EFFECT OF STOCKING RATE AND COW LACTATION STAGE ON NITROGEN BALANCE OF GRAZING DAIRY COWS

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I. BACKGROUND

The **main N input at a cow level is via feed:**

To improve grazing dairy management systems by applying appropriate stocking rates (SR) on the farm while **decreasing levels of supplementation at pasture according to cows’ lactation stage (LS).**

Where is feed protein?

N balance at a cow level
II. INTRODUCTION

There are **important biological** and **economical reasons** to reduce N losses and **improve its utilization in dairy cattle**:

- Excessive N intake causes **low reproduction** and **low efficiency** in BW.
- Low efficiency of protein utilization in grazing dairy systems.

**Improved feed N utilization feeding efficiency** can be got by:

- Feeding dairy cows according to their production levels (grouping animals according to lactation stage).
- Using **properly balanced diets** (the goal is maximize protein utilization by making sure that total protein is not overfed and rumen degradable and un-degradable protein is balanced).
III. OBJECTIVES

To investigate the effect of stocking rate (SR) and cows’ lactation stage (LS) on animal N-balance in two periods (P) of supplementation at pasture.

To determine the N-conversion rate from $\sum N$ inputs (grass, grass/maize silage and concentrate) to $\sum N$ outputs (milk and body weight gain) in order to decrease the N-surplus by improving efficiency of N utilization at the animal level.
A randomized block design was established by a $2 \times 2$ factorial arrangement of 4 treatments (LE, LM, HE and HM): two stocking rates and two lactation stages.

**ANIMALS & PASTURES**
HF cows ($n=72$) grazing rotationally on ryegrass + legume pastures.

**SWARD & ANIMAL DETERMINATIONS**
- **Pasture:** pre-/post-grazing SH, HM, DHA, SR and sward quality (CP, fibers, WSC and OMD) determined by NIRS.
- **Animal:** BW, BCS, MY and milk quality (protein).
- **$\Sigma N$ inputs:** Total intake/Nutritive value G+S+C.
- **$\Sigma N$ outputs:** MY (daily) and BW (weekly).
- **$\Sigma N$ inputs - $\Sigma N$ outputs:** N excretion (urine + faeces).
V. RESULTS

Animal performance and milk quality responses

<table>
<thead>
<tr>
<th>Herds</th>
<th>Cows (number)</th>
<th>Lactation (days)</th>
<th>Stocking rate (cows/ha)</th>
<th>Milk (kg/cow/day)</th>
<th>Protein (g/kg DM)</th>
<th>Fat (kg)</th>
<th>BW (kg)</th>
<th>BCS (1-5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LE</td>
<td>22</td>
<td>33&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.3&lt;sup&gt;a&lt;/sup&gt;</td>
<td>24.9&lt;sup&gt;a&lt;/sup&gt;</td>
<td>29.2&lt;sup&gt;a&lt;/sup&gt;</td>
<td>35.6&lt;sup&gt;a&lt;/sup&gt;</td>
<td>573&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>2.8&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>HE</td>
<td>22</td>
<td>28&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.8&lt;sup&gt;b&lt;/sup&gt;</td>
<td>26.5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>28.7&lt;sup&gt;a&lt;/sup&gt;</td>
<td>36.3&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>564&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.7&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>LM</td>
<td>14</td>
<td>139&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3.6&lt;sup&gt;a&lt;/sup&gt;</td>
<td>20.4&lt;sup&gt;b&lt;/sup&gt;</td>
<td>30.6&lt;sup&gt;b&lt;/sup&gt;</td>
<td>39.3&lt;sup&gt;b&lt;/sup&gt;</td>
<td>600&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.9&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>HM</td>
<td>14</td>
<td>140&lt;sup&gt;b&lt;/sup&gt;</td>
<td>4.6&lt;sup&gt;b&lt;/sup&gt;</td>
<td>18.9&lt;sup&gt;b&lt;/sup&gt;</td>
<td>31.6&lt;sup&gt;b&lt;/sup&gt;</td>
<td>36.8&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>574&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>3.0&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

**E lactacion stage** (31) cows showed lower DIM than **M lactation stage** (140) cows.

**Imposed SR** were higher (P<0.05) in cows at H (5.2 cows/ha) than at L (3.9 cows/ha) SR.

**MY** (kg/cow/day) was higher (P<0.05) in cows at E (25.7) than at M **lactation stage** (19.6).

**Milk protein, fat, BW and BCS** were higher (P<0.05) in cows at M than at E **lactation stage**.
V. RESULTS

Total feed intake and sward quality characteristics

<table>
<thead>
<tr>
<th>Herds</th>
<th>Pasture DM intake (kg DM/cow/day)</th>
<th>Grass silage DM</th>
<th>Maize silage DM</th>
<th>Concentrate DM</th>
<th>CP (%)</th>
<th>ADF (g/kg DM)</th>
<th>NDF (g/kg DM)</th>
<th>WSC (g/kg DM)</th>
<th>IVOMD (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LE</td>
<td>18.8a 14.2a 1.5 0 1.7 0</td>
<td>4.1a 1.8a</td>
<td>17.3a</td>
<td>131a 275a 487a</td>
<td>185a</td>
<td>749a</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HE</td>
<td>16.4a 18.2a 1.5 0 1.7 0</td>
<td>4.1a 1.8a</td>
<td>16.9b</td>
<td>149ab 261b 475b</td>
<td>193a</td>
<td>759ab</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LM</td>
<td>25.9b 21.0b 1.8 0 2.0 0</td>
<td>2.6b 0b</td>
<td>18.5a</td>
<td>146ab 278a 505a</td>
<td>74b</td>
<td>757ab</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HM</td>
<td>21.0b 17.6b 1.8 0 2.0 0</td>
<td>3.3b 0b</td>
<td>16.7b</td>
<td>157b 266b 483ab</td>
<td>177b</td>
<td>790b</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Pasture and silage DM intake were higher (P<0.001) in cows at M than at E lactation stage.

Concentrate DM intake was higher (P<0.001) in cows at E than at M lactation stage.

DM (16.8 vs. 18%), ADF (264 vs. 277 g/kg DM) and NDF (479 vs. 496 g/kg DM) content were lower (P<0.05) in cows managed at H than at L stocking rate.

WSC were higher in cows managed at E than at M lactation stage.
V. RESULTS

$\sum N$ inputs (G+S+C) and $\sum N$ outputs (M+BW) (g N/cow/day)

$\sum N$ inputs from concentrate were higher ($P<0.01$) in cows managed at H than at L stocking rate.

$\sum N$ inputs from concentrate and $\sum N$ outputs from milk were higher ($P<0.001$) at E than at M lactation stage.
V. RESULTS

**ΣN inputs, ΣN outputs and N excretion (g N/cow/day)**

| Groups¹ | LE | HE | LM | HM | Periods² | P1 | P2 | P1 | P2 | P1 | P2 | P1 | P2 | LS | SR | P | LSxSR | LSxP | SRxP | LSxSRxP |
|---------|----|----|----|----|---------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Grass   |    |    |    |    |         | 68 | 67 | 83 | 95 | 105 | 95 | 83 | 87 |     |     |     |     |     |     |     |     |
| Grass silage |    |    |    |    |         | 26 | 0  | 30 | 0  | 31 | 0  | 31 | 0  |     |     |     |     |     |     |     |     |
| Maize silage |    |    |    |    |         | 17 | 0  | 20 | 0  | 20 | 0  | 21 | 0  |     |     |     |     |     |     |     |     |
| Concentrate |    |    |    |    |         | 121| 51 | 121| 56 | 74 | 3  | 97 | 3  |     |     |     |     |     |     |     |     |
| ΣN inputs |    |    |    |    |         | 232| 118| 254| 151| 230| 98 | 232| 90 |     |     |     |     |     |     |     |     |
| Milk output |    |    |    |    |         | 143| 90 | 150| 101| 124| 78 | 122| 73 |     |     |     |     |     |     |     |     |
| Body weight gain |    |    |    |    |         | -6 | -3 | 10 | -1 | 10 | 7  | 8  | -2 |     |     |     |     |     |     |     |     |
| ΣN outputs |    |    |    |    |         | 137| 87 | 160| 100| 134| 85 | 130| 71 |     |     |     |     |     |     |     |     |
| ΣN inputs-ΣN outputs |    |    |    |    |         | 95 | 30 | 94 | 50 | 96 | 12 | 102| 18 |     |     |     |     |     |     |     |     |
| N excretion |    |    |    |    |         | 442| 36 | 356| 119| 466| -6 | 576| 41 |     |     |     |     |     |     |     |     |

¹Groups: Stocking Rate (L, Low vs. H, High) x Stage of Lactation (E, Early vs. L, Late) ²Periods of the Grazing Season (P1, March-April vs. P2, May-August); ³Significance:*** (P<0.001); ** (P<0.01); * (P<0.05); ns, not significant.

**ΣN inputs from silage (G + M) and concentrate** were higher (P<0.001) in **P1** than in **P2**.

**ΣN outputs from milk** were higher (P<0.001) in **P1** than in **P2**.

**ΣN inputs - ΣN outputs** and **N excretion** were also higher (P<0.001) in **P1** than in **P2**.

**No differences** were found between **LS** and **SR** for **ΣN inputs - ΣN outputs** and **N excretion**.
VI. CONCLUSIONS

1.- The results pointed the interest of evaluating cows’ lactation stage and stocking rate on $\Sigma N$ inputs and $\Sigma N$ outputs to minimize N-losses at the animal level.

2.- Higher $\Sigma N$ inputs and $\Sigma N$ outputs were found in cows at early than at middle lactation stage.

3.- Higher $\Sigma N$ inputs and $\Sigma N$ outputs were reached at high than at low stocking rate.

4.- $\Sigma N$ inputs and $\Sigma N$ outputs were higher in P1 than in P2 and supplementation (concentrate + silage) highly increased N-excretion in grazing dairy cows.
ACKNOWLEDGMENTS

THANK YOU VERY MUCH FOR YOUR ATTENTION

ANY QUESTIONS? ...
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