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REPORT OF THE OECD PESTICIDE RISK REDUCTION STEERING GROUP SEMINAR "PESTICIDE RISK REDUCTION THROUGH BETTER APPLICATION TECHNOLOGY"

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Series on Pesticides

No. 35

REPORT OF THE OECD PESTICIDE RISK REDUCTION STEERING GROUP SEMINAR

"PESTICIDE RISK REDUCTION THROUGH BETTER APPLICATION TECHNOLOGY"

IOMC

INTER-ORGANISATION PROGRAMME FOR THE SOUND MANAGEMENT OF CHEMICALS

A cooperative agreement among

UNEP, ILO, FAO, WHO, UNIDO, UNITAR and OECD

Environment Directorate
ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT
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ABOUT THE OECD

The Organisation for Economic Co-operation and Development (OECD) is an intergovernmental organisation in which representatives of 30 industrialised countries in North America, Europe and the Asia and Pacific region, as well as the European Commission, meet to co-ordinate and harmonise policies, discuss issues of mutual concern, and work together to respond to international problems. Most of the OECD's work is carried out by more than 200 specialised committees and working groups composed of member country delegates. Observers from several countries with special status at the OECD, and from interested international organisations, attend many of the OECD's workshops and other meetings. Committees and working groups are served by the OECD Secretariat, located in Paris, France, which is organised into directorates and divisions.

The Pesticide Programme was created in 1992 within the OECD's Environmental Health and Safety Division to help OECD countries:

- harmonise their pesticide review procedures,
- share the work of evaluating pesticides, and
- reduce risks associated with pesticide use.

The Pesticide Programme is directed by the Working Group on Pesticides, composed primarily of delegates from OECD Member countries, but also including representatives from the European Commission and other international organisations (*e.g.* United Nations Food and Agriculture Organization, United Nations Environment Programme, World Health Organization, Council of Europe), and observers from the pesticide industry and public interest organisations (NGOs).

The Environment, Health and Safety Division publishes free-of-charge documents in ten different series***:*** **Testing and Assessment; Good Laboratory Practice and Compliance Monitoring; Pesticides and Biocides; Risk Management; Harmonisation of Regulatory Oversight in Biotechnology; Safety of Novel Foods and Feeds; Chemical Accidents; Pollutant Release and Transfer Registers; Emission Scenario Documents; and the Safety of Manufactured Nanomaterials.** More information about the Environment, Health and Safety Programme and EHS publications is available on the OECD's World Wide Web site (http://www.oecd.org/ehs/).

This publication was produced within the framework of the Inter-Organization Programme for the Sound Management of Chemicals (IOMC). It was approved for derestriction by the Joint Meeting of the Chemicals Committee and the Working Party on Chemicals, the governing body of the Environment, Health and Safety Division.

The Inter-Organization Programme for the Sound Management of Chemicals (IOMC) was established in 1995 by UNEP, ILO, FAO, WHO, UNIDO and the OECD (the Participating Organizations), following recommendations made by the 1992 UN Conference on Environment and Development to strengthen co-operation and increase international co-ordination in the field of chemical safety. UNITAR joined the IOMC in 1997 to become the seventh Participating Organization. The purpose of the IOMC is to promote co-ordination of the policies and activities pursued by the Participating Organizations, jointly or separately, to achieve the sound management of chemicals in relation to human health and the environment.

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Seminar Report

Risk Reduction through Better Application Technology

30 November 2005
Wellington, New Zealand

Introduction

This report presents the results of an OECD seminar on pesticides risk reduction through better application technology. The purpose of the seminar was to:

- Identify key opportunities to achieve pesticide risk reduction through better application technologies;
- Review technical requirements for application *equipment and technologies*, e.g. minimum requirements and standards for technologies and equipment, and certification for performance, maintenance and control of application equipment;
- Review certification programmes for *workers* and *applicators*;
- Review *regulatory* (e.g. equipment inspections) and *voluntary* (e.g. spray drift management guidelines) mechanisms that exist, which address these issues;
- Consider how countries could *stimulate the development and use* of pesticide application technologies that reduces risks (to human and the environment), also with respect to *the economics and practicability* of such technologies; and
- Identify options available to OECD countries and key stakeholders in OECD and non-OECD countries regarding steps that can be taken to address these issues.

The seminar was co-hosted by the New Zealand Environmental Risk Management Authority and the New Zealand Food Safety Authority, and held at the Te Papa National Museum in Wellington, New Zealand, on 30 November 2005. It was chaired by Dr Wolfgang Zornbach of the German Federal Ministry of Food, Agriculture and Consumer Protection.

This was the fifth[1] in a series of seminars on pesticide risk reduction organised by the OECD Pesticide Risk Reduction Steering Group, a sub-group of the OECD Working Group on Pesticides. The seminars focused on key issues in pesticide risk reduction of concern to OECD governments. The seminars were intended to provide an opportunity for discussion, learning and information sharing.

The OECD Pesticide Risk Reduction Steering Group selected application technologies as the topic of this seminar because of its potential for pesticide risk reduction in the fields of human health including worker protection as well as the environment. Earlier work in the context of the International Conference on Pesticide Application for Drift Management (Hawaii, October 2004), including its proceedings were used as background material. The conference proceedings are available at:
http://pep.wsu.edu/Drift04/proceedings.html.

[1] The Risk Reduction Steering Group has held four seminars to date: on compliance (2003), minor use (2003), container management (2004) and labelling (2005). Outputs from these seminars are available at: www.oecd.org/env/pesticides, in the "Don't Miss" box on right, click on "Risk Reduction".

Other relevant work includes the European Network for Testing of Agricultural Machines (ENTAM) efforts to develop legal requirements for application equipment. Also, the European Committee for Standardisation (CEN) and the International Standards Organisation (ISO) have already adopted and continue to adopt standards for certification of new equipment and regular inspections of equipment in use. Finally, the FAO has adopted several guidance documents on this issue.

Participants

Forty five people attended the seminar including representatives of:

- the pesticide regulatory authorities of Australia, Canada, Denmark, Germany, Japan, New Zealand, the US, and the European Commission;
- the International Standards Organisations (ISO) in Australia;
- the pesticides industry and application equipment manufacturers; and
- a public interest organisation, the Pesticide Action Network, from Aotearoa, New Zealand.

A participants list is attached in Annex 1.

Scope

The seminar considered opportunities for risk reduction through better pesticide application technologies. It considered a variety of technology options with such opportunities (*e.g*. equipment and techniques for reducing spray drift, technical requirements for spraying, establishing buffer zones, etc). While pesticide application technologies for agricultural use was the primary focus, the seminar also addressed municipal (*e.g.* for bio-security, mosquito control) and other non-agricultural sectors as they are also important in some OECD countries.

The seminar considered the role of government and others in promoting innovations in modern, lower risk technologies and their adoption. Issues of safe handling closely related to application technology such as filling and cleaning of sprayers were also addressed. The seminar discussed areas such as minimum technical requirements, standards and certification for performance, maintenance and control of application equipment and technologies, and training and certification of workers and applicators. Regulatory requirements that address these areas, such as inspections of application equipment, were presented during the seminar. Also, voluntary measures such as guidelines addressing these technical requirements were reviewed.

Structure

The seminar followed the established format developed for the RRSG seminar series, with presentations in the morning and roundtable discussions in the afternoon. The morning session was devoted to presentations by experts from governments and stakeholders, including a standards organisation, industry, users/sprayers and a consumer NGO.

Presentations and Papers

All speakers were invited to provide papers that:

- Reviewed their government's or organisation's experience with application technologies for pesticide risk reduction;
- Described regulatory requirements and standards, and/or voluntary guidelines/codes regarding application technologies and risk reduction;

- Presented technical requirements and/or standards for application technologies, as well as maintenance and control of application technologies; and
- Addressed economic aspects related to innovation and adoption of lower risk application technologies, and any measures in place to promote them.

The presentations are attached in Annex 2.

Government Experience and Perspectives

Australia

- In Australia, current major approaches to Spray Drift Risk Management include control of droplet size, wind speed limits for use, spray release height limits, protective buffer zones, and specification of equipment type and arrangement. Protective buffer zones are only used when no other approach would be adequate.
- Labels on pesticides products refer to the ASAE S572 standard as a way of prescribing droplet spray quality. Computer modeling tools support the view that spray quality (droplet size) is one of the most important parameters to control in order to reduce risk.
- Australia currently uses the AgDRIFT model as its principal predictive tool but also makes use of AGDISP, a Gaussian Diffusion model and specific data sets as a way of determining buffer zone size.
- As part of the implementation of its updated spray drift risk management approach, Australia intends to promote uptake of improved, drift reducing technology by providing label incentives related to buffer zone reduction when drift reducing technology and methods are used.
- Beginning in 2007, Australia hopes to implement its new approach by applying it to new labels and upgrading existing product labels on a prioritized basis over the next several years.

Japan

- Japan has carried out research to see the general risk tendency during 2005. Its main objective was to identify the reality of agro-chemical usage and exposure. A questionnaire was distributed, concerning chemical usage on urban greens including road trees, parks and greenery on city buildings. The questionnaire was sent to 267 cities with population of 100,000 or more. Most of the city governments have responded, and 86 percent indicated that they use chemicals for greenery management.
- The frequency of application has no clear difference compared with other greenery. Cities normally use “engine set power sprayers” or “small sprayers”. They are known to fit for small areas and precise application where the drift problem is not serious.
- However, the major spraying method for trees was reported as “to blow up from the ground”. In addition, the use of “gun type nozzle”, which is widely used in the major cities in Japan, is known labour-saving and efficient but it causes certain drifts.
- Generally speaking, Japan’s city governments have made every effort to avoid exposure of inhabitants to pesticides. Nevertheless, there might be several points to be improved. Regarding improvement of equipment, wider use of rough mist nozzles would be one of the important issues in Japan to reduce drift or exposure risk. Avoidance of “blow up” application or setting adequate “keep off” area would be other important points to be improved.
- In consultation with specialists, Japan will start a project to rank equipments depending on their performance in reducing drifts or other run outs. The government will publish the results so that farmers or city governments can select appropriate technologies and equipments fitting for their

needs. By doing so, the government hopes better equipment will have higher chance to be widely used.
- Japan will use the research results for the project in setting the pre-conditions of the ranking later on.

In the second presentation, the delegate presented the trends in the formulation type and spray technique of risk reduction in paddy field over the past 25 years.

- Among the various formulations including dust, granule, emulsion, water soluble powder, the use of dust is recently in decrease due to the drift problem. Improved pest control systems have been found more effective and labour-saving.
- The advanced seeding box treatment technology was introduced in the 1990s and has played a significant role in reducing pesticide use.
- Regarding paddy rice, young rice plants are grown in the seeding box. Then, they are planted in paddy fields. Advantages of such system include the long duration of the effectiveness of active ingredients, slow release formulation, combination of formulation of fungicide and insecticide, and lower dosage rate than field application.
- Governmental measures include developing guidance documents on pesticide risk reduction, establishing educational programs, and promoting understandings of the necessity of reducing pesticide drift.
- Some industry and research body have developed spray nozzles and advanced sprayers reducing the drift.

Germany

- In Germany, a declaration procedure for new sprayers is mandatory since 1988. The BBA (Federal Biological Research Centre for Agriculture and Forestry) evaluation ensures that new plant protection equipment complies with appropriate legal requirements.
- The areas which require testing by the BBA include the function of drift reduction (wind tunnel, field testing). Currently 257 types of approved drift-reduced plant protection equipment (50, 75, 90, 99 %) are available.
- Germany follows European testing of sprayers with mutual recognition among test stations. ENTAM (European Network for Testing Agricultural Machines) aims mutual recognition of testing activity; creation of a network of skilled laboratories; and development of common activities.
- Within German experience, voluntary testing, including technical measurements and extensive field testing of new sprayers, is found helpful to ensure the suitability of new equipments. When the results are proved sound, equipment is approved by the BBA and a test report is published.
- Setting standards is necessary not only for farmers but also for manufacturers and testing authorities. They help saving resources, facilitating mutual recognitions of tests, and making a wider range of tested machinery/equipment available.
- Germany has long experience in inspection of sprayers, and sprayer inspections are obligatory by law. Method 1 (measurement of cross distribution) is applied in Germany when equipment is inspected for the first time.
- The standard that Germany applies to the sprayer inspection is based on the European standard, EN 13790 and includes the measurement of cross distribution. The adjustment of the German sprayer inspection to European standards will not result in any major changes to the current inspection procedure.
- The BBA has been supporting further steps for harmonisation of sprayers inspection across Europe in agreement with the European Commission.

United States

- Since the 1990s, the US EPA Pesticide Program has expanded its spray drift database and developed modeling to improve the quality of its estimates of spray drift from different types of pesticide applications and uses on a pesticide specific basis. These improvements promote more informed decisions for risk assessment/mitigation and product licensing. The US uses its estimates of risks to the environment and human health from spray drift of each pesticide to determine the appropriate drift restrictions for each pesticide label.
- In addition to these improvements for risk assessments and mitigation, the US EPA is developing a program to promote the use of drift reducing technologies by pesticide applicators and better education on drift reduction techniques for applicators. US EPA believes these efforts will ultimately be successful in reducing spray drift and incidents of adverse environmental and health effects. The US EPA acknowledges the success of European programs on application equipment and is considering elements from these programs that may assist in development of the US drift reduction technology program.
- US EPA's Pesticide Program and the R & D Program are collaborating with the chemical and equipment industry, universities, and other experts to develop a program to identify types of technologies (drift retardant chemicals and equipment) that have the potential to significantly reduce spray drift. EPA is following its successful approach for partnerships of government and industry to solve environmental problems--EPA's Environmental Technology Verification Program which provides credible performance data for commercially available environmental technologies. The system benefits vendors, purchasers, users, and ultimately the public.
- US EPA is developing a standard test protocol for technology vendors to voluntarily use to measure potential spray drift reduction of their equipments and drift retardant chemicals. Types of technologies tested with the protocol and shown to significantly reduce spray drift can be recommended for use by pesticide chemical companies on their pesticide product labels.
- The DTP project has been enthusiastically supported by a diverse group of stakeholders. These technologies will allow pesticide applications to be equally, or more, protective of the environment and the health of those in the vicinity than current methods. In addition, applicators will have more flexibility in making application decisions. Use of drift reduction technologies will allow more targeted, and therefore more effective, pesticide applications.
- US EPA hopes to have the test protocol completed and ready for use by vendors by late 2006. As more vendors voluntarily test their equipment and drift reducing equipment technologies are identified and included on pesticide product labels, US EPA believes this will promote development, marketing, and use of such equipment and ultimately reduce spray drift, risks, and adverse effects.

New Zealand

- In 1995, ENZA[2] imposed "a mandatory calibration requirement" for pipfruit growers in response to a US market access crisis. In 1995, calibration requirements were speed check, total flow check or flow meter check, working tachometer and pressure gauge, fan clutch check, documentation for drenching, spring and full canopy spray applications, calibrator training, and sprayer registration numbers.
- In 1998, attempts were made to introduce individual nozzle flow tests and reference to target canopies. This was not viable for providers of "free" calibration services, so requirement for independent calibration checks was shifted from annual to biennial

[2] The name under which the New Zealand Apple & Pear Marketing Board trades.

- EUREP GAP[3] standards for export fruit and NZ FQPA standards for local production have been introduced since 2000. Since the AGMARDT project identified the necessity of calibration, New Zealand Agrichemical Education Trust Calibrator Training has focused on the following areas; (1) review of international calibration systems and requirements (2) emphasis on nozzle output checking, plume management and matching output targets (3) Ca.70 calibrators trained nationally (4) Ca.1,500 calibrations per year in pipfruit; (5) increase of demand on calibration for equipments used for other crops.
- In order to protect sensitive areas, NZS 8409:2004 Management of Agrichemicals[4] identified sensitive areas by legislation (the Resource Management Act 1991), which include schools/houses, roads/footpaths, watercourses, organic crops & other crops that have been considered on a case-by-case basis to be sensitive under that Act.[5] Agrichemical users are required to develop specific strategies to minimise spray movement onto those areas.
- There is no single solution to risk reduction in agrochemical uses; buffer zones and calibration standards are only partial solutions; nozzle/adjuvant technology offer immediate advances. Policy integration is important, that is, integrating risk reduction polices in a package which will encourage user adoption. Appropriate communicative mechanisms are needed to deliver the right messages to agrichemical users.

Stakeholder Experience

Standards Organisation: International Standards Organisation (ISO)

- New ISO drift-related standards (measurement and classification) have recently been developed. In advancing the DRT (Drift Reduction Technologies) verification, testing requires appropriate protocols, standards and test methods. DRT options include entire sprayers (e.g. air assisted boom sprayers, tunnel sprayers), specific parts of sprayers (e.g. nozzles), modification devices (e.g. reverse venturi chamber, shields, shrouds) wing tip devices, pulsed flow modulation, adjuvants (e.g. drift control agents, hedges and barrier vegetation or structures). Each of these can be tested differently and consideration has been made on how to tie these different elements with modeling.
- Specific parts of sprayers can often be tested in low speed wind tunnels simulating the field – removing the need for expensive field trials and covariate approach. Primary example is a nozzle type (e.g. twin fluid "air induction"; pre-orifice; rotary atomisers). Draft ISO standards cover test methods and drift classification.
- ASAE droplet size classification standard and draft ISO version are under development.
- Test guidelines are introduced on background for pesticide aerial drift evaluation (EPA 840.1000), spray droplet size spectrum (EPA 840.1100), spray drift field deposition (EPA 840.1200).
- International interactions have been achieved in this field, the major experience include ISO and Buffer Zone Working Group meetings, international conference on spray drift and WHO's activity on drift management for specific applications, e.g. space spraying at present.

[3] The Euro-Retailer Produce Working Group (EUREP). It has evolved into an equal partnership of agricultural producers and their retail customers. Their mission is to develop widely accepted standards and procedures for the global certification of Good Agricultural Practices (GAP) http://www.eurepgap.org/Languages/English/index_html.

[4] A New Zealand's Code of Practice in use of agricultural pesticides pursuant to sections 78 and 79 of the Hazardous Substances and New Organisms Act.

[5] For example, an export crop in which residues must be strictly controlled, or a crop which may be sensitive to an active ingredient or one or more of the excipients in its formulation.

Pesticide Industry: CropLife International

- Industry's involvement in designing application equipment becomes important. Industry recognises the importance of proper application for efficacy, efficiency and risk-reduction in the use of their products.
- Industry has engaged in training of users. A wide range of training programmes have been implemented. Training on use and maintenance of application equipment are included in training material. Application included in IPM/Safe Use training. Industry participated in more than 80 countries. In 2003, almost 100,000 people were trained, including 9,000 trainers, in 30 countries including Africa, Asia and Latin America; over 2.5 million trained since 1991.
- Independent audits (e.g. Kenya) showed change in attitude and behaviour amongst farmers thanks to training and certification programmes. Lessons learnt on improved training methodologies and monitoring behaviour changes will be fully incorporated in the next programmes.
- Optimal application requires a compromise between differing requirements including formulation possibilities, engineering limitations, etc. and availability and practicality of equipment in different regions need to be considered.
- As the FAO Code of Conduct on the Distribution and Use of Pesticides encourages, it is important to promote closer collaboration between the pesticide industry, application equipment manufacturers, farmers and governments.

User/Sprayers: Micron Sprayers Ltd. UK

- Application technology and techniques are central to any practical risk reduction measures.
- Equipment manufacturers, including Micron, have developed novel technology and techniques to improve efficiency and safety in application – but these have not generally been supported by the agrochemical industry which has tended to ignore (and thus devalue) application technology and techniques.
- The agrochemical industry view that the regulatory framework guarantees safe use of products is highly questionable, particularly with respect to use in developing countries. Users and regulators have been confused by the conflicting messages from equipment manufacturers and the agrochemical industry.
- Operator training and maintenance of equipment are vital for safe use of pesticides in practice.
- Increasing regulation of pesticide use in developed countries has, paradoxically, posed a threat to novel application technologies and techniques by tending to standardise on existing high volume high dosage technologies and techniques (with some current International Standards anti-innovative – and not relevant in all areas of the world).
- Innovation in application technologies and techniques is critical to reduce risks in use and needs to be supported by the agrochemical industry and regulators.

Consumer Interest (NGO): Pesticide Action Network Aotearoa New Zealand

- PAN is concerned that focussing on better application technology does little to reduce the reliance of agricultural systems on toxic synthetic chemical inputs, which are affecting human health, environmental health, and indeed agricultural sustainability, and so has been campaigning for pesticide use reduction, as well as risk reduction.
- Better application technology cannot solve the problems created by failure to adhere to basic safety measures such as warning notices and no re-entry periods, or the failure to observe no spray areas.
- Some pesticides are just too hazardous for use at all (paraquat, endosulfan).
- Handheld equipment is the most widely used. It frequently leaks, and should not be used for applying toxic pesticides.

- Airblast sprayers throw the spray up into the air and should be replaced by tower sprayers that direct the spray downward, or better still tunnel sprayers that direct the spray inwards.
- Aerial spraying is the most hit and miss application technology of all, and it has caused many problems in many countries.
- Better application technology should aim to prevent exposure of bystanders through drift or volatilisation, minimise operator exposure, especially through direct skin and clothing contact, deliver pesticides directly to the target pest, weed, disease and minimise entry into the environment, reduce the amount of pesticide used through better targeting, be able to be used correctly and adequately maintained under normal conditions and be tailored to fit the growing system.

Roundtable Discussions

- **Standardisation/minimum requirements**

In response to a question of whether global minimum technical requirements and/or standards for application technology are necessary and desirable, some felt that this would be helpful in non-OECD countries, but such requirements should not be too prescriptive. Further, the focus should be on standards for equipment. To allow for flexibility and innovation, performance standards, rather than mandating certain equipment should be considered. To make such standards effective, good data must be available and known to consumers to inform their choice of equipment. Many felt that global harmonisation of standards may be desirable, but only in the long-term. Such an approach would require global testing procedures. Given different regulatory and legal systems and the importance of local conditions, the immediate focus should be on local or national standards. If looking towards a more global approach, it is possible to envision a system which classifies equipment, and provides common minimum requirements (e.g., knapsack sprayers should not leak during filling and use).

It was noted that FAO has developed Guidelines on minimum requirements, standards and test procedures for pesticide application equipment (for portable and vehicle-mounted ground and aerial spraying). Some suggested that there may be value in considering whether these requirements/standards are sufficient and whether any gaps in coverage exist. Further, it is important to clarify what aspects of the standards to consider. When considering ways to reduce risk due to exposure from pesticide application, it may be useful if the minimum requirements first focus on addressing routine situations, rather than worst cases (i.e., accidents). Should OECD consider working to develop minimum requirements, it would be important to note that there are significant differences in infrastructure in OECD versus non-OECD countries, as well as the ability of farmers to pay for new or improved equipment.

- **Labelling**

Labels play an important role in preventing risk due to exposure from pesticide applications. Therefore, it is essential that such labels are clear and understandable by those who use the equipment. It is also important that labels not be too narrow/restrictive so as to hinder innovation. Labels can promote innovation by putting pressure on the design or use of equipment (e.g., by the requirement for smaller buffer zones if certain low-drift application equipment is used.) At the same time, it is important that the equipment remain efficacious. And, as stated above, sufficient performance data should be provided to help the user to make an informed choice on equipment.

Governments should strive to streamline the review procedure for labels, so that new and effective technologies are made available to farmers as soon as practicable. Also, efforts should be made to identify any regulatory requirements that may hamper innovation. Some expressed concern that labels are not

sufficiently detailed and thus may not be a good communication tool for minimising risk from pesticide applications.

The use of a proper dose or application rate is an important element in minimising risk. But, the dose rates may vary considerably due to differences in equipment. Therefore, there may be value in considering a harmonisation of the expression of dose rates on labels.

- **Promoting innovation**

Governments, working with the relevant agencies, industries and other stakeholders, should consider ways to provide incentives for innovation. Some suggested that governments can play a large role by co-ordinating research, or setting up funds to provide the resources for the development of new technologies, or paying growers to use better systems. Doing so would be in the public interest as it can lead to less risk for the public. Others suggested that the development of new technologies was best left to industry. Many agreed that the current *ad hoc* approach to the development of new technologies may not be the most effective one, and that a more systematic approach which monitors/matches needs and new technologies, should be considered. As the market for equipment is relatively small and diffuse, there may be value in making information about new and/or effective technologies more widely available across countries.

- **Education/Training and Certification**

The participants agreed that education and training play a crucial role in reducing risk. They are an efficient and effective way of delivering complicated information to farmers, perhaps even more so than labels. Without good training, use of even the best equipment may not lead to the desired result of lower risk.

Consideration should be given to "training the trainers." That is, if those speaking with farmers are not up-to-date in their knowledge about equipment and techniques, or are providing the wrong information, the training can actually be counter-productive. With respect to who trains the trainers, and how, one country indicated that trainers in their country are associated with universities, and the universities routinely exchange the latest information amongst themselves. Some participants suggested that suppliers and extension officers should also be trained.

There was considerable discussion about the certification of equipment and those who operate the equipment to ensure good practices are applied. FAO has published Guidelines on the organisation and operation of training schemes and certification procedures for operators of pesticide application equipment. Some suggested that training and certification of operators should be mandatory, although the time and cost to set up such a system can be considerable.

Others suggested that, while certification could be of value, it may not always be feasible as traditional farmers may be reluctant to listen to a presentation about a new approach, let alone actually apply such an approach. One country noted that it started with a voluntary system, but it did not work, and so they switched to a mandatory system. One suggested that consideration be given to who should pay for such training and certification: farmers, suppliers, retailers, extension officers, etc.? It was also noted that education should not be a one-off exercise, but applicators should continually attend refresher courses. During such courses, not only application technology but also other essential risk reduction training can be given.

With respect to certification of equipment, the cost and value of certification can vary with the size of the equipment. For instance the testing for correct use of a knapsack can be as expensive as the knapsack itself. A benefit of any scheme to certify equipment, is that good data will be generated that can be provided to

users. Another benefit is that by going through an inspection, equipment can be better calibrated, which should lead to better performance. It was also noted that there is a difference between "certification" and "inspection."

Proper maintenance is another important issue in the performance of equipment. This is linked with the intensity of usage. Thus, there may be problems with applying the same requirements for equipment, when the usage and durability of such equipment may vary considerably in practice.

Recommendations

Industry

Equipment manufacturers

- Fund R&D for innovation in better application equipment and to improve efficacy
- Reduce and eliminate unnecessary usage of pesticides through better application equipment

Equipment manufacturers and pesticide producers

- Initiate product stewardship programmes for private-private partnership (focusing on the relationship between the agrochemical industry, retailers/suppliers, and applicators)

Governments

- Consider providing a certain degree of R&D support, such as co-financing
- Set priority at the domestic level
- Consider appropriate regulatory standards and controls for application equipment that will help reduce risks while not hindering innovation.

Government and Industry

- Supporting education programmes for users, and
- Development of Codes of Practice for users

OECD

- Continue facilitating exchange of information about current programmes and promoting work sharing regarding application requirements and training and certification, etc.
- Help member countries to exchange information on national experiences

ANNEX 1

PARTICIPANTS LIST FOR RISK REDUCTION SEMINAR ON APPLICATION TECHNOLOGIES

30 November 2005

Australia / Australie

Graham BARRETT
Spraycheck Pty Ltd.
13 Green Lane
Orange, NSW 2800
Australia

Tel : 61 263 614 324
Fax : 61 263 611 550
Email : spraychk@netwit.net.au

Eva BENNET-JENKINS
Program Manager (Pesticides)
Australian Pesticides & Veterinary Medicines Authority
PO Box E240
Kingston ACT 2604
Australia

Tel : +61 2 6272 5248
Fax : +61 2 6272 3195
Email : eva.bennet-jenkins@apvma.gov.au

Rod EDMUNDSON
Australian Pesticides & Veterinary Medicines Authority (APVMA)
John Curtin House
22 Brisbane Avenue
Barton ACT 2603
Australia

Tel : 61 2 6272 3859
Fax : 61 6272 3218
Email : rod.edmundson@apvma.gov.au

Alan NORDEN
Australian Pesticides & Veterinary Medicines Authority (APVMA)
John Curtin House
22 Brisbane Avenue
Barton ACT 2603
Australia

Tel : 61 2 6272 3726
Fax : 61 2 6272 3218
Email : alan.norden@apvma.gov.au

Gary FAN
Policy Coordination and Development
Australian Government Dept of Agriculture, Fisheries & Forestry
GPO Box 858
Canberra, ACT
Australia

Tel : +61 2 6272 3964
Fax : +61 2 6272 5697
Email : Gary.Fan@daff.gov.au

Andrew HEWITT
University of Queensland
Gatton QLD 4343
Australia

Tel: +61 7 5460 1292
Email : a.hewitt@uq.edu.au

Phil HURST
Aerial Agricultural Association of Australian
Dickson, ACT 2602
Australia

Tel : 61262628256
Fax : 61262628257
Email : phil@aerialag.com.au

David LOSCHKE
Australian Pesticides & Veterinary Medicines Authority (APVMA)
P.O. Box E240
Canberra, Kingston ACT
Australia

Tel : +61 2 627 253 96
Fax : +61 2 627 235 51
Email : david.loschke@apvma.gov.au

Bill MAGEE
Australian Government Dept of Agriculture, Fisheries & Forestry
GPO Box 858
Canberra, ACT
Australia

Tel : +61 2 6272 3220
Fax : +61 2 6272 5697
Email : bill.magee@daff.gov.au

Canada / Canada

Richard AUCOIN
Acting Chief Registrar
Pest Management Regulatory Agency
Sir Charles Tupper Building, 7th fl.
2720 Riverside Drive
Ottawa, Ontario K1A 0K9
Canada

Tel : (613) 736-3705
Fax : +1 613 736 3707
Email : Richard_Aucoin@hc-sc.gc.ca

Karen MCCULLAGH
Pest Management Regulatory Agency
Health Canada, Product Efficacy and Sustainability Division
Sir Charles Tupper Building
2250 Riverside Drive, Room 735E (6607E)
Ottawa, Ontario K1A 0K9
Canada

Tel : +1 613 736 3486
Fax : +1 613 736 3770
Email : karen_mccullagh@hc-sc.gc.ca

Denmark / Danemark

Lena GRAVESEN
Chemicals Division
Danish Environmental Protection Agency
Strandgade 29
DK-1401 Copenhagen K
Denmark

Tel : +45-32 66 0573
Fax : +45-32 66 0479
Email : lgr@mst.dk

Germany / Allemagne

Herbert KOEPP
Federal Office for Consumer Protection and Food Safety
Bundesamt für Verbraucherschutz und Lebensmittelsicherheit (BVL)
Messeweg 11/12
D-38104 Braunschweig
Germany

Tel : +49 531 299 3456
Fax : +49 531 299 3003
Email : herbert.koepp@bvl.bund.de

Wolfgang ZORNBACH (CHAIR)
Bundesministerium für Ernährung, Landwirtschaft und Verbraucherschutz (BMELV)
Ministry of Food, Agriculture and Consumer Protection
Referat 317 (Pflanzenschutz -Plant Protection)
Rochusstr. 1, 53123 Bonn
Germany

Tel : +49-228 529 4317
Fax : +49-228 529 55 3595
Email : Wolfgang.Zornbach@bmvel.bund.de

Georg BACKHAUS
Federal Biological Research Centre of Agriculture and Forestry
Messeweg 11/12, D-38104 Braunshweig
Germany

Tel: +49 531 299 3200
Fax: +49 531 299 3001
Email : G.F.Backhaus@bba.de

Ireland / Irlande

Mark LYNCH
Department of Agriculture and Food
Pesticide Control Service
Department of Agriculture & Food Laboratories
Backweston Campus
Young's Cross, Celbridge
County Kildare
Ireland

Tel : +353 1 615 7616
Fax : +353 1 615 7575
Email : MarkR.Lynch@agriculture.gov.ie

Japan / Japon

Jun KOIDE
Deputy Director
Agricultural Chemicals Control Office, Environmental Management Bureau, Ministry of the Environment
Chiyoda-ku, 1-2-2 Kasumigaseki
100-8975 Tokyo
Japan

Tel : +81 (0)3 5521 8323
Fax : +81 (0)3 3501 2717
Email : JUN_KOIDE@env.go.jp

Shiori SASAKI
Chief
Agricultural Chemicals Inspection Station (Incorporated Administrative Agency)
Planning and Strategy Office
2-772 Suzuki-cho, 187-0011 Kodaira-shi Tokyo
Japan

Tel : +81 423 83 2151
Fax : +81 423 85 33 61
Email : sasaki-s@acis.go.jp

Katsuya SATO
Chief, Plant Protection Safety Division
Ministry of Agriculture, Forestry and Fisheries
1-2-1 Kasumigaseki, Chiyoda-ku
100-8950 Tokyo
Japan

Tel : +81 3 3501 3965
Fax : +81 3 3501 3774
Email : katsuya_sato@nm.maff.go.jp

Akio YAMAMOTO
Director, Planning and Strategy Office
Agricultural Chemicals Inspection Station
Incorporated Administrative Agency
Kodaira-shi
2-772 Suzuki-Cho
187-0011 Tokyo
Japan

Tel : +81 423 83 2151
Fax : +81 423 85 3361
Email : yamamoto@acis.go.jp

New Zealand / Nouvelle-Zélande

Paul DANSTED
NZ Food Safety Authority
6001 Wellington
New Zealand

Tel : +64 4 463 2536
Email : paul.dansted@nzfsa.govt.nz

Peter DAWSON
ERMA New Zealand
P.O. Box 131, Wellington,
New Zealand

Tel: 64 4 9184 833
Email: peter.dawson@ermanz.govt.nz

Sarah GAUDEN-ING
ERMA NZ
P.O. Box 131, Wellington
New Zealand

Tel: 64 4 98 48 54
Email: sarah.gauden-ing@ermanz.govt.nz

Donald HANNAH
Group Manager
Environmental Risk Management Authority
Strategy and Analysis
P.O. Box 131
L1 20 Customhouse Quay, 6015 Wellington
New Zealand

Tel : +64 4 918 4839
Fax : +64 4 914 0433
Email : donald.hannah@ermanz.govt.nz
Warren HUGHES
New Zealand Food Safety Authority
New Zealand

Email : john.reeve@nzfsa.govt.nz

Matthew LEWER
ERMA New Zealand,
P.O. Box 131, Wellington,
New Zealand

Tel: +64 4 918 4801
Email: lewerm@ermanz.govt.nz

John MABER
John Maber and Associates Ltd
New Zealand

Email : jmaber@bordernet.co.nz

Geoff MAYES
ERMA New Zealand,
P.O. Box 131, Wellington,
New Zealand

Tel: +64 4 918 4888
Email: geoff.mayes@ermanz.govt.nz

John REEVE
Principal Adviser (Toxicology)
Science Group
New Zealand Food Safety Authority
86 Jervois Quay, P O Box 2835
Wellington 6001
New Zealand

Tel : +64 4 463 2533
Fax : +64 4 463 2566
Email : john.reeve@nzfsa.govt.nz

Deanna RICHARDS
Research Assistant (Strategy and Analysis)
Environmental Risk Management Authority
Strategy and Analysis
P.O. Box 131, L1 20 Customhouse Quay
6015 Wellington
New Zealand

Tel : +64 4 918 4839
Fax : +64 4 918 4792
Email : deanna.richards@ermanz.govt.nz

Robin TOY
ERMA NZ
PO Box 131, Wellington
New Zealand

Tel: +64 4 918 4848
Email: robin.toy@ermanz.govt.nz

United States / Etats-Unis

Jay ELLENBERGER
Associate Director, Field and External Affairs Division
US Environmental Protection Agency
Field & External Affairs Division
Office of Pesticide Programs
7506C Ariel Rios Building
1200 Pennsylvania Ave.
Washington D.C. 20460
United States

Tel : +1 703 305 7102
Fax : +1 703 305 6244
Email : ellenberger.jay@epa.gov

George HERNDON
Deputy Division Director
US Environmental Protection Agency
Health Effects Division
1200 Pennsylvania Ave.
Washington DC 20460
United States

Tel : +1 703 305 6362
Fax : +1 703 305 5147
Email : herndon.george@epa.gov

Jane HOPKINS
Field and External Affairs Division
US Environmental Protection Agency
Office of Pesticides Programs, 7506C
1200 Pennsylvania Ave.
Washington DC 20460
United States

Tel : +1 703 305 7195
Fax : +1 703 308 1850
Email : hopkins.jane@epa.gov

Dan KUNKEL
Assistant Director
IR-4 Project Headquarters
681 US Hway #1 South
North Brunswick NJ 08902
United States

Tel : 1 732 932 9575 X 616
Fax : 1 732 932 8481
Email : kunkel@aesop.rutgers.edu

Susan LEWIS
Branch Chief, Special Review and Reregistration Division
US EPA – Office of Pesticide Programs
7508C, Ariel Rios Building
1200 Pennsylvania Avenue, NW
Washington, DC 20460
United States

Tel : +1 703 308 8009
Fax : +1 703 308 7042
Email : lewis.susan@epa.gov

Lois ROSSI
Director, Registration Division
US EPA, Office of Pesticide Programs (7505-C)
1200 Pennsylvania Avenue, N.W.
Washington D.C. 20460
United States

Tel : +1 703 308 8162
Fax : +1 703 305 6920
Email : rossi.lois@epa.gov

EC / CE

Klaus BEREND
Deputy Head of Unit
European Commission
DG Environment
Unit B.4-Biotechnology and Pesticides
Office BU-9, 6-167
Rue de la Loi 200, Brussels
Belgium

Tel : +32-2-299 4860
Fax : +32-2-299 0167
Email : Klaus.BEREND@cec.eu.int

Business and Industry Advisory Committee (BIAC) / Comité consultatif économique et industriel (BIAC)

Tom BALS
Micron Sprayers Ltd.
Bromyard
Bromyard Industrial Estate
Herefordshire HR7 4HS
United Kingdom

Tel : 0044 (0)1885 482397
Fax : 0044 (0)1884 483043
Email : tom.bals@micron.co.uk

William GRAHAM
International Regulatory Affairs Lead
Monsanto Company
Agricultural Sector
Gt. Comberon, Pinewood House
Church Street, Pershore
Worcestershire WR10 3DS
United Kingdom

Tel : +44 1223 849 258
Fax : +44 1386 710143
Email : william.graham@monsanto.com

Peter HORNE
Global Regulatory Affairs Manager
DuPont Crop Protection Products
Stine-Haskell Research Center
1090 Elkton Road
PO Box 30, Newark
DE 19714-0030
United States

Tel : +1 302 366 6228
Fax : +1 302 366 6112
Email : peter.horne-1@usa.dupont.com

Keith JONES
CropLife International
143 Avenue Louise
1050 Brussels
Belgium

Tel : +32 2 542 0410
Fax : +32 2 524 0419
Email : keith@croplife.org

Felix MEIER-MANZ
Head Regulatory Support
Syngenta, Crop Protection AG
P.O. Box
CPCP 9.26
WRO-1093.3.17
CH-4058 Basel
Switzerland

Tel : +41 61 323 2721
Fax : +41 61 323 4966
Email : felix.meier-manz@syngenta.com

Maximilian SAFARPOUR
Director, Global Regulatory & Government Affairs
BASF Corporation
PO Box 13528
26 Davis Drvie
Research Triangle Park
North Carolina 27709-3528
United States

Tel : +1 919 547 2675
Fax : +1 919 547 2850
Email : safarpm@basf-corp.com

PAN

Meriel WATTS
Co-ordinator,
Pesticides Action Network Aotearoa New Zealand
PO Box 296
Ostend Waiheke Island
1240 Auckland
New Zealand

Tel : 64-9 372 2034
Fax : 64-9 372 2034
Email : merielwatts@xtra.co.nz

Alison WHITE
Safe Food Campaign / Pesticide Action Network
P.o. Box 9206
Wellington
New Zealand

Tel: +64 4 476 8607
Email: Alison@safefood.org.nz

OECD / OCDE

Jeong-Won PARK
OECD
ENVIRONMENT DIRECTORATE
2, rue André Pascal
75016 Paris
France

Tel : +33 (1) 45 24 89 45
Email : Jeong-Won.PARK@oecd.org

Richard SIGMAN
OECD
ENVIRONMENT DIRECTORATE
2, rue André Pascal
75016 Paris
France

Tel : +33 (1) 45 24 16 80
Email : Richard.SIGMAN@oecd.org

ANNEX 2
SEMINAR PRESENTATIONS

Australia : Spray Drift Management
David Loschke

The 5th RRSG Seminar on Risk Reduction through Better Application Technologies

Australia: Spray Drift Management

30 November 2005

David Loschke
Principal Scientist, Agricultural Chemicals

1

Current Major Approaches to Spray Drift Risk Management

- Control of Droplet Size
- Wind speed limits for use
- Spray release height
- Protective buffer zones
- Equipment type and arrangement

2

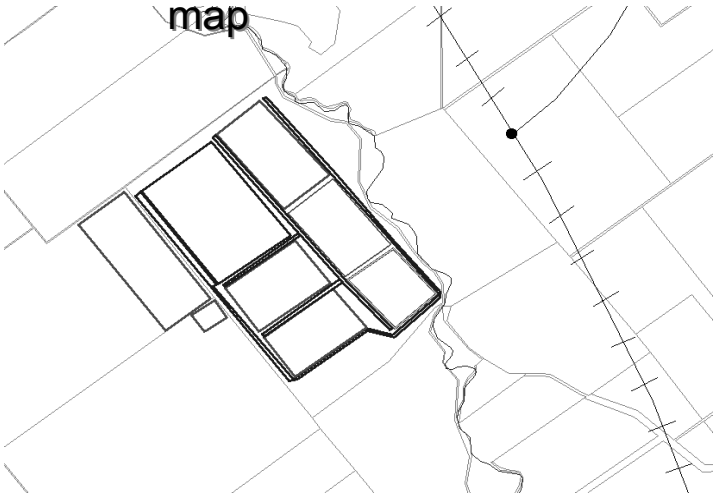
Standard to Describe Droplet Spectra

- **ASAE Standard S-572**

  Very Fine to Fine
  Fine to Medium
  Medium to Coarse
  Coarse to Very Coarse
  Very Coarse to Extremely Coarse

3

Farm shown on GIS map



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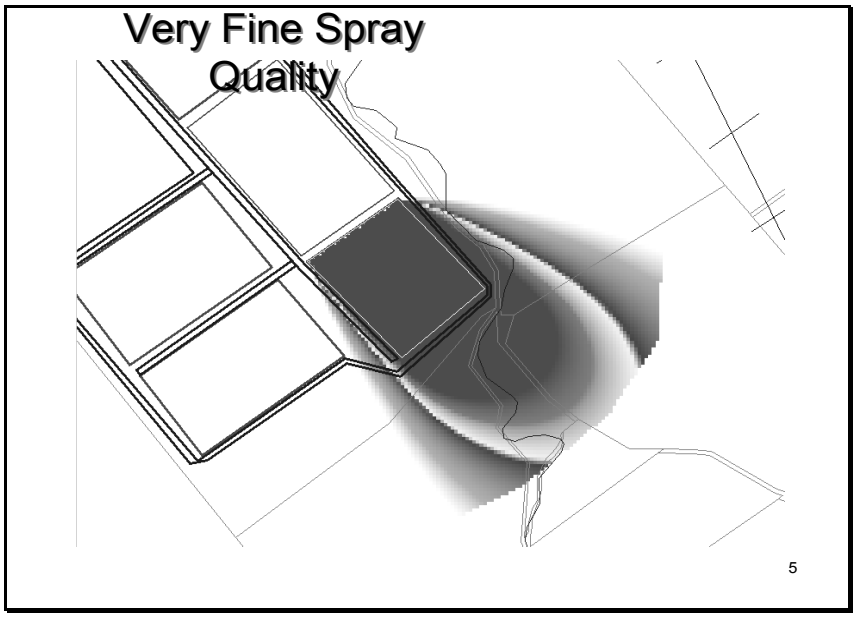
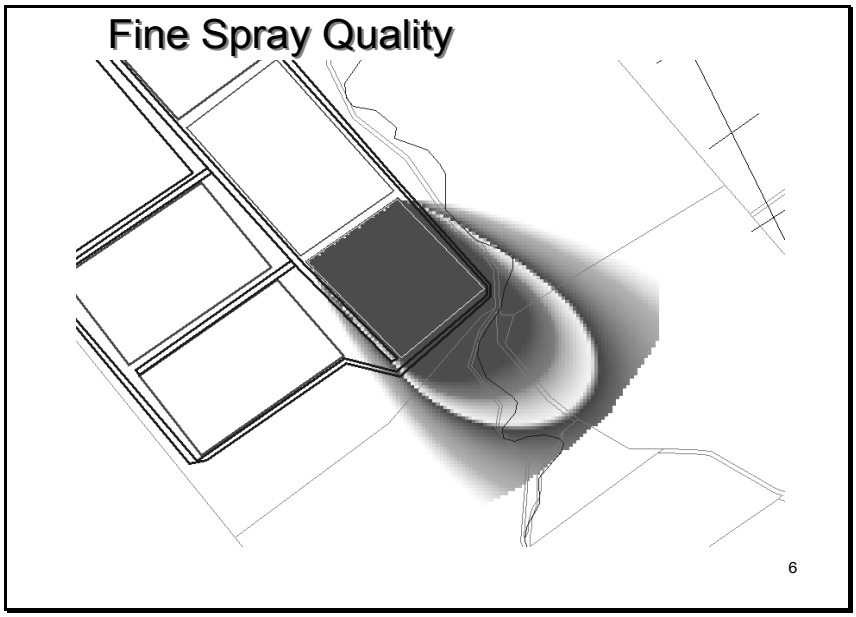

Very Fine Spray Quality
5


Fine Spray Quality
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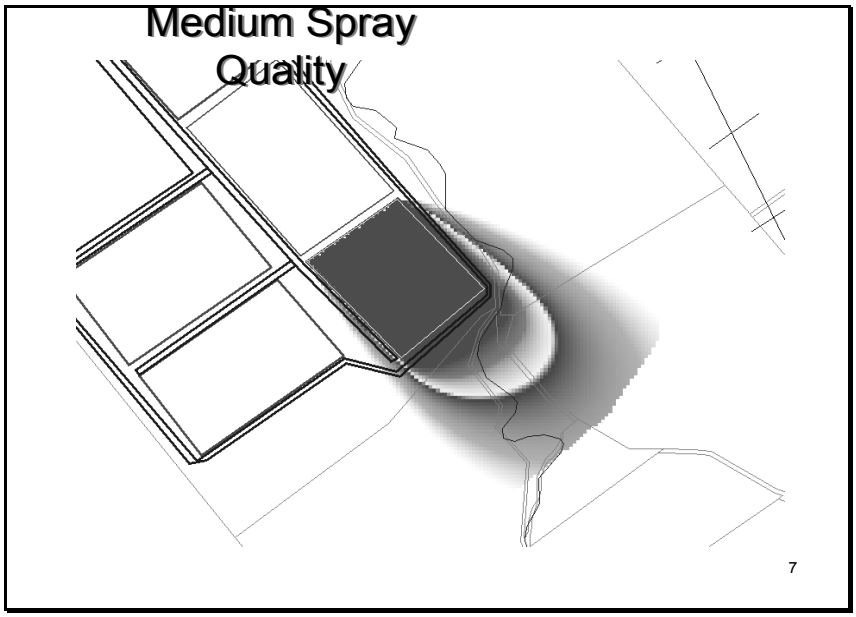
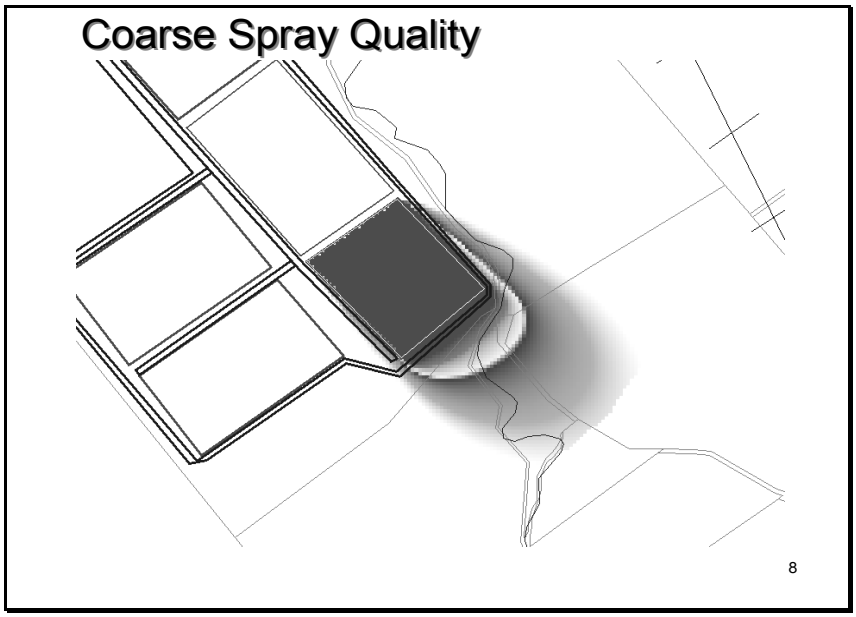
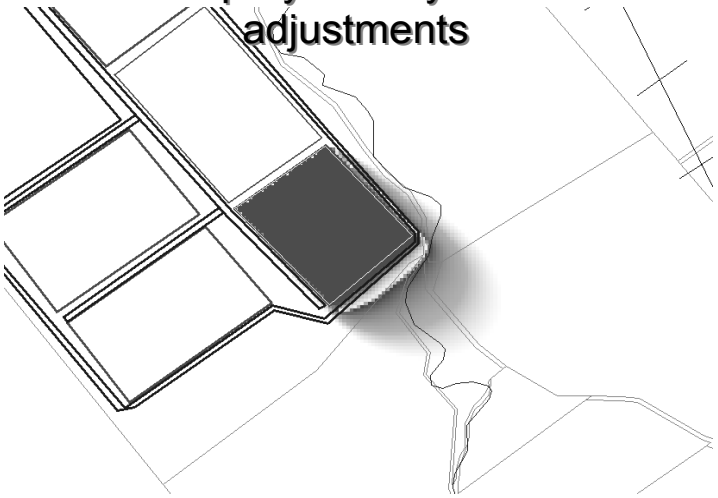

Medium Spray Quality
7


Coarse Spray Quality
8

Coarse Spray Quality with further adjustments



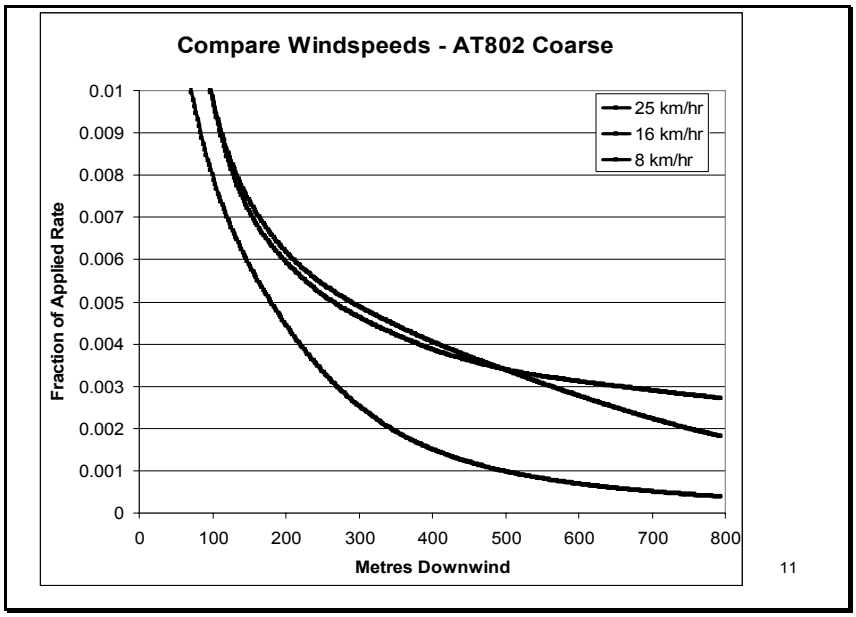
9

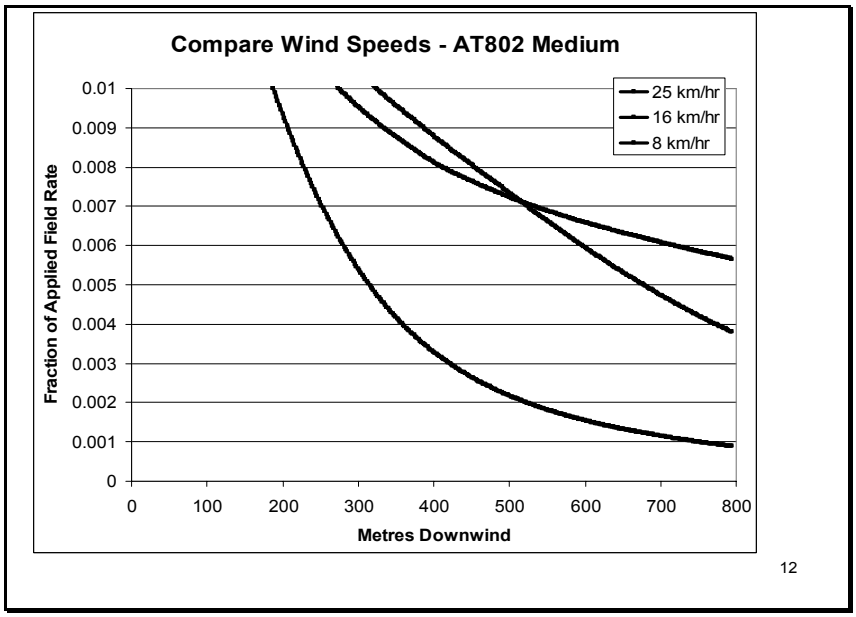
Predictive Tools for Spray Drift

- **AgDRIFT Model**
  (All uses up to about 800 metres)

- **Gaussian Diffusion Model**
  (Mainly trade risk concerns beyond 700 to 800 metres)

10


Compare Windspeeds - AT802 Coarse
Fraction of Applied Rate
0.01
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
0
100
200
300
400
500
600
700
800
Metres Downwind
25 km/hr
16 km/hr
8 km/hr
11


Compare Wind Speeds - AT802 Medium
Fraction of Applied Field Rate
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0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
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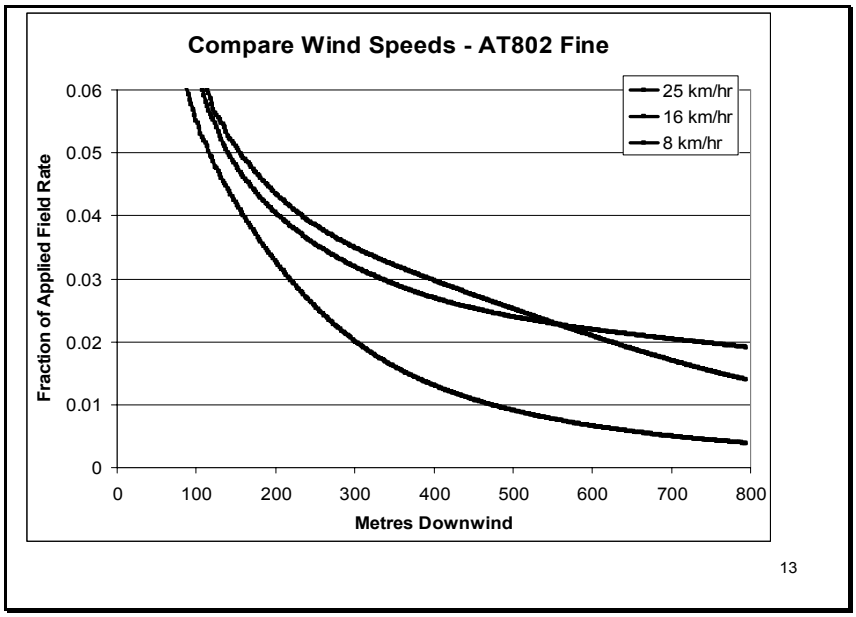
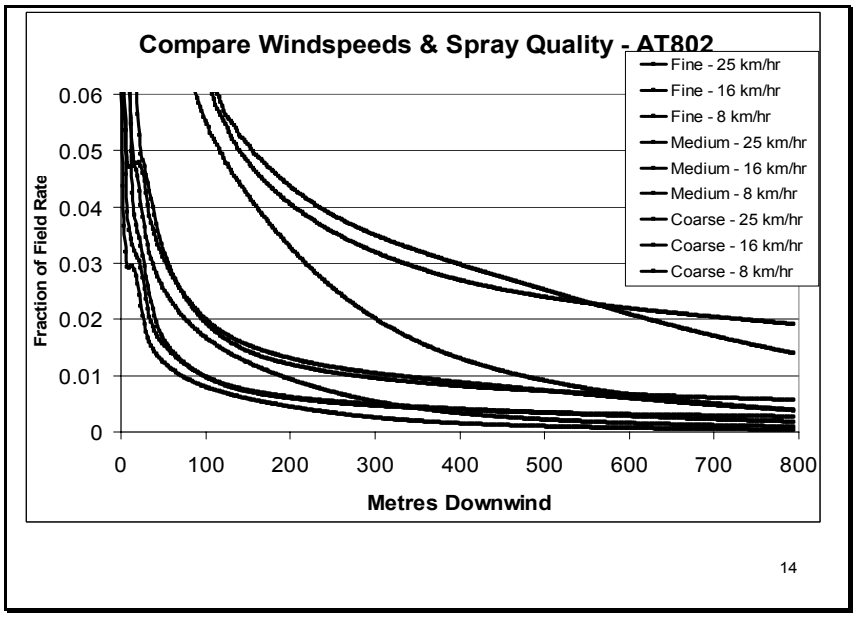
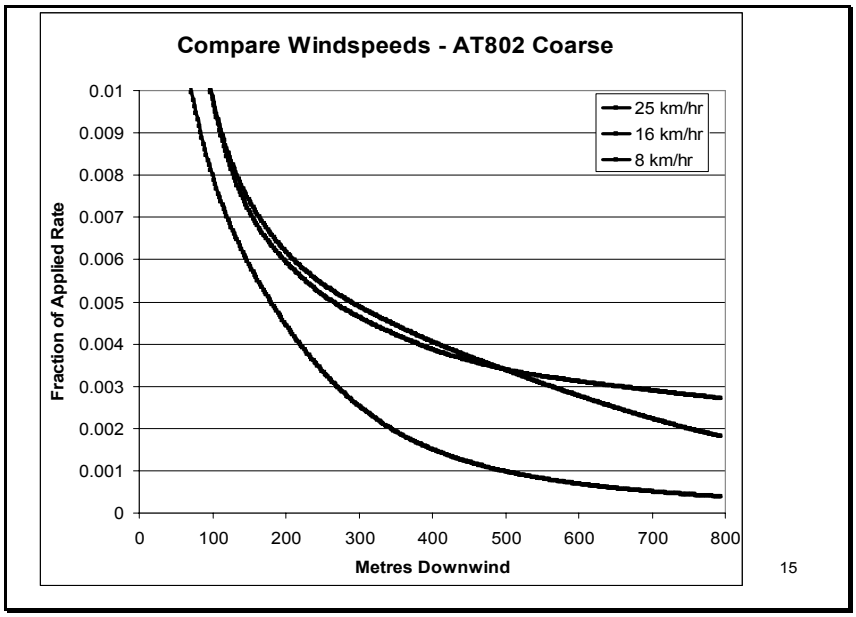
800
Metres Downwind
25 km/hr
16 km/hr
8 km/hr
12


Compare Wind Speeds - AT802 Fine
25 km/hr
16 km/hr
8 km/hr
Fraction of Applied Field Rate
0.06
0.05
0.04
0.03
0.02
0.01
0
0
100
200
300
400
500
600
700
800
Metres Downwind
13


Compare Windspeeds & Spray Quality - AT802
Fine - 25 km/hr
Fine - 16 km/hr
Fine - 8 km/hr
Medium - 25 km/hr
Medium - 16 km/hr
Medium - 8 km/hr
Coarse - 25 km/hr
Coarse - 16 km/hr
Coarse - 8 km/hr
Fraction of Field Rate
0.06
0.05
0.04
0.03
0.02
0.01
0
0
100
200
300
400
500
600
700
800
Metres Downwind
14


Compare Windspeeds - AT802 Coarse
Fraction of Applied Rate
0.01
0.009
0.008
0.007
0.006
0.005
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0.002
0.001
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100
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300
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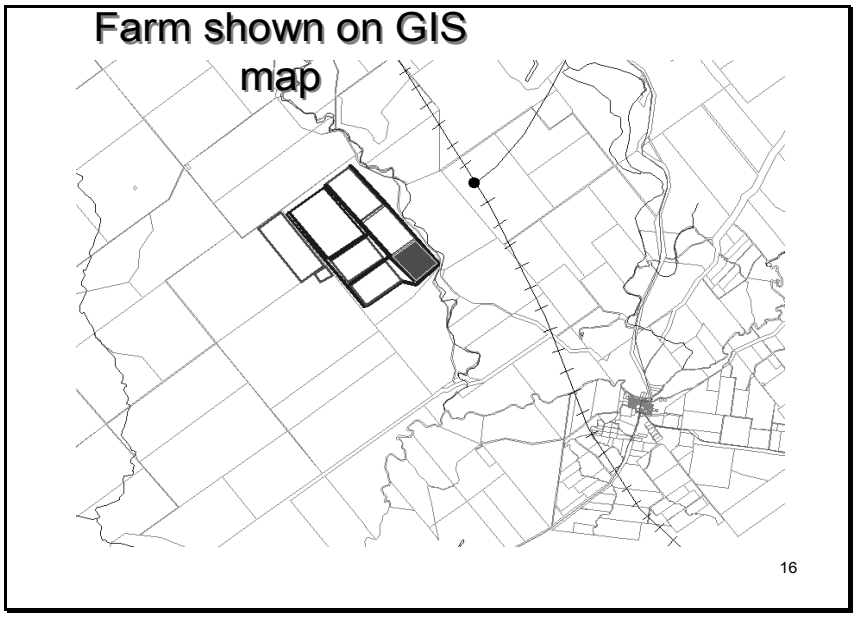
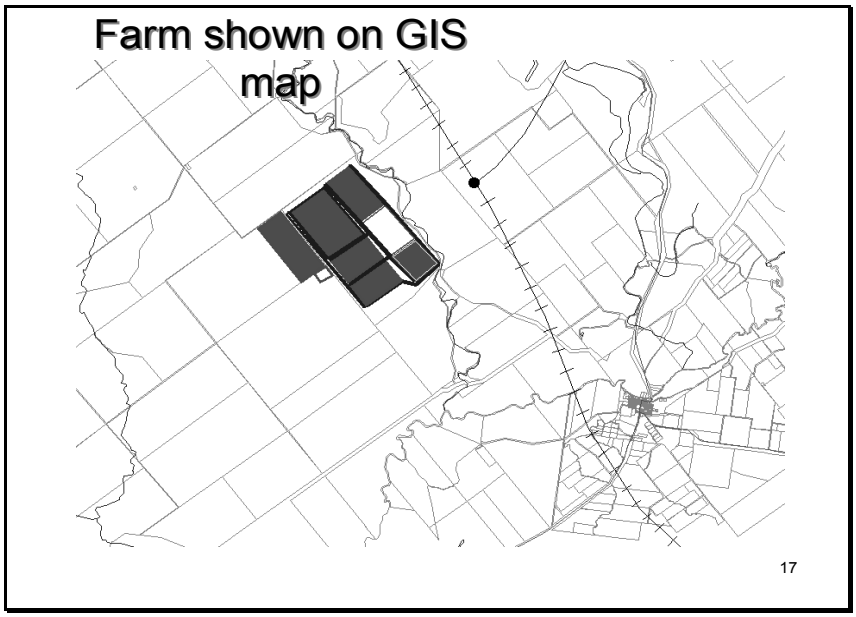
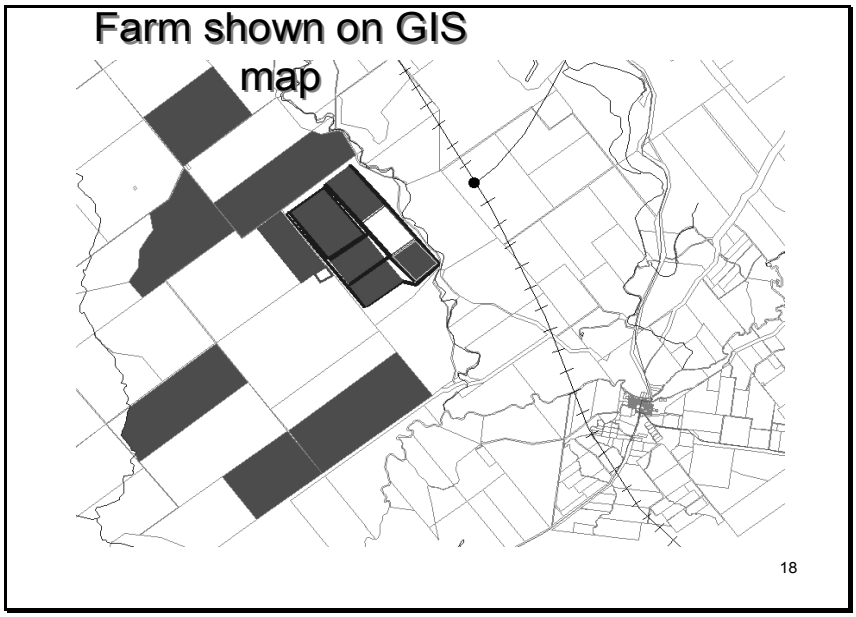
500
600
700
800
Metres Downwind
25 km/hr
16 km/hr
8 km/hr
15


Farm shown on GIS map
16

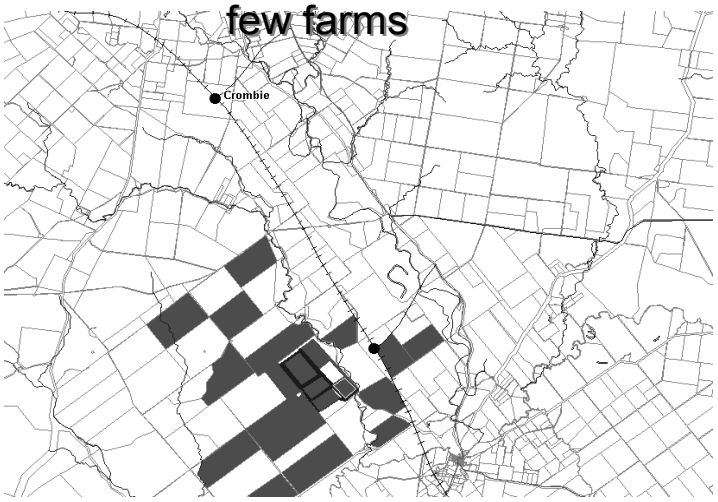

Farm shown on GIS map
17


Farm shown on GIS map
18

Insect pressure commonly covers a large area

19

Applications won't be limited to a few farms



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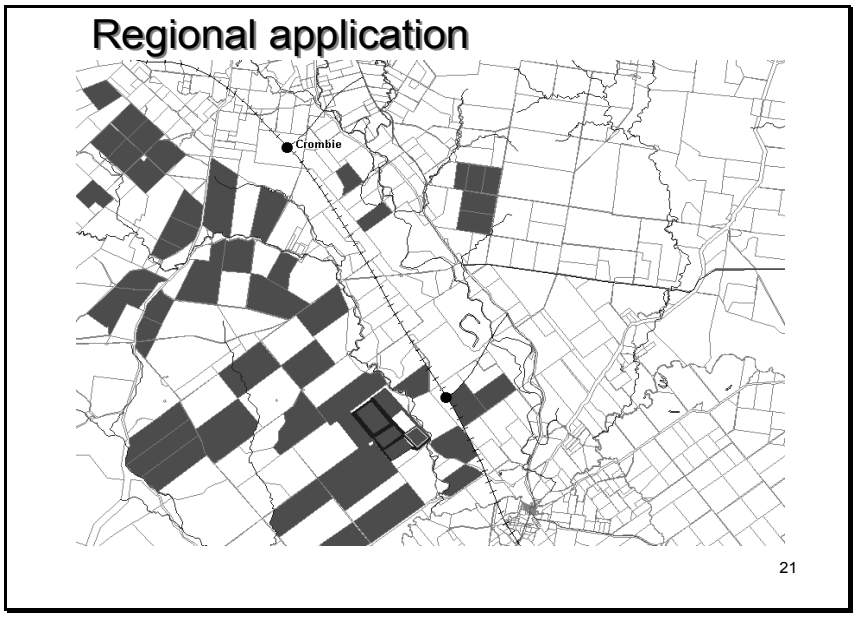
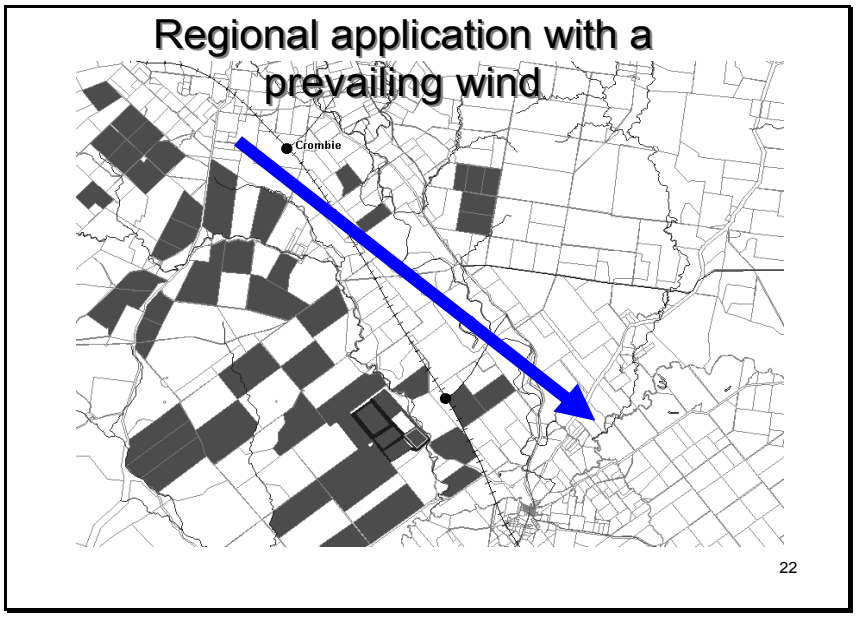

Regional application
Crombie
21


Regional application with a prevailing wind
Crombie
22

First We Do What We Can Do Today

- Training & awareness raising
- Encourage or mandate larger droplet sizes
- Confine applications to sensible wind speeds
- Restrict practices where necessary

23

What do we propose to do?

- Require spray drift risk information from industry
- Apply the new standards to new products
- Update existing products according to the new standards

24

Likely Products Affected

Herbicides	-	799
Insecticides	-	415
Fungicides	-	115
Miticides	-	43
Plant Regulators	-	43
Mixed Function	-	10

25

Testing of Plant Protection Equipment in Germany
Georg F. Backhaus

Testing of plant protection equipment in Germany

H. Ganzelmeier and G. F. Backhaus

- **Introduction**
- **Observance of basic requirements by legal regulations**
- **High suitability of sprayers by voluntary testing**
- **European testing of sprayers with mutual recognition among test stations**
- **Precise and reliable function of sprayers by periodical testing**
- **Harmonization of technical regulations by EN / ISO standards**
- **Concluding remarks**

1

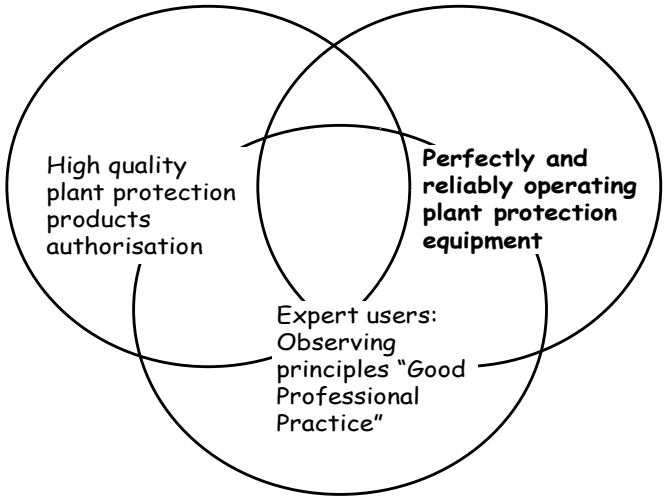
Plant protection equipment - survey of the state of the art -

Sprayers and air assisted sprayers for field crops	3-point hitch	mounted	trailed	self propelled	line spraying	among all: air assisted
total available sprayer types	84 (36%)	27 (12%)	93 (40%)	24 (11%)	6 (1%)	17 (8%)
tank (l)	200 - 1500	600 - 5000	600 - 7000	300 - 5000	100 - 1000	600 - 5000
spray boom (m)	7 - 24	8 - 36	6 - 45	4,5 - 48	4 -12reihig	12 - 36
pump (l/min)	58 - 240	94 - 2x225	94 - 545	138 - 1400	16 - 225	100 - 344
tech. rest volume (% of tank capacity)	1,2 - 2,6	1,9 - 3,0	1,2 - 3,0	0,6 - 3,0	1,2 - 3,0	1,1 - 3,0

Last update August 2005

2

Pre-conditions for proper and sustainable plant protection



3

Testing of plant protection equipment in Germany

- **Observance of basic requirements by legal regulations**

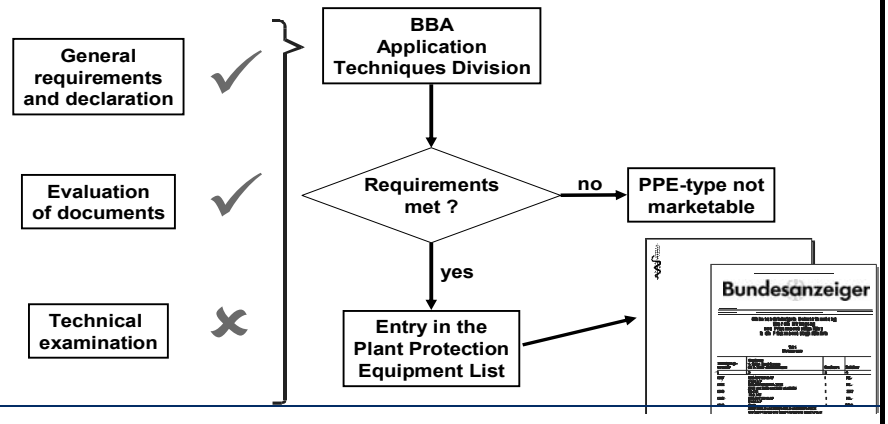
4

Plant Protection Equipment Testing

The declaration procedure guarantees, that new plant protection equipment complies with the legal requirements.

To this end
- documents must be submitted for assessment and
- plant protection equipment may have to be made available for testing.

BBA - Declaration Procedure, obligatory



5

Testing of plant protection equipment in Germany

- **High suitability of sprayers by voluntary testing**

6

High suitability of sprayers by voluntary testing

Drift reducing plant protection equipment

Classification in 50 % / 75 % and 90 % drift reducing classes and entry in the register of loss reducing equipment

7

Directions for use

for the protection of surface water

<u>Measures to be fulfilled:</u> Compliance of buffer zones (dependent on the product)

Flexible buffer zones are possible through Consideration of application conditions:

- **Use of drift reducing sprayers**
- **Size of running water**
- **Riparian vegetation**

8

Testing of plant protection equipment in Germany

- **European testing of sprayers with mutual recognition among test stations**

9

ENTAM

European Network for Testing of Agricultural Machines

aims:

a - mutual recognition of testing activity;
b - creation of a network of skilled laboratories;
c - development of common activities;

in order to:

a - reduce costs of testing activities and other common activities;
b - optimise investments in testing implements;
c - offer the manufacturer the possibility to obtain a full international certification with one test;
d - give the farmers an effective support for the choice of machinery and equipment and a guarantee to use machines conceived to be perfectly suitable for their needs;

10

Testing of plant protection equipment in Germany

- **Precise and reliable function of sprayers by periodical testing**
  (obligatory at least once every 2 years)

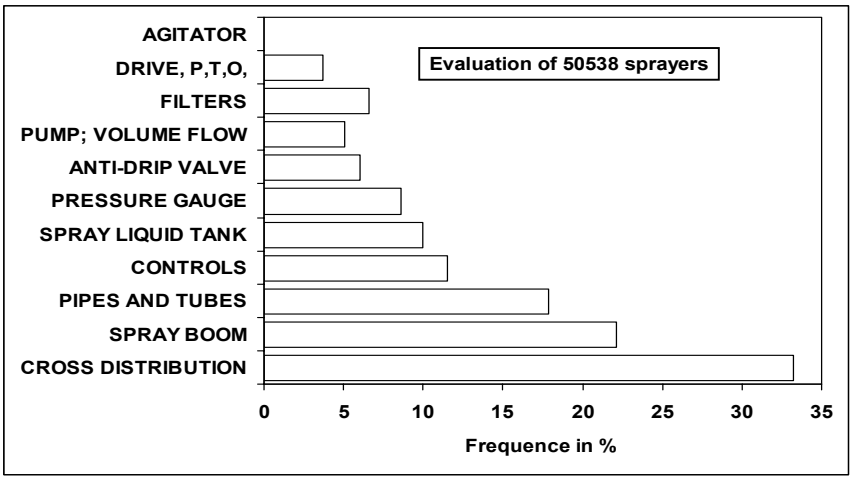
11

Inspection of field sprayers

Officially Approved Test Station for the Inspection of Field Sprayers

12

Technical defects of inspected field sprayers Germany 2001

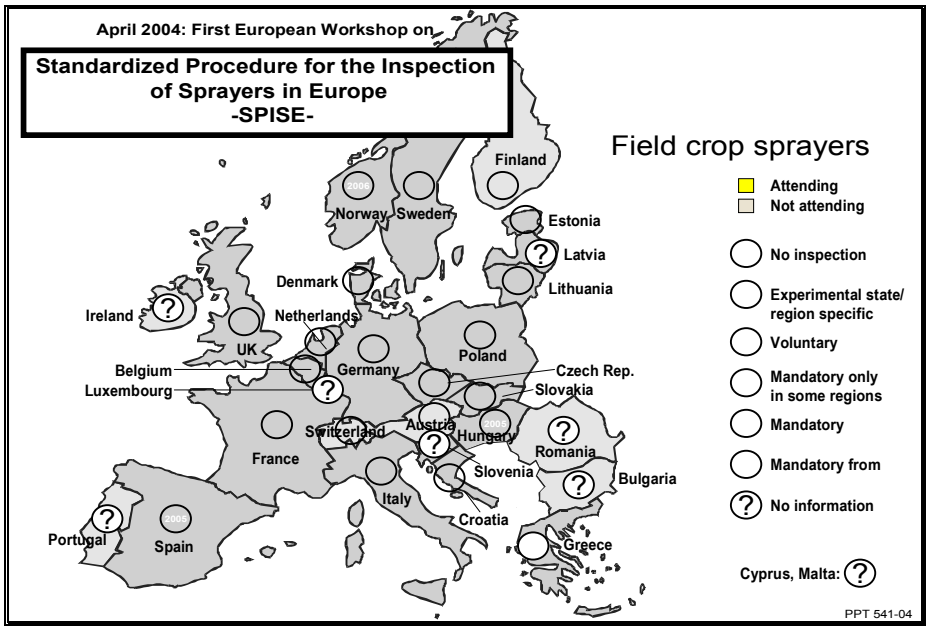


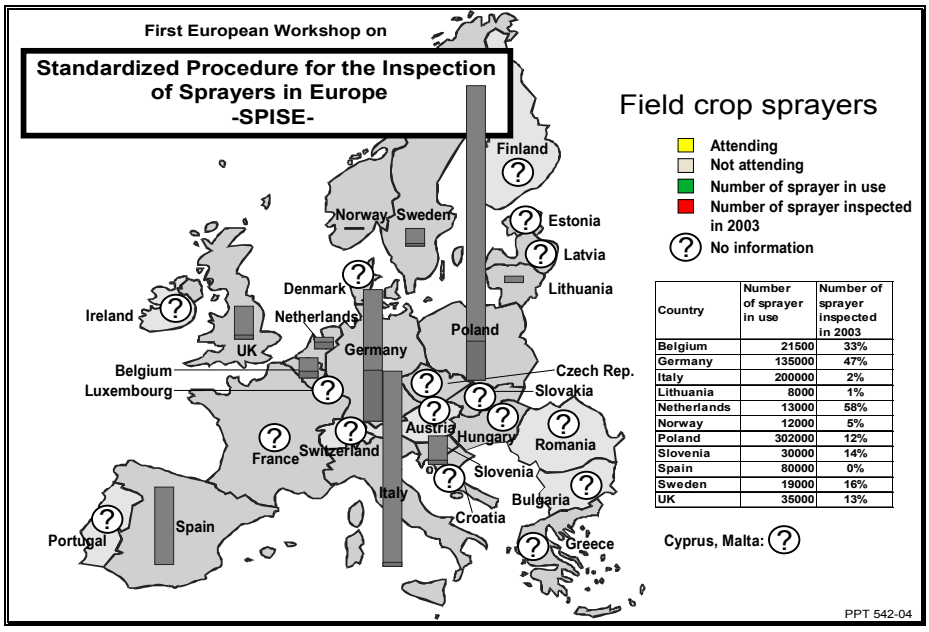
13

Spise-Workshop 27./29. April 2004 – BBA Braunschweig

-SPISE-
Standardized Procedure for the Inspection of Sprayers in Europe

14





Country	Number of sprayer in use	Number of sprayer inspected in 2003
Belgium	21500	33%
Germany	135000	47%
Italy	200000	2%
Lithuania	8000	1%
Netherlands	13000	58%
Norway	12000	5%
Poland	302000	12%
Slovenia	30000	14%
Spain	80000	0%
Sweden	19000	16%
UK	35000	13%

Testing of plant protection equipment in Germany

- **Harmonization of technical regulations by EN / ISO standards**

17

Spraying equipment standards

General
ISO 4287
ISO 4288
ISO 5681
ISO 10627-1/-2
ISO 13441-1/-2
ISO 22368-1/-2/-3

Safety / Environment
EN 907
ISO 4254-6
EN ISO 4254-6
EN 12761-1/-2/-3
EN 13790-1/-2

Nozzles / Filters
ISO 4102 ISO 5682-1
ISO 6686 ISO 8169
ISO 10625 ISO 10626
ISO 14710 ISO 19732

Portable equipment
ISO 19932-1/-2

Distribution / Drift
ISO 5682-2 ISO 5682-3
ISO 11783-1/-13
ISO 12057 ISO 22369-1/-2
ISO 22522 ISO 22866

Boom / Blower
ISO 9898
ISO 14131
ISO 22763

Tank
ISO 9357
ISO 13440
ISO 21278

Granules applicator
ISO 8524

18

Conclusions (1)

- The state of technological development in plant protection equipment has reached a high level. The spraying quality of modern plant protection equipment is very high and extremely effective.

19

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- **Legal regulations for new sprayers are in force in Germany (since 1988).**
  Accordingly, plant protection equipment is evaluated on the basis of documents to be submitted. When results are positive the equipment is registered in the plant protection equipment list. Only then may plant protection equipment be put on the market.

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- **The European Commission intends to introduce such a certification procedure to all EU-Member-States in the near future.**

21

Conclusions (1)

- The state of technological development in plant protection equipment has reached a high level. The spraying quality of modern plant protection equipment is very high and they are extremely effective.
  A wide range of accessories are available which contributes to the improvement of the quality of work and to relieving the strain on the driver.
- Legal regulations for new sprayers which guarantee a minimum performance (requirements) are still in force in Germany (since 1988).
  Accordingly, plant protection equipment is evaluated on the basis of documents to be submitted. If the results are positive the equipment is registered in the plant protection equipment list. Only then may plant protection equipment be put on the market in Germany.
- The European Commission intends to introduce such a certification procedure to all EU-Member-States in the near future.
- **Voluntary testing of new sprayers guarranties suitability.
  This includes technical measurements and extensive field testing.
  In case of positive results the plant protection equipment
  is approved by the BBA and a test report is published.**

22

Conclusions (2)

- Drift reducing sprayers are the key factor for reducing minimum distances to surface waters and biotopes.
  Therefore plant protection equipment is also tested by the BBA regarding drift reduction (wind tunnel, field testing).
  At present 257 pieces of approved drift-reduced plant protection equipment (50, 75, 90, 99 %) are available.

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- **A collaboration of European testing authorities is realised by ENTAM on the basis of voluntary agreements.**
  The BBA is responsible for ENTAM tests of sprayers.
  Goal: Once tested → Europe-wide recognition.
  Test stations and manufacturers welcome this co-operation.

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  The BBA/FA is responsible for ENTAM tests of sprayers.
  Goal: Once tested → Europe-wide recognition.
  Test stations and manufacturers welcome this co-operation.
- **A permanently precise and reliable function of sprayers can only be ensured by periodic inspections of plant protection equipment. In Germany an obligatory inspection for field sprayers and air assisted sprayers is established .**

25

Conclusions (3)

- **Initiatives about the Standardised Procedure for Inspection of Sprayers in Europe (SPISE) showed that**
  - **most European countries started to inspect sprayers**
  - **quality and extend has to be harmonized**
  - **equivalent results and mutual recognition are aimed at.**

26

Conclusions (3)

- An initial European Workshop about the Standardised Procedure for Inspection of Sprayers in Europe (SPISE) was held in Braunschweig in April 2004 which goes to show that
  - most European countries started to inspect sprayers
  - quality and extend differs significantly
  - equivalent results and mutual recognition are aimed at.
- European and international standardisation made great progress in the last years.
- The standards are helpful for manufacturers, testing authorities and farmers in order to save resources, facilitate mutual recognitions of tests and to make a wider range of tested machinery/equipment available.

27

Research on pesticide usage close to third party toward drift risk management
Jun Koide

A research for drift of agricultural chemicals in urban areas

Jun Koide
Deputy Director,
Agricultural Chemicals Control Office
Environmental Management Bureau
Ministry of the Environment

Background

- Exposure of agricultural chemicals:
  Unintended exposure to non-farmers/non-workers may occur in urban areas (i.e. from greenery)

  …it may be a health risk BUT
  no information actually

Research: aim and target

- Object: to understand the reality of chemical usage & exposure
- Target elements: chemical usage for road trees, parks, etc.
- Questionnaire
  - sent to 267 cities with pop.>100,000 (>60% of national pop.)
  - period: Jun.-Sep. 2005

Result in general

- 86% cities use chemicals
- Main target greens: road trees and park greens
- Drift claims (by target)
  - Road trees 45%
  - Parks 51%

(by element)

  - trees (high) 65%
  - trees (low) 19%

Road trees (2-3m and higher)
(height 5-10m:61%)

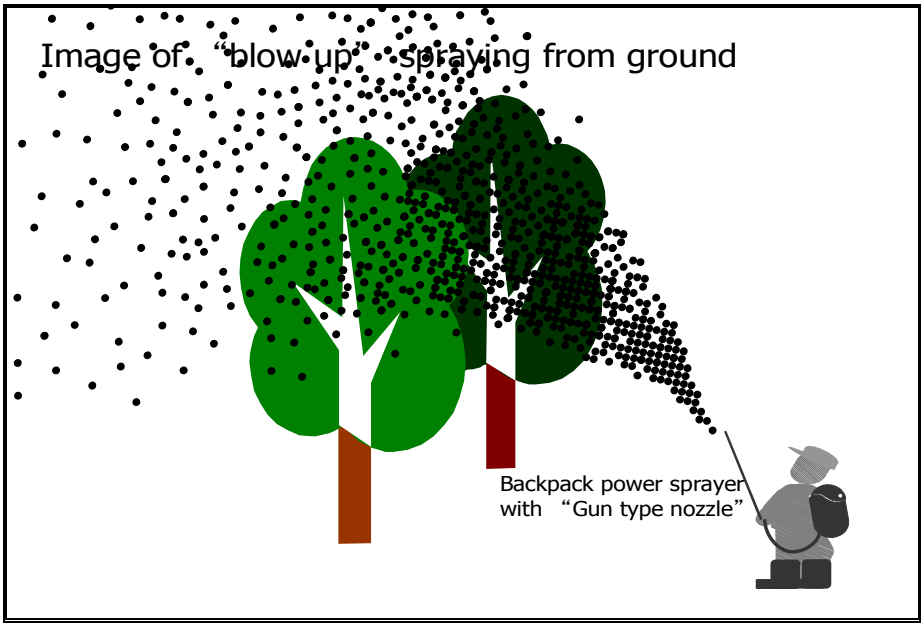
Situation:
- The number of trees applied per year:
  - <100 trees 18%
  - 1001-5000 34%
  - >5001 12%
- Spray area: by individual trees 40%
  - by area (i.e. green belt) 42%

High trees (road trees) Cont.

Application:
- When: early morning 49%
  - day time 23%
- Trigger: when pests found 77%
  - fixed time of the year 17%
- Frequency: Once a year 48%
  - Twice 25%
  - 2-3 times 13%

High trees (road trees) Cont.

Spray method:
- Equipment: engine set power sprayer 80%
  small sprayer (i.e. backpack power sprayer) 15%
- Spray method: blow up from ground 87%
- Nozzles (with flow control attachment):
  "Gun type nozzle" (to spray distance) 52%
  "thin mist nozzle" (with large spray angle) 25%



Should focus on....

- Major target
  Tree application
- Technical
  "Rough mist" nozzle for tree application
- Application method
  - Avoid "blow up" application
  - Set adequate "Keep off" area, etc.
- Activity of FY2006

Competition of technologies and equipments (plan)

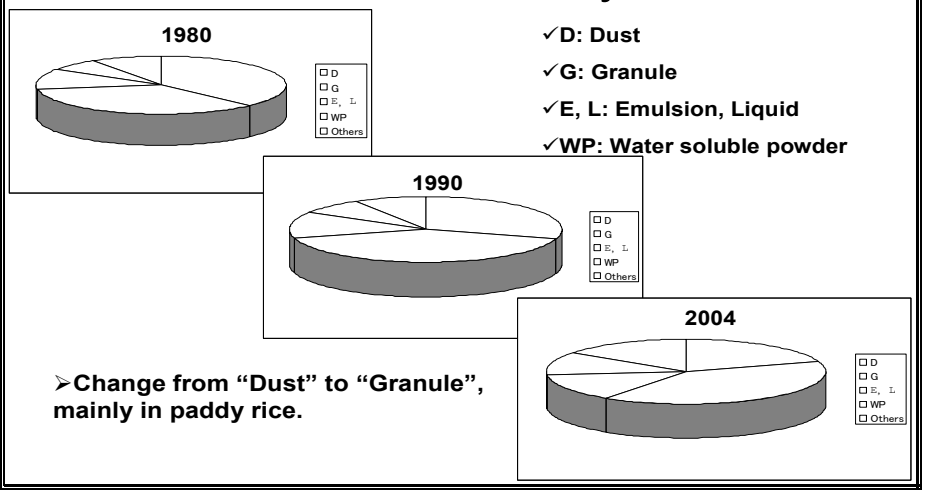
- Application from producers
- Evaluate items by efficiency
- Publish the result
- 3 year project, run by MOE
- Expect:
  - Provide farmers information to select items
  - Provide chance for items to be used widely

Pesticide spray techniques and measures for risk reduction in Japan
Katsuya Sato

Risk Reduction by Pesticide Application Technologies in Japan

Katsuya SATO
Japan-MAFF

Change of typical pesticide formulations in 25 years.



- ✓**D: Dust**
- ✓**G: Granule**
- ✓**E, L: Emulsion, Liquid**
- ✓**WP: Water soluble powder**

➢**Change from "Dust" to "Granule", mainly in paddy rice.**

Typical pest control programs in paddy rice.

		Seed	Seeding box	Pre Planting	Post Planting	Early Stage	Mid Stage	Late Stage
1980s	Fungicide	WP	L× 2			D or G	D or G	D
	Insecticide				G or WP/E/L		D or WP/E/L	D or WP/E/L
	Herbicide			E		G (*)		
2000s	Fungicide	WP	L× 1, G				D or WP/E/L	
	Insecticide						(G)	D or WP/E/L
	Herbicide				G (*)			

*** Application rate; 30kg/ha(1980s) →10kg/ha(2000s)**

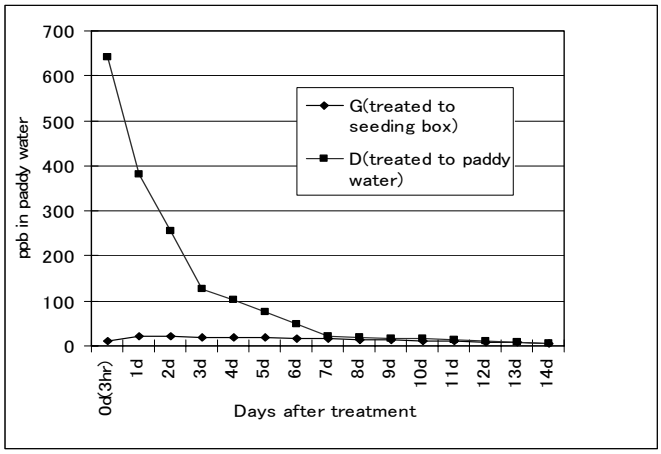
Revolution in Paddy Rice Program

Development of advanced seeding box treatment technology.

- Active ingredient effective over long time.
- Slow release formulation.
- Combination formulation of fungicide and insecticide.
- Lower input rate than field application.

reduced use of "Dust" formulation and total application rate / times !

-Comparison of seeding box treatment and direct spray-



Additional Activities for Risk Reduction

- One of trend issues around pesticide use.
- Bring troubles between neighbors, contamination into surface water and side effects to non-target organisms.

Education Programs

- Development of guidance by specialists on spray technique.
- Development of local-education programs.
- Promotion under relationship with MAFF, local governments and relative organizations.

Development of drift reduced spray techniques.

- Spray nozzles with course droplet size such as air injector nozzles.
- Research on their effective use.
- Research on additional ways for more risk reduction by spray drift, e.g. buffer-zone, effective barriers or clop planting.
- Development of advanced sprayers which can reduce spray drift.

USEPA: Drift Reduction Technology Program
Jay Ellenberger, USEPA

US ENVIRONMENTAL PROTECTION AGENCY

Drift Reduction Technology Program

Jay Ellenberger
USEPA, Office of Pesticide Programs

OECD Risk Reduction Steering Group
Seminar on Risk Reduction Through Better Application Technologie s

30 November 2005
Wellington, New Zealand

11/05 1

Genesis of DRT Project in US

- Expansion of spray drift database and development of modeling in the 1990s
- Smarter, more informed decisions for risk assessment/mitigation and product licensing
- Attempts to require a more uniform approach to drift restrictions on labels met significant opposition

11/05 2

Genesis of DRT Project

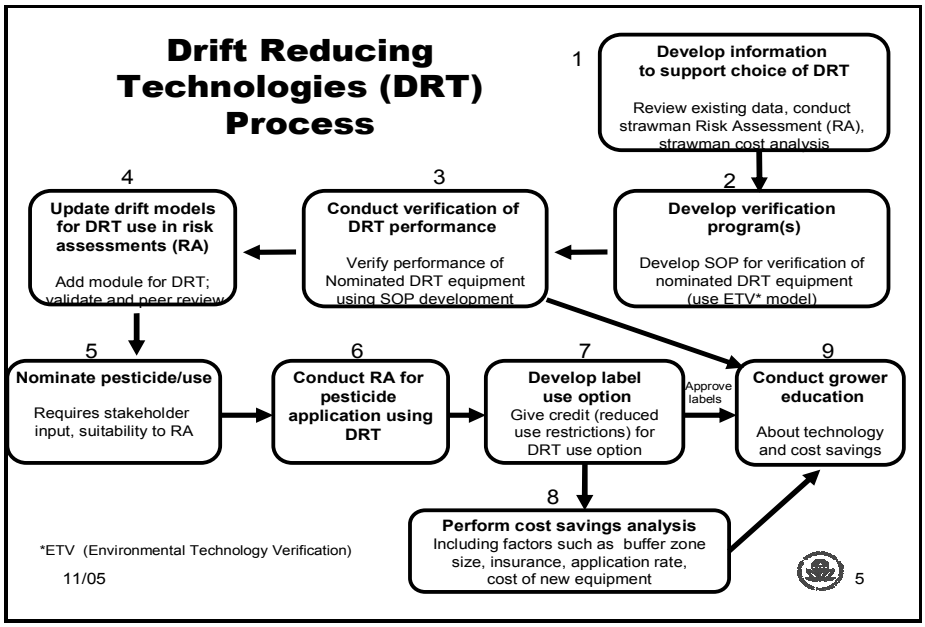
- Drift awareness raised – more focus
  - More, better education for applicators
  - More applicators using drift reduction equipment and techniques
- Development of better technology
- Knowledge of European programs of application equipment
- Collaboration of US EPA's Pesticide Program with Research & Development

11/05 3

EPA's Environmental Technology Verification Program

- Program since 1995 under EPA's Office of Research & Development
- Provides credible performance data for commercial-ready environmental technologies
  - Speeds implementation, benefits vendors, purchasers, users, public
- ETV has verified 250 environmental technologies, developed 75 protocols for testing
- Use the successful ETV model for the DRT project

11/05 4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Develop information to support choice of DRT
Review existing data, conduct strawman Risk Assessment (RA), strawman cost analysis
2
Develop verification program(s)
Develop SOP for verification of nominated DRT equipment (use ETV* model)
3
Conduct verification of DRT performance
Verify performance of Nominated DRT equipment using SOP development
4
Update drift models for DRT use in risk assessments (RA)
Add module for DRT; validate and peer review
5
Nominate pesticide/use
Requires stakeholder input, suitability to RA
6
Conduct RA for pesticide application using DRT
7
Develop label use option
Give credit (reduced use restrictions) for DRT use option
Approve labels
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Perform cost savings analysis
Including factors such as buffer zone size, insurance, application rate, cost of new equipment
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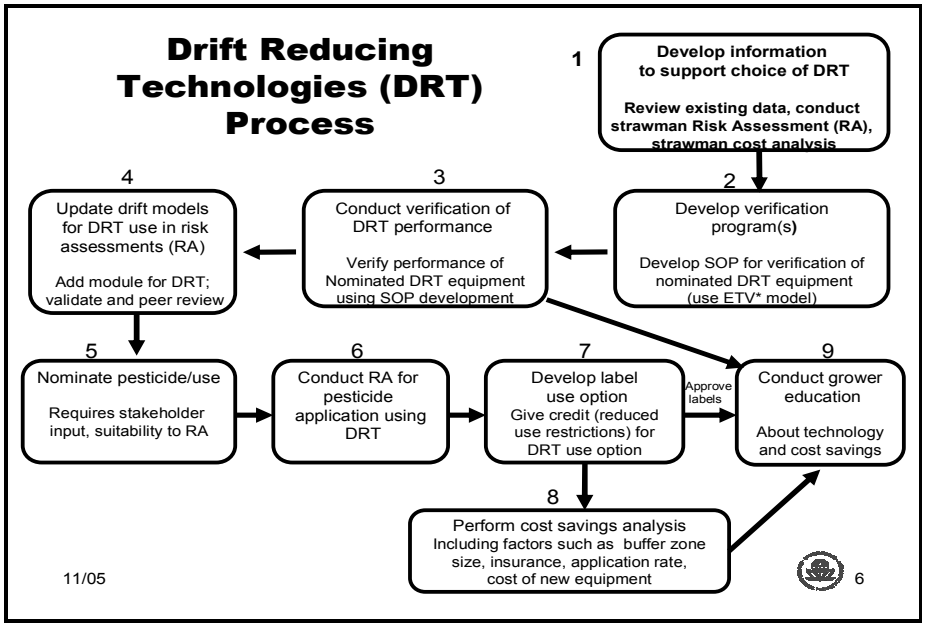
About technology and cost savings
*ETV (Environmental Technology Verification)
11/05
5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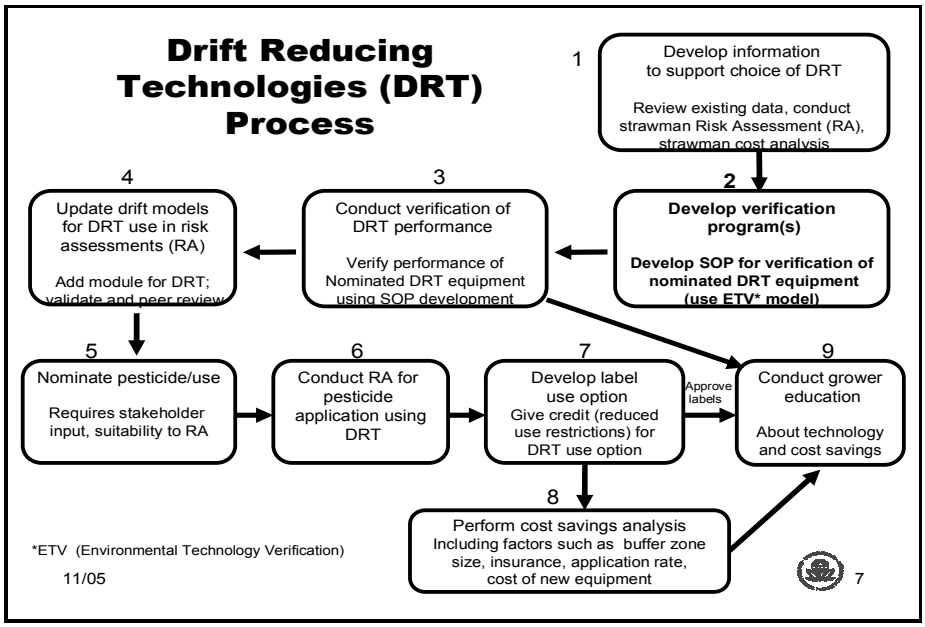
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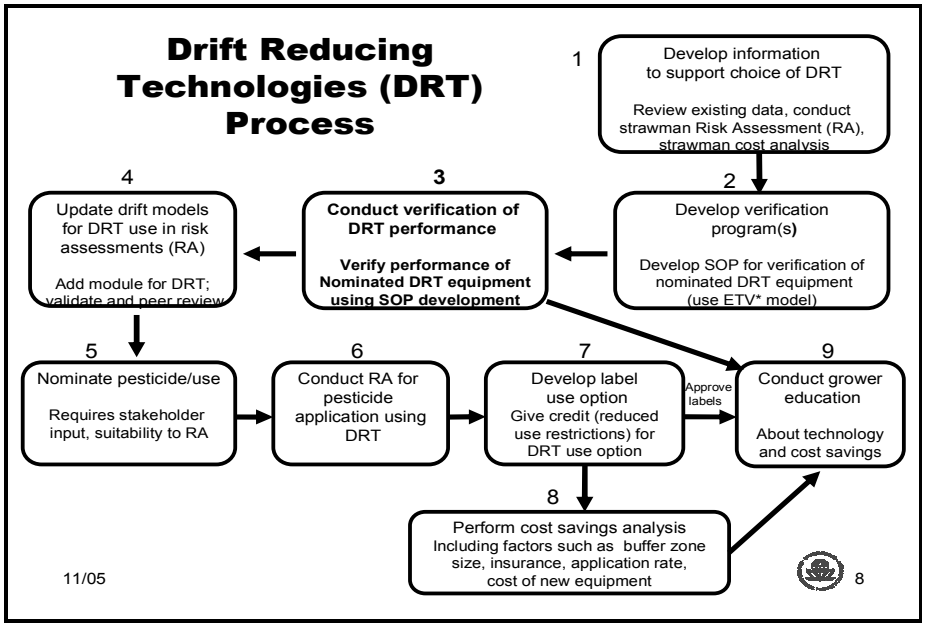
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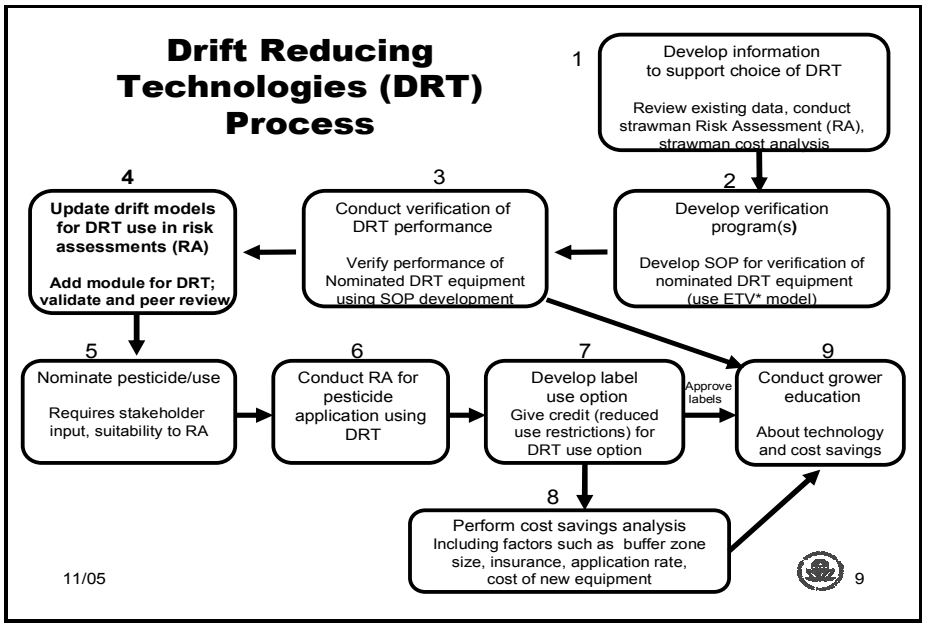
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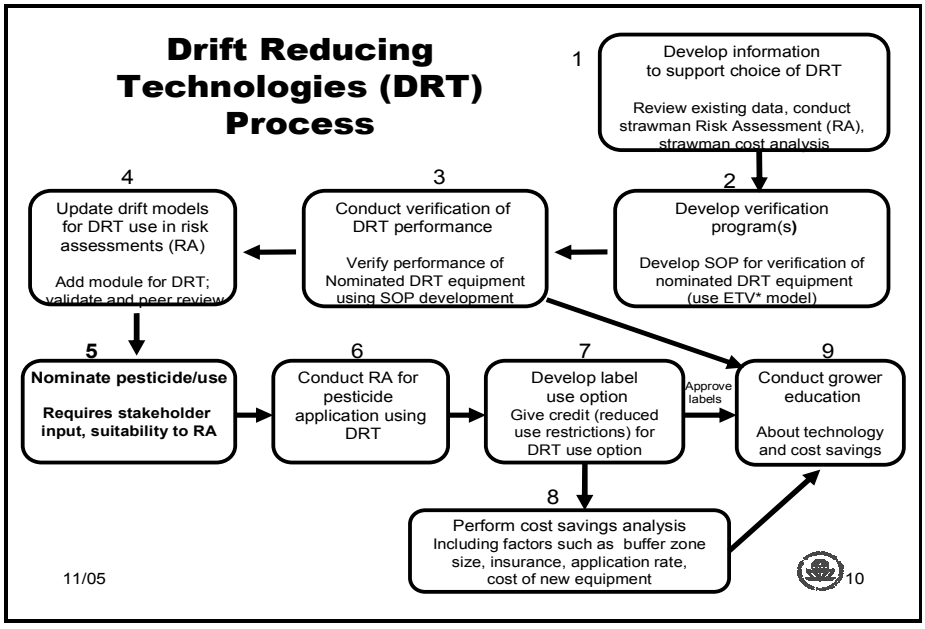
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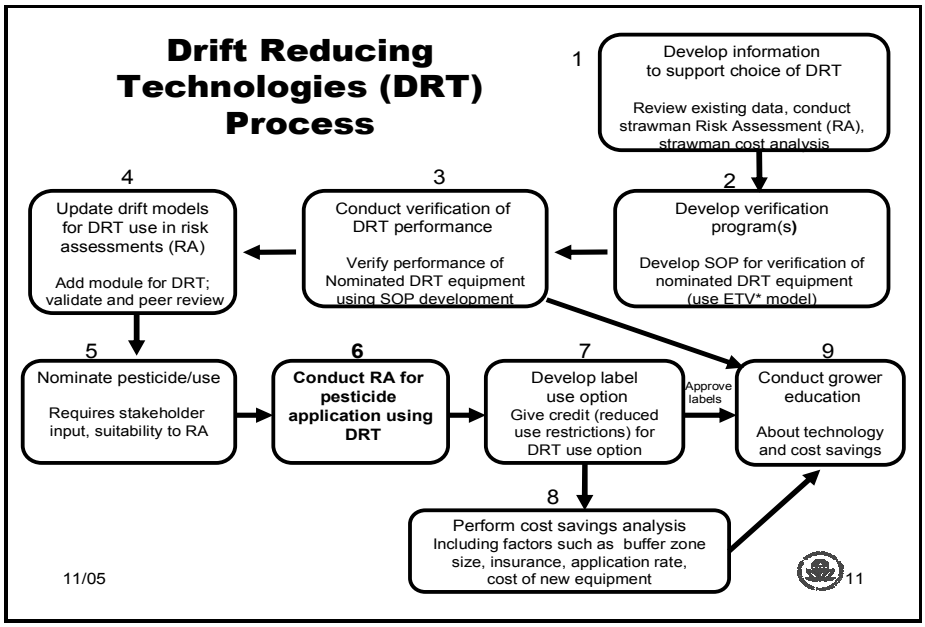
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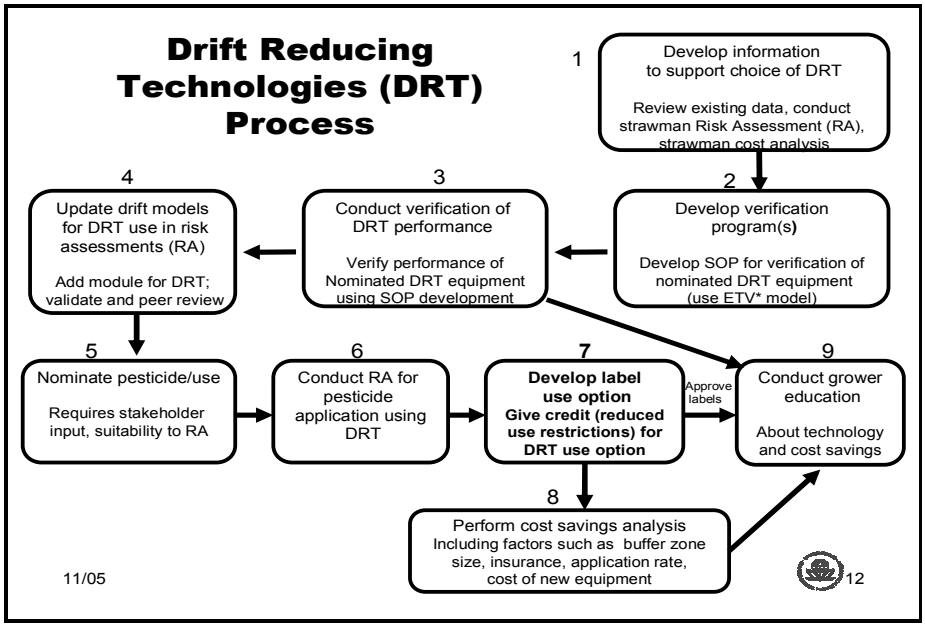
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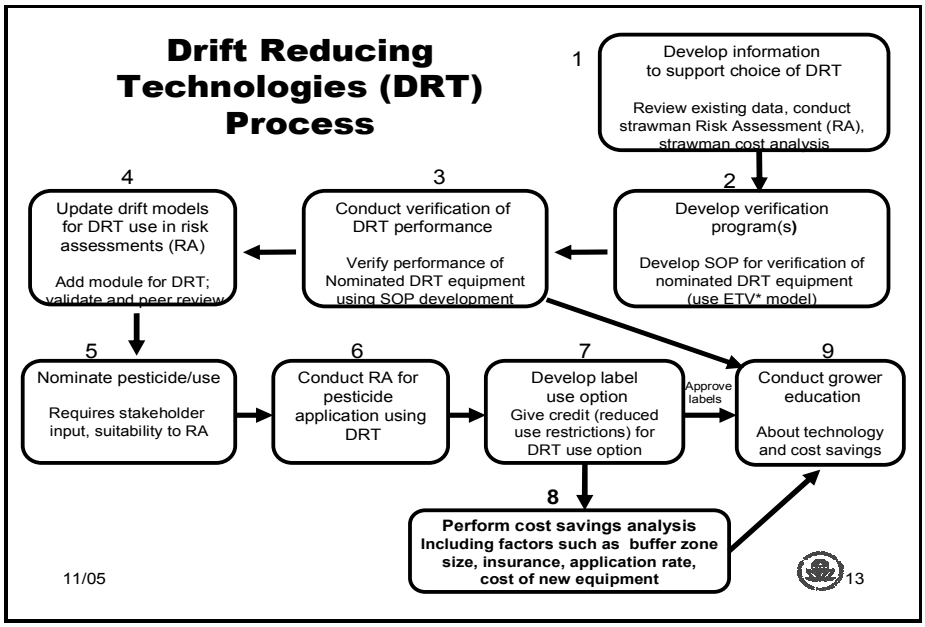
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Review existing data, conduct strawman Risk Assessment (RA), strawman cost analysis
2
Develop verification program(s)
Develop SOP for verification of nominated DRT equipment (use ETV* model)
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Conduct verification of DRT performance
Verify performance of Nominated DRT equipment using SOP development
4
Update drift models for DRT use in risk assessments (RA)
Add module for DRT; validate and peer review
5
Nominate pesticide/use
Requires stakeholder input, suitability to RA
6
Conduct RA for pesticide application using DRT
7
Develop label use option
Give credit (reduced use restrictions) for DRT use option
Approve labels
9
Conduct grower education
About technology and cost savings
8
Perform cost savings analysis Including factors such as buffer zone size, insurance, application rate, cost of new equipment
11/05
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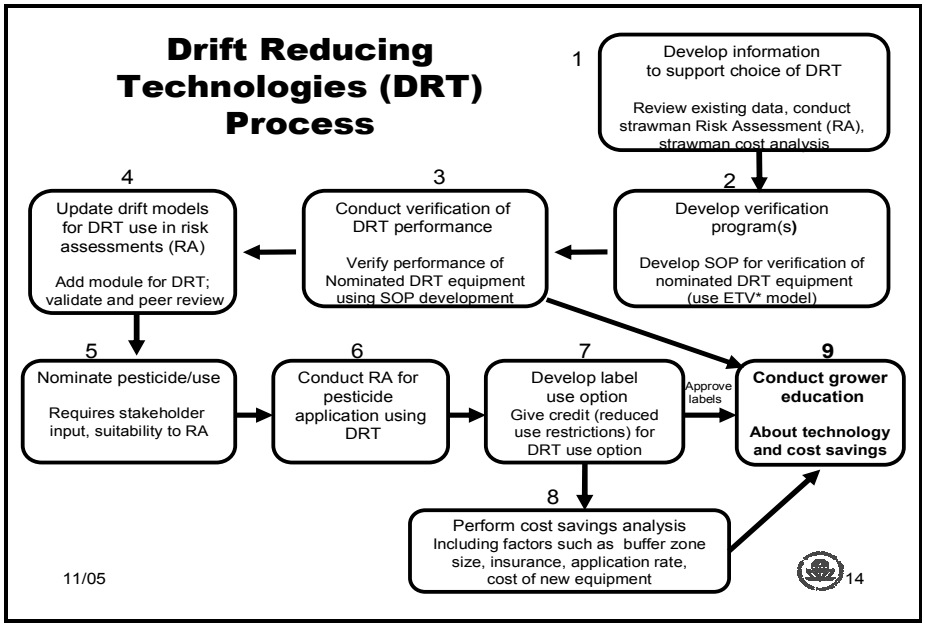
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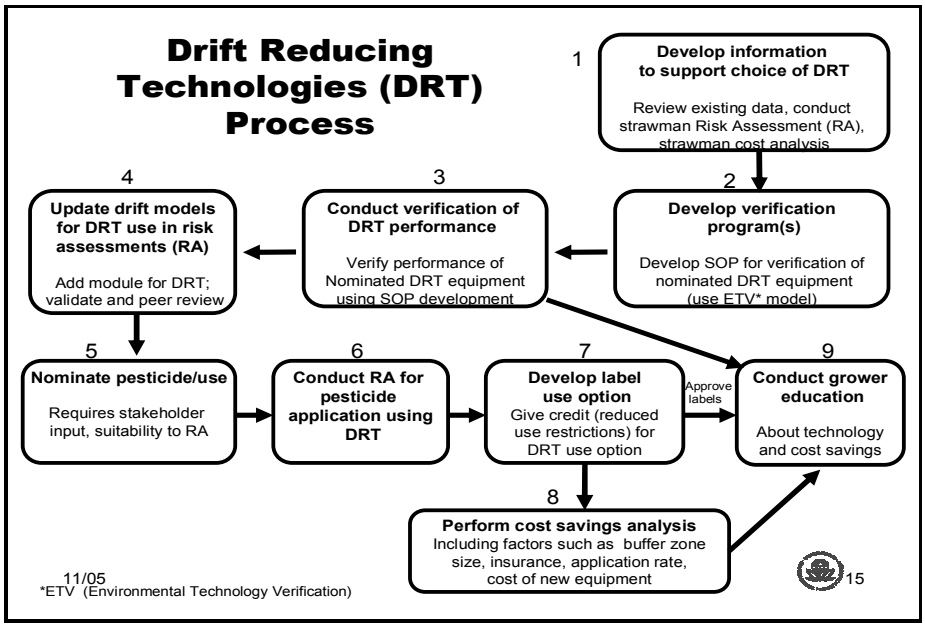

Results

- Less drift, more protection for public and environment, lower drift restrictions for users
- A "win" all the way around:
  - Equipment manufacturers
  - Applicators
  - Registrants
  - Insurance industry
  - General public
  - Environment

11/05

16

Three New Zealand Experiences
John Maber

Application technology and agrichemical risk reduction:

Three New Zealand experiences

David Manktelow[1] and John Maber[2]

[1]Agribusiness Training
[2]John Maber and Associates Ltd

Three NZ experiences

1. Aerial application
2. Sprayer calibration standards and calibrator training
3. Air blast sprayers

2

#1 Aerial application and the use of Through Valve Booms

Droplet formation from TVB® on a helicopter showing straight streams which break up into uniform-sized spherical droplets.

Technology that delivers very low spray drift risks for some specific application problems

http://www.waldrumspecialties.com/tvb/drop-heli.html

#2 Topfruit sprayer calibration standards and calibrator training

Advice to growers

(1997 ENZA technical bulletin on calibration)

Calibrators are expected to leave the orchard with the sprayer able to deliver targeted and controlled spray volumes to trees of different sizes or growth stages.

Calibrators are also expected to provide the documentation required by the sprayer operator to achieve different volumes, travel speeds etc.

However, the sprayer operator remains the key to obtaining effective coverage and control.

6

Advice to industry

(Manktelow 2001 report to pipfruit industry)

It would be unreasonable to expect anything but a significant minority of growers to undertake a comprehensive technical calibration.

The job requires some specialist equipment and knowledge, and as such is best performed by specialist calibrators.

7

Some history….. 1995

- ENZA imposed a mandatory calibration requirement for pipfruit growers in response to a US market access crisis
- 1995 calibration requirements
  - *Speed check*
  - *Total flow check OR flow meter check*
  - *Working tachometer and pressure gauge*
  - *Fan clutch check*
  - *Documentation for drenching, spring and full canopy spray applications*
  - *Calibrator training*
  - *Sprayer registration numbers*

These measures addressed poor application practices in the bottom 20% of the industry?

8

Some history …..1998

- Market access issues less critical
- Calibration audits found some deficiencies
- Attempted to introduce individual nozzle flow tests and reference to target canopies
- This was not viable for providers of "free" calibration services
- Requirement for independent calibration checks shifted from annual to biennial

Calibration worked?
Focus too much on simple machine tests
Need to address canopy target issues and empower the operator

9

Source of calibrators

1998 ENZA data

Industry Group	% of calibrations
AgChem merchant	51%
Machinery servicing	24%
Specialist consultant	11%
Grower	12%
Unidentified	2%

Still largely dominated by agchem merchants
There is a lack of specialist calibration service providers

10

Some history……2000+

- EUREP GAP standards for export fruit
- NZFQPA standards for local production
- Maber and Manktelow work with fruit industries to identify calibration needs *(2002-03 AGMARDT project)*
- NZ Agrichemical Education Trust calibrator training
  - *Reviewed international calibration systems and requirements*
  - *Emphasis on nozzle output checking, plume management and matching outputs targets*
  - *Ca. 70 calibrators trained nationally*
  - *Ca. 1,500 calibrations per year in pipfruit*
  - *Increasing demand for calibration in other crops*

Seeking to avoid mandated calibration requirements

Focus on risk reduction from maximising spray retention on target

11

#3 Reducing off-target losses from airblast sprayer applications

Maximising agrichemical deposits
Protecting sensitive areas

Protecting Sensitive Areas

NZS 8409 (2004) Management of Agrichemicals

- Identify sensitive areas
  - *Schools/houses*
  - *Roads/footpaths*
  - *Watercourses*
  - *Rough terrain*
  - *Organic crops & other crops*
- Agrichemical users are required to develop strategies to minimise spray movement onto these areas

13

Buffer zones

NZS 8409 guidelines

	With shelter	Without shelter
Boom Sprayer	2 m	10 m
Air blast sprayer	10 m	30 m
Aerial application	100 m	300 m

These buffer zone distances are not a legal requirement, they are recommended as a consideration to help mitigate drift

14

Drift management begins with
sensible spray plume targeting

Too much air still a common problem

Especially in dwarf trees

Airblast sprayer issues and solutions:
Kiwifruit hydrogen cyanamide example

- *Dormancy breaker applied to bare vines*
- *High value to industry*
- *Limited alternative options*
- *A caustic/toxic material*
- *Drift damage to other plants*
- *Calibration standards a partial solution*
- *Nozzle technology options?*
- *Adjuvant technology options?*

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Deposit efficacy and drift tests comparing:

Application machinery,
Air assistance volumes,
Air induction nozzle options
Drift reducing adjuvants

Food dye tracer used in this example
(conventional nozzles, 600 l/ha)
On vine deposit tests plus
Off target drift collectors

Results example – August 2005 test

Four treatments

1. *Standard nozzling no adjuvant*
2. *Standard nozzling + drift reduction adjuvant*
3. *Air inclusion nozzling no adjuvant*
4. *Air inclusion nozzling + drift reduction adjuvant*

All treatments provided equivalent target deposits

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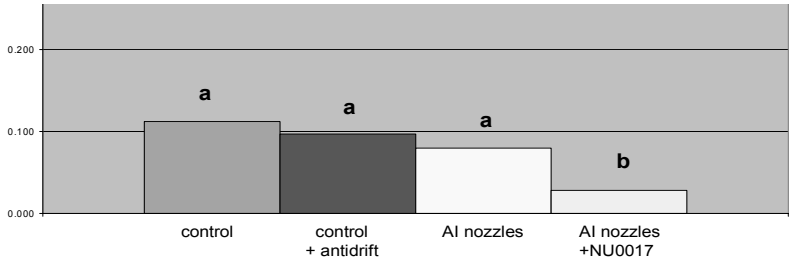
Effect of treatments on drift



Treatment 4 achieving up to 87% reduction (cf Trt 1) in off-target movement at 17m from sprayed rows

Summary

- There is no one answer to agrichemical use risk reduction
- Buffer zones and calibration standards are partial solutions
- Nozzle/adjuvant technology offer immediate advances
- Need to integrate risk reduction polices in a package that encourages user adoption
  = low risk + some financial return
- Need appropriate extension vehicles to take these messages to agrichemical users

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International Standards for Drift Reduction Technology Studies

Dr Andrew Hewitt: a.hewitt@uq.edu.au or ajhewitt@yahoo.com

OECD Workshop, November 30, 2005

Background

- 1990/2000's: LERAP and BBA Drift Reduction Technology (DRT) Testing Programs Verify Nozzles and Sprayers for Drift Reduction using similar protocols (some also allow for buffer adjustments with hedges, larger water bodies, lower dose rates, etc)
- 2001: EPA issues Draft PR Notice on Pesticide Drift Regulations in U.S. for conventional application types
- 2005: Draft Australian and Canadian Regulatory Notices (some inclusion of low drift technologies with examples of buffer zone reductions in Canada); Initiation of U.S. DRT Program Plans; new ISO drift-related standards being developed (measurement and classification)

2

DRT Verification

- Testing requires appropriate protocols, standards and test methods
- Harmonization would be good, if possible, to prevent duplicate testing

3

DRT Options

- Entire sprayers, e.g. air assisted boom sprayers, tunnel sprayers
- Specific parts of sprayers, e.g. nozzles
- Modification devices, e.g. reverse venturi chamber, shields, shrouds, wing tip devices, pulsed flow modulation
- Adjuvants, e.g. drift control agents
- Hedges and barrier vegetation or structures

- Each of these can be tested differently
- Need to consider how to tie in with modeling if possible

4

Available Information

- Thousands of publications referencing drift – only some are in Agricola and CAB databases
- SDTF database and literature collection at New Mexico State University
- AgDBAIS project (funded by CLA and SDTF) developed database on major regulatory studies: DEFRA (UK) (still pending inclusion), BBA (Germany), AAFC (Canada), IMAG (Netherlands), SDTF (still pending) for ease of access to specific studies – some of these included DRTs

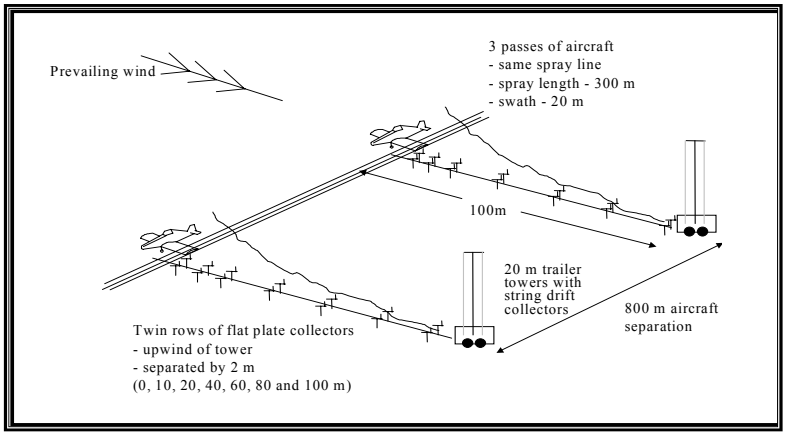
5

Entire Sprayers

- Examples: tunnel sprayers, air-assisted or air curtain sprayers,
- Usually need to be tested in field studies
- Need to consider possible crop interactions
- May be set up in various configurations (e.g. BBA has extensive tables listing exact setup of sprayer to qualify for drift reduction approval)
- ASAE and ISO have standards on field drift study procedures
- Consider covariate design and analysis to statistically separate meteorological effects from application effects

6

Possible Field Trial Layout



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Specific Parts of Sprayers

- Can often be tested in low speed wind tunnels simulating the field – removing the need for expensive field trials and covariate approach
- Primary example is nozzle type (e.g. twin fluid "air induction"; pre-orifice; rotary atomisers)
- Need to consider use setting – nozzle may operate more effectively at certain pressures for example (can therefore classify differently according to use conditions)
- Draft ISO standards cover test methods and drift classification
- ASAE droplet size classification standard (under revision) and draft ISO version under development

8

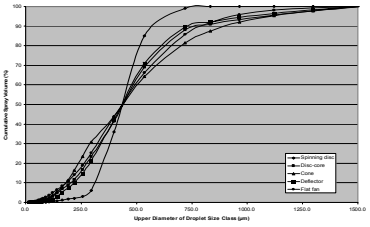
Challenges for Field/ Wind Tunnel Drift Data Use

- ISO and ASAE standards address how to measure drift
- Draft ISO standards attempting to address drift classification, however no consistent agreement yet on addressing drift reduction
- Is reduction in total airborne drift leaving the edge of the field most important? (this is potential exposure and was the initial focus of the German BBA DIX scheme). This can be measured on a vertical collector such as a string sampler
- Or is reduction in deposition most important (e.g. for actual aquatic or terrestrial exposure); in which case what distance is important, or do we integrate across a range of distances?
- (There are also sub-groups, e.g. deposition could be sedimentation measured on flat cards e.g. for aquatic assessments and/ or impaction measured on vertical collectors e.g. for human/ terrestrial exposure)
- Perhaps a combination of these should be considered?

9

Is it Time to Start Looking More Closely at Nozzles that Offer Narrow Droplet Size Spectra (Reducing Fines)?

Droplet Diameter (micrometers)	Fall velocity (m/s)	Drift distance Downwind (m)
10	0.003	1000
30	0.027	111
100	0.25	12
300	1.2	2.5
1000	5.0	0.6



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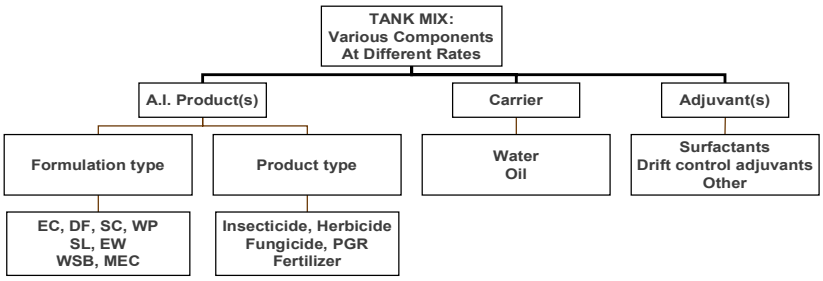
Modification Devices

- Examples: reverse venturi chamber, wing tip modification devices, dropped boom, shields, shrouds, air foils
- Wind tunnel and field testing options
- Variable adjustment devices, e.g. pulsed flow modulation, electric driven rotary atomizers rotating boom assembly

11

Tank Mix Effects



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How Important is the Tank Mix?

- Most atomization and drift studies testing nozzles and spraying systems have used water or water+surfactant for evaluations
- In reality, the surface tension and viscosity of real tank mixes will produce different droplet size and drift potential than water
- The response to tank mix physical properties can vary among nozzle types

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Possible Solution

- Include several surrogate tank mixes for evaluations that cover the range of real-world tank mix physical properties, especially the worst-case values
- ASTM has cited possible surrogate tank mixes in publications and draft standards

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Vegetative Buffers: Design Principles

- **A wide band of porous vegetation minimises air disturbance while providing a large number of catching surfaces**
- **Thin rough foliage should extend from the base to the crown - mixed plantings to reduce gaps**
- **Small and or hairy leaves maximise droplet capture**
- **Permeable barriers should allow air to pass through the buffer (50%porosity?)**
- **Barrier height greater than 1.5 - 2 times release height**

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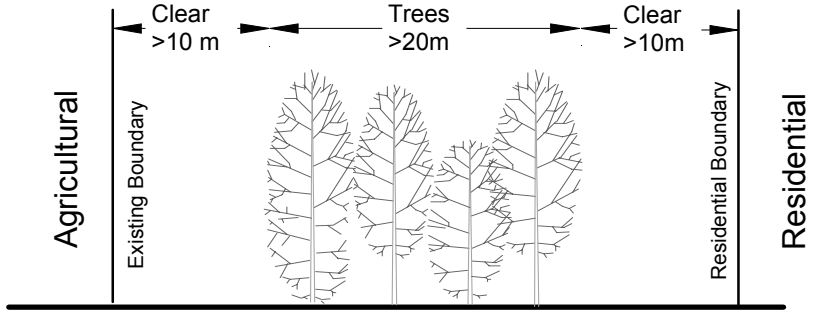
Queensland Guidelines Separating Agricultural and Residential Land Uses



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Other Considerations

- Balance is needed - avoid trading drift for another source of environmental exposure, e.g. coarser sprays can sometimes increase application volume rate requirements
- Need to consider effects of technologies on other aspects of application - c.o.v., patternation, etc
- BMP development activities important

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Test Guidelines

- EPA 840.1000: Background for Pesticide Aerial Drift Evaluation
- EPA 840.1100: Spray Droplet Size Spectrum
- EPA 840.1200: Spray Drift Field Deposition

(These are probably going to be extensively updated and revised soon)

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Droplet Size Standards

- ASTM E 799 Practice for Determining Data Criteria and Processing for Liquid Drop Size Analysis
- ASTM E 1088 Definitions of Terms Relating to Atomizing Devices
- ASTM E 1296 Standard Terminology Relating to Liquid Particle Statistics
- ASTM E 641 Standard Methods for Testing Agricultural Hydraulic Spray Nozzles
- ASTM E 1260 Test Method for Determining Liquid Drop Size Characteristics in a Spray Using Optical Non-Imaging Light-Scattering Instruments
- ASTM E 1458 Test Method For Calibration Verification of Laser Diffraction Particle Sizing Instruments Using Photomask Reticles
- ASTM Draft Standard Test Method for Determining Cross Section Averaged Liquid Droplet Size Characteristics in a Spray Using Laser Diffraction Instruments
- ASAE S 327.2 Terminology and Definitions for Agricultural Chemical Applications
- ASAE S 386.2 Calibration and Distribution Pattern Testing of Agricultural Aerial Application Equipment
- ASAE S572: Spray Nozzle Classification by Droplet Spectra
- ISO Draft Standard 25358: Agricultural Machines: Crop Protection Machines: Droplet Size Classification

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Drift Standards

- ISO Draft Standard: Equipment for crop protection — Laboratory drift methods measurements – Wind tunnels
- ASAE Standard S561 Procedure for Measuring Drift Deposits from Ground, Orchard and Aerial Sprayers
- ISO Standard 22866: Equipment for Crop Protection: Methods for the Field Measurement of Spray Drift
- ISO Draft Standard 22856: Equipment for Crop Protection – Laboratory Drift Methods Measurements
- ISO Draft Standard 22369 Crop Protection Equipment: Drift Classification of Spraying Equipment – Part 1: Classification

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Physical Property Standards

- ASTM draft Standard Test Method: Characterization Performance of Drift Control Adjuvants
- ASTM Standard Test Method: A Rheological Standard Test Method for the Relative Extensional Viscosity of Agricultural Spray Tank Mixes (in finalization)
- E 1142 Standard Terminology Relating to Thermophysical Properties
- E 1194 Standard Test Method for Vapor Pressure

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Other Standards

- ASTM E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods
- ASTM E691 Standard Practice For Conducting an Interlaboratory Study to Determine the Precision of a Test Method
- ASTM E456 Definition of Terms Relating to Statistical Methods

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Websites

- epa.gov/pesticides/factsheets/spraydrift.htm
- publish.csiro.au/Books/download.cfm?ID=3452
- epa.gov/opppmsd1/PR_Notices/prdraft-spraydrift801.htm
- pesticides.gov.uk/fg_leraps.asp?id=207
- bba.de/english/inst_eng/ap_eng/lossredequip/beschreibung_e.pdf
- ew.govt.nz/policyandplans/wrpintro/wrp/wrp6.2.9.htm

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International Interactions

- ISO and Buffer Zone Working Group meetings
- International conference on spray drift
- WHO addressing drift management for specific applications, e.g. space spraying at present

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Conclusions

- Drift reduction technologies: application technique, adjuvants, etc
- Barrier vegetation filtration of drift
- Wind tunnel versus field evaluations
- Drift classification systems
- Interactions pose challenges – e.g. changes in tank mix and crop type/ growth stage can totally change the drift performance of a technology
- Tie into modeling to handle other factors (meteorology, dispersion etc)
- International harmonization

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Other Issues

- Focus only on primary drift (particle movement at the time of application) or also include technologies that can reduce secondary (e.g. “lift-off” vapor, contaminated dust) drift?
- Solids (e.g. dusts, granules) and liquids as well, or just liquid sprays?
- Forestry, vector control, home and garden, rights of way use as well as agriculture?
- Quality issues: GLP requirements, data review (e.g. SAP) and acceptance

26

OECD Spray Applications
Keith Jones

Representing the Plant Science Industry

Enhanced efficacy, efficiency and safety through improved application

Keith Jones
Manager, Stewardship & Sustainable Agriculture

Outline

- Introduction
- Spray technology
- Risk reduction
- Training
- Conclusions

More accurate and timely application of pesticides will be of increasing importance to integrate their use in IPM programmes and to minimise pollution
(van Emden & Peakall, 1996)

Industry involvement in design of application equipment

- Tree row volume and crop adapted spraying (the dose rate is adapted to the crop volume (height, width, row distance)
- Recycling spraying in vine (vine is sprayed horizontal, spray not cached by the leaves are recovered by a wall, fed back to the tank, and sprayed again). Savings about 30% of product.
- Direct injection systems (product from container is dosed to the water coming from the tank, no tank mix with product anymore).

Industry involvement in design of application equipment

- Rope application for some herbicides (products are not sprayed, but put drift-free with a rope to high weeds)
- Electrostatic spraying (3 main principles of charging) – little or no improvement or commercial success
- Air inclusion nozzles for low drift application: field trials not only in field crops, but also in vine and orchards (see next section)
- CDA low and ultra-low volume spraying with rotary discs

Novel application technique greenhouses Spain

In collaboration with the Agricultural Research Centre in Gent, Belgium novel application techniques with vertical spray booms were tested

Trolley pulled manually

Fumimatic

Novel application technique greenhouses Spain

Compared to the standard spray gun operator exposure with the trolley is reduced by a *factor of 25*

Compared to the standard spray gun operator exposure with the Fumimatic is reduced by a *factor of 70*

Nozzle design to target spray

Targeted application to trees: increasing efficiency and reducing water use by 10 – 100 fold

Safety & Efficiency: Drift reduction through Spray Drift Reduction Technology (SDRT)

Factors Contributing to Spray Drift

- Nozzle fines (droplets < 150 μm)
- Wind speed and direction
- Effective release height

Nozzle fines

Standard flat fan nozzle

Spray drift reducing nozzle

Drift Reduction Technology Applied to Boom Sprayer

Standard flat–fan nozzles

Low drift (air induction) nozzles

Drift Reduction Technology Applied to Vineyard Application Equipment

Standard nozzles

Low drift (air induction) nozzles

Drift Reduction Technology Applied to Orchard Application Equipment

Hollow cone nozzles

Low drift (air induction)

Effect of boom height

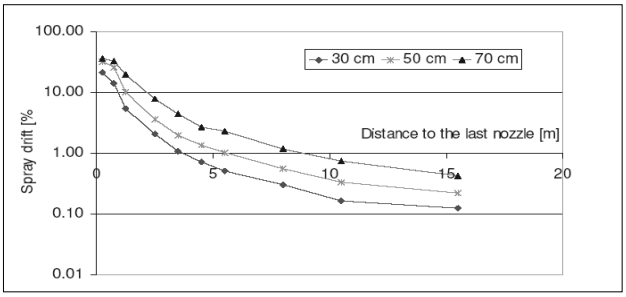


Figure 1.2. Effect of sprayer boom height (30cm, 50cm and 70cm above crop canopy) on spray drift deposition next to the field when spraying a potato field (spray volume 300 l/ha, Nozzle XR11004 @ 3bar; de Jong et al., 2000a).

Effective release height

No air-assistance

Air-assisted application

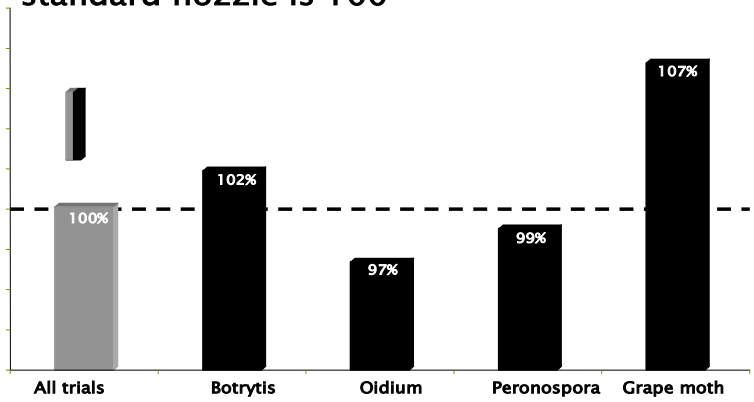
Impact of SDRT nozzles

- SDRT nozzles reduce the production of droplets < 150 μm, therefore reducing the influence of:
  - Wind speed
  - Release height

Efficacy

- How does SDRT affect efficacy?
  - Reducing drift increases in-field deposition
  - Efficacy can be maintained even when droplet size is increased

SDRT nozzle efficacy trials in vines – standard nozzle is 100



Reference: Proceedings of International Pesticide Application for Drift Management, October 2004, Hawaii

Value to Growers

- SDRT nozzles can be used without changing other application parameters such as water volume, pressure, application speed, use rate or frequency of application etc.
- SDRT nozzles can easily substitute for standard hydraulic nozzles for a reasonable price, without any significant technical modification to the sprayer.
- This reduction in drift, also means that in-field buffers could be reduced, thereby helping the grower to maintain the tools and his hectares in production.

Advantages of SDRT

- Environmental safety
  - aquatic
  - non-target arthropods and plants
- Human safety
  - applicator and bystander exposure
- 12 years of trials demonstrate efficacy is maintained with insecticides, fungicides and herbicides

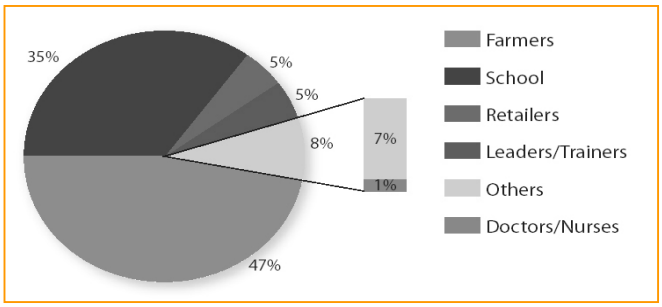
Use and maintenance of application equipment included in training material

Application included in IPM/'Safe Use' training

- Industry participation in 80+ countries
- In 2003 almost 100,000 people trained (including 9000 trainers) in circa 30 countries in Africa, Asia and Latin America; over 2.5 million trained since 1991
- Participation in programmes in developed countries, e.g. certification schemes
- Independent audits (e.g. Kenya) show change in attitude and behaviour amongst farmers
  - » Lesson learnt on improved training methodologies and monitoring behaviour change – will be incorporated in all programmes

More needs to be done!

IPM/'Safe Use' training numbers – 2003



Conclusions

- Industry recognises the importance that proper application plays in efficacy, efficiency and risk–reduction in the use of their products
- Industry has collaborated in development of new equipment and application strategies, as well as training of users
- Improvements in equipment and strategies has occurred, but their have also been failures

Conclusions

- Development of optimal application requires a compromise between differing requirements – formulation possibilities, engineering limitations, etc.
- Availability and practicality of equipment in different regions needs to be considered
- The FAO Code of Conduct on the Distribution and Use of Pesticides encourages collaboration between the pesticide industry and application equipment manufacturers – *this has occurred, but further collaboration between these and with other stakeholders (farmers, governments) is needed*

Acknowledgements

European Crop Protection Association
Roy Bateman, IPARC, Imperial College, UK
Hans Felber, European Safe Use Initiative
Angela López Berrocal, Aepla
Anarco Garcia, CropLife Latin America

A Public Interest Perspective
Meriel Watts

Reducing Risk with Better Application Technology:
a Pubic Interest Perspective

Dr Meriel Watts
Pesticide Action Network
Aotearoa New Zealand

PAN's View on Risk Reduction

- Must have *use* reduction
- Must reduce reliance
- Better education of users
- Chemical inputs are affecting human health, environmental health, agricultural sustainability

Global problems

- Failure to apply basic safety measures e.g. re-entry
- Failure to observe no spray zones
- Failure to apply penalties for non-compliance
- Pesticides too hazardous to be used at all - endosulfan
- Real conditions of use and maintenance
- Slow uptake of improved technology

Hand-held equipment

- Most widely used
- Used for most toxic pesticides
- ***Leaks!***
- Malaysia: 30,000 women spray on average 262 days per year, frequently paraquat
- Should not be used for toxic pesticides where there is a chance of leaking

Airblast sprayers

- Bad technology
- Throws spray up into the air
- No amount of nozzle improvement can keep the pesticide on target
- Replace with tunnel sprayers

Aerial spraying

- NZ: 2,4-D - crop losses, human health effects
  - Agricultural Chemical Trespass Bill
  - Users say they must be allowed to drift
  - Need legal protection for victims
- Kasargod: cashews - endosulfan
- Hungary: mosquitoes - dichlorvos, deltamethrin
- Andalucia: olives - dimethoate
- West Auckland - latest technology didn't prevent drift and off-target deposition
- Should not be used where people are exposed or with hazardous pesticides

PAN activities

- **PAN North America**: new drift website
- **PAN UK**: bystanders exposure campaign
- **PAN Europe**: total ban on aerial spraying
- **PAN Asia Pacific**: ban on paraquat - common cause of poisoning with handheld sprayers
- **PAN Aotearoa NZ**: supports Ag Chem Trespass Bill - no drift beyond boundary of property

Better technology?

- prevents exposure to bystanders
- minimises operator exposure
- delivers pesticides directly to the target
- reduces amount of pesticide used
- used correctly under common conditions of training
- properly maintained under common conditions of use
- fits the growing system

Concluding Comments

- Must acknowledge conditions of use
- Must remove worst pesticides because of inherent hazard or conditions of use - endosulfan, paraquat
- ***Onus of responsibility on those who promote pesticide use to ensure appropriate technology - that will reduce amount of pesticide used, and reduce risk to operator, bystanders, environment - is available and practicable under conditions of use, and is accompanied with training to ensure proper use and maintenance***