The robustness of dairy cows analyzed through the profiles of their adaptive responses


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Scientific issues

- Robustness: ability to maintain within the herd despite environmental variability
  - Cope with farmer production expectations
  - Give appropriate adaptive responses in disturbed situations

- Conceptual framework: In case of suboptimal nutritional environment, dairy cows’ adaptive responses account for trade-offs between life functions (Friggens and Newbold, 2007)

- Objective: method to screen the diversity of adaptive responses accounting for the trade-offs between life functions
Work organization

Adaptive responses profiles during disturbances (Ollion et al, EAAP 2013)

Disturbances

Dairy herd

Milk production

Body condition

Links?

Trades-offs profiles between life functions in suboptimal environment

Milk production

Reproduction

Body condition

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Phenotyping trade-offs profiles

  - 489 statistical individuals (1 lactation/cow)
  - Information about: milk production, body condition score, reproduction events, individual characteristics (breed, parity, age at first calving....)
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Preynat, 2009
Phenotyping trade-offs profiles

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Phenotyping trade-offs profiles basing on dynamics of MY, BCS and on reproduction

- PCA and clustering method ➔ Trade-offs between life functions

489 individuals

334 undisturbed

244 Repro +

Variables MY, BCS, reproduction

90 Repro -

Variables MY, BCS

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Results: Trade-offs profiles in Repro + cows

Trade-off profile 1 (N=114)
- Short Int. AIC
- 27 days

Trade-off profile 2 (N=41)
- Long Int. AIC
- 99 days

Trade-off profile 3 (N=89)
- Short Int. AIC
- 28 days
Results: Trade-offs profiles in Repro + cows

- **Trade-off profile 1 (N=114)**
  - Short Int. AIC 27 days

- **Trade-off profile 2 (N=41)**
  - Long Int. AIC 99 days

- **Trade-off profile 3 (N=89)**
  - Short Int. AIC 28 days

- **Trade-off 1**
  - BCS ↘ ↘
  - BCS_{calving} > average
  - Short repro period (NbAI−)
Results: Trade-offs profiles in Repro + cows

Trade-off profile 1 (N=114)
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◆ Trade-off 2
- Long repro period (Nb AI +)
- BCS_{calving} < average
- Interval calving-milk peak < average
Results: Trade-offs profiles in Repro + cows

**Trade-off profile 1 (N=114)**
- Short Int. AIC: 27 days

**Trade-off profile 2 (N=41)**
- Long Int. AIC: 99 days

**Trade-off profile 3 (N=89)**
- Short Int. AIC: 28 days

- **Trade-off 3**
  - BCS stable
  - BCS $>$ average
  - Short repro period
Results: links between trade-off and adaptive response profiles

- Reminder: 4 main adaptive response profiles for cows Repro +:
  - Same dataset
  - Disturbed period
  - Similar method of characterization based on MY and BCS dynamics

- Significant link for individuals who succeeded reproduction (Test $X^2$: $p$-value=0.026)

- No significant link for individuals who failed reproduction ($p$-value=0.550)
Links between profiles (cows repro +)

Trade-offs between life functions from 0 to 90 days postpartum

Adaptive responses to disturbances (>90 days postpartum)

1. **Adaptive response 1**
   - No effect on Milk
   - Decline of BCS

2. **Adaptive response 2**
   - No effect on Milk and no BCS flexibility

3. **Adaptive response 3**
   - Flexible: Milk drop and rebound decline of BCS

4. **Adaptive response 4**
   - No effect on BCS with flexible Milk

Trade-offs between life functions from 0 to 90 days postpartum:

- **Trade-off profile 1 (N=114)**: Trade-off affects BCS
- **Trade-off profile 2 (N=41)**: Trade-off affects repro and low BCS
- **Trade-off profile 3 (N=89)**: No trade-off

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Conclusions

- 27% of cows were non pregnant at 90 days post partum: no links between profiles

- 3 main trade-offs profiles highlighted for pregnant animals

- Significant links with adaptive responses profiles despite the data
  ➔ The observation of trade-offs between life functions during identified situation can be a source of information to anticipate cow adaptive response in disturbed situation

- Profile stability? Long term analysis on individual careers

- A method that can be improved and validated with high-throughput phenotyping data

- Detection and valorization of this diversity by farmers: toward more robust systems to environmental variability
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