



Nuclear-based science benefiting all Australians

23 September 2015

Committee Secretary
House of Representatives Standing Committee on Agriculture and Industry

Via email: AgInd.reps@aph.gov.au

Dear Committee Secretary

Re: *Agricultural Innovation Inquiry*

Please find attached the Australian Nuclear Science & Technology Organisation's (ANSTO) submission to the *Agricultural Innovation Inquiry* of the House of Representatives Standing Committee on Agriculture & Industry.

We would like to thank the Committee for the opportunity to contribute to this important inquiry. Additionally, ANSTO is happy to provide a representative if invited to give evidence at a public hearing.

Please do not hesitate to contact me if the Committee has any questions regarding this submission.

Yours sincerely

Steve McIntosh
Senior Manager
Government and International Affairs

AUSTRALIAN NUCLEAR SCIENCE AND TECHNOLOGY ORGANISATION

New Illawarra Road, Lucas Heights (Locked Bag 2001, Kirrawee DC 2232) T +61 2 9717 3111 F +61 2 9717 9210
www.ansto.gov.au



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ANSTO Submission

House of Representatives Standing Committee on Agriculture & Industry: *Agricultural Innovation Inquiry*

The Australian Nuclear Science and Technology Organisation (ANSTO) is the custodian of Australia's operational nuclear science and technology expertise. As the operator of the OPAL nuclear research reactor, the Australian Synchrotron and the Centre for Accelerator Science, ANSTO is at the forefront of innovation for the benefit of public health, industry, agriculture and the environment in Australia. In addition to its world-class research capabilities, including partnerships and collaborations across Australia, ANSTO produces vital nuclear medicines which one in two Australians will rely on, in their lifetime, for the diagnosis and treatment of a range of diseases and cancers.

ANSTO thanks the House of Representatives Standing Committee on Agriculture and Industry for the opportunity to present a submission and notes the Terms of Reference provided for this inquiry:

The Committee will inquire into and report on the role of technology in increasing agricultural productivity in Australia. The inquiry will have particular regard to:

- *improvements in the efficiency of agricultural practices due to new technology, and the scope for further improvements;*
- *emerging technology relevant to the agricultural sector, in areas including but not limited to telecommunications, remote monitoring and drones, plant genomics, and agricultural chemicals; and*
- *barriers to the adoption of emerging technology.*

ANSTO notes that these terms of reference are strongly aligned with two of the Australian Government's recently announced National Science and Research Priorities:

- **Food (Science and Research Priority Number 1)**
- **Soil and Water (Science and Research Priority Number 2)**

ANSTO undertakes a wide range of research activities that relate to both the aims of the current inquiry and the National Science and Research priorities highlighted above. Of particular interest to the current inquiry is ANSTO's work in developing technologies that have the potential to improve the effectiveness and efficiency of Australia's agricultural sector. ANSTO's facilities are user-based and allow researchers from universities and a range of commercial users including grain producers, dairy industry, water companies and livestock organisations to conduct research that can directly affect their activities, including yield, marketing and export markets. ANSTO also conducts research that investigates the underlying environmental challenges faced by Australian farmers as they seek to effectively manage scarce natural resources.

This submission will describe ANSTO's research relating to agricultural and environmental innovation in regards to the two relevant National Science and Research Priorities.

Research Priority One: Food

Food security is a key national challenge for the 21st century. Accordingly, this research priority focuses on the need *"to develop internationally competitive sustainable, profitable, high intensity and high production capacity in new and existing food products, and in new and existing regions of Australia"*.

ANSTO and its research partners are undertaking a range of activities relating to this priority. In particular ANSTO has prioritised research that will lead to:

“enhanced food production through:

- *Novel technologies, such as sensors, robotics, real-time data systems and traceability, all integrated into the full production chain;*
- *Better management and use of waste and water; increased food quality, safety, stability and shelf life;*
- *Protection of food sources through enhanced biosecurity; and*
- *Genetic composition of food sources appropriate for present and emerging Australian conditions”*

ANSTO is using its world class landmark infrastructure to improve outcomes for Australian farmers. The following is an overview of the organisation’s current research in this field.

The Australian Synchrotron

The Australian Synchrotron (Synchrotron) is a world class research facility that uses accelerator technology to produce a powerful source of light – x-rays and infrared radiation - many times brighter than the sun. Thousands of Australian researchers are using this light to help local farmers improve production processes and become more competitive and efficient. This research is aimed at:

- **Improving crop yields** – University of Queensland researchers have used the Synchrotron to improve plant resistance to fungal and microbial infections and make them less susceptible to pre-harvest diseases. These diseases, which affect a range of fruit and vegetables including potatoes, tomatoes and kiwifruit, can cause crop losses of up to 15% in a single season.
- **A more competitive meat industry** - In partnership with the Australian Meat Processing Association, university researchers and State Government agencies, Synchrotron researchers are improving testing process for meat tenderness and juiciness. These results are being correlated with feed, season and geographic region to improve the quality of Australian meat.
- **Creating new milk varieties** – Researchers are hoping to open new markets for Australian dairy farmers by developing new types of milk suitable for premature babies and people with milk intolerances.

- **Improving wine quality** – Synchrotron researchers are working with the NSW Department of Primary Industries to determine the exact influence of tannins on the taste and aging qualities of wine. It is hoped that this research will provide globally competitive insights for the Australian wine industry.
- **Supporting rice growers** – Synchrotron researchers are working to explore new opportunities for our rice growers, who already produce more rice per hectare than anywhere else in the world. Future plans include exploring new high-quality black and red rice varieties suited to Australian growing conditions.

GATRI

ANSTO operates an irradiation facility known as GATRI (Gamma Technology Research Irradiator) that can accurately deliver high doses of radiation with a precision not achievable in industrial-scale irradiators. GATRI has allowed ANSTO to undertake crucial research in Food Biosecurity, Agriculture and Horticulture.

ANSTO is at the forefront of research into alternatives to pesticides for control of insect pests. For over 25 years, ANSTO has sterilised millions of laboratory-reared Queensland fruit flies per week for the NSW Department of Primary Industries (DPI). ANSTO has also supported research to examine the quality of the fruit fly for various radiation doses, to select the most effective treatment.

ANSTO has supported researchers studying radiation dose response, nutritional and other effects from the gamma irradiation of various fruits and vegetables. The research supported by ANSTO has enabled Food Standards Australia New Zealand (FSANZ) to make informed decisions on the approval of food irradiation, and has been used to establish commercial-scale irradiation protocols, leading to increased Australian export market access for products such as mangoes and tomatoes as well as reduced post-harvest pesticide use.

This research is ongoing. For example, ANSTO is currently collaborating with NSW DPI to determine generic doses for the species of thrips and mites that occur in fruits and

vegetables destined for the New Zealand fresh produce market. The resulting generic dose will be adopted by New Zealand Ministry of Primary Industries (MPI) as the irradiation dose required for the commercial exportation of fresh produce into New Zealand.

The Bragg Institute

ANSTO's Bragg Institute is a multidisciplinary international centre of excellence associated with the OPAL reactor, specialising in the application of neutron and X-ray scattering techniques in the study of matter in various physical states: solid, liquid and gas. It operates landmark infrastructure in the form of neutron beam instruments and associated sample environment at Australia's only nuclear research reactor – OPAL.

Since 2006 the Bragg Institute has been home to ANSTO's Food Science Project, in which researchers have been applying nuclear-based techniques to investigate fundamental and industrial problems of national significance in food science. Of particular significance is research into how starch behaves at the molecular level. The consumption of Resistant Starch (a slowly digestible constituent of starch) is inversely correlated to the incidence of colorectal cancer. ANSTO researchers have been able to examine and describe the structure on multiple length scales, permitting a correlation between the structure of starch and the digestion properties to be drawn. It is hoped that this research will lead to a clearer understanding of the benefits of resistant starch used in common foodstuffs including pasta and breakfast cereals.

Research Priority Two: Soil and Water

This research priority focuses on the need to ensure that Australia's soil, vegetation, biodiversity and water are highly valued and effectively managed. It specifically seeks to focus research on:

- *new and integrated national observing systems, technologies and modelling frameworks across the soil-atmosphere-water-marine systems;*
- *better understanding of sustainable limits for productive use of soil, freshwater, river flows and water rights, terrestrial and marine ecosystems; and*

- *minimising damage to, and developing solutions for restoration and remediation of, soil, fresh and potable water, urban catchments and marine systems.*

Researchers at ANSTO's Institute for Environmental Research are undertaking a range of activities in these areas that will assist the agricultural sector in managing our nation's crucial land and water resources.

Soil Research

Soil Erosion Studies

Measuring soil erosion is a key element in soil conservation and improved soil fertility strategies. Reliable quantitative data on the actual rates of soil erosion will allow us to better assess its impact on the quality of our farming land. With this information, we can develop scientifically-sound land use policies and implement appropriate and effective soil conservation measures and land management strategies

Researchers at ANSTO have been involved in an International Atomic Energy Agency sponsored regional project to study and further develop the use of fallout isotopes to measure soil erosion in a project entitled *Improving Soil Fertility and Soil Erosion in South East Asia*. This project has some 15 member countries and all have national programmes. As part of this project, ANSTO researchers have started a new pilot study in the vineyard area of Mudgee, NSW. This pilot aims to better understand current soil erosion rates and historical changes in soil erosion as a result of land-use changes. The pilot is underway on an historic property that changed from traditional mixed land-use in the late 19th century to cattle and sheep grazing during much of the 20th century, and then comparatively recently to use as a vineyard. The pilot aims to reconstruct the land-use history contained within the sediments of the various farm dams and measure directly the current rate of soil erosion.

Water Research

Rainfall studies

Accurate and comprehensive rainfall records are an important planning tool for our agricultural sector. Currently, we lack reliable rainfall records beyond the instrumental record, especially in relation to variability in rainfall caused by longer cycles in the climate system, which drives long term rainfall variability in North and North Eastern Australia. ANSTO is undertaking a study into the history of the Northern Monsoon Climate system by studying Stalagmites from the Northern Territory (Cutta Cutta Caves, Katherine, NT). This research seeks to reconstruct the rainfall variability and intensity from stalagmites, using the overlap with the instrumental record as a yard-stick and establish a “rainfall” history over hundreds of years. This will enable the researchers to understand the variability in rainfall in the monsoon climate-dominated part of Australia, and will help the agricultural sector to better plan for the future. Similar studies in Western Australia have shown the suitability of the technique for measuring long-term rainfall trends.

Improving groundwater sustainability

Water remains a scarce resource in Australia, and effective water management is the cornerstone of good agricultural practice. ANSTO researchers are using the nuclear technique of Isotope Hydrology to understand how freshwater resources are renewed, how they interact with ecosystems, and the effects of climate and human impacts on these processes. This technique uses isotopic dating to measure and estimate the age, origins, and the movement of water within the hydrologic cycle. This research forms an independent tool that will assist the sustainable management of water resources.

Currently this research is being undertaken in locations of agricultural significance across Australia including the Sydney Basin, Lockyer Valley, Gippsland Basin, Condamine River, Lower Namoi, The Gnamagara groundwater system and the Darling River. This technique is used around the world to assess groundwater resources.

ANSTO remains committed to applying innovative nuclear science and technology solutions to the challenges faced by farmers and the broader agricultural community. In particular ANSTO will continue to work to improve food quality and security, and develop new land management practices that will assist in creating a more economically productive and sustainable agricultural sector.