

# Effect of breed and animal genotype on dairy cow production efficiency based on commercial and research farm data

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## Summary

- Total lactation kg of milk solids per kg bodyweight during mid-lactation (MS/BW) is a robust and accessible measurement to evaluate animal production efficiency on-farm.
- There is large variation between and within breeds for MS/BW on commercial dairy farms in Ireland.
- Farmers should routinely milk record throughout the year and weigh their herds in mid-lactation to identify the most efficient animals within their herd to increase performance and farm profitability and improve the environmental footprint for the herd in the future.

## Introduction

Excellent grassland management and genetically elite animal genotypes form the basis of a successful and profitable pasture-based dairy system. Increasing the feed conversion efficiency of a herd, and therefore maximising milk output from a given amount of feed, is a key measure of both the efficiency and environmental impact on-farm. Worldwide, breeding programmes have started to include feed efficiency (FE) estimates in selection indices to accelerate improvements in productivity and sustainability. The evaluation of FE traits, however, is costly and has largely been based on individual animal intake data, mostly collected from animals in confinement systems fed Total Mixed Rations. The absence of a large database of feed intake records from individual cows within commercial grazing dairy herds is a barrier to the development of robust FE measures. Feed efficiency information is indeed valuable for both pasture-based animal breeding programs and on-farm selection intensity. Therefore, Teagasc evaluated the relationship of traditional FE measurements and a routine cost-effective production efficiency measurement using data collected from both research and commercial herds, and compared different breeds and genotypes during stages of lactation.

## Commercial and research data

Individual animal intake data were collected during four years from 1,788 lactations from 407 Holstein-Friesian (HF) and Jersey × Holstein-Friesian (JFX) cows on two Teagasc research farms (Evers *et al.*, 2023). On these farms, data for total milk solids production (MS), bodyweight (BW), total dry matter intake (TDMI), TDMI per kg BW (TDMI/BW) and total kg MS per kg BW in mid-lactation (MS/BW) were available throughout the lactation. To validate the production efficiency measurement MS/BW, 27,951 records from 16,898 animals across 80 commercial dairy farms mostly located in the south of Ireland were compiled across four years (Evers *et al.*, 2021). Within each breed, cows were subsequently ranked as either top 25% (High Eff), or bottom 25% (Low Eff) for efficiency. We then identified the characteristics of the most efficient animals and compared MS/BW to other FE measurements.

## Results

There was large variation in MS/BW between animals within commercial farms (0.42 to 1.47 kg MS per kg BW) and the average values between these herds (0.73 to 1.14 kg MS per kg BW). Despite considerable variation between animals within breed, JFX cows were consistently more efficient in terms of MS/BW than HF cows on both the research farms (Table 1) and commercial dairy farms. Moreover, JFX cows also reached a greater TDMI per kg BW (+0.25 kg/kg) and daily MS yield per kg TDMI (+0.005 kg/kg) compared with HF cows (3.26 kg/kg and 0.109 kg/kg, respectively). Within breed, High Eff cows (top 25%) were 20 kg lighter during mid-lactation and produced 15% more MS over the total lactation than Low Eff cows (bottom 25%). This finding was in accordance with High Eff cows having greater genetic merit (EBI) for both the Milk and Maintenance sub-indices. When comparing the High Eff and Low Eff cows, Low Eff cows exhibited a steady decline in daily milk and MS production after peaking at 2.06 kg MS in early lactation and did not have an increase in daily TDMI from early to mid-lactation (15.5 kg DM). In contrast, High Eff cows maintained high levels of milk production into mid-lactation, which was supported by an increase in TDMI (17.3 kg DM) compared with early lactation (15.7 kg DM). Indeed, High Eff cows achieved increased daily MS yield (+0.16 kg/cow) during the measurement periods. The top 25% of animals also reached a higher daily MS yield per TDMI in mid and late lactation, compared to Low Eff cows. The consistently positive correlations (0.33 and 0.52) between MS/BW and TDMI per kg BW and daily MS per TDMI, respectively, demonstrated that MS/BW is a robust measure that can be applied within commercial grazing dairy systems to increase the selection intensity for FE.

**Table 1.** Production and efficiency parameters for HF and JFX animals

	HF		JFX	
	Low Eff	High Eff	Low Eff	High Eff
MS/BW (kg/kg)	0.80	1.06	0.91	1.21
Milk SI (€)	35	54	46	70
Maintenance SI (€)	5	19	25	37
Total MS yield (kg)	460	533	473	543
BW (kg)	541	517	485	470
TDMI (kg DM)	17.1	17.5	16.6	17.2
TDMI/ BW (kg DM/100 kg)	3.18	3.40	3.43	3.66

<sup>1</sup>Breed: HF = Holstein-Friesian where  $\geq 75\%$  of the breed proportion was Holstein-Friesian; JFX = Jersey  $\times$  Holstein-Friesian crossbreds where  $\geq 25\%$  of the breed proportion was Jersey.

## Conclusion

The results of the present study highlight the potential to increase productive efficiency through both selecting for high genetic potential within breed and crossbreeding programs. Given the large variability in MS/BW within and between herds, this study validates the significant opportunity for farmers to increase the selection intensity within their herd. Incorporating a mid-lactation BW measurement to allow calculation of MS/BW will aid identification of the most efficient cows from which to breed replacement heifers. This robust breeding strategy will not only enhance animal productivity, but also develop a more resilient, profitable and environmentally sustainable national dairy herd for the future.

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