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Genetic Evaluation for Milk Fat Composition in the Walloon Region of Belgium

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Context

Walloon Region of Belgium:

- **collecting fatty acid composition since March 2005**
- **first experimental on 25 farms**
- **currently nearly all cows under milk recording**

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- collecting fatty acid composition since March 2005
- first experimental on 25 farms
- currently nearly all cows under milk recording

Current data status (April 2010):

864,835 test-days (all-lactation), increasing

Next step: development of a genetic evaluation system for milk fat composition

Data and Model

- Previous research done has shown for milk fat composition traits (e.g., Soyeurt et al., 2008):
  - genetic variation and
  - medium to high hertitabilities
- Some modelling issues however:
  - repeated records
  - longitudinal traits
  - highly correlated traits
    - with traditional traits (milk, fat, protein)
    - among different fatty acids and fatty acid groups

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Use of historical test-day data

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Large number of relevant traits

Data and Model

- Selection of traditional traits
  - based on INTERBULL traits
    - milk, fat, and protein yield
- Selection of milk fat composition traits
  - based on potential place in breeding goal
  - milk pricing
    - saturated fatty acid content (SAT) in milk (g/100g)
  - potentially health related
    - monounsaturated fatty acid content (MONO) in milk (g/100g)
  - prediction from MIR spectral data
    - latest prediction equations
    - developed in RobustMilk 7FP project (Soyeurt et al., 2010)

Data and Model

- Only first lactation (for the moment)

Trait*	N	Mean	SD
MILK (kg)	6,749,239	16.96	6.83
FAT (kg)	6,746,993	0.68	0.29
PROT (kg)	6,727,524	0.56	0.22
PFAT (%)	6,746,993	4.02	0.72
PPROT (%)	6,727,524	3.33	0.40
SAT (%)	220,397	2.79	0.49
MONO (%)	220,396	1.15	0.24

* FAT = fat yield, PROT = protein yield, PFAT = fat content, PPROT = protein content, SAT = saturated fatty acid content in milk and MONO = monounsaturated fatty acid content in milk

Data and Model

- Heritabilies (diagonal) and genetic correlations (above) expressed on a lactation base

	Trait				
Trait	MILK	FAT	PROT	SAT	MONO
MILK (kg)	**0.31**	0.57	0.83	-0.42	-0.31
FAT (kg)		**0.33**	0.70	0.50	0.38
PROT (kg)			**0.26**	-0.11	-0.11
SAT (%)				**0.61**	0.80
MONO (%)					**0.51**

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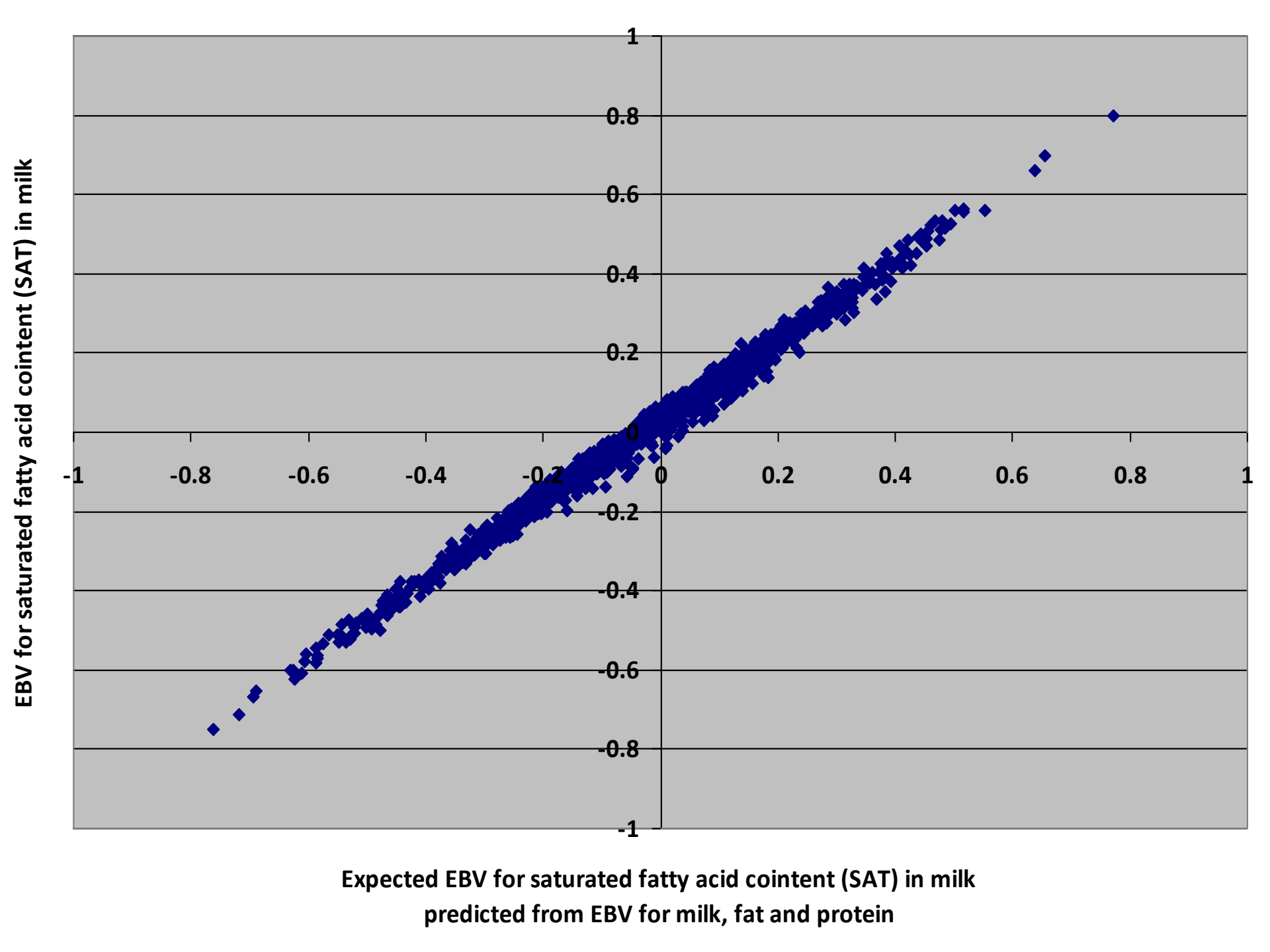
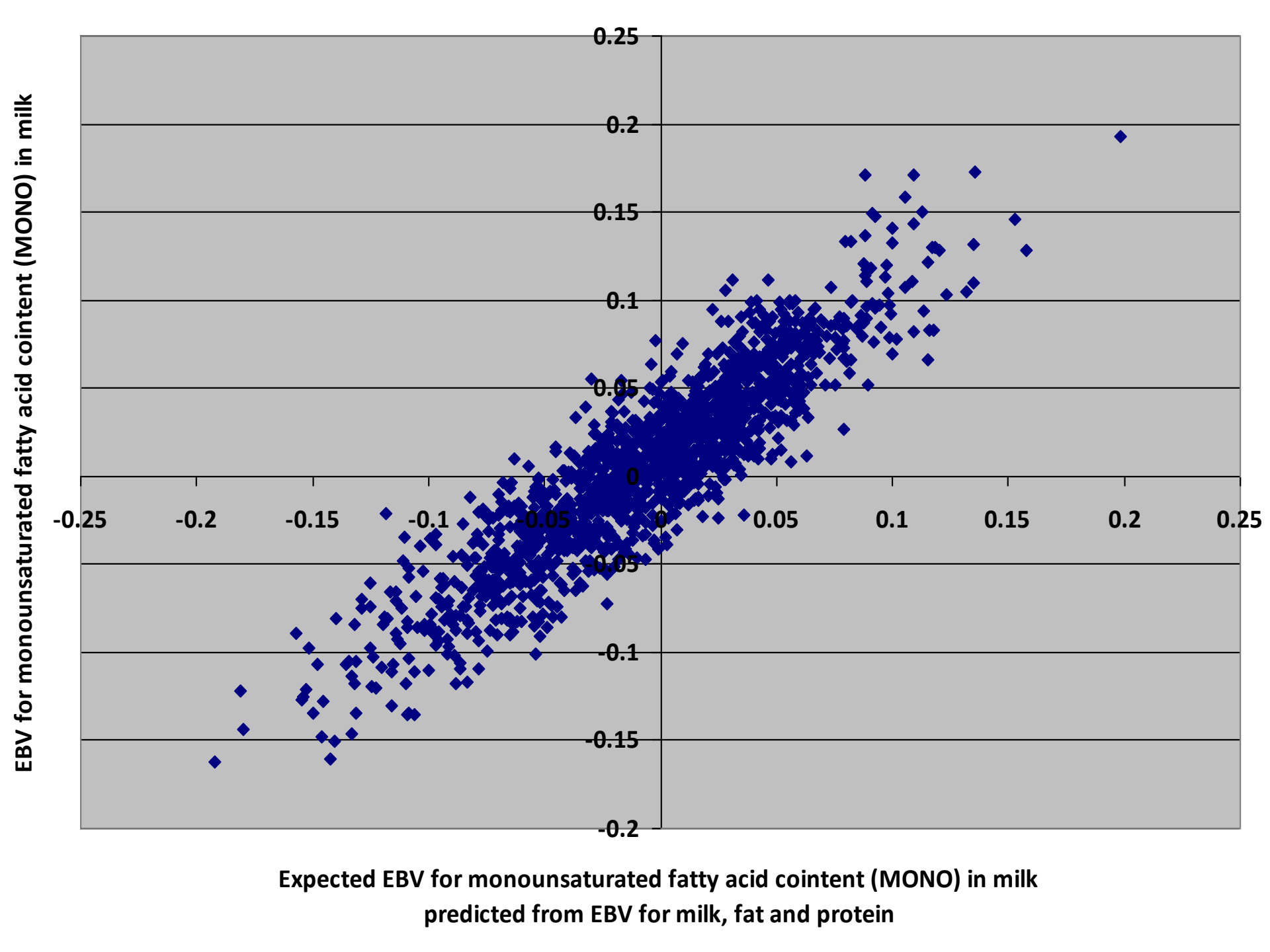
MONO (%)					**0.51**

Expressing Results?

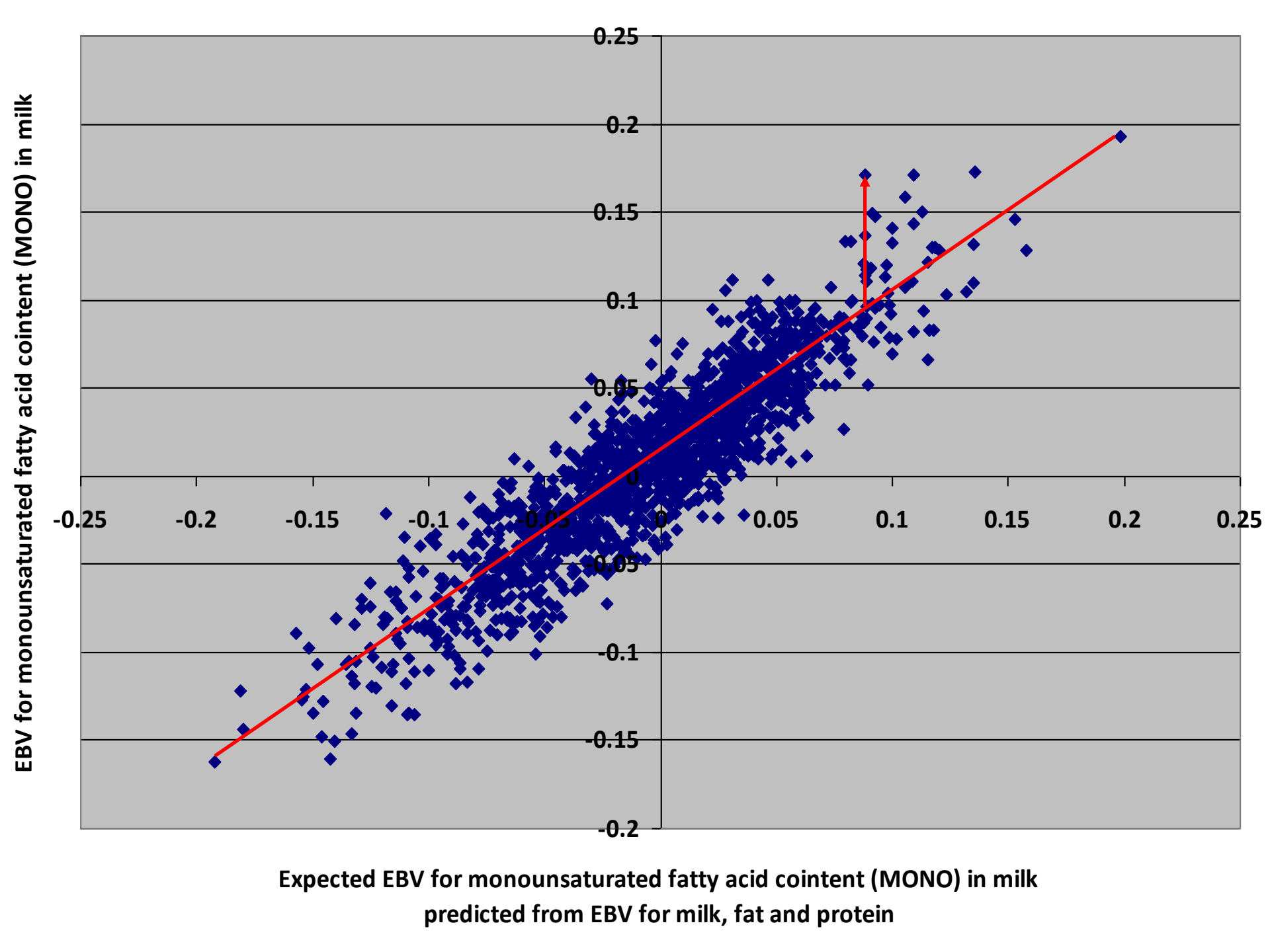
- **Two potential components** could contribute to selection objective
  - **milk pricing**: SAT
  - **health related**: MONO
- However underlying problem:
  - **both traits highly correlated to major traits**
- Two consequences:
  1. Risk of deleterious effects on current selection objectives
  2. EBV of SAT and MONO expressing differences in MILK, FAT and PROTEIN


EBV for saturated fatty acid cointent (SAT) in milk
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-1
-0.8
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
0.8
1
Expected EBV for saturated fatty acid cointent (SAT) in milk
predicted from EBV for milk, fat and protein


EBV for monounsaturated fatty acid cointent (MONO) in milk
0.25
0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
-0.25
-0.2
-0.15
-0.1
-0.05
0
0.05
0.1
0.15
0.2
0.25
Expected EBV for monounsaturated fatty acid cointent (MONO) in milk
predicted from EBV for milk, fat and protein

Expressing Results

- **Idea** expressing relative differences
- Computation of new “traits” (indexes)
  - **milk pricing**: dUNSAT
  - **health related**: dMONO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Expressing unsaturation

Expressing Results

- Idea expressing relative differences
- Computation of new "traits" (indexes)
  - dMONO = MONO – E(MONO|MILK, FAT, PROTEIN)
  - dUNSAT = – (SAT – E(SAT|MILK, FAT, PROTEIN)
- Expressed on a standardized scale
- Genetic parameters for dUNSAT and dMONO
  - Genetic correlation: 0.93
  - h^2: dUNSAT 0.21 and dMONO 0.42

Results and Discussion

- **EBV for evaluated and expressed traits (sires REL ≥ 0.50)**

		EBV		REL	
Trait	N	Mean	SD	Mean	SD
Milk (kg)	1844	450	424	0.78	0.14
FAT (kg)	1929	16.1	16.6	0.80	0.13
PROT (kg)	1780	18.9	11.9	0.77	0.14
SAT (%)	1949	0.005	0.207	0.82	0.12
MONO (%)	1583	0.008	0.053	0.75	0.14
dUNSAT (rEBV)	1904	-1.02	0.69	0.80	0.13
dMONO (rEBV)	1583	0.34	0.62	0.80	0.11

Results and Discussion

- **Correlation of EBV for milk composition traits with official EBV**

	Trait*							
	MILK	FAT	PROT	PFAT	PPROT	SCS	LONG	FFERT
SAT	-0.56	0.34	-0.31	0.95	0.60	-0.04	-0.12	0.19
MONO	-0.48	0.33	-0.20	0.86	0.64	-0.03	-0.08	0.14
dUNSAT	-0.01	-0.04	0.05	-0.02	0.12	0.06	-0.11	0.03
dMONO	0.26	0.07	0.26	-0.21	-0.07	0.05	0.07	-0.18

* Individual traits represent official EBVs computed during routine genetic evaluations or provided by INTERBULL. For more details please refer to http://www.elinfo.be.
FFERT = female fertility, SCS = somatic cell score, LONG = longevity.

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Results and Discussion

- **Correlation of EBV for milk composition traits with official indexes**

	Index			
	V€L	V€T	V€F	V€G
SAT	0.00	-0.15	-0.10	-0.08
MONO	0.08	-0.10	-0.08	0.01
dUNSAT	0.04	0.01	-0.10	0.09
dMONO	0.19	0.07	0.06	0.16

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V€L = subindex 'milk', V€T = subindex 'type', V€F = subindex 'functionality'
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Conclusions

- First results genetic evaluation system for milk fat composition in the Walloon Region of Belgium:
  - still under development
  - only current status
- Chosen traits showed:
  - high heritabilities
  - genetic variability
- With still limited data:
  - 1904 sires: EBV with REL ≥ 0.50 for dUNSAT
  - 1583 sires: EBV with REL ≥ 0.50 for dMONO

Perspectives

- Adding more data:
  - currently 500,000 records added every year
- Going to a multi-lactation model:
  - better use of existing data from later lactations
- Adding new traits:
  - additional fatty acids
- Integration of external information:
  - different possibilities to be explored to integrate MACE EBV for MILK, FAT and PROT
- Genomic selection:
  - specific situation well suited to use one step approach (Aguilar et al., 2010)

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