Should we select for cows that eat more or cows that eat less at the same yield level?

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Introduction

- Science: two schools of thought:
    - Using nutrition models -> cows should increase intake (capacity).
    - Animal breeder: Profit = returns milk – feed cost.
- Pedigree breeders: cows should become big and tall to process as much roughage as possible
- Circular economy: rely less on human edible food

Objective

- To justify selecting for cows that eat relatively more, these cows should benefit from the higher intake capacity on a roughage-based diet, and a re-ranking should be observed (GxE)

- Investigate GxE for milk yield (FPCM), feed intake (DMI) and liveweight (LW) and investigate selection response

Methods: Genetics approach

- 1,602 cows with daily records on DMI, FPCM and LW recorded in 2,652 lactations and 281 experimental treatments between 1990 and 2015
- Energy content of diet was estimated based on the within experimental treatment response of FPCM on DMI → High, Medium and Low environment group
- Estimate genetic parameters for DMI, FPCM and LW within and across environments (9 trait model)

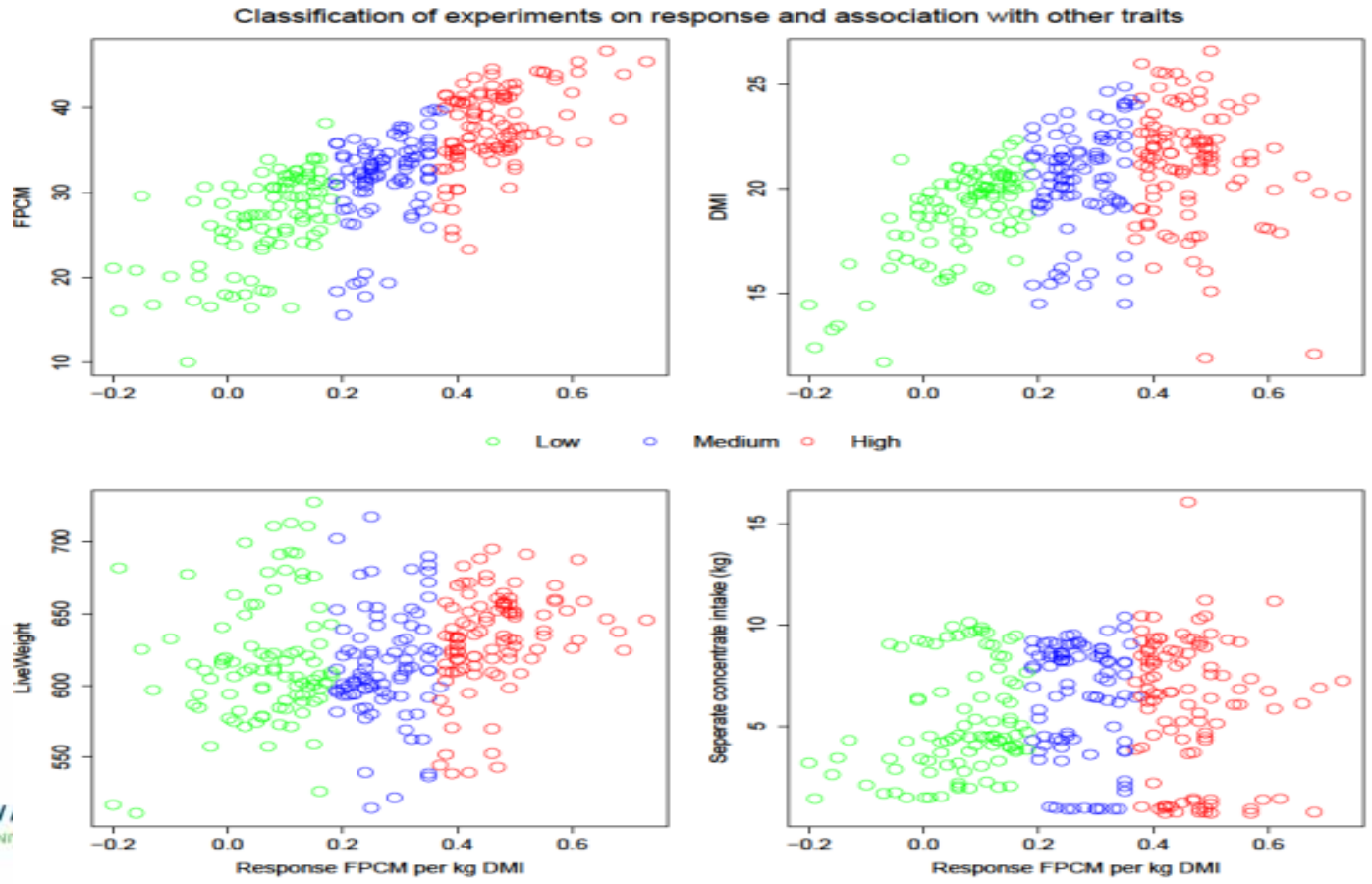
Genetics approach (2)

- Selection index assuming true EBV are known
- Response in the high and low environment from selection in the high and low environment for breeding goal:
    - FPCM
    - Profit (milk price €0.34 - cost a kg DMI €0.20)
    - Feed intake (capacity) (DMI)
    - 0.34 FPCM + X DMI
      where X ranges from €0.20 to €-0.20.

Results: classification of experiments

	High environment			Medium environment			Low environment		
	#	Mean	Std	#	Mean	Std	#	Mean	Std
DMI	83,366	21.8	4.9	98,081	21.7	4.4	66,281	19.5	3.8
FPCM	8,180	38.8	8.5	9,681	32.9	8.7	5,499	27.9	8.3
LW	81,848	635	77	64,988	653	80	31,861	633	89

Results: classification of experiments



Results: Variance components

	High environment			Medium environment			Low environment		
	σ_p	h^2	c^2	σ_p	h^2	c^2	σ_p	h^2	c^2
DMI	3.51	0.14	0.17	3.37	0.12	0.21	2.81	0.15	0.21
FPCM	5.67	0.19	0.35	5.99	0.13	0.47	5.66	0.09	0.32
LW	63.5	0.64	0.17	59.6	0.62	0.16	58.1	0.60	0.13

Standard errors for h^2 and c^2 0.02 for DMI and LW and 0.04 for FPCM.

Results: Genetic correlations

		DMI			FPCM			LW		
		High	Med	Low	High	Med	Low	High	Med	Low
DMI	High	-								
	Med	0.90	-							
	Low	0.68	0.82	-						
FPCM	High	0.62	0.56	0.26	-					
	Med	0.60	0.72	0.43	0.82	-				
	Low	0.35	0.55	0.61	0.56	0.76	-			
LW	High	0.44	0.48	0.56	0.14	0.09	0.15	-		
	Med	0.47	0.56	0.62	0.22	0.21	0.29	0.93	-	
	Low	0.47	0.53	0.56	0.21	0.19	0.21	0.90	0.97	-

SE: DMI 0.11-0.14 FPCM 0.18-0.31 LW 0.09-0.14

Results: selection in high, response in high

	Response in High environment			
	Milk (€)	Feed cost (€)	Profit (€)	LW (kg)
Selection in High environment for:				
FPCM	0.84	-0.16	0.68	7.1
Profit	0.80	-0.10	0.71	0.1
Intake (capacity)	0.52	-0.26	0.25	22.3
Milk from roughage	0.82	-0.20	0.62	11.6

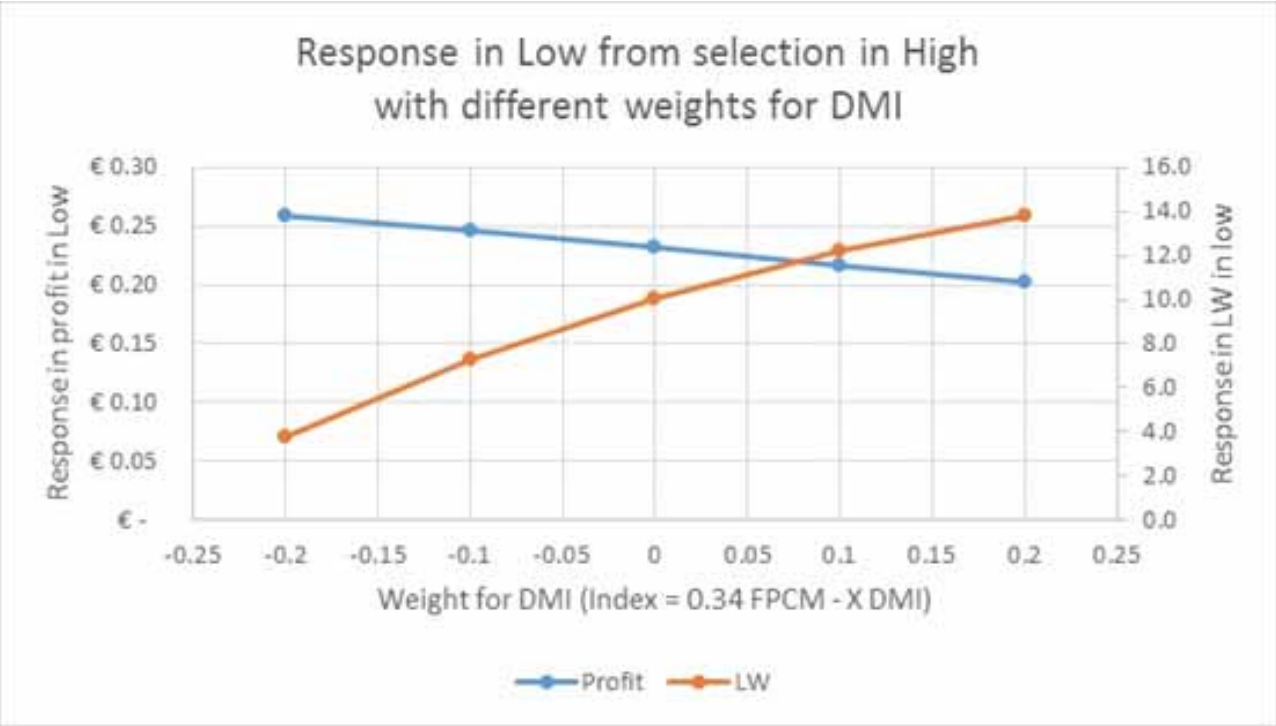
- Goal FPCM gives 0.96 profit compared with goal Profit: more milk but heavier cows and higher feed costs
- Positive weight for DMI: increasing feed costs and LW.
- Even with milk "Milk from roughage" only 0.87 response in profit

Results: selection in high, response in low

	Response in Low environment			
	Milk (€)	Feed cost (€)	Profit (€)	LW (kg)
Selection in High environment for:				
FPCM	0.29	-0.05	0.23	10.0
Profit	0.27	-0.01	0.26	3.8
Intake (capacity)	0.19	-0.14	0.05	21.7
Milk from roughage	0.28	-0.08	0.20	13.8

- Goal FPCM gives 0.88 of profit compared with goal Profit and "Milk from roughage" only 0.77
- Increasing intake (capacity) gave only 0.20 of response in profit: there is a big loss in trying to anticipate on high roughage diet by selecting for higher DMI!!

Results: selection index



Conclusions

- Liveweight and size are second order traits, the response follows first order traits (yield and DMI) and has no separate economic value
- There is no benefit on lower density diets of selecting for a higher intake (capacity) relatively to milk yield
- Be careful when allowing nutrition models that model the “mean” should point the direction of selection (use variances)

Finally the answer:

Should we select for cows that eat more or cows that eat less at the same yield level?

Less, as profitable cows remain profitable across feeding systems

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Results: selection in low, response in low

	Response in Low environment			
	Milk (€)	Feed cost (€)	Profit (€)	LW (kg)
Selection in Low environment for:				
FPCM	0.59	-0.14	0.44	11.3
Profit	0.55	-0.08	0.47	2.6
Intake (capacity)	0.39	-0.22	0.17	25.3
Milk from roughage	0.58	-0.17	0.41	14.9

- Lower response than in high environment;
  but relative same responses as in high environment
- Goal FPCM gives 0.94 of profit compared with goal Profit and "Milk from roughage" only 0.87.

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Results nutritional approach

% concentrates in ration		Liveweight 625 kg	650 kg	675 kg
2 kg FIC per day for each 100kg LW extra				
Milk yield	**25.0**	31.8%	30.4%	29.1%
	30.0	43.7%	42.4%	41.1%
	35.0	53.5%	52.2%	50.9%
1.5 kg FIC per day for each 100kg LW extra				
Milk yield	**25.0**	31.2%	30.4%	29.7%
	30.0	43.2%	42.4%	41.6%
	35.0	53.0%	52.2%	51.4%
0.75 kg FIC per day for each 100kg LW extra				
Milk yield	**25.0**	30.4%	30.4%	30.5%
	30.0	42.4%	42.4%	42.3%
	35.0	52.3%	52.2%	52.1%

Results nutritional approach

- In the "nutritional model" heavier animals translates into higher intake capacity AND higher maintenance
- Less energy dense ration required with increasing LW
  - small effect compared to increasing yield
  - uncertainty about the relationships between LW and maintenance costs and intake capacity is critical
- There might be some economic value,
  - but if costs price is similar for concentrates and roughage ...
  - Useful to determine direction of selection ??