Effect of mating strategies on genetic and economic outcomes in a Montbéliarde dairy herd

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Study funded by MO3
The Montbéliarde breed in France

In 2017

- Dual purpose breed
- 2nd dairy breed in France
  - 17.7% of French dairy cattle
  - 388,124 lactations recorded

https://www.montbeliarde.org/localisation-nationale-fr.html

Number of lactations

80,087
2009: X- Sexed semen

↑ within herd selection intensity
2009: X-Sexed semen

↑ within herd selection intensity

2011: Commercial female genotyping

↑ within herd selection accuracy
2009: X-Sexed semen

↑ within herd selection intensity

2011: Commercial female genotyping

↑ within herd selection accuracy

↑ within herd genetic gain
2009: X-Sexed semen

↑ within herd selection intensity

2011: Commercial female genotyping

↑ within herd selection accuracy

↑ within herd genetic gain
2009: X- Sexed semen

2011: Commercial female genotyping

What is the impact of alternative replacement and genotyping strategies on genetics and economics at herd level?
Simulation study - Method

ECOMAST simulation program

• 77-cows Montbéliarde herd
Simulation study - Method

ECOMAST simulation program

- 77-cows Montbéliarde herd

- Daily milk production
- Gestation status
- Mastitis status
- Health status
- Culling probability
- ...

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Simulation study - Method

ECOMAST simulation program

- 77-cows Montbéliarde herd
- Pasture based farming system with relatively high milk price

- Daily milk production
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- ...
Simulation study - Method

ECOMAST simulation program

- 77-cows Montbéliarde herd
  - Daily milk production
  - Gestation status
  - Mastitis status
  - Health status
  - Culling probability
  - ... 

- Pasture based farming system with relatively high milk price
- Females genotyped when 15-day old (40€ all included)
Simulation study - Method

- 15 years of simulation
  - 5 initialization years: no genotyping, no sexed nor beef breed semen
  - 10 years of different strategies
Simulation study - Method

- 15 years of simulation
  - 5 initialization years: no genotyping, no sexed nor beef breed semen
  - 10 years of different strategies

- Strategies:

  - Heifers genotyping
    - 0%
    - 100%

  - Use of sexed semen
    - Yes
    - No

  - Use of beef breed semen
    - Yes
    - No

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Variation in $\Delta G$ of breeding objective from year 0 to year 10

- No Genotyping

<table>
<thead>
<tr>
<th>Breeding objective (SD units)</th>
<th>P</th>
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Simulation study - Results

Variation in $\Delta G$ of breeding objective from year 0 to year 10

- Bars with different superscripts differ significantly (Tukey test)
- p-value < 0.05

Breeding objective (SD units)

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Simulation study - Results

Variation in $\Delta G$ of breeding objective from year 0 to year 10

Breeding objective (SD units)

P | P | P | P | G | G | G | G
NSex-NCr | Sex-Cr | Sex-NCr | NSex-Cr | NSex-NCr | Sex-Cr | Sex-NCr | NSex-Cr

Genotyping

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Variation in \( \Delta G \) of breeding objective from year 0 to year 10

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Conventional semen only

+ Genotype

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Sexed semen and Crossbreeding

+ Genotype

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- Sexed semen and no crossbreeding
- + Genotype

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Variation in $\Delta G$ of breeding objective from year 0 to year 10

Conventional semen and Crossbreeding

+ Genotype

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Simulation study - Results

Variation in $\Delta G$ of breeding objective from year 0 to year 10

Breeding objective (SD units)

- **P NSex-NCr**
- **P Sex-NCr**
- **G NSex-NCr**
- **G Sex-NCr**

Sexed semen ↑ genetic gain (+ 0.18 σ)
Simulation study - Results

Variation in $\Delta G$ of breeding objective from year 0 to year 10

Breeding objective (SD units)

- $P$ NSex-NCr
- $P$ Sex-NCr
- $G$ NSex-NCr
- $G$ Sex-NCr

Female genotyping ↑ genetic gain (+ 0.07 $\sigma$)
Simulation study - Results

Variation in ΔG of breeding objective from year 0 to year 10

Use of sexed semen and female genotyping ↑ genetic gain

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Variation in total products from year 0 to year 10

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Simulation study - Results

Variation in total products from year 0 to year 10

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Variation in total products from year 0 to year 10

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| Variation in total product is linked to animals sales

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Variation in total expenses from year 0 to year 10

Raising and reproduction costs increased a lot

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Variation in total expenses from year 0 to year 10

Raising and reproduction costs increased a lot

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Variation in net margin from year 0 to year 10

Always a gain in net margin
Take home messages

• Use of sexed semen and female genotyping → ↑ genetic gain
Take home messages

• Use of sexed semen and female genotyping $\rightarrow$ ↑ genetic gain

• Benefits of “sexed semen only” strategy depend on the market
Take home messages

• Use of sexed semen and female genotyping $\rightarrow$ $\uparrow$ genetic gain

• Benefits of “sexed semen only” strategy depend on the market

• Long term sustainable strategy: “G – sexed – crossbreeding”:
  • increases genetic gain,
  • maintains the increase in net margin
  • is less sensitive to fluctuations of market conditions
Take home messages

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• Delay of several years before observing a return on investments
Take home messages

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Interest of combining genotyping with use of sexed semen