Common bunt resistant wheat composite cross populations

Research output: Contribution to conference › Conference abstract for conference › Research

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Utilising diverse populations instead of genetically homogeneous varieties is expected to lead to a number of advantages in cereal production. These include reduced epidemics of plant diseases, improved weed competition and better exploitation of soil nutrients, resulting in improved yield stability. However, a number of challenges must be met before diverse wheat populations can be introduced into commercial wheat production: one of these is the development of breeding technologies based on mass selection which enable breeders and farmers to improve specific traits in populations and maintain diversity at the same time. BIOBREED is a project which commenced in Denmark in 2011 to meet these challenges for wheat population breeding. The project focuses on the development of tools and methods for mass selection of traits relevant for organic and low input production, where it is expected that the highest benefits of utilizing diverse populations can be achieved. BIOBREED focuses on three main aspects of wheat population breeding for organic and low input production systems: i) common bunt (caused by Tilletia caries) resistance, ii) selection for improved protein content and iii) the influence on population diversity of different selection pathways.

Thirty three crosses were made between 23 common bunt resistant winter wheat varieties in order to generate two composite cross populations (CCPs). Progeny of all crosses was bulked in the F3 to constitute the first population (Pop.No.Sel). Prior to the creation of the second population (Pop.Sel), 20 head rows of each of the F3 of the parental crosses were inoculated with common bunt. From these segregating lines, 160 that showed high levels of resistance to common bunt were used to create Pop.Sel in generation F4. Afterwards the two populations were grown with and without inoculation with common bunt in order to i) select for bunt resistance and ii) to be able to compare the effect of heavy bunt infection on diversity. Preliminary results show a higher level of common bunt resistance in Pop.Sel (6% infection) than in Pop.No.Sel (20% infection) in the first year.

Prior to sowing the F5 seed of population Pop.Sel, all seeds were sorted individually for protein content using a BoMill IQ Grain Quality Sorter 1002S. The 10% of seeds with the highest and the 10% of seeds with the lowest protein content were selected to generate two new populations (Pop.Sel.high.Protein and Pop.Sel.low.Protein). All four populations (Pop.No.Sel, Pop.Sel, Pop.Sel.high.Protein and Pop.Sel.low.Protein) and their parental lines were sown in a randomized complete block trial at two locations in Denmark in order to compare yield and quality parameters such as protein content and baking quality, and to assess their stability across environments. Results are expected for the summer 2013.

Research to date has not yet answered the question, ‘how much diversity is needed in populations?’ BIOBREED aims to quantify the levels of diversity in wheat CCPs after the different selection steps of i) cultivation with and without common bunt inoculum, and ii) sorting for single seed protein content. Molecular markers will be used to describe the influence of these different selection pathways on population diversity. 90 SSR markers — about two markers per chromosome arm

— will be used to describe the initial genetic diversity of the 23 parental lines. F6 seed of the different populations will be analysed with the same markers and population diversity after different selection pathways will be quantified.

Original language	English
Publication date	21 Jan 2013
Number of pages	1
Publication status	Published - 21 Jan 2013
Event	International Symposium on Evolutionary Breeding in Cereals - Aston University, Birmingham, United Kingdom Duration: 21 Jan 2013 → 21 Jan 2013

Conference

Conference	International Symposium on Evolutionary Breeding in Cereals
Location	Aston University
Country	United Kingdom
City	Birmingham
Period	21/01/2013 → 21/01/2013