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# Milk yield and lactation curves of first-lactation Simmental cows with respect to intensity of the management system and genetic value for milk yield of sire

A. GERBER*, D. KROGMEIER*, R. EMMERLING* und K.-U. GÖTZ*
*Institute for Animal Breeding, Bavarian State Research Center for Agricuture,
Prof.-Dürrwaechter-Platz 1, 85586 Grub, (Dieter.Krogmeier@lfl.bayern.de)

## 1. Introduction

Under continuous selection for milk yield, practical breeders frequently raise the question, if it is possible to use top milk yield bulls on extensive dairy farms, too. The present investigation analyses the effect of genetic value for milk yield of AI-sires on farms with different intensity of management. Special points of interest are first lactation yield for milk, fat and protein and the shape of lactation curve for milk yield. Since persistency of lacatation curves varies with intensity of management (ZWALD et al., 2001; ZWALD et al., 2003), it was analyzed, whether the shape of lactation curves of daughters of high and low yielding bulls differs in different production levels.

## 2. Material and Methods

Data comprised 278 bulls of birth years 1993 to 1994 and their daughters (327.509 cows) of the Simmenthal breed in Bavaria. Daughters were divided into 3 groups with respect to relative breeding value for milk yield (RBM) of their sire and to intensity of management.

Table 1: Number of animals in management groups, in classes of relative breeding value for milk yield (RBM) of sire and combination of groups

| | **RBM group** | | | |
|---|---|---|---|---|
| **Management group** | Low | Average | High | Total |
| Extensive | 22.115 | 46.995 | 39.997 | 108.107 |
| Average | 17.479 | 43.687 | 42.953 | 104.119 |
| Intensive | 16.566 | 45.942 | 52.775 | 115.283 |
| Total | 55.160 | 136.624 | 135.725 | 327.509 |
| Number of sires | 88 | 123 | 67 | 278 |
| Average RBM of sires | 94 | 105 | 115 | 104 |

Management groups were defined using herd-year-effect estimates from the routine test day model breeding value estimation for milk yield (Table 2). In contrast to average herd year milk yield, herd year effects are corrected for all fixed effects and for genetic level of cows. About one third of all cows was classified in extensive, average and intensive production levels, respectively (Table 1).

Milk, fat and protein yield as well as lactation curves were compared between genetic levels, intensities and combinations of both. The model for the analysis of lactation milk, fat and protein yields included RBM class of sire, production level, interaction between both, days in milk, age at first calving and year by season effects.

Shape of lactation curve was derived from corrected test day milk yields. Comparable variables of lactation curves are milk yield at 8., 14., 61. and 305. day of lactation as well as

maximum of lactation curve (yield and day). To characterize slopes of lactation curves, linear regressions were calculated between days in milk (DIM) 8 and 14, between DIM 8 and lactation maximum and between lactation maximum and DIM 305.

Table 2: Characterization of management groups (herd-year-classes for sum of fat and protein-kg)

| **Management group** | **Extensive** | **Average** | **Intensive** |
|---|---|---|---|
| Herd year effect (min/max) | 106 – 397 | 398 – 442 | 443 – 863 |
| Mean herd year effect | 342 ± 43 | 419 ± 13 | 481 ± 36 |
| Average herd milk yield (kg) | 5469 ± 777 | 6554 ± 518 | 7452 ± 717 |
| Number of dairy farms | 10.703 | 7.608 | 7.242 |
| Average herd size (cows) | 26,9 ± 14,6 | 32,0 ± 16,3 | 34,4 ± 17,6 |
| Total mix ratio (TMR) (%) | 6,0 | 12,6 | 17,8 |
| Free stalls (%) | 22,0 | 28,3 | 31,5 |
| Average RBM of cow | 100 | 102 | 104 |

## 3. Results

As expected, the advantage in milk, fat and protein yield of daughters of bulls with high breeding values is significantly higher under intensive management (Table 3, Figure 1). Under extensive conditions milk yield of daughters of sires with high RBM is about 5% higher than milk yield of sires with low RBM. In comparison, under intensive conditions, milk yield of daughters of high RBM bulls is 9% higher than for daughters of low RBM bulls. The corresponding increase in both fat and protein yield is 6% and 10%, respectively.

The higher increase in cows with higher genetic valued for milk yield with increasing intensity confirms results of PRYCE et al. (1999) and KEARNEY et al. (2004). Further selection for milk yield will lead to a higher phenotypic increase in milk yield on intensive farms than on extensive farms. However, also for extensive farms an increase in milk yield can be expected. Additional analyses not shown here revealed no significant differences in functional traits between daughters of the different groups of bulls examined here (GERBER et al., 2006). Therefore, the use of top bulls is also profitable for less intensive farms.

Table 3: Effect of management intensity and genetic value of the sire on milk, fat and protein yield of first lactation (LSMEANS)

| | **RBM sire** | **Low** | | **Average** | | **High** | | **Difference** |
|---|---|---|---|---|---|---|---|---|
| **Trait** | **Intensity** | **LSM** | **SE** | **LSM** | **SE** | **LSM** | **SE** | **High / Low** |
| | **Extensive** | 4827 | 9 | 4959 | 7 | 5089 | 8 | 261 *** |
| **Milk yield** | **Average** | 5472 | 9 | 5690 | 7 | 5865 | 8 | 392 *** |
| | **Intensive** | 6003 | 10 | 6313 | 7 | 6532 | 7 | 529 *** |
| | **Extensive** | 199 | 0,37 | 204 | 0,31 | 212 | 0,34 | 13 *** |
| **Fat yield** | **Average** | 227 | 0,40 | 235 | 0,32 | 245 | 0,33 | 18 *** |
| | **Intensive** | 249 | 0,41 | 261 | 0,32 | 273 | 0,32 | 25 *** |
| | **Extensive** | 163 | 0,31 | 168 | 0,26 | 174 | 0,28 | 10 *** |
| **Protein yield** | **Average** | 190 | 0,33 | 198 | 0,26 | 206 | 0,28 | 16 *** |
| | **Intensive** | 211 | 0,34 | 223 | 0,26 | 232 | 0,26 | 21 *** |

Significance of difference: *** P < 0,001

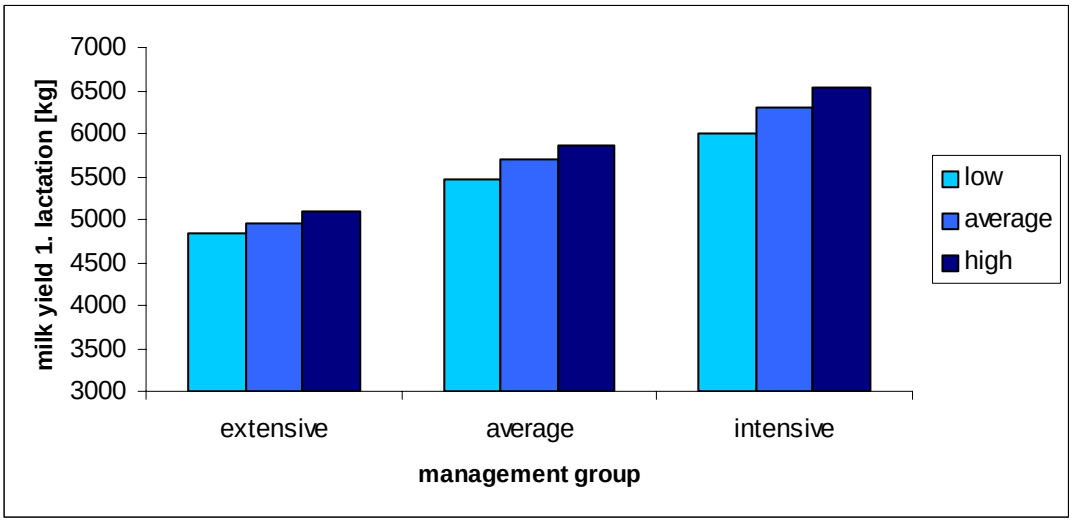


Figure 1**:** Effect of management intensity and genetic value of the sire (high, average and low RBM class) on first-lactation milk yield

Table 4: Effect of the interaction of management intensity and genetic value of the sire on parameters of the lactation curve

| **Intensity** | **Extensive** | | | **Average** | | | **Intensive** | | |
|---|---|---|---|---|---|---|---|---|---|
| **RBM sire** | **Low** | **Average** | **High** | **Low** | **Average** | **High** | **Low** | **Average** | **High** |
| **DIM 8 (kg)** | 18,9 | 19,4 | 19,7 | 20,2 | 20,7 | 21,2 | 21,3 | 22,1 | 22,7 |
| **DIM 14 (kg)** | 19,5 | 20,0 | 20,4 | 21,0 | 21,7 | 22,2 | 22,3 | 23,2 | 23,9 |
| **Max. of lact. (kg)** | 20,1 | 20,7 | 21,2 | 22,1 | 23,1 | 23,7 | 23,7 | 24,9 | 26,0 |
| **Max. of lact. (day)** | 29 | 33 | 34 | 36 | 40 | 40 | 39 | 39 | 42 |
| **DIM 61 (kg)** | 18,9 | 19,6 | 20,2 | 21,4 | 22,4 | 23,2 | 23,2 | 24,7 | 25,6 |
| **DIM 305 (kg)** | 12,1 | 12,6 | 13,1 | 13,9 | 14,8 | 15,4 | 15,7 | 16,8 | 17,5 |
| **Difference Max – DIM 305 (kg)** | 8,0 | 8,1 | 8,1 | 8,2 | 8,3 | 8,3 | 8,0 | 8,1 | 8,5 |
| | | | | | | | | | |
| **Slope (kg/day)** | | | | | | | | | |
| **DIM 8 – 14** | 0,086 | 0,087 | 0,094 | 0,114 | 0,131 | 0,138 | 0,133 | 0,163 | 0,170 |
| **DIM 8 - maximum** | 0,055 | 0,052 | 0,057 | 0,068 | 0,073 | 0,079 | 0,077 | 0,090 | 0,094 |
| **DIM 60 - 305** | -0,028 | -0,029 | -0,029 | -0,031 | -0,031 | -0,032 | -0,031 | -0,032 | -0,033 |

We were especially interested in the shape of lactation curves of daughters from sires with high RBM on farms of different production level (Table 4 and Figure 2). The shape of lactation curves of high yielding cows under intensive management differs from lactation curves of similar cows under extensive management. Differences are more pronounced in the early stages of lactation.

Lactation curves of cows with a high genetic value for milk yield clearly show a flatter trajectory in an extensive level than under intensive conditions. On intensive farms these cows show a steep increase up to lactation maximum and a steeper decrease afterwards. These results indicate, that shape of lactation curve is an interaction between genetic potential for

milk yield and corresponding husbandry and feeding. There was no evidence for the assumption that cows with a high genetic potential will even under extensive conditions start very high into lactation followed by a drastic collapse in milk yield due to metabolic stress.

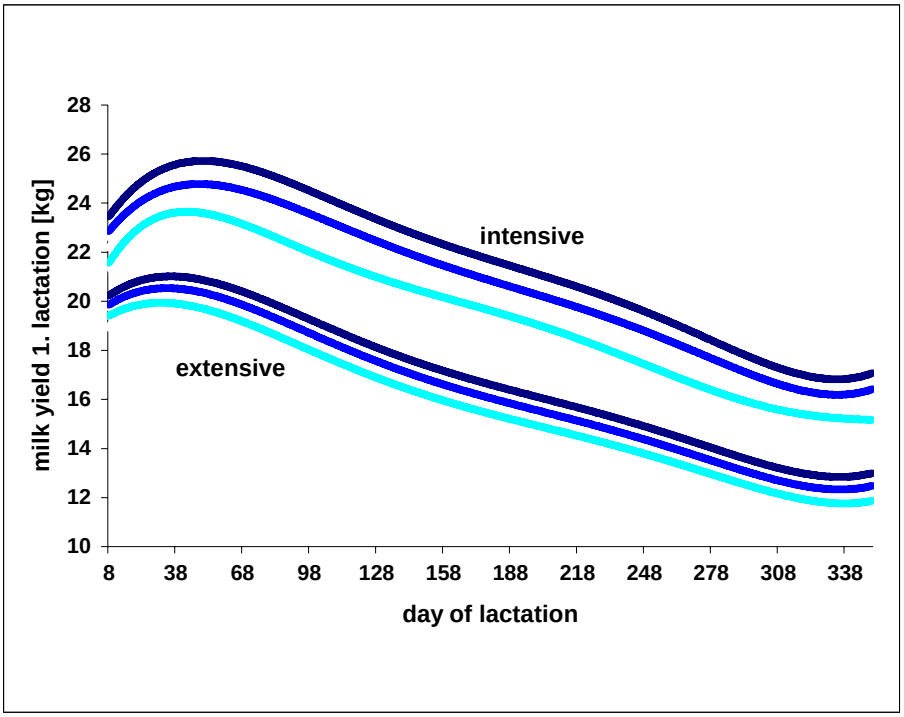


Figure 2: Effect of genetic value of the sire on lactation curves in intensive and extensive management systems

## 4. Conclusions

Further selection for milk yield will lead to a higher phenotypic increase in milk yield on intensive farms than on extensive farms. The assumption that under extensive conditions the lactation curve of cows with a higher genetic level starts out very high, followed by a drastic slump due to metabolic disorders did not hold. In could be shown that the lactation curves of cows with a high genetic capacity for milk yield run clearly flatter under extensive management than under intensive conditions.

## 5. Literature

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