



Analytical Research Laboratories headquarters in Napier, New Zealand

## First NexION 300 in New Zealand Showcases the Expertise of Analytical Research Laboratories to Better Serve the Agricultural Community

The agricultural industry traditionally represents only a small percentage of all inductively coupled plasma mass spectrometers (ICP-MS) being used today. Laboratories performing agricultural-type analysis typically only require the detection capability of either flame atomic absorption (FAA) or inductively coupled plasma optical emission spectroscopy (ICP-OES) to carry out their trace metal determinations. And if on the rare occasion that ultra-trace element detection limits are

required for some analytes, single-element graphite furnace atomic absorption (GFAA) or hydride generation is sufficiently sensitive. However, with the growing demand for lower levels of trace metals in plant materials, soils, and groundwater samples, driven by environmental concerns, both AA and ICP-OES struggle to supply the answers. ICP-OES has the sample throughput capability, but is not sensitive enough, while GFAA can achieve the levels, but is very slow and labor intensive to set up and run the methods. It is therefore clear that laboratories serving the agricultural sector must invest in state-of-the-art trace element analytical capabilities like ICP-MS to keep up with the growing demands of their clients, particularly in parts of the world where the agricultural industry has a significant impact on a country's economy.

One such company that has realized the importance of having cutting-edge technology is Analytical Research Laboratories (ARL) Ltd.,<sup>1</sup> a division of Ravensdown Inc., the large farmer-owned fertilizer and farm input cooperative, headquartered in Christchurch, New Zealand.<sup>2</sup> Based in Napier, ARL offers a fertility management service to the Australasian farmers in order to help them maximize the use of farm input materials, such as fertilizers, to enhance pasture and agricultural crop yields. This includes a complete panel of tests on the plant material as well as a full analysis on the soil and water supply. In existence since 1986, the company has gained the reputation of being the leading laboratory in New Zealand servicing the agricultural community.

Over this time period, it has successfully been supporting its customers' chemical analysis requirements, including trace element determinations using various atomic spectroscopic techniques. However, with the increasing workload, combined with the need to offer lower levels of detection, it has realized its current technology of ICP-OES, ultrasonic nebulization, hydride generation and atomic absorption was not adequate for many of the analytes. For example, to provide a more complete picture of the nutrient content of pasture grass, the elements P, K, S, Mg, Ca, Na, Fe, Cu, Zn, Mn, B, Mo, Co and Se need to be determined. Some of the elements such as molybdenum, cobalt and selenium are present at sub-part per million (ppm) levels in the grass. When the sample has gone through the sample preparation process using microwave digestion, this often translates into very low-ppb levels in solution – not easy for FAA and ICP-OES to determine with good accuracy and precision.

For that reason, ARL decided to invest in a new ICP-MS system. They were totally new to the technique, so besides evaluating the different commercial designs, they also had to get educated about the real-world capabilities of the technique. It took them about 18 months to go through the selection process but finally came to the conclusion in September, 2010 that PerkinElmer's NexION® technology best fitted their needs. In the words of Michael White the ARL Laboratory Manager, who led the selection process, together with colleagues Gary Glenn, the QC Manager and Peter Lorentz, the Technical and Business Development Manager:

*"It took us a very long time to evaluate the marketplace. While we were testing some of the other instruments, PerkinElmer introduced the NexION technology. We were very impressed with the design of the instrument, but were a little concerned about investing in brand new technology. However, it wasn't the performance of the instrument that caught our eye, it was the ease-of-use and the fact that it required very little maintenance compared to the other instruments. The decision was not easy, but after careful consideration, we chose the NexION 300D ICP-MS."*

The instrument was installed in the middle of November, 2010 by Gavin Robinson of Robinson Scientific, the local PerkinElmer dealer in New Zealand. Even though the actual installation was finished in a few days, it took the operators a few weeks to get familiar with the operation of the instrument. With a lot of hard work and dedication, their first major task was to validate a method for analyzing plant tissues. They successfully completed this by mid December, only four weeks after the instrument was commissioned.

In fact, during the validation of the plant tissues, ARL experienced maintenance issues with their two existing ICP-OES instruments. For that reason, they took the opportunity to fast track the method development for the analysis of soils by ICP-MS. Gary Glenn, the QC Manager, summed up the situation:

*"It is amazing how such an event will sharpen the mind, and get the whole team pulling together. Having the NexION 300, combined with the very dedicated team at ARL and the technical experts at Robinson Scientific, meant that our customers experienced the normal timely delivery of analytical results over the busy Christmas period."*

ARL has just about wrapped up the validation of ground waters and waste waters and are well on their way to developing routine methods for both soils and fertilizers. The objective is to enable a complete crossover from their ICP-OES instruments to the NexION ICP-MS for most routine methods. These will mostly be the lower level analytes, where the improved detection capability will offer significant benefits, such as in the determination of trace metals in plant materials and water samples. However, they are very hopeful that many of the other high-concentration elements such as phosphorus, sulfur, potassium, magnesium and calcium, can also be determined using the unique dual-stage detector of the NexION ICP-MS, which has the ability to extend the dynamic range and determine high-concentration metals in the same multi-element run as the ultra-trace levels. With this capability, they are now able to use a single microwave digestion to determine the full suite of elements in their plant tissue samples, without having to use any other additional techniques. The early work looks to be very promising,



ARL Manager Michael White, Technical & Business Development Manager Peter Lorentz and Quality Manager Gary Glenn with their NexION 300D ICP-MS instrument.

as they have recently developed a method to analyze all fifteen elements in plant digests in less than 1½ minutes utilizing a combination of standard mode together with collision cell and kinetic energy discrimination (KED) technology. It's also worth pointing out that they have achieved this very impressive sample throughput using the SC-FAST (Elemental Scientific Inc., Omaha, NE) automated sample delivery system<sup>3</sup> coupled to the NexION ICP-MS.

When ARL first evaluated the ICP-MS marketplace, they did not really understand the importance of routine maintenance, such as cleaning cones or replacing sample introduction components, because they had never used the technique before. However, now that they have run the instrument for a few months, they have a better appreciation of what this really means. So they are now experiencing first hand the significance of the NexION software that sends out alarms to remind the operator when it's time for simple preventative maintenance tasks, such as oil changes and tubing replacement. Or that the system will even display the number of hours of use of various components and suggest when they might need to be cleaned or replaced. This feature is a very important to them, as explained by Gary Glenn:

*"The ease by which servicing and preventative maintenance is performed, is very impressive. For example, to clean the first interface cone, we just use a soft cloth and water. Very occasionally, we have to remove the other cones to clean them. Other systems we evaluated took significantly longer to perform weekly maintenance tasks and were very complex in the cleaning process. In addition, the NexION software is very user friendly and helps to prevent operator mistakes."*

We know the NexION 300D ICP-MS is in very good hands at Analytical Research Laboratories. They have only had it a few months, but in a very short time, it has completely replaced their two ICP-OES instruments, an ultrasonic nebulizer, and hydride generation system for all their plant tissues, ground water and waste water samples. There is no question that it is their goal to be the leader in the very competitive world of agricultural contract analysis, by being at the forefront of analytical technology. This is very clear from their Mission Statement, which follows.

### ARL Mission Statement

To provide an unparalleled analytical service to our Australasian Agribusiness stakeholders through the provision of scientifically grounded results, state-of-the-art technology, uncompromised quality and individuals working with a common purpose.

We are very happy to be associated with such a professional organization and look forward to supporting ARL as they continue to grow.

For additional information, please refer to the following URL addresses:

1. Analytical Research Laboratories website:  
<http://www.ravensdown.co.nz/Services/ARL/Default.htm>
2. Ravensdown website:  
<http://www.ravensdown.co.nz/default.htm>
3. Elemental Scientific, Inc. website:  
<http://www.elementalscientific.com/products/SC-FAST.asp>

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