

Effect of GEI on cool-season WSC

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Water-soluble carbohydrates

Grass and For

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Effects of Drought on Water Relations, Mineral Uptake, Water-soluble Carbohydrate Accumulation and Survival of Two Contrasting Populations of Cocksfoot (*Dactylis glomerata* L.)

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Ecotypic variation of water-soluble carbohydrate concentration and winter hardiness in cocksfoot (*Dactylis glomerata* L.)

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Toshihiko Yamada

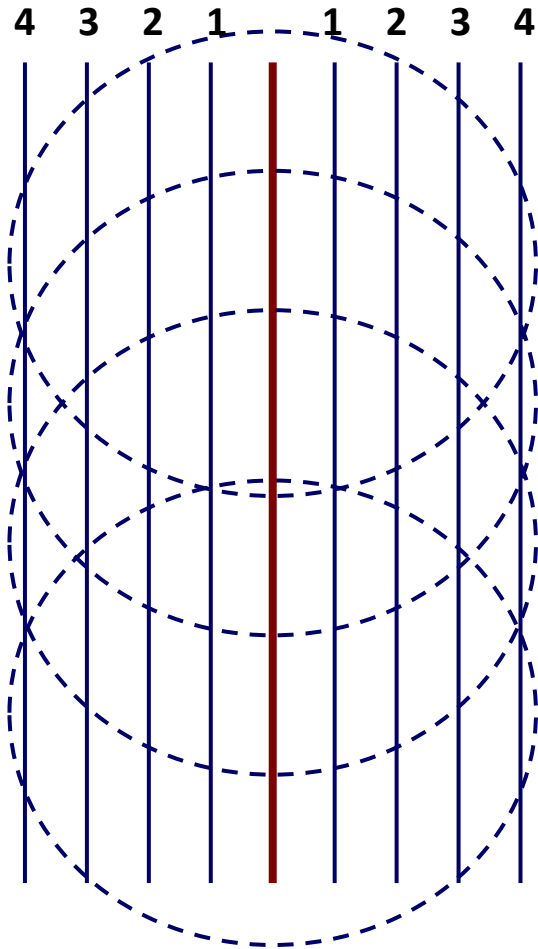
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Perennial ryegrass design

Cultivars	Early	Intermediate	Late	Total
Diploid		8	4	12
Tetraploid	1	2	4	7
Total	1	10	8	19
Locations	Utah	Scotland	Wales	
	Millville	Edinburgh	Aberystwyth	
Irrigation	4 levels	None	None	
Years	2011 - 2012			
Data	Herbage, digestibility, protein, carbohydrates			

Robins and Lovatt, 2015

Line-source irrigation



Orchardgrass design

	Entries	Locations	Data
FRR	51	2 (ID & UT)	DM yield, maturity, protein, fiber, carbohydrates
DSV	46	2 (FR & GE)	DM yield, maturity, protein, fiber, carbohydrates, rust



Robins and Feuerstein, unpublished

Perennial ryegrass WSC

Phenotype	Low	High	GEI Pattern
HDM ($\text{Mg} \cdot \text{ha}^{-1}$)	5 (L4)	15 (L1)	73%
DMD ($\text{g} \cdot \text{kg}^{-1}$)	777 (A)	879 (L1&2)	73%
CP ($\text{g} \cdot \text{kg}^{-1}$)	112 (A)	180 (L3)	35%
WSC ($\text{g} \cdot \text{kg}^{-1}$)	231 (A)	101 (L3&4)	82%



Perennial ryegrass WSC

Correlations	DMD	CP	WSC
HDM	0.53 ^{0.007}	-0.62 ^{0.004}	0.36 ^{0.13}
DMD		-0.19 ^{0.45}	0.67 ^{0.002}
CP			-0.45 ^{0.06}

Contrasts:

Diploids: 8.2 (± 1.1) g·kg⁻¹ higher WSC

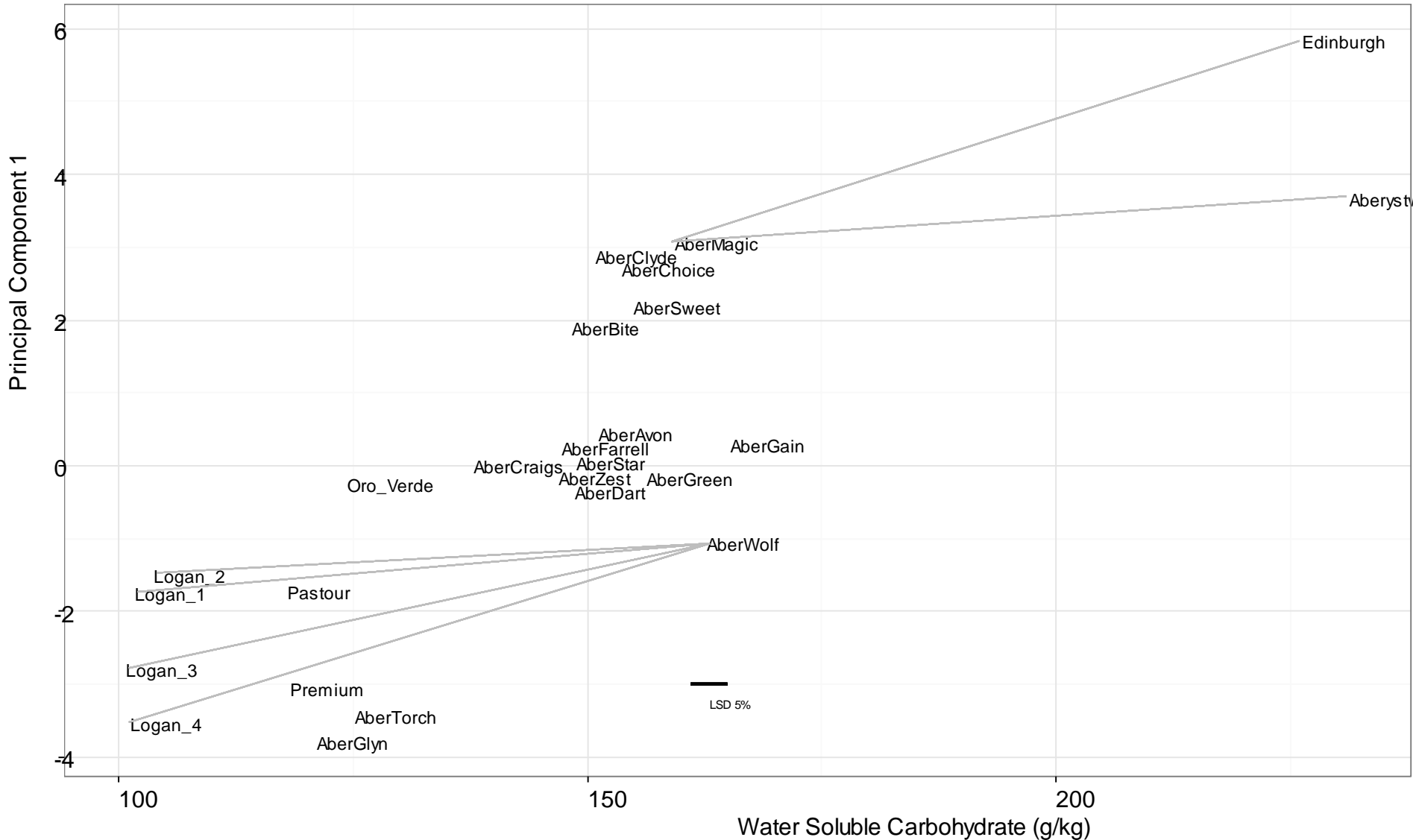
Lates: 3.3 (± 1.2) g·kg⁻¹ higher DMD

Relationships between year of release and phenotype:

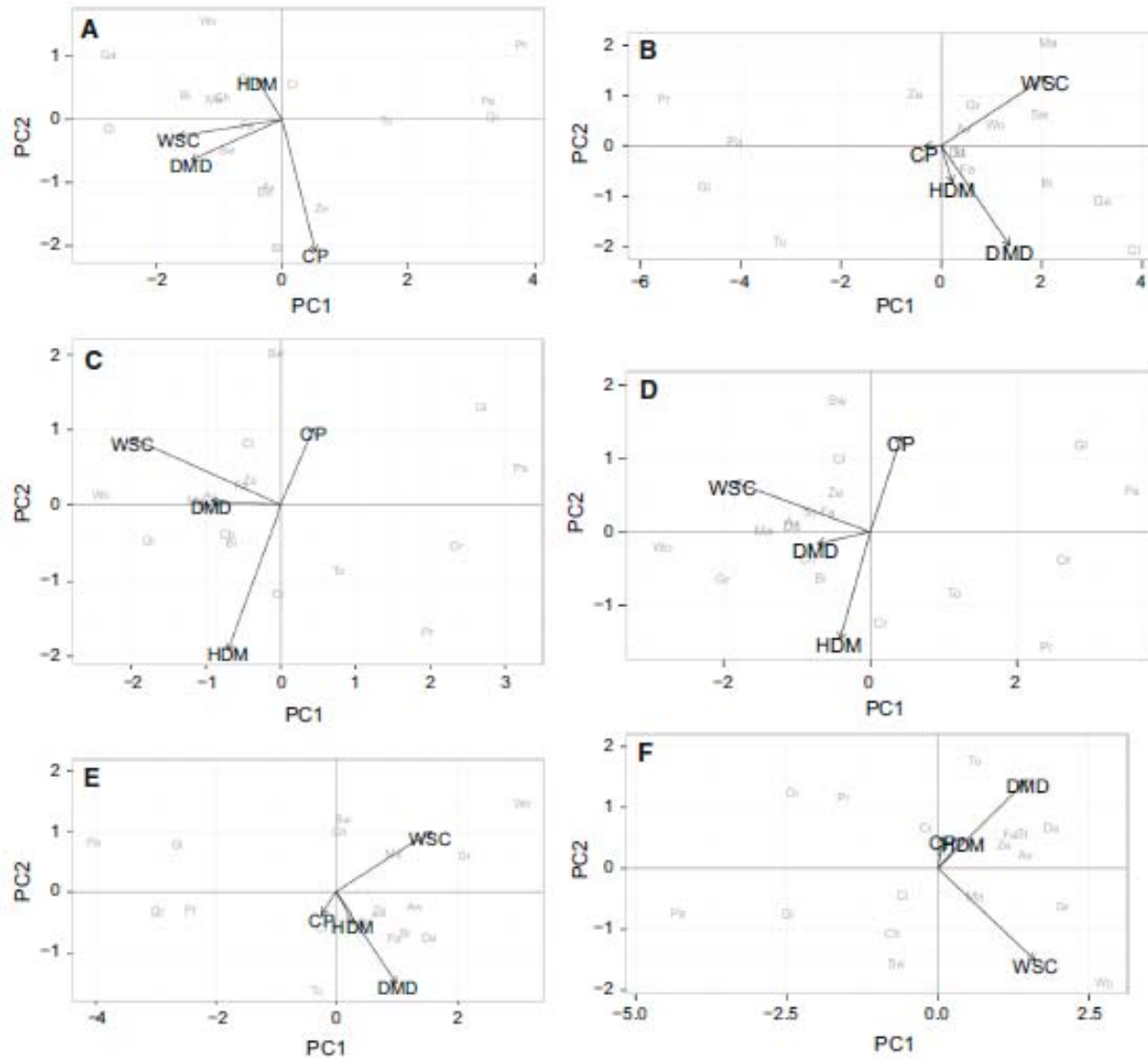
CP: $b = -0.40$ g·kg⁻¹·yr⁻¹; $P = 0.06$

WSC: $b = 2.01$ g·kg⁻¹·yr⁻¹; $P = 0.001$

Perennial ryegrass WSC



Perennial ryegrass WSC



Perennial ryegrass WSC

1. Aberystwyth ryegrass breeding successfully developed cultivars with high yield and WSC.
2. Higher precipitation leads to higher WSC.
3. High temperatures decrease WSC.
4. Water stress allows expression of genetic variation for WSC.
5. Effect of WSC on drought tolerance unclear.

Orchardgrass rust in Germany



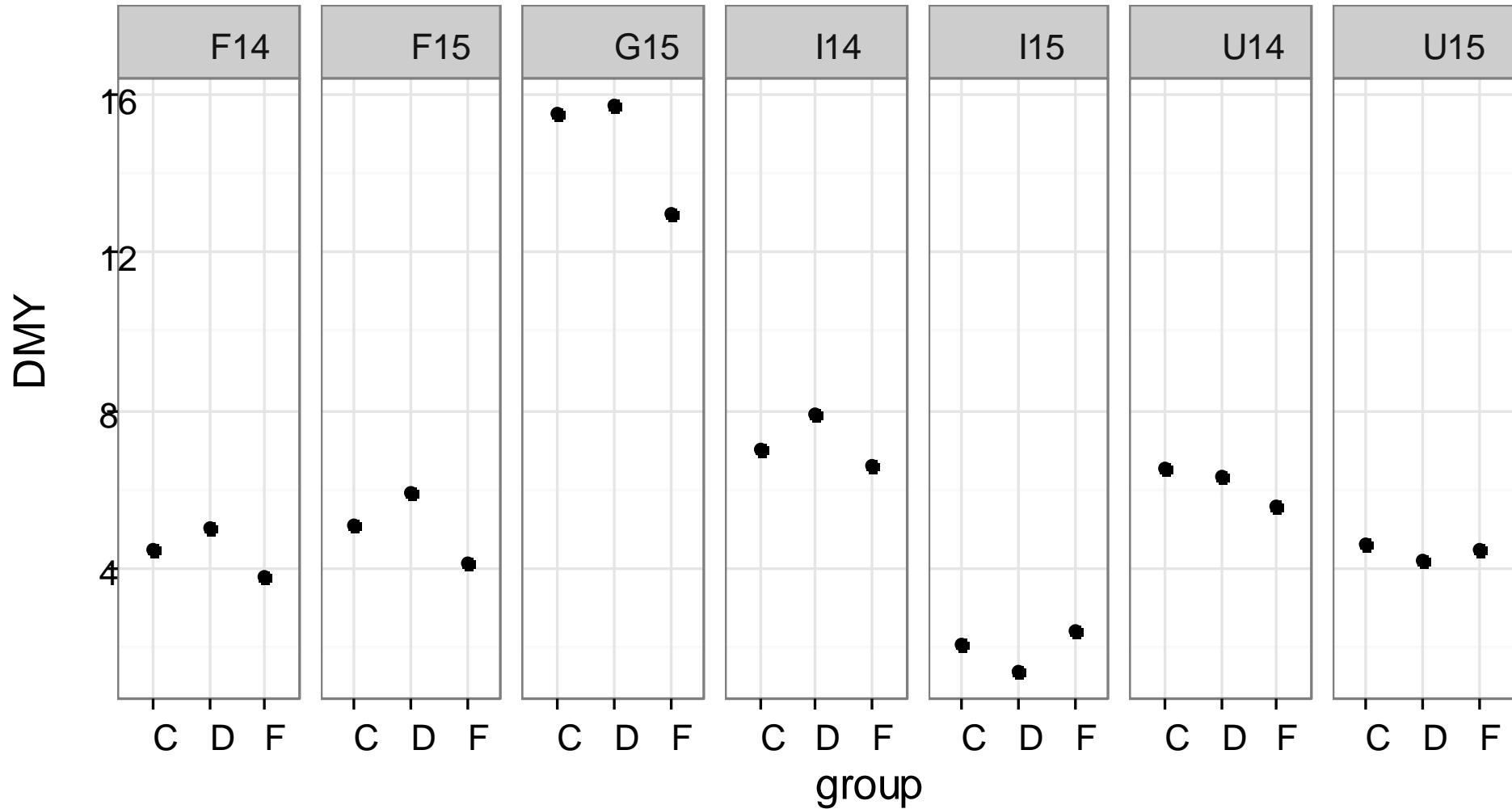
Orchardgrass results

	Maturity		Rust			
	EU	US	FR.14	FR.15	GE.14	GE.15
DSV	46 ^c	4.0	8.2 ^a	7.8 ^a	7.4 ^a	7.2 ^a
Min	30	2.0	2.8	3.5	2.8	3.0
Max	50	4.8	9.0	9.0	9.0	8.5
FRR	33 ^a	4.5	3.8 ^c	5.4 ^b	3.8 ^c	4.4 ^c
Min	25	2.2	2.0	2.0	2.0	2.5
Max	37	5.7	5.4	5.8	5.0	5.3
Checks	40 ^b	4.6	6.2 ^b	7.1 ^a	5.3 ^b	6.4 ^b

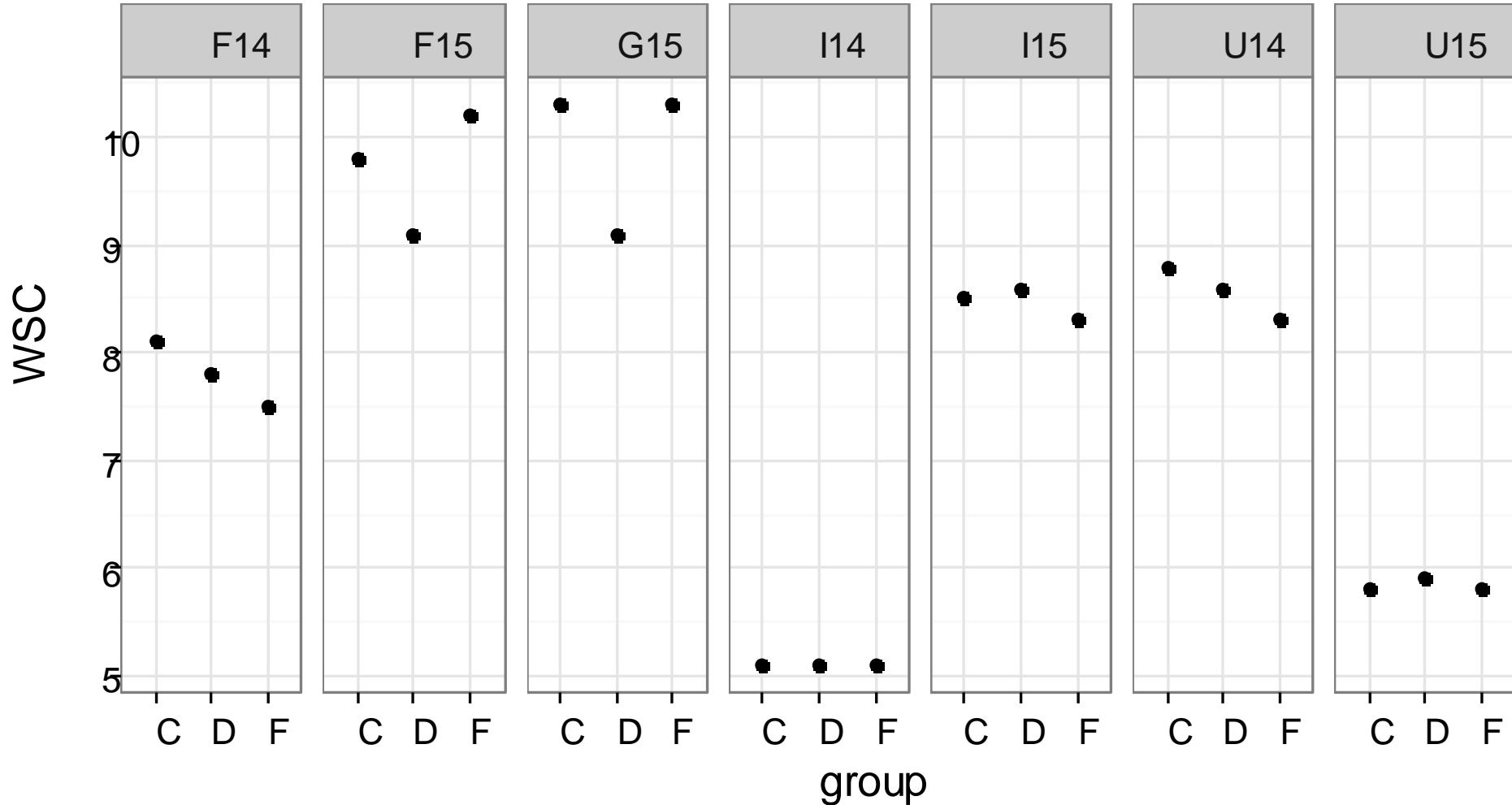
France orchardgrass DMY



Orchardgrass DMY



Orchardgrass WSC



Orchardgrass correlations

	Mat	Rust	DMY	WSC	NDF
Rust	0.79				
DMY	0.69	0.92			
WSC	-0.52	-0.47	-0.55		
NDF	0.69	0.71	0.76	-0.87	
CP	-0.72	-0.85	-0.80	0.33	-0.67

Orchardgrass

	FR14	FR15	GE15	UT14	UT15	ID14
FR15	4					
GE15	1	1				
UT14	2	1	0			
UT15	2	1	0	1		
ID14	1	1	0	1	0	
ID15	2	2	0	1	0	4

15 genotypes among top 10 % in multiple environments

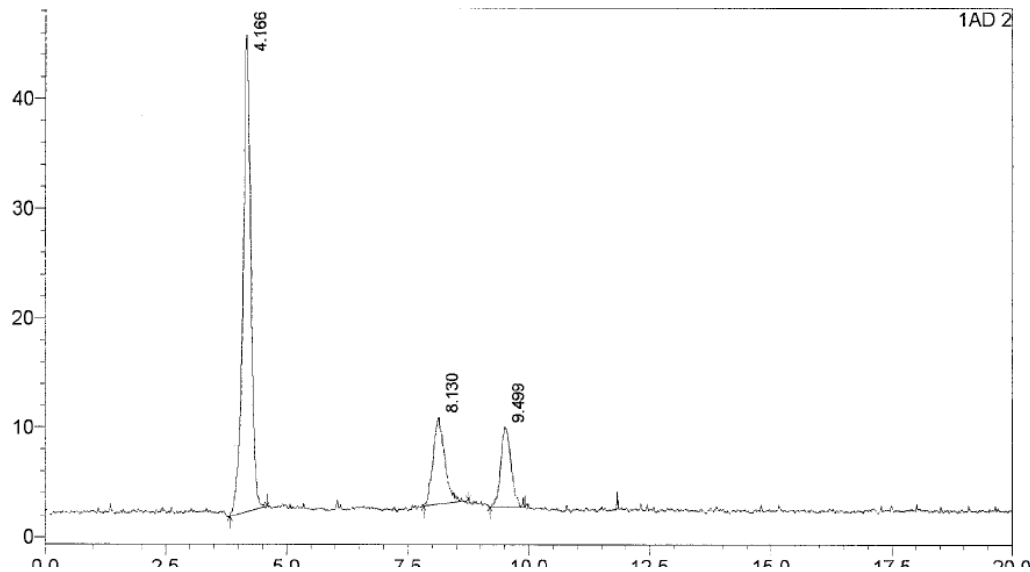
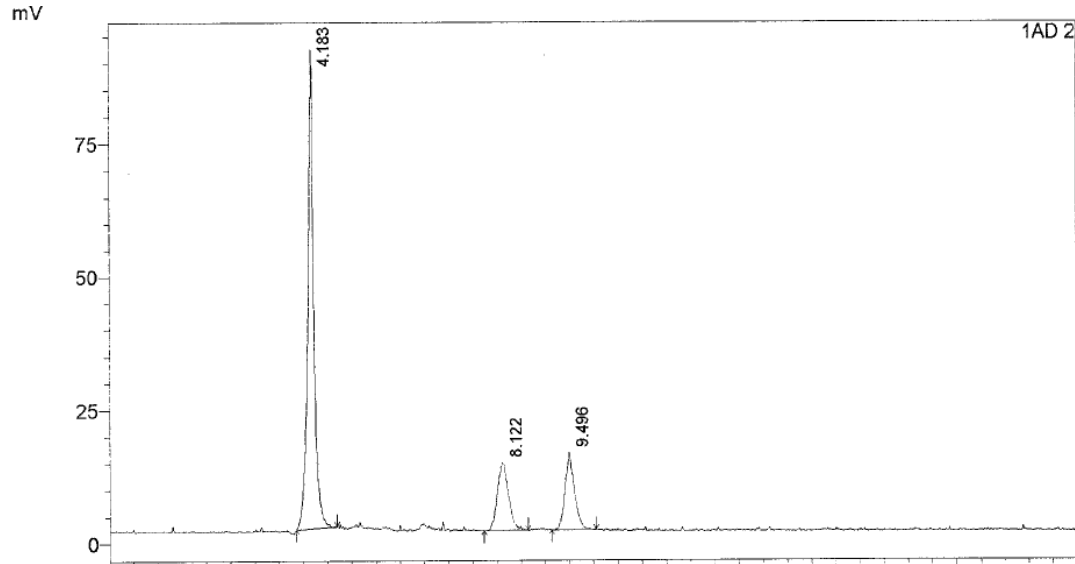
5 DSV & 10 FRR

only 5 among top 10 in 3 environments

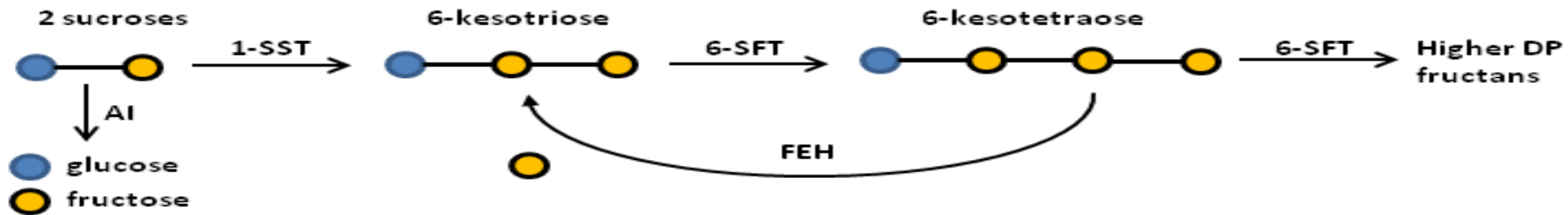
Orchardgrass overview

1. Moderate to high heritability for most traits.
2. FRR germplasm possessed high WSC
Effect of rust on WSC expression.
3. Significant GEI.
4. Variation in each environment.
5. European locations exhibited higher WSC.
Less dramatic than perennial ryegrass study.

Orchardgrass



WSC pathway



Future work

