GUEST EDITORIAL

Tom Bals, born 1958. Chairman and Joint Managing Director of Micron Sprayers Ltd, Bromyard, Herefordshire, UK; joined the firm in 1980. Director, Enviromist Industries Pty Ltd, Berri, South Australia. B.A. (Hons) Philosophy, Politics and Economics, Oxford University, UK. *Further activities:* Chair, UK Agricultural Engineers Association (AEA) Chemical Application Committee; Director, British Crop Protection Enterprises; Member of British Crop Protection Council Board of Management and Applications Working Group (representing AEA); Secretary of American Society of Agricultural Engineers' PM 41 and 23/6 Application Systems Committee; Convenor ISO/TC 23/SC6 Working Group on Field Measurement of Spray Drift. *Main fields of interest:* All aspects of improving the efficiency and safety, and minimizing the environmental impact of pesticide application, particularly for Third World smallholder farmers. Currently involved in standardization work on application equipment and research into reduced-volume reduced-dosage application techniques.

Less is More – The Sustainable Use of Pesticides

There is increasing pressure, particularly within Europe, to reduce the environmental impact of pesticide use, with many environmental pressure groups arguing for reductions in the total amount of pesticides used. However, the debate – primarily between environmental pressure groups and the agrochemical industry – is still centered predominantly on eliminating the use of certain pesticides, with environmental pressure groups pushing for comparative risk assessment (CRA) at the regulatory level. This ignores the potential to use reduced dosages, which forms a key part of the strategy of the approach to reduce pesticide impacts and usage in Denmark, employing the concept of a Treatment Frequency Index, backed by a well researched and supported PC-based decision support system (4).

The potential for successful use of reduced dosages with better spray timing and targeting is well known, and offers a good example of utilizing CRA at the farm level. This approach is likely to be acceptable to farmers and growers, since it preserves the capability to employ pesticides, and therefore be successful in advancing environmental impact reduction, although there will be increases in time and management costs to implement use of reduced dosages (with decision support systems and advisory support required).

Unfortunately, the regulatory system in Europe still rests on principles, mainly surrounding product efficacy, developed during the years when pesticides were introduced. The regulatory system developed primarily to provide an insurance policy to farmers and growers by guaranteeing product efficacy – even when products were not applied optimally in terms of spray timing and targeting. This has led to general overuse of pesticides employing high-dosage high-volume techniques as standard.

Many application equipment manufacturers have developed innovative devices to allow use of reduced dosages by better spray targeting, mainly at lower/reduced volumes (1).

However, these innovations have generally been ignored by the agrochemical industry and regulatory system. More recent regulation to reduce environmental impact has tended to refine the existing system, and failed to understand the fundamental processes involved in pesticide application. It has thus failed to support, and in some instances has even hindered, reduced-volume reduced-dosage techniques using innovative application equipment (2), or other novel techniques such as matching applied dosages to the crop canopy/characteristics (particularly valuable in bush and tree crops) and variable rate application.

However, with increasing economic pressures on agriculture, and pesticide use constituting a significant part of variable production costs, many European arable farmers and growers have moved to using dosages lower than recommended on the label, with this trend particularly pronounced in the UK and Denmark. Another key economic driver is the need for increased sprayer work rates as farm sizes have increased and labor use has been reduced. In the UK there are often very few days when the weather allows spraying within the terms of the UK Codes of Practice. The drive to raise sprayer work rates on arable farms has seen bigger booms driven faster and applying lower/reduced volumes – with 60–150 l ha^{-1} commonly used on larger UK arable farms, although 200 l ha^{-1} is still used as standard in the UK regulatory system. High sprayer work rates have significant potential to advance the use of reduced dosages, since optimizing the timing of spray application is a key factor (5). Syngenta UK have calculated that when spraying cereals with a 2500-liter work rates 24-m sprayer at 12 kph, reducing spray volumes from 200 l ha^{-1} to 100 l ha^{-1} boosted the area sprayable per day by over 20%, from 79 ha per day to 102 ha per day. It should be noted that reducing spray volumes to 70 l ha^{-1} or less is quite feasible with twin fluid nozzles, rotary atomizers and some air-assisted sprayers and would raise work rates further. Similar levels of saving are achievable in other crops, with possibly even more savings in some fruit and vegetable crops which are often unnecessarily sprayed with very high volumes.

However, larger and faster sprayers using reduced volumes with traditional hydraulic pressure nozzles, where lower volumes generally require use of finer sprays, can conflict with the push to reduce spray drift sedimentation onto water courses. This has been the key regulatory driver in Europe over the past decade, although new research would seem to indicate that point-source contamination from mixing, filling and cleaning operations generally results in water contamination an order of magnitude greater than drift from spraying. Regulators have concentrated on application of coarser spray qualities to reduce spray drift, with use of the newly developed air induction (AI) nozzles to the fore in this respect, although these are still not well understood or classified in terms of spray quality produced. However, there is substantial evidence that in many situations finer sprays are better targeted and retained and can thus optimize pesticide performance – allowing use of reduced-dosage reduced-volume techniques – whereas coarse sprays generally require use of higher volumes and dosages. A considerable body of research has shown that coarse sprays are not well suited to reduced-volume reduced-dosage application, and this is also likely to be true of AI nozzles (*e.g.* 6).

With the move to reduced volumes and regulatory involvement in spray quality and nozzle types, there has been some research on reduced-volume application with different nozzle types, *e.g.* a project at the UK Silsoe Research Institute (3). One agrochemical company in the UK, Syngenta, is supporting use of reduced volumes in some situations, which has included development of innovative equipment, and publicizing the importance

of spray targeting to farmers and growers (7).

Reduced-volume reduced-dosage application techniques do offer a possible win–win scenario in the current debate about minimizing pesticide impacts and use, giving the reduced environmental impact (and potentially usage) sought by regulators and economic benefits to farmers *via* higher work rates and reduced costs.

There is a need for skilled spray operators and managers and good equipment to implement reduced-volume reduced-dosage applications successfully. However, training to improve the skills of spray operators and managers is a key element in improving pesticide usage and is already being implemented throughout Europe, as is the inspection of sprayers to ensure they are well maintained.

The effects of formulation and pesticide concentration can be significant at reduced volumes and this is an area in which further research is still required, with past research showing that some adjuvants can give proportionately larger effects at low volumes.

Despite the potential advantages, reduced-volume reduced-dosage application is still not widely supported or researched in Europe, although the UK has at least developed relatively sensible and straightforward guidelines in the UK Codes of Practice. High-volume high-dosage application still forms the basis of most European pesticide approvals, reinforced by the recently regulatory induced shift to coarser sprays. This actually hinders IPM programs and results in the use of higher dosages of pesticides than are necessary, as well as adding to farmers' costs. The EU now intends to address use issues and devise a Thematic Strategy for the Sustainable Use of Pesticides under the 6^{th} Environmental Action Programme, but considerable attention needs to be paid to this to ensure regulation supports, rather than stifles, implementation of reduced-volume reduced-dosage application techniques.

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REFERENCES

1. Bals, E.J. (1970) Some thoughts on the concept of ULD (Ultra Low Dosage) spraying. *Int. EPPO/IAAC/GIFAP Conf.* (Belgrade, Yugoslavia).
2. Bals, T.E. (1993) Missing the target – UK regulation of pesticide application. *Proc. ANPP-BCPC Second Int. Symp. on Pesticide Application Techniques* (Strasbourg, France), pp. 533–540.
3. Butler-Ellis, M.C., Scotford, I.M. and Webb, D.A. (2003) The deposit characteristics of pesticide sprays applied at low volumes. *Proc. BCPC Int. Congr. Crop Science and Technology 2003* (Glasgow, Scotland), pp. 279-284.
4. Jorgenson, L.N.O., Hagelskjaer, L. and Nielsen, G.C. (2003) Adjusting the fungicide input in winter wheat depending on variety resistance. *Proc. BCPC Int. Congr. Crop Science and Technology 2003* (Glasgow, Scotland), pp. 1115-1120.
5. Miller, P.C.H. (2003) The current and future role of application in improving pesticide use. *Proc. BCPC Int. Congr. Crop Science and Technology 2003* (Glasgow, Scotland), pp. 247-254.
6. Powell, E.S., Orson, J.H., Miller, P.C.H., Kudsk, P. and Mathiassen, S. (2003) Defining the size of target for air induction nozzles. *Proc. BCPC Int. Congr. Crop Science and Technology 2003* (Glasgow, Scotland), pp. 267-269.
7. Robinson, T. (2001) *Grower Mag. UK* (24/5/01), p. 13.