

White Paper:
Study Reveals Profound
SNP Genotyping Results
on **Array Tape™** Platform

Market Situation

Douglas Scientific has achieved a significant position among high throughput screening laboratories in the ag biotech market with its laboratory automation system optimized for Array Tape™. During the past several years, Douglas Scientific clients have noted profound improvements, cost savings, and rapid return on investments related to the platform. However, due to the proprietary nature of the client processes, chemistries, automation, and plant genetic research in each of the laboratories, it has been difficult for Douglas Scientific to publish specific laboratory outcomes such clients have achieved with the Array Tape™ platform.

Research Methodology

In an effort to bring information to its prospective markets, Douglas Scientific embarked on a research project to amass composite outcomes and data from a number of its laboratory clients in ag biotech, all performing similar SNP genotyping, while respecting the proprietary nature of their operations and genetic testing. Douglas Scientific contracted with Dr. David Vaske to oversee the study and prepare the results. Dr. Vaske holds a Bachelor's Degree in Chemistry and a Doctorate in BioChemistry from North Dakota State University. Dr. Vaske has over 15 years experience managing high throughput genotyping laboratories.

This study does not convey data from any singular or named facility, yet will be directional to scientists and laboratory automation professionals evaluating the merits of Array Tape™ for their various applications.

Profile of Researched Laboratories

- Genotyping Laboratories of Global Plant Genetic Companies
- U.S. Laboratory Locations
- Supporting Global Plant Breeding Initiatives
- Labs Were Typically Operational Eight hours per Day
- Performing More than 20 million SNP Genotypes per Year
- Results were Derived from a Single Nexar™ and Araya™ Instrument in Each Lab

Common Laboratory Goals Associated with Douglas Scientific Platform

Although the laboratories observed in the research were part of diverse ag biotech companies, they had several common goals that are summarized herein. These facilities shared a common function to generate SNP genotype data to support global molecular plant breeding and product development. All of the laboratories were expected to increase SNP genotyping throughput while reducing associated data point costs with new technology platforms. In some cases, the technologies needed to address the projected SNP genotyping demand were to be funded from the actual, realized cost savings from the new platform.

The projected SNP genotyping demand, combined with capital budget constraints, dictated that any new platforms must sharply reduce SNP genotyping costs. The Douglas Scientific Nexar™, Araya™, and Array Tape™ platform were implemented in that context. The Douglas Scientific platform was compared to outcomes from existing legacy platforms, and in some cases relative to new alternative platforms also being evaluated. In all cases, the Douglas Scientific system delivered profound outcomes.



Summary of Laboratory Goals and Outcomes

Common Laboratory Goals	Laboratory Results
Increase SNP genotyping throughput	Increased SNP genotyping throughput by 10-fold
Reduce laboratory processing costs significantly	Decreased SNP genotype costs by 70 - 90%
Utilize existing SNP genotyping chemistry	Existing chemistry platforms were maintained
Increase throughput without adding staff	Reduced lab staffing by more than 60%
Maintain existing turnaround time	Improved turnaround time
Achieve a return on investment that would justify a platform change and meet genotyping demand	Savings paid for a \$700K investment in three to six months



The Nexar™ is a modular, high throughput fluid dispensing instrument configured per laboratory customer to accommodate process and results.

Composite Outcomes Realized by Laboratory Scientists

Increased Daily Throughput

The legacy laboratory processing systems in use relied on automation for extensive microtiter plate handling, with various technologies surrounding those movements. Although, the movement was needed due to the singularity and profile of the plate media, the robotic workstation presented significant throughput limitations in contrast to the continuous, inline movement of Array Tape™.

The first observed limitation was workstation speed. There are a finite number of plate movements that can be completed in a set time. While utilizing the Douglas Scientific system and continuous Array Tape™, daily throughput was dependent primarily on the factor of the Nexar™ speed.

The second limitation was related to the microtiter plate geometry. There are a maximum number of plates that can be loaded into a waterbath thermocycler to conduct polymerase chain reaction (PCR).

As such, daily throughput with microtiter plates was a function of several factors, including: workstation speed, waterbath capacity per processing cycle, and run time on the waterbath thermocycler.

As a result, findings showed that with the Douglas Scientific system using Array Tape™, a large number of arrays were run on a single waterbath cycle because the thermal mass of Array Tape™ is a fraction of the mass of a 384-well microtiter plate. The low mass and thin walls of the Array Tape™ also allowed for very rapid temperature changes, a key PCR process advantage noted by laboratory scientists.

On the average, the SNP genotyping labs were able to increase their throughput from about 150 microtiter plates per day in a 384 well format to 400 arrays per day on tape in a 384 well format using the Douglas Scientific system. The labs were able to structure dispensing process to align with waterbath timing, which provided further throughput advantages. The labs were able to nearly triple the data points processed in less time compared to existing platforms.

	Plates per Day	Datapoints per Day	Lab time to process
Microtiter Plate Solution	150	57,600	10 hours
Array Tape™ Solution	400	153,600	8 hours

Significant Chemistry and Consumable Savings

The Douglas Scientific Array Tape™ solution demonstrated true reaction scalability in the test group of laboratories. Array Tape™ well geometry in the laboratories was optimized for small volume SNP genotyping reactions, usually at 800 nL or lower. This fluid volume was in stark contrast to microtiter plates where the minimum practical reagent volume was ~5uL in a 384 well plate. These reaction volumes led to significant reagent cost savings.

Array Tape™ and seal tape were also shown to be a fraction of the cost of a quality 384-well PCR plate and seal. These two consumable factors – reagent volumes and tape cost savings – contributed to a profound reduction in laboratory process costs and a rapid return on investment.

	Plates per Day	Individual Plate and Seal Cost	Daily Plate and Seal Cost	Reaction Volumes	Daily Reagent Cost*	Daily Operational Cost
Microtiter Plate Solution	150	\$3.50	\$525	5 uL	\$8,640	\$9,165
Array Tape™ Solution	400	\$2.25	\$900	800 nL	\$3,686	\$4,586

* At a reagent cost of \$0.03/uL

Other Notable Savings

The footprint of a typical high throughput automated workstation in these laboratories was anticipated to become a considerable cost factor. Even for those facilities without current space constraints, the projected increase in screening volumes would create constraints without miniaturization of their existing platforms.

The Douglas Scientific Nexar™ and Araya™ system addressed this reality with an attractive alternative. The complete Nexar™ footprint is approximately 2.5 feet wide by 8 feet long. As such, a single Nexar™ instrument replaced multiple robotic workstations and freed up valuable laboratory space. Likewise, in one laboratory, a single Araya™ scanner replaced two competitive readers that were unable to meet the throughput speeds of the Nexar™. The Araya™ retained ample capacity for additional throughput.

Additional Information

If you would like more information about these findings or to arrange a site visit or teleconference with laboratory scientists participating in this study, please contact Douglas Scientific.



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