1. Background

The modern, commercial plant breeding in the Nordic countries was initiated as early as at the end of 19th 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. 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.

4. Results

The changes in agronomic traits were detected, such us 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 stable 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. 'WMCE19', 'Bmac0384', and 'Bmga0173' had a significant positive, whereas 'HVM36' (Figure 3) and 'AF043094A' a significant negative correlation with the trait '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.

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:

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.

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