appliedbiosystems

Agrigenomics solutions

Your partner for smarter agrigenomics—
solving challenges together

ThermoFisher
SCIENTIFIC

Our commitment to you

We're dedicated to partnering with you to find the right solution for your needs. Whether you're looking to streamline marker-assisted breeding programs or perform accurate genomic evaluations, we provide simple, scalable, and affordable solutions that help agricultural scientists accelerate their research programs. Our comprehensive portfolio of Thermo Scientific™, Applied Biosystems™, Invitrogen™, and Ion Torrent™ products and services offers an unmatched combination of innovation, convenience, affordability, and support.

Contents

Leading-edge solutions tailored for you to address today's agricultural challenges

Unprecedented population growth, urbanization, and climate change are contributing to an increasingly complex and dynamic agricultural landscape. You are striving to improve productivity and efficiency to meet the world's growing food supply demands. Implementing a breeding program to meet these challenges requires a significant investment of time, resources, and budget. That's why having the right partner can give you that competitive advantage to succeed in today's market.

With over 20 years of agrigenomics experience, we have a proven track record of collaborating with agricultural industry and researchers to understand their specific needs and tailor a pathway to success that is cost-effective and delivers the right results for projects big, small, or anywhere in between. With a comprehensive portfolio of solutions and a superior service and support structure, we're here to put the power of agricultural genomics in your hands.

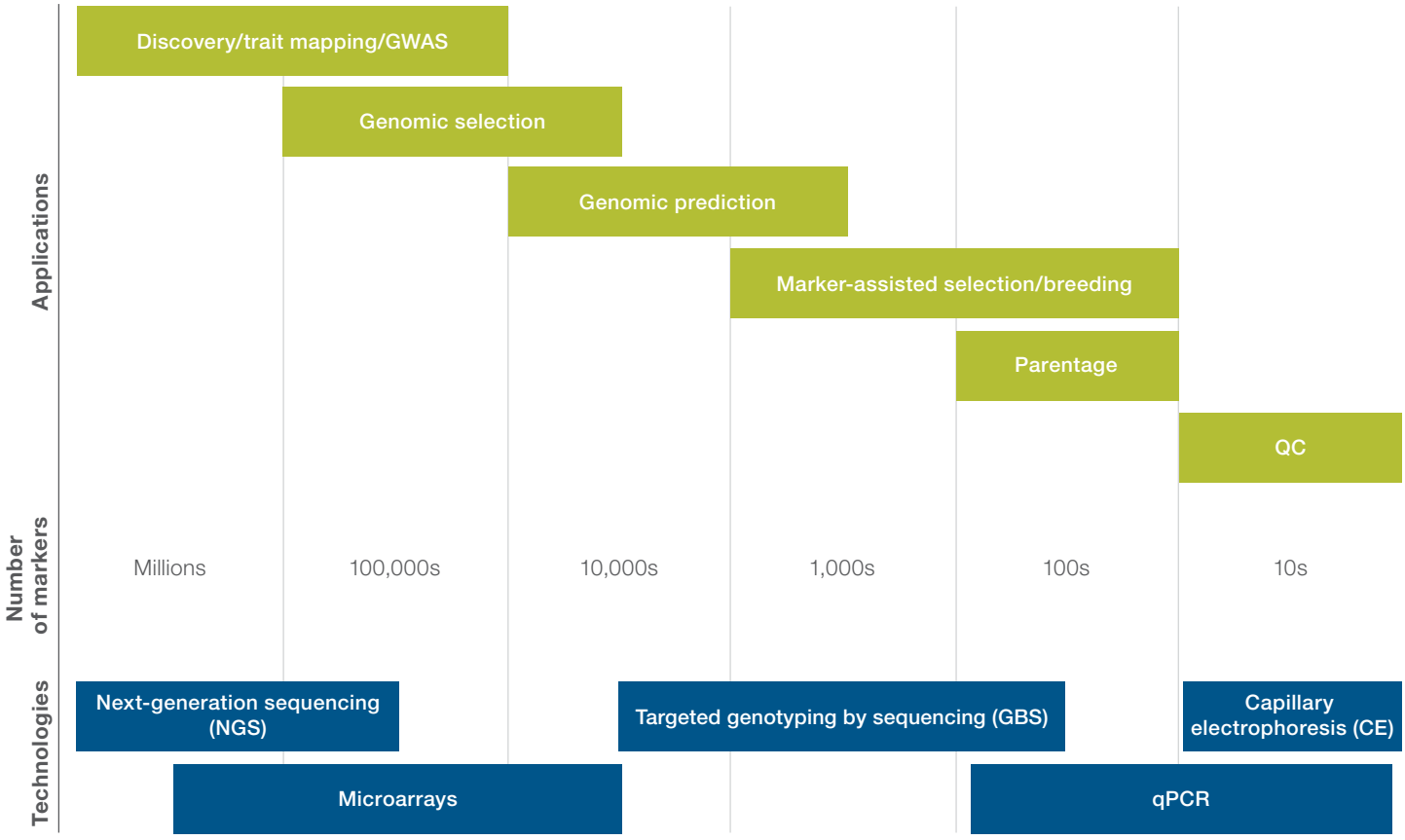
Overview of our comprehensive portfolio of solutions supporting agrigenomics applications

A breadth of state-of-the-art platforms to suit your molecular breeding needs

Our family of brands offers a wide range of technologies to facilitate molecular breeding and functional genomic efforts. Selecting an appropriate technology is largely driven by the throughput need of the researcher and the number of markers being interrogated. The charts below provide a high-level representation of the different technologies we offer for your genotyping projects.

Each technology has been designed for maximum accuracy, robustness, and compatibility across varied plant and animal workflows. Whether you need to discover new genetic variants through *de novo* genomic sequencing, confirm identify of a few markers across a large number of samples, or do anything in between, our extensive portfolio of instruments and consumables can help you get there quickly and efficiently.

Overview of genotyping solutions for molecular breeding workflows.



Genome sequencing

Ion Torrent next-generation sequencing systems

Genome sequencing allows researchers to uncover the genetic makeup of plants and animals and discover new important markers for agricultural studies. Advancements in Ion Torrent™ semiconductor sequencing are improving the simplicity and cost-effectiveness of sequencing, whether it be for genome sequencing or for exome, transcriptome, or targeted resequencing applications. Our integrated suite of next-generation solutions, including the Ion GeneStudio™ S5 and Ion Chef™ systems, enables accurate results with industry-leading speed and affordability.

Key features include:

- Automated template preparation and chip loading
- Cartridge-based reagent system
- Up to 130M reads per chip
- 2.5–4 hour sequencing run time
- Simplified NGS data analysis with end-to-end bioinformatics solutions

Ion Chef System

Ion GeneStudio S5 System

Find out more at **thermofisher.com/genestudio**

SeqStudio Genetic Analyzer

Same workflow, same trusted technology—now with an innovative all-in-one cartridge that reduces setup time from hours to minutes. The new Applied Biosystems™ SeqStudio™ Genetic Analyzer is a low-throughput, easy-to-use, and convenient benchtop system that delivers gold-standard Sanger sequencing and fragment analysis with just a simple click. It is easily used across a broad range of applications as well as multiple users.

SeqStudio Genetic Analyzer

	Convenient and easy-to-use cartridge system includes the capillaries, polymer, and buffers required for each run
	Combine Sanger sequencing and fragment analysis reactions in the same instrument run
	Fast turnaround with a run time as low as 30 minutes
	Set up and monitor your runs; view, manage, and share your data from anywhere, using your phone, tablet, or PC or Apple™computer*
	In-lab application training will get you up and running quickly
	Secondary analysis software package included with system purchase

* Internet connection and Thermo Fisher™ Cloud account required.

Find out more at **thermofisher.com/seqstudio**

Microarrays

Our portfolio of array-based genotyping and expression solutions, for applications ranging from genome-wide analysis to routine screening, delivers high accuracy and reproducibility. Our solutions also offer a straightforward workflow, and low cost per sample.

Affordability

- Cost-effective genotyping and expression tools to identify, validate, and screen complex genetic traits in plants and animals

Simplicity

- Consolidate multiple applications under a single technology platform
- Easy-to-use, simple workflow
- Enables accurate answers in a few hours

Flexibility

- High-throughput tools for low- to high-density genotyping applications and genome-wide gene expression analysis
- An assay for genotyping of all relevant markers of interest
- Low sample volume commitment

Robust assays

- Start genotyping with only 7.5–10 ng/µL of gDNA from a variety of sample types
- Use as little as 100 pg of total RNA for expression analysis
- Compatabile with indels and candidate SNPs that have high GC content or interfering SNPs in the flanking sequences

The Applied Biosystems™ GeneTitan™ Multi-Channel Instrument is the only integrated and fully automated microarray processing system available for simple, flexible high-throughput genotyping analysis, and genome-wide gene and miRNA expression profiling.

Key features include:

- Automated target hybridization, washing, staining, and array scanning
- Flexible 16-, 24-, 96-, and 384-array plate formats
- 30 min of hands-on time
- Scalable workflows for medium- and high-throughput applications

Axiom genotyping solution

Accelerate phenotype–trait association and selection efforts with our robust technology

The Applied Biosystems™ Axiom™ genotyping solution offers:

Superior customization

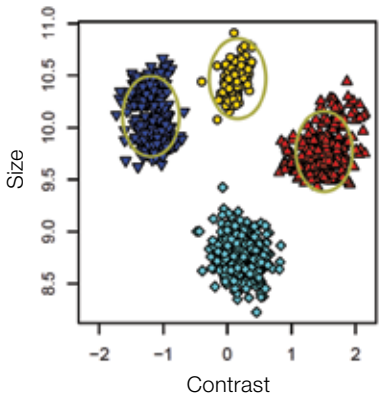
- Fully customizable content on multiple array formats
- Multispecies capability, with no limit on the species or number of markers per species
- Axiom™ 384HT and Mini-96 format arrays are ideal for breeding programs that need high-throughput and flexible solutions

Consistency and ease of use

- Axiom arrays offer up to 100% manufacturing fidelity with no dropped SNPs, so all of your designed markers are on every array
- Axiom™ Analysis Suite and microarray analysis algorithms provided as command-line tools, offering ease of analysis across multiple platforms
- Fully automated cluster and genotype calling on diploid and polyploid species

Efficiency and speed

- Receive your custom array in less than 6 weeks after finalizing the content, and reorder arrays in as few as 2 weeks



The Axiom automated genotype clustering and genotype assignment algorithm automatically classifies the markers into six different categories for ease of visualization and analysis. This cluster plot represents the off-target variant category.

Access custom and expert designs for your species of interest

Select from our diverse catalog of genotyping arrays, or get experienced advice on array design and support. We work with you to understand the goals and objectives of your breeding program or research when designing your Axiom arrays. This is one way we've enabled industry, consortia, and academic institutions to advance the use of genomics in agriculture and to address global food security.

- Axiom aquaculture arrays have allowed scientists to integrate genomic technologies into aquaculture breeding programs for a variety of species such as salmon, tilapia, catfish, sea bass, herring, carp, sea lice, and trout
- Axiom genotyping arrays are used for genotyping a variety of diploid and polyploid species, including sugarcane, wheat, rapeseed, strawberry, citrus, pear, and trees with very large genomes such as pine and cedar
- Axiom animal genotyping arrays have been developed by partnering with scientists and breeders from various academic institutions and consortia to design multiple arrays for a diverse set of animals

"Development of SNP arrays and automated genotyping in Atlantic salmon is complicated by the autotetraploid whole genome … the unparalleled design support and expertise from [your] bioinformatics scientists helped tremendously to cope with these obstacles."

Dr. Sigbjørn Lien
Professor and Assistant Director
Norwegian University of Life Sciences (NMBU)
and Centre for Integrative Genetics (CIGENE)

Find out more at **thermofisher.com/microarrays**

Targeted genotyping by sequencing

Targeted genotyping by sequencing (GBS) is the latest innovation in genomics-assisted breeding programs. Targeted GBS uses a powerful multiplexed approach that enables users to interrogate large panels of markers across hundreds to thousands of samples simultaneously. The table below highlights the differences between our Applied Biosystems™ AgriSeq™ and Eureka™ technologies as approaches to targeted GBS. Each technology has simple, high-throughput workflows to deliver consistent genotyping calls for markers of interest. Key differences between the two technologies include sequencing chemistries and the ability to discover new variants.

Applications

- Evaluating population structure
- Parentage and traceability
- Marker-assisted selection and breeding

	AgriSeq genotyping solution	Eureka genotyping solution
Requires Ion Torrent instrument	Yes	No
SNPs per panel	50–5,000	50–3,000
Ability to discover new variants	Yes	No
Expected call rates*	~95%	~95%
Processing time	2 days	2 days
Panel design	2–6 weeks for custom panel design	Up to 12 weeks
Sample throughput/week	22,500†	Up to 20,000**
Cost per sample	Low	Low

* Depends on level of genome annotation.

** Based on panel size with one instrument and one technician.

† Requires additional barcodes.

AgriSeq targeted GBS solutions

The AgriSeq targeted GBS solution allows for high-throughput analysis of plant and animal genotypes in a flexible and cost-effective manner. Leveraging a highly efficient multiplex chemistry, hundreds to thousands of genetic loci can be simultaneously targeted and efficiently amplified in a single reaction. Libraries are then processed for next-generation sequencing (NGS) where hundreds of samples can be barcoded and sequenced in the same run. Capable of generating up to 2.6 million genotypes per day from high-quality next-generation sequencing data at pennies per data point, AgriSeq targeted GBS represents the future of technology to help advance your plant and animal research.

Customized panels designed to target your relevant markers

AgriSeq chemistry is designed for analysis of panels ranging from 50–5,000 markers. We have a dedicated team of agrigenomic bioinformatics professionals who have designed hundreds of successful panels for organisms ranging from corn and cattle to soybean and salmon, and much more.

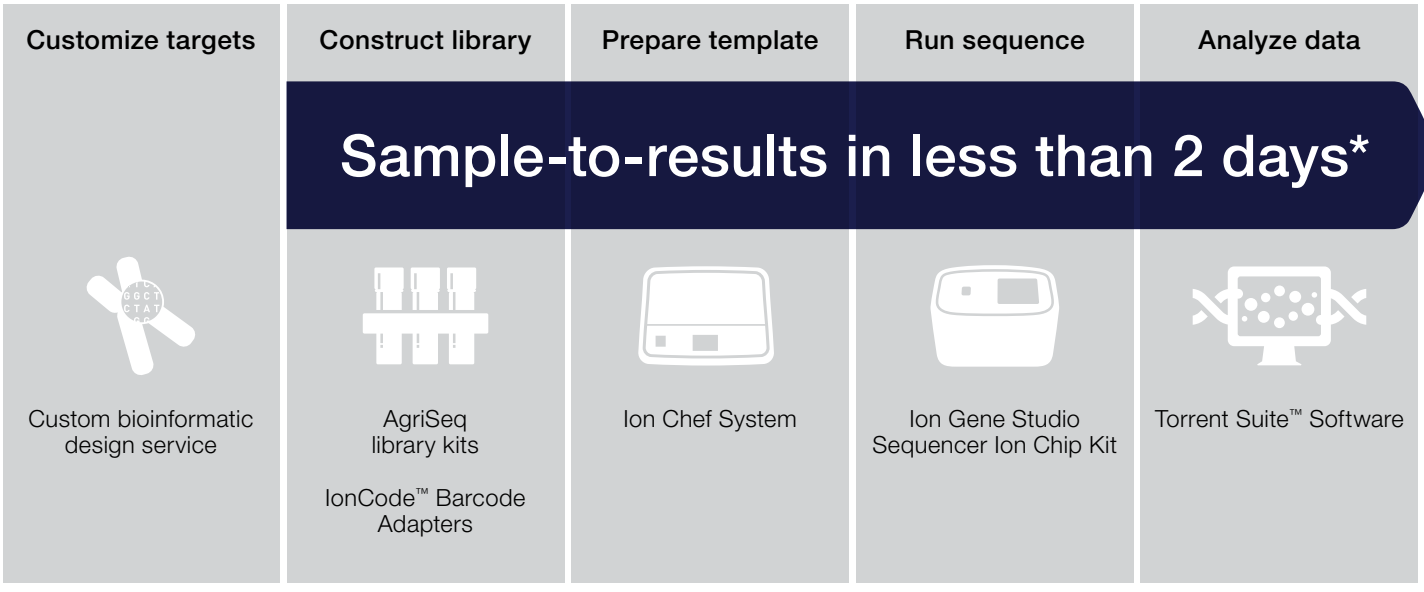
Consistent performance across samples with high marker call rates

Unlike other nontargeted GBS approaches (e.g., RAD-Seq) that can be susceptible to variable performance and missing data between samples, AgriSeq GBS consistently generates high marker call rates across diverse sample sets. For well-designed panels such as the Applied Biosystems™ Bovine ISAG SNP parentage panel (2013), >98% marker call rates can be achieved with >99% concordance with orthogonal technologies.

Fast workflow for cost-effective high-throughput genotyping

The AgriSeq workflow is simple, taking ~2 days from sample to results, including library prep, automated template preparation, sequencing, and data analysis. Up to 1,536 samples can be processed per day with only a few hours of hands-on time. The system is also flexible for users who wish to use larger panels and fewer samples. With low all-inclusive sample prices and specific targeting of your most relevant markers, AgriSeq technology is an economical way to generate high-throughput genotyping data for plant and animal research.

The 2-day AgriSeq GBS workflow.



* Automated template preparation on the Ion Chef System is performed overnight to achieve a 2-day workflow.

Eureka genotyping solution

Traditional GBS techniques only target genomic regions or genes, leaving a susceptibility to SNP dropouts, lower throughput, higher sequencing costs, and reduced control of sequencing cycles. The Eureka genotyping solution overcomes these problems by enabling the targeting of specific markers on the chromosomes.

Flexibility

The Eureka genotyping solution includes custom Eureka™ myDesign™ genotyping panels, which are designed using customer-provided markers. Alternatively, you can order catalog Eureka™ genotyping panels, designed with publicly available markers in combination with the Eureka library prep reagents. The assay can interrogate biallelic SNPs and indels of any size, from diploid or polyploid species.

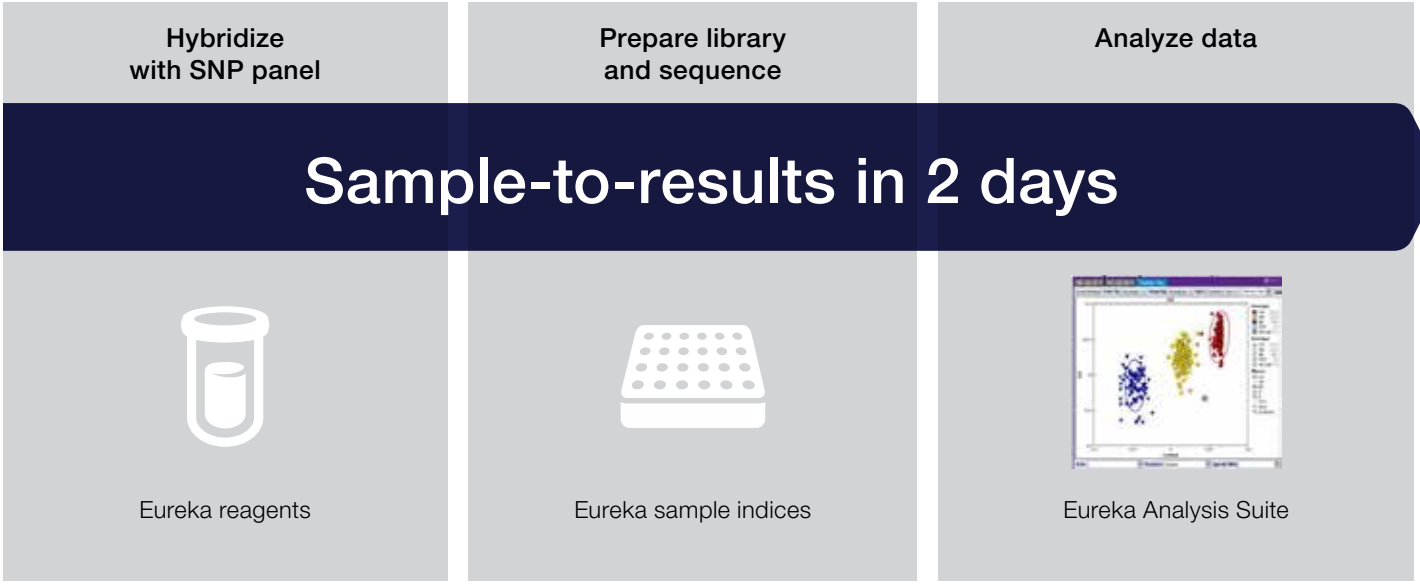
Simplified, automated analysis

The Applied Biosystems™ Eureka™ Analysis Suite simplifies the analysis of samples that have been processed using GBS. Calculation, genotyping analysis, and viewer functionalities in a single software package help reduce time-to-results.

Key features include:

- Up to 20,000 samples per run
- Two-day assay
- Multiple marker types: biallelic SNPs and indels of any size
- Multiple sample types: crude lysate, hair follicles, dried blood spots, buccal swabs, semen straws and dots, degraded DNA, and leaves

The Eureka solution can genotype up to 20,000 samples from gDNA to data in a single 2-day run.



Real-time PCR

Genotyping by qPCR

Genotyping by real-time PCR is a well-known and reliable approach that is used widely in both research and industrial settings for the confirmation of SNPs and to screen panels of markers in hundreds or even millions of samples. We offer real-time PCR instruments, Applied Biosystems™ TaqMan® Assays, and reagents that are designed to generate reliable results for validation and screening.

QuantStudio real-time PCR systems

The Applied Biosystems™ QuantStudio™ family of real-time and digital PCR systems offers superior flexibility, connectivity, speed, and precision. Contact a sales representative to personalize a solution to meet your needs, or use our online product configuration tool to easily configure the QuantStudio system that's best for you.

Overview of the Applied Biosystems workflow for genotyping by qPCR

Prepare samples	Select assays	Set up reactions	Run PCR	Analyze data
We provide multiple solutions to isolate and purify DNA. The Applied Biosystems™ DNA Extract All Reagents Kit provides PCR-ready DNA from a wide variety of samples in about 5 minutes.	Choose from predesigned or custom assays for a wide variety of applications. Assays are available in single tubes, 96- and 384-well plates, 384-well microfluidic cards, and TaqMan® OpenArray™ plates.	Prepare a reaction plate using TaqMan Assays and TaqMan® ProAmp™ Master Mix, along with your DNA samples. No additional reagents required.	Amplify DNA and achieve allelic discrimination by running the PCR reaction on an Applied Biosystems™ real-time PCR system and/or thermal cycler.	Analyze and interpret real-time PCR data with intuitive software tools including TaqMan® Genotyper Software or our cloud-based Genotyping app available on Thermo Fisher Connect.

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Custom TaqMan SNP Genotyping Assays

These assays provide a highly flexible technology for detection of polymorphisms within any genome. Create your own assays by submitting target sequences to our secure assay design pipeline using the Applied Biosystems™ Custom TaqMan® Assay Design Tool. This pipeline has successfully generated millions of assay designs by utilizing heuristic rules deduced from both manufacturing and assay performance data. TaqMan Assays can be run on any of our real-time PCR instruments or used as an endpoint assay on other third-party systems, including the Array Tape™ platform.

TaqMan Gene Expression Assays

In addition to custom design options, we offer Applied Biosystems™ TaqMan® Gene Expression Assays that are predesigned for a wide variety of agricultural species, including soybean, corn, rice, wheat, cattle, pig, sheep, goat, and chicken. TaqMan® chemistry remains the gold standard for gene expression analysis.

TaqMan Sample-to-SNP Kit

The Applied Biosystems™ TaqMan® Sample-to-SNP™ Kit contains DNA Extract All lysis reagents, which allow preparation of PCR-ready DNA from a wide variety of plant tissues, typically in 5 minutes. The kit also contains Applied Biosystems™ TaqMan® GTXpress™ Master Mix for robust PCR amplification of extracted DNA, typically in less than 50 minutes.

Together, the custom TaqMan SNP Genotyping Assays and QuantStudio systems provide the flexibility and throughput you need for your project. Contact your sales representative to discuss your needs. Find out more about plant and animal analysis by qPCR at **thermofisher.com/agrigenomics**

Capillary electrophoresis and STR analysis

Animal STR genotyping kits

Short tandem repeat (STR) loci, or microsatellites, are a class of nuclear DNA markers consisting of tandem repeated sequence motifs of 2 to 7 base pairs in length. Alleles of STR loci vary by the number of times a specific sequence motif is repeated. STR alleles are detected using PCR and electrophoretic separation of amplification products. Due to their high level of informative polymorphism and Mendelian inheritance, STR loci have become the markers of choice for parentage testing and individual identification.

We offer several animal STR genotyping kits for bovine, canine, and equine parentage. These kits contain all the reagents necessary for multiplex amplification of target STR loci, including PCR master mix, fluorescently labeled primer pools, and a control DNA. When multiplex PCR reactions are completed, amplification products are separated and analyzed in a single injection using an automated capillary electrophoresis instrument. Markers in these kits are based on the recommendations set by the International Society of Animal Genetics (ISAG) and have been preoptimized to perform robustly for signal height and allele discrimination.

Key features include:

- Simple, fast workflow that can be completed in <1 day
- Accepted, ISAG-approved markers for animal parentage
- Easy interpretation of allele calls
- Economical, fit-for-purpose approach

Nucleic acid isolation for plants and animals

Performance in downstream applications is often influenced by the quality of the starting nucleic acid being analyzed. We offer kits for purifying genomic DNA from a variety of plant and animal samples. Our portfolio includes a broad range of technologies that are optimized for different features, such as sample type compatibility, speed and throughput, and performance across varying applications. We have several products that can address the unique challenges of isolating DNA from plants with abundant phenolics and carbohydrates that can inhibit downstream reactions, including the Applied Biosystems™ MagMAX™ Plant DNA Isolation Kit, which can be easily automated on Thermo Scientific™ KingFisher™ magnetic particle processors without the need for phenol/chloroform extraction or alcohol precipitation.

We also offer an expansive portfolio of kits, reagents, and devices for the isolation, purification, analysis, and quantitation of genomic DNA from plants and animals, as well as total RNA, mRNA, and microRNA.

Features of recommended nucleic acid preparation kits for agrigenomic applications.

Product	Plant DNAzol Reagent	PureLink Genomic DNA Mini Kit	PureLink Genomic Plant DNA Purification Kit	DNA Extract All Reagents Kit	MagMAX DNA Multi-Sample Ultra 2.0 Kit	PureLink *Pro* 96 Genomic DNA Purification Kit	MagMAX Plant DNA Isolation Kit
Recommended for plant samples	√		√	√		√	√
Recommended for animal samples		√		√	√	√	
High throughput–compatible	No	No	No	Yes	Yes	Yes	Yes
Isolation method	Organic extraction	Silica spin column	Silica spin column	Lysis solution	Scalable, flexible format with magnetic beads	Filter plate	Scalable, flexible format with magnetic beads
Compatible applications	Cloning, qPCR, sequencing	Cloning, qPCR, sequencing, genotyping	Cloning, qPCR, sequencing, genotyping	qPCR	Cloning, qPCR, sequencing, genotyping	Cloning, qPCR, sequencing, genotyping	Cloning, qPCR, sequencing, genotyping
Prep time	60 min	15 min	40 min	5 min	60 min	35 min	40 min

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