International Specialised Skills Institute

Industry: Australian Agriculture – Crops

Craig Day
The Pratt Foundation/ISS Institute Overseas Fellowship

Fellowship supported by The Pratt Foundation

PRATT FOUNDATION

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Executive Summary

The aim of this Fellowship is to evaluate the European methodologies for training pesticide applicators and the requirements for testing spraying machinery. The intention is to integrate the skills gained into the chemical training programs that exist in Australia to ensure Australian chemical application meets recognised international standards. It is vital that Australian agriculture maintains its current high standing to maintain market access and to retain current levels of foreign investment.

Methodologies varied between Belgium, the Netherlands, Denmark and the United Kingdom (UK) in spray application standards. Ultimately, the overseas models would be difficult to implement in Australia. Instead, a focus on training the applicator to thoroughly understand the equipment and the spraying process would be far more beneficial than a testing regime limited to the analysis of individual parts, not an holistic framework.

Since his return, Craig Day has been working with the Grain Industry Training Network to deliver Don't Be A Drifter workshops in New South Wales (NSW), South Australia (SA), the Australian Capital Territory (ACT) and Victoria. He is working with the Department of Primary Industries in Victoria, firstly, by delivering training as part of Environmental Management Action Planning and, secondly, by making two videos that promote techniques for better spray application. Day will be presenting at the Birchip Cropping Group forum in July 2011 and he has already conducted an information session at a Farmlink seminar in Junee, NSW.

Day will continue to deliver one- and two-day courses across Australia with his Level III and Level IV accredited programs. These courses include the use of dye technology that allows farmers to actually see, under a Lambino light, the efficaciousness of various nozzles under a specified set of conditions. The opportunity is also given to spray applicators to have Day calibrate their spray units and develop spray plans that help manage risk in direct alignment with the Australian Pesticides and Veterinary Medicines Authority's (APVMA's) requirements. If required, occupational health and safety support is also provided. Integral to this training is the knowledge acquired from overseas about spray application equipment, sprayer testing and international standards.

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Abbreviations/Acronyms

AAMS	Advanced Agricultural Measurement Systems
ACT	Australian Capital Territory
APVMA	Australian Pesticides and Veterinary Medicines Authority
BFS	Billericay Farm Services Ltd
CDA	controlled drop application
cm	centimetres
COAG	Council of Australian Governments
EU	European Union
GITN	Grains Industry Training Network
GPS	Global Positioning System
ISC	International Standards Committee
ISO	International Standards Organisation
ISS Institute	International Specialised Skills Institute
km	kilometre
LERAP	Local Environment Risk Assessment for Pesticides scheme
m	metre
mm	millimetre
NAP	National Action Plans
NRoSO	National Registration of Spray Operators
NSTS	National Sprayer Testing Scheme
NSW	New South Wales
PAE	pesticide application equipment
PPP	plant protection product
SA	South Australia
SKL	The Foundation for Quality Control of Agricultural Equipment, part of the Dutch Ministry of Agriculture
TMA	Tractor and Machinery Association
UK	United Kingdom
VI	Voluntary Initiative
6EAP	6th Environment Action Program

Definitions

Design

Design is problem setting and problem solving. Design is a fundamental economic and business tool. It is embedded in every aspect of commerce and industry and adds high value to any service or product—in business, government, education and training, and the community in general.[1]

Innovation

Creating and meeting new needs with new technical and design styles. (New realities of lifestyle).[2]

Skill deficiency

A skill deficiency is where a demand for labour has not been recognised and training is unavailable in Australian education institutions. This arises where skills are acquired on-the-job, gleaned from published material or from working and/or studying overseas.[3]

There may be individuals or individual firms that have these capabilities. However, individuals in the main do not share their capabilities, but rather keep the intellectual property to themselves. Over time these individuals retire and pass away. Firms likewise come and go.

Sustainability

The ISS Institute follows the United Nations for Non-Governmental Organisations' definition on sustainability: *"Sustainable Development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs".*[4]

Acknowledgements

Craig Day would like to thank the following individuals and organisations who gave generously of their time and their expertise to assist, advise and guide him throughout the Fellowship program.

Awarding Body – International Specialised Skills Institute (ISS Institute)

The International Specialised Skills Institute Inc is an independent, national organisation that for over two decades has worked with Australian governments, industry and education institutions to enable individuals to gain enhanced skills and experience in traditional trades, professions and leading-edge technologies.

At the heart of the ISS Institute are our Fellows. Under the **Overseas Applied Research Fellowship Program** the Fellows travel overseas. Upon their return, they are required to pass on what they have learnt by:

1. Preparing a detailed report for distribution to government departments, industry and educational institutions.
2. Recommending improvements to accredited educational courses.
3. Delivering training activities including workshops, conferences and forums.

Over 200 Australians have received Fellowships, across many industry sectors. In addition, recognised experts from overseas conduct training activities and events. To date, 22 leaders in their field have shared their expertise in Australia.

According to Skills Australia's 'Australian Workforce Futures: A National Workforce Development Strategy 2010':

> Australia requires a highly skilled population to maintain and improve our economic position in the face of increasing global competition, and to have the skills to adapt to the introduction of new technology and rapid change.
>
> International and Australian research indicates we need a deeper level of skills than currently exists in the Australian labour market to lift productivity. We need a workforce in which more people have skills, but also multiple and higher level skills and qualifications. Deepening skills across all occupations is crucial to achieving long-term productivity growth. It also reflects the recent trend for jobs to become more complex and the consequent increased demand for higher level skills. This trend is projected to continue regardless of whether we experience strong or weak economic growth in the future. Future environmental challenges will also create demand for more sustainability related skills across a range of industries and occupations.[5]

In this context, the ISS Institute works with Fellows, industry and government to identify specific skills in Australia that require enhancing, where accredited courses are not available through Australian higher education institutions or other Registered Training Organisations. The Fellows' overseas experience sees them broadening and deepening their own professional practice, which they then share with their peers, industry and government upon their return. This is the focus of the ISS Institute's work.

For further information on our Fellows and our work see http://www.issinstitute.org.au.

Fellowship Supporter

The Pratt Foundation was established in 1978 by Richard and Jeanne Pratt with the shared vision of supporting charitable enterprises and adding value to philanthropy. The Foundation is now one of the largest private sources of philanthropy in Australia. In the words of its mission statement, it aims *"to enrich the lives of our community"* and, in the words of Jeremiah, it works to fulfil this aim in a spirit of *"kindness, justice and equity"*. Craig Day would like to thank them for providing funding support for this Fellowship.

Supporters

The Fellow would like to thank the following supporters:

- Peter Alexander, Regional Sales Manager, TeeJet Australasia Pty Ltd, for support in the provision of technical advice and training resources.
- Nickie Berrisford, Executive Officer, Grains Industry Training Network (GITN), for the promotion and development of high level application training throughout Australia.
- Harry Combellack of Spray Smart Enterprises, for the benefit of his extensive knowledge and experience of chemical application on a global scale and for his assistance with the organisation of the itinerary.
- Per Gummer Andersen, Better Spraying, Denmark, for his support and assistance in the development of the itinerary and for the time spent discussing global issues concerning chemical application.
- HARDI International and HARDI Australia for support in training resources and for contacts in Denmark.
- Niel Jacobsen, Dane Consulting, for discussions on the development of the Fellowship program and for his experience on training packages.
- Professor John Kent, Charles Sturt University, for his commitment to agricultural chemical user training, especially at a higher level.
- Jake Lanyon, Technical Specialist, TeeJet Australasia Pty Ltd, for ongoing support regarding technical issues concerning application.
- Peter O'Connor, Day's business partner, for his commitment to the development of Spray Safe and Save initiatives.
- Cath Sullivan, Day's wife, for her support and persistence in the completion of this final report.
- To all the people visited as part of the Fellowship tour: your time and expertise were greatly valued.

Organisations Impacted by the Fellowship

Government

- Australian Pesticides and Veterinary Medicines Authority (APVMA)
- Council of Australian Governments (COAG) Product Safety and Integrity Committee
- Department of Primary Industries Victoria

Industry

- AgriFood Skills Australia
- Tractor and Machinery Association (TMA)

Professional Associations

- NSW Groundsprayers Association

Education and Training

- Charles Sturt University, Wagga Wagga
- GITN

Community

- Canberra Water
- Landcare

About the Fellow

Name: Craig Day

Employment

- Weddin Agricultural Chemical Services Pty Ltd, Spray Safe and Save Pty Ltd

Qualifications

- Bachelor Applied Science – Agriculture, Charles Sturt University, Wagga Wagga, New South Wales (NSW), 1993

Memberships

- NSW Groundsprayers Association

Brief Biography

- Application Consultant
- Contract Sprayer
- Farmer, Central West NSW
- Chemical User Trainer since 1993
- Formed Spray Safe and Save Pty Ltd in 2002 to promote sustainable use of chemicals for crop protection and pest management
- Developed the award winning Quick N Safe Chemical Mixing Apron in 2004
- Developed Level IV application training program Don't Be A Drifter to respond to changes to national legislation with respect to drift management.

Craig Day grew up on a property near Cowra, NSW, which he now owns and operates. He is also a spray contractor in the Cowra district. Day attended Charles Sturt University at Wagga Wagga, graduating in 1993. He began training farm chemical users in 1993 and since then has gone on to help form and successfully operate Spray Safe and Save Pty Ltd. Day worked tirelessly with the GITN to develop the program Don't Be A Drifter, which not only has enabled farmers to undertake professional development in a farmer-friendly manner, but also gives them the relevant skills and knowledge to operate their often highly technical equipment, taking into consideration the wide range of factors that impact on spray application. The Don't Be A Drifter program has been developed to provide Level III and Level IV training in spray application and has been delivered throughout NSW, Victoria, Tasmania, Australian Capital Territory (ACT) and South Australia (SA).

In 2010, after Day was awarded a Fellowship with the International Specialised Skills Institute, he travelled to Europe to investigate sprayer testing and the European approach to environmental legislation. His aim is to continue to present his findings in workshops and to government bodies in 2011/2012.

Aims of the Fellowship Program

To investigate sprayer testing and the European approach to environmental legislation to ensure the mitigation of drift and off-target movement of pesticides.

The aim of this Fellowship is to evaluate the European methodologies for training pesticide applicators and the requirements for testing spraying machinery. The intention is to integrate the skills gained into the chemical training programs that exist in Australia to ensure Australian chemical application meets recognised international standards. It is vital that Australian agriculture maintains its current high standing to maintain market access and to retain current levels of foreign investment.

The evaluation of sprayer testing schemes across Europe is vital to the future of Australia's export industries within the scope of food and fibre producing industries. The European Union (EU) has set down a target date of 2016 where all member states have to implement a sprayer testing scheme for spray application equipment used in the production of food and fibre. Currently in Australia there is no plan for such a program. Through evaluation of testing schemes in Europe, it is Day's aim to pursue the implementation of a scheme that suits Australia's diverse production systems. For a scheme to gain acceptance, it needs to be underwritten by an agricultural university to ensure it is recognised by trading partners.

Australian agriculture needs to address an alarming skills shortage that exists among Australia's chemical user trainers. A significant number of trainers lack the skill to accurately set up, maintain and operate spray application equipment to ensure environmental and food safety demands are met, let alone impart these skills to others. The quality of information transfer has been raised by many organisations within Australian agriculture and is a common criticism of training that the Fellow sees when working with clients to set up spraying machinery from broad acre to the amenity horticulture sectors. Spray Safe and Save, the training company the Fellow has helped establish and operate, aims to ensure that participants in training achieve an improvement in their skills. They receive practical training that is relevant to the participant's workplace.

The Fellowship has also enabled the Fellow to evaluate the best practice management approaches adopted by the EU to manage off-target movement of pesticides during application and the legislative framework that underpins these schemes. The aim of this is to be aware of external forces that will dictate the terms of trade in relation to management of pesticides and the willingness of the EU to accept the current standards that exist within Australia. There is a directive within the EU to harmonise the management of pesticide application and a move towards the adoption of international standards.

The Australian Context

A review of the 2009 AgriFood Skills Australia Environmental Scan and the 2010 AgriFood Skills Australia Environmental Scan highlights we are in for ***"a perfect storm of shortages"***.[6 7] The scans outline the fact that by 2030 food and fibre production must increase by 50% to keep pace with population growth worldwide. This will see the need for increased production from less water, less arable land, less fossil fuels and a more erratic and warmer climate. The scans lay down a challenge: we need a significant shift in technology, science, our practices and the skills of our people.

With relation to training, AgriFood Skills Australia promotes the idea that the training model within the agrifood industries needs to be re-worked to address a pending skills shortage. AgriFood Skills Australia outlines the main challenges as:

- attraction of workers;
- adoption of higher skills across the workforce;
- adoption and diffusion of new research, practice and technology across the industry; and
- workforce retention and effective skills utilisation.

If we are to produce an increased output with less input to meet population increases, we need to evaluate technology improvements and reduce the lag in the adoption of new technologies. The consuming public, at the same time, expects our production techniques to have a sustainable footprint.

Food security is the world's greatest challenge facing a population that is set to hit 9.1 billion by 2050, requiring a 70% increase in food and fibre production. Australia currently produces 90% of our food locally but generates food that currently feeds 60 million people. This is 80% of the total gross value of Australian agricultural production. If Australia is to build on this fortunate position we must take note of systems that are being demanded by consumers and markets throughout the world to ensure the required increases in production are carried out sustainably and that consumer confidence is maintained.

The fact that we do not have a system currently in place to check the efficiency of pesticide application equipment (PAE), places us at risk of maintaining market access. Australia may see this issue raised as competing markets start to recover from the current financial crisis and the pressure is applied by overseas producers on their governments to protect markets.

In Australia, buffer zones are being developed for protection of the downwind environment during pesticide application. The proposed buffer widths are larger than those proposed in Europe. These widths are generated from a computer model based on aerial agriculture, which has been manipulated by the modellers to simulate ground-based spraying. This model is limited by the fact that it does not take into account ground speed, droplet velocity and ground surface characteristics. In order to limit the reduction of productive land, we need to look at systems of buffer zone management that are already in place, and how they are determined and implemented by European producers.

The key for technology adoption across agrifood industries is to reconnect training with the transfer of the latest technologies. This can only be achieved by ensuring trainers have current and relevant skills, experience and a pertinent industry background.

SWOT Analysis

Strengths

- Many European systems for spray training, control and environmental management are already in place in Australia.
- Strong support from industry exists for improved stewardship of chemical management.

The Australian Context

Weaknesses

- Australia is exposed to trade barriers due to a lack of sprayer testing.
- There are different requirements for spray management in each state.
- A lack of uniformity exists in the quality of spray application training and trainers.

Opportunities

- Chance to harmonise existing systems within Australia with European methodologies.
- Chance to harmonise training/ chemical use across all states.

Threats

- Doing nothing regarding sprayer testing may lead to Australia's exclusion from international trade.

Identifying the Skills Deficiencies

PAE is continually improving due to advancements in technology. The consuming public have a perception that pesticide use is a threat to human health through residues in food and potential effects on the environment, such as contamination of water resources and the potential effects to non-target organisms.

This situation has seen a need for regulators to intervene in the management of pesticide application. In Australia, we have regulations that have been implemented to require the certification of pesticide applicators, and the keeping and maintenance of pesticide application records.

The federal regulator, the APVMA, is currently developing a new framework for the management of spray drift. The operating principles of these legislation changes outline changes to chemical label directions, in relation to spray equipment settings, that an operator must carry out to reduce spray drift risk prior to undertaking application. The operator will be required to select nozzles that provide a required droplet size, and to operate during suitable weather conditions with respect to wind speed, temperature and relative humidity, with a potential for buffer zones to be designed to protect the off-target environment.

These regulations and proposed changes are not dissimilar to the application regulations that exist in several European countries in the use of crop protection chemicals to manage drift.

Australia has had major cross industry drift issues that have been occurring too frequently in the past five years. With the increased level of training of chemical users, one would expect the drift incidence to be on the decline rather than the increase.

In 2004/2005, major drift issues occurred in the border irrigation districts along the Murray River resulting in millions of dollars of damage to grape and horticultural crops in Victoria. The damage was caused by 2,4-D Ester being sprayed under inappropriate weather conditions. Cotton growing areas are consistently reporting damage to their crops from chemical drift from commonly used broad acre herbicides. These occurrences have left the APVMA with no choice but to restrict the opportunity for the use of Ester formulation of 2,4-D.

The drift situation is getting worse, not better, and there are a number of reasons as to why this is the case. Spray drift is defined as airborne movement of pesticide outside the target zone. Contributing factors are:

- spray droplet size;
- spray release height;
- operating speed;
- wind speed;
- wind direction; and
- chemical characteristics of the chemical and additives.

These factors are all within the operator's control and should be managed through a risk assessment approach to pesticide application.

It is vital that these issues are integrated into all chemical user training as a matter of urgency. It is essential that chemical user training in Australia is responsive to a new regulatory approach and that the people delivering the training have a sound understanding of how to operate the application machinery. If this is not addressed we are missing an opportunity during training to achieve practice change. We need to integrate into the current training networks a program of educating communicators so they can demonstrate how to manage for drift risk. A failure to act on this will place great pressure on the confidence that is held in the safety of our food and fibre on the world stage.

Sprayer machinery is undergoing many significant changes and improvements. The move to conservation farming is going to place an increased reliance on crop protection chemicals. The current labour skills shortage, and the low retention rate of young people in agricultural industries, is also placing greater pressure on our production systems. A labour shortage will give rise to less people doing more and may see spraying being carried out in less than favourable weather conditions contributing to drift risk. Less workers mean sprayer machinery is getting larger and wider so fewer individuals can complete the area more efficiently. Wider sprayers tend to see spray release heights increase, also contributing to drift risk.

As experienced operators leave agricultural sectors to start new careers, this will give rise to the need for alternative sources of labour. This will then see people with less skills and relevant industry experience presenting for training. If labour is imported, it is vital that our training is extremely practical in its design and delivery to minimise chemical application mishaps during the application of pesticides.

Technological advancements, such as Global Positioning Systems (GPS), enable operators to spray at night. Although this does assist with work rate, it poses great increases to the potential for drift, a fact that needs to be communicated during training and can, in fact, encourage operators to rely purely on equipment without considering what is actually happening.

The GITN has highlighted the need for the improved training of primary communicators to ensure they have the skills to communicate how the application of pesticides needs to be managed. This is essential to ensure the protection of our markets and to guarantee we deliver on food safety as is demanded by consumers of our produce. The current regulatory framework in Australia creates challenges for achieving national standards for chemical training. This is because there is a two-tiered approach to the legislation controlling pesticide registration and use.

Firstly, the registration of pesticides is federally administered under the Agricultural Veterinary Chemical Code, implemented by the APVMA. The APVMA are responsible for the registration and reviewing of agricultural veterinary chemicals. Secondly, the control of use of chemicals is a state responsibility and is administered with slight variations between the states in relation to the training and accreditation of chemical users. In NSW, there is a requirement to reaccredit every five years, which is not the case in Victoria. Five years is a long time when looking at technology advancements and changes in legislation, but when there is no mandatory requirement for reaccreditation, as is the case in Victoria, the opportunity to promote advancements in technology is significantly reduced.

The perception of strong chemical management to our trading partners is vital if we are to maintain Australia's quality standing. If members of the EU can harmonise their legislative framework to drift control and sprayer testing and manufacturing standards, we should be taking notice.

Activities Undertaken for the Fellowship

With respect to the issues outlined above, the Fellow travelled to Belgium, the Netherlands, Denmark and the United Kingdom (UK) to evaluate sprayer testing schemes and the legislative frameworks that control off-target movement of pesticides. He visited field research testing stations and held discussions with scientists, researchers, manufacturers and farmers to evaluate the procedures and instruments used to accredit spraying machinery, and the implications for farm management of such schemes.

The Fellow gained a working understanding of the Local Environment Risk Assessment for Pesticides scheme (LERAP) and the testing that is carried out on nozzles at the Silsoe Wind Tunnel, Silsoe, UK, under Professor Paul Miller and Claire Butler Ellis. The LERAP scheme relates to the ability to reduce the width of a buffer zone to protect surface water from contamination of plant protection products (PPPs) by rating nozzles for their ability to reduce drift.

The final area of study was based on the implementation of International Standards Organisation (ISO) requirements for spray machinery and how this has been adopted into the manufacturing of new sprayers across Europe and the UK.

The International Experience

In this chapter the Fellow describes a brief overview of the destinations visited. The findings of these visits and the Fellow's insights in relation to the application of these findings in Australia are expanded on in the Summary of Conclusions from Overseas Site Visits in this report.

Destinations

Advanced Agricultural Measurement Systems (AAMS)

Location: Maldegium, Belgium

Contact: Jan Langenakens, Managing Director, AAMS

AAMS manufactures and distributes sprayer testing machinery to many EU member states in the EU. The objective of the Fellow's visit was to observe the operation of a testing and calibration manufacturer and to gain an overview of the testing protocols in Europe.

The Fellow participated in the testing of equipment and discussed the suitability of such a system for Australian conditions. The testing machinery was very technical and has been developed as a response to the German approach to standards and testing. There are significant differences between the testing protocols of various European countries, but there are moves to harmonise these differences.

Flanders

Location: Begium

Contact: Johan Declercq, Overseer of Sprayer Testing, Flanders Region

A compulsory sprayer testing regime operates in Belgium. Since 1995, all agricultural sprayers need to be assessed by official and mobile teams from regional authorities and agricultural research centres.

The aim of this visit was to observe the compulsory inspection of sprayers at a mobile site (farmers drive no more than 15 km to a testing centre to have their sprayer assessed) and to assess the effectiveness of the program.

The Belgian approach to sprayer testing is based on an analytical method, that is, parts of the sprayer are measured separately and independently to determine possible defects.

This method of sprayer testing would be difficult to achieve in Australia because of the distances to be travelled, especially when considering oversize sprayers travelling on roads. Belgian sprayers are much more compact and the distances to be travelled far less.

This system did not make provision for back checking, whether or not the automatic rate controller was delivering the pesticide accurately. The machine could potentially pass the testing of the individual components, but might not necessarily be calibrated correctly.

Left: A Belgian mobile sprayer inspection van

Testing individual parts as part of the analytical inspection process in Belgium

Testing boom line pressure at a mobile testing station located in the Flanders region

Institute for Agriculture and Fisheries Research (ILVO)

Location: Merelbeke, Belgium

Contacts

- David Nuyttens, Research Scientist
- John Declercq, Overseer of Sprayer Testing, Flanders Region

There was a dual purpose to this visit. Discussions with Johan Declercq were to deepen awareness of the testing framework as it operates in Belgium, while David Nuyttens is an expert in buffer zones and the determination and implementation of these requirements in Belgium.

The Belgium system has much narrower buffer zones than the Australia. There is a well-established system for reducing buffer zones via spray drift reduction technologies.

Wageningen

Location: Netherlands

Contact: Jako Kole, from The Foundation for Quality Control of Agricultural Equipment, part of the Dutch Ministry of Agriculture (SKL)

This location allowed access to testing centres within the Netherlands, as well as the opportunity to visit a manufacturer of spray equipment. The objective was to contrast their testing protocols with those of Belgium.

Testing within the Netherlands is carried out by private enterprise, whereas Belgium's testing is a government responsibility. The Netherlands testing is generally undertaken by machinery dealers, which means that a defective machine can be readily repaired by qualified technicians.

A Netherlands testing station conducting a pump test

Electronic spray scanner in operation in the Netherlands

Testing of individual nozzles with a computerised flow meter in the Netherlands

By observing two different machinery dealers, Claas and Massey Ferguson/Agco, variations were highlighted within the testing approach. One centre had a fully electronic spray scanner, while the other was manual. A large part of the test is centred on the static patternation of a sprayer. This requires expensive equipment that will only provide limited information about how the sprayer will perform in the field. The visit to Agrifact machinery highlighted the difficulties experienced by manufacturers when producing machinery for a variety of markets with a variety of testing protocols. There are different rules for different countries and the manufacturers have to individualise sprayers to meet the requirements of each member state, increasing costs and production inefficiencies.

Wageningen University and Research Centre

Location: Wageningen, the Netherlands

Contact: Jan van de Zande, Research Scientist, Wageningen University and Research Centre

The objective in meeting with Jan van de Zande was to investigate the Netherlands drift models and the development of buffer zones. It was also an opportunity to discuss the implementation of water testing in canals throughout the Netherlands to assess the off-target movement of PPP.

Despite high population densities, the Netherlands operates under very small buffer zones. Contamination of surface water is a significant issue that drives their small buffer zone system. Groundspeeds of the Netherlands spray applicators are in the order of 9–10 km per hour, whereas Australian farmers drive, on average in a broad acre situation, 20 km per hour. Therefore, slower ground speeds enable smaller buffers because of decreased wind shear at the nozzle.

Boom widths in the Netherlands, however, are increasing substantially. This will lead to increased boom heights that may challenge their narrow buffer zones. A boom height increase from 50 cm to 70 cm off-target will potentially lead to a fourfold increase in drift.

HARDI International Production Facility

Location: NorreAlslev, Denmark

Contacts

- Christoph Shulze Stentrop, Product Manager, HARDI
- Anthony Fachin, HARDI After-market, HARDI Academy

HARDI, as a global manufacturer of spraying equipment, is very cognisant of the challenges of delivering machinery into different markets. The purpose of this visit was to explore these challenges, as well as to gauge the differences in training offered by the HARDI Academy since a previous study tour in 2005.

Since the previous visit, HARDI's ownership has changed and, as a consequence, training has been scaled back, a very unfortunate circumstance for the industry as the Academy delivered high quality outcomes to international participants. Many of the people visited by the Fellow on this Fellowship, at universities and research centres, have been through the HARDI Academy.

Mertz, Machinery Dealership

Location: Nykobing Falster, Denmark

Contact: Leif Trane, Mertz

Per Gummer Andersen, a Danish spray application consultant, facilitated a meeting with a new and second-hand machinery dealer in order to deepen understanding of machinery turnover and the adoption of new technology by Danish farmers. It was also an opportunity to discuss cultivation techniques.

Discussions revealed that Danish machinery has a high turnover rate. Many farmers use new or near-new machinery and older equipment is exported to places, such as Poland or the Czech Republic.

Due to government policy to decrease pesticide use, cultivation is important in pre-crop weed control management. This cultivation regime requires a high energy input and leads to organic matter decay and the release of carbon dioxide.

Greve

Location: Denmark

Contact: Per Gummer Andersen, Better Spraying

Per Gummer Andersen was previously head of the HARDI Academy and now operates a spraying consultancy business. He has been part of International Standards Committees (ISCs) providing standards for knapsack sprayers and in-field cleaning of PAE. The purpose of this meeting was to discuss European legislation and Per Gummer's work on international standards. Training of applicators and sprayer testers were also considered.

Regular checks by the user of the PAE, in accordance with EN 13790, while it is being operated and maintained, are advocated rather than a one- or three-year inspection. This means that good quality training of the operator is essential. Per Gummer works in Eastern European countries to train chemical users.

Landbocentre

Location: Ronnede, Denmark

Contact: Soren Holmgren, Agronomy Consultant

The aim of this meeting was to learn more about Danish farming systems and the move towards low pesticide input.

Danish farmers have, due to legislation, restricted access to certain chemicals. They also have restrictions on chemical application rates. The farming systems are based around high water quality and, consequently, limitations are placed on pesticide and fertiliser use. Fertiliser budgeting is calculated by consultants, such as Soren Holmgren. As a result of reduced chemical use and the limited access to a range of chemical products, the crops are very weedy. There are also low rates of adoption of air induction nozzles. Instead, there is a reliance on low drift nozzle technology.

Farm Visit, Near Ronnede, Denmark

Contact: Jens Husby, Bayer Crop Scientist

The main objective in meeting with Jens Husby was to observe the construction, maintenance and use of organic bio-beds. Farmers dispose of spray unit rinsate into the bio-bed (a hole in the ground filled with humus and a recirculation pump). The chemicals are repeatedly circulated through the bio-bed filter. The aim is to reduce point source pollution from the decontamination of PAE.

Farm Visit, Near Stede, Denmark

Contacts

- Lars Johannson, Farmer
- Per Gummer Andersen, Better Spraying

The farming enterprise of Lars Johannson provided first-hand experience of mixed farming in Denmark.

The cost of land is forcing many Danish farmers to sell and take up farming in other European countries such as Poland. This is also a response to limitations in chemical and fertiliser use. Due to these land costs and the costs of getting into agriculture, many young people are not involved in on-farm operations. Instead, they become agricultural consultants or simply move to larger urban centres.

There is no objection to wind turbines on farms, according to Lars, and a substantial wind structure was located not far from his house.

Lars operates within a co-operative in order to diversify income and share resources. Farmers within co-operatives are responsible for managing different enterprises and the profits are shared among the members. This enables efficiencies in machinery use and crop rotation.

Peterborough, United Kingdom

Contacts

- Duncan Russell, National Sprayer Testing Scheme (NSTS)
- Brian Knight, Knight's Sprayers

The intention of meeting with Duncan Russell was to learn about the UK's NSTS and to contrast this with those of the Netherlands and Belgium. Knight's Sprayers provided the opportunity to inspect a British manufacturer of spray equipment.

The NSTS was established in 2003 and was based on a scheme launched in 1997 by the Agricultural Engineers Association. The NSTS requires is an annual, independent inspection of spray application equipment by a qualified examiner. Since its launch, NSTS has become a requirement of the UK's crop assurance schemes and major supermarket protocols.

In contrast to the European systems, the NSTS does not subject sprayers to the same scrutiny of individual components, but is a more holistic appraisal of the machine. Overall, the requirement for testing has improved the quality of spray application equipment.

Silsoe Wind Tunnel

Location: Silsoe, United Kingdom

Contacts

- Claire Butler Ellis, Head of Silsoe Spray Application Unit
- Dr Paul Miller, Specialist Advisor, The Arable Group
- Clive Tuck, Researcher, The Arable Group

The research facility at Silsoe allowed for observation of a wind tunnel and how this can be used to measure drift. Droplet size testing of nozzles is also conducted here and this led to a discussion of the ISO droplet size classification system.

The ISO droplet size classification system is still being debated within an international committee, as a consequence, the United States of America is operating on one system, the UK on another.

Silsoe, one of the world's leading wind tunnel centres for spray application and nozzle technology, has recently experienced significant cutbacks. Meanwhile, major changes are occurring to regulation, but the capacity to perform research and inform debate is being globally diminished.

Billericay Farm Services Ltd (BFS)

Location: Billericay, United Kingdom

Contact: Richard Goddard, Application Advisor, BFS

The visit to BFS provided a chance to discuss the adoption of drift reducing technology across the UK with a nozzle manufacturer. There has been a major shift towards the acquisition of this technology particularly since the implementation of the LERAP scheme. The latest products coming onto the market are angled nozzles designed to improve penetration, but they have limited application for broad acre agriculture in Australia due to our faster groundspeeds.

The observation of a sprayer being put through its annual test on a local Billericay farm, allowed for another comparison to the European systems. Here the machine was checked over visually. It was not subject to pump or patternation tests as in the Netherlands. Again, little attention was paid to the automatic rate controller and this is a failing of all the testing protocols observed.

Conference of the Association of Applied Biologists

Location: The Olde Barn Hotel, Marston, Lincolnshire, United Kingdom

The opportunity to attend this conference arose during the overseas tour and, given that its theme was the Development of New Pesticide Application Machinery, the timing was serendipitous. Leading researchers from all over the world addressed the conference, covering a broad range of topics. Please see the 'Attachments' Chapter of this report for more information. A machinery expo was also part of this conference with the latest spray application equipment from the UK and Europe on display.

Micron Sprayers

Location: Bromyard, Herefordshire, United Kingdom

Contact: Tom Bals, Chairman, Enviromist Industries Pty Ltd

Tom Bals provided another point of view in understanding the overseas position on chemical application regulation in Europe. He effectively communicated his very sound understanding the process of the development of ISO standards and highlighted the different approaches taken by various EU member states.

The danger of standards being too restrictive, leading to a decrease in innovation, was also discussed. Very prescriptive standards regarding current practices will lead to a reduction in innovation of technologies that could reduce the environmental impact of pesticide use. Concerns were raised about the oversimplification of drift as the cause of all environmental contamination, the danger of standards being developed by staff from testing institutes and consultants, and the use of over prescriptive engineering measures without consideration being given to the role of the applicator in the spraying process.

A range of controlled drop application (CDA) and shielded sprayers, that had been designed for specific niche markets, for example fruit and vegetables, were viewed and discussed.

Summary of Conclusions from Overseas Site Visits

Sprayer Testing

Article 8 of the Framework Directive (EU Thematic Strategy for Pesticides) applies to every EU member state.[8] It relates to the inspection of spray equipment:

1. regular inspection of PAE for professional use at least every five years until 2020, every three years after 2020;
2. by the year 2016 PAE for professional use is to be inspected at least once;
3. inspections to verify whether the use of PAE is delivering a more sustainable use of pesticides, reducing the risk to human health and the environment;
4. regular calibration and technical checks; and
5. the bodies responsible for inspections must issue certificate of machinery test.

The European standard, EN13790 – Inspection of sprayers in use – was developed in 2003 and underpins the development of testing protocols in EU member states. The concepts:

- *inspection* – investigation by eye;
- *function test* – running the machine to simulate usage; and
- *measurement* – measure some items by using special equipment, give guidance to the inspection staff.

The following table specifies the part to be tested and the process:[9]

Part	Check Method and Demand
Power transmission parts	Visual check that there are no damages and that guards are in place and working properly.
Pump flow and agitation	Check with tank half full of clean water. Spray with the biggest nozzle on the highest used pressure. Visual check of the agitation in the tank. No leakages from the pump.
Tank	Visual check for leakages. No leakages. Lid in place.
Armature	Check, by operating, that on/off adjustments and measuring device work reliably. Manometer (pressure gauge) shows stable pressure. No leakage.
Pipes and hoses	Visual check. No leakages. Not disturbing spray pattern.
Filters	Filters not blocked. Good condition and work reliably.
Boom	Visual check. Boom is straight. No damages. Boom-height adjustment and boom-end return works reliably
Nozzles	Nozzles shall be suitable for the task. Identical. Good condition and work reliably. Spray pattern – visual inspection. No spray pulsation. No dripping after shut-off.
Fan	Visual check. Good condition. Guards are safe. Gear works (if applicable). No vibrations
Chassis, wheels	Visual check of chassis, draw-bar, three-point connection, wheel axles and wheels including bearings. Good condition.

Belgium

In Belgium, the inspection of sprayers is performed by official mobile teams divided into two regional inspection authorities. Overall management is carried out by the Federal Ministry for Consumer Protection, Public Health and the Environment. Regional authorities need to have an ISO 17020 certification and, as this is a recognised international standard, the inspection process is, therefore, independent and objective.

The data generated from having a central testing authority gives an overall picture of the condition of Belgian sprayers and is useful in informing policy makers. Further, farmers can be given advice as to how to improve their spraying equipment or what points to consider when buying a new or used machine.

In many ways the mandatory inspection of sprayers in Belgium differs from inspections in other European countries. The inspection is carried out by two official government bodies (regional inspection authorities), one in the Flemish region and one in Walloon region. The Flemish region has three mobile inspection teams and there are two in the Walloon region. Each team is equipped with a test van that contains all the necessary equipment to perform testing according to Belgian legislation. The inspections occur at neutral locations and farmers/contractors are invited to present their sprayer for inspection at a specific time and date. No farmer/contractor has to travel a great distance (maximum 15 km). At present 21,200 machines are tested every three years. Based on the analytical principal, all parts of the machine are tested separately and if the sprayer passes the inspection, the farmer/contractor is issued with a certificate approving the sprayer for use for the next three years. A sticker is fixed to the sprayer identifying its compliance. If the machine is rejected, it is up to the farmer/contractor to arrange for repairs and the machine then has to be re-submitted for inspection.

The Netherlands

The testing of sprayers in the Netherlands started in the 1980s and SKL was founded in 1988. Its purpose was to develop uniform testing guidelines and to establish a countrywide network of testing stations. Now sprayer testing is mandatory and 150 testing stations, under SKL's supervision, test all sprayers. SKL registers all tests carried out, performs the control and calibration of the testing equipment used by the testing stations and supervises the testing station's quality control by randomly assessing already tested sprayers.

As in Belgium, SKL testing is based on the European standard, EN 13790, which means all items on the sprayer that are necessary to provide safe, adequate and homogenous application of pesticide are checked or measured. Emphasis is placed on the accuracy and uniformity of testing. This is achieved by creating uniform requirements of the sprayers and a uniform way of inspecting the machines. The test is based on visual inspection as well as measurement. The following equipment is required to perform the tests:

- manometer tester: to test the manometer on the sprayer – values on the sprayer's manometer are compared to the manometer tester;
- pump tester: to measure the capacity of the pump on the sprayer;
- horizontal patternator: to measure evenness of nozzle distribution (static); and
- single nozzle output measuring device: to compare the output of a nozzle to that of a new nozzle to assess wear.

SKL is able to certificate organisations, manufacturers and dealers of spraying equipment according to EN 13790, and SKL's quality management system is itself certified under ISO 9001:2000. This certification impacts on the total system of testing: the testing equipment, the test operators, the testing sites and the registration of performed tests. The requirement that the sprayer is approved, well calibrated and in a well-serviced condition is a vital element in food safety certification schemes such as GLOBAL-GAP.

Unlike Belgium, if a sprayer in the Netherlands requires repairs before it is certified, the repairs can be carried out immediately as the testing centres are machinery dealers or manufacturers of machinery. This saves time and money for the farmer/contractor.

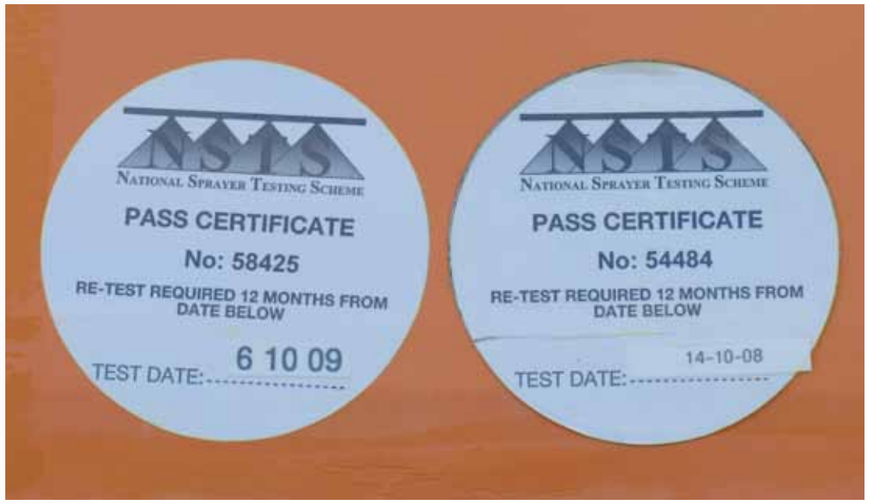
Denmark

The Fellow did not investigate sprayer testing in Denmark but concentrated on speaking to experts to enable to him to truly understand Europe's methodologies.

United Kingdom

The UK operates the NSTS. This scheme was set up as part of the Voluntary Initiative (VI), a range of measures agreed with government to minimise the effects of pesticide on the environment. The NSTS protocol is a series of checks on application machinery to ensure that the machine is functioning correctly and is safe for the operator and the environment. The protocol checks the integrity of the equipment, systems and output to ensure PPPs are being applied correctly. The NSTS equipment certification has since become a requirement of the major crop assurance schemes and supermarket protocols and is now an accepted part of the UK's agriculture.

Participation in the test equates to three National Registration of Spray Operators (NRoSO) continuous professional development points. An applicator must obtain 30 points in a three-year period to maintain their accreditation within NRoSO.



Pass certificates for the UK's NSTS

Unlike Belgium and the Netherlands, which have a tri-annual testing regime, the NSTS is an annual test carried out by certified machine examiners who hold a level three qualification recognised by the National Proficiency Test Council. Examiners are either individuals or employees affiliated with the NSTS. They all have the necessary testing equipment (as listed in the *NSTS Training Manual* for people wishing to become NSTS sprayer testers):

- 6 inch master pressure gauge (accuracy of this gauge must be checked annually);
- means of measuring boom pressures, all common nozzle types required;
- measuring cylinder with 100ml graduations (must be cylinder, not jug);
- stop watch; and
- means of collecting the water ejected from the sprayer for safe and proper disposal.

Pressure gauge testing block for the NSTS

The cost of the test is dependent on the complexity of the machine involved, but in most cases an examiner sets a simple rate per hour, plus travel costs. Repairs required to bring the machine up to the necessary standard are additional. A registration fee for each test is collected by the examiners on behalf of the scheme.

The NSTS protocol contains 47 checks on application machines. The first 30 are mandatory, the next 10 are advisory and the last seven are optional. While the NSTS checks the output of a machine, it is not considered a calibration; calibration is a matter for a trained and qualified instructor. The NSTS ensures the machine is capable of accurate application provided it is set correctly by the operator. See Attachment 2 for a copy of the NSTS Report Form.

Independent auditors conduct random visits of test centres as part of the NSTS Quality Audit process. They watch a test being performed and ensure the test centre not only has the required equipment but that it is able to make the necessary measurements and checks for the test to meet NSTS standards.

Implications for Australia

With the approach of 2016 and the requirement for all EU member states to conduct PAE inspections, Australia must consider the potential trade implications of not having such a scheme in place. However, the development of an Australian sprayer testing scheme needs to be carefully planned, taking into consideration distances to be travelled, the technical expertise of the assessors and the creation of a national administrative body to oversee the program.

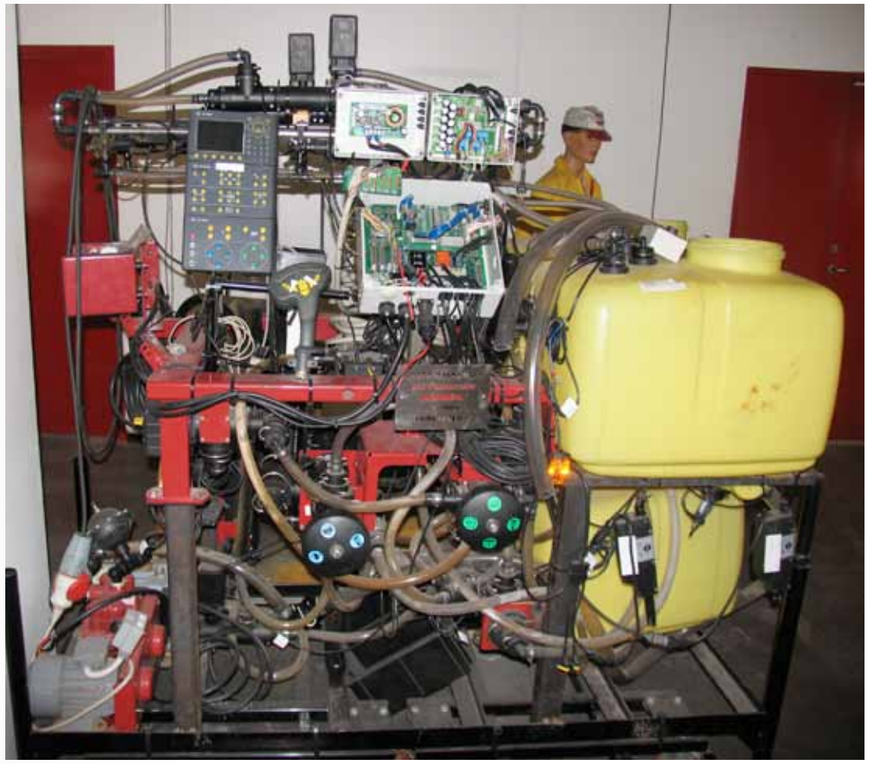
In Europe, relatively speaking, distances to be travelled to have a sprayer inspected are minimal. In Australia this would not be the case, regardless of whether inspection sites were fixed or mobile. Even mobile inspectors, because of the distances to be covered, would not be able to test enough machines in a day to make the scheme cost comparable to our European trading partners.

The implications of moving sprayers to testing stations means that you are adding oversized loads to country roads, a potentially hazardous outcome. Therefore, different thinking needs to be applied, for example, test all new sprayers post production at the point of manufacture against a national protocol that is developed in line with EN 13790.

The technical expertise of the assessors is critical to the success of such a program. From observations made in Europe, it was evident that the inspectors were highly knowledgeable about spray application equipment, but lacked an understanding of the actual application of PPP. The inspection of a sprayer is the perfect time to ensure the machine is accurately calibrated, yet the analytical approach of testing individual parts, as carried out in the Netherlands and Belgium, does not calibrate a machine, nor is this achieved by the UK's NSTS. The development of an Australian scheme must have as its centrepiece machine calibration. Assessors must be thoroughly trained to ensure that they:

- understand legislation relating to PPP;
- understand the application process and the decisions made by the applicator in the planning of a spray job; and
- have an extensive knowledge of the machine to be inspected, including peripherals such as GPS.

Due to the complexities of modern spray equipment, the inspections should be carried out by specially trained technicians from the machine manufacturer.



An example of the complexities of a modern sprayer – HARDI factory, NorreAlslev, Denmark

A potential vehicle for the delivery of this scheme would be the TMA. Firstly, a protocol for testing criteria, based on EN 13790, needs to be developed and agreed upon by all manufacturers. All new machines should be tested and certified before delivery to dealers. A service plan model needs to be developed to allow purchasers of new machinery to opt for ongoing testing. The recommendation would be inspection after one year of service and then tri-annually. Producers catering for an overseas market would then have an opportunity to meet EU standards.

To ensure the success of an Australian sprayer testing scheme, an industry-based national administrative authority would need to be established. This authority would be responsible for creating the sprayer testing protocol in conjunction with manufacturers, relevant government departments and industry groups affected by the creation of such a scheme.

The authority would also be responsible for the coordination of training of assessors, especially in relation to spray planning and legislation. They would also create and maintain a database of all spray equipment inspection results. The authority would be responsible for promoting the scheme to industry, the community and government.

The national administrative authority would be encouraged to develop an incentive program to retire aged sprayers that are beyond compliance, rather than investing huge resources into the testing of these machines.

Buffer Zones

Buffer zones are defined as unsprayed zones along water bodies. The buffer zone width is detailed on a product's label and is based on the toxicity of the product. The reduction of buffer zones can be achieved by using drift reducing techniques.

Belgium

Buffer zone legislation was introduced in 2005 under the Federal Agency of Health, Food Safety and Environment. This was driven by the sustainable use of PPP and issues with surface water quality. The rationale was to develop a simple classification system, easy to use in practice. Data was collated from existing schemes in the UK, Germany and the Netherlands.

The reduction of buffers can be achieved by using drift reducing techniques. There are four drift reduction classes for field crop sprayers. These are determined based on nozzle type, nozzle size and the type of sprayer. Sprayers are classified as:

- standard sprayer;
- air support;
- shielded spray boom;
- band sprayer; and
- band spraying plus shields.

Depending upon the above factors, a drift reduction class is assigned. This provides growers with an incentive to adopt drift reduction technologies. The classes are:

1. 0% (Standard sprayer – no buffer zone reduction)
2. 50%
3. 75%
4. 90%

Field crop sprayers

	Bufferzone on the label (field crop sprayers)						
	2 m	5 m	10 m	20 m			
	Standard technique				50%	75%	90%
Standard	*2 m*	*5 m*	*10 m*	*20 m*	*30 m*	*40 m*	*200 m*
50%	*1 m*	*2 m*	*5 m*	*10 m*	*20 m*	*30 m*	*40 m*
75%	*1 m*	*2 m*	*2 m*	*5 m*	*10 m*	*20 m*	*30 m*
90%	*1 m*	*1 m*	*1 m*	*1 m*	*5 m*	*10 m*	*20 m*

4 drift reduction classes

Effective bufferzone width

- Under all conditions: 1 m non sprayed zone on field edges (Good Agricultural Practice)

Nuyttens Field Crop Sprayers Slide 1

Field crop sprayers

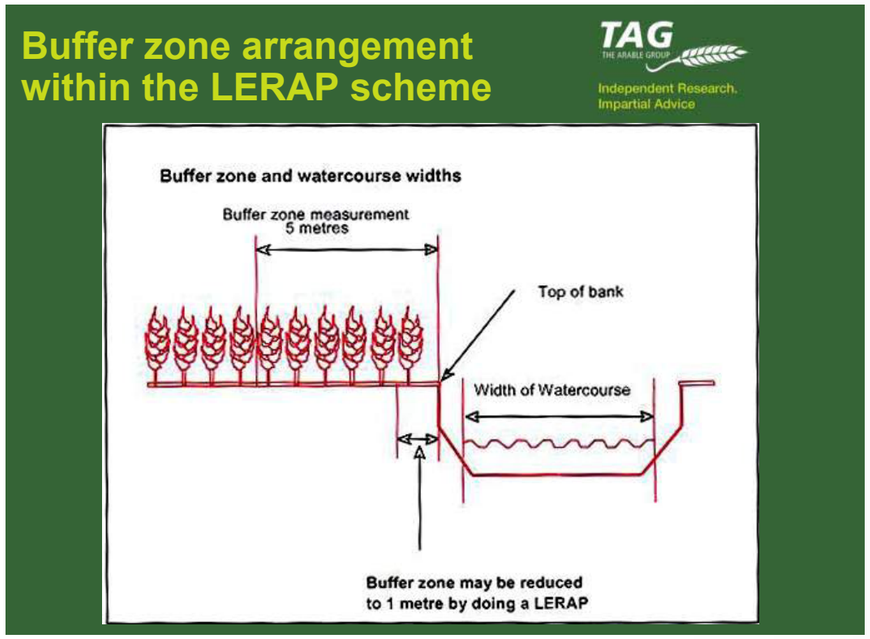
Merk	Type	Dopmaat	Percentage driftreductie volgens spuittechniek				
			standaard spuittoestel 	Luchtondersteuning 	afgeschermde spuitboom	rijen- of beddenspuit 	overkapte rijen- of beddenspuit
Agrotop	TD	ISO 015 – 03	50	90	75	90	90
		ISO 04 – 05	75	90	90	90	90
		ISO 06 - 15	90	90	90	90	90
Albuz	AVI	ISO 015 – 03	50	90	75	90	90
		ISO 04 – 05	75	90	90	90	90
		ISO 06 - 15	90	90	90	90	90
	AVE	geel , oranje, rood	50	90	75	90	90
		groen, turquoise	75	90	90	90	90
		blauw,- grijs, zwart, ivoor, wit	90	90	90	90	90
	ADI	ISO 03 - 15	50	90	75	90	90
	ADE	rood - groen - turquoise - blauw - grijs - zwart - ivoor – wit	50	90	75	90	90
	AXI	ISO 05 - 15	50	90	75	90	90
Hardi	Injet air inclusion nozzle	ISO 015 – 03	50	90	75	90	90
		ISO 04 – 05	75	90	90	90	90
		ISO 06 - 15	90	90	90	90	90
	ISO LD	ISO 03 - 15	50	90	75	90	90
	Hardi LD 4110	rood – wit	50	90	75	90	90
Lechler	ID	ISO 015 – 03	50	90	75	90	90
		ISO 04 – 05	75	90	90	90	90
		ISO 06 – 15	90	90	90	90	90
	IDK	ISO 03 – 15	50	90	75	90	90
	AD	ISO 03 – 15	50	90	75	90	90
	LU	ISO 05 – 15	50	90	75	90	90
Teejet	AI	ISO 015 – 03	50	90	75	90	90
		ISO 04 – 05	75	90	90	90	90
		ISO 06 – 15	90	90	90	90	90
	TT	ISO 03 – 15	50	90	75	90	90
	DG	ISO 03 – 15	50	90	75	90	90
	XR	ISO 05 – 15	50	90	75	90	90
Lurmark	DB	ISO 015 – 025	50	90	75	90	90
		ISO 03 – 15	75	90	90	90	90
	LD	ISO 03 – 15	50	90	75	90	90
Alle andere doppen			0	75	50	75	90

Nuyttens Field Crop Sprayers Slide 2

United Kingdom

The LERAP scheme has been developed for the protection of surface water from overspray and drift. This scheme is based on the following buffer zones:

- 5.0 m from the top of the bank;
- 6.0 m from edge of the water.



Buffer Zone Arrangement within the LERAP scheme

Buffer widths are adjusted based on a risk assessment.

LERAP has three classes of chemicals:

- LERAP A – No adjustment of buffer zone permitted;
- LERAP B – Buffer zone widths to be varied depending on risk assessment; and
- LERAP C – No buffer zone required.

Modification of the width of LERAP depends upon dose rate, the watercourse and the engineering controls (drift reducing capabilities of the application equipment).

LERAP low drift star ratings are assigned to both sprayers and nozzles. Sprayers (boom sprayers and air-assisted tree crop sprayers) undertake field trials while nozzles are tested in wind tunnels.

The LERAP star ratings are as follows:

* drift less than 75% of reference condition;

** drift less than 50% of reference condition; and

*** drift less than 25% of reference condition.

The reference condition is based on nozzle pressure, nozzle height, forward speed, spray configuration, crop condition and application conditions. The LERAP star rating reference condition for boom sprayers is as follows:

- conventional boom structure;
- 12 m wide (24 nozzle) boom;
- 0.5 m boom height;
- short crop (cut grass);
- standard flat fan nozzles 110/1.2/3.0 operating at three bar pressure; and
- spraying water + tracer dye + surfactant.

Reference conditions for nozzles are based on wind tunnel measurements with 2 m per second wind speed and a low turbulence level but greater than 75% humidity. Drift measurements for horizontal sedimentation are taken from a nozzle mounted at 0.6 m high with sampling collectors mounted 100 mm above tunnel floor and at 1.0 m spacings between 2 and 7 metres.

LERAP – combining factors

TAG

Conventional sprayer – no LERAP Star rating

Dose / Watercourse	Full 75.1 – 100%	¾ rate 50.1 – 75%	½ rate 25.1 – 50%	¼ rate 0 – 25%
Less than 3.0 m	5.0 m	4.0 m	3.0 m	2.0 m
3.0 – 6.0 m	3.0 m	2.0 m	1.0 m	1.0 m
6.0 m or wider	2.0 m	1.0 m	1.0 m	1.0 m
Dry ditch	1.0 m	1.0 m	1.0 m	1.0 m

Conventional sprayer – no LERAP star rating

LERAP – combining factors

TAG

Conventional sprayer – LERAP Two Star rating

Dose / Watercourse	Full 75.1 – 100%	¾ rate 50.1 – 75%	½ rate 25.1 – 50%	¼ rate 0 – 25%
Less than 3.0 m	2.0 m	2.0 m	1.0 m	1.0 m
3.0 – 6.0 m	1.0 m	1.0 m	1.0 m	1.0 m
6.0 m or wider	1.0 m	1.0 m	1.0 m	1.0 m
Dry ditch	1.0 m	1.0 m	1.0 m	1.0 m

Conventional sprayer – LERAP Two Star Rating

The Netherlands and Denmark

The Fellow did not investigate buffer zones in the Netherlands or Denmark but concentrated on speaking to experts to enable to him to truly understand Europe's methodologies.

Implications for Australia

Both schemes adopted by Belgium and the UK provide growers with well-defined techniques to reduce buffer zones. This is a clear incentive for growers to adopt drift reducing technologies to reduce the off-target impact of PPPs. It is important that Australia considers both of these methodologies when developing drift reduction technologies under the APVMA's Operating Principals for Drift Risk Assessment.

The APVMA's methodology to date is relying too heavily on computer modelling alone. The fact that Belgium and the UK have incorporated field trials in their assessment process complements the wind tunnel data. These methodologies should be explored and expanded upon to develop reference conditions for Australian spraying as there are significant differences in ground speed (Australians drive faster); boom width (Australian booms are often much wider); and nozzle release height (in Australia this is higher because of the increase in ground speed and boom width). Weather conditions must also be integrated into field drift trials to explore the implications of heat, humidity and temperature inversions as these are commonplace conditions for Australian applicators.

The reliance on computer modelling as a single tool for determining buffer zones will lead to much wider buffer zones. Australian farmers need a system that is based on practical research to provide encouragement to adopt drift reducing technologies.

Knowledge Transfer: Applying the Outcomes

The EU has set down a very prescriptive plan for the sustainable use of pesticides. Part of this challenge is to recognise and harmonise current regulations that exist within member states and this is leading to significant debate.

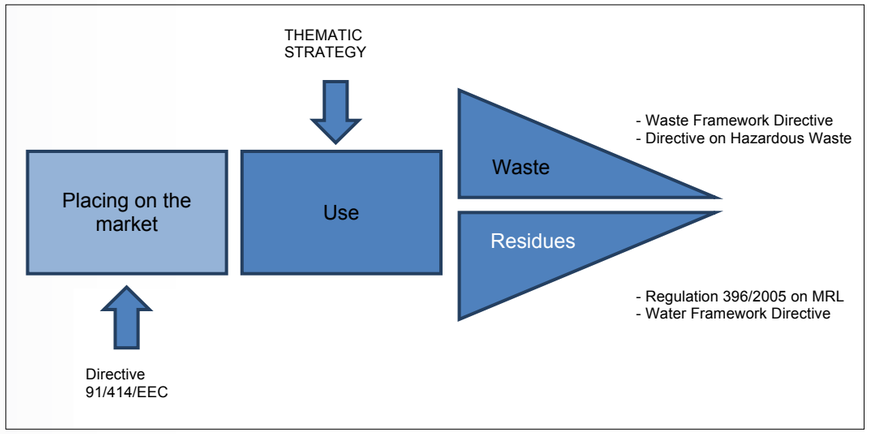
Despite substantial efforts to prevent the undesirable effects of pesticides on human health and the environment, incidences of excess residues and environmental contamination still occur. The adoption of the 6th Environment Action Program (6EAP) by the European Parliament recognises that the impact of pesticides on human health and on the environment must be further reduced.

The community at large is suspicious of pesticide use and there are many examples of how governments react to the power of public opinion. However, a need for the sustainable use of pesticides is paramount due to the pending increases in food production because of population growth.

Australia must have a clear understanding of the trends in European environmental legislation, particularly those outlined in the EU Thematic Strategy for Pesticides. Australia needs to raise its profile in the development of international standards and to ensure that our existing system is recognised by European trading partners.

EU Thematic Strategy for Pesticides and its Objectives

The development of the EU Thematic Strategy for Pesticides aims, *"To achieve a more sustainable use of pesticides and a significant reduction in risks in the use of pesticides consistent with necessary crop protection"*.[10] The European Parliament recognised there was a legislative gap within the EU in relation to pesticide use.



Label – Legislative gap at EU level in the use-phase of pesticides[11]

Objectives are:

- Minimise the hazards and risks to health and the environment for plant protection PPP use in plant protection.
- Improve controls, use and distribution of PPP.
- Reduce the level of harmful active substances including the substitution with safer alternatives.
- Encourage low input or pesticide-free cropping systems.
- Establish a transparent system for reporting and monitoring the objectives.

Measures within the thematic strategy include:

- Establishment of National Action Plans (NAP) to reduce hazards and control risks with PPP.
- Stakeholder consultation in development of NAPs.
- Mandatory education awareness raising, training and licensing of all professional PPP users.
- Standardisation and compulsory control of application equipment and sprayer testing.
- Restriction of aerial spraying.
- Defining areas of strongly reduced or zero pesticide use.
- Collection of PPP packaging and unused obsolete products.
- Monitoring of results and collection of information to establish harmonisation of the strategy.

Australia has many of the areas outlined in the EU Thematic Strategy for Pesticides well in hand. However, Australia could not survive without an aerial application industry as was evident in the 2010 wheat growing season with aerial sprayers responsible for protecting many thousands of hectares due to boggy conditions.

Australia has a well-developed training regime for pesticide application, but the quality of this training and the lack of consistency between states needs immediate attention. Issues arise with the use of PPPs so it makes sense to focus on practical aspects when training occurs. Sprayer testing should be integrated into application training.

Many pesticide application trainers are training well outside their area of expertise when instructing on the set up of application equipment. This is a failure of the bodies that review and regulate training within Australia. The fact that applicators can do training online should be more of a concern to the community than the use of pesticides in general. Online training does not deliver the exposure to the practicalities of spray application, which is essential if applicators are to minimise the risks associated with spraying.

In the 1980s and early 1990s, operator safety was at the heart of regulation until the focus shifted in the mid-1990s to environmental protection when the protection of water quality became the main concern. Many legislative changes have focused on drift as the major cause of water contamination, with less concentration on diffuse point source pollution, for example, soil, drains, equipment filling and cleaning procedures.

Bals highlights a different regime within Europe and the UK to legislation.

- UK regulations concentrate on guidance and outcomes
- German regulation uses engineering measures and standards.[12]

These approaches lead to different regulatory regimes. Bals warns of the danger of having standards that are too prescriptive, based on current methods of application, as they may result in reduced innovation.[13] There is also a danger that there is a lack of industry involvement in the development of standards. Bals highlights the limited involvement in the development of standards of the agrochemical industry or of farmers when they are actually using the chemicals.[14]

Australia needs to raise its profile in the development of international standards so we are recognised for what we are doing and not forced to change systems to comply with a majority vote that is not necessarily globally representative.

Knowledge Transfer: Applying the Outcomes

Sharing of Knowledge

Since his return, the Fellow has been working with GITN to deliver Don't Be A Drifter workshops in NSW, the ACT, SA, Tasmania and Victoria. He is working with the Department of Primary Industries in Victoria, firstly, by delivering training as part of Environmental Management Action Planning and, secondly, by making two videos that promote techniques for better spray application. Day will be presenting at the Birchip Cropping Group forum in July 2011 and he has already conducted an information session at a Farmlink seminar in Junee, NSW.

The Fellow will continue to deliver one- and two-day courses across Australia with his Level III and Level IV accredited programs. These courses include the use of dye technology that allows farmers to actually see, under a Lambino light, the efficaciousness of various nozzles under a specified set of conditions. The opportunity is also given to spray applicators to have their spray units calibrated and spray plans developed that help manage risk in direct alignment with the APVMA's requirements. If required, occupational health and safety support is also provided. Integral to this training is the knowledge acquired from overseas about spray application equipment, sprayer testing and international standards.

Spray Safe and Save, now the Fellow has returned, is actively seeking to work with chemical training bodies to 'train the trainer' on the skills they need to communicate the best methods available to manage issues of sprayer set up and drift management to chemical users.

Recommendations

Government

- Fast track COAG process through the Product Safety and Integrity Committee to harmonise chemical user training throughout Australia.
- Review the value of online chemical user training.
- Actively involve Australia in the development of international standards in order to ensure that a) our voice is heard and b) we are recognised for current practices and systems.
- Review drift reduction technology systems that are in place in Belgium, the Netherlands, Denmark and the UK and incorporate these findings in the development of Australian buffer zones.
- Customise buffer zones according to the risk profile of the particular agricultural sector, for example, broad acre, vegetable, amenity horticulture, in relation to the equipment used and the ground speed of the operation.
- Invest money in the training of undergraduate university students in application technology to ensure a more effective transfer of application information between the agronomy sector and the chemical user.

Education and Training

- Training organisations need to invest, as a matter of urgency, in improving the standard of trainers delivering chemical user courses.
- Seriously consider the abolition of online chemical user training as it does not cover practical elements, such as calibration of spray units. Training must be practical if risk management is to be effectively addressed. The APVMA's Operating Principals to Minimise Spray Drift Risk must be incorporated into the training of pesticide applicators. A national training program that incorporates a risk-based rationale to plan and manage spray application must be developed. This will provide an opportunity to communicate to applicators information regarding nozzle selection, suitability of weather for spraying, identification of down-wind no-spray buffer zones and the implementation of drift reduction technologies. This is an integrated approach, using the research information but also bringing in a holistic approach giving consideration to all factors that impact on application.
- Incorporate sprayer testing protocols into chemical user training based on EN 13790 (2003) Agricultural Machinery – Sprayers – Inspection of sprayers in use.
- Develop return-to-industry training for trainee agronomists to improve skills in practical application technology, that is, boom spray set-up and operation.
- Develop resources to support the farmer in assessing application equipment and planning set-up and operation.
- Improve training of applicators to ensure sprayer set-up is correct when using GPS technology.
- Up-skilling of agronomists, equipment manufacturers.
- Develop a practical spray application program for undergraduate students of agriculture where they operate spray equipment as part of a joint initiative between private enterprise and universities. Aim to develop a trial between Spray Safe and Save and Charles Sturt University, Wagga Wagga.
- Review secondary school curriculum in regard to chemical application technology and ensure adequate information is included in relation to chemical use.

Industry

- AgriFood Skills Australia to promote current Australian practice in relation to chemical use and application in an international forum.
- AgriFood Skills Australia to communicate to the broader community the essential role of chemicals in food production and highlight the importance of chemicals in the functioning of any integrated pest management strategy.
- AgriFood Skills Australia to support industry in the development of higher level application training, targeting chemical users, manufacturers, trainers and students of agronomy.
- TMA to investigate the development of annual sprayer testing as part of a sales package extending over the first four years of a sprayer's life. This would allow exporters to meet proposed European requirements, if necessary.
- Develop an Australian testing protocol for all new sprayers that is harmonised to EU standards. Include an awareness of the limited value of patternation; instead focus on the importance of accurate flow meters and tank volumes.
- Improve the rate of adoption of new technologies to narrow the skills transfer lag that exists in agriculture. This can only be addressed through training and extension.

Community

- Actively enter the debate regarding chemical use to provide informed and balanced information on what is often an emotional and subjective discussion.
- The current push to follow a European model and restrict chemical availability will have a severe impact on agricultural production at a time when population growth forecasts require a doubling of current production within 30 years. The community must be made aware of this requirement, but it is up to industry, on all levels, to gain community confidence.
- Community concerns over chemical use must be heard and addressed in a thoughtful and inclusive manner.

International Specialised Skills Institute

- Promote the debate about the chemical user training skills deficit that exists not only within Australia, but also internationally. Shift the focus to chemical application and the end user. Environmental issues related to chemicals originate from the use phase. Strategic investment in improving chemical user knowledge would mitigate concerns and deliver on the aims and objectives of legislation changes, such as, drift management.
- Encourage government and industry to attract and retain key individuals in spray application research, training and policy development, with a particular emphasis on the recruitment of younger people.
- The offering of further Fellowships within the spray application industry would be advantageous.

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Attachments

Development of New Pesticide Application Machinery

to be held at the Olde Barn Hotel, Marston, Lincs, UK

on 21st October 2010

Programme

09.15	**Registration and coffee**
09.45	**Introduction** – Paul Miller (The Arable Group, Silsoe, Beds
10.00	**Improved sprayer control** – Andrew Kneen (Househam Sprayers Ltd, Lincs)
10.25	**Regulation and innovation in application equipment** – Tom Bals (Micron Sprayers Ltd, Bromyard, Herefordshire)
10.50	**Increasing automation in the spraying process** – Mark James (John Deere Ltd, Langar, Notts)
11.15	**Coffee**
11.45	**Improving the efficiency of potato seed treatment application** – Ben Magri (Syngenta Crop Protection UK, Cambridge)
12.10	**Discussion**
12.25	**Lunch**
13.30	**Loading of water disposable granules into field crop sprayers** – Dilwyn Harris (Dow AgroScience Ltd, Hitchin Herts), William Taylor (Consultant, North Leigh, Oxon) Simon Cooper (Harper Adams University College, Newport, Shropshire)
13.55	**Development of Crop Adapted Spray Application (CASA) sprayer for orchards** – Jan van de Zande (Plant Research International, Wageningen, the Netherlands), Greg Doruchowski (Research Institute of Pomology and Floricultre, Skerniewicze, Poland), Paolo Balsari (DEIAFA, Universita di Torino, Grugliasco (TO), Italy), Marcel Wenneker (Applied Plant Research (WUR-PPO-Fruit), Zetten, the Netherlands)
14.20	**Discussion**
14.35	**Exhibition**
16.00	**Tea and depart**

Attachment 1

NSTS
NATIONAL SPRAYER TESTING SCHEME

Previous Report No

NSTS Report Form
(Hydraulic nozzle application)

This report must be conducted in conjunction with the appropriate reference sheet

Report No Date .....

Test Company .....

Test Location: Test Centre ☐ Farm ☐ Other (Please Specify) .....

Sprayer Type / Sector: Agricultural ☐ Amenity ☐ Horticultural ☐

Self Propelled ☐ Demount ☐ Trailed ☐ Mounted ☐ Other (Please Specify).....

Self Propelled / Vehicle Reg N°.....

Sprayer Make .....Model.....

Year of Manufacture ..... Boom Width .....(Metres) Tank Capacity .....(Litres)

Sprayer serial No. ..... Total Machine Hectares per annum ☐

Sprayer Owner .....

Address (in full with postcode) .....

.....

.....Post Code .....

Test Result **PASS** ☐ **FAIL** ☐ **Operator Present** **YES** ☐ **NO** ☐

Examiner: (Print Name) .....

NPTC Certificate N° .....Signed (Examiner) .....

Fault identification and confirmation of **R**epair (please tick as appropriate)

Code	F	R	Code	F	R	Code	F	R	Code	F	R	Code	F	R	Code	F	R
1			10			19			28			37			46		
2			11			20			29			38			47		
3			12			21			30			39					
4			13			22			31			40					
5			14			23			32			41					
6			15			24			33			42					
7			16			25			34			43					
8			17			26			35			44					
9			18			27			36			45					

White - NSTS copy Yellow - Test Centre copy Pink - Machine Owner copy

Attachment 2

ITEMS 1 - 30 ARE PASS/FAIL ITEMS		Pass	Notes
1	Guards, inc. PTO Guard - Complete and correct		
2	Free from leaks, all connections - visual inspection		
3	Hoses in good condition		
4	Pressure gauge/s, legible - scale and graduations		
5	Reading zero - record error		
6	Gauge accuracy **Test Gauge Pressure** **Actual Gauge Pressure**		
7	Free from leaks under pressure - above normal working pressure **Test pressure** **bars**		
8	Pressure stable and adjustable		
9	Measure pressure differential between operator gauge and the centre of spray boom. **Record differential**		
10	Uniform pressure across boom **Record on attached sheet**		
11	Controls, master ON / OFF		
12	Boom section controls ON / OFF		
13	DCV's working correctly – No drips		
14	Consistent pressure when boom sections shut off		
15	Spray patterns unobstructed		
16	Nozzles - consistent height and spacing		
17	Nozzle flow rates **Record on attached sheet**		
18	Tank lid intact, secure and with seal intact		
19	Tank security - mountings - inc front tank		
20	Tank agitation functioning with all nozzles spraying		
21	Operating labels – complete and legible		
22	Contents gauge legible		
23	Filters in good condition		
24	Hydraulic system free from leaks		
25	Pneumatic system free from leaks - if applicable		

Attachment 2

		Pass	Notes
26	Chemical induction system - working - if fitted		
27	Chemical induction system - free from leaks		
28	Induction system control labels, complete and legible		
29	Induction rinse system and container rinse - working		
30	Main sprayer tank rinse system working - if fitted		
FOLLOWING ITEMS ARE CAUTIONARY NOTE ITEMS			
31	Structural wear and corrosion		
32	Security of sprayer mounting points - demounts and self propelled		
33	Security of hitch points and drawbar - mounted and trailed		
34	Boom straight and height adjustable		
35	Boom transport position correct and secure		
36	Boom suspension and return to level		
37	Boom mounting points and linkages, yaw		
38	Boom break backs, working		
39	Clothing locker – Clean and used for purpose - if fitted		
40	Clean water supply for personal hygiene - if fitted		
OPTIONAL ITEMS	**CARRIED OUT**		
41	Patternation test **YES/NO**		
42	Lights and indicators working correctly **YES/NO**		
43	Wheels and tyres, condition **YES/NO**		
44	Hydraulic hoses, condition **YES/NO**		
45	Pneumatic hoses, condition **YES/NO**		
46	Electrical wiring, condition **YES/NO**		
47	Power unit oil/fuel/water leaks **YES/NO**		

Disclaimer:

1. *No responsibility whatsoever is accepted for any subsequent mis-applications by the equipment tested due to defects, whether reported or undetected, or which develop after the test date.*
2. *The NSTS endorsement of this test, and the consequent use of its name in association with the test, is conditional on the procedures contained herein being strictly adhered to, without variation or amendment.*
3. *Certain information will be made available to Crop Assurance Schemes for verification purposes*

Attachment 2

Use columns A & B for Boom Pressures and columns 1,2,3,4 & 5 for nozzle flow rates

Boom pressures @ ..... bars		Nozzle locations	Nozzle flow rates ..... bars (Please fill in the nozzle no. next to 12345)				
A	B	FROM LEFT Direction of travel	1.....	2.....	3.....	4.....	5.....
		1					
		2					
		3					
		4					
		5					
		6					
		7					
		8					
		9					
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Attachment 2

Attachments

Use columns A & B for Boom Pressures and columns 1,2,3,4 & 5 for nozzle flow rates

Boom pressures @ ..... bars		Nozzle locations	Nozzle flow rates ..... bars (Please fill in the nozzle no. next to 12345)				
A	B	From left Direction of travel	1.....	2.....	3.....	4.....	5.....
		49					
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Attachment 2