

# Nordic spring barley

## Diversity of agronomic traits and molecular markers

Kolodinska Brantestam A.<sup>1</sup>, Tuveesson S.<sup>2</sup>, Rashal I.<sup>3</sup>, Christerson T.<sup>2</sup>, Legzdina L.<sup>4</sup>, Gullord M.<sup>5</sup>, Weibull J.<sup>6</sup>, Martynov, S.<sup>7</sup> and Roland von Bothmer<sup>1,8</sup>

<sup>1</sup> Nordic Genetic Resource Center, Smedjevägen 3, Alnarp, Sweden; <sup>2</sup> Lantmännen SW Seed, Onnsjögatan 13, Svalöv, Sweden; <sup>3</sup> LU Institute of Biology, Miera 3, Salaspils, Latvia; <sup>4</sup> State Priekuli Plant Breeding Institute, Zinatnes str. 1a, Priekuli, Latvia; <sup>5</sup> Graminor AB, Hommelstadvegen 60, Ridabu, Norway; <sup>6</sup> Swedish Board of Agriculture, Jönköping SE-55182, Sweden; <sup>7</sup> N.I.Vavilov Institute of Plant Industry, 42-44, B. Morskaya Street, 190000, St. Petersburg, Russia; <sup>8</sup> Swedish University of Agricultural Sciences, Sundsvägen 10, Alnarp, Sweden;

### 1. Background

The modern, commercial plant breeding in the Nordic countries was initiated as early as at the end of 19 century. Various materials were employed and new techniques introduced during this time (Figure 1). The breeding efforts have made an impact on agronomical performance and genetic diversity of Nordic barleys. The aim of the study was to visualise these effects by means of SSR markers and agronomic traits comparing material from different breeding periods, countries and row types and associate variation of SSRs and agronomic traits.

### 2. Material

Material for this study was acquired from Nordic Genetic Resource Center (former Nordic Gene Bank) and breeding companies dealing with cereal breeding in Denmark, Finland, Norway and Sweden. In total 132 accessions were used including landraces, cultivars (1890ies-2000ies) and breeding lines. Among these 61 were six-rowed and 71 were two-rowed accessions.

### 3. Methods

Simple sequence repeats (SSR) markers (21 primer pairs) were used to assess the diversity<sup>1</sup>. Agronomic traits like days to heading, days to maturity, plant height, harvest index, thousand kernel weight and volumetric weight were evaluated at three sites during two years<sup>2</sup>.

### 4. Results

The changes in agronomic traits were detected, such as increase of 'harvest index' and decrease of 'plant height'. Whereas the plasticity (bi value) of traits have not changed for majority of traits and material. The exceptions were observed only in six-rowed barleys for traits: 'days to maturity' and 'days to heading', where older cultivar demonstrated more stabile response of these traits (bi close to 1) and in Norwegian six-rowed accessions demonstrating correlation between age of material and plasticity of 'plant height' (r=0.62).

The within accession diversity (Hs) of SSRs has been decreasing with the time having negative correlation values with age of material within both types of barley and within all countries (Figure 2).

Either the average SSR diversity within accessions (Hs) or diversity at individual loci (h) was not found to be a correlating value with the plasticity (bi) of agronomic traits studied. With an exception of Danish six-rowed material where bi values for traits 'days to maturity' and 'harvest index' correlated with Hs values (r=-0.83 and r=-0.63). There was also no relation between the trait plasticity and length of microsatellite fragments studied.

The relations between variation of agronomic characteristics and length of microsatellite fragments were revealed, e.g. 'WMC1E8', 'Bmac0384', and 'Bmag0173' had a significant positive, whereas 'HVM36' (Figure 3) and 'AF043094A' a significant negative correlation with the trait of 'days to maturity' at all trial locations and years. However this relations were only true when two-rowed and six-rowed material were analyzed together, when analyzed separately - no such clear and predictable patterns could be observed.

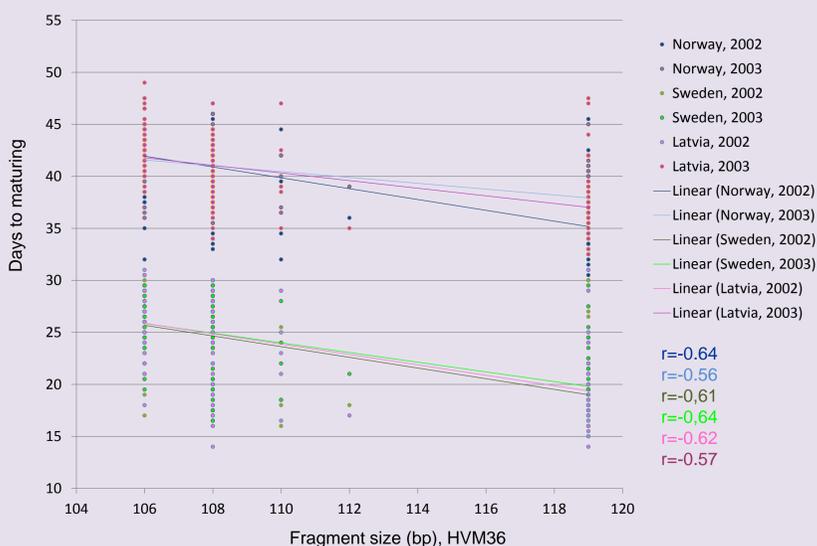


Figure 3. The 'days to maturing' relation to fragment size of HVM36, data shown for each trial site and year

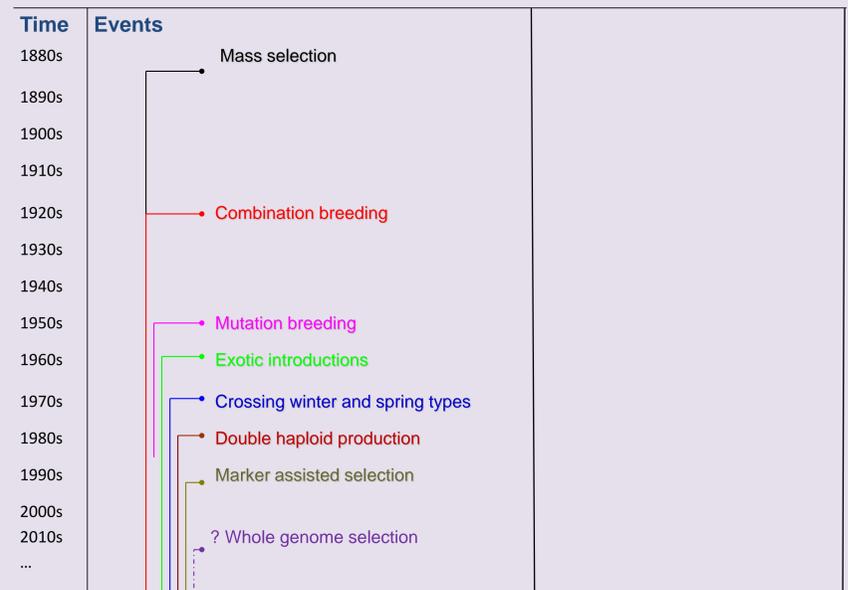


Figure 1. The time frame of introduction of new techniques in Nordic plant breeding

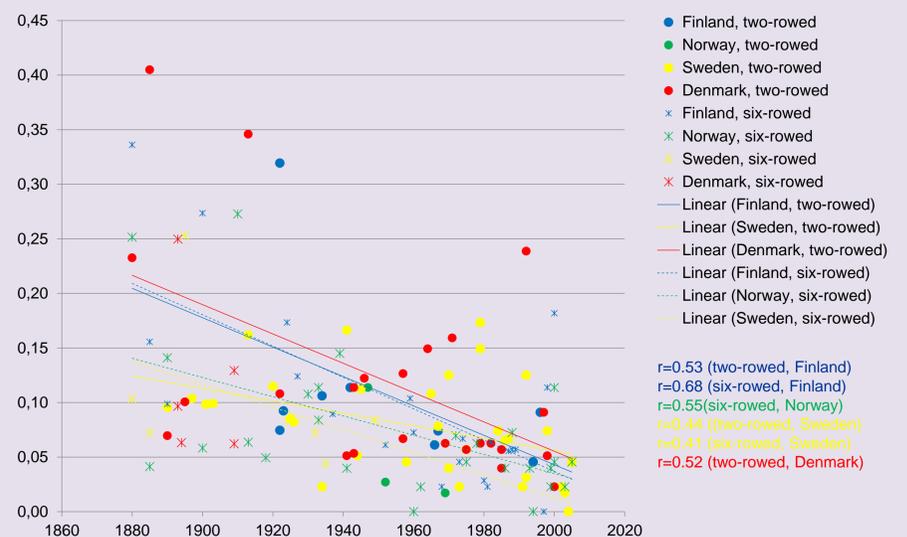


Figure 2. The genetic diversity of SSRs within accession (Hs) - differences between material depending on the breeding decade, country of origin and row type  
\* trend lines shown only for type of material having representation in at least three breeding decades

### 5. Conclusions

- The **within accession diversity of SSRs** has been **decreasing** with time
- A significant **increase of 'harvest index'** and **decrease of 'plant height'** in both two-rowed and six-rowed accessions over time was detected
- Plasticity of agronomic traits** in Nordic countries have **not changed** with few exceptions in six-rowed material
- Either the **SSR diversity** (both the average value and per individual locus) within accession or **SSR fragment sizes** is **not associated with plasticity** of studied agronomic traits
- Relations between SSR fragment length and variation of agronomic traits** was detected, though there were differences depending on the subset of material analysed.

### References:

- Kolodinska Brantestam, A., Bothmer, R., Dayteg, C., Rashal, I., Tuveesson, S. and Weibull, J. 2007. Genetic diversity changes and relationships in spring barley (*Hordeum vulgare* L.) germplasm of Nordic and Baltic areas as shown by SSR markers. *Genetic Resources and Crop Evolution* 54(4), 749-758
- Kolodinska Brantestam A., von Bothmer R., Rashal I., Gullord M., Marlynov S. Weibull J. 2008. Variation of agronomic traits in Nordic and Baltic spring barley. In: Proceedings of the 10<sup>th</sup> International Barley Symposium, 5-10 April 2008, Alexandria, Egypt. ICARDA PO Box 5466, Aleppo, Syria, p. 39-45



### NordGen

The Nordic Genetic Resource Center is an organization dedicated to conservation and sustainable use of plants, farm animals and forest trees. Biological diversity is the foundation of human existence and adaptation to constantly changing environmental conditions. NordGen secures the biological livelihood of present and future generations.

### NordGen Plants

Box 41, SE-230 53 Alnarp, Sweden  
Visiting address: Smedjevägen 3  
Tel: +46 40 53 66 40  
Fax: +46 40 53 66 50