Optimization of dairy herd replacements combining conventional, sexed, and beef semen in mating programs

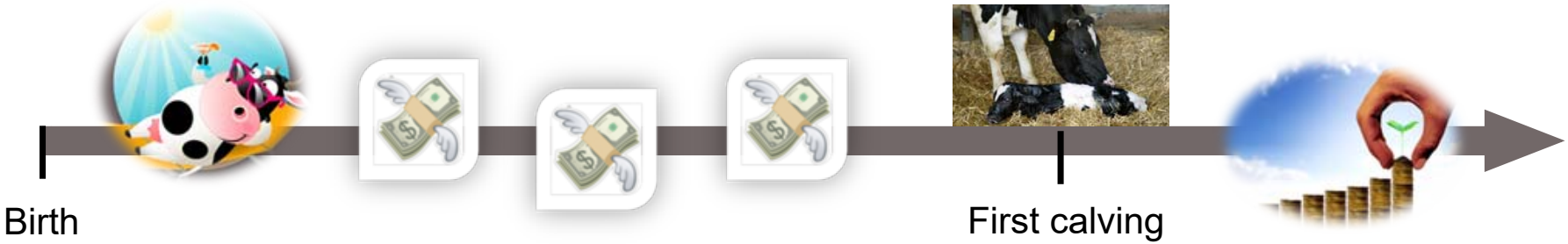
***Valentina Ferrari*[1]**, *Maurizio Marusi*[1], *Mauro Penasa*[2], *JT van Kaam*[1], *Raffaella Finocchiaro*[1] *and Martino Cassandro*[1,2]

[1]*ANAFIBJ*, [2]*University of Padova*

Special thanks to Maurizio Marusi and Manuel Galleani for their support with tool development.

46th ICAR and INTERBULL 2024
19 – 24 May, 2024
Bled, Slovenia

General introduction

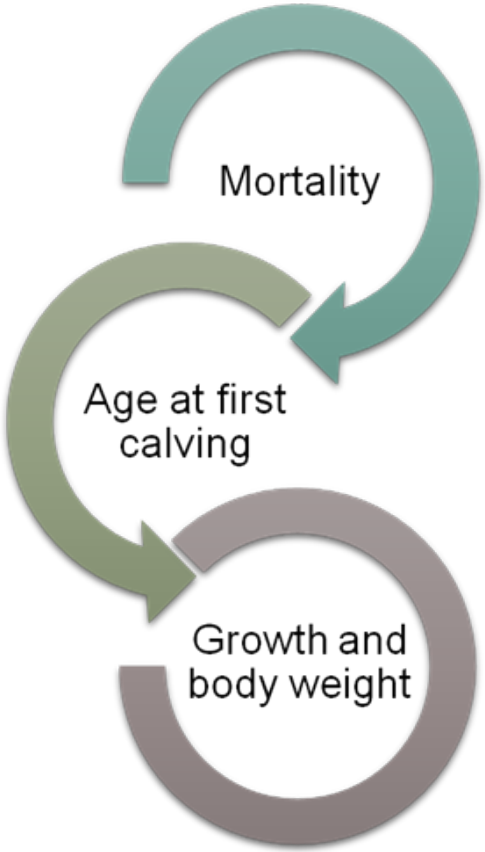


Improve lifetime performances

Minimize rearing costs

your COW our FUTURE

What affects the process of rearing heifers?



- ✓ Rearing costs
- ✓ Number of breeding heifers
- ✓ Cubicles (overcrowding)

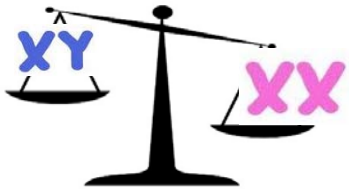
- ✓ Milk production
- ✓ Health issues
- ✓ Reproductive efficiency (→ maximize conception rate, favor shorter calving interval, reduce the number of heifers that fail to conceive)

Advancements in A.I.

Technologies and tools available

Genomics

Animal genetic value in advance



Sexed semen + beef semen

Female calves from the best animals in the herd

+

Increasing profits from crossbred calves

your COW our FUTURE

Heifers: which strategies?

✓How is it possible to define how many heifers are needed?

✓How to decide which animals to breed with Holstein bull?

Aim

- To develop a tool to help dairy farmers identify their annual female replacement needs.

The tool is based on herd performance level and combination of type of semen (conventional, sex-sorted, and beef semen) to optimize the economic outcome.

your COW our FUTURE

How does this tool work?

1) Define the number of heifers that the farm needs.

2) Define the number of animals to breed with Holstein semen.

3) Choose which animals to breed with Holstein semen (using mating programs).

your COW our FUTURE

Materials and methods (1/2)

- We developed a tool to let users adapting it to their situations (approach proposed by Genex Cooperative, Ontario, CA, and adjusted to Italian herd and market conditions).
- Simulated case study with input variables:

Variables	Unit	Input value
Cows (lactating and dry)	n	250
Breeding heifers entering the herd	n/yr	100
Annual replacement rate	%	30
Annual herd growth rate target	%	0
Heifers' safety percentage	%	10
Sex ratio (females/males) by semen type	%	47/53 (conventional and beef), 90/10 (sexed)
Calving interval	(mo)	13
Animals not inseminated	%	2
Pregnancy loss	%	8
Stillbirth rate	%	7
Mortality from weaning to first calving	%	5

Semen type (conventional, sexed, beef) can be changed accordingly to farmer's utilisation.

Materials and methods (2/2)

Annual dairy replacement needs = result is derived from the number of animals in the herd and the annual turnover rate, adjusted for age at first calving.

Number of heifers yielded per year = result is derived by semen type utilization, calf and heifer mortality, pregnancy losses, and calving interval.

Heifer balance*:* number of heifers yielded - annual dairy replacement needs.

Animals yielded → used to evaluate the **replacement cost** (RC) per 100 L of milk

$$RC = \frac{cost\ of\ rearing\ replacements - (cull\ cow\ income + income\ from\ male\ calves\ sold)}{income\ from\ 100\ L\ of\ milk\ sold}$$

cost of rearing replacements: all costs incurred from birth to first calving calculated for all females yielded;

cull cow income: revenue from selling cull cows and heifers;

income from male calves: revenue from selling dairy male calves and calves from beef when beef semen is used

your COW our FUTURE

EC APP

AN FARM REPLACEMENT

Insert by farmer based on its herd data and/or performances

Dairy heifers replacement calculation

Example 1: 100% use of conventional semen

NR. OF COWS (LACTATING AND DRY)	250
NR. OF BREEDING HEIFERS ENTERING THE HERD	100
ANNUAL REPLACEMENT RATE	30%
ANNUAL HERD GROWTH RATE TARGET	0%

	DAIRY CONVENTIONAL SEMEN		BEEF SEMEN		DAIRY SEXED SEMEN	
	COWS	HEIFERS	COWS	HEIFERS	COWS	HEIFERS
CONCEPTION RATE	38%	38%	38%	55%	32%	50%
FEMALE SEX RATIO	48%	48%	48%	48%	93%	93%

	% COWS	NR. OF COWS	% HEIFERS	NR. OF HEIFERS
% DAIRY CONV. SEMEN	100%	250	100%	100
% BEEF SEMEN	0%	0	0%	0
% DAIRY SEXED SEMEN	0%	0	0%	0
TOTAL	100%	250	100%	100

TOTAL DAIRY CONV. SEMEN UNITS	607	263
TOTAL BEEF SEMEN UNITS	0	0
TOTAL DAIRY SEXED SEMEN UNITS	0	0

CALVING INTERVAL	13
AGE AT FIRST CALVING	24
% DO NOT BREED (DNB)	2%
PREGNANT COWS CULLED	5%
PREGNANCY LOSS (POST PREGNANCY CHECK)	8%
% STILLBORN MALE CALVES	7%
% STILLBORN FEMALE CALVES	5%
HEIFER REARING LOSS	5%

TOTAL DAIRY MALE CALVES	45
TOTAL BEEF MALE CALVES	0
TOTAL BEEF FEMALE CALVES	0
ANNUAL DAIRY HEIFERS NEEDED	82
MONTHLY DAIRY HEIFERS NEEDED	7
NR. OF DAIRY HEIFERS YIELDED	111
SURSPLUS DAIRY HEIFERS	29

Dairy heifer replacement calculation: replacement cost

AVARAGE DAIRY-BEEF MALE CALVES BODY WEIGHT	50 KG
AV. DAIRY MALE CALF MARKET VALUE	1.3 €/KG
AV. DAIRY-BEEF MALE CALF MARKET VALUE	3.5 €/KG
DAYS FROM BIRTH TO DAIRY-BEEF MALE CALF TO BE SOLD	40 DAYS
AV. HEIFER MARKET VALUE	1500.0 €
AV. CULL COW MARKET VALUE	600.0 €
AV. COST FOR DISPOSAL OF DEAD-ON-FARM-COW	120.0 €
COWS MORTALITY	5%
HEIFER FEED COST	3.00 €
CALF FEED COST	3.5 €
AV. REARING COST FROM BIRTH TO FIRST CALVING	3137.0 €
MILK YIELD	30 L/DAY
TOT. ANNUAL MILK YIELD	2737500 L/ANNO/STALLA

AV. DAIRY CONVENTIONAL SEMEN UNIT PRICE	15.00 €/DOSE
AV. BEEF SEMEN UNIT PRICE	7.00 €/DOSE
AV. DAIRY SEXED SEMEN UNIT PRICE	40.00 €/DOSE

PROFIT/LOSS FROM PREGNANT HEIFER SALE	-47473.0 €
PROFIT/LOSS FROM CROSSBREED CALVED AND DAIRY MALE CALF SALE	0.0 €
REPLACEMENT COST (ON 100L OF MILK)	10.08 €
TOTAL SEMEN COST	13050.0 €

your COW our FUTURE

EC APP

AN EASY TOOL TO CALCULATE YOUR FARM REPLACEMENT

Example 2: combined use of conventional, sexed and beef semen

Dairy heifer replacement calculation

NR. OF COWS (LACTATING AND DRY)	250
NR. OF BREEDING HEIFERS ENTERING THE HERD	100
ANNUAL REPLACEMENT RATE	30%
ANNUAL HERD GROWTH RATE TARGET	0%

	DAIRY CONVENTIONAL SEMEN		BEEF SEMEN		DAIRY SEXED SEMEN	
	COWS	HEIFERS	COWS	HEIFERS	COWS	HEIFERS
CONCEPTION RATE	38%	38%	38%	55%	32%	50%
FEMALE SEX RATIO	48%	48%	48%	48%	93%	93%

	TOTAL DAIRY MALE CALVES	40
	TOTAL BEEF MALE CALVES	64
	TOTAL BEEF FEMALE CALVES	58
	ANNUAL DAIRY HEIFERS NEEDED	82
	MONTHLY DAIRY HEIFERS NEEDED	7
	NR. OF DAIRY HEIFERS YIELDED	83
	SURSPLUS DAIRY HEIFERS	1

	% COWS	NR. OF COWS	% HEIFERS	NR. OF HEIFERS
% DAIRY CONV. SEMEN	32%	80	20%	20
% BEEF SEMEN	68%	170	0%	0
% DAIRY SEXED SEMEN	0%	0	80%	80
TOTAL	100%	250	100%	100

TOTAL DAIRY CONV. SEMEN UNITS	194	42
TOTAL BEEF SEMEN UNITS	413	0
TOTAL DAIRY SEXED SEMEN UNITS	0	168

CALVING INTERVAL	13
AGE AT FIRST CALVING	24
% DO NOT BREED (DNB)	2%
PREGNANT COWS CULLED	5%
PREGNANCY LOSS (POST PREGNANCY CHECK)	8%
% STILLBORN MALE CALVES	7%
% STILLBORN FEMALE CALVES	5%
HEIFER REARING LOSS	5%

AVARAGE DAIRY-BEEF MALE CALVES BODY WEIGHT	50 KG
AV. DAIRY MALE CALF MARKET VALUE	1.3 €/KG
AV. DAIRY-BEEF MALE CALF MARKET VALUE	4.00 €/KG
DAYS FROM BIRTH TO DAIRY-BEEF MALE CALF TO BE SOLD	40 DAYS
AV. HEIFER MARKET VALUE	1500.0 €
AV. CULL COW MARKET VALUE	600.0 €
AV. COST FOR DISPOSAL OF DEAD-ON-FARM-COW	120.0 €
COWS MORTALITY	5%
HEIFER FEED COST	3.00 €
CALF FEED COST	3.5 €
AV. REARING COST FROM BIRTH TO FIRST CALVING	3137.0 €
MILK YIELD	30 L/DAY
TOT. ANNUAL MILK YIELD	2737500 L/YEAR/STABLE

AV. DAIRY CONVENTIONAL SEMEN UNIT PRICE	15.00 €/DOSE
AV. BEEF SEMEN UNIT PRICE	7.00 €/DOSE
AV. DAIRY SEXED SEMEN UNIT PRICE	40.00 €/DOSE

PROFIT/LOSS FROM PREGNANT HEIFER SALE	-1637.0 €
PROFIT/LOSS FROM CROSSBREED CALVED AND DAIRY MALE CALF SALE	0 €
REPLACEMENT COST (ON 100L OF MILK)	8.4 €
TOTAL SEMEN COST	13151.0 €

~ 2 € less

Conclusions

- Yielding more heifers than needed is not the most profitable strategy for farmers (given the current Italian market conditions).
- Combining beef and sexed semen to reach heifer balance close to zero, decreased the replacement cost.
- The tool will be implemented into ANAFIBJ online mating program to provide farmers an approach to identify the best replacement strategy.

ITALIAN JOURNAL OF ANIMAL SCIENCE
2024, VOL. 23, NO. 1, 409–415
https://doi.org/10.1080/1828051X.2024.2324130

Taylor & Francis
Taylor & Francis Group

OPEN ACCESS Check for updates

BRIEF REPORT

A tool to optimise dairy herd replacements combining conventional, sexed, and beef semen

Valentina Ferrari[a,b], Maurizio Marusi[a], Mauro Penasa[b], Johannes Baptist Cornelis Henricus Maria van Kaam[a], Raffaella Finocchiaro[a] and Martino Cassandro[a,b]

[a]Associazione Nazionale Allevatori della Razza Frisona, Bruna e Jersey Italiana, Cremona, CR, Italy; [b]Dipartimento di Agronomia Animali Alimenti Risorse naturali e Ambiente, Università di Padova, Legnaro, PD, Italy

https://doi.org/10.1080/1828051X.2024.2324130

Thank you for your attention!

Ferrari Valentina

valentinaferrari@anafi.it

www.anafibj.it

your COW our FUTURE