Applied Biosystems™ Axiom™ Microarrays
Innovating for healthier, cleaner and safer world

Not for use in diagnostic procedures
Demand keeps growing

Global per capita meat consumption doubled in last 50 years
By 2050 …

9 billion people

100% more food

70% of this increase must rely on efficiency-improving technology
By 2030, 62% of the seafood we eat will be farm-raised.
Applied Biosystems™
Axiom™ aquaculture arrays
Advancing research to deliver farmed fish to meet the growing global appetite for protein
Innovations in Applied Biosystems™ Axiom™ microarrays for agrigenomics

- Customized Axiom arrays
- Multi-species arrays
- Automated Polypoid analysis
- Axiom 384HT Format and workflow
- Axiom Present-Absent Variation (PAV) Array
- Axiom Microbiome array
- Design of complex markers
- Copy number analysis solutions
- Scalable workflow for >2M samples/yr

- No SNP dropout
- More selection flexibility
- Lower cost and inventory consolidation
- Wheat
- Strawberry
- Salmon
- Ornamentals
- Low cost
- High throughput
- Interrogate large insertion/deletions
- Virus and bacteria analysis in a single solution
- Scrapie resistance in sheep
- Bovine and canine solutions
- Transformative in lowering running and scale-up costs
Axiom Analysis Software for Genotyping, Copy Number and Advanced Visualization

Off-Target Variant (OTV)

10 times cheaper than DNA sequencing

Lawrence Livermore National Laboratory

A single platform for accurate genomic evaluation across a diverse set of breeds

Scrapie resistance marker, 15K_OAR13_46225765

15K_OAR13_46225765

More robust than GBS


Development of a highly efficient Axiom™ 70 K SNP array for Pyrus and evaluation for high-density mapping and germplasm characterization


Thermo Fisher Scientific

Research Article

Development and preliminary evaluation of a 90 K Axiom® SNP array for the allo-octoploid cultivated strawberry Fragaria × ananassa

Lawrence Livermore National Laboratory
5,000,000+

Samples will need to be genotyped each year to meet growing demands
Applied Biosystems™
Axiom™ Propel Workflow:
Breaking the barriers to scalability
Benefits of Axiom Propel Workflow

- Minimize scale-up costs
- Re-use/Minimize lab-ware
- Fast 48 hour TAT
Empowering you to deliver more

- Simplification
- Flexibility
- Efficiency

Standalone
Applied Biosystems™
GeneTitan™ Scanner

Bulk reagent packaging

ThermoFisher
Scientific
Applied Biosystems™ AgriSeq™ For Targeted GBS

Jan. 13. 2020
Thermo Fisher Scientific Offers Solutions Across the Agrigenomics Continuum

- **Discovery GWAS**
  - Number of markers: Millions
  - Technology: Genomic Selection
  - Solution: 100,000s

- **Genomic Prediction**
  - Number of markers: 10,000s
  - Technology: Marker Assisted Selection or Breeding
  - Solution: 1000s

- **Parentage**
  - Technology: QC
  - Solution: <100
  - Known Targets: Mid-Density
  - Multiplex

Dedicated to scientific partnership with customers
AgriSeq :: A Complete Targeted Genotyping-By-Sequencing Solution

Sample Prep.  
Custom Panels  
Library Prep.  
Sequencing  
Data Analysis
Value Creation

**Flexible**
- All in one - SNP, MNPs, INDELs and structural variants
- Multi-species panels

**Powerful**
- Workflow automation
- Novel genotypes

**Cost Effective**
- Multiplexing
- High throughput

AgriSeq™
NGS Adoption Challenges In Agriculture Industry

• Complex Workflows
  • Technical expertise
  • Hands-on time

• Data Analysis
  • Pipelines
  • Bioinformatics training
  • Interpretation
  • Multiple data formats

• Panel Design
  • Specificity and Sensitivity
  • Genome complexities
Workflow Automation Delivers Results Faster

<table>
<thead>
<tr>
<th></th>
<th>Library Construction</th>
<th>Templating</th>
<th>Sequencing</th>
<th>Data Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sample-to-results in 3 days</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hands-on time</td>
<td>&lt; 3 hr (manual)</td>
<td>&lt; 15 min</td>
<td>&lt; 15 min</td>
<td>&lt; 15 min</td>
</tr>
<tr>
<td></td>
<td>&lt; 1 hr (automated)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total time</td>
<td>6 - 7 hr</td>
<td>Overnight</td>
<td>2.5 hr</td>
<td>6 - 24 hr</td>
</tr>
</tbody>
</table>

* Depends on customer implementation or varies depending upon system used and samples/chip.

Highly scalable with automation to help reduce hands-on time
### Design Automation For High-Performance Panels

<table>
<thead>
<tr>
<th>Pre-Design QC</th>
<th>Design</th>
<th>Post Design QC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design time</td>
<td>2 weeks</td>
<td>1 week</td>
</tr>
</tbody>
</table>

90% Design Rate

**Bioinformatics design support for over 40 different species**
Seamless Integration Between Sequencing and Data Analysis

Ion GeneStudio S5 Series system

Ion Torrent™ Server & Torrent Suite Software

Torrent Variant Caller plug-in

AgriSum

Down stream analysis

Data Storage & Primary Analysis

Call Variants

Actionable Genotypes
Interpretation Made Easy With AgriSum

**Panel Summary**

- Number of Markers
  - SNP: 476
  - DEL: 40
  - INS: 14
  - MNP: 3
  - COMPLEX: 2

**Number of Amplicons**: 513  
**Mean Coverage**: 533X  
**Mean Call Rate (Mean CR)**: 94%

**Marker Summary**

- **Number of Markers**
  - # Markers = 100% CR: 535
  - # Markers 98% - 100% CR: 0
  - # Markers 95% - 98% CR: 0
  - # Markers 90% - 95% CR: 7
  - # Markers 80% - 90% CR: 5
  - # Markers 50% - 80% CR: 0
  - # Markers 10% - 50% CR: 0
  - # Markers 0% - 10% CR: 0
  - # Markers = 0% CR: 0

**Sample Summary**

- **Samples Run**
  - # Samples = 100% CR: 288
  - # Samples 98% - 100% CR: 0
  - # Samples 95% - 98% CR: 101
  - # Samples 90% - 95% CR: 64
  - # Samples 80% - 90% CR: 39
  - # Samples 50% - 80% CR: 19
  - # Samples 10% - 50% CR: 11
  - # Samples 0% - 10% CR: 1
  - # Samples = 0% CR: 1

- **Overall Marker Performance**

- **Number of Samples wrt Call Rate**

- **ThermoFisher Scientific**

- **Genotype Matrix**
- **TOP/BOTTOM Format**
- **Parentage Format**

*Proprietary & Confidential*
### Continuous Innovation Enabling Agriculture Research

<table>
<thead>
<tr>
<th>Year</th>
<th>Barcodes</th>
<th>Software</th>
<th>ISAG Bovine Parentage</th>
<th>SNPs</th>
<th>MNPs &amp; INDELs</th>
<th>Structural Variants</th>
<th>Custom Panels</th>
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</thead>
<tbody>
<tr>
<td>2017</td>
<td>384 Barcodes</td>
<td>Torrent Suite</td>
<td>ISAG Bovine Parentage</td>
<td>SNPs</td>
<td>MNPS &amp; INDELs</td>
<td>Structural Variants</td>
<td>Custom Panels</td>
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<tr>
<td>2018</td>
<td>768 Barcodes</td>
<td>AgriSum 1.0</td>
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<tr>
<td>2019</td>
<td>1152 Barcodes</td>
<td>AgriSum 2.0</td>
<td>Canine &amp; Feline Parentage</td>
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<tr>
<td>2020</td>
<td>1536 Barcodes</td>
<td></td>
<td>Canine &amp; Feline Defects</td>
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</tr>
</tbody>
</table>
Balancing Mitochondrial and Genomics Sequencing Coverage in Targeted GBS Applications

Angela Burrell1, Hakan Sures1, Prasad Siddaravam2, and Rick Conrad1
1Thermo Fisher Scientific, 2130 Woodward Street, Austin, TX, USA, 78744.

ABSTRACT

The strategies we are taking to optimize sequencing of targets and allow for the maximum number of targets, the approach we are testing and the results achieved.

Versatile, Robust, Low Cost Genomic DNA Extraction Solution for Use Across Multiple Sample Types and Downstream Genomic Platforms

Hoang1, Quoc1; Manley1, Lillian; Gunter1, Calvin; Chadarang1, Srinivas; Patil1, Mohini A.; Lei1, Tao; Conrad1, Rick
1Thermo Fisher Scientific, 2100 Woodward St, Austin, TX 78701
2Thermo Fisher Scientific, 3460 Central Expressway, Santa Clara, CA, 95051

ABSTRACT

The sample types we are using and the protocols we are using to extract DNA from these types. We have tested the effectiveness of the protocol in downstream applications.

A flexible automation solution for genotyping by sequencing in plant breeding to maximize sample throughput

Michelle S. Swinley, R. C. Willis, A. Burrell and R. Conrad, Thermo Fisher Scientific, 2130 Woodward Street, Austin, TX, USA, 78744

ABSTRACT

We have developed a fully integrated approach to increasing genotyping capacity by sequencing in plant breeding. This approach allows for the rapid and efficient analysis of large numbers of samples, thereby maximizing throughput.

RESULTS

The results we have obtained from using the automation solution in plant breeding. We have demonstrated the effectiveness of the approach in increasing genotyping capacity.

Additional Information:: Posters & Booth

PO0121

PE0122

PO0061
Applied Biosystems™ QuantStudio™ 6 and 7 Pro Real-time PCR Systems
Real-Time PCR Applications

Real-time PCR is used for **sensitive, specific detection** and **quantification** of nucleic acid targets. We have developed powerful assay design algorithms, optimized master mixes, intuitive data analysis software, and flexible instrumentation to help harness the power of qPCR across a rich and diverse set of applications:

- Plant sciences and agricultural biotechnology
  - Gene expression
  - Genotyping
  - Copy number variation
- Food/waterborne pathogen detection
- Infectious disease research

…and many more!
QuantStudio 6 and 7 Pro Real-time PCR Systems
QuantStudio 6 and 7 Pro Real-time PCR Systems

Innovative technology to enable smart qPCR workflow for greater productivity

- **Smart qPCR workflow**—ultimate traceability to reduce manual errors and hands-on time
- **Hands-free operation**—greater ease and convenience
- **Smart Help**—maximum uptime and convenience
- **Format flexibility**—interchangeable blocks (96-well; 384-well and TaqMan Array card)
- **Automation compatibility**—Ability to run plates 24/7 with no manual intervention
RFID-taged qPCR Plates For Reduced Human Error And Time Saving

**Standard workflow**

- Go to TaqMan Files download page
- Enter sales order information
- Download AIF to USB drive
- Transfer files to your computer
- Upload plate layout/ assay information to template file
- Start run

**Smart qPCR workflow**

- Load RFID tagged-plate
- Start run

**RFID tag contains:**
- Plate layout – Assay IDs in each well
- Plate type
- Expiration date
- Catalog number
- Lot number
- Reaction volume per well
- Passive reference dye
- Thermal protocol

**Ultimate traceability, quality and ease of use**
Minimize Downtime With Smart Help and Smart Remote Support

- Can send eds and/or log files to tech support *directly from the instrument*
- No need to manually obtain files and then e-mail to technical support for troubleshooting
- After reviewing files, technical support will get in touch with specific next steps
- Troubleshoot with augmented reality remote support

Improved uptime with quick, efficient access to technical support without the need to download files
Benefits

- Motorized block-change design for greater ease
- Smaller, lighter block/heated cover with grip and storage box for convenience
- Veriflex zones for faster optimization of assays (3 zones for the 6 Pro and 6 for the 7 Pro)

Allows maximum flexibility with qPCR formats
**Thermo Scientific™ Orbitor® RS2 Microplate Mover**

- Integrate with QuantStudio 7 Pro systems for scalability
- Random or sequential access for plates: Flexibility in setup and operation
- Collision detection/recovery and plate sensing: Safe operation and eliminates plate dropping

**Applied Biosystems™ PowerUp™ SYBR™ Green master mixes**

- Dual-lock for exceptional specificity
- Allows up to 72 hour benchtop stability
- Includes heat-labile UNG and a blend of dTTP/dUTP for carryover contamination control

**Enable 24/7 Operation With Our Robot And qPCR Master Mixes**

Allows the ability to process large numbers of samples, 24/7 with minimal hands-on time
Review Data Easily With Customized, Content-Driven Configuration

Customize your own layout to see the plate grid, the result table, and the plots the way you want to see it – reducing learning curve

Automatically identify problematic data based on a set of criteria defined by the experimental design – simplifying data interpretation for fixed content
Transition Your Experiments Seamlessly to QuantStudio Pro

Equivalent performance to Applied Biosystems QuantStudio Flex, ViiA7 and 7900 HT Real-Time PCR Systems

• Relative Quantitation

Similar ΔΔCq directionality and magnitude across all 3 platforms tested

• Discrimination

Distinct clusters indicating 2-fold and 1.5-fold discrimination on QuantStudio 7 Pro system with 99.9% confidence, equivalent to other platforms

Data courtesy of Research and Development
We enable our customers to make the world healthier, cleaner and safer
Investing and Driving Agrigenomics Forward

Drivers of Innovation: Shantanu Kaushikkar, Prasad Siddivattam, Christie Fekete

Dr. Patrick Cumbie, PhD, Manager, Pine Development ArborGen

Applying genomic tools to loblolly pine: Adding value to our germplasm and our products

Dr. Andrew Cromie, Technical Director Irish Cattle Breeding Federation (ICBF)

Utilizing genomics to address global challenges facing our agrifood industry

Dr. Ivan Schuster, Ph.D. Genetics and Breeding

Molecular breeding is a powerful approach to accelerate genetic gain, the final target of plant breeding