

**Project number:** 5891  
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## Effects of stocking rate and calving date in dairy systems



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

**Practical implications for stakeholders:**

- The results of this study indicate that milk production per cow is reduced as stocking rate (SR) increases whereas a strong positive relationship exists between SR and milk production per hectare.
- The results of this project also indicate that increased SR and earlier calving can be achieved at farm level without adverse effects on overall pregnancy rates or the health of animals. Similar to a number of recent studies, strain of Holstein-Friesian had a significant impact on the results observed as animals of NZ ancestry maintained a higher BCS throughout lactation and tended to have superior reproductive performance compared with animals of North American ancestry.
- The results illustrate that high levels of milk production per ha can be achieved within Irish grazing systems by increasing SR at farm level without the requirement for large inputs of supplementary feed.
- Increasing SR has no effect on grass growth or on net herbage production within Irish grazing systems and although increased SR resulted in increases in milk production per ha, grazed grass utilisation and sward nutritive value, the reduction in the quantity of winter forage produced at the higher SR will limit the overall economic benefit of increasing SR at farm level as the failure to conserve adequate winter feed for the higher SR treatments would result in significant additional feed costs to these systems.

### Main results:

- The reduction in milk production per cow associated with an SR increase is a consequence of both an increased grazing intensity associated with a reduction in daily herbage allowance and a reduction in lactation length.
- The animal response to an increase in SR appears to be different for larger cows compared with smaller cows.
- The existence of a SR by strain interactions for a number of reproductive variables suggests that the NZ strain of Holstein-Friesian is more suited to intensive grazing systems and can cope better with potentially reduced feed allowances at increased SR.
- These results indicate that adjusting mean calving date can be an effective strategy to align animal requirements and grass supply, increase herbage allowance and reduce supplementary feed requirements at increased SR in early lactation
- The results also show that, although reducing daily milk production and lactation length, delaying mean calving date had no effect on total lactation performance but did influence the seasonality of milk supply.

### Opportunity / Benefit:

The improved performance associated with increased grazed grass utilisation is estimated to improve overall farm profitability by €160 per ton of DM utilised per hectare per year

### Collaborating Institutions:

UCD, INRA

**Teagasc project team:** Dr. Brendan Horan (PI)  
Dr. Brian McCarthy  
**External collaborators:** Dr. Karina Pierce, UCD  
Dr. Luc Delaby, INRA

### 1. Project background:

Worldwide demand for dairy products has been increasing rapidly as a result of projected population growth, urbanization and increases in per capita disposable income (Delgado, 2005; Rae, 2002). By 2020, it is predicted that developing countries will consume 152 m tonnes more milk compared with 2002/2003 (Delgado, 2005). Grazing systems of production, such as those in Ireland, which are characterized by seasonal calving, a prolonged grazing season and a predominantly grazed grass diet, have the potential to supply large additional volumes of high quality dairy products post European Union (EU) milk quota abolition in 2015 (Lips and Rieder, 2005). Increased milk production from grass-based dairy production systems can be achieved by converting increased quantities of grazed herbage efficiently to milk (McMeekan and Walshe, 1963). Stocking rate (SR), traditionally defined as the number of animals per unit area of land used during a defined period of time (cows/ha), is acknowledged as the main driver of production from grazing systems (Baudracco et al., 2010; Hoden et al., 1991; Macdonald et al., 2008). Ultimately, achieving high levels of milk production from grazed grass with minimal supplementation occurs when the appropriate mean calving date (CD) and distribution of calving is achieved in conjunction with the optimum SR to align herbage supply to herd demand (Dillon et al., 1995). While many SR experiments have been undertaken, few have investigated the effect of SR in conjunction with CD. In order to investigate the interaction between SR and CD treatments on milk production from a grazing system, a range of SR and mean CD treatments must be compared on a common diet.

### 2. Questions addressed by the project:

- What is the effect of an increase in SR on individual animal and per hectare milk production performance?
- Does SR and Calving Date affect herd reproductive efficiency?
- What is the relationship between SR and individual animal grass DM intake?

### 3. The experimental studies:

The objective of this study was to evaluate the effect of stocking rate (SR) and calving date (CD) on milk production, BW and BCS within grass-based production systems post European Union milk quotas using modern grazing management practices and high genetic potential Holstein-Friesian (HF) spring calving dairy cattle over a two year period. Two groups of HF dairy cows with different mean CD were established from within the existing research herd at Moorepark (Teagasc, Ireland). Animals were assigned either to an early calving (mean CD: 12 February) treatment or a late calving (mean CD: 25 February) treatment. Animals within each CD treatment were randomly allocated to 1 of 3 SR treatments, Low (2.51 cows/hectare (ha), Medium (2.92 cows/ha) and High (3.28 cows/ha) which were designed to represent 3 alternative whole farm SR in a post-European Union milk quota, spring calving, grass-based milk production system. A total of 138 spring-calving dairy cows, comprised of two strains of HF (North American HF and New Zealand HF genetic strains), were used during 2009 and 2010, respectively. The effects of CD, SR treatment, genetic strain and their interactions on milk production per cow and per ha, body weight and body condition score, reproductive performance, DM intake and environmental efficiency were analysed.

### 4. Main results:

- Although reducing per animal production, increased SR resulted in increased milk and milk solids production per ha. The results also indicate that although CD had no effect on total lactation performance, adjusting mean CD can be an effective strategy to align animal requirements and grass supply and reduce the requirement for supplements at increased SR in early lactation.
- Stocking rate had a small effect on total herbage accumulation (11 860 kg DM ha<sup>-1</sup> year<sup>-1</sup>) but had no effect on total herbage utilization (11 700 kg DM ha<sup>-1</sup> year<sup>-1</sup>).
- Milk and milk solids (MS; fat + protein) production per ha increased by 2 580 kg ha<sup>-1</sup> and 196 kg ha<sup>-1</sup> as SR increased from 2.5 to 3.3 cows ha<sup>-1</sup>.
- Milk production per ha and net herbage accumulation and utilization were unaffected by CD. Winter feed production was reduced as SR increased.
- Increased SR, associated with increased grazing severity, resulted in swards of increased leaf

content and nutritive value.

- The results indicate that, although associated with increased milk production per ha, grazed grass utilisation and improved sward nutritive value, the potential benefits of increased SR on Irish dairy farms can only be realized if the average level of herbage production and utilisation is increased.
- The results indicate that earlier calving and increased SR can be achieved without adverse effect on overall pregnancy rates.
- The existence of a SR by strain interaction for a number of reproductive variables suggests that the smaller New Zealand strain is better adapted to increased SR systems.
- Individual animal milk production, bodyweight, body condition score and the efficiency of milk production were significantly reduced as SR increased due to a reduction in herbage availability.
- The existence of CD x SR x season interactions for production, DMI and EB indicate that delaying herd mean CD can be an effective strategy to minimise the reduction in animal performance particularly in spring at higher SR.
- This study further confirms the benefits of a new approach to the evaluation of herbage allowance known as the Individual Herbage Allowance which encompasses the 3 main factors restricting DM intake in rotational grazing namely: the average daily herbage allowance of the group, the intake capacity of the individual animal within the group and the relative intake capacity of the animal within the competing herd.
- Stocking rate had no significant effect on soil solution concentrations of N.
- Modelling analysis indicated that the increased grass utilisation and milk production per hectare resulted in a reduction in N surplus and an increase in N use efficiency at higher SR.
- The results highlight the possibility for the sustainable intensification of grass based dairy systems and suggest that SR is a poor indicator of N loss in pastoral systems with limited imported feed.

## 5. Opportunity/Benefit:

- The results reported in this study provides an insight into the potential productivity and nutrient efficiency of technically focused grazing systems based on high productivity grassland swards (15.2 t DM/ha/year) with medium N inputs (250 kg N/ha/year). In contrast, commercial farm data indicates that, based on increased N input, average grass DM production on intensive Irish dairy farms in Ireland is approximately 10 t DM/ha resulting in reduced milk production per hectare, increased concentrate supplementation and ultimately reduced N use efficiency. These stark differences indicate the potential contribution of improved basic agronomic and nutrient management practices at farm level to increase grazed grass utilization and resulting in increased farm system productivity from highly N efficient grazing systems.

## 6. Dissemination:

During the life time of this project 2 open day events were held at Moorepark that 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:

McCarthy, B, L. Delaby, K. M. Pierce, A. Brennan, and B. Horan. 2013. The effect of stocking rate and calving date on milk production of Holstein-Friesian dairy cows. *Livest. Sci.* 153:123-134.

Tunon, G., E. Kennedy, B. Horan, D. Hennessy, N. Lopez-Villalobos, P. Kemp, A. Brennan and M. O'Donovan, 2013. Effect of grazing severity on perennial ryegrass herbage production and sward structural characteristics throughout an entire grazing season *Grass and Forage Science* doi: 10.1111/gfs.12048

McCarthy B., K. M. Pierce, L. Delaby, A. Brennan, and B. Horan. 2012b. The effect of stocking rate and calving date on reproductive performance, body state, and metabolic and health parameters of Holstein-

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Friesian dairy cows. J. Dairy Sci. 95:1337-1348.

**Popular publications:**

Horan, B., L. Shalloo and D. Patton, 2012. 'What stocking rate for my farm? Maximising milk production from pasture' in National Dairy Conference 2012, Tralee, Co. Kerry.

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**7. Compiled by:** Dr Brendan Horan

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