

### R&D FUNCTIONS OF THE CROP PROTECTION INDUSTRY

Ken Pallett of Bayer CropScience discusses the continuing need for the R&D functions of the crop protection industry.

The major companies involved in the discovery and development of new agrochemicals are no longer referred to as agrochemical companies. Most have invested in both seeds and biotechnology and cannot now be considered as purely chemical companies, but as the Plant Science Industry. This should not deflect from the important role agrochemicals have and will continue to play in global disease, pest and weed management.

In my first editorial for *Outlooks in Pesticide Management* I would like to reflect on the present demand for agrochemical discovery and its status when I first became involved in research into herbicide mode of action in the mid-1970s. At that time, and during the 1980s, we saw a boom in the discovery of new active ingredients into the crop protection market. A search for the original source of the active ingredients in the *Pesticide Manual* illustrates the breadth of companies who were introducing new chemistry via their own R&D. Many of these molecules are still currently important in world-wide agriculture and pest management; however, the companies involved in their discovery and development have long since exited from the Agrochemical Industry. Whilst the names of Bayer, BASF, Dow, DuPont and Monsanto remain as players, many of the companies active in the 1970s and 1980s have either sold their agrochemical interests or have been merged or taken over by the current players in the industry. These companies included American Cyanamid, Boots, Celamerck, Chevron, Ciba, Duphar, Ely Lilly, Fisons, FMC, Geigy, Hoechst, ICI, May & Baker, Novartis, Rohm & Haas, Rhone-Poulenc, Roussel Uclaf, Schering, Sandoz, Shell, Stauffer, Union Carbide and Uniroyal

Today, only six major R&D-based multinational companies remain, with the two largest (Bayer CropScience and Syngenta) clear examples of the consolidation of the Industry in recent years.

Bayer CropScience activities comprise the former Bayer Crop Protection, Aventis CropScience, AgrEvo (Hoechst + Schering) Roussel Uclaf, FBC (Fisons + Boots + Hercules), Rhone-Poulenc, May & Baker, Union Carbide, Mobil and Amchem. Syngenta comprises the former activities of Novartis, Ciba Geigy (Ciba + Geigy), Sandoz, Zeneca (ICI + Stauffer).

The leading position in the global agrochemical market of Bayer CropScience and Syngenta in both turnover and numbers of active ingredients is as a result of the activities of their former companies. This is despite the considerable divestment of active ingredients that has occurred during the consolidation of these two leading companies. The main

beneficiaries of many of these divestments have been the emerging non-R&D based generic companies, which now figure as major players in the global agrochemical market.

During the 1980s the R&D activities of the many companies contributed to the introduction of 10 or more new active ingredients every year (as indicated by the New Molecule sessions at the annual BCPC Conferences). Whilst this was not the only forum for new molecule announcements in the world, the vast majority were announced at the annual BCPC conferences in Brighton, herbicides one year with insecticides and fungicides the next. As an indication in the current annual output of new active ingredients, the very recent 2005 BCPC Congress in Glasgow resulted in announcements of only 6 new molecules since the last BCPC Congress in 2003, the last time that new molecules were announced.

The reduced number of R&D-based agrochemical companies clearly has had an impact on new molecule announcements as has the increased regulatory requirements. Whilst clearly necessary, the increasing numbers of regulatory studies and risk assessments (to ensure that the new molecules do not have adverse effects on the applicator, the environment and wildlife plus the consumer), have been the major trigger for the extensive consolidation of the industry. The synergy within the consolidated companies, with their large turnovers and profitability, has been necessary to support the cost of the research and development of new molecules. New molecule discovery is still an empirical screening process, at least for the initial discovery of the lead molecules. These will become the basis for the chemists to optimise the biological activity via analogue synthesis, coupled with extensive laboratory, glasshouse and field testing that occur before development decisions are made. Statistical analysis of success rates in agrochemical discovery shows that they have been reducing from 1 in 11,000 molecules screened in the mid-1960s to 1 in 46,000 in the mid-1990s (Berg *et al*, 1999). This was the reason behind the move from traditional glasshouse-based screening to a more miniaturised high throughput *in vitro* and *in vivo* screening in the mid-1990s to identify new leads for chemical optimisation. This move to increase the chances of success necessitated considerable investment in the introduction of automated technologies (such as combinatorial chemistry and genomics for both the synthesis of the potential lead molecules and the biological and biochemical screening). The industry average for R&D investment is around 8-10% of turnover and such investment for new molecule discovery can only be made by the larger companies.

A further feature to be considered is the demand for new molecules. There are over 850 molecules listed the 13th Edition of the *Pesticide Manual* and there are very few disease, pest and weed problems for which there is not a solution for their control, at least for the major crops. However, as the impact of Council Directive EC91/414 on the registration of active substances in Europe becomes reality, the numbers of molecules available for disease, pest and weed management will diminish. Greater reliance on fewer molecules will increase the likelihood of their ineffectiveness due to factors such as disease, pests and weed resistance. A continual flow of new chemistries into the market with the correct biological properties will still be required, providing they have no adverse impact on the environment and lead to acceptable residues in the crop produce. This is despite the adverse publicity on pesticides from environmental groups and NGOs. However, for the UK and Europe to continue providing sufficient crop produce locally on the land available for agriculture, conventional crop production with responsible use of agrochemicals in integrated crop management practices, is a necessity. The alternative would be relying on others to produce our food, with greater adverse impacts on the environment from the transport of this food around the world. Furthermore, if conventional approaches to crop production were reduced, leading to lower farmer income, land is likely to be taken out of farming and into amenity and other uses. This will result

in a far greater impact on farmland wildlife than any continued conventional crop production use.

To conclude, there have been many changes in the sources of the discovery, development and regulation of agrochemicals over the last 30-40 years but new discoveries will still be required to continue sustainable crop protection. The major source of these molecules will be the limited number of companies able to support the new approaches to discovery and the extensive series of regulatory studies and risk assessment necessary for the registration processes.

**Reference**

Berg, D, Tiejn, K, Wollweber, D & Hain, R (1999), From genes to targets: impact of functional genomics on herbicide discovery. *Proceedings of the Brighton Crop Protection Conference – Weeds*, 2: 491-500.

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