UNIVERSITÀ DEGLI STUDI DI SASSARI

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UNIVERSITÀ DEGLI STUDI DI UDINE
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Selection for feed efficiency of male candidates in performance test in Italian Simmental breed

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dualbreeding

ICAR THE GLOBAL STANDARD FOR LIVESTOCK DATA

Italian Simmental (IS) - Pezzata Rossa Italiana

- IS is a dual-purpose cattle breed and HB is managed by the Italian Simmental Breeders Association (ANAPRI)
- 95,000 females registered in HB
- IS is mainly reared in small farms (< 20 heads);
- 57% of the farms are located in the mountainous area
- 7,449 kg milk, 3.93 fat %, 3.42 protein % (AIA Bolletin 2022)
- High fertility, low somatic cell count, good beef performance

Feed Efficiency (FE)

- The feed costs represent ~60% of the total costs of the cattle industry. The economic profitability of farms is strongly related with the FE (Connor, 2015) .
- FE is intensively associated with the sustainability and environmental impact of the farms. A more efficient animal has lower feed intake and, thus, it has a lower environmental impact.
- Mitigation of enteric methane (CH4) emission in ruminants has become an important area of research because accumulation of CH4 is associated to global warming.
- The reduction of environmental impact configures as one of main objectives of the cattle sector.

The aims

- Estimate genetic parameters (variance components and heritability) for RFI in young performance tested bulls of Italian Simmental.
- Evaluate the feasibility and advantages of implementing a genomic evaluation for RFI in the IS dual-purpose cattle breed.

MATERIAL AND METHODS

Performance test (PT)

As part of our breeding program we performance test 250 male candidates born from bulls sires and bull dams for beef traits

Age in month	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**

Weaning

Calves are quarantined in a designated barn away from the GS

Candidates are introduced in GS and divided into homogeneous groups and raised together in the same facility

PT starts when calves are 5 months old and ends when they are 12 months old (every 42 days calves are weighted)

Calves are raised in pens equipped with Roughage Intake Control system (Hokofarm); BW at 9 month is 376.1±52.0 kg

At the end of the PT, conformation traits are collected


RIC
3
4


8
9109
344

Residual Feed Intake (RFI)

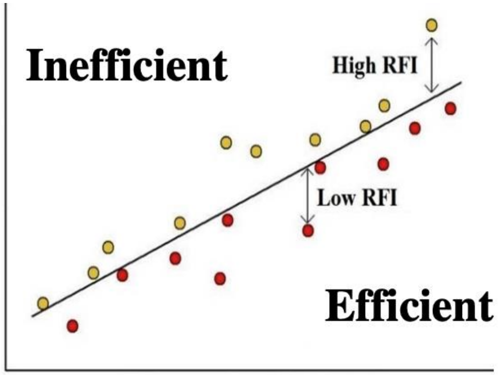
- RFI is the difference between actual and expected Dry matter Intake (DMI)

Expected DMI (Koch et al., 1963) $eDMI = \alpha + \beta\,(DG) + \gamma\,(BW^{0.75})$

- Positive RFI = animals eat more than expected (inefficient)
- Negative RFI = animals eat less than expected (efficient)

- CH_4 (g/day) = (DMI × 18.45 × (6.5 × 10))/55.65

(adapted from IPPC, 2006)



Variance component estimation

- RFI and CH_4 records 601 (1,800,000 individual obs. in RIC)
- Pedigree used for variance component 16,000 animals

$$y_{ijkl} = m + Box_i + Weight_j + Animal_k + e_{ijkl}$$

- y_{ijkl} = Residual Feed Intake
- m = mean
- Box_i: Fixed Effect of the contemporary group; all calves present in that particular pen are considered as contemporaries in a particular round of evaluation (106 levels).
- $Weight_j$: Live weight at the beginning of the detection period of individual ingestion (covariate).
- $Animal_k$ = Random additive genetic effect of animal
- e_{ijkl} = Random residual effect

- Variance component estimation, GIBBS3F90 (500,000 rounds, 200,000 burn-in, 1 sample every 100)
- Breeding values estimation: BLUPF90

Validation

12/2017 Complete BV_C 04/2022

Records 749

12/2017 Reduced BV_R 12/2021

Records 683

Candidates for validation 66

- Pedigree used for genomic evaluation 600,000 animals
- Animals with genotype 14,181 (after editing ~42k SNP)
- 2 different model BLUP and SS-GBLUP applied in order to analyzed both RFI in complete and reduced data-sets

LR Method (Legarra and Reveter, 2018)

Predict the EBV estimated using the Complete data set starting from the EBV estimated using the Reduced data set with a regression linear model

$$BV_C=B_0+B_1*BV_R$$

Correlation $BV_C \sim BV_R$ and B_1-=1

RESULTS AND DISCUSSION

Descriptive statistics

Trait	Mean ±SD	Min	Max
BW at 12 month	**480.0±43.9**	350	630
ADG (Kg/d)	**1.550±0.28**	0.860	2.230
DMI (Kg/d)	**10.2±1.06**	6.88	13.3
RFI (Kg/d)	**0.00±0.79**	-2.55	1.86
CH4 (g/d)	**220.5±24.0**	151.1	286.7

Phenotypic correlations				
	ADG	**DMI**	**RFI**	**CH4**
ADG (Kg/d)	1	0.38	0.00	0.38
DMI (Kg/d)		1	0.74	1.0
RFI (Kg/d)			1	0.74
CH4 (g/d)				1

Descriptive statistics

Positive RFI = animals eat more than expected (inefficient)
Negative RFI = animals eat less than expected (efficient)

Genetic Parameters

	Mean ± PSD	CI 95%
Error Variance (kg^2/d^2)	0.271±0.060	0.160 - 0.382
Genetic Variance (kg^2/d^2)	0.114±0.060	0.011- 0.225
Heritability	0.293±0.147	0.052 - 0.580

Can we produce a genetic evaluation for feed efficiency?

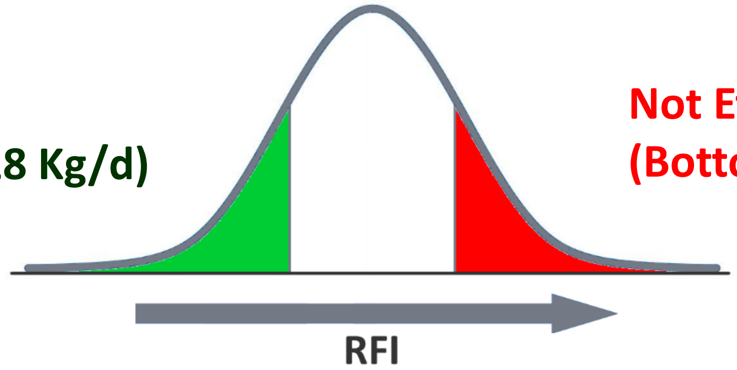
Validation

Method	r	b0	b1
BLUP	0.72	-0.01	1.14
ssGBLUP	0.74	-0.01	1.17

- The use of genomic information to estimate GEBV gave a small advantage in terms of reliability; however, the results could improve in the future as the number of records increases.

The economic importance

Efficient
(Top 25% RFI=-1.328 Kg/d)



Not Efficient
(Bottom 25% RFI=1.238)

	DMI (Kg/d)	Met. (g/d)	BW 12 M. (kg)	Return* (€)	Feed Cost (€)**
Not Efficient	11.5	248	529	1,323	483

*BW X 2,5 €/Kg

** Feeding cost calculated for 120 days from 9 to 12 month; cost of DM 0,35 €/kg

The economic importance

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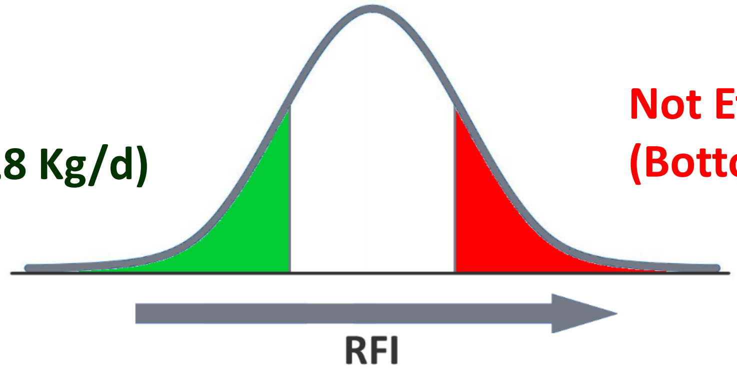
(Top 25% RFI=-1.328 Kg/d)



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Efficient	8.8	191	509	1,273	**370**

***BW X 2,5 €/Kg**

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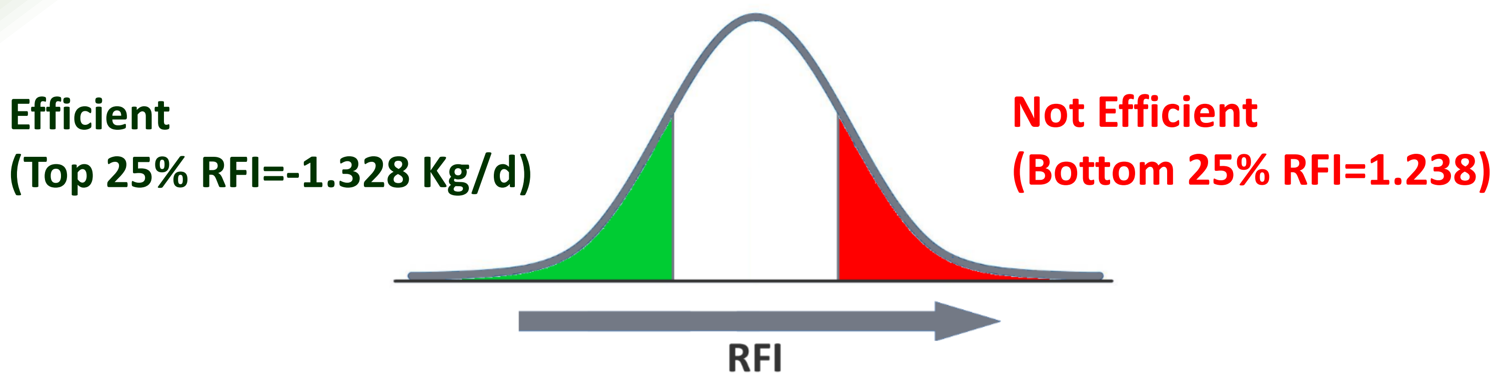
The economic importance



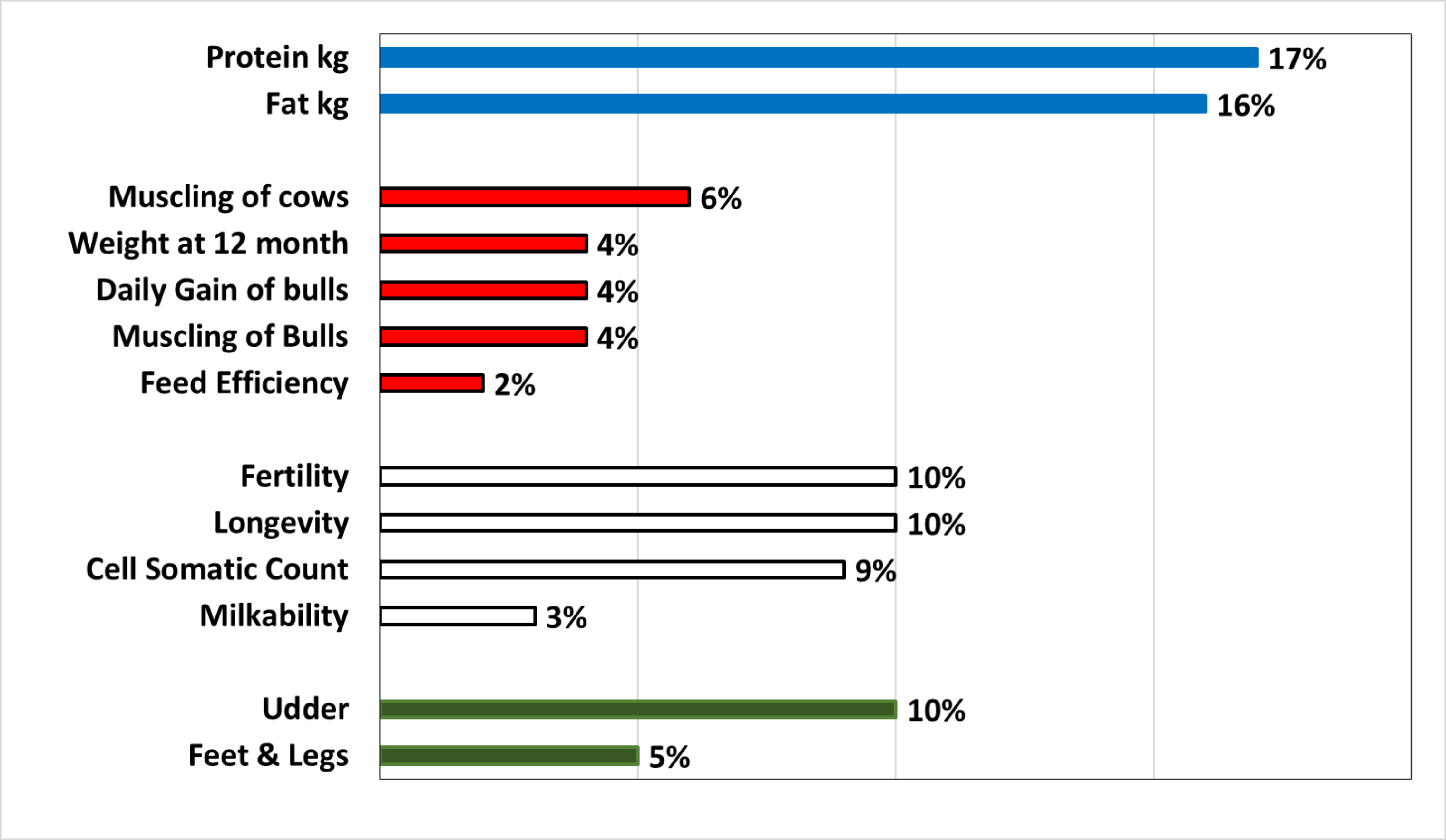
	DMI (Kg/d)	Met. (g/d)	BW 12 M. (kg)	Return* (€)	Feed Cost (€)**
Not Efficient	11.5	248	529	1,323	483
Efficient	8.8	191	509	1,273	**370**
Diff. Eff.- Not Eff.	**-2.66**	**-57**	**-20**	**-50**	**-113**

*BW X 2,5 €/Kg

** Feeding cost calculated for 120 days from 9 to 12 month; cost of DM 0,35 €/kg

IS Breeding goals

IS Selection is based on a composite index Indice Duplice Attitudine Sostenibile – IDAS (Dual Purpose Sustainable Selection Index)



CONCLUSIONS

Conclusions

- Selection to reduce RFI is feasible in the Italian Simmental cattle breed
- Genetic variance and heritability estimates are good and comparable to the values reported in literature.
- These parameters, considering the high values of PSD, should be confirmed considering a larger dataset.
- The use of genomic information to estimate GEBV gave a small advantage in terms of reliability; however, the results could improve in the future as the number of records increases.
- Feed efficiency has been introduced in the definition of the new selection index IDAS with a weight of 2%

Work in progress

- Selection of efficient bulls could lead to a reduction in body fat
- For this reason we are monitoring fat deposition at longissimus dorsi level

Thank you for the attention

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dualbreeding