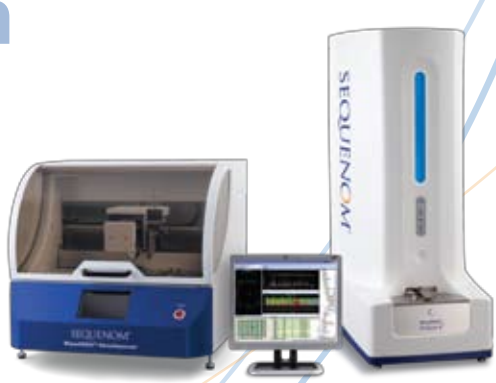
MassARRAY® System

For Agricultural Genomics

Flexible and Cost-Effective High-throughput Screening Tool



Genome-wide association and next-generation sequencing studies have identified a vast number of genetic markers, which are now being used in molecular breeding of plants and animals for a variety of improvements, such as increased yields, disease resistance, feed efficiency and nutrition. With its unmatched performance and versatility, the Sequenom® MassARRAY® system is a powerful tool for downstream marker validation and large-scale screening.

> "The Sequenom MassARRAY system has facilitated the Centre for Plant Conservation Genetics at Southern Cross University to overcome many of the challenges in plant genetics such as ploidy, gene duplications, and low amounts of input material. The superior accuracy and sensitivity of the MassARRAY has enabled development of novel methods and panels for application in our academic and commercial agriculture and livestock testing operations, whilst maintaining low cost structures and high throughput as required by the agriculture sector."
>
> Professor Robert Henry, Director Centre for Plant Conservation Genetics, Southern Cross University

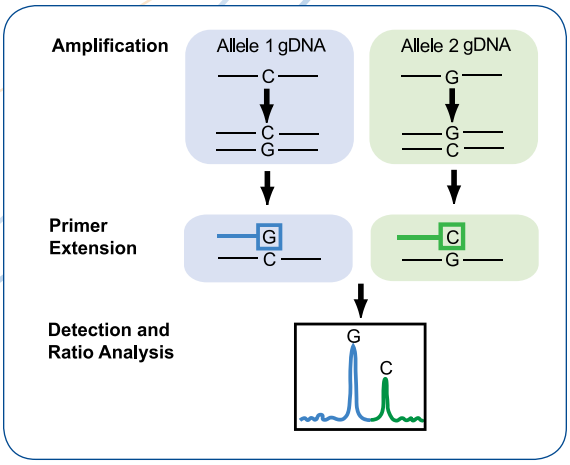


Figure 1: iPLEX® Gold Genotyping Assays with the MassARRAY System

In addition to SNP genotyping, Sequenom offers a broad portfolio of solutions for agricultural genomics including copy number variation (CNV), methylation, and gene expression (QGE). The MALDI-TOF (matrix assisted laser desorption/ionization time-of-flight) mass spectrometry-based MassARRAY system offers highly flexible, accurate, sensitive, and cost-effective solutions to the agricultural community.

SEQUENOM®

MassARRAY® System

For Agricultural Genomics

Applying Agricultural Genomics Discoveries to Commercial Programs of High Value

Parentage verification for livestock breeding

With the advent of automated genotyping methods, SNP-based genotyping applications are increasingly valuable to the commercial livestock industry. Genetic and parental identification is important for determining pedigree, managing breeding efforts, tracking farm of origin, and animal forensics. A previous study comparing a 60-SNP Sequenom panel with a 20-microsatellite marker panel showed that the SNP panel was slightly more effective than microsatellite analysis at determining both one- and two-parent exclusion but was clearly superior for individual animal identification (Rohrer, et al. 2007).

The parentage verification tests large numbers of animals on a pre-designed SNP panel at an early developmental stage. Any schedule delay adds significant cost to the breeding companies. After rapid assay design, it takes less than a week for researchers to have everything needed for the screening process. The short assay development time, the use of off-shelf reagents, and robust system performance makes the iPLEX® Gold genotyping assay a superior choice for the large-scale screening. Many core labs and service providers are using the iPLEX Gold to routinely screen large numbers of sheep, cattle, pig, fish, and other livestock species, generating huge economic value to farmers, breeding companies, and downstream commercial groups.

Crop strain validation and marker assisted selection

Recent technology advances make it possible to routinely apply genetic markers to characterize germplasm and to select for favorable alleles in plant breeding programs. The ideal marker system would be highly polymorphic, co-dominant, accurate, reproducible, high-throughput and low cost.

To evaluate informativeness, levels of missing data, repeatability, and the ability to detect expected alleles in hybrids and DNA pools, Jones et al. conducted a study to characterize 58 inbred and four hybrid maize samples using 80 SSR markers and 118 SNP markers on the MassARRAY system (Jones, et al. 2007). Average expected heterozygosity values were 0.62 for SSRs, 0.43 for SNPs (pre-selected for their high level of polymorphism) and 0.63 for the underlying sequence haplotypes. Most importantly, SNP marker data had a four-fold lower level of missing data (2.1 to 3.1%) and higher data reproducibility (98.1%) than SSRs (13.8% and 91.7% respectively). The high data quality, in conjunction with low cost and high throughput, make iPLEX Gold genotyping assays the most favorable method for the genotypic analysis of crops.

Candidate genetic marker evaluation

Finding rapid and cost-effective methods to accelerate breeding is a high priority for the AgBio community. In addition to traditional markers, functional markers can also provide a reliable method for identification and selection of favorable alleles due to the absence of recombination between the marker and target locus, increasing diagnostic power.

Candidate genetic marker development with the MassARRAY system is preferable over the other systems due to its flexibility. The highly efficient assay design, short lead time, and easy panel modification enable users to rapidly validate those genetic markers at low reagent and labor cost.

Other Applications

QTL detection for:

- Milk yield prediction and improvement
- Feed efficiency improvement
- Meat quality diagnostics

Companion animal breeding origin studies

Phenotype selection (coat color, horned/polled)

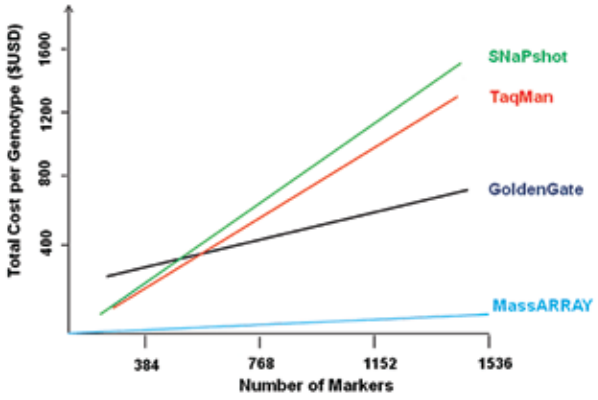
MassARRAY: A Versatile and Robust Platform Accelerating Genetic Marker Validation and Screening

- **Highly flexible system:** Cover all of your important SNPs. No need to limit your panel to a fixed SNP number. Modifying an existing panel is fast and easy without wasting the reagents or oligos in existing panels.
- **Low cost per SNP**
- **High sample throughput:** 10 hours from DNA to results with 70 minutes hands-on-time. One technician can generate 4,000-250,000 genotypes on one MassARRAY Compact system per day.
- **High call rate irrespective of organism:** Up to 99% call rate on agricultural organisms achievable.*
- **Short order lead time:** Assay design takes hours; off the shelf reagents; only a few days to oligo receipt.**
- **Reliable system:** Robust MALDI-TOF mass spectrometry detection delivers consistently high quality data to keep your screening schedule.
- **One system meets all of your validation and screening needs:** The MassARRAY platform supports genotyping, CNV, QGE, and methylation applications.

*: Some assay optimization required. Overall ~90% call rate observed with no optimization.

**: Depending on oligo vendor.

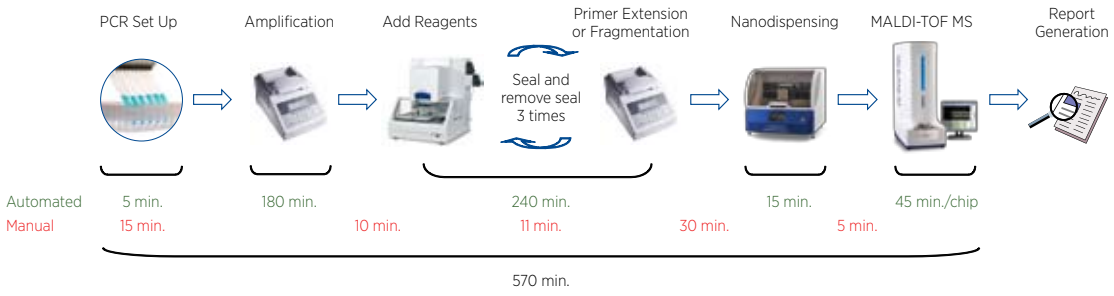
Figure 2: Total costs in US dollars per genotype as a function of the number of markers (Bagge, et al. 2008)



"Considering only the costs per marker per genotype, MassARRAY is generally preferable, as it is highly flexible and may be used for all the different scenarios present in a breeding company." *(Bagge, et al. 2008)*

Around the world, scientists are working on applying today's research results to tomorrow's agricultural breakthroughs. Sequenom's MassARRAY genetic analysis system offers great versatility, high throughput, low cost, and unmatched performance for today's agricultural researchers.

MassARRAY Workflow



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14. Sexton, T.R. *et al.* (2011) Capture of assay template by multiplex PCR of long amplicons for genotyping SNPs and InDels with MALDI-TOF mass spectrometry. *Molecular Breeding. 25:471-480.*

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