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COMPARISON BETWEEN TWO GENETIC EVALUATION INDEXES IN RABBIT (*)

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Abstract

The aim of the study was to evaluate the performance of five N.Z.W. bucks used for a.i in four rabbitries and to determine the differences in judging the bucks by their phenotypic performance only compared to the estimation of their BLUP indexes. For this 289 multiparous does (N.Z.W. or crossbred) were inseminated after a treatment with PMSG and GnRH. The traits studied were: fertility rate (FER), litter size at birth (LS), litter size at weaning (LSW), weaning weight (WW), weight at 52 d (W52), weight at 73 d (W73), daily gains 52-73 d (DG) and feed efficiency (FE). In reproductive traits the performance of the five bucks, estimated by the phenotypic indexes, showed a high variability by rabbitries and did not provide a useful ranking, while the growing traits had a rather high variability between the bucks. The heritability coefficients showed that the reproductive traits had a low genetic determination (0.02 - 0.03), while those for growing traits ranged from 0.66 (WW) to 0.14 (FE). The BLUP indexes showed good performance for the bucks 2 and 4 and unfavorable results from bucks 1 and 3. The ranking of the bucks according to both the BLUP and phenotypic indexes verified that there is generally a difference in the buck's rank position. It means that if also the environmental effects are not significant, the BLUP index should not be substituted by the phenotypic one.

Introduction

In commercial rabbitries the choices for replacing animals are based on the progeny of bucks and does which seem to have the best potential for production or, more simply, getting the young rabbits who have the best morphology. In this way, selection is powerless and has no appreciable effect on the reared population. Moreover the characters with high heritability could be selected within the rabbitry while the traits with low genetic determination need of a mating plan involving several rabbitries to estimate the breeding

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values of the animals (15). To date few studies have been done on this subject and those available were conducted in one rabbitry only (3, 4, 5, 6). This research evaluated the differences that occur when the best bucks are judged by their phenotypic performance or by the estimation of their BLUP indexes. If no consistent difference between the two evaluation methods of evaluation exists, the traditional method must be followed, in order to save the money and time which is required to set up a BLUP index estimation.

Materials and Methods

The trial was carried out on N.Z.W. bucks reared in an insemination center of Northern Italy. The males were chosen as semen donors according to the sperm concentration and motility of their ejaculates. The semen was collected once a week; immediately after collection it was diluted (1:7) with an extender (tris buffer and 20% egg yolk) and analyzed with a microscope to subjectively evaluate sperm concentration and motility.
The semen of each buck was refrigerated at 5° C and used within 10 hours after collection in four different rabbitries in March and April 1991.
The chosen rabbitries had similar management practices, environmental conditions and feeding systems. In all 289 does (N.Z.W. or crossbred) were inseminated during the trial; all of them were treated with 20 IU of PMSG two days before the insemination and with 10 μg of GnRH at the time of insemination. All does were multiparous and were generally inseminated 8-15 d after kindling.
The traits studied were:

- fertility rate (kindling/inseminations) (FER);
- litter size at birth (LS);
- litter size at weaning (LS);
- weaning weight (WW);
- weight at 52 d (52W);
- weight at 73 d (73W);
- daily gains 52-73 d (DG);
- feed efficiency (FE).

The statistical analysis was carried out according to the following linear models:
- For the reproductive traits

$$Y_{ijkl} = \mu + B_i + R_j + b(D)_{ijkl} + M_k + e_{ijkl}$$

Y_{ijkl} = litter size, number of rabbits weaned per litter;
μ = overall mean
B_i = fixed effect of doe breed;
Ri_j = hierarchical fixed effect of rabbitry within breed;
$b(D)_{ijkl}$ = partial regression coefficient (b) of dependent variable on the parturition interval (D)
M_k = random effect of buck
e_{ijkl} = residual random effect

- For the growing traits:

$$Y_{ijkl} = \mu + B_i + Ri_j + b(N)_{ijkl} + M_k + e_{ijkl}$$

Y_{ijkl} = weaning weight, 53 d weight, 73 d weight, daily gain 52-73, feed conversion;
μ = overall mean;
B_i = fixed effect of doe breed;
Ri_j = hierarchical fixed effect of rabbitry within breed;
$b(N)_{ijkl}$ = partial regression coefficient (b) of dependent variable on the number of rabbits per litter (N)
M_k = random effect of buck
e_{ijkl} = residual random effect

Since fertility rate was a discontinous variable, the statistical analysis was done by a X^2 test.
The statistical analysis was carried out using SAS software (14).

Results and Discussion

The observed performance is shown in Table 1. The fertility rate was about 60%, which is rather good given the experimental conditions. The numbers of born rabbits (8.70) and weaned per litter (7.23) were similar to those usually observed (1), indicating good management conditions during the trial. Also the weights obtained at weaning (5.74 kg), at 52 d (1.52 kg) and 73 d (2.10 kg) agreed with the weights observed in the same breeds (1). The average daily gain was 28.22 g and the feed efficiency was 3.84.
The significance of the effects in the models is reported in Table 2.
The reproductive traits (rabbits born and weaned per litter) were significant (P = 0.005) for the breed effect only. On the contrary, factors of the model were significant for almost all the growing traits, only the 73 d weight and the daily gains had nonsignificant F values for the breed effect; the rabbitry effect was not significant for daily gain.
Table 3 shows the reproductive indexes of the bucks. The indexes were estimated as the difference between the performance of the buck and the general mean of the trait. This kind of index did not take into account any genetic parameter, therefore it was called "phenotypic index". For the fertility trait the performance of the five bucks had a high variability by farms, probably because the females inseminated with each male were different. In these traits the best general results were obtained at farm "2" and the best buck was number "2".
The trend in litter size at birth was rather different, in fact buck "5" was the best in three rabbitries and therefore had the best total phenotypic index (0.67). The best rabbitry was number "3"; four of the five bucks gave their best performance at this farm.
The results observed in the litter size at weaning did not show notable

difference for any buck, in fact, the performance of each buck in each farm was very different. Overall the best buck was number "5" and the best rabbitry was number "3". Moreover it should be noted that this trait depends on the maternal effect of doe (milking ability).
The phenotypic indexes concerned to the growing traits (Table 4) had a rather high variability between the bucks as was also shown by the significance levels reported in Table 2; slight differences between males were observed for 73 d weight only. The variability of buck's performance in the different rabbitries was very high and difficult to interpret. The best buck in the weaning weight was number "5"; in the 52 d weight and in feed efficiency the best results were observed in male "2", in the 73 d weight in buck "4" and in the daily gains in buck "1". Rabbitry "4" was the best for weaning weight, 73 d weights and daily gains; farm "2" was the best for 52 d weight and farm "1" for feed efficiency.
The estimated heritability coefficients (Table 5) showed that, as already observed in other studies (2, 8, 12, 13), the reproductive traits had low genetic determination (0.02 - 0.03). On the contrary, the heritability in the growing traits ranged from 0.66 (WW) to 0.14 (FE) in agreement with the results of other authors (7, 8). On the contrary the value concerning litter size at weaning was lower than those obtained from other Researchers (10, 11). Similar differences between the two kinds of characters are verified in all species related to animal production (9).
The BLUP indexes reported in Table 6 show the good performance of bucks 2 and 4 and the unfavorable results obtained by bucks 1 and 3.
The rankings of the bucks according to both the BLUP and phenotypic indexes are reported in Table 7 and demonstrate the differences between the method currently used by farmers in choosing the best males (phenotypic index) and the BLUP results. Since the rankings are similar, the justification for spending time and money for BLUP estimation decreases. The two ranks were the same in the daily gains only; in the other traits the differences in buck ranking were more or less evident, but always present. It means that if also the environmental effects are not significant (rabbbitry effect in the reproductive traits) the BLUP index cannot be substituted by the phenotypic one. It should be pointed out that the differences between the two types of indexes are not very large in agreement with the results obtained by Estany et al (3) for litter size.

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Table 1 - Overall means observed in the studied traits.

Trait		Mean
Fertility	%	60.40
Litter size	No.	8.70
Weaned/litter	"	7.23
Weaned litter	kg	5.74
Weight at 52 d	"	1.52
Weight at 73 d	"	2.10
Daily gain	g/d	28.22
Feed efficiency	kg/kg gain	3.84

Table 2 - Significance ($P \leq F$) of sources of variation.

Source of variation	FER	LS	LSW	WW	52W	73W	DG	FE
Breed	-	0.0053	0.0011	0.0001	0.0001	0.3624	0.1954	0.0005
Rabbitry	0.6835	0.7334	0.3840	0.0001	0.0001	0.0001	0.5321	0.0002
Buck	0.8360	0.1939	0.5586	0.0001	0.0001	0.0270	0.0001	0.0001
Parturition interval	-	0.1939	0.5586	-	-	-	-	-
Litter size	-	-	-	0.0001	0.0001	0.0001	0.0001	0.0001

Table 3 - Phenotypic indexes of the buck ($x+\mu$) in the reproductive traits.

Trait	Rabbitry	Buck					Total
		1	2	3	4	5	Rabbitry
FER	1	28.5	-12.5	-8.4	4.5	-12.5	-0.05
	2	4.5	3.5	12.5	6.5	-5.4	4.35
	3	-4.4	12.5	-10.5	-14.5	-13.5	-6.05
	4	-22.5	14.5	0.5	6.5	9.5	1.75
	Total buck	1.55	4.55	-1.45	0.80	-5.45	
LS	1	-1.9	-0.1	-0.4	-1.1	0.05	-0.72
	2	-0.4	-0.2	-0.5	-2.0	-0.7	-0.80
	3	1.2	-0.2	1.6	1.4	2.0	1.22
	4	-1.3	1.5	1.1	-1.2	1.4	0.30
	Total buck	-0.60	0.25	0.42	-0.74	0.67	
LSW	1	-0.3	-0.8	0.2	-0.01	-0.3	-0.22
	2	0.3	-0.3	-1.3	-0.6	0.2	-0.34
	3	1.0	-0.1	0.1	0.9	0.5	0.48
	4	-0.7	0.3	0.3	0.3	0.2	0.08
	Total buck	0.09	-0.21	-0.17	0.14	0.15	

Table 4 - Phenotypic indexes of the buck (x+μ) in the growing traits.

Trait	Rabbitry	Buck					Total rabbitry
		1	2	3	4	5	
WW	1	-0.2	-0.4	0.7	0.6	-0.1	0.13
	2	-0.1	0.2	-1.0	0.2	0.7	-0.07
	3	-0.5	-0.7	-0.6	-0.6	-0.7	-0.64
	4	-0.3	1.0	0.5	0.8	0.9	0.60
	Total buck	-0.31	0.03	-0.10	0.16	0.22	
52 W	1	-0.09	0.02	0.08	0.1	-0.02	0.02
	2	-0.02	0.2	0.02	0.1	0.1	0.08
	3	-0.2	-0.06	-0.1	-0.2	-0.2	-0.16
	4	0.05	0.07	0.02	0.09	0.04	0.05
	Total buck	-0.07	0.05	-0.01	0.03	0.03	
73W	1	0.1	0.1	-0.2	-0.04	-0.1	-0.01
	2	-0.1	-0.1	-0.1	0.4	0.2	0.05
	3	-0.2	-0.1	-0.1	-0.1	-0.1	-0.13
	4	0.1	0.1	0.0	0.2	0.07	0.09
	Total buck	-0.02	0.01	-0.09	0.10	0.00	
DG	1	10.3	4.3	-13.2	-7.0	-5.2	-2.16
	2	-4.9	-4.3	-1.7	8.9	2.5	0.09
	3	0.8	-2.5	1.5	3.5	-0.2	0.63
	4	3.8	0.7	-1.2	3.0	0.8	1.44
	Total buck	2.50	-0.45	-3.65	2.10	-0.50	
FE	1	-0.5	0.8	-0.02	1.3	0.6	0.45
	2	0.2	0.1	-0.1	-0.4	-0.02	-0.02
	3	-0.5	-0.3	-0.3	-0.6	-0.4	-0.44
	4	-0.1	-0.04	0.05	0.04	0.07	0.07
	Total buck	-0.02	0.16	-0.10	0.08	0.07	

Table 5 - Heritability in the studied traits.

Trait	h^2
FER	0.0312
LS	0.0200
LSW	0.0204
WW	0.6590
52W	0.2944
73W	0.2048
DG	0.1642
FE	0.1390

Table 6 - Blup indexes of the bucks.

Buck Trait	1	2	3	4	5
FER	-0.410	0.054	-0.003	0.013	-0.024
LS	-0.118	0.229	0.074	-0.380	0.194
LSW	-0.000	0.001	0.000	0.001	0.002
WW	-0.582	0.224	-0.453	0.253	0.150
52W	-0.104	0.061	-0.026	0.072	-0.003
73W	0.002	0.024	-0.050	0.077	-0.053
DG	0.004	-0.000	-0.002	0.000	-0.001
FE	0.595	-0.028	0.012	-0.001	0.010

Table 7 - Ranking of the bucks by phenotypic and blup indexes.

Buck	1		2		3		4		5	
Trait	P	B	P	B	P	B	P	B	P	B
FER	2	5	1	1	4	3	3	2	5	4
LS	4	4	3	1	2	3	5	5	1	2
LSW	3	5	5	2	4	4	2	2	1	1
WW	5	5	3	2	4	4	2	1	1	3
52W	5	5	1	2	3	4	2	1	4	3
73W	4	3	2	2	5	4	1	1	3	5
DG	1	1	3	3	5	5	2	2	4	4
FE	2	5	5	1	1	4	4	2	3	3