Genetic correlation between composition of bovine milk fat in winter and summer, and DGAT1 and SCD1 by season interactions

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Introduction

Bovine milk fat:

→fat-soluble vitamins and bio-active lipids

→important sources of **energy** in human diets

(German & Dillard, 2006)

Genetic factors influence milk fat composition, which shows **genetic variation** (e.g., Schennink et al., 2007)

Polymorphisms in DGAT1 and SCD1 have been recognized as having **large effects** on milk fat composition (e.g., Schennink et al., 2008)

Nutrition can alter milk fat composition (e.g., Chilliard et al., 2007)

→ indications that it affects **mammary lipogenic gene expression** (e.g., Mach et al.,2011)

Seasonal variation in European countries (e.g., Heck et al., 2009)

	Winter	Summer
FA composition	**SFA – 69.0%***	**SFA – 65.7%***
	UFA – 25.0%*	**UFA – 28.0%***

Significant levels via t-test: * = significant difference

Cows in **winter** → indoors + silage

Cows in **summer** → pasture + fresh cut grass

Genotype by season interaction ?

Aims

Is milk fat composition in winter genetically the same trait as in summer ?

1) Estimate genetic correlations between winter and summer milk samples

2) Test for DGAT1 and SCD1 by season interactions

Phenotypes and Genotypes

~ 2,000 first lactation Holstein-Friesian cows from 400 herds in the Netherlands

Morning milk samples - Winter and Summer

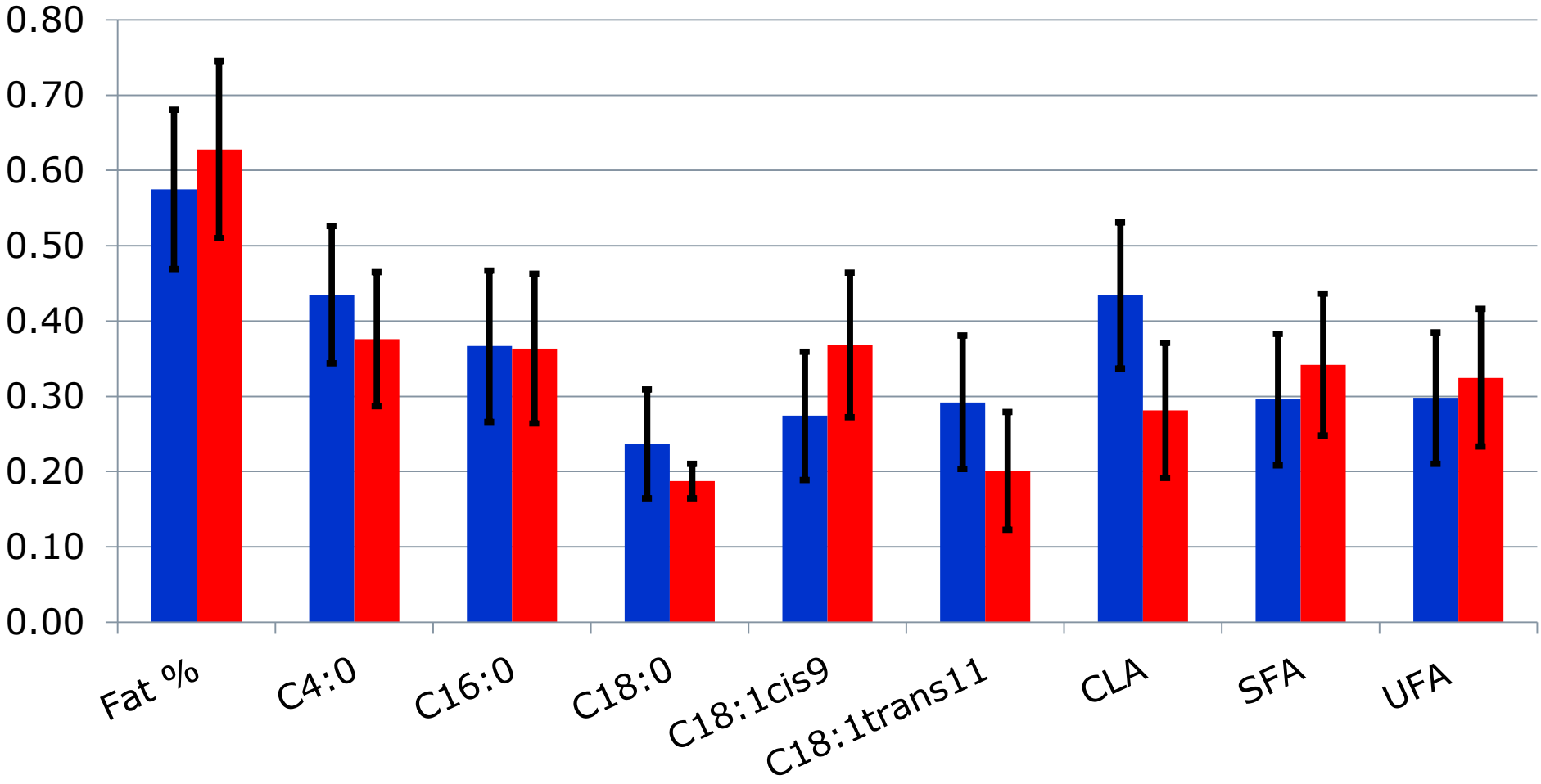
Individual FA measured by Gas Chromatography

- C4:0-C18:0, C10:1-C18:1*cis-9*
- C18:1*trans-6-11,*
- C18:2*cis-9,trans-11*(CLA)
- C18:2*cis-9,12,* C18:3*cis-9,12,15*

DGAT1 K232A polymorphism → 1,692 animals

SCD1 A293V polymorphism → 1,637 animals

Heritability estimates between winter and summer milk samples



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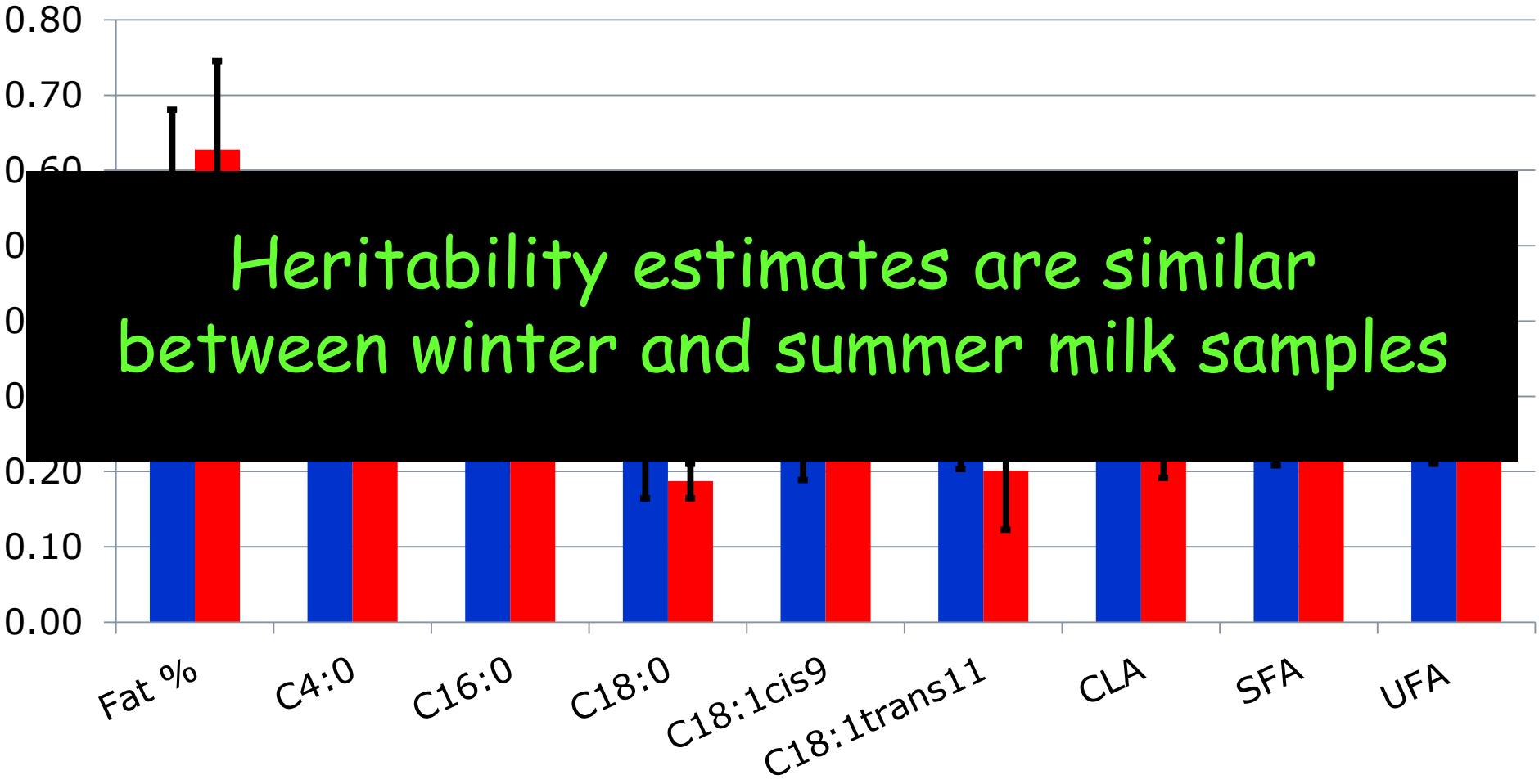
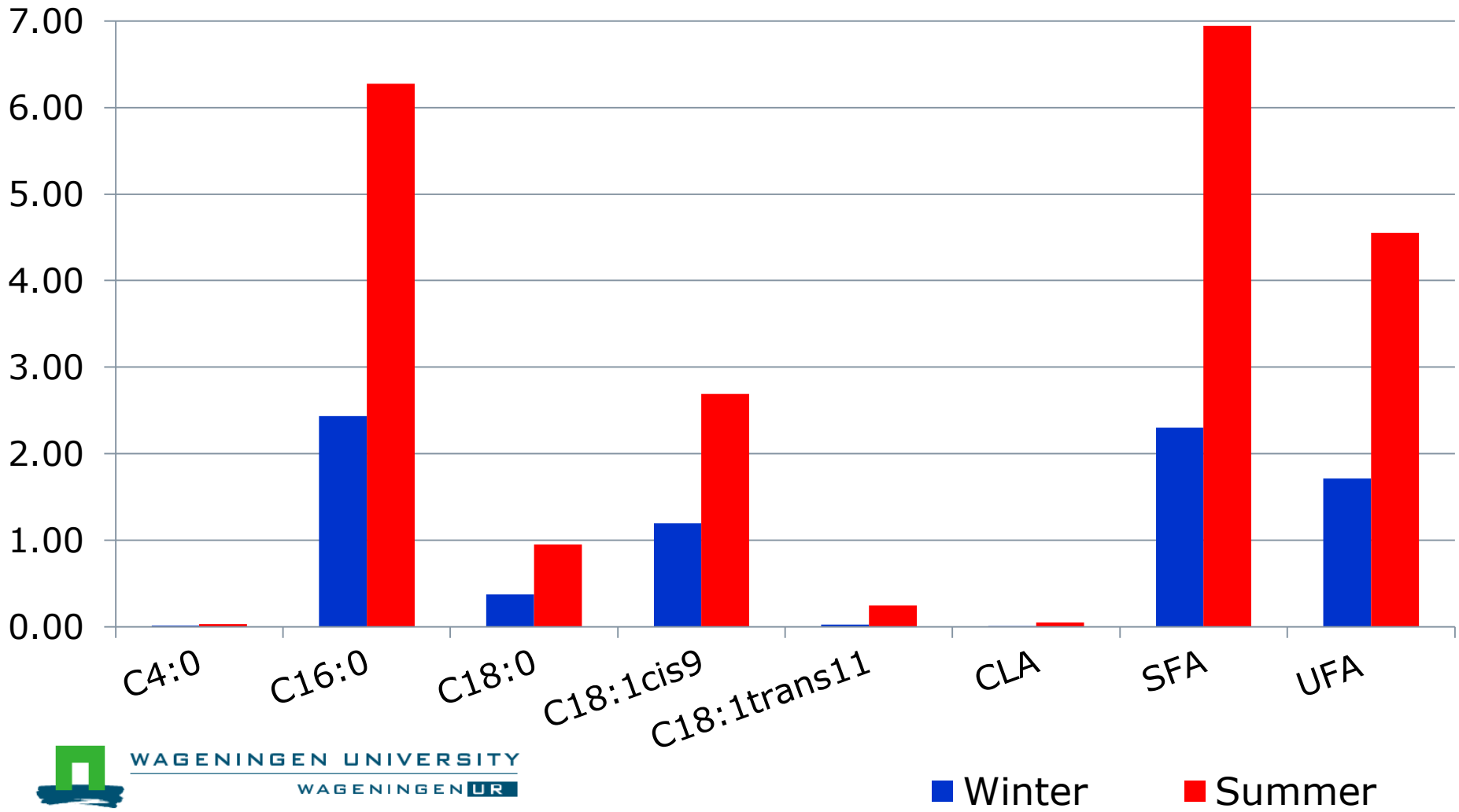
Heritability estimates between winter and summer milk samples



Heritability estimates are similar between winter and summer milk samples

Herd variances in winter and summer milk samples



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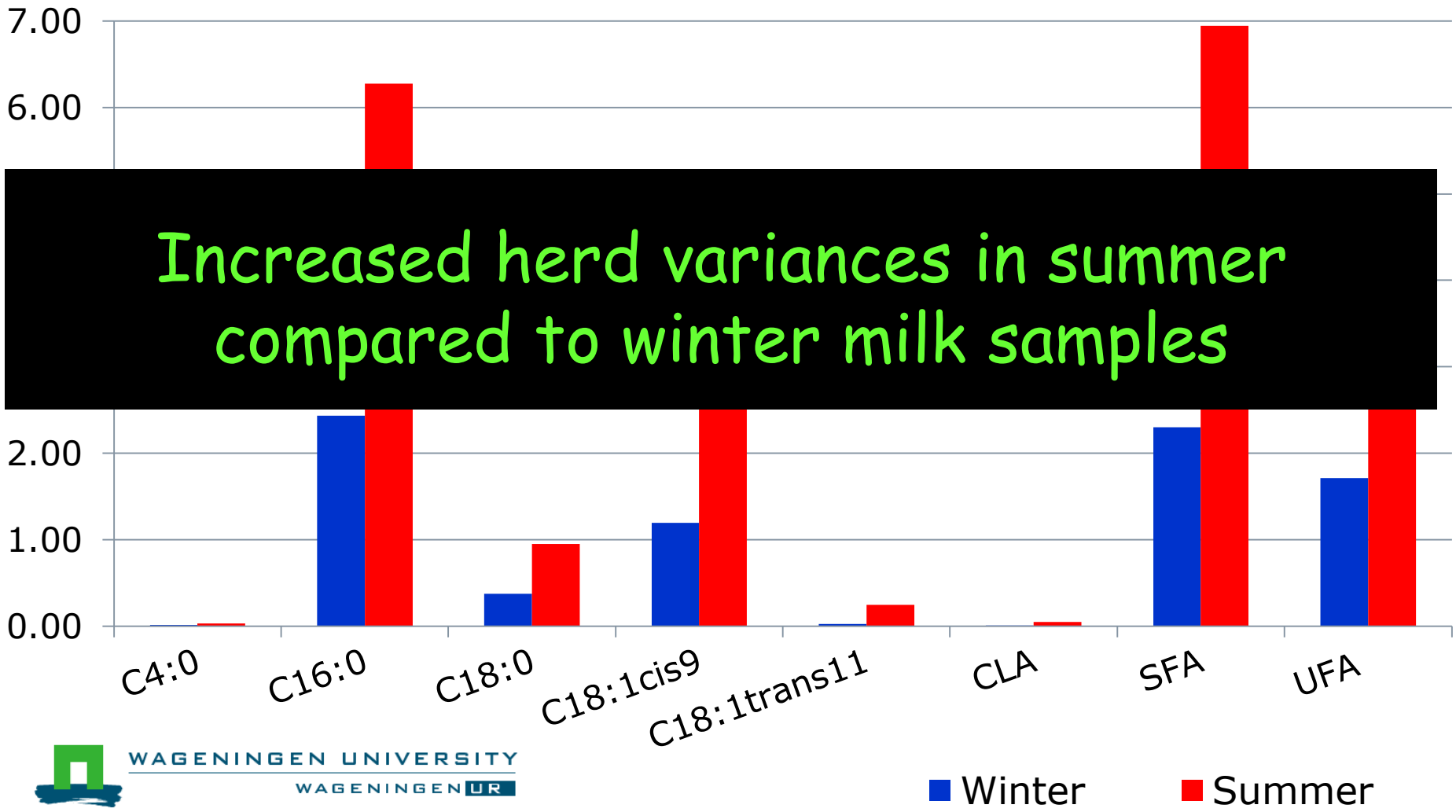
Herd variances in winter and summer milk samples



Increased herd variances in summer compared to winter milk samples

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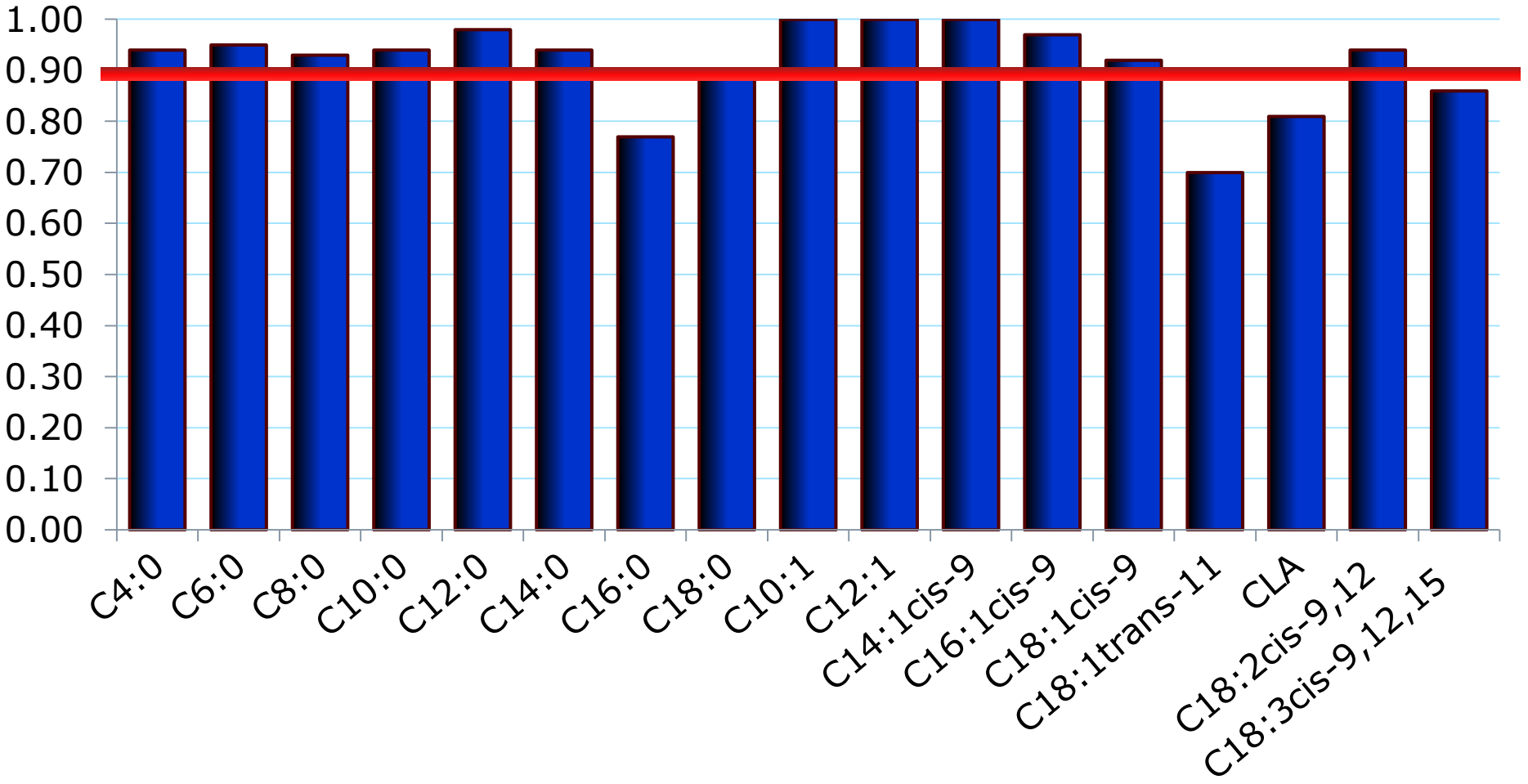
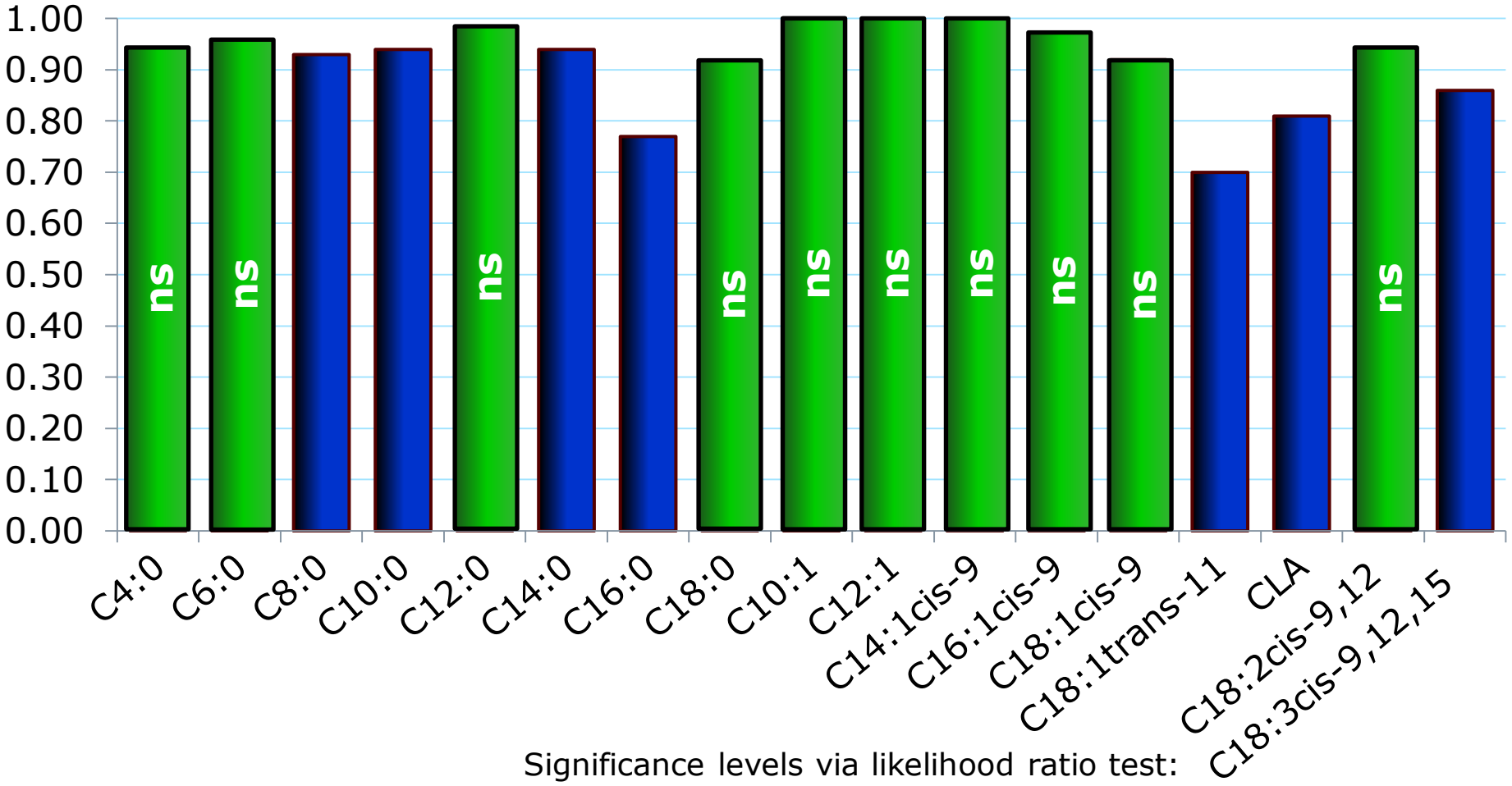
Genetic correlations between winter and summer milk fat composition



Genetic correlations between winter and summer milk fat composition



Significance levels via likelihood ratio test:

ns = non-significantly different than 1

= significantly different than 1

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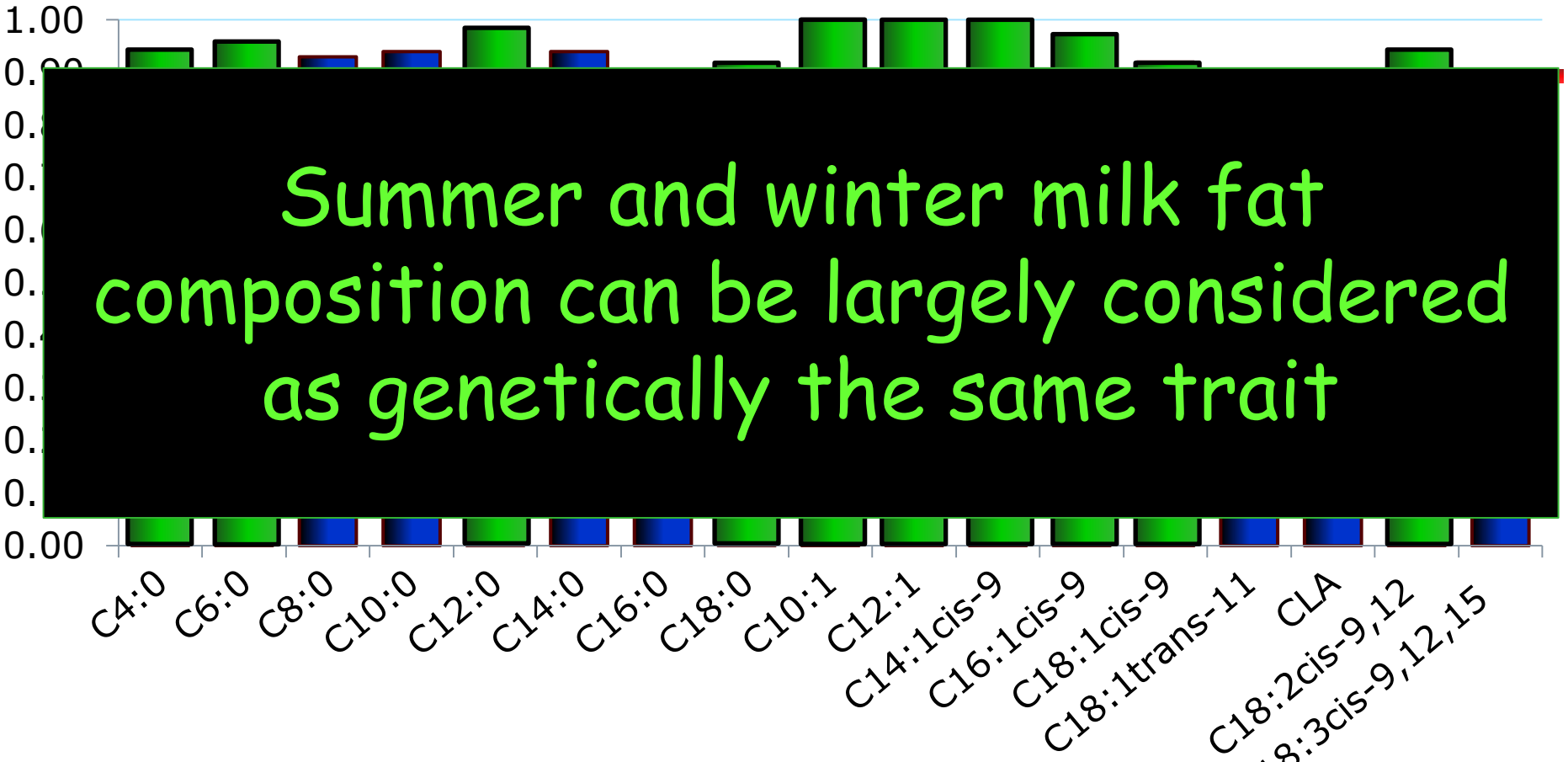
Genetic correlations between winter and summer milk fat composition



Summer and winter milk fat composition can be largely considered as genetically the same trait

Significance levels via likelihood ratio test:

ns = non-significantly different than 1

= significantly different than 1

Aims

Is milk fat composition in winter genetically the same trait as in summer ?

1) Estimate genetic correlations between winter and summer milk samples

2) Test for DGAT1 and SCD1 by season interactions

Effects of DGAT1 and SCD1 between winter and summer milk samples

DGAT1 232A allele:

- *Negatively associated* with fat%, most FA with less than 18 carbons, SFA, and C10 to C16 unsaturation indices
- *Positively associated* with C14:0, unsaturated C18, UFA , and C18 to CLA unsaturation indices

SCD1 293V allele:

- *Negatively associated* with C18:0, C10:1 to C14:1cis-9, C18:1trans-11, C10 to C14 unsaturation indices
- *Positively associated* with C8:0 to C14:0, C16:1cis-9, C16 to CLA unsaturation indices

Effects of DGAT1 and SCD1 between winter and summer milk samples

DGAT1 232A allele:

- *Negatively associated* with fat%, most FA with less than 18 carbons, SFA, and C10 to C16 unsaturation

Effects of DGAT1 and SCD1 are similar between winter and summer milk samples.

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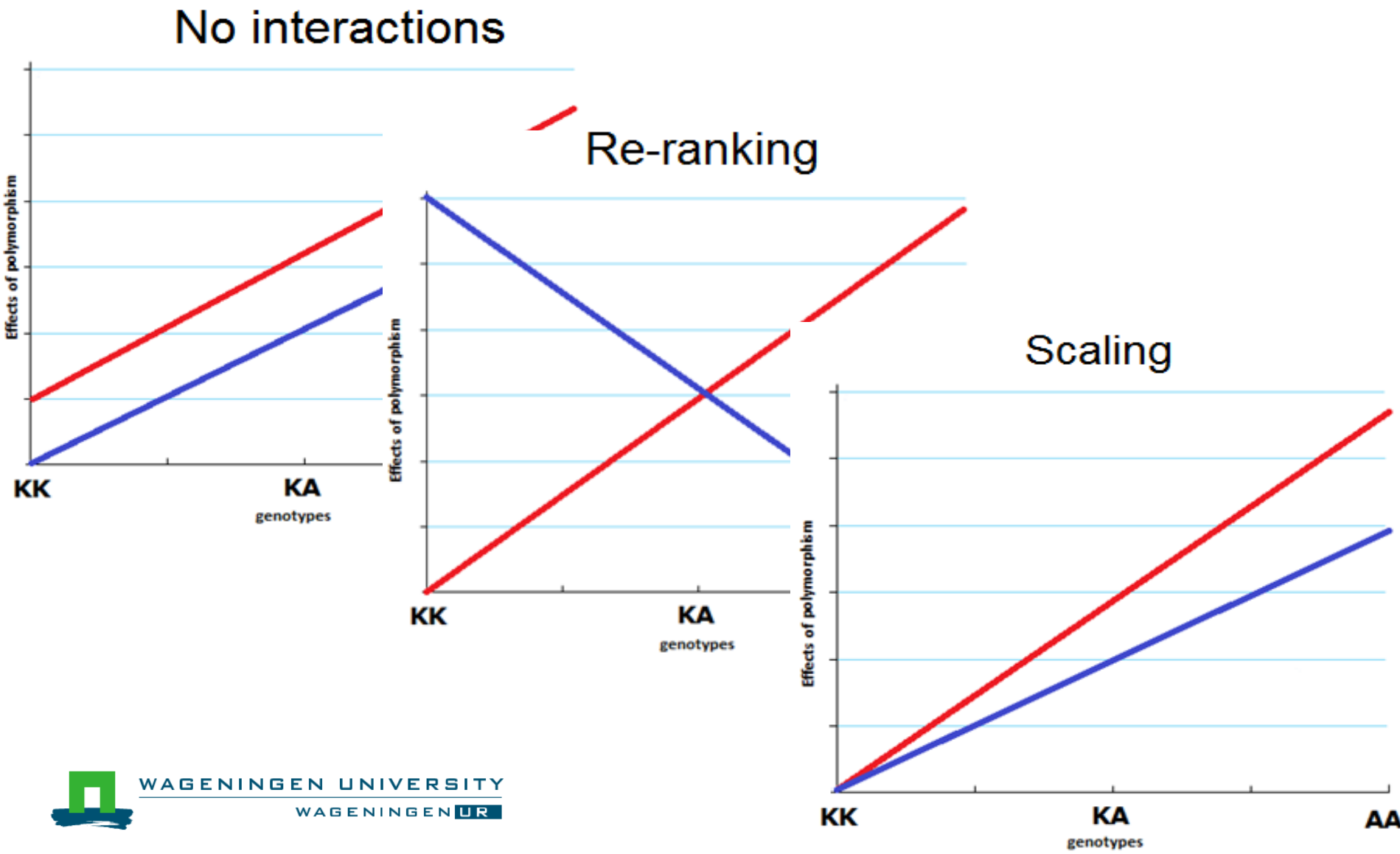
Genotype by season interactions

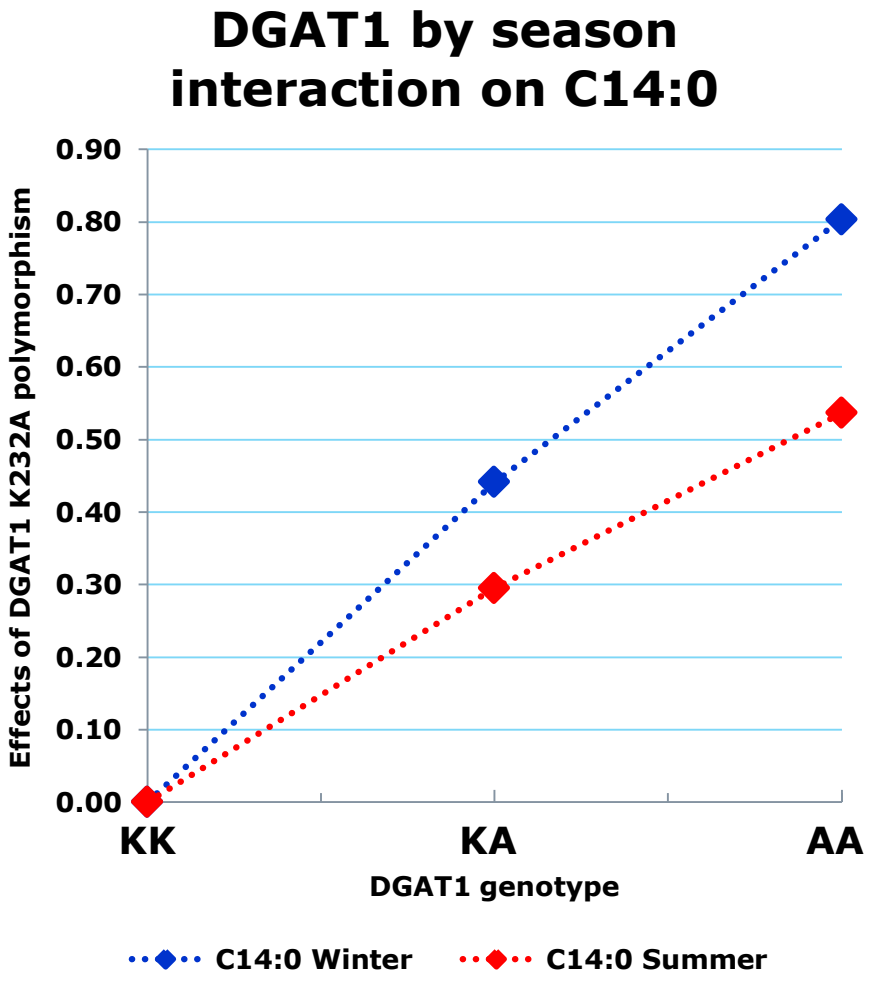


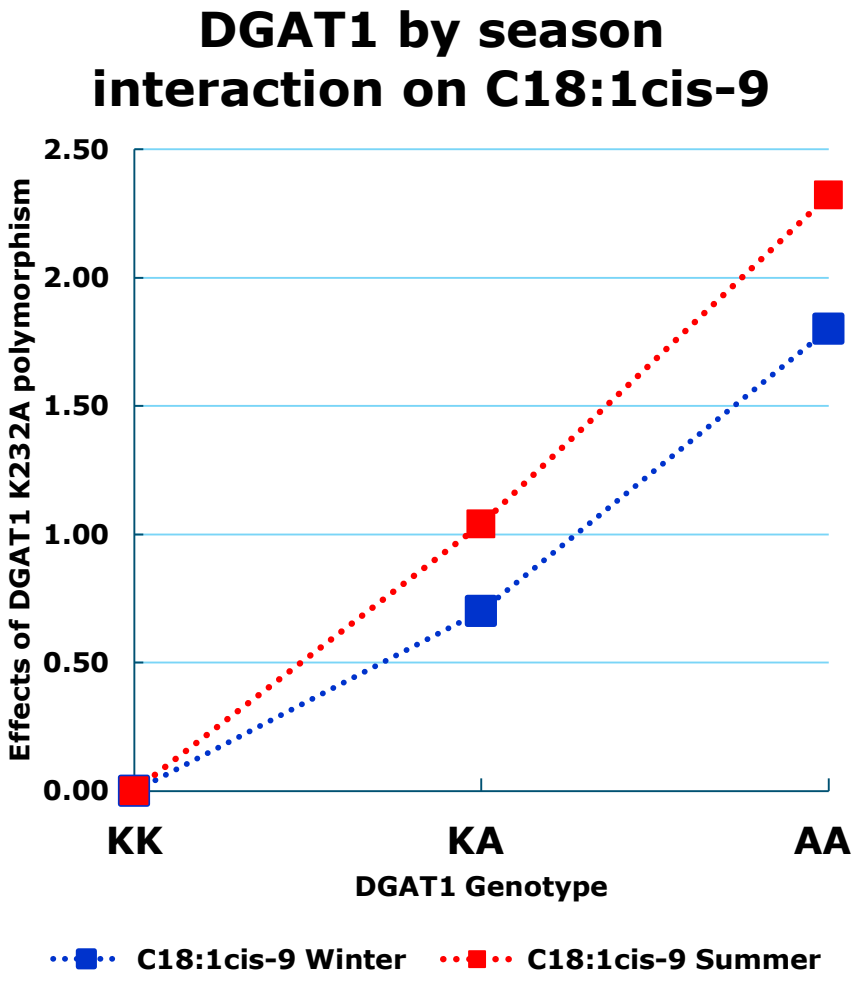
DGAT1 by season interaction

DGAT1 by season interaction was found for:

- C4:0, C6:0, C8:0, C10:0, C12:0, and C14:0,
- C16:1*cis-9*, C18:1*cis-9* CLA, and C18:3*cis-9,12,15,*
- SFA and UFA,
- C14 and C16 unsaturation indices.

DGAT1 by season interaction





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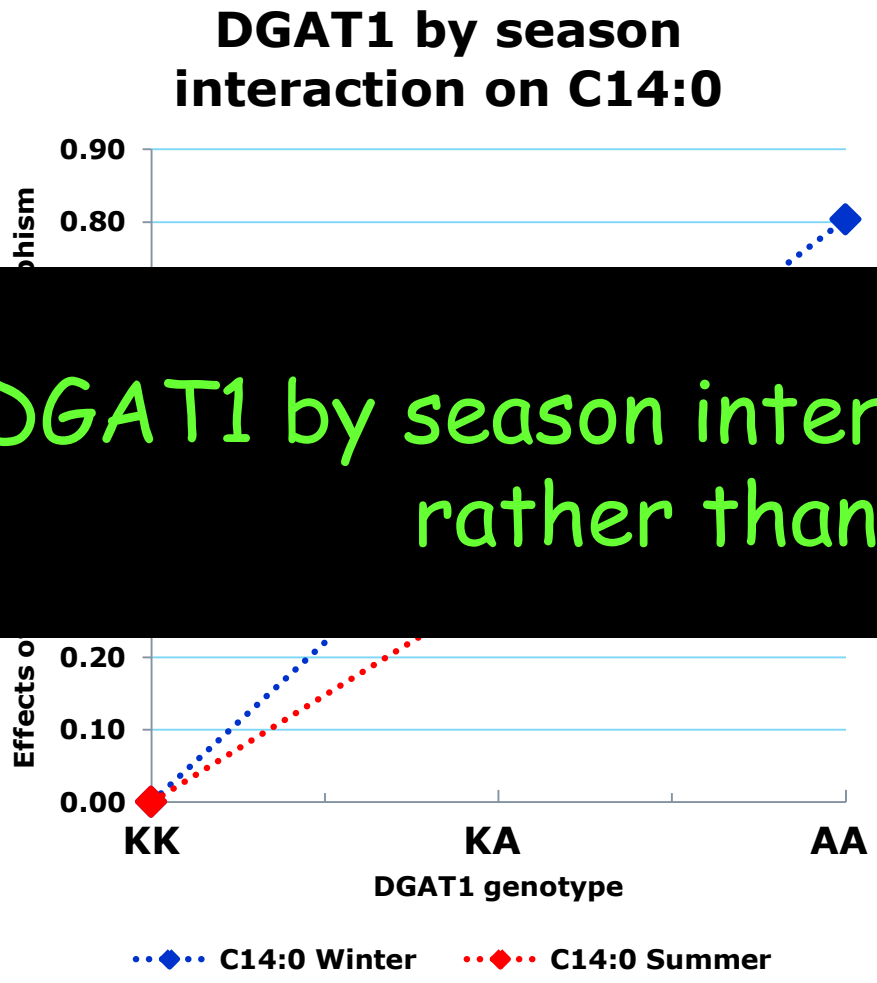
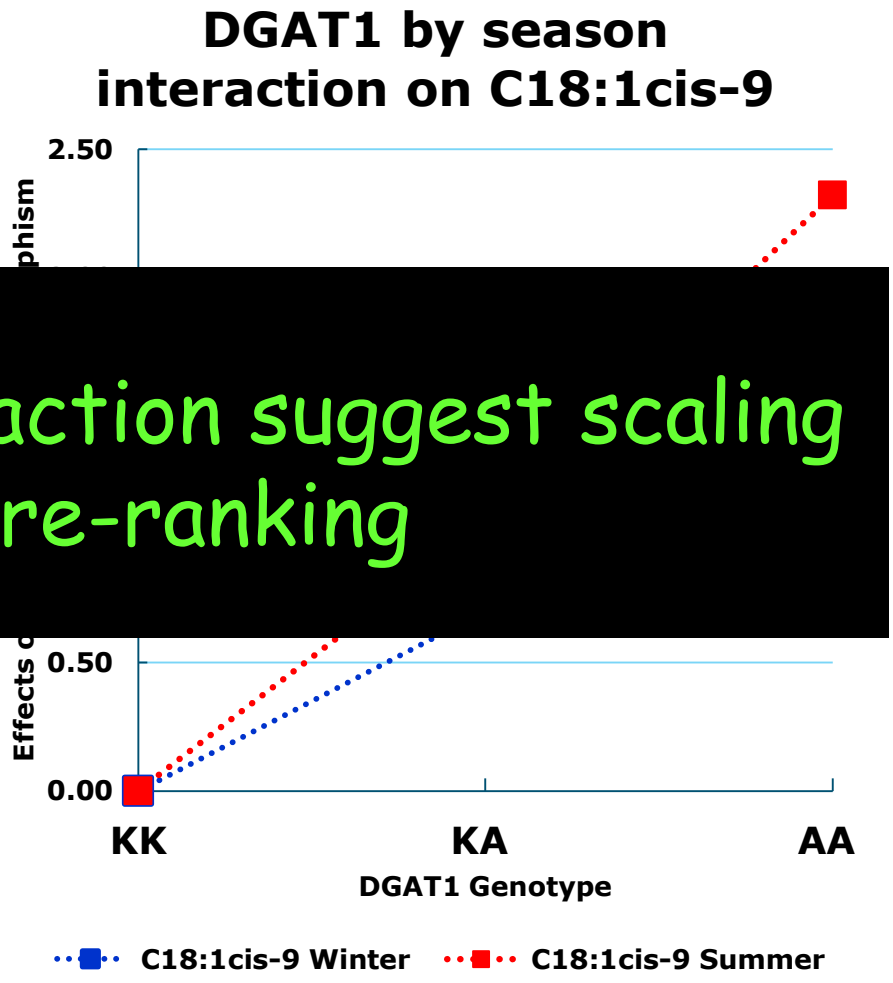
DGAT1 by season interaction



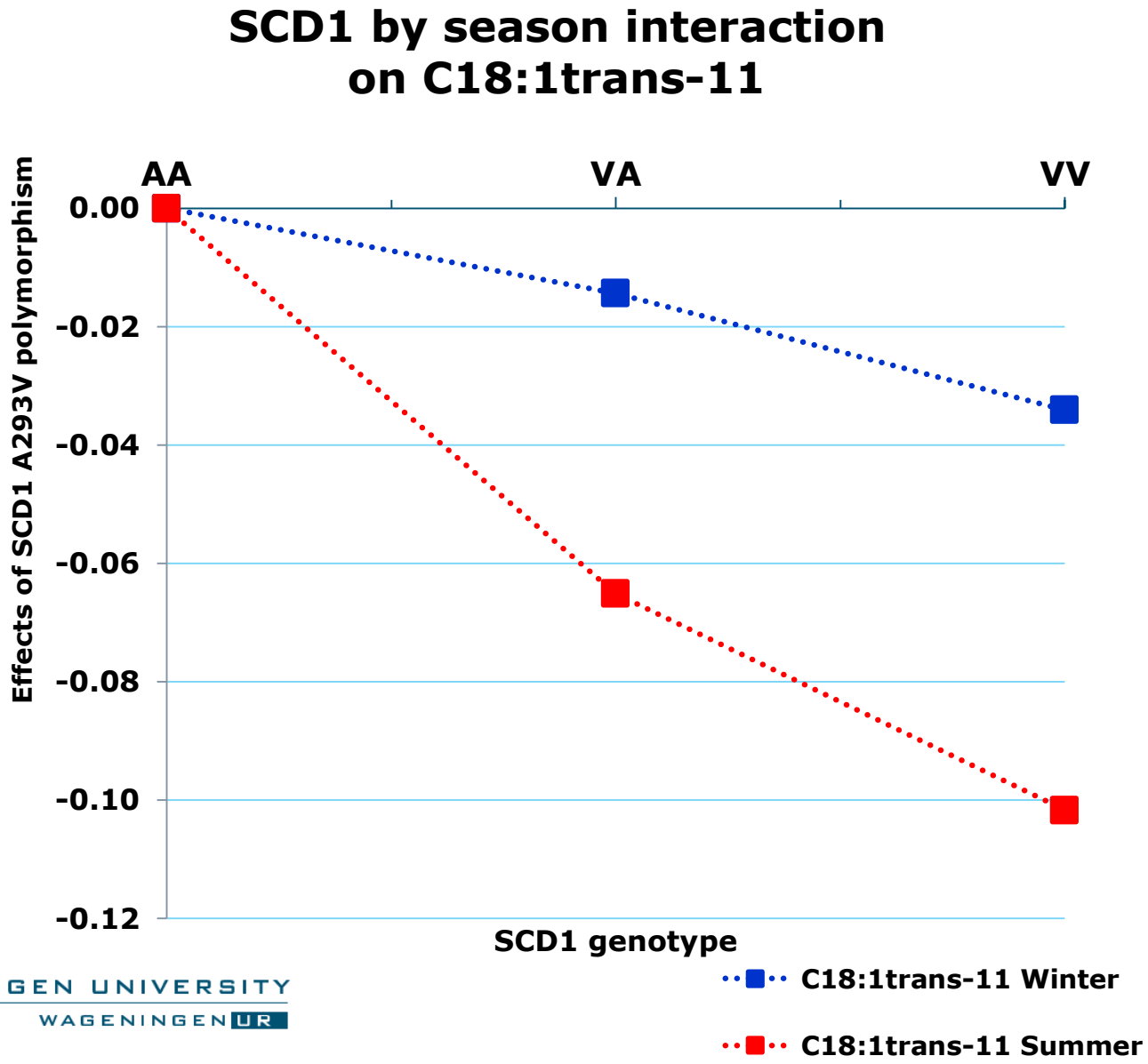


DGAT1 by season interaction suggest scaling rather than re-ranking

SCD1 by season interaction

C18:1*trans-11* was the only one to show SCD1 by season interaction

SCD1 by season interaction



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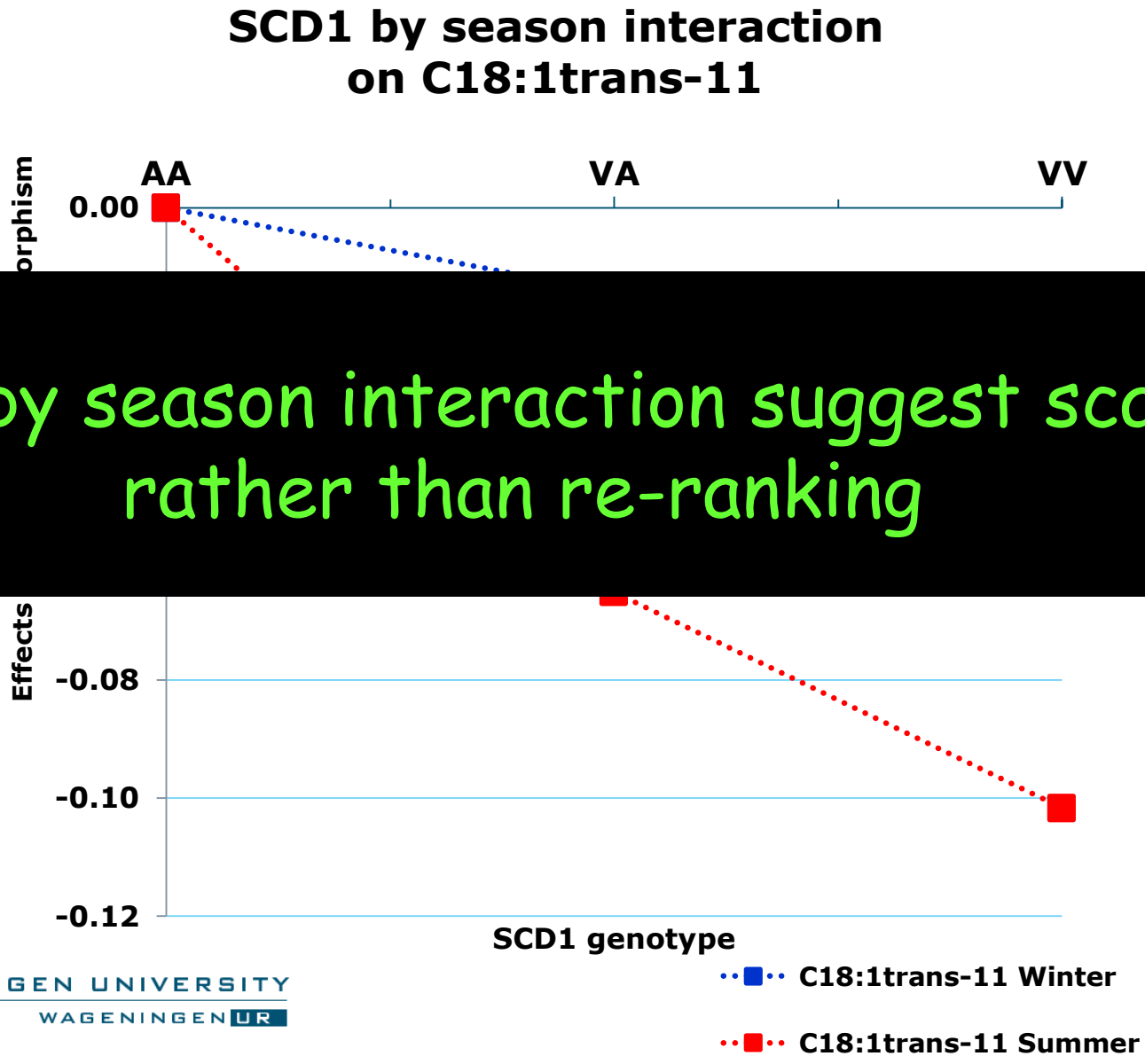
SCD1 by season interaction



SCD1 by season interaction suggest scaling rather than re-ranking

Conclusions

- **Heritability** estimates between winter and summer milk samples were **similar**.
- **Increased herd variances** were found in **summer** compared to winter milk samples.
- Summer and winter milk fat composition can be **largely considered** as genetically the **same trait**.
- **Effects of DGAT1 and SCD1** are similar between winter and summer milk samples.
- **DGAT1 and SCD1 by season interactions** are **present** and suggest **scaling** rather than re-ranking.

Ackownledgements

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