PEST CONTROL ON FIELD VEGETABLES THREATENED BY THE LOSS OF ORGANOPHOSPHORUS (OP) AND CARBAMATE INSECTICIDES?[1]

Alwyn Thompson reports on views and opinions expressed at a discussion forum[2] organised by the British Crop Protection Council (BCPC) on 6 November 2001

For the foreseeable future, the planned, large-scale commercial production of most high-quality field vegetables in the UK will depend on the availability of appropriate synthetic insecticides. There was resonance with this forecast in the recent *Report of the Policy Commission on the Future of Farming and Food* (see p. 45 in this issue) but pest control has generally been so good since the post-Second World War introduction of synthetic insecticides that very many consumers today probably fail to appreciate the huge losses in produce availability and quality that would occur inevitably were effective insecticide treatments not to be available.

There have been significant changes in recent years in the safety standards applied under the legislation affecting the UK use of the organophosphorus (OP) and carbamate groups of anticholinesterase insecticides, as well as threats to the availability of key insecticidal active ingredients. In the UK the field vegetable industry now faces problems, the size of which jeopardises the future existence of some sectors.

It was against this background that the British Crop Protection Council (BCPC) invited representatives of growers, regulators, researchers, crop consultants and advisors, and the agrochemical and biological-control industries, as well as consumers, to a discussion forum at HRI-Wellesbourne to debate the present situation and thus contribute to improved understanding of the threats and suggest appropriate courses of action.

Control of pests of field vegetables: the role of OP and carbamate insecticides

OP pesticides (largely insecticides but also including some fungicides) have been used to excellent effect for more than 40 years, providing well-characterised, cost-effective treatments in a wide range of world crops; the carbamates are more recent but have performed equally well. Since 1997, the use of OPs has declined and this trend is likely to continue as the use of these insecticides becomes better targeted, manufacturers rationalise their commercial strategies and increasing legislation takes effect. However, they continue to play a major role in crop protection and still have a vital (to global crop production) 24% of the world insecticide market; carbamate-based products have a further 16%.

The primary uses of OPs in the UK are on horticultural crops, especially field vegetables (with annual sales of £1097k per annum) and top fruit (£768K) where the products are used extensively in Integrated Pest Management (IPM) programmes. Growers depend heavily on them, and carbamate insecticides, to meet market requirements. Thus, in 1999 (the most recent year reported in the Pesticide Usage Survey), major uses (in 'spray hectares') of these insecticides included:

- aldicarb – alliums (2700); carrots (7800)
- carbofuran – brassicas (1500); root crucifers (2800)
- chlorfenvinphos – root crucifers (7700)
- chlorpyrifos – alliums (2700); brassicas (>2700)
- demeton-S-methyl – brassicas (10200)
- dimethoate – brassicas (49900); alliums, root crucifers and sweetcorn (1000–2000)
- disulfoton – brassicas (3400); carrots (1200)
- heptenophos – brassicas (1400)
- pirimicarb – brassicas (27300); carrots, salads and sweetcorn (2000–8000)
- legumes (28100)

Without access to OP products, major problems confronting growers in the planned production of high quality crops would include:

- cabbage root fly on leafy brassicas, swedes and turnips
- aphids on a wide range of field vegetables
- thrips on leeks and peas
- pests of sweetcorn

Without carbamates, likely problems would include nematodes, aphids, slugs and cabbage stem weevil.

The regulatory situation

Since 1986 in the UK, all pesticides have been subject to regulations requiring them to be registered in order for them to be advertised, stored, sold, supplied and used; these regulations include the 1985 Food and Environment Protection Act, the 1986 Control of Pesticides Regulations, the European Council Directive 91/414, the 1995 Plant Protection Products Regulations, the Council Directives on Maximum Residue Limits (MRLs) and the UK MRLs Regulations.

[1] Based on an article 'Turnip Wars' published in *Grower* (21 February 2002).

[2] The invited speakers at the forum were Fred Tyler (Consultant), Peter Chapman (Pesticides Safety Directorate), Dr Bob Dutton (Dow AgroSciences), Julian Ives (Koppert UK Ltd) and Dr Rosemary Collier (HRI). The forum was chaired by Dr Alwyn Thompson.

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There is much misunderstanding concerning the concept of MRLs. MRLs (which are **not** safety limits) are set on the basis of supervised field trials using pesticide applications in accordance with Good Agricultural Practice (GAP). This ensures that, where pesticides are used in accordance with product label recommendations, MRLs are unlikely to be exceeded, thus minimising the exposure of consumers to harmful or unnecessary intakes of pesticides. Harmonisation of MRLs in the EU began in 1975. Since then, a number of EC MRL Directives has been published, with MRLs implemented subsequently through national legislation. Recently, the EC has reviewed the way MRLs are set and, as a result, will be proposing changes to simplify the process in order to provide greater uniformity and clarity across Member States.

The relatively recent focus of public attention on possible health and environmental hazards associated with the use of OP products in general contributed to the UK Government initiating a specific review of anticholinesterase pesticidal actives in 1998.

Some of these actives were withdrawn from the market by approval-holders at an early stage; some others were unsupported by approval-holders in 1999 when data were due to be submitted to the UK regulatory authority (the Pesticides Safety Directorate). As a result, products with the following actives were withdrawn by the end of December 2001: carbaryl, carbofuran, chlorfenvinphos, diazinon, disulfoton, ethiofencarb, etrimfos, fenitrothion, heptenophos, mephosfolan, methomyl, phosalone, propoxyr, pyrazophos, quinalphos, thiometon and trichlorfon – an extension of approval (until July 2003) was allowed subsequently for the use of chlorfenvinphos on swedes and turnips.

Since 1999, the UK review has been progressed to consider the human health and environmental assessments of those actives which were supported (aldicarb, azamethiphos, bendiocarb, benfuracarb, carbosulfan, chlorpyrifos, chlorpyrifos-methyl, dichlorvos, dimethoate, ethephon, ethoprophos, fosthiazate, malathion, methiocarb, oxamyl, phorate, pirimicarb, pirimiphos-methyl, thiodicarb, tolclofos methyl and triazamate). As a result of this review, some approvals may be revoked or restricted; in any event, it is likely that not all current approvals will continue and clearly this will have serious implications for UK growers within the next two years.

There is also an on-going EU review, established through Directive 91/414 and subsequent regulations. Most OP and carbamate actives are included in the second stage, for which dossiers will be submitted this year (2002). Although some actives of importance to UK field vegetable growers are included amongst those being supported, it is probable that various products (possibly including some with currently-supported actives) will be withdrawn from the market – again with serious implications for UK growers. Draft Assessment Reports (DARs) on actives being reviewed are due to be completed by October 2003, after which they will be considered by Commission/Member States Working Groups and the Standing Committee on Plant Health. Notifications for those actives being supported in the third and fourth stages of the EU review programme will be required before July 2003. To date, more than 360 pesticides are set to be withdrawn from the market across the European Union as a result of manufacturers choosing not to support re-evaluation in the review. It is conceivable that this number will rise to as many as 500 as a result of further withdrawals and failure to achieve the necessary authorisation through the review procedure. Currently, the picture in the UK is not as severe as might be expected because only a proportion of the 360 or so actives not supported so far is approved in pesticide products in the UK.

Future insecticide availability

The agrochemical industry is facing ever-increasing regulatory hurdles (with their associated costs) and product-development costs. In addition, with the general downturn in agrochemical sales and prices and with consequently fewer products in development, the industry must increasingly target products based on new chemistry towards large, commercially-sustainable markets (which do not include any UK horticultural crops alone – these, in terms of global agriculture, comprising 'minor uses' for products).

In due course, the development of insecticide products based on new chemistry will have some impact on UK horticulture as approvals become extended to minor use situations. However, for the foreseeable future, UK horticulture will continue to depend on a limited range of chemistry and its associated products, to be used alone and increasingly in IPM programmes. It will be vital for the continued production of many horticultural crops in the UK at reasonable (rather than much-increased) costs to consumers that key insecticide products based on OP and carbamate insecticides are available.

It is also important that cognisance is given to the well-proven possibility that, were products from both groups of chemistry to become widely unavailable, new secondary pest problems, currently well controlled, might emerge. There is also apprehension that, with a much-reduced choice of chemistry available to growers, the pressure for the selection of resistant strains would increase – thus further increasing the magnitude of the crop protection problems.

Agrochemicals companies alone will be unable to support the availability of minor use products to field vegetable growers in the UK and it is clear that implementation of a highly co-ordinated programme of work is required without delay in order that all appropriate action is taken promptly. There is an urgent need for growers in the sector to work in a co-ordinated manner with the agrochemicals companies, the regulators, consumer organisations, retailers, educationists, central Government and others involved in the food chain to support the future longer-term availability of key products. The Specific Off Label Approvals (SOLA) scheme of the Horticultural Development Council is likely to be seminal in this regard but who has the capacity to undertake the overall co-ordination role effectively is not as clear as it needs to be; this situation demands very prompt resolution. Meanwhile, growers need to ensure that the BCPC Minor Uses Group, the HDC, the NFU and the Crop Protection Association are well-aware of the problems that need addressing.

Other methods of pest control

Whereas the effective control of pests with biological agents in controlled environments is now widespread, major problems remain with field vegetables although there has been relative success (albeit often expensive) with some pests (*e.g.* the control of caterpillars with products based on the toxin of strains of *Bacillus thuringiensis*). Nevertheless, commercial producers of biological control agents are actively reviewing market opportunities associated with field vegetable production in the UK. However, the long research lead times plus the high costs of meeting regulatory requirements (which are seen to be unnecessarily restrictive in the UK, compared with some other countries) militate against other than the major companies being involved and they, like the major agrochemicals companies, must aim primarily at the larger global markets.

As with the minor uses of chemical (including OP and carbamate) insecticides, there is need for the UK horticulture industry to present its case more effectively than at present if cost-effective, biological components of pest control programmes for field vegetables are to become commercial realities.

Other methods of pest-control offering opportunities as components of integrated control programmes to produce the increasingly high quality, safe produce that will be required by the market include a wide range of cultural operations and the use of resistant varieties. However, the widespread adoption of non-traditional methods is likely to involve major changes in crop production practices and will only follow widespread demonstration of their effectiveness under a range of conditions, together with reassurance that further problems will not be generated.

It is generally accepted that all long-term alternatives to the use of insecticides are likely to be more technically challenging and, importantly, more expensive.

The way ahead

With the UK Government proceeding with its own review of OP insecticides ('to address public fears about the safety of these materials'), the use of some products has already been revoked in the UK ahead of corresponding action in other EU Member States, resulting in UK growers facing the current and future growing seasons at a severe disadvantage to their continental competitors.

For example, the competitive disadvantage of UK growers can be illustrated by the fact that, with cauliflower, producers in France have recourse to 32 active ingredients and those in Spain can use 28, whilst in the UK only 13 remain. As a part consequence of this, it has been forecast that, from 2002, 50% of the white turnips consumed in the UK will be grown in France and Spain. There is obvious danger that similar situations will develop on other crops.

Similarly, this year, some field brassica crops in the UK will lack adequate crop protection products and other field vegetables may well be in similar jeopardy. Pest control on some crops (*e.g.* carrots) will certainly depend on insecticides within only one chemistry group (pyrethroids in the case of carrots), with the attendant enhanced risks of the development of resistance by the target insects. It also seems certain that 2002 will see a significant reduction in the areas of many minor crops (*e.g.* watercress) in the UK. To avoid gaps on retailers' shelves, the shortfall will need to be made up by imports (possibly treated with pesticides no longer available to UK growers and which consumers may assume to be no longer available more widely).

Despite the introduction of Assured Produce Schemes, Producer protocols, environmental safety schemes and 'Branded produce', there is a view that growers (like farmers) have a negative public image. The public image of farmers and growers as responsible producers of safe, nutritious food and guardians of the national landscape and environment appears to have declined drastically to the extent that consumers (especially the urbanised ones) are unaware (and, worse, uncaring) of the issues facing very many growers today.

For field vegetable growers, there is urgent need for a 'champion' to be identified to effectively enhance the public image of the sector and help ensure that consumers are fully aware and appreciative of the current problems faced by the sector – as well as their wide implications.

BACTERIA TACKLE ORGANOPHOSPHATES

Genetically engineered bacteria could break down pesticide residues left in agricultural aircraft, tractors or animal dips, says Ashok Mulchandani and his colleagues at the University of California in Riverside. Mulchandani's team had previously given *E. coli* an enzyme that naturally breaks down organophosphates,[1] taken from wild soil microbes. Now they have fine-tuned their bacteria by adding a protein that binds the bacteria to cellulose, stopping them from being washed away by chemicals. Stick-on bacteria increased the degradation rate tenfold.[2] They also customized the wild enzyme, organophosphorus hydrolase. By creating many slight genetic variations, the team found one form that chews up the pesticide methyl parathion 25 times faster than the original.[3]

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