THE BCPC WEEDS REVIEW 2022

Ken Pallett, *Outlooks on Pest Management* Editorial Board Member

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The 59th Annual BCPC Weeds Review had the theme 'What next for IPM' and took place as a live event on Thursday 3rd 2022 at Sophie Taylor Building, NIAB, Cambridge with 72 delegates in attendance plus another 13 joining on-line.

The meeting was chaired by **Bill Lankford** (Adama) who outlined the IPM focus of the Review but started with an overview of the current status of herbicides based on the perspective from an early screening R&D company, MOA Technology.

Mark Bartlett (https://www.moa-technology.com) introduced this new Oxford-based start-up company, founded in 2017 and has just raised $44 million in series B funding. The background for the company arises from the fact that weeds are the single most important biotic constraint to crop productivity leading to crop losses exceeding 40%. The challenges are that more than half of the herbicide market is under heavy pressure from herbicide resistance and in spite of decades of industry effort it has been unable to deliver the only lasting solution: new herbicide modes of action. In order to achieve its mission of discovering novel herbicide modes of action, MOA Technology uses three proprietary platforms, comprising GALAXY, a high throughput *in vivo* screen to identify herbicidal compounds with novel modes of action. A second platform, TARGET elucidates the exact mode of action and gives some indication of its plant specificity and safety and the third platform, SELECT supports MOA-specific chemotype discovery. These three platforms are supported by more conventional laboratory and glasshouse approaches to herbicide discovery to achieve the discovery of new herbicides

The current status and issues were then presented on root crops in the UK.

Pam Chambers (UPL; https://www.upl-ltd.com) covered *Weed control in sugar beet – herbicide changes/impact/issues*. Weed management in sugar beet is necessary to minimise competition from weed species during crop establishment. Many herbicides used in sugar beet were introduced in the 1960s. Since then, just one herbicide authorisation has occurred in the UK, Conviso One for use in ALS tolerant sugar beet lines. For annual broad leaved weed control in conventional sugar beet since the early 1980s, there is a heavy reliance of the older herbicides such as metamitron, ethofumesate, phenmedipham and triflusulfuron-methyl. The latter two, meet the EU criteria for endocrine disruptor (ED) which puts in doubt their inclusion beyond 2023 in the EU. The EU inclusion of metamitron expires in 2023 and in the UK, in 2025. This puts in doubt the availability of these key actives for the UK.

Furthermore, the sugar beet acreage in the UK is projected at 95K ha in 2023/24 this is under 10% of that of the major sugar beet producers in the EU such as France, Germany and Poland whose acreage totalled over 1,000K ha in 2022 and decisions taken in these countries could influence the availability of weed control options for the UK.

In summary, legislation and loss of actives plus herbicide resistance will continue to be an issue in the UK. As well as the influence of the EU on the availability of actives, there is pressure to use less PPPs in the UK. However, whilst there will be a move toward including non-chemical methods such as precision weeding, it is projected that these will only be used in 25% of sugar beet acreage leaving 50% still needing chemical and the other 25% a combination of chemical and mechanical weed control beyond 2030.

Graham Tomalin (VCS; https://www.pcspotatoes.co.uk) then covered *Weed control in potatoes – herbicide changes/impact/issues*. In addition to weeds competing for water, nutrients and light in potatoes, weeds can also contribute to the spread of diseases from virus (PVY/PVLR and TRV) and *Phytopthera infestans* and *Rhizoctonia solani*.

Mechanical weed control options exist in organic potato production e.g. thermal control prior to crop emergence; use of rake harrows (at the rosette stage); star/finger weeders (20% ground cover); combination tines/disc ridgers (40% ground cover); or high clearance re-ridger (up to 80% ground cover).

Chemical weed control options are currently used as pre-crop applications to control creeping thistle (*Cirsium arvense*), couch grass (*Elymus repens*) and volunteer potatoes; pre-emergence applications of both residual and contact herbicide and post-emergence for limited broad leaved and grass weeds. The residual herbicide options include aclonifen, clomazone, metobromuron, methribuzin, pendimethalin, prosulfocarb, and flufenacet. However, most of these have some restrictions for soil type, following crop and varieties. Five of the seven actives also have potential future regulatory issues within the EU which could reduce their availability for use in the UK.

As an alternative to the use of residual herbicides, the option may exist for non-selective contact herbicides such as carfentrazone, pyraflufen-ethyl or glyphosate, although all have strengths and weaknesses in terms of weed spectrum. Other IWM measures include options for integrating herbi-

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cides with companion crops and band spraying to reduce AI loading and for novel approaches such as electric weeding.

The next session covered *Herbicides in water* and comprised 5 presentations. Firstly, **Neal Evans** from the Voluntary Initiative (VI) (https://voluntaryinitiative.org.uk) gave an update on herbicides in water/IPM survey. VI was initiated in 2001 as a raft of measures to self-regulate and ensure "Best Practice" use of plant protection products. There are three main instruments: National Register of Sprayer Operators (NRoSO) with 21000 members; National Sprayer Testing Scheme (NSTS) with 16000 sprayers tested in 2022; and an IPM plan, central to the "Best Practice" message of the VI. VI is facilitated across agriculture via a raft of organisations and a range of stewardship programmes. Two examples were presented. Firstly, for oilseed rape herbicides with five actives, with a stewardship group of 4 agrochemical companies, 3 water companies and 5 organisations. Secondly, for bentazone which focuses on knowing the risks of detection in water and the three major manufacturers of the herbicide who have formed a partnership to help safeguard its future under the "*Better Bentazone Together*" initiative. Details were summarised of new IPM plans established in the last 2 years.

A water authority update on the state of play with herbicides in water was then presented by **Richard Reynolds** from Anglian Water (https://www.anglianwater.co.uk). Options for pesticide treatment in water ranged from a low difficulty of removal via chlorination (glyphosate and bentazone) to high difficulty via UV and advanced oxidation (metaldehyde). Options with intermediate difficulty are ozone, granular activated carbon and slow sand filter (mecoprop, MCPA, carbetamide and propyzamide) or fresh granular activated carbon (quinmerac and clopyralid).

Average maximum herbicide detections throughout 2020-2022 were summarised for arable situations (propyzamide, carbetamide, flufenacet quinmerac and glyphosate) and grassland/other situations (2,4-D, MCPA, bentazone, clopyralid and triclopyr). All herbicides exceeded 0.1ug/l in one or more time periods with glyphosate consistently exceeding this trigger between 2015-2022.

Steve Moss an independent consultant presented a propyzamide case study with an objective to reduce the amount of this herbicide leaching into water supplies by placing a greater reliance of clethodim with a lesser reliance on propyzamide for blackgrass (*Alopecurus myosuroides*) management. Water hardness had no impact on blackgrass control with clethodim, However, a water conditioner (X-Change) increased clethodim efficacy in 6 oilseed rape trials (2020-2022) by an average of 11%. In seven trials, a reduction of propyzamide from 850g/ha to 500g/ha resulted in a 91% reduction in soil water detection and if this lower rate of propyzamide were applied following 120g/ha clethodim, blackgrass control was not compromised. Testing for resistance to clethodim was necessary to check blackgrass resistance status to this herbicide.

Joe Martin from Corteva (https://www.corteva.co.uk) presented a further propyzamide case study which covered the company's stewardship approaches to optimise the use of propyzamide whilst minimising the risk of entry into water. Kerb® Flo 500 (propyzamide) and AstroKerb® (propyzamide and aminopyralid) are two formulations that work best when applied to cold, moist soils when oilseed rape crop is at the 3-leaf stage up to before February 1st. Soil moisture should be at 80% field capacity with soil temperature at 30 cm at a maximum of 10°C and declining. A maximum of 840 gai/ha propyzamide should only be applied for severe blackgrass situations with lower rates of 750 or 500 gai/ha for less severe blackgrass or other grasses and broad-leaved weeds. Only one propyzamide product should be used per crop per year.

The average soil-half life is 35-40 days and soil persistence varies between 2-9 months depending on soil type and climatic conditions.

Data were presented from field trials with Kerb® Flo 500 showing the best blackgrass control was with applications in the last week of November. In a NIAB field trial the optimum timing was early December and that a double application of 750g ai/ha did not increase weed control over a single rate of 840g ai/ha. Glasshouse efficacy testing for resistance management revealed no cases of blackgrass resistance to propyzamide.

A checklist for high risk areas to water was presented of eight criteria and if at least five of these are met, risks to water contamination are significantly reduced. In addition, a Kerb weather data app has been developed as a tool to help farmers plan their propyzamide applications to oilseed rape.

The final presentation on water, was by **Alex Brook** from Ebsford Environmental Ltd (https://www.ebsford.co.uk) entitled '*Aquatic invasives – problems and control options*'. These are defined as invasive non-native species, also referred to as 'alien species' or 'invasive alien species'. The presentation focussed on aquatic freshwater environments with examples of some of the major invasive species, their impact on the environment and their management.

Elodea canadensis and *E. nuttallii* (Canadian and Nuttall's water- or pond-weed) are examples of submerged species originating from North America. These are found rooted is sediment in slow-moving water bodies such as ponds and lakes spreading via fragments causing problems with fishing and reducing biodiversity. No herbicides are available and no specific biological control exist, limited by mechanical management via cutting and shading and hand weeding.

Myriophyllum aquaticum (Parrot's feather) is an example of an emergent species originating from Central America. It is a perennial species rooted to sediment in slow-moving water of lakes and ponds and spreads via fragments causing problems with fishing and reduces biodiversity. It can be controlled by herbicides approved for application to water. Mechanical methods such as cutting are an option for management and there is no specific biological control.

Free floating species include *Azolla filiculoides* (waterfern) originating from Central and North America and *Hydrocotyle ranuculoides* (pennywort) originating from the Americas. Waterfern is a perennial species occurring in slow-moving water or ponds and lakes spreading via individuals and spores causing problems with fishing and reducing biodiversity. It can be managed by biological control with the water fern weevil, *Stenopelmus rufinasus*. Pennywort is also perennial and rooted in sediment of slow-water bodies such as ponds, lakes, rivers and canals spreading via fragments and also causing problems with fishing and reducing biodiversity. It can

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also be managed by biological control with a weevil native to South America, *Listronotus elongatus*.

Marginal/Amphibious species include *Crassula helmsii* (Pygmyweed or Swamp Stonecrop) originating from New Zealand and Australia. Also, a perennial species rooted in the sediment of slow movingwater bodies such as ponds, lakes, rivers and canals. It is distributed throughout the UK, causing problems with fishing and reducing biodiversity. Management is difficult with physical removal an option in small ponds but not suitable for large lakes.

There were two post-graduate student poster presentations. **Jed Clark** from the University of Leeds presented his research project: *Wheat contra weed – identifying wheat germplasm for enhanced competition against blackgrass*. This is a novel IWM approach to identify varieties of wheat that can suppress the above ground and/or below ground root growth of blackgrass. Initial studies have been conducted with container trials with various wheat varieties grown with different densities of blackgrass. Some differences in their competitive abilities against blackgrass are seen between the wheat varieties tested, although the major finding to date is that barley is more competitive against blackgrass than wheat. Future work will investigate the impact on blackgrass root growth.

Jonathan Binder from Royal Holloway College presented his research project: *Investigating biotic and abiotic factors that affect blackgrass seed persistence*. The objectives of this project are firstly to understand how abiotic environmental factors affect blackgrass seed dormancy and germination and secondly to describe the origins of microbial communities in the soil and how they impact blackgrass longevity. Results to date show that blackgrass seed from different batches showed different patterns of emergence in the lab. Identification of the factors behind these differences as well as longevity in the seed bank will lead to an improved understanding to anticipate and counter future weed outbreaks.

The final three presentations focussed on re-generative agriculture and new technology.

Firstly, **Martin Lines** from the Nature Friendly Farming Network (https://nffn.org.uk) gave a presentation on *ELMS and biodiversity: IPM practical impact on weed management*. A number of approaches were proposed to support farmers to adopt a truly IPM approach to land management fully. Firstly, farmers should learn from each other and share best practice of what works for them and the environment whilst at the same time improving the farming business; there should be a focus on soil health and environmental benefits that help reduce farmers costs and the need for pesticides; there should also be a focus on how farmers can reduce their pesticide use over a number of years by changing their farming practices; to use science to lead the way but also take into account public opinion; to also focus on how we can farm with fewer inputs; to have the same standards for all food consumed in the UK; to incentivise farmers to use the full range of management tools and not just tick boxes.

New sustainable farming initiatives (SFI) IPM standards are coming soon which will focus on ways to combine cultural, biological, physical and chemical tools to manage diseases, weeds and invertebrates in an environmentally sensitive way. They will also focus on training and knowledge transfer, habitat creation, long crop rotations and reducing pesticide inputs.

Examples were given on changing crop establishment to help improve soil health and using cover crops to improve soil health and reduce weed burdens. A further example was given on improving outputs by working with nature where over a 4-year period with cereals and oilseed rape crops, yield increases of up to 17.9% were achieved, compared to control i.e. (business as usual) were achieved due to increased slug predation rates, improved soil fauna health and increased populations of beneficials.

Tom Pearson from Raynham Estates, Norfolk (https://raynham.co.uk/raynham-estate-history-family-farming/raynham-farm) gave a presentation on the impact on weed control of developing rotational, cultivation and cover crop practices newly adopted on the Raynham Estate.

The Raynham Estate comprises a 2000 ha area, two-thirds of which is farmed with minimum tillage. It once was a plough-only based system but now ploughing is once in a 9-year rotation. As a result, numbers of cultivators, ploughs and tractors on the farm have reduced. The weed control advantages and disadvantages within a diverse crop rotation were presented. Overall, there was a reliance of glyphosate. For oilseed rape Belkar® (picloram) has been a useful weed management tool. For whole crop rye, there is excellent crop competitiveness and the ability to harvest prior to problem weed seeds setting. For sugar beet, weed beet is an issue in areas. For spring beans, there are limited post-emergence options and a reliance on weather-dependant pre-emergence herbicide application. There were positives and negatives with the introduction of cover crops in the rotation.

Finally, **Will Smith** from NIAB (https://niab.com) presented *Mechanical Weed Control – advances in arable crops*. The current state of weed management in the UK was described as being a significant dependence on synthetic herbicides for effective control. There is pressure on these compounds from resistance, regulation and market preferences. There is evidence of uptake of IWM messaging e.g., drilling date, although often reactive to issues. Alternative in-crop tools are going to be needed in the future. Future methods for weed control were listed as introduction of new modes of action, RNAi silencing, biological control, mechanical weed control, use of robots and electrical weeding.

Mechanical weed control is a mature technology for inter-row weed management and is immediately available on farm using existing dealer networks for support. On the negative side it only targets the inter-row gaps and requires some specialist knowledge to set up.

It was concluded that mechanical weed control can support herbicides to deliver improved weed control. In a future of pesticide reduction targets, mechanical cultivation and banded herbicides could play an important role in delivering effective weed control. Inter-row cultivation is economically viable, particularly as control with herbicides becomes more challenging.

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