46 (height). Phenotypic and genetic correlations between weight at 13 months and price per klw on the one hand and the linear traits on the other hand were estimated. Scores for vertical, longitudinal and lateral growth were mainly correlated with weight while the scores for muscular development and to a lesser degree the scores concerning the skeletal body conformation were correlated to the price. The synthetic note for muscling and the synthetic note for skeletal body conformation, both based on their corresponding individual scores, had genetic correlations with the price per klw of 1.0 and 0.79 respectively. In a beef breed like the Belgian Blue, linear traits are good predictors of meat yield and income.

Keywords : Belgian Blue, performance test, linear traits.

Introduction

Performance testing in station is carried out in the Belgian Blue breed since 1974. Bulls selected at the completion of the test are directed either to private breeders or to A.I. centers. The traits recorded during or at the end of the test period concern growth, feed consumption and the price per kilogram of live

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weight. On the other hand, in 1988, a linear scoring system was devised by the Belgian Blue Cattle Society and applied since then to the bulls finishing the test at the age of 13 months. In 1994, the method was extended to the whole population of Belgian Blue registered cows. A description of the traits considered is given elsewhere (Hanset, 1995).The aim of this study was to estimate the amount of genetic variation still present in the breed after the fixation of the mh gene and a period of fifteen years of strong selection and to assess the relation between linear traits and production traits.

Materials and methods

The data concerned 2139 bulls of the Belgian Blue cattle breed having completed the performance test through the period 1988-1996. These bulls born from selected parents were reared in three geographical locations. In a first site, the calves were brought at about one week of age, in a second one at about 5 months and in a third one either at one week or at 5 months but in different and isolated buildings. Consequently in the analysis, four « sites » were taken into account. Whatever the age at entrance, the test started at 7 months to be ended at 13 months. The concentrate was fed ad lib from 6 months to the end with free access to straw. The bulls, allotted in groups of five according to age, were kept in loose-housing on straw bedding. Individual recording of the consumption of concentrate was only achieved for 1099 animals. The traits considered in this study were: at 7 months, weight (We7), height at withers (He7), chest girth (ChG7); at 13 months, weight (We13), height (He13), chest girth (ChG13), average daily gain (G7-13), feed conversion ratio (FCR), price per kilogram of live weight (PKLW) assessed by the panel of breeders in charge of the selection after test. On the other hand, 20 linear traits were scored on a 1 to 50 scale on 1673 bulls through the years 1991-1996. Summary descriptions and abbreviations used are given in Table 2. Height was measured, then converted into a linear score as follows : the deviation of the actual height from the expectation in the general population given the age is multiplied by 2.5 and then added to 25, the most extreme values being 1 and 50. Multiple-trait derivative-free restricted maximum likelihood (MTDFREML) estimates of genetic (co)variance components were calculated (Boldman and Van Vleck, 1991, Boldman et al., 1993). The model of analysis was an animal model with as fixed effect: year x month x site and as covariates: the age at the beginning of the test and/or the age at the end of test according to the trait considered. The number of animals in A-1 was 15844.

Results and discussion

Phenotypic means, standard deviations, coefficients of variation and heritability estimates of the production traits are given in Table 1. Weights, daily gain, feed conversion ratio and price showed the highest coefficients of variation. The individual prices were not corrected for the market fluctuations. The heritability estimates were higher at 13 months than at 7 months for weight, height and chest girth. Traits measured at 13 months had heritabilities above 0.3 except for the feed conversion ratio (0.14). The highest estimates concern height (0.51), weight (0.49) and chest girth (0.40).

Phenotypic means, standard deviations, coefficients of variation and heritability estimates of the type traits are shown in Table 2. With a scale from 1 to 50 to represent the breed range, one expects means and standard deviations approximating 25.5 and 8.23 respectively. Except for height, in fact a measured trait transformed into a linear score as explained above, all standard deviations are below this expectation. Meyer et al. (1987) made the same observation in dairy cattle and proposed as explanation either that the scale was set too wide or that classifiers were reluctant to score in extreme classes. Traits with the lowest standard deviations (below 4.0) : shoulder joint, top line, fore- and rear legs, are traits with score 25 as the anatomical norm, by far the most frequent : therefore a narrower distribution.

Table 1. - MEANS, STANDARD DEVIATIONS, COEFFICIENTS OF VARIATION AND HERITABILITY ESTIMATES FOR PRODUCTION TRAITS

Traits	n	Mean	s.d.	c.v.	h^2
We7 (kg)	2139	285.7	36.6	12.83	0.44
He7 (cm)	2139	104.4	4.0	3.82	0.32
ChG7 (cm)	2135	153.3	8.1	5.30	0.24
We13 (kg)	2139	549.1	50.1	9.12	0.49
He13 (cm)	2139	121.6	3.3	2.76	0.51
ChG13 (cm)	2136	196.7	7.2	3.65	0.40
G7-13 (kg)	2139	1.474	0.186	12.65	0.31
PKLW (bef)	2128	115.7	12.9	11.19	0.30
FCR (kg/kg)	1099	5.670	0.657	11.58	0.14

Heritability estimates range from 0.06 (fore legs) to 0.46 (stature), the lowest concerning the leg traits.

The genetic and phenotypic correlations between the linear traits on the one hand and the weight at 13 months and the price per klw on the other hand are given in Table 3.

Table 2. - MEANS, STANDARD DEVIATIONS, COEFFICIENTS OF VARIATION AND HERITABILITY ESTIMATES FOR TYPE TRAITS

Traits	1	50	Abbrev.	Mean	s.d.	c.v.	h^2
Height	small	tall	HE	32.51	8.39	25.79	0.46
Length	short	long	LE	34.19	5.04	14.74	0.25
Chest Width	narrow	wide	CW	31.65	4.82	15.24	0.11
Pelvis Width	narrow	wide	PW	33.02	4.62	14.00	0.24
Should. Muscl	poor	extreme	ShM	34.50	4.13	11.98	0.22
Top Muscling	poor	extreme	ToM	32.96	4.38	13.28	035
Rib Shape	flat	round	RI	25.60	6.22	24.30	0.47
Skin	thick	thin	SK	25.88	4.58	17.69	0.31
Rumb	horizontal	sloping	RU	27.80	5.38	19.36	0.31
Pelvis Length	short	long	PL	32.66	5.54	16.97	0.22
Tail Set	deep	prominent	TS	26.14	5.39	20.62	0.38
Buttocks Side	flat	round	Buside	34.66	4.75	13.71	0.30
Buttocks Rear	square	circle	BUrear	34.12	4.85	14.21	0.29
Bone Struct.	thick	fine	BO	27.55	5.08	18.44	0.28
Shoulder Joint	prominent	smooth	ShJo	25.54	3.91	15.30	0.09
Top Line	concave	convex	TL	23.60	2.47	10.46	0.28
Fore legs	open	knock-kneed	FL	28.96	3.82	13.18	0.06
Rear legs	open	cow-hocked	RL	22.14	3.68	16.64	0.10
Hocks	straight	bent	HO	27.42	4.79	17.48	0.14
Locomotion	difficult	easy	LO	22.76	4.65	20.44	0.13

Table 3. - GENETIC (PHENOTYPIC) CORRELATIONS BETWEEN THE TWENTY LINEAR TRAITS AND THE WEIGHT AT 13 MONTHS AND THE PRICE PER KILOGRAM OF LIVE WEIGHT

Linear Traits	Weight	Price per klw	Linear Traits	Weight	Price per klw
HE	0.75 (0.66)	0.23 (-0.00)	TS	0.11 (0.00)	0.29 (0.18)
LE	0.98 (0.20)	0.50 (0.13)	BUside	0.18 (0.03)	0.93 (0.54)
CW	0.52 (0.24)	0.60 (0.40)	BUrear	0.29 (0.11)	0.93 (0.61)
PW	0.61 (0.22)	0.78 (0.46)	BO	-0.24 (- 0.23)	0.20 (0.03)
ShM	0.50 (0.21)	0.89 (0.50)	ShJo	-0.12 (0.02)	- 0.12 (-0.02)
ToM	0.34 (0.21)	0.67 (0.46)	TL	-0.12 (-0.13)	0.18 (-0.08)
RI	-0.14 (-0.01)	0.43 (0.19)	FL	0.06 (0.01)	0.04 (-0.01)
SK	-0.21 (-0.11)	-0.06 (0.04)	RL	0.06 (0.01)	-0.09 (-0.03)
RU	-0.03 (0.04)	0.31 (0.23)	HO	0.04 (- 0.07)	-0.42 (0.04)
PL	0.45 (0.01)	0.65 (0.14)	LO	-0.22 (0.08)	-0.12 (0.06)

Scores for vertical, longitudinal and lateral growth are highly correlated with weight while the scores expressing muscular development are closely correlated with price. A synthetic note for muscling was calculated from the individual scores: ShM, ToM, BUside and -rear and a synthetic note for skeletal body conformation from the individual scores: CW, PW, RI, RU and TS. Their heritabilities were respectively 0.31 and 0.26 and their genetic (phenotypic) correlations with the price: 1.00 (0.56) and 0.79 (0.47). There is a slight tendency for heavy weight to be associated with thicker bones and extreme muscling with fine bones. On the other hand, as the regressions of weight or price on leg traits are curvilinear with a maximum at score 25 (not shown), the corresponding correlations are to be interpreted with caution.

Meat yield is obviously more closely associated with morphology than milk yield. Consequently, it is not surprising that in a beef breed like the Belgian Blue, linear traits are good predictors of meat yield and income in contrast to what has been observed by Meyer et al. (1987) regarding milk yield.

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NASLJEĐIVANJE OSOBINA PROIZVODNJE I LINEARNOG TIPA U BIKOVA BELGIAN BLUE TESTIRANIH NA VLASTITU PROIZVODNJU

Sažetak

Testiranje na vlastitu proizvodnju na pasmine Belgian Blue provodi se u stanici od 1974. Bikovi izabrani po završenom testu usmjeravaju se ili privatnim uzgajačima ili centrima za umjetno osjemenjivanje. Osobine zabilježene za vrijeme ili na kraju testiranja odnose se na rast, konzumaciju hrane i cijenu po kilogramu žive vage. S druge strane, 1998. g. linearni sustav bodovanja načinjen je u Društvu za Belgian Blue govedo i od tada se primjenjuje na bikovima koji su završili test u dobi od 13 mjeseci. Godine 1994. ta je metoda proširena na čitavu populaciju registriranih krava Belgian Blue. Cilj ovog rada bio je procijeniti količinu genetske raznolikosti koja još postoji u pasmini nakon određivanja mh gena i razdoblja od petnaest godina jake selekcije te ocijeniti odnos između linearnih osobina i proizvodnih osobina.

Analizirano je 2139 podataka o bikovima Belgian Blue nakon što su završili performance test u stanici. Promatrane osobine (proizvodne osobine) bile su: težina, visina i opseg prsnog koša sa 7 i 13 mjeseci, dnevni prirast od 7.do 13. mjeseca, omjer konverzije hrane, cijena po kilogramu žive vage. Među ovim bikovima 1673 je klasificirano za 20 linearnih osobina. Za te su osobine

dobivene procjene komponenata (ko) varijance mnogostrukih osobina bez derivata ograničene maksimalne vjerojatnosti (MTDFREML). Za devet proizvodnih osobina procjena heritabiliteta kreće se od 0.14 (omjer konverzije hrane) do 0.5 (visina s 13 mjeseci). Za linearne osobine, heritabilitet se kreće od 0.06 (prednje noge) do 0.46 (visina). Procijenjene su fenotipske i genetske korelacije između visine s 13 mjeseci i cijene za 1 kg ž.v. s jedne strane i linearnih osobina s druge. Bodovi/skorovi za vertikalni, longitudinalni i lateralni rast uglavnom su bili u korelaciji s težinom, dok su bodovi za razvoj mišića i u manjoj mjeri bodovi u vezi s tjelesnom konformacijom kostura bili u korelaciji s cijenom. Sintetske značajke za mišičje i sintetske značajke za tjelesnu konformaciju kostura na osnovi njihovih pojedinačnih bodova imale su genetske korelacije s cijenom po kilogramu žive vage od 1.0 odnosno 0.74. U mesnoj pasmini poput Belgian Blue, linearne osobine su dobar pretkazivač prinosa mesa i dohotka.

Ključne riječi: Belgian Blue, test performance, linearne osobine

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