THE BCPC WEEDS REVIEW 2021

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The 58th Annual BCPC Weeds Review "*IWM-it's not just about weeds!*" took place as a webinar on 4th November 2021, with over 100 delegates logging on to this second virtual Weeds Review event.

Nicola Perry from Corteva Agriscience and the Review Chairperson introduced the agenda and explained that a return to IWM as the topic for the 2021 Review was due to the feedback from the 2020 Review requesting further discussion.

The first presentation was by **Peter Lutman** covering a summary review of the 2020 weather in an attempt to put the crop and weed management issues of the previous 12 months into context of the weather experienced across the UK. The summary was based on monthly anomaly weather maps produced by the Met Office comparing the mean weather conditions for every month of the previous 30 years. Overall, it was a relatively benign autumn followed by an unexceptional winter. The spring of 2021 was cold and dry in April, followed by a cold and rainy May and the weather was unsettled up until harvest time, which was delayed. In fact, the whole year was classified as unsettled with extremes in some areas where there was flooding and storms. The question was asked if weather was getting worse or if the Met Office was more assiduous in their reporting.

The agricultural implications were summarised as: a reasonable autumn of crop establishment; the cold dry spring slowed crop growth, delayed spring crop establishment and damaged fruit crops; the run up to harvest was rather too unsettled and wet but improved throughout August and led to a reasonable UK cereal yield of 14 million tonnes, better than 2020 and equivalent to 2019.

Alastair Leake the Allerton Project Director at Loddington, Leicestershire then gave a presentation entitled 'Farming systems, soil management and weeds – holistic approaches to crop production'. This was a very comprehensive summary from over 30 years of experiences with different farming systems ranging from: mixed organic farming; all-arable organic farming (stockless rotations); integrated farm management; conventional farming (maximising production); conservation and regenerative agriculture.

The overall conclusions were that: diverse crop rotations very much assist in crop management; there is an interaction of weed populations with rotation and soil cultivations; the field history, rather than the tillage system, is an important determinant of weed pressure; ley periods are a valuable tool in depleting short lived arable weeds; employing multiple control strategies enables a progressively step-wise approach to weed management; and short-term changes in cultivation strategies can assist weed containment.

Gary Willoughby from the Gentle Farming Group then presented a Farmer/Practitioner perspective. He classified himself as a generic farmer from near Skegness with a farm on predominantly silty clay soil on a marsh at sea level. The farm was a plough-based but now direct-drilling with all combinable cropping of wheat, barley oilseed rape (not in 2021), beans and linseed. No livestock on farm but manure is used. Philosophy for weed management is to mix-up rotations and to avoid herbicide application until absolutely necessary and then to use different active ingredients for each crop and with different modes of action. Glyphosate is used to control as many weeds as possible before drilling.

The future on-farm direction is seen as extending the diversity of cropping including grass leys, possibly *Miscanthus*, with whole fields down to pollen, nectar and bird seed mixes and to maintain as many herbicide options as possible by continuing a fully integrated farm management strategy.

A presentation was then given by **Henry Creissen** (SRUC) and **Holly Clarkson** (ADAS) entitled 'Barriers and enablers to IPM adoption'. Henry presented the recently revised Voluntary Initiative IPM assessment plans. IPM is an iterative process recently defined by AHDB as: prevent; detect; control; then evaluate. A tool has been developed to facilitate IPM discussion 'what you are doing and why' between the main decision makers, farmers and agronomists to develop IPM action plans, some of which can be very specific to a field, crop or a specific pest. Scoring system developed for IPM based on 20-24 questions with a weighting given to the answers. A weighting of around 50% is given for preventing the spread of pests, diseases and weeds. Other factors such as: reasons for adopting a rotation; proportion of land under continuous cereals production; establishing a pest management plan; choice of crop varieties and membership of agronomy/crop discussion group contributed the other 50% weighting.

On the prevention of introduction and spread weeds across the four regions of the UK, 20% of those surveyed conducted crop inspections however there were regional differences in other IPM measures. Minimal tillage and stale seedbed methods were practised more in England and Northern Ireland and the use of the plough was greatest in Scotland and Wales as were spot spraying and rogueing to remove weeds.

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The high adopters of IPM scored the highest and practised more preventative measures, considered more factors when IPM planning and actively sought IPM knowledge. The low adopters had low scores across the board. It was established that the agronomist has a crucial role in giving clear, consistent and evidence-based advice.

Holly Clarkson covered the outcome of the behavioural insight interviews conducted as part of the Environment Land Management (ELM) IPM test and trial conducted by SRUC and ADAS over the last year for Defra. The interviews had three main aims to understand; the key drivers for IPM; the impact of participation of this ELM test and trial on IPM uptake and guidance; and key enablers and barriers to IPM uptake. 46 interviews were completed with UK farmers conducted in workshops, one-to-one interviews or self-completion. Behavioural similarity occurred across all three groups with around 50% feeling the IPM Land Management Plan (LMP) tool was useful. The most cited drivers to the use of IPM advice and guidance were economic and environmental. 65% of interviewees stated that they had a good understanding of IPM before the IPM project. Key barriers to the uptake of IPM practices were highlighted as; economic; lack of knowledge or understanding of IPM; and mind-set or habits. 50% of interviewees highlighted economic factors as being the biggest encouragement to implement on farm IPM practices.

Stephen Flack (NIAB) gave a presentation on seed certification with a focus on weed seeds as contaminants of crop seed. NIAB conducts seed certification work in England and Wales on behalf of Defra and the Welsh Government. Standards of sold crop seed for the content of weed seeds and other crops seeds are mainly achieved by seed testing methods. There are relatively few field standards for the presence of other species of plants in a seed production field. Field inspection is mostly concerned with varietal identity and purity of seed crops. However, if field observation indicates unacceptable levels of weeds in the crops, they can be refused as a seed crop. Two examples of where field standards exist are for wild oat contaminants of cereal crops and *Lolium* species in ryegrass. The standards differ for the generation of the crop seed and there are two levels of standard, a higher voluntary (HVS) and minimal contamination level. Imported seed to the UK is now certified under OECD seed testing schemes and by an ISTA test. All seed imported into the UK is also subject to phytosanitary standards, including a list of prohibited species. Farm-saved seed is common for many farmers, however it is not marketable and there is no compulsory testing for weed or other seeds. However, it is important that this seed is properly sampled and tested. One final source of seed is on the internet from suppliers in the UK, Europe and beyond some of which may not have the required standards, and is regulated by customs and PHSI.

Richard Barnes (Kings Crops) gave a presentation entitled 'Bringing clarity to seed standards across non-combinable crops'. Non-combinable crops include the evolving sectors of cover, catch, and companion crops, which are just as important as combinable crops with the same seed quality standards. Growers of these crops need seed of the highest quality, formulated correctly not only to meet seed standards but compliance and stewardship expectations.

Odinkemneme Ukwoma-Eke (University of Reading) presented a poster on his post-graduate research looking for opportunities for more precise weed management in fields of lowland rice. The aim of his project is to introduce precision agriculture to manage species such as *Nymphaea maculata* and *Echinocloa* species, which if not controlled can lead to complete crop loss.

Barrie Hunt (BCPC Weeds Group Chair) briefly presented the development of the BCPC's free access Knowledge Bank databases (https://www.bcpc.org/open-access). This will be searchable and includes 60,000 pages of information from 50 years of BCPC Symposia and other proceedings. If further finance is available then the intention is to include reports from the old Weed Research Organisation. This is part of the BCPC charitable objectives to provide information and has been supported by many of the Agricultural charities.

Helen Metcalf (Rothamsted) gave a presentation entitled 'Modelling the effect of glyphosate loss' which is part of the Assist programme (Achieving Sustainable Agricultural Systems) conducted by Rothamsted and the UK Centre for Ecology and Hydrology. It is a holistic approach not just focussing on the impact on weed communities, but also on profitability, productivity and environmental impact. The study was based on the Rothamsted Landscape (crop/soil/weed community) model. It simulated two minimal tillage farms in the East of England with medium clay soils, two farm situations, Farm A with a weed community dominated by *Poa annua* with no herbicide resistance and Farm B with a community dominated by herbicide-resistant black-grass. Simulations were run for 10 years using continuous weather data from the region between 1970 and 1998. Typical herbicide programmes were simulated for each crop rotation based on the Defra pesticide usage survey. The scenarios applied to the model were, a baseline of glyphosate; no glyphosate (with no other management interventions); and 4 IWM scenarios, changing crop rotations by increasing the frequency of grass leys or of spring cereals; managing stale seed by delaying drilling of winter wheat crops by 3 weeks or switching from minimal tillage to ploughing.

Weed abundance modelling shows much variation between the scenarios and the only instance with near zero weed population was glyphosate alone. None of the other scenarios came close to zero weeds and only ploughing coming close to that with glyphosate. Food production was significantly higher with glyphosate and ploughing compared to the IPM scenarios.

Food production and profitability were significantly lower on Farm B (herbicide resistance). Overall profitability increased over the ten years of the simulation across all scenarios and differences between all scenarios levelled out.

Environmental impact modelling took into account the hazards and risks chemicals used in the scenarios and there were significant differences between them over time. Glyphosate alone had the highest environmental impact after 3 years with all other scenarios less impactful but after 5 and 10 years the spring cropping scenario had more environmental impact.

It was concluded that there was variation in modelling results making conclusions difficult. Glyphosate did improve weed control compared to IWM options however; these could be mitigated through IWM. Herbicide resistance status did reduce

both food production and profitability but did not impact the relative efficacy of the different IWM options. The choice of the best option is dependent on the metric and timescale.

Brian Taylor (The Knotweed Company Ltd) gave a presentation entitled, 'IWM elements in amenity'. After an introduction to amenity areas and the situations and problems which an amenity weed expert encounters, the presentation focussed on invasive terrestrial weed control. Legislation means that it is an offence to permit many non-native species (e.g. Japanese Knotweed, Himalayan Balsam), but not all (e.g. Bamboo, Field Horsetail), from growing in the wild. However, it is not illegal to buy any of these species in the UK and many incidences of these species appearing in the wild arise from escapes from domestic gardens. A modified IWM tiered scheme was summarised for invasive species, starting with prevention; early detection and monitoring to treat them at an early stage; physical and mechanical methods of control; biological control (limited options for a few species) and the last resort of chemical control, where there is a heavy reliance on glyphosate. Management options were presented for some species.

The reality of damage from Japanese Knotweed was demonstrated and in many cases the only solution is a herbicide. There are few effective alternatives, particularly once the plant is established. Although some alternative methods have been tried such as, excavation to reduce the amount of herbicide needed, they are costly with high carbon usage and are not suitable for many amenity sites. The choice of herbicides is very limited and it can take many years to achieve control/eradication, as an example treatment of a 5ha site for knotweed has had 16 years of herbicide treatment and a further 14 years is anticipated before complete eradication.

Himalayan Balsam,, unlike knotweed is an annual species giving more options for IWM. Prevention can be achieved by limiting seed spread and physical methods such as mowing and hand weeding can be used. Rust from CABI may give a biological option before use of herbicides.

Invasive Bamboos is often spread from gardens or from fly-tipping and is increasing in the wild. It is spread vegetatively with similar impacts as knotweed, but once established, it can spread more rapidly and is very tough and can cause physical damage to buildings. From an IWM perspective, prevention is clear, do not plant bamboo. Early detection and monitoring can permit IWM as bamboo often takes 5-10 years to establish and permits effective physical or mechanical control measures, although the toughness of the rhizomes limits these. There are no biological options so once established, glyphosate provides reasonable control but needs several years of treatment to achieve remediation, in combination with physical removal of canes.

Field Horsetail causes hard surface damage if root barriers have not been applied as a preventative measure. There are no biological options and effective chemical control is limited. IWM options are physical or mechanical, with excavation, pH change, rhizome cultivation, root barriers, drainage and site management changes.

Control of invasive weeds is complicated due to no effective controls on introducing new species into the UK. Many invasive species have been introduced without their biology being well understood leading to sub-optimal management techniques. There are few herbicides and there is a risk of resistance. Biological methods are few and generally ineffective. Cost-effective solutions are generally herbicide based. More research is necessary to develop IWM techniques for invasive weeds.

Richard Hull (Rothamsted) gave a presentation entitled, 'What IWM strategies/tactics are UK arable farmers employing for weed control'. This was a case study using farmer interviews and is part of the European wide IWM PRAISE project. The objective of the interviews with UK arable farmers was to develop an understanding of: their problem weeds; the strategies/tactics being used to control them; the barriers to the uptake of IWM; and where knowledge is gained and trusted. The interview protocol was used across all participating countries and cropping systems. In terms of weed abundance black-grass was the highest, followed by cleavers, brome, cranes-bill, wild-oats, Italian ryegrass and charlock. The weeds seen as an issue were the grass weeds apart from charlock in oil-seed rape, the major reason being that there are sufficient herbicide options for broad-leaved weeds. The major weed control tactics used by farmers are split into 4 areas: reducing impact of weeds on crop (diversifying rotation, sowing date, increasing seed rate, post-emergence herbicides in the autumn or spring); prevent establishment (tillage/depth, pre-emergence and pre-sowing herbicides); reduce seed return (patch spraying and hand weeding); and supportive tactics (scouting). Focussing on black-grass abundance (follow on from the BGRI project), examples were provided from abundance maps based on field observations on black-grass density each year on farms using different tactics to manage this weed. In one example where there was no major change from wheat/oil-seed rape or wheat/wheat/oil-seed rape rotation over 5 years, there was little effect on abundance. A second example which did result in a major reduction in black-grass abundance, grass was put down for 18 months, followed by 2 spring crops, then winter wheat. However, there was still major reliance on herbicides. A third example where there was also a reduced black-grass abundance, incorporated the use of rotational ploughing whilst keeping winter wheat in the rotation. Two other examples were shown which successfully reduced black-grass abundance by the introduction of spring cropping. It was concluded that diversity/flexibility in rotations, cropping, drilling dates, cultivations, monitoring and herbicides, are key to sustainable weed control.

Economics was the major factor affecting the decision-making process for weed management. The most trusted sources of information experience were from independent peer-to-peer learning (experience of farms, independent farm advisors, demonstration days, peers/colleagues and study clubs).

My conclusion from this Weeds Review is the same as that from the 2020 review, which also focussed on IWM. Herbicides, particularly glyphosate, remain a key component in the toolbox for weed control, but there should not be an over-reliance on them or any other single weed management strategy. The common theme from many of the IWM presentations was to maintain diversity in approaches for weed control and if, or when, new molecules from ongoing herbicide research and development become available, no individual molecule should become the dominant tool of use, but should be integrated with other molecules and the range non-chemical options for effective and sustainable weed management.