**International Advances in Pesticide Application;** a report by David Talbot, ADAS following attendance of this Association of Applied Biologist conference, held at the School of Agriculture, Universitat Politecnica de Catalunya, Barcelona, Spain, 13 – 15 January 2016.

For further information readers should refer to Aspects of Applied Biology 132 (page numbers are listed where relevant). Information reproduced by kind permission of the Association of Applied Biologists.

**Introduction**

The biennial conference brings together key players from research institutes, industry and regulatory authorities to focus on pesticide and biopesticide application issues. Many of the challenges that pesticide / plant protection product application poses are the same irrespective of the crop. The international nature of this conference, with delegates from many different sectors provides a forum to share knowledge and ultimately improve spray application across the globe.

Agri food makes up more than 8% of Spain’s GDP (valued at €1.049 billion), employs more than 7% of the population and accounts for 17% of the country’s exports and accounts for 20.5% of the net sales of the Spanish industry. Horticulture makes up 18% of the Spanish agricultural sector. The ministry of Agriculture, Food and Environment is responsible for plant protection product authorisations in Spain. Public research organisations are dedicated exclusively to agricultural and forestry research (approximately 900 staff). The industry prioritises research spend on the challenges it faces through applied research calls (Page iii).

The Universitat Politecnica de Catalunya, Barcelona hosted the conference and has an off-site, 10 Ha (of which 5Ha is dedicated to field trials) research facility built with the support of the ministry of Agriculture, Food and Environment. The site includes open fields, glasshouse and polythene tunnels to test various aspects of spray application in different production environments. The work carried out their largely focuses on spray application in grapes, fruit and olive trees, with a focus of reducing spray volumes applied via orchard sprayers. Work on drift reduction is also carried out (much of which is done at night when there is no wind). The research facility and university maintain good relationships with companies with interests in spray application and offers training courses for both agrochemical and sprayer manufactures. The information summarised below will be of interest to growers, regardless of sector and will update them on new technology, helping to guide there decision making in relation to spray application in the future.

**Remotely piloted aircraft**

Whilst remotely piloted aircraftcan and are being used to apply plant protection products they have many other potential uses. They are being used to remotely inspect crops, using crop and field sensing, to track vehicles, personnel and materials. Regulatory and design constrains have limited the widespread use of remotely piloted aircraft for the application of plant protection products in some countries. Despite this fact they are being used to apply plant protection products in field crops such as rice, grapes and nuts. Operating low to the ground, the air space that they work in may not be that highly regulated (depending on nation rules). Application volumes of 10 – 50 L/Ha can be delivered to crops and good results have been obtained, particularly in low disease pressure years. Backing up with conventional ground sprayers is likely to be necessary when disease pressure is high (Page 15 – 21).

Unmanned aircraft vehicles (UAV) used for spray application have developed rapidly in China in recent years. These UAV are used to apply plant protection products, largely to rice crops, partly due to the difficulties associated with terrestrial travel upon the wet soil the crop is grown in. UAV with a working efficiency of up to 6 Ha/hr with 5-30 L tanks are in use, with 5-20 m spraying swaths. Results have shown that small UAV are ideal for small plots, delivering efficient pest control whilst minimising operator exposure (Page 73 – 81).

**Highly efficient airblast sprayers**

Where plant protection products are applied with air assistance (e.g. airblast / orchard sprayers, as used in fruit production) part of the plant protection product does not reach the target and is ‘lost’ in the atmosphere, ground or surface water as drift. Drift is recognised as being the most important source of diffuse environmental contamination. The EU Horizon 2020 project *Healthy crop, Healthy environment, Healthy finances through optimisation* (H₃O) will result in a new generation of sprayers coming to market in the near future with the aim of reducing the amount of product that is released to the environment by 50% and delivering savings of diesel fuel by 38.5%. This is achieved by sprayers which operated at lower horse power. Other benefits include reductions in noise associated with sprayer operation (Page 23 – 29). Since the conference the sprayers designed in this project won the outstanding technical innovations award at the agricultural machinery fair in Zaragoza, Spain. These Smart Air Pro sprayers will be commercially available from September 2016. In the meantime growers can test a H3O sprayer free of charge by contacting Mrs Ekaterina Ukhandeeva via [ekaterina@fedepulverizadores.com](mailto:ekaterina@fedepulverizadores.com)

**Spray deposition and drift in orchard spraying, using multiple row sprayers**

Evaluation of the latest data on spray drift associated with orchard spraying in the Netherlands and tests to evaluate water quality, confirm that current legislation is insufficient to protect surface water in Holland. Therefore a reduction in chemical inputs is required. Multi row orchard sprayers (typically spraying three crop rows at once from both sides) have become increasingly popular in the Netherlands, these sprayers (fitted with drift reducing nozzles) are proven to reduce spray drift significantly. (Page 391 -396) UK growers should embrace drift reduction technology to help to maintain water quality and plant protection product authorisations in the future.

**Online support for pesticide users and their trainers**

<https://Pesticidewise.com/> is a website developed by Syngenta to support and encourage safe and effective use of pesticides. It is aimed at spray operators applying pesticides via a knapsack sprayer and those whom train operators. The website is free to use, whilst being user friendly and interactive. A range of resources are available including videos, calculators, checklists and reports forms which can be accessed via desktops, mobiles and tablets. There are plans to develop the website further in the future to include boom sprayers and mist blowers (Page 49 – 54).

**Improving spray retention through an appreciation of droplet behaviour**

The amount of spray retained by plants can be quite variable, it is dependent on leaf character (whether it is easy / hard to wet). High levels of spray retention are important as non-retained droplets represent a total waste of product and a potential environment contaminant. Upon leaving the sprayer, spray droplets that hit the target either adhere to the leaf (known as primary retention), bounce on impact (sometimes bouncing off the leaf), shatter on impact which can result in smaller daughter droplets being recaptured and retained (secondary retention). Computer modelling enables us to understand how droplets behave on certain leaf surfaces, particularly those that are difficult to wet, including weeds such as Fat hen *(Chenopodium album)*. In some cases surfactants can help to improve adhesion to leaves that are difficult to wet, however droplet velocity is also important.

**Precision spraying in greenhouses**

A joint project between researchers in Holland and Germany (Healthy greenhouse 2011 – 2014) utilises (amongst other things) automated image processing as a monitoring tool, biological controls and precision spraying technology. Monitoring of both micro and macro levels enables the detection of diseases before symptoms are visible to the naked eye. This early detection is often essential when using biological agents for control. If chemical plant protection products are still required, a reduction in the use of pesticides is achieved through optimal precision spraying. A spraying system with software that adapts spray volume and dose to crop canopy size has been developed. Spray distribution is optimised for maximum efficiency and minimal environmental and operator exposure. The system has been tested on different crops including a pot grown cyclamen crop. The Crop Adapted Spraying (CAS) is an intelligent sensor based sprayer which applies spray onto the crop only when and where it is necessary to do so. This prevents losses to the ground, and the glasshouse walls / roof as potential emissions to the environment. The system is adapted from the Weedit (Rometron, Standeren, NL) sprayer used to control weeds on pavements. The sprayer is built on a horizontal boom and uses a sensor to detect the presence of a green crop and the size / density of the canopy so only sprays where plants are present. This saved 20 – 35% of spray liquid applied when compared to a conventional boom (depending on plant spacing in container grown crops). When grown at wide pot spacing’s this can result in savings of up to 55%. With the CAS sprayer the in-crop spray deposition was higher or comparable than with a standard boom, variability was also lower. The CAS-sprayer reduced spray deposition on the ground between benches by 80-90% and by 50-80% on glasshouse walls compared to the conventional spray boom. Spray deposition on the glasshouse roof was similar for both sprayers (Page 137 – 144).

**Canopy density spraying (CDS) of strawberries (Wageningen, The Netherlands)**

Angling of the air sleeve and spray nozzles towards the crop rows improved spray deposition compared to a horizontal spray boom and nozzle orientation when tested at two growth stages. Spray deposition on the leaves was 15 – 25% higher compared to the standard air-assisted spray application. Losses to the soil surface on the top of the bed and in between rows was also lower for the CDS sprayer than the standard air-assisted sprayer. Spray deposition above the crop rows was also higher where the CDS sprayer was used. Monitoring may be necessary as a higher spray deposition on the canopy and fruits may increase the risk of exceeding residue limits. Ongoing trials are underway with a 15 meter boom CDS sprayer (Page 153 – 158).

**Ensuring negligible operator exposure; easyFlow – the safer transfer of concentrated liquid formulated plant protection products.**

The easyFlow closed transfer system was developed and launched by agrotop and Bayer. It is a closed transfer system that avoids contamination during the mixing of plant protection products from small canisters into all types of spray application equipment. This system has been shown to reduce worker exposure by 98% and can be used for all liquid formulated products and standardised containers with a neck size of 63mm. It should be noted that this is more or less the standardised width of container neck regardless of supplier. It is said to be the first contamination avoiding, self-cleaning system of liquid crop protection products from sealed or opened containers that enables the user to safely apply some, or all of the contents of a plant protection product container. This system enhances operator safety, is efficient whilst ensuring fast and efficient cleaning of plant protection product containers.

Ensuring negligible operator exposure when handling plant protection products will help to fulfil current and future requirements regarding operator safety and environmental protection. One of the development objectives was to ensure that the system was easily affordable to facilitate widespread use. The easyFlow transfer system is easy to install on all sprayer tanks and can be retro fitted to older sprayers. The current minimum volume is 1L as the system was initially developed for fruit and vine growers. It is recognised that some growers will need to mix smaller volumes than 1L so easyFlow M has been developed which is capable of mixing much smaller quantities (from 17ml). Adoption of such technology will help to enhance operator safety, ensure negligible exposure whilst delivering fast and complete cleaning of empty containers (Page 177 – 181).

**Novel spray adjuvants to decrease spray drift**

Tank-mix adjuvant’s ability to reduce drift is well recognised however the use of different nozzles and product types introduces variability. The drift reducing adjuvant, referred to as DAS DRT was investigated on its own and with three herbicide products of different formulation type. Three different nozzles were used in the tests, a standard flat fan nozzle, and two air induction nozzles, one with a 2-star rating, the other producing relatively large droplets when operated at 2.0 bar, giving a 3-star rating. The additive reduced drift significantly with all nozzles and products. The use of DAS DRT consistently reduced drift between 18 and 66%, therefore there it has potential to reduce and minimise spray drift (Page 257 – 263).

**Preliminary study on the effect of spray pressure in hand held sprayers.**

A study carried out in peppers in Almeria, Spain has identified that plant protection products are usually applied with hand held spray guns / lances at high pressures and application rates. This low technology equipment results in low deposition and poor uniformity of spray distribution within the crop canopy, heavy losses to the ground and high pesticide exposure risk for the operator. The trials were carried out with a lance sprayer equipped with two twin flat-fan nozzles. The results show that the use of high pressure in spray application of pesticides does not improve deposition on the plant canopy. Lower pressures resulted in slightly greater deposition, however applications at lower pressures also resulted in greater losses to the ground due to larger droplets creating runoff. Moving to an appropriately sized, smaller nozzle size would prevent run off being an issue. Application at the highest pressure resulted in less deposition in the plant canopy; high pressure does not improve deposition onto or penetration into the crop canopy. (Page 363-367)

This ties in with many of the findings of HDC (now AHDB) funded project PO 008. Growers should refer to this for further guidance along with HDC (now AHDB) factsheet 06/15. In summary, high pressure results in finer spray quality, increases flow rate, (regardless of nozzle type) and therefore increases the amount of spray applied (litres per hectare). Growers should use the minimum pressure to achieve the desired spray quality as many sectors use unnecessarily high water volumes.

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*Aims of the GCRI Trust*

*The GCRI Trust promotes scientific research & education on cultivation of glasshouse and protected crops/mushrooms/bulbs etc, provides small travel grants to researchers involved in British horticulture and publishes technical reports of new/interesting items of potential value to UK horticulture. The GCRI Trust sponsors a high prestige biennial seminar ‘The Bewley Lecture’ on international matters relating to future trends in horticulture.*