

ADJUVANTS FOR AGROCHEMICALS

Alan Knowles of FORM-AK Formulation Consultancy Services, Tonbridge, UK, reports on the 6th International Symposium on Adjuvants for Agrochemicals (ISAA 2001) held in Amsterdam from 13–17 August 2001

This symposium was the sixth in a series of symposia which began in 1986 at Brandon, Manitoba (Canada). Further symposia have been held every 3 years in Blacksburg, Virginia (USA), Cambridge (UK), Melbourne (Australia) and Memphis, Tennessee (USA). About 340 delegates attended the symposium from all over the world.

Over the last few years the number of scientists working on adjuvants in academic institutions has been decreasing, while the interest of agrochemical companies and adjuvant suppliers in the potential benefits of adjuvants has been increasing. Another trend is that in the past the use of adjuvants was concentrated on herbicides, whereas there is now considerable interest in using adjuvants for fungicides and insecticides to enhance activity and possibly reduce dose rates for application. There is still considerable development of new adjuvants for the enhancement of glyphosate formulations. Research on adjuvants to control drift and volatilisation is another challenging area for reducing dose rates and wastage of active ingredients.

Opening addresses

Dale Steichen of Akzo Nobel, Sweden, gave an overview of the agrochemical and surfactants industries, which he called "The Matched Pair". It is estimated that the agrochemical industry consumes over 350,000 tonnes of surfactants and it is essential for the surfactants industry to understand the needs of the agrochemical industry for formulated products as well as for tank mix adjuvants. Examples of formulation development are the need to move from solvent-based formulations containing Volatile Organic Compounds (VOC's) towards water-based emulsions and microemulsions requiring specialised surfactants.

The second opening address was given by Jeff Graham of Monsanto, USA. Dr Graham concentrated on the use of glyphosate formulations particularly for overspraying on genetically engineered crops (Roundup Ready crops). Glyphosate is the largest-selling herbicide in the world with total estimated sales of about US\$ 3 billion. This figure is larger than the next 10 herbicides in the world combined. Many formulations using different salts of glyphosate and a variety of adjuvants are now available from agrochemical companies around the world. Herbicidal activity is not an issue, but Dr Graham warned of the potential crop safety effects with some formulations on GM crops.

Wetting and uptake

A number of speakers discussed research into understanding the mode of action of adjuvants. It is essential for the spray droplets to wet the leaf surfaces, and sometimes organosilicones are used as 'Superspreaders'. Dynamic surface tension is an important parameter, but surface elasticity of the droplets should also be taken into account. Furthermore, uptake of the active ingredient into the plant is a function of the concentration on the leaf. Therefore, too much spreading may reduce uptake into the plant. Rain, dew or irrigation on the crop can affect redistribution and uptake of the active ingredient. Solvency effects from oil-based adjuvants are also important in terms of biological efficacy.

Regulatory and environmental

Adjuvants can be built into the formulation or added as a tank mix. They may constitute up to 30% of the pesticide formulation. In the USA adjuvants are controlled by EPA and are subject to tolerance limits. The safest adjuvants are placed on List 4a¹ if they are food-like materials, or List 4b if the materials are believed to be safe. However, in Europe the registration system is not yet clearly defined and is not covered by Directive 91/414/EEC. Most European countries require a separate hazard assessment of each adjuvant.

Biological performance

Adjuvant performance can be affected by weather and UV light effects, product formulation, spray application and plant biology. These factors were discussed by Jerry Green (Du Pont, USA). As much as 80–85% of the pesticide can be lost during spraying, of which spray drift may account for 15%, rebound 30% and run-off 20%. Robyn Gaskin (Forest Research, New Zealand) said that in some cases pesticide dose rates can be reduced by 50–60% using organosilicone 'superspreaders'.

Trends in methodology and chemistry

The use of adjuvants to enhance the activity of fungicides is becoming more popular. Johan Rommens (Uniqema, Belgium) described the alkylpolysaccharides which reduce the 'effective surface tension' giving improved retention on leaves. These adjuvants can reduce the dose rates of

¹ For a full list of List 4 inert ingredients see <http://www.epa.gov/oppr001/inerts/list4inerts.html>

strobilurin fungicides. Alkoxylated triglycerides were discussed by Cognis, while Huntsman recommended short-chain alkylene carbonates to increase the solvent power of conventional ethoxylated surfactant adjuvants. Clariant International have developed a range of waxes which have film-forming properties to reduce evaporation and improve rainfastness. Microemulsions can also be considered as water based formulations containing a high concentration of emulsifying and bioenhancing surfactants.

Glyphosate targeting

OSi Specialties, USA, have developed blends of trisiloxane alkoxylate with tallow amine ethoxylates which have been shown to enhance the activity of glyphosate on certain weeds. Victorian Chemical Company, Australia have developed homogenous liquid compositions incorporating several desirable but physically incompatible adjuvant components such as oil based adjuvants and aqueous ammonium salts. Several glyphosate products containing built-in adjuvants have also been developed by a novel method which is now part of a patent application. Dr Feng (Monsanto, USA) examined the possible problems of crop safety when different salts of glyphosate acid are sprayed onto Roundup Ready crops. Water hardness and water temperature can also be important factors in glyphosate efficacy.

Drift and vapour management

Losses due to spray drift are a serious economic and environmental problem. Andrew Hewitt (Stewart Agricultural Research Services, USA) said that the performance of adjuvants in relation to spray formation, droplet movements, deposition and coverage depends on the physical properties of the product, interactions with other tank mix additives, and the spray nozzle design. A Spray Drift Task Force has been set up to examine all of these effects and in many cases the droplet size range for several nozzles can be predicted by a model called 'DropKick'. Air induction nozzles can improve spray targeting and reduce drift.

Future outlook

New research work is taking place to use adjuvants in novel ways such as inducing insects to absorb more insecticide by feeding, or to spray foams to mark the limits of crop treated areas during spray application. A totally novel area of adjuvant use was presented by Wim Hennick (Utrecht University) in which methacrylate based polymers are used as non-viral gene carriers to deliver DNA cells for genetic modification.

The symposium ended with an overview of the agrochemical and adjuvants markets and likely future trends from Allen Underwood (Helena, USA). The global agrochemical market is estimated at US\$ 31 billion and the global adjuvants market at US\$ 1 billion. The USA is the major market for agrochemicals (*ca.*25%) and adjuvants (*ca.*40%). The use of adjuvants will become more important in the future as companies try to enhance the activity of pesticides and reduce dose rates. The restructuring of agrochemical companies and the influx of generic products will dramatically impact the agrochemical and adjuvant markets, particularly with glyphosate, but increasingly also with fungicides and insecticides.

Alan Knowles has been consulting since 1992 in new formulations, surfactants and adjuvants for the agrochemical industry. He is also a United Nations consultant with experience in developing countries in Asia and Africa. Alan edited a book entitled *Chemistry and Technology of Agrochemical formulations*, published by Kluwer Academic Publishers, Netherlands, in 1998. For more details of his consultancy services, visit his new website at <http://www.form-ak.com>

PREVIOUS PESTICIDE OUTLOOK ARTICLES ON FORMULATIONS

Use of surfactants for pesticide formulations (Knowles) – *Pesticide Outlook* 1995, 6(3)

Biologically optimised agrochemical formulations (Stock) – *Pesticide Outlook* 1998, 9(1), 21

Improved insecticides through encapsulation (Perrin) – *Pesticide Outlook* 2000, 11(3), 68

Adjuvants for agrochemical formulations (Green) – *Pesticide Outlook* 2000, 11(5), 196