37th ICAR Annual Meeting
May 31 – June 4 2010, Riga, Latvia

Adding Value to Test-Day Data by Using Modified Best Prediction Method

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Context

Lactation yields are used for :

- **Genetic evaluations**
  - **First models : lactation models**
  - **Now : Test - day models more and more used**
- **Management purposes**
  - **Farms are getting larger**
  - **Economic sustainability becomes difficult to achieve**

Context

Methods for computing lactation yields (1) :

- **Official method (ICAR)**
  - **Test interval method (TIM)**
- **Other methods approved by ICAR**
  - **Interpolation using standard lactation curves**
  - **Multiple trait prediction (MTP)**
  - **Best prediction (BP)**

Context

Methods for computing lactation yields (2) :

- **Other Methods based on test-day models (TDM)**

  Pool and Meuwissen (1999), Mayeres et al. (2004), Vasconcelos et al. (2004)

  Mayeres et al. (2004) :

  Herd x test-day (fixed) → { Herd x year (fixed); Herd x month x 5 years (fixed); Herd x test-day (random) }

  Sum of all effects (except HTD) = daily yield

Context

Methods for computing lactation yields (3) :

- **TDM can also bring management tools**

  Mayeres et al. (2004), Koivula et al. (2007), Caccamo et al. (2008)

  Herd effects reflect evolution of management and are corrected for age, lactation stage, breed …

- Dairy farmers need lactation yields and management tools a few days after milk recording

  → impossible with population wide TDM

Objectives

Develop a new lactation yields computation method which :

- **Brings useful management tools to farmers**
- **Is robust with alternative testing plans**
- **Gives results directly after milk recording**

Test the ability of this new method to predict daily and lactation yields

Method

Multi-trait :

milk, fat and protein yields, somatic cell score

Standard lactation curves account for :

- **breed**
- **age at calving**
- **year of production within herd**
- **season within herd**
- **year of calving within herd**
- **genetic value of the cow**

Method

Random regression test-day model :

- **modification to allow prediction of herd effects at each day of the lactation (Mayeres et al. (2004))**
- **Population level effects are pre-corrected to allow daily run at herd level**
  - ✓ **Genetic**
  - ✓ **Stage of lactation x breed x age at calving**

Method

Differences with BP :

- **Herd-level standard lactation curve components are computed jointly with random effects**
- **Genetic value of the cow is taken into account**

Between BP (selection index) and population wide TDM (BLUP)

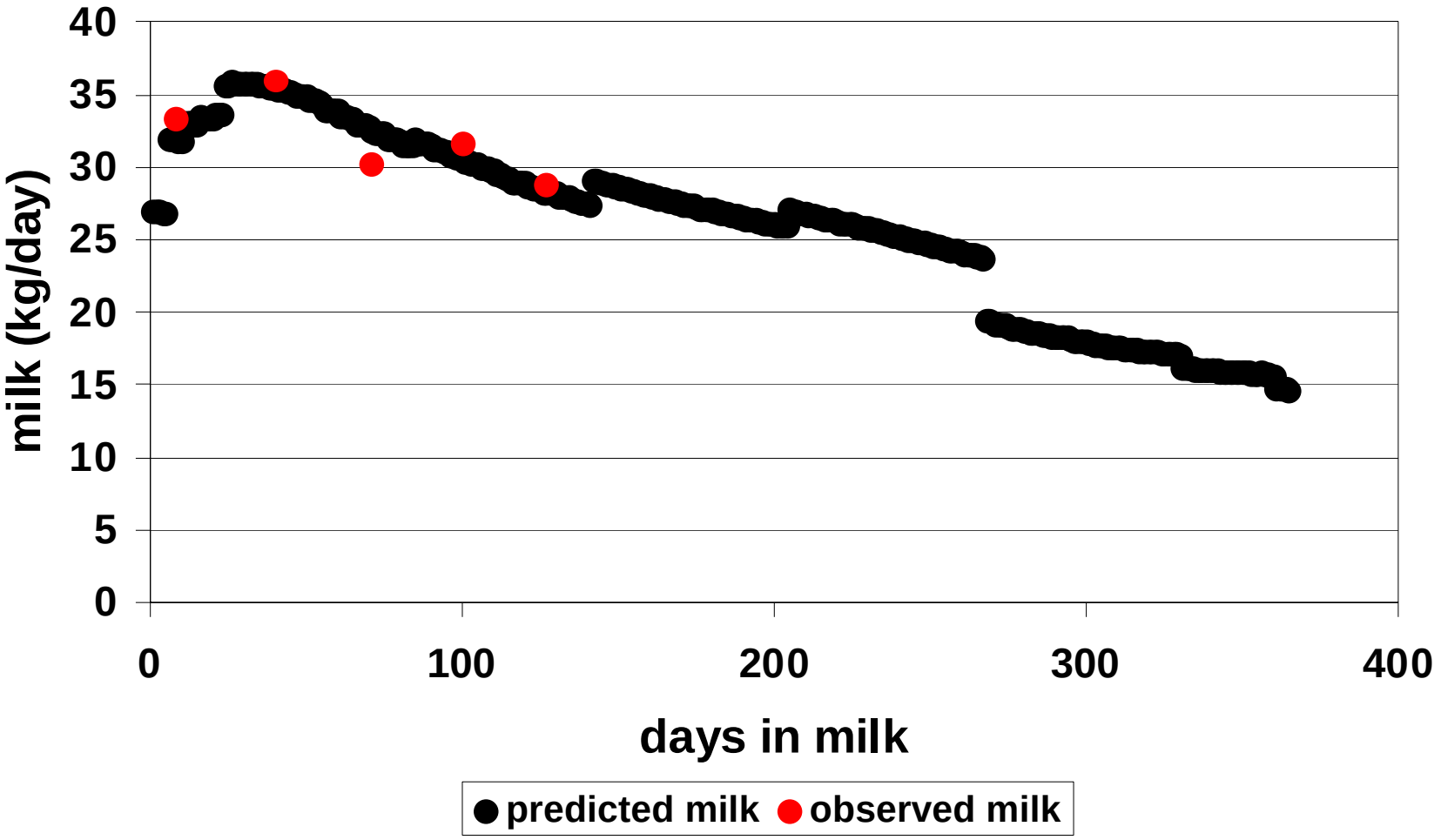
→ **called modified best prediction (mBP)**

Method

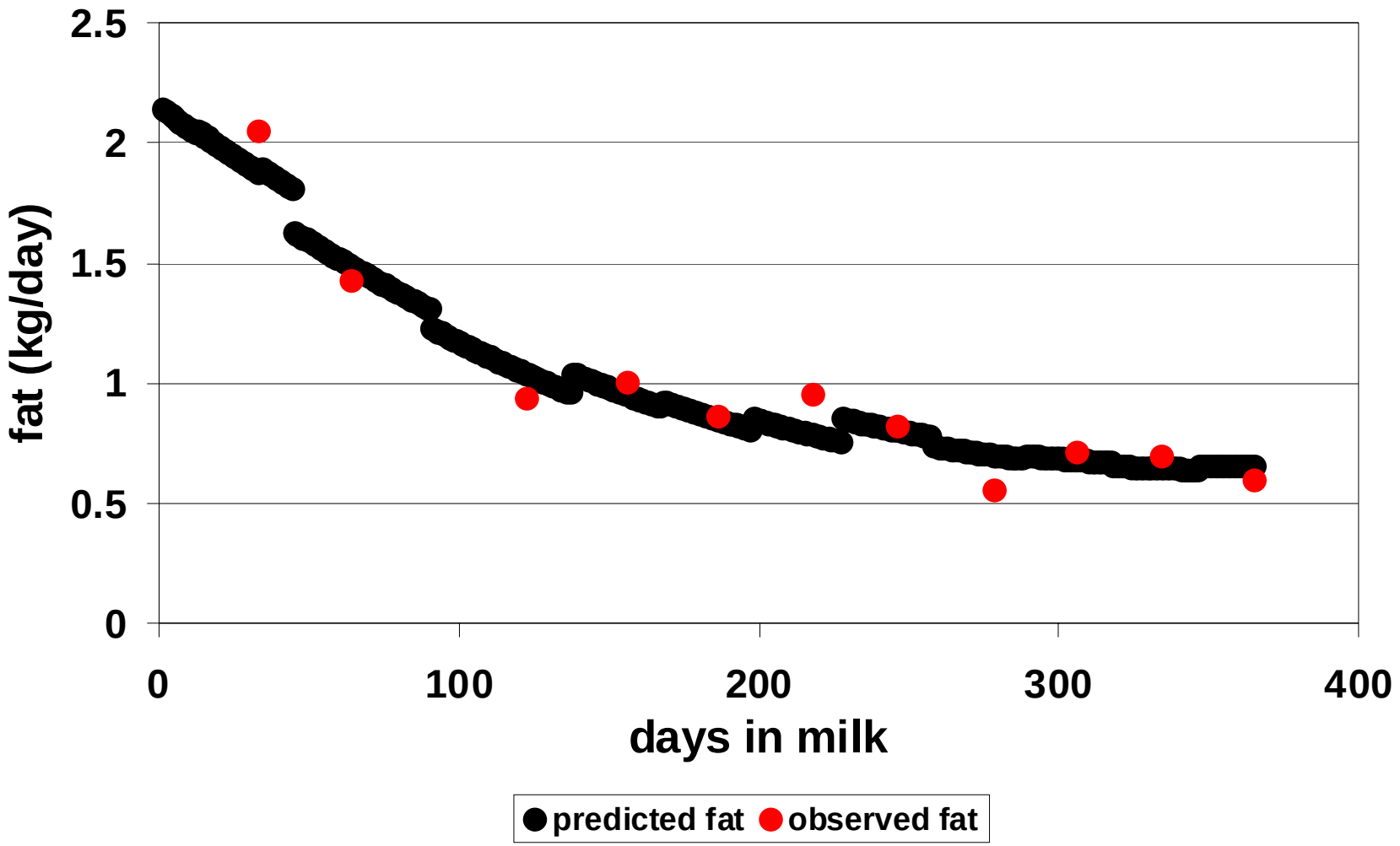
A variant was also tested : mBPb

- **Bayesian prediction**
- **Sum of residuals = 0 by lactation**

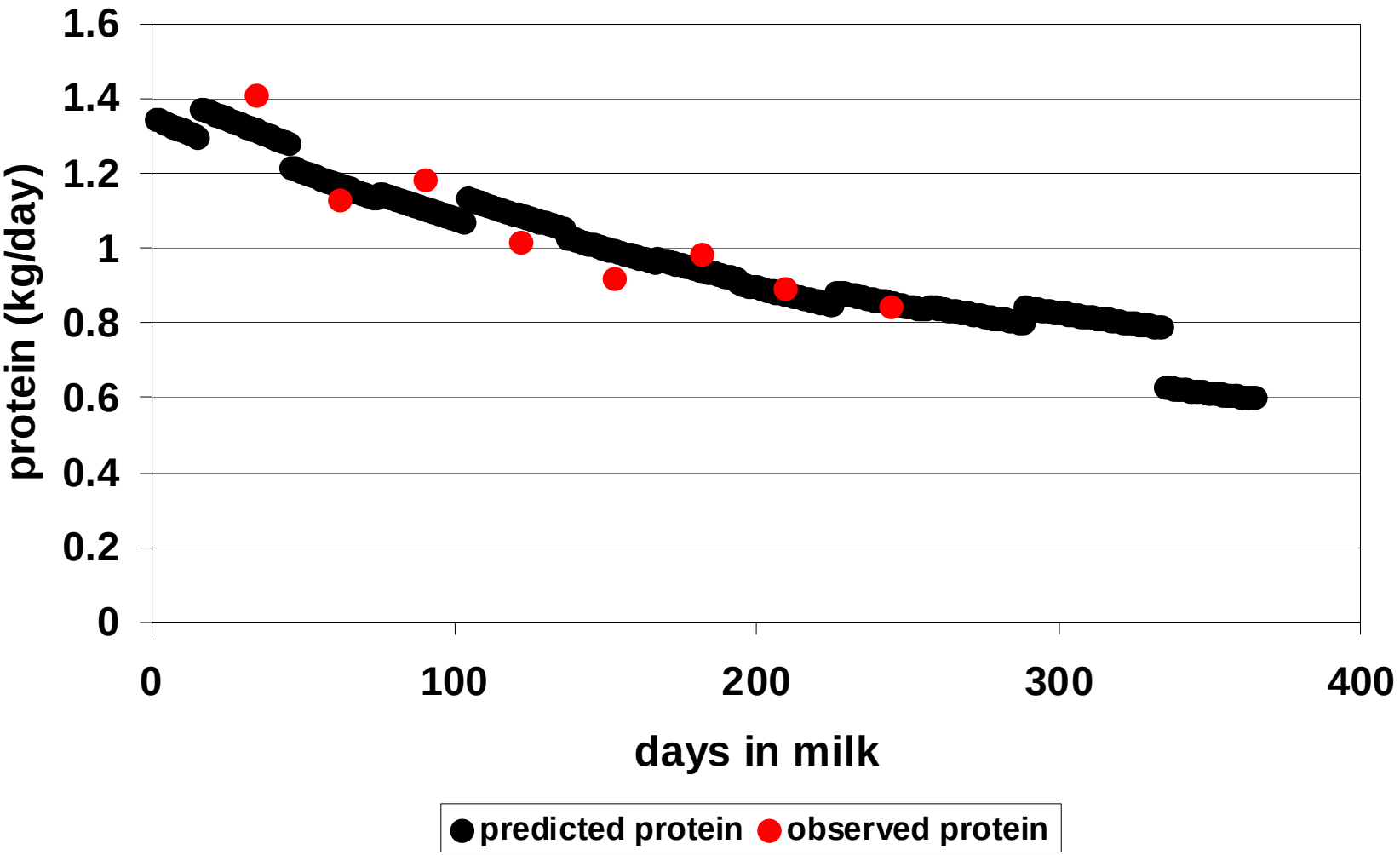
Milk yield (kg)



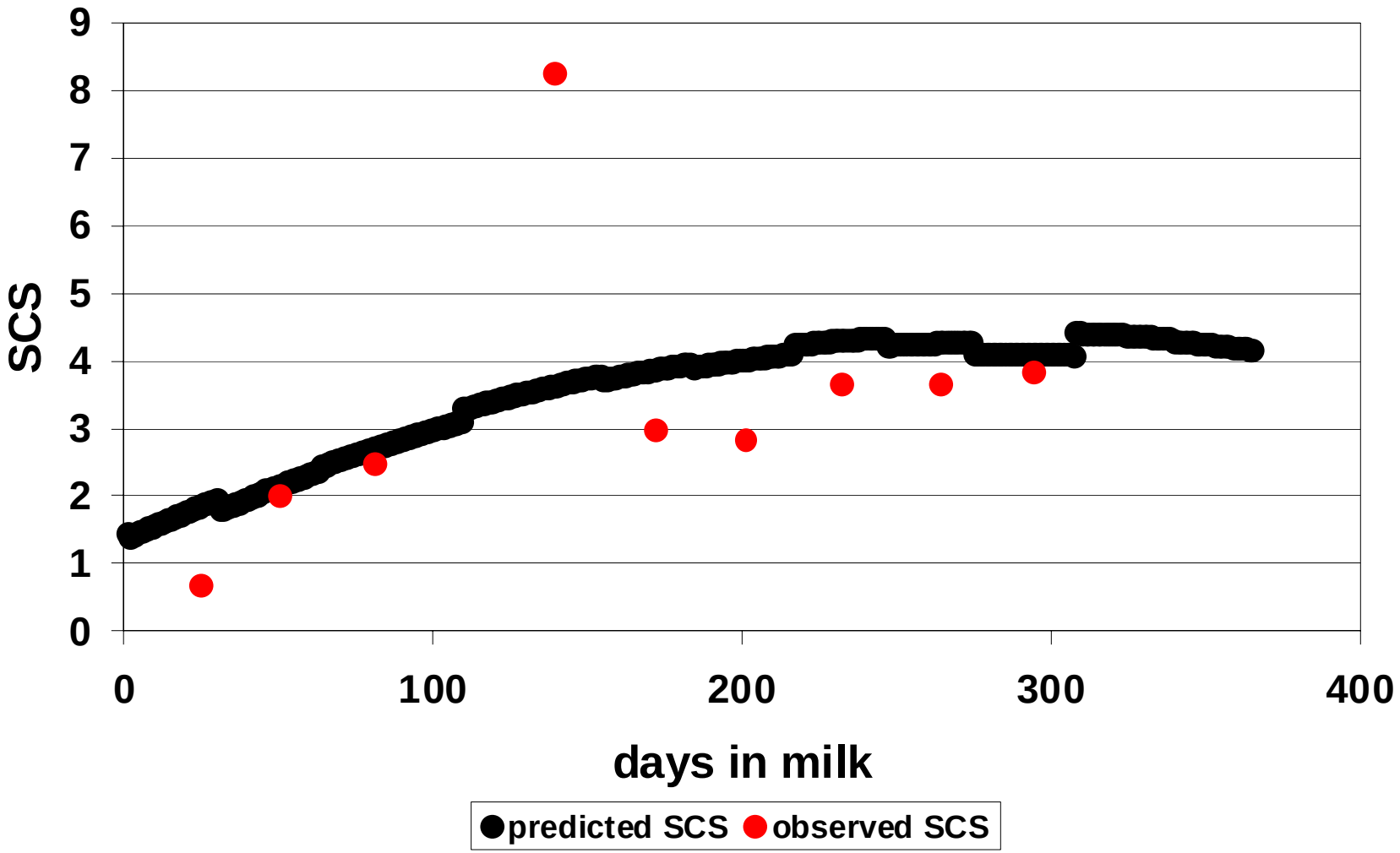
Fat yield (kg)


2.5
2
1.5
1
0.5
0
fat (kg/day)
0
100
200
300
400
days in milk
predicted fat
observed fat

Protein yield (kg)



Somatic cell score



Management tools

Daily yields prediction

- **Peak yield and persistency**

305-d lactation yields prediction

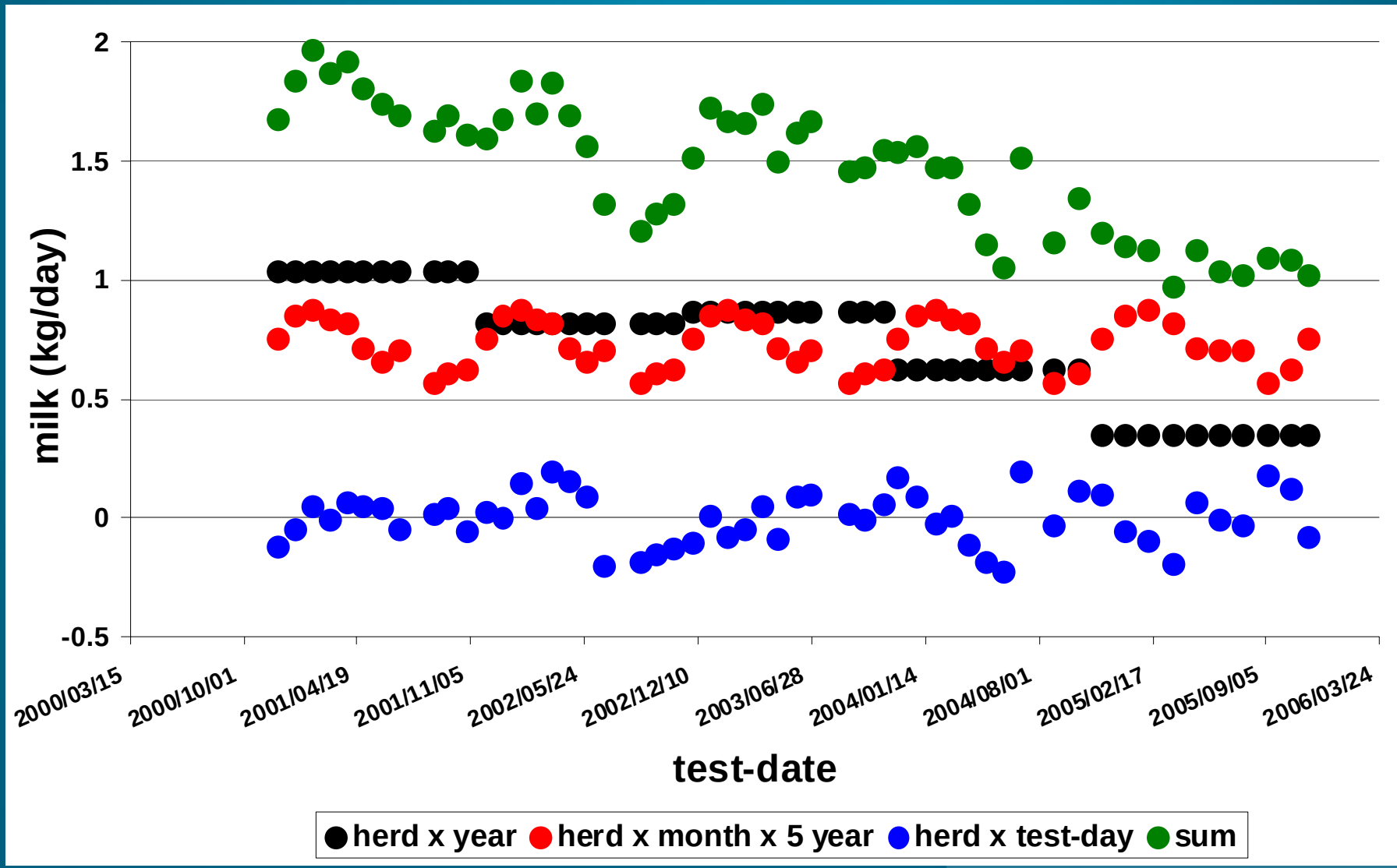
- **Even if lactation is in-progress**

Alerts **(Koivula et al., 2007; Bastin et al., 2008; Bastin et al. 2009)**

- **If observed production is different than predicted**

Evolution of management level

Evolution of management level



Validation

On daily yields prediction

- **Adjustment quality :**

  Difference between observed records used for solving the model and predicted values for these test-days

Validation

Adjustment quality (1st parity)

Trait	N	mBP			mBPb		
		ME[1]	MSE[2]	corr.[3]	ME[1]	MSE[2]	corr.[3]
Milk (kg)	651,266	0.00	4.28	.95	0.00	4.17	.95
Fat (kg)	651,266	0.00	0.01	.92	0.00	0.01	.92
Protein (kg)	651,266	0.00	0.01	.93	0.00	0.01	.94
SCS	556,791	0.00	0.70	.85	0.00	0.68	.85

[1] ME : mean error

[2] MSE : mean square error

[3] corr. : correlation between observation and prediction

Validation

On daily yields prediction

- **Prediction ability**

  Ability to predict values of the following test-day

Validation

Prediction ability (1st parity)

Trait	N	mBP			mBPb		
		ME[1]	MSE[2]	corr.[3]	ME[1]	MSE[2]	corr.[3]
Milk (kg)	7,368	-0.09	12.37	.87	-1.73	29.47	.75
Fat (kg)	7,368	0.00	0.03	.83	-0.06	0.06	.69
Protein (kg)	7,368	0.01	0.01	.85	-0.07	0.03	.72
SCS	6,233	0.00	1.70	.57	-0.22	2.31	.49

[1] ME : mean error

[2] MSE : mean square error

[3] corr. : correlation between observation and prediction

Validation

On lactation yields prediction

- **Daily milk production data collected in the field :**

  4 herds - 312 cows - 562 lactations - 132,607 daily productions

- **Simulation of test-day records**

  Respect of schedule of conditions and characteristics of Walloon Region of Belgium

Validation

On lactation yields prediction

- Comparison of real lactation yields with mBP, mBPb, BP, and TIM
- BP downloaded on AIPL website
  - Pre-correction for parity x age at calving x breed
  - Standard lactation curves account for herd x season of calving
- Terminated and in-progress lactations

Terminated lactations

	N	mBP		mBPb		BP		TIM	
		r.bias[1]	corr.[2]	r.bias[1]	corr.[2]	r.bias[1]	corr.[2]	r.bias[1]	corr.[2]
ALL DATA									
	80200	-0.04	0.991	0.07	0.990	-2.12	0.985	0.33	0.990
BY PARITY									
lact=1	26600	0.00	0.985	0.13	0.985	-5.49	0.979	0.24	0.984
lact=2	17600	0.11	0.990	0.20	0.990	-1.78	0.987	0.50	0.990
lact=3	15600	-0.30	0.991	-0.15	0.991	-0.50	0.991	0.18	0.990
lact=4	10000	-0.09	0.990	0.17	0.989	0.11	0.989	0.62	0.988
lact=5	4800	-0.36	0.986	-0.11	0.987	-0.25	0.988	0.23	0.987
lact=6 +	5600	0.51	0.988	0.02	0.988	-0.18	0.987	0.18	0.988
BY DATA COLLECTING PLAN									
A4	69774	-0.01	0.991	0.08	0.991	-2.07	0.986	0.32	0.991
A6	10426	-0.24	0.988	-0.07	0.987	-2.43	0.982	0.36	0.987

[1] relative bias (%) = (mean – real mean) * 100 / mean real

[2] correlation between real and predicted lactation yields

In-progress lactations

AVAILABLE TESTS	N	mBP		mBPb		BP		TIM	
		r.bias[1]	corr.[2]	r.bias[1]	corr.[2]	r.bias[1]	corr.[2]	r.bias[1]	corr.[2]
1	3179	-2.94	0.907	-4.45	0.811	0.19	0.838	-	-
2	5638	-1.42	0.934	-1.19	0.884	3.04	0.896	-	-
3	6271	-0.50	0.948	0.48	0.920	2.41	0.923	-	-
4	6695	-0.27	0.960	0.73	0.943	1.04	0.942	-	-
5	7603	-0.22	0.974	0.60	0.966	-0.04	0.962	-	-
6	7211	-0.33	0.979	0.37	0.975	-0.81	0.968	-	-
7	6842	-0.32	0.985	0.27	0.983	-1.15	0.977	-	-
8	6066	-0.47	0.988	-0.09	0.987	-1.55	0.981	-	-
9	5267	-0.32	0.992	-0.04	0.991	-1.74	0.986	-	-
10	3701	-0.34	0.992	-0.17	0.992	-2.41	0.987	-	-
11	2656	-0.38	0.993	-0.17	0.992	-2.46	0.988	-	-

[1] relative bias (%) = (mean – real mean) * 100 / mean real

[2] correlation between real and predicted lactation yields

Conclusions

Modified best prediction :

- **Gives a good description of lactation curve**
- **Gives useful management tools**
- **Results are available directly after milk recording**

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Thank you for your attention!

Study supported by:

- Ministry of Agriculture of the Walloon Region of Belgium (SPW – DGARNE)
- National Fund for Scientific Research (FRS – FNRS)