Breeding for Grain Protein Content Stability in Wheat

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Background

- Grain protein content (GPC) is an important determinant of bread and pasta quality of wheat
- Nested association mapping (NAM) populations have high statistical power and mapping resolution
- Finlay-Wilkinson (FW) regression helps in calculating stability of genotypes
- Genomic selection (GS) is a technique to predict quantitative traits in plants

Objectives

- Identify families having less variation in GPC
- Genetically mapping of GPC stability loci
- Apply GS models for predicting GPC in wheat

Materials and Methods

- 650 recombinant inbred lines (RILs) from a NAM population were used (Figure 1)
- Lines were grown in Pullman, WA during the 2014-2016 growing season
- Stability index and families having less variation were selected using FW regression
- Significant QTLs controlling GPC stability were identified using FarmCPU model
- Genomic selection (GS) was performed using rrBLUP model

Results

- Heritability of GPC ranged from 0.36 to 0.68
- Seven families having less variation for GPC
- Thirty-three RILs had stable GPC across environments ($p < 0.05$)(Figure 2)
- Six significant QTLs were identified for GPC stability (Figure 3)
- Genomic prediction accuracy reached to 0.70 (Table 1)

Discussion and Implications

- Genes controlling stability of GPC can assist in multi-environments selection
- Stability loci can be identified by genome-wide association studies
- GS aids in evaluating all genotypes for high and stable GPC

Table 1: Genomic prediction accuracies for GPC and GPC stability

<table>
<thead>
<tr>
<th>Trait</th>
<th>Prediction accuracy</th>
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</thead>
<tbody>
<tr>
<td>GPC14</td>
<td>0.55</td>
</tr>
<tr>
<td>GPC15</td>
<td>0.70</td>
</tr>
<tr>
<td>GPC16</td>
<td>0.58</td>
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<tr>
<td>GPC stability index</td>
<td>0.40</td>
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</tbody>
</table>

*GPC14, GPC15, and GPC16 stands for grain protein content for 2014, 2015, and 2016, respectively

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