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Evaluation of Jersey, Jersey × Holstein-Friesian and Holstein-Friesian cows under Irish grass-based spring milk production systems

Key external stakeholders:
Irish dairy farmers, ICBF, AI companies, consultancy agencies

Practical implications for stakeholders:

- Jersey × Holstein-Friesian (F_1) cows produced less milk volume compared to Holstein-Friesians (HF). They had higher milk composition, higher milk solids yield and consequently increased milk value.
- The F_1 cows were more efficient, producing 10% more milk solids per unit area compared to HF cows. This is largely due the innate ability of the Jersey (J) breed to consume a higher intake relative to body size, thus diluting maintenance requirements. These findings also indicate that it would not be correct to increase the stocking rate of J crossbreds relative to HF cows on a live weight basis.
- The superior performance of the F_1 equates to an increased profit potential of almost €20,000 annually for a 40 ha unit. The reduced cull cow and male calf value are more than compensated by the overall performance of the F_1.
- Research is warranted to develop an index (independent of the EBI) that will reflect the potential extra profit per lactation that can accrue as a result of heterosis, as well as other factors in addition to additive genetic merit that affect the short term (in the current/subsequent lactation) profit potential of the dairy cow.

Main results:

- The F_1 cows produced less milk volume compared to HF. They had higher milk composition, higher milk solids yield and consequently increased milk value. They were better able to maintain better body condition, were of moderate size, and had substantially better reproductive efficiency. Milking duration and udder health was similar for the three breed groups.
- Dry matter intake was similar for the HF and F_1 but significantly lower for the J. Intake capacity was greatest for the J, intermediate with the F_1 and lowest for the HF. Yield of milk solids per unit body weight and milk solids per unit intake was more favourable for the J and F_1 compared to the HF.
- Economic analyses showed that while milk volume and cull cow revenue were highest for the HF; the value of milk output and overall farm profit was superior for the F_1 compared to either pure breed.

Opportunity / Benefit:

The improved performance associated with the J×HF cows is estimated to equate to an increased profit potential of almost +€20,000 per lactation for a 40 ha unit.

Collaborating Institutions:

UCD, INRA

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1. Project background:

The challenge for Irish dairy farmers in the years ahead is to increase the competitiveness of their business through innovation, productivity gain and increased operational scale (Shalloo et al., 2004). With revenue from milk production projected to fall, national farm statistics show that costs of milk production are increasing by 0.15c/ litre per year while the variation between the highest cost and lowest cost producers is in excess of 9.2 c/l. This data suggests that producers must focus on achieving cost efficient milk production through more efficient use of pasture. Walsh et al. (2008) suggested that crossbreeding may offer a "quick fix" to counteract some of the antagonisms of past selection policies, in particular the well documented slippage in reproductive efficiency within HF herds (Evans et al., 2002). Crossbreeding with the J is expected to offer the opportunity to maximise solids production per hectare (Penno, 1998), improve milk value due to introduction of multi component milk payment (Shalloo, 2007), and improve production efficiency (Grainger and Goddard, 2004).

2. Questions addressed by the project:

- Are J × HF cows as productive as pure HF cows?
- Do they have improved reproductive efficiency?
- Is there a difference in production (feed) efficiency between the two types of cow and are differences consistent through the production cycle?
- Do they differ in grazing behaviour?
- Are there udder health differences between the breed groups?
- How do they differ in terms of overall economic efficiency?
- Does the reduced cull cow and male calf value negate any potential economic benefits arising with the J × HF cows?

3. The experimental studies:

A five year study evaluating the comparative performance of HF, J and F_1 crossbreds, under experimental conditions representative of Irish grass-based production circumstances was established by Teagasc Moorepark at the 'Ballydague' research farm in 2006. The data incorporated 329 lactations from 65 HF, 48 J and 49 F_1 cows; 2006, 2007 and 2008 (years 1, 2 and 3, respectively). Mean calving date was February 21 (±19 d) across the three years. A total of 18, 20 and 16 sires were represented in the HF, J and F_1 groups, respectively. All sires were commonly available in Ireland. Animal performance results pertaining to milk production and milking characteristics, udder health, fertility performance, body weight, body condition score, feed intake, intake capacity, feed efficiency and grazing behaviour are presented.

4. Main results:

- Milk yield was highest for the HF and lowest for the J. Milk fat and protein content were highest for the J, intermediate for the F_1 and lowest for HF. Lactose concentration was lowest for the HF and similar for the J and F_1. Milk solids production (fat + protein yield) was highest for the F_1, intermediate for the HF and lowest for the J.
- The HF cows were heaviest, the J cows were lightest and the F_1 were intermediate. These differences were consistent throughout lactation. Body condition score tended to be highest for the F_1 and lowest for the HF throughout lactation.
- Reproductive efficiency (calving to conception interval, pregnancy rate to first service, six week in-calf rate and overall pregnancy rate) was similar for the HF and J. The F_1 exhibited substantially superior reproductive performance compared to the pure breeds.
- Dry matter intake was similar for the HF and F_1 but significantly lower for the J. Intake capacity was greatest for the J, intermediate for the F_1 and lowest for the HF.
- The highest yield of milk solids per 100 kg body weight was achieved by the J; 0.35kg and 0.27 kg for the J and HF, respectively. The F_1 produced 16% more milk solids per unit body weight compared to the HF.
- Production expressed as milk solids per unit intake was greater for the J and F_1 (0.088 and 0.087 kg/kg) compared to the HF (0.079 kg/kg). Net energy intake/unit of milk solids was also more favourable for the J and F_1 compared to the HF.

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- Residual feed intake was similar across the breed groups.
- Significant estimates of hybrid vigour for milk solids/TDMI, NEI/milk solids, NEI-NEM/ milk solids and NEI-NEM-ΔNEM/ milk solids were obtained.
- Production efficiency was positively associated with milk solids yield.
- When expressed per unit body weight and per unit intake J, were more vigorous grazers compared to the HF.
- Associations were determined between grazing behaviour and intake capacity and some of the feed/production efficiency measures. A positive relationship was evident between rate of intake (grass DMI (GDMI)/minute) and intake capacity. Cows that spent more time masticating the herbage had a higher output of milk solids/100 kg BW and higher milk solids yield/GDMI. The rate of grazing mastications was positively associated with output per 100 kg BW and output per unit GDMI. Cows that had increased ruminating mastications/100 kg BW also had a higher intake capacity and produced more milk solids/100 kg BW. Similarly, cows that had more ruminating bouts had a greater output of milk solids/100 kg BW and milk solids/GDMI.
- Udder health, as indicated by somatic cell score and incidence of mastitis, were not different for the HF and J breeds. Somatic cell score and incidence of mastitis, of the F_1 were similar to the mean for pure breeds.
- Average milk flow was greater for the HF compared to the J. Peak milk flow also tended to be higher for the HF. The F_1 had higher milk flow rates compared to the mean for pure breeds. Milking duration was similar for the three breed groups.
- Economic analyses showed that while milk volume and cull cow revenue were highest for the HF; the value of milk output and overall farm profit was superior for the F_1 compared to the parent breeds. A substantial component of the superior economic performance of the F_1 was due to the superior reproduction/survival compared to the HF and J.

5. Opportunity/Benefit:

- The results clearly illustrate the potential benefits to dairy farmers achievable from crossbreeding with J in Ireland. J × HF cows are highly productive, have excellent fertility and are efficient convertors of grass to milk. This results in a substantial economic benefit.
- Teagasc and ICBF should develop an index that is independent of the EBI and which should reflect the potential extra profit that can accrue as a result of heterosis, as well as other factors in addition to additive genetic merit that affect the short term (in the current/subsequent lactation) profit potential of the dairy cow. This is essential to enable accurate sire advice and female culling decisions to be made in a crossbred population. This work has begun.

6. Dissemination:

During the life time of this project, two open day events were held at Ballydague and two others were held at Moorepark. These provided key findings from this research to Irish dairy farmers and industry representatives. The objective of these events was to highlight research technologies that will increase farm profitability post milk quotas by instigating management practices that grow and utilise higher quantities of superior quality grass and achieve high animal performance over a long grazing season.
In addition to scientific, popular press articles and open day events, individual discussion groups frequently visited the experiment during the project. Topics covered at these events by research and advisory staff included grassland management best practice advice, animal breeding and the economic implications of research results. The research results were also disseminated via in-service training to Teagasc Advisory staff annually.

Main publications:

Prendiville, R., E. Lewis, K.M. Pierce, F. Buckley. (2010). Comparative grazing behaviour of lactating Holstein-Friesian, Jersey and Jersey × Holstein-Friesian cows and it association with intake capacity and production efficiency. *Journal of Dairy Science* 93: 764-774.
Prendiville, R., K.M. Pierce, L. Delaby, F. Buckley. (2011). Animal performance and production efficiencies of Holstein-Friesian, Jersey and Jersey×Holstein-Friesian cows throughout lactation. *Livestock Science* 138: 25-33.
Prendiville, R., L. Shalloo, K.M. Pierce and F. Buckley. (2011). Comparative performance and economic appraisal of Holstein-Friesian, Jersey and Jersey×Holstein-Friesian cows under seasonal pasture-based management. *Irish Journal of Agricultural and Food Research* 50: 123–140

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Popular publications:

Kennedy J, “The Jersey Cross Debate”,28 February, 2009. Irish Farmers Journal.

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