Functional Single nucleotide polymorphism (SNP) markers for the vernalization requirement in barley

Review of Defra Funded R&D Programme

Main researchers, collaborators

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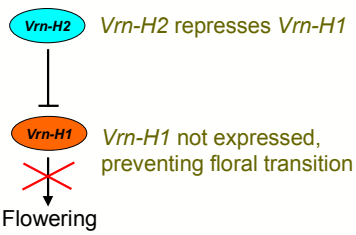
David Laurie, JIC (consultant)

Seasonal type
UPOV TG/3/11 character 29
1=winter
2=alternative
3=spring

Vernalization trial at NIAB

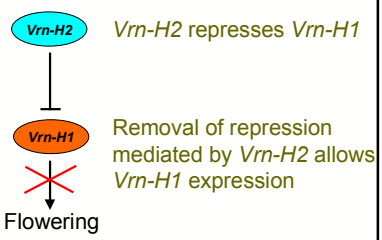
2 major genetic loci (*Vrn-H1* and *Vrn-H2*) control vernalization requirement in European barley

Vernalization sensitive (winter) variety **before** cold treatment:

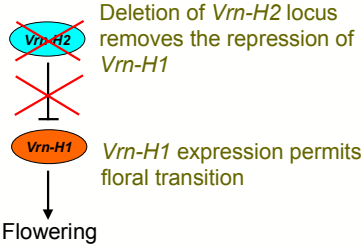


2 major genetic loci (*Vrn-H1* and *Vrn-H2*) control vernalization requirement in European barley

Vernalization sensitive (winter) variety **during** cold treatment:



Vernalization insensitivity can be achieved by mutation at *Vrn-H1* or *Vrn-H2*



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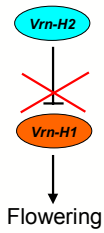
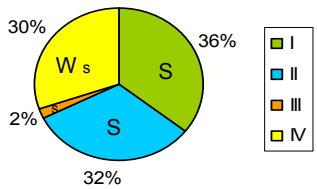


Mutation of a recognition site within *Vrn-H1* makes *Vrn-H1* 'blind' to *Vrn-H2*, permitting floral transition

Aims and objectives

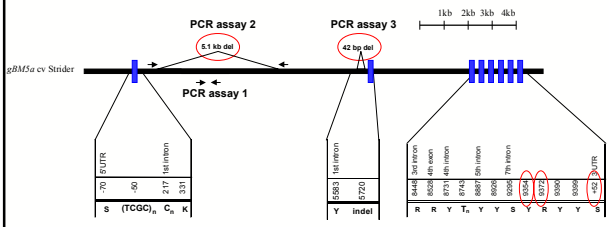
- Fully sequence the *Vrn-H1* gene including regulatory regions, and define haplotypes.
- Assay genetic markers to obtain a set of sequence diversity data for the *Vrn-H2* gene.
- Develop a single reaction SNP assay which is predictive for seasonal growth habit.
- Make recommendations for implementation of vernalization markers in future testing.

Previous Results



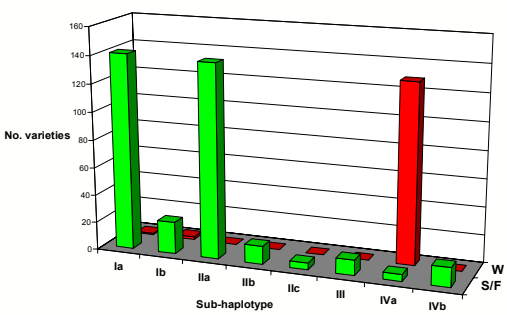
Vrn-H1 haplotype distribution in the GEDIFLUX barley collection (569 varieties)

Previous Results



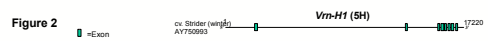
Vrn-H1 Intron I polymorphisms used

Vrn-H1 Haplotype – seasonal habit correlation



Vrn-H1 allelic series

Figure 2

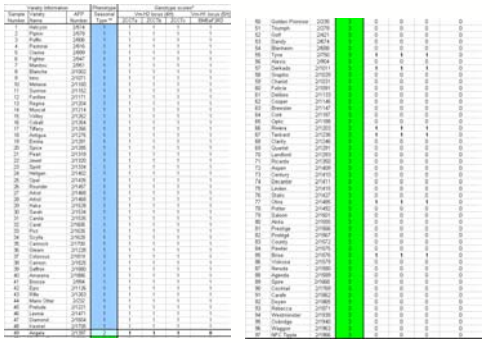


Haplotype	*n*	Varieties sequenced	Habit	Schematic of polymorphisms*
IVa	129	Igri, Panda, Pearl	W	
IVb	13	Dram, Mazurka , Varunda	S	
IVc	3	Arra, Etu, Lise	S	
Ia †	142	Golden Promise, Golf, Pohto	S	
Ib	24	Oriol, Pegasus	S	
IIa	139	Erkki, Optic, Triumph	S	
IIb	13	Hora, Maris Canon, Prisma	S	
IIc	5	Agneta, Jadar, Otra	S	
III†	11	Beatrice, Chariot, Dandy	S	
Ic	1	Express	S	

†Identical with previouslydescribed *Vrn-H1* alleles Ia = Morex III = Oregon Wolfe barley. N.B.

*Compared with reference Strider allele; insertion ▼ deletion ⊣⊢

Validation of diagnostic test



97/97 correct

Conclusions

- All winter barleys tested contain a single configuration of the*Vrn-H1* and *Vrn-H2* genes
- Detailed sequence analysis within grouping of "winter-like" *Vrn1* haplotypes reveals putative polymorphisms causative for the spring growth habit
- First example in the UK of a robust functional marker for an official DUS trait using an Option I(a) type approach

Knowledge gaps identified

- The application of the molecular test in assessment of Uniformity (detection of off-types).
- Further development of the assay to identify "alternative" types from "spring" types.
- Development of markers for further DUS characters – e.g. row number, height genes.