Technical Session 16: New Milk Recording Methods and Services

Analysis of the accuracy of lactation qualification methods and use of weighting factors for genetic evaluation

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Context of this French study

- Number of dairy cows and herds in 2020
  - 2,300,000 dairy cows and 32,000 herds (72 cows by herd)
- 8 protocols in Dairy Cattle Milk Recording
  - A protocol by MRO's technician
  - B protocol by farmer
  - C protocol, by MRO's technician and farmer

    and T, Z methods (AT, BT, BZ, CZ protocols) with Liu's method

    Possibilitity C method without alternation (AC) with Liu's method*

    and Robots (AR, BR protocols) with at least two samples by cow

    Possibilitity only one sample (AR, BR*) with Peeters&Galesloot's method*

→ Used methods approved by ICAR to answer expectations of farmers, changes in measuring equipment, new services,…

Context of the French study

➢ Methods by protocols

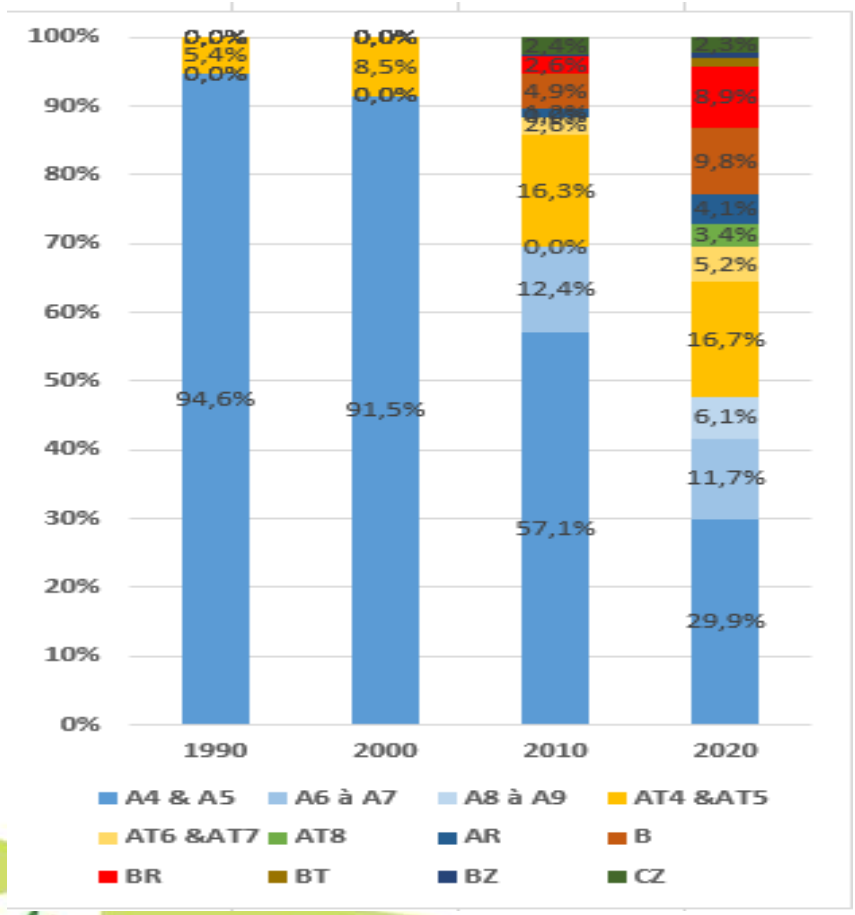
Combination between protocol and method		Individual lactation qualification methods					
		4	**5**	**6**	**7**	**8**	**9**
8 protocols	**A**	A4 (1)	A5	A6	A7	A8	A9 (1)
	B	B4	B5	B6	B7	B8	B9
	AT	AT4	AT5	AT6	AT7	AT8	AT9
	BT	BT4	BT5	BT6	BT7	BT8	BT9
	BZ	BZ4	BZ5	BZ6	BZ7	BZ8	BZ9
	CZ	CZ4	CZ5	CZ6	CZ7	CZ8	AT9
	AR	AR4	AR5	AR6	AR7	AR8	AR9
	BR	BR4	BR5	BR6	BR7	BR8	BR9

(1) The accuracy level is higher for A4 method in comparison with A9 method

From requirements defined in the French Guidelines: interval between calving date-1st test-day, interval between test-day, minimum number of test-day during the first 305 lactation days

Context of the French study

- The evolution of protocols&methods



% of herds by protocols in 2020

A= 48%

AT= 25%

Robots AR BR = 13%

B BT BZ = 12%

CZ = 2%

Aims of this study

- Many protocols and methods are proposed
  - A, AT, AR, B, BT, BR, BZ, CZ with 4 to 9 possible methods
- Willingness to evaluate the accuracy of protocols, methods
  - On lactation reference-305 days from relevant data sets in comparison with A4, AR4 methods (gold standard)
  - Calculation of R^2, bias, std dev of bias on criteria milk yields, fat%, fat yields, protein%, protein yields for each method
- Calculate weighting factors for genetic evaluation
  - A lactation model is used in France for genetic evaluation
  - Necessity to update first weighting factors implemented since 2001
  - From new relevant data sets
  - With a model which takes into account R^2 and repetabilty by criteria

Description of the data sets

➢ Two data sets

- First 19 047 lactations reference-305 days A4, separate am/pm milkings from Holstein breed (for T, Z, C methods)

  Average Milk yields 9 172 kg, Fat yields 351 kg, Protein yields 285 kg

- Second with 8 250 lactations reference-305 days AR4, at least 2 samples from Holstein 74%, Montbéliarde 22% breeds (for R methods)

  Average Milk yields 9 495 kg, Fat yields 361 kg, Protein yields 303 kg

➢ Selection criteria

- Maximum delay between calving - first test-day 60 days
- At least 7 test-day during the lactation
- Lactation days: minimum 280, maximum 399
- Lactation number < 10

Statistical method

➢ Methodology

- From reference data set A4 method, simulation of A8 method by keeping one test-day out of two on lactation
- Calculation of lactation 305 days from A8 method
- Comparison with reference-305 days A4 method
- Accuracy on criteria: milk yields, fat%, protein%, fat yields, protein yields
- Same methodology used for AR4 method (versus AR8 method)

➢ Extrapolation of accuracy

- For other methods A5, A6, A7 and A9 versus AR5,…
- By linear regression model

Some results of accuracy by lactation qualification methods

Results of R^2 on lactation - Methods type 4

Protocol/Method	Milk Y.	Fat%	Protein%	Fat Y.	Protein Y.
Reference A4 AR4	1	1	1	1	1
AT4 Liu	0.997	0.962	0.997	0.989	0.997
AC*4 Liu	0.966	0.853	0.955	0.940	0.971
AR*4 P&G	0.997	0.878	0.997	0.954	0.997

For fat% the # of accuracy between AT4 Liu, AC*4 Liu= 11%

For fat yields the # of accuracy between AR4, AR*4 P&G= 5%

Results of R^2 on lactation - Methods type 8

Protocol/Method	Milk Y.	Fat%	Protein%	Fat Y.	Protein Y.
A8	0.972	0.902	0.946	0.955	0.966
AT8 Liu	0.967	0.861	0.940	0.945	0.963
AC*8 Liu	0.925	0.749	0.894	0.876	0.928
AR8	0.980	0.941	0.963	0.970	0.979
AR*8 P&G	0.979	0.845	0.961	0.930	0.978

For fat yields the # of accuracy between AT8 Liu, AC*8 Liu= 7%

For fat% the # of accuracy between AR8, AR*8 P&G= 10%

Calculation of weighting factors

➢ Methodology

- R^2 of each protocol and method
- The repetability (Rep) of each criteria

  = 0.5 for milk yields, fat yields, protein yields

  = 0.7 for fat% and protein%

➢ Description of the formula

- Weighting factor= 1 - Rep / [1 - Rep + (1 - R^2 / R^2)]
- Example: A8 method for milk yields: R^2= 0.972 and Rep= 0.5

  = 1 - 0.5 / [1 - 0.5 + (1 - 0.972 / 0.972)]

  = 0.95 applied for this lactation on criteria milk yields, in genetic evaluation

Some results of weighting factors by lactation qualification methods

Comparison of weighting factors (old & new)

OLD Factors	Method 4					Method 8				
Protocol/Method	Milk Y.	Fat %	Prot. %	Fat Y.	Prot. Y.	Milk Y.	Fat %	Prot. %	Fat Y.	Prot. Y.
A	1	1	1	1	1	0.93	0.78	0.89	0.87	0.91
AT LIU	0.99	0.94	0.99	0.96	0.99	0.92	0.71	0.88	0.81	0.90

NEW Factors	Method 4					Method 8				
Protocol/Method	Milk Y.	Fat %	Prot. %	Fat Y.	Prot. Y	Milk Y.	Fat %	Prot. %	Fat Y.	Prot. Y.
A	1	1	1	1	1	0.95	0.73	0.84	0.91	0.93
AT LIU	0.99	0.88	0.99	0.98	0.99	0.94	0.65	0.83	0.90	0.93

For AT4 Liu, overall no # between old and new factors except fat%

For A8 AT8 Liu, new factors are lower for fat&prot.%, better for fat&prot. yields

Results of weighting factors for new protocols

FACTORS / Protocol/Method	Method 4					Method 8				
	Milk Y.	Fat %	Prot. %	Fat Y.	Prot. Y.	Milk Y.	Fat %	Prot. %	Fat Y.	Prot. Y.
AC*LIU	0.93	0.64	0.86	0.89	0.94	0.86	0.47	0.72	0.78	0.87
AR*P&G	1	0.68	0.99	0.91	0.99	0.95	0.62	0.88	0.87	0.96

Overall the level of weighting factors is relevant between methods 4 and 8 for new protocols

In the case of low accuracy level, especially for fat%, it will be necessary to assess the impact and the additional number of lactations on genetic evaluation

Conclusion - Discussion

➢ About the context in milk recording

- Willingness of France Genetics Breeding to propose all the protocols & methods approved by ICAR to the farmers
- The wish is to simplify and to reduce the cost of Milk Recording mainly in big herds and AMS Robots

➢ Changes in the FGE Guidelines from 2020

- New protocols (AC Liu, Robots Peeters&Galesloot)
- New individual lactation qualification model in 2020 (more simple and in accordance with ICAR Guidelines)

➢ Link lactation qualification and genetic evaluation

- Update and calculation of weighting factors by methods and criteria
- To improve the QUALITY of genetic evaluation

Thank you for your attention