

Axiom® Wheat Breeder's Genotyping Array

High-throughput genotyping for elite breeder wheat lines

Axiom® Wheat Breeder's Genotyping Array is a cost-effective and highly efficient system for screening large numbers of wheat lines. The array was designed through Affymetrix® Expert Design Program in collaboration with Professor Keith Edwards and Dr. Sacha Allen from the Cereal Functional Genomics Group at the School of Biological Sciences, University of Bristol, funded by the Biotechnology and Biosciences Research Council (BBSRC) in the UK. Axiom® Wheat Breeder's Genotyping Array is ideally suited for high-throughput screening in wheat breeding programs and was described by Dr. Gary Barker from the University of Bristol at the Plant and Animal Genomes Conference, 2014.^{1,2}

The array interrogates pre-validated SNPs that were carefully selected by the breeders and are polymorphic in elite wheat lines from European and North American varieties. The array offers coverage of markers spaced across the wheat genome. The markers are a subset of the markers on Axiom Wheat HD Genotyping Arrays, which contain 817,000 SNPs. The probes were selected based on their genetic map location, their diversity level, and their usefulness in a range of elite global germplasm.

Highlights

Content:

- 35,143 markers spaced across the A, B, and D genomes of which 35,042 are physically and/or genetically mapped to each of the 21 wheat chromosomes:
 - A genome: 10,819 markers
 - B genome: 12,932 markers
 - D genome: 11,291 markers
- Markers have been previously tested on Axiom® Genotyping platform and were selected for being highly polymorphic
- Inclusion of codominant SNPs, ensuring clear differentiation between homozygotes and heterozygotes³
- SNPs exhibit a range of polymorphism information content (PIC) scores (see Figure 1)

Diversity:

- SNP discovery and validation were completed by using a diverse set of 140 elite wheat lines used by breeders
- Samples tested, representing hard and soft varieties, were provided by Syngenta, KWS, RAGT, and Limagrain

Applications

Molecular breeding:

- Genomic selection
- Marker-assisted selection
- Detection of introgressed genes
- Germplasm characterization and high-throughput screening

Polymorphic content

The polymorphic markers on Axiom Wheat Breeder's Array are searchable on CerealsDB website (<http://www.cerealsdb.uk.net/>). This is a database that was created by the Functional Genomics Group at the University of Bristol, UK, for the purpose of making SNP information available to the worldwide wheat community. It is updated regularly and contains:

- **SNP statistics:**⁴ Data related to every SNP including map location, 120 bp flanking sequences, MAF, and PIC score
- **Variety comparison:**⁵ Select two or more varieties of wheat to see the SNPs in common or SNPs that are different between them

SNP selection

The marker discovery was completed by high-coverage (48x) exome sequencing using a 132,000 feature Nimblegen capture array based on wheat cDNAs. Following marker discovery, 817,000 markers were screened on Axiom HD Wheat Genotyping Arrays. The 35,143 markers on Axiom Wheat Breeder's Genotyping Array were selected from Axiom Wheat HD Genotyping Arrays using the following criteria:

- SNPs that were polymorphic in hexaploid varieties on elite lines
- Markers that were on contigs identified by the International Wheat Genome Sequencing Consortium (IWGSC)
- Markers that were genetically mapped were selected before selecting unmapped SNPs
- Markers were selected by prioritizing codominant markers (more likely to lie in coding regions), followed by partially codominant markers and dominant SNPs. Markers that had the highest PIC score within the best available dominance class were prioritized.

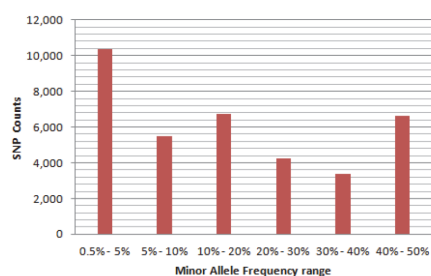
Content

Table 1: Lines already screened using the array.

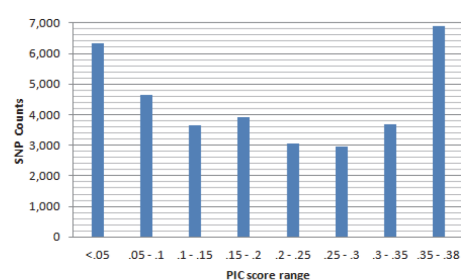
Azzerti	Bacanora	Badger	Batis	Battalion	Beluga	Bergamo	Bermude
Biscay	Bobwhite	Boregar	Brompton	Bussard	Buster	Cadenza	Capelledesprez
Caphorn	Cellule	Charger	ChineseSpring	Claire	Cocoon	Cordiale	Cougar
Crusoe	Cubus	Dekan	Delphi	Dickens	Dinosor	Duxford	Einstein
Except	Exotic	Expert	Fabian	Fiorello	Gallant	Garcia	Gatsby
Glasgow	Gravitas	Gulliver	Hereford	Hereward	Highbury	Hobbit	Horatio
Humber	Invicta	JB_Diego	Julius	Koreli	KWS_Gator	KWS_Kielder	KWS_Podium
KWS_Santiago	KWS_Target	Laurier	Leeds	Longbow	Lynx	Malacca	Mercado
Moisson	Moulin	NIABParagon	Oakley	Opata	Option	Oratorio	Panorama
Paragon	Pavon76	Premio	Relay	Renan	Revelation	Rialto	Riband
Robigus	Rocky	Savannah	Shamrock	Shango	Skyfall	Soisson	Solstice
Spark	Tommi	Tremie	Tuerkis	Tuxedo	Viscount	Weebil	Xi19

Figure 1: MAF and PIC ranges represented on the array.

SNPs on the array exhibit the following minor allele frequencies in the wheat lines listed in Figure 1:



SNPs on the array exhibit the following PIC scores in the wheat lines listed in Figure 1:



References

1. LabTube interview with Gary Barker, University of Bristol <http://www.labtube.tv/playVideo.aspx?vid=161532>
2. PAG Presentation by Gary Barker, University of Bristol <https://www.youtube.com/watch?v=9YLydFzaM4Y>
3. Allen A. M., et al. Discovery and development of exome-based, co-dominant single nucleotide polymorphism markers in hexaploid wheat (*Triticum aestivum* L.). *Plant Biotechnology Journal* **11**(3):279–295 (2012).
4. http://www.cerealsdb.uk.net/cerealgenomics/CerealsDB/axiom_mapped_snps.php
5. http://www.cerealsdb.uk.net/cerealgenomics/CerealsDB/axiom_35K_search.php

Ordering information

Part number	Description	Details
550524	Axiom® Wheat Breeder's Genotyping Array	Contains one plate with 384 arrays. Reagents and GeneTitan® MC consumables must be quoted separately.
902234	Axiom® GeneTitan® Consumables Kit	Contains all GeneTitan® Instrument consumables required to process one array plate
902245	Axiom® 2.0 Reagent Kit	Includes all reagents (except isopropanol) for processing 384 DNA samples

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