THE BCPC WEEDS REVIEW 2020: KEN PALLETT (*OUTLOOKS ON PEST MANAGEMENT* EDITORIAL BOARD MEMBER)

Ken Pallett

The 57th Annual BCPC Weeds Review "*The illusion of IWM: Sustainable weed management?*" took place as a webinar on 3rd December 2020, with over 120 delegates logging on to this first virtual Weeds review event.

Following an introduction to the agenda by the review chair, **Nicola Perry** (Corteva Agriscience), **Henry Creissen** (Scotland's Rural College, SRUC) gave an introduction to IPM, attempting to quantify its adoption in a presentation entitled 'Measuring adoption levels of IPM practices on arable farms'. This was achieved via a farmer survey comprising a combination of 14 IPM and 8 sociodemographic questions and resulted in 225 responses from farmers in England, Northern Ireland, Scotland and the Irish Republic.

Prior to conducting this survey, it was established that very little information existed on IPM adoption and perception in this sector and that familiarity of IPM was fairly low amongst arable farmers. A scoring system was developed to quantify adoption in an assembly of stakeholders of farmers, advisors, researchers, merchants and policy makers. All farmers surveyed had adopted IPM to some extent ranging from 27–92% with a mean of 65%. Greatest adoption based on the IPM score was seen in England and Scotland and correlated with differences in soil cultivation, where there was a trend for less regular ploughing and more minimal tillage and rotational ploughing. High adopters tended to conduct regenerative agriculture with greater crop rotation practices to control weeds such as black-grass (*Alopecurus myosuroides*) and to a lesser extent pests and diseases.

Adrian Dixon from the Chemicals Regulation Division (CRD), spoke about the legislation framework, the pesticide National Action Plan and priorities for IPM.

The DEFRA 25 Year Environment Plan has IPM at the heart of a holistic approach to encourage and support sustainable crop production with minimal use of pesticides. The plan also ensures that existing regulation of pesticides continues to develop based on scientific knowledge, is robust and fit for purpose. It also includes a review of the UK National Action Plan for the sustainable use of pesticides.

The Sustainable Use Directive for pesticides (2009/128/EC) promoted the use of IPM and alternative approaches and techniques such as non-chemical alternatives to pesticides under national regulations. The directive defined IPM as 'careful consideration of all available plant protection methods and subsequent integration of appropriate measures that discourage the development of populations of harmful organisms and keep the use of plant protection products and other forms of intervention to levels that are economically and ecologically justified and reduce or minimise risks to human health and the environment'. A definition clearly devised by a committee. IPM emphasises the growth of a healthy crop with the least possible disruption to agro-ecosystems and encourages natural pest control mechanisms.

The changes in pesticide regulation from 1st January 2021 were briefly reviewed. A new independent pesticide regulatory system will operate in GB (England, Scotland and Wales) whereas Northern Ireland continues under EU rules. All existing active substance approvals, PPP authorisations and MRLs will continue to be valid in GB, with existing PPP authorisations valid until their expiry date. Active substance approvals due to expire between 1st January 2021 and 31st December 2023 will be extended for 3 years. New MRLs will be set for GB, based on its own assessments but all existing MRLs will remain until they are amended.

A new National Action Plan is being drafted aiming to minimise risks and impacts of pesticides whilst ensuring pests and pesticide resistance are managed effectively and will continue with robust regulation to support the development and update of IPM ensuring that pesticide use is safe and sustainable.

Barney Tremaine (Weston Park Farms and Groundswell) presented the first of three IPM case studies entitled 'No till-weed dynamics/carbon implications of IPM'. The Groundswell conference started in 2016 and provides a farmer-led knowledge exchange for no-till and regenerative agriculture. In 2010, there was a switch on the Weston Park Farms to no-till after concerns over soil health and crop quality. Since then, there has been a 3% rise in soil organic matter. There has also been a 35% reduction in nitrogen input with no P or K applied since 2010 and a reduction in general pesticide use with no seed treatments or insecticide applications for 5 years.

This has been achieved through zero tillage, minimising soil disturbance and retaining living roots in the soil. There has been a strong focus on increasing diversity with a flexible rotation with diverse cropping and over-wintering cover crops. Companion cropping of oilseed rape with species such as vetch, mustard and buckwheat has also increased diversity. Livestock integration has also been key for building soil carbon and soil condition improvement.

In 2010, black-grass was the major weed issue on the farms, but this has been dramatically reduced through no-till, spring cropping, delayed drilling and rotation. Drilling into cover crops reduces weed emergence and there has been a decreased reliance on pre-emergence herbicides with mostly spring herbicides and some glyphosate at drilling regularly

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needed. This has led to an overall reduction of herbicide use. There has been a broad-leaved weed spectrum change and increased brome species. Future concerns for weed management are an over-reliance on glyphosate and using non-chemical weed management options.

Hannah Darby (T E Darby & Sons) presented a farmer perspective on IPM based on her experiences of farming on three farms around Peterborough since 2014. Historically, grass weeds, particularly black-grass and broad-leaved weeds had always been a major issue. The presentation focused on the constantly evolving challenge with weed seeds and how they have worked with cultural and chemical weed control. An over-reliance on post-emergence sulfonylurea chemistry has led to resistant or high resistant black-grass and there has been a switch to the use of pre-emergence herbicides and glyphosate to provide weed control, particularly in winter cereals.

Increased weed pressure on the farms was a result of a number of factors. It was suggested that a switch from winter-based crop rotations did not allow destruction of black-grass prior to drilling and encouraged overwintering of this weed species. Also, an improvement in farm machinery hygiene to minimise transfer of weed seed between fields was seen as contributing to reducing weed seed spread.

A number of IWM approaches have been adopted to reduce weed burden including: a switch to reduced cultivations and delayed drilling; awareness of soil health and properties essential for optimum crop growth and drainage; establishment of cover crops to keep soil active and functioning biologically; minimising soil compaction and allowing drainage; reducing soil movement at drilling; crop rotation of alternate spring and winter crops; in-crop cultivations such as harrowing and weed wipe with glyphosate on tall weeds.

Future weed management measures to be investigated include: increasing understanding of weed physiology; introduction of catch crops to hold the soil together at drilling and investigation into further inter-cropping and catch crops.

Joe Martin from the Agriculture and Horticulture Development Board AHDB) presented 'Sceptre Plus – project perspective'. This is a four-year project researching sustainable plant protection products in horticulture in association with product manufacturers. The programme has already led to a number of Extensions of Authorisations for Minor Use (*EAMUs*) and others are ongoing in trials and residue data are being generated, many for weed management in a range of field vegetables, ornamentals, protected edibles, soft and tree fruit. Ongoing trials were reviewed for weed control in cucurbits, brassicas, lettuce and baby leaf, volunteer potatoes in carrots and parsnips, problematic weeds in asparagus, Sweet Williams and new apple plantations.

In the case study Q&A session, both Barney and Hannah stated that the use of glyphosate was a key component of their IWM approaches to avoid a return to heavier cultivation. Hannah also stated that herbicides remained important for broad-leaved weed control and non-chemical approaches for weed management may have potential in the future, if they are shown to work.

There were short presentations from two PhD students. **Sophie Hocking** from the University of Swansea is working on sustainability in Japanese Knotweed (*Reynoutria japonica* synonyms *Fallopia japonica* and *Polygonum cuspidatum*) management comparing a range of chemical and physical methods, the latter often suggested as environmentally friendly alternatives, but have limited efficacy. **Will Smith** from National Institute of Agricultural Botany (NIAB) is working on the potential of inter-row cultivations for black-grass control. These cultivations provide a physical non-selective control of weeds with limited crop damage when using modern guidance systems to improve accuracy. The project addresses the following questions: Could these cultivations deliver effective control? Is there an interaction with autumn applied herbicides? Are there differences between inter- and intra-row weeds species? Could they influence the perception of weed control? First year results showed that cultivation did not provide comparable control to herbicides.

Sean Sparling from the Association of Independent Crop Consultants (AICC) summarised IWM lessons learnt from autumn 2019. He believes that smart phones have aided the take up of IWM by increasing availability of knowledge. He also asserted that every farmer in the UK is practicing IWM, knowingly or not. Herbicides are and will remain key components for weed management of IWM and are vital for food security and must be protected by responsible use, to retain their efficacy and avoid weed resistance. IWM benefits the management of black-grass over other weed species. Cultural and rotational approaches in 2019 had been influenced by a very wet autumn and mild winter encouraging spring cropping due to issues with autumn drilling. This was stated as IWM in action.

IWM is common sense good agricultural management, its methods, comprising biological, cultural, rotational, chemical and mechanical must be integrated fully rather than being used independently. Glyphosate must be retained as a key for IWM, being a replacement for mechanical weeding and resistance management and is a reliable and safe option.

Part of IWM is the understanding of weed problems, making inventories and weed maps and developing management plans accordingly, then monitoring the process. It was emphasised that some alternative control measures may not be as carbon friendly and this needs to be recognised when deciding weed management options.

Sarah Wynn (ADAS) covered the 'Carbon impact of weed management'. The presentation started by saying that there was no one single and simple answer and that you need to look at a number of interactions in the aspects of weed control. The presentation covered three broad categories of weed control and their implication: tillage scenarios (inversion tillage, minimum and direct drill); the impact of herbicide use for weed control and of alternative options.

Key sources of carbon emissions are predominately fuel usage of farm machinery with more soil movement leading to greater emissions. There are also embedded emissions on herbicide manufacture and also impact on soil carbon as the exposure of soil to oxygen leads to CO_2 release.

The negatives and positives were summarised for each of the three tillage scenarios for weed control. Intense cultivation such as inversion tillage leads to increased fuel consumption, soil compaction and can cause carbon loss from soil in pre-planting situations, but on the positive side it reduces the need for herbicides, if weed seeds are buried too deep to germinate. Minimal tillage increases the need for herbicides. However, it is not always as effective at controlling weeds when weed seeds

are not buried deeply enough to prevent germination. On the positive side, minimal tillage retains increased soil carbon in the surface layers compared to heavier tillage, has lower fuel consumption with less soils moved and there are fewer soil compaction issues. Direct drilling requires herbicide such as glyphosate for a stale seedbed, risks higher weed competition when weed control is not effective and there is increased carbon impact due to herbicide manufacture and application. On the positive side direct drilling retains soil carbon and leads to lower soil disturbance and reduced soil erosion. The general consensus is that more cultivation leads to greater loss of soil carbon. Minimal tillage tends to increase soil carbon in surface layers but ploughing increases soil carbon at depth. This was stated as not being a simple message. The negatives of using herbicides were both the carbon impacts associated with their manufacture and also their activity towards soil organisms but on the positive side they reduce the need for tillage, lower fuel use and reduce loss of soil carbon.

An example was provided quantifying CO_2 emissions in a clay soil with the three tillage scenarios and assuming a single herbicide application. Inversion tillage clearly leads to the greatest emissions however, when you take into account impact on crop yield, the need for more herbicides later and more intensive cultivation, the difference in emissions are lower, but still higher than minimal tillage and direct drilling.

The negatives and positives on alternatives for weed control were also identified. Thermal weeding has high fuel consumption, reduces biodiversity of soil organisms and organic carbon. On the positive side it reduces the need for herbicides, the need for multiple passes and can provide effective weed control. Electrical weeding also has high fuel emissions for the tractor and the weeder and does not offer as effective control as herbicides and tillage. However, there are fewer machinery passes compared to heavier tillage and is an option for 'greener energy' if solar energy powers the weeder. Bio-herbicides are not as effective as other forms of weed control; they still require energy associated with manufacture and may require multiple applications due to their weed selectivity. On the positive side, bio-herbicides reduce soil disturbance or erosion, protect biodiversity and beneficial organisms in the soil and can also target weeds within the crop so reducing the need for further weed control options.

Overall there is a balance to be found in maintaining weed control and balancing yield verses climate impact. Just because a method is designated 'low carbon' on its own does not mean across the rotation it is the lowest carbon approach. There is a need to look at the combined impact across a range of crops within crop rotations. The end goal is to reduce inputs whilst maintaining or increasing carbon storage within the soil.

Pete Saunders (Alan Bartlett and Sons) presented his practical experiences of improving weed control in root vegetable crops, particularly carrots and parsnips. Four major challenges were identified: supply 42,000 tons washed and packed root vegetables annually; insufficient detail in herbicide manufacturer label rates to manage customer residue requirements with MRL levels at 30% below those of the EU MRL; loss of active ingredients with no phase out of the old actives and no overlap period for any new actives; and climate change.

Details were presented on some of the bespoke herbicide trials, specific for vegetable root crops that have been conducted, focussing on nozzle configuration to optimise spray application on crop rows. Benefits have been identified when allowing weed growth within the tractor wheelings between the crop rows which can act a refuge for predatory insects and reduce wind and water erosion. Any decisions to control weeds within the wheelings are dependent on the species growing in the wheelings and on any pests and diseases. Seed bed consolidation and uniformity was identified as being essential for crop establishment, crop uniformity and safety from post-emergence herbicides. Further trials are planned to compare the performance of any new actives for root vegetable crops, to obtain EAMU, to extend studies to improve weed control and to develop novel application techniques further, to understand the role of soil, crop health and the whole crop environment and maximise the use of the limited herbicides available for root vegetables.

Jonathan Storkey (Rothamsted Research) completed the review with a Roadmap towards IWM. He was encouraged by the review in making weed management sustainable and that IWM is positively being taken up. He raised a series of questions that need to be addressed. How to incentivise those not practicing IWM? How do we measure progress and are there false summits or dead-ends in the journey towards IWM? Is there enough emphasis on prevention (managing communities rather than controlling species?) These questions are partially addressed in a recent publication by MacLaren *et al* (2020); An ecological future for weed science to sustain crop production and the environment, *Agronomy for Sustainable Development* **40**(4), 29.

It had been a long time since I last participated in a series of presentations on IWM and I leave it with mixed feelings. The first presentation from Henry Creissen, only 65% of the 225 responses to his IPM survey claimed to be practising IPM and it seemed to me that there was some way to go to encourage its take up and the need for inclusion of IPM in legislation was understandable. However, in most of the following presentations, IWM was clearly being practiced. As Sean Sparling stated, most farmers practice it whether they know it or not and that it is common sense. I would like to think that most, if not all farmers and growers, practice IWM measures and practice sustainable agricultural and horticultural practices. Hopefully, the days of unsustainable mono-cultural practices with repeated use of the same herbicides for weed control, year after year, have passed, as many of these herbicides now have resistance issues, even if they are still available. Changing weather conditions will mean adjusting weed management practices, which if sustainable will meet IWM requirements. One concern is that all presenters stated that herbicides were a key component of IWM, particularly the use of glyphosate. Its use is threatened from a regulatory perspective, or more appropriately political perspective, although regulatory science does not suggest there is an issue. However there is also the issue of loss of efficacy due to the development of weed resistance due to overuse. I live in hope that glyphosate can remain as part of the toolbox IWM and that my former colleagues in the remaining Agrochemical Companies undertaking R&D are able to discover and develop new and environmentally safe herbicides to provide the tools to contribute to IWM for years to come.