BCPC Pests and Beneficials Review Meeting 29th January 2020 Report

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Sixty people attended the Review which was held at Rothamsted Research. The participants included agronomists, farmers, AgChem industry, academics and government. The Review was organised by Dr Sacha White and Dr Mark Ramsden (both of ADAS), Dr Larissa Collins (Fera) and Moira hart (BCPC) with input and advise from the BCPC Pest and Beneficial Insects Expert Working Group. The Review was Chaired and introduced by Tim Isaac, Director of Knowledge Exchange, AHDB.

Dr Bill Parker, Research Director AHDB, spoke on 'Thresholds, risks and realities – lessons from the past to inform the future?' Dr Parker discussed the history of Integrated Pest Management (IPM) and questioned whether we have moved on in the last 30 years. He thinks that we are on the verge of a quiet revolution in arable, driven by the reduced agrochemical toolbox and environmental policy. However, there is no agreed definition of IPM which is a "way of thinking". IPM embraces monitoring, identification, sanitation, exclusion, treatment strategy, measurement and evaluation. In Scotland and Ireland in 2019 only 6% of farmers/growers adopted more than 85% of available techniques. Thresholds are the key tools which require metrics but establishing a good threshold takes a lot of effort. We also need to understand the spatial distribution of pests to know how to sample for them in the field. The established thresholds may not be relevant to today's crop varieties and the data is often flimsy in the first place. Sometimes the threshold is not the most important tool, for example the Aphid Forecast is more important for targeting control options for the carrot-lettuce aphids and lettuce-root aphids. There are issues with sampling for wireworms and to understand the ideal interval for crop rotation for potatoes it is necessary to sample for Potato Cyst Nematode between crops in the rotation. The use of thresholds is not always appropriate. We need to understand what we are looking for and why and, if this is difficult, we need to use a proxy. We also need to understand when to look for a pest and where to look; the latter is not always obvious. The time required to sample for pests is the biggest barrier to using thresholds. IPM carries risk – failure of IPM can be catastrophic to a horticultural crop. Perception of risk and judging risk varies between people and is different for different crops. The risks can be mitigated by on-farm experience and this could be improved by data-sharing, as happens in the US GiSC grower cooperative. The agronomist takes the biggest risk. Farmers, growers and agronomists must have confidence in the data and pool and share data. New methods must be quick and easy as well as being technically sound and feasible to implement. Implementation of IPM depends on cooperation between the researcher, the agronomist and the farmer/grower and the researcher must respect the risks taken by the agronomist.

Dr Kate Storer, ADAS, spoke on 'What to measure from a crop physiology perspective'. Dr Storer framed the challenge as pinpointing how crops can be managed sustainably in the face of variable conditions and pest pressures. For most crop plants, the relationship between crop injury and crop performance varies with the growth stage of the plant at the time of injury, the ability of the plant to resist and/or tolerate the injury, and the part of the plant affected. By identifying the appropriate crop features to monitor, it is often possible to identify crops more or less at risk of pest damage, a critical aspect of IPM. As they relate to both crop protection and productivity, collection of crop physiological data is increasingly an essential part of decisions making within an IPM Strategy. Dr Storer asked the questions 'Can we do nothing?', 'How does the pest interact with the crop?' and 'What should a threshold scheme consider?'. The answer to the latter is that we need to consider how much damage a pest does, how much damage a crop can tolerate, methods for monitoring and predicting the state of the crop and the pest population. Dr Storer used pollen beetles as an example. For an AHDB funded project she considered how many excess flowers are produced and assessed whether we can measure this. Practically we cannot, however we can predict the number of excess flowers from the variety and

the density of plants. Dr Storer also took into account other damage such as defoliation. Most of the sites studied did not exceed the EAT. Oilseed rape (OSR) plants were more resilient to bud loss and simulated defoliation mimicking pigeon damage than expected. There are common themes between crops as to what we need to measure: how much damage does an individual pest cause, and how much damage can a crop tolerate before losing yield. We need methods for easily monitoring/predicting the state of the crop and pest prevalence.

Dr Mark Ramsden, ADAS, spoke on 'Decisions – Forecasts, monitoring and Decision Support Systems'. Dr Ramsden recognised that IPM practices to tackle pests, weeds and diseases can be a real challenge for farmers and advisors. Decision Support Systems (DSS), including monitoring, forecasting and threshold tools, can assist on-farm decisions to implement IPM. Support systems include Monitoring Forecasting and DSS. We need to bring together thresholds, forecasts and other tools in one place. A number of factors are limiting the use of DSS: lack of awareness that they exist, they are not user friendly, they are insufficiently risk-averse, the benefits are unclear, they do not reflect multi-pest pressures, people are unwilling to trust the outputs, and there is a lack of support in using DSS. The EU Horizon project – to "increase the impact of DSS on IPM"- will provide an open, online platform for DSSs allowing wide access with easy "click and go" to select a relevant system. This will involve an international network of farmers, agronomists, and researchers sharing knowledge including showing on-going research programmes, a map of adoption and gaps in availability. Farmer-agronomist workshops will be used to validate the "dashboard" and individual DSSs to select the best, e.g. lowest risk, for inclusion. The IPM Decisions project will create an online platform that is easy to use for the monitoring and management of pests. The platform will be available across the EU with DSS, data, tools and resources tailored to individual regions. A pan-European collective of farmers, advisors, DSS providers and researchers will design and develop the platform so it meets the needs of different types of user. This community will be called the IPM Decisions Network and will ensure that the constraints currently limiting the impact of DSS can be overcome. https://www.ipmdecisions.net/

Mr Colin Carter, Landseer Ltd, spoke on 'Remote sensing of pests'. Modern agriculture is transforming, adopting technological advancements as it strives for ever greater efficiency and enhanced IPM strategies. Automated pest monitoring systems are being developed and now being deployed in an increasing number of countries and crops. Key players in the automated monitoring sector include SemiosBio Technologies Inc, EFOS d.o.o., Anticimex AB, DunavetNET and FaunaPhotonics. Landseer has worked closely with EFOS since 2012, who have now launched the Trapview system across a number of markets. The main drivers for remote sensing are the loss of key actives, the availability of new technology, (including biopesticides), the emergence of a new pest complex, dispersal of production areas, and increased farm size. Current pheromone traps can have camera monitors ("Trapview") allowing remote observation, audit and archive. Mr Carter described the Delta trap for codling moth monitoring which has had Trapview incorporated. Mr Carter also described how the Trapview system has been used in an AHDB funded project to monitor Silver Y Moth. Remote sensing can be used to facilitate the use of narrow-spectrum or growth-stage dependant products where the timing of application is critical, e.g. Methoxyfenozide, an ovicide/early stage larvicide. 1000 Self-cleaning traps have been used to monitor for *Helicoverpa armigera* in tomatoes in the Mediterranean zone. Remote sensing is continuing to develop particularly in covering a wider pest spectrum, algorithm developments, improving accuracy, improving data transfer capacity to facilitate better image resolution. Remote sensing should be used to enhance good ground observation and agronomy.

Mr Edward Cross, Farmer, spoke on 'Perspectives on metrics and DSS'. Mr Cross used IPM over 12 months to make decisions regarding his peas, sugar beet and barley. Mr Cross used pest monitoring

and thresholds for pea month, aphid transmission of virus yellows in sugar beet and aphid transmission of BYDV in barley. For each crop/pest combination Mr Cross presented his monitoring results together with the economic information he used to make is spray/no spray decision. Mr Cross included the potential damage to beneficial insects from non-selective spraying. For pea moth, the case to spray was very clear given the monitoring results and the high value of the crop vs. the cost of spraying. Monitoring in sugar beet reported a high number of aphids but no local virus incidence in the aphids trapped. The agronomist recommended spraying. Other factors taken into account were financial pressure to avoid yield loss and the impact on beneficial insects and wildlife. The decision on whether to spray the winter barley to prevent BYDV transmission was less straightforward. The T-Sum suggested spraying 1-3 times from mid-October but there were low virus levels at the nearest monitoring sites and aphid flights decreased from early November onwards. Mr Cross found very few aphids from late October onwards but he did find beneficial insects. Each insecticide application would have cost approximately 1% of the value of the crop. Mr Cross made the decision to spray the earliest sown field in mid-October, although this was a difficult decision to make for a number of reasons. These were that there was less input from the agronomist, aphid monitoring stopped too soon because Mr Cross was too busy on the farm to continue, the AHDB network of monitoring sites is not as dense as the BBRO network, and the warnings about BYDV transmission seemed alarmist.

Mr Nicolas Munier-Jolain, INRAE, spoke on 'DEPHY and IPM monitoring; lessons learnt in France'. The DEPHY network was launched in France in 2010 as a component of the National Action Plan for Sustainable Use of Pesticides. It includes 3,000 volunteer farmers, from all agricultural sectors. The explicit objective is to reduce the reliance on pesticide with IPM, and to demonstrate that it is possible without impairing profitability. The network is based on 250 advisers with specific skills for promoting co-innovation processes based on peer-to-peer knowledge exchange, and specific skills for promoting a holistic view of IPM, both for the design of strategies and their evaluation. The average decrease in pesticide use since the beginning of the network ranged from -14% in arable field crops to -43% in horticulture. In arable field crops, based on the diversity of pest management strategies in DEPHY farms, Lechenet et al. (2016, 2017) showed that IPM strategies reduced pesticide use by 42% compared to average pesticide use in neighbouring farms with similar production systems. The pesticide reduction due to IPM was not correlated to any corresponding decrease in farm productivity or profitability in 94% and 78 % of farms, respectively. The most frequently used IPM components were (i) crop diversification (with temporary grasslands whenever possible, with hardy and disease-resistant crops and with diversified sowing seasons); (ii) diversity of sown cultivars and the choice of cultivars with low susceptibility to diseases; (iii) delay in cereal sowing; (iv) reduction of pesticide doses; (v) soil tillage regime, and (vi) moderate nitrogen fertilization level. In some instances, e.g. wheat crops, yield potential was reduced under IPM strategies, but reduced inputs resulted in more cost-effective production. If all of the farmers in France, including the arable farmers in the North of France, adopted the lowest pesticide use DEPHY systems, there would be a 40% reduction in the export trade balance, particularly of barley, and a reduction of energy inputs. Therefore, in terms of economics this is a zero-sum game. However, there would also be an environmental gain.

Ms Alice Midmer, Demonstration and Innovation Manager, LEAF, spoke on 'Economic trade-offs associated with IPM'. LEAF has been championing an Integrated Pest Management approach for farmers for the last 27 years. Ms Midmer posed the following questions: To what extent are farmers doing this and why aren't more adopting the approach? What are the risks, pitfalls and economic trade-offs associated with an IPM strategy and what more information do growers need before taking a leap of faith? There are economic trade-offs associated with IPM. The primary motivation for farmers is to have a resilient cropping system. IPM, as promoted by LEAF, includes actions on IPM, community, landscape, water and waste. IPM is a mindset change; it can offer a more resilient cropping system,

with reduced inputs, but greater risks in the short term. There is a lot of room for improvement in uptake of IPM, however 52% of LEAF Marque Certified Farms use all eight aspects of best practice in IPM, 38% of UK members use biological control and 60% of UK LEAF members take steps to minimise damage to beneficial species and other non-target species. LEAF Marque growers have seen a 8-20% reduction of pesticide and fertiliser inputs without yield loss. Smaller farmers can be more involved and able to sign-off on risks, however, big business farming may be more risk averse because it has a longer chain of authority and influence. LEAF has an online self-assessment tool – the LEAF Sustainable Farming Review. LEAF is working with AHDB and ADAS to pull together technical resources for IPM. Demonstration, information and practical solutions are required to increase uptake of IPM.

Dr Emily Pope, Knowledge Transfer Manager Arable, AHDB, spoke on 'Understanding the factors that influence the uptake of new approaches on farm'. Dr Pope demonstrated the experience of using a structured methodology, in the form of the Campaign Strategy Instrument and RESET mindset tools, to develop a campaign for communicating a technical message and driving change on-farm. The RESET mindset tool recognises that different farmers are stimulated by different prompts, and their decision making is not linear. To maximise the impact of communication a range of prompts should be used simultaneously. The Campaign Strategy Instrument allows communication activities to be goal oriented. To effectively use the two models presented, it is necessary to engage with multiple stakeholders. This promotes greater information sharing and continued communication between previously disparate and fragmented organisations within the agricultural industry. In the future, it is anticipated that this approach can be used by extension services to increase the efficiency of innovation and the adoption of research within commercial farming systems. Furthermore, developing campaigns with multiple stakeholders will build trust and a cyclical process of continued communication for the benefit of UK agriculture. Dr Pope explained that everyone responds to different cues to different extents when making decisions, therefore if we want to change the way people make decisions, we need to take this into account. One way of doing this is to use the RESET model to understand the factors which people use to make decisions: Rules and regulations, Education, Social pressure, Economic impulses, and Tools. AHDB is very good at providing information and tools but we need to influence farmers rather than just giving information and education. We could do this by using farmer role models as messengers. Dr Pope found that dialogue with colleagues and past experience combined comprised 66% of the influence on growers to act, for example vs trap data. Dr Pope ended with the statement that there is an assumption that a farmer is an empty cup that needs to be filled whereas a farmer is a cup of tea full of knowledge that needs stirring.

The speakers' presentations can be viewed on the BCPC website: https://www.bcpc.org/events/bcpc-pests-and-beneficials-review-2020

There were two lively discussion sessions during which the speakers from each of the sessions formed panels to consider and respond to questions from the audience. The first panel responded to questions such as: The requirement for a definition of IPM to develop relevant Government policy; How much does the overlap of pest damage in a crop influence the threshold and crop tolerance?; Would DSS systems be better if they had insurance option behind them in the event of a false negative and crop loss?; DSS is very useful but we only have certainty at 3 days in the weather forecast; To what level can software identify insects?; Should DSS include the option for growers/agronomists to input their own data on crop/pest/weather and would that encourage buy-in and confidence in the results?; How do we monitor the successes and failures of DSS?; How does DSS stack up with the freak weather patterns we are seeing recently? Is this information considered against existing DSS? The second panel responded to questions such as: Is there any distinction between molecules with the drive to reduce pesticides e.g. taking environmental and user safety into account?; With regard to the LEAF marque,

how much would IPM be worth to a customer of broad acre crops rather than meat/horticulture?; Has the impact of DEPHY on carbon footprint been calculated (impact of increased tillage)?; Does anyone have an understanding of how the baseline of 'pre-DEPHY' pesticide use compares with levels of pesticide use in the UK?; If DSS becomes live who should pay for the information, farmer, agronomist, or government, to ensure that it continues?. A theme which emerged in the discussion was 'Who carries the risk?' and 'Who pays for "errors"?'. The agronomist advises and the farmer decides. The farmer considers that they carry the fiscal risk, however the agronomist's job might be on the line if they give the wrong advice. IPM is inherently more risky than pesticide application, if this is available; how would Defra value or reward such risk-taking?

Seven posters were presented during the breaks:

- Finding genetic resistance to the cabbage stem flea beetle - Lucy Thursfield (John Innes Centre)
- Are pitfall traps measuring the tip of the iceberg? - [1,2] Kelly Jowett, [1] Alice Milne, [1]Jon Storkey, [2]Deepa Senapathi, [2]Simon Potts ([1]Rothamsted Research, [2]Reading University)
- Understanding the origins and spread of resistant-breaking biotypes - Dr James Bell[1], Dr Ramiro Morales-Hojas[1], Dr Rosemary Collier[2], Dr Graham Teakle[2], Emma Garfield[3] ([1]Rothamsted research, [2]University of Warwick, [3]G's Fresh). Presented by Dion Garrett
- New heroes to defeat cabbage stem flea beetle - Patricia Ortega-Ramos[1], Alice Mauchline[2], Robbie Girling[2], Larissa Collins[3], Sam Cook[1] ([1]Rothamsted Research, [2]University of Reading, [3]Fera)
- Revolutionizing biomonitoring: rapid and accurate identification of insect pests and beneficials through DNA metabarcoding - Dimitrios Petsopoulos[1], James Kitson1, Dave Lunt[2], Ramiro Morales-Hojas[3], Larissa Collins[4], Neil Boonham[1] & Darren Evans[1] ([1]Newcastle University,[2]University of Hull, [3]Rothamsted Research, [4]Fera)
- Grain aphids (*Sitobion avenae*) with knockdown resistance (kdr) to insecticide exhibit fitness trade-offs, including increased vulnerability to the natural enemy *Aphidius ervi* - Damon Little[1], Gaynor Malloch[2], Louise McNamara[3], Gail E. Jackson[1] ([1]University of Edinburgh, [2]The James Hutton Institute, [3]Teagasc)
- Inside out crop protection; use of endophytic entomopathogenic fungi - T. L. O'Neill[1,2], A. C. Gange[1], V. Sarasan[2], B. Luke[3] ([1]University of London, [2]Royal Botanical Garden, Kew, [3]CAB International)