BCPC Pests and Beneficials Review

30th January 2019

Rothamsted Research, Harpenden, Hertfordshire, AL5 2JQ

Breeding to Boost IPM – Can We Rise to the Pest Control Challenge?

'Increasing insecticide resistance and fewer actives are something with which we are all too familiar. In addition, cultural control is more difficult because changing weather patterns are impacting the timing of migrations and life cycles of pests. Can we better equip our crops by improving their natural defences to manage pest problems?'

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PROGRAMME

09:30	**Registration and refreshments**
10:00	**Welcome** **Caroline Nicholls** - BCPC Pests & Beneficials Group Chairman / Technical Manager, Prime Agriculture LLP
10.05	**Introduction** **Thomas Bradshaw** – Chair / NFU Combinable Crops Board Chairman
10:15	**Strategy and the future of pest management** **Ian Boyd** – Defra Chief Scientific Adviser
10:45	**Plant breeding for insect resistance and new breeding approaches** **Rachel Wells** - JIC
11:05	**A novel pre-breeding strategy to reduce dependence on insecticides for virus yellows control in sugar beet** **Lucy James** – RSK ADAS
11:25	**Refreshments**
11:40	**Aphid resistant wheat: is it probable or even possible?** **Gia Aradottir** – Researcher, Biointeractions and Crop protection, Rothamsted Research
12:00	**Crop tolerance as a component of IPM** **Steve Ellis** – Consultant, RSK ADAS
12:20	**PANEL DISCUSSION**
12:50	**Lunch and posters**
13:35	**Horizon scanning and overview from a crop breeding perspective** **Phil Howell** - NIAB
13:55	**Recommended Lists: Looking Beyond Headline Yields** **Jenna Watts –** Crop Production Systems Senior Scientist (Cereals & Oilseeds Recommended Lists) AHDB
14:15	**Living with IPM as an Independent agronomist** **Patrick Stevenson** - AICC
14:35	**PANEL DISCUSSION**
14:55	**Closing remarks – and farmer perspective** **Thomas Bradshaw** - Chair

15:15	Review close

ABSTRACTS

Oral presentations

Plant breeding for insect resistance and new breeding approaches
Rachel Wells – JIC

Crop protection against insect pests and the ongoing loss of chemical controls is one of the biggest challenges in modern agriculture. Breeding for plant resistance is a proven crop protection strategy, however examples of conventional breeding for insect resistance are limited. With any genetic resistance strategy, it is necessary to identify a source of resistance resulting in the need to screen large germplasm collections. Phenotyping for insect resistance is difficult. Within field situations, insect distribution and environmental interactions result in high variability within trials. Controlled laboratory assays are either dependent on seasonal insect availability or require the ability to rear species.

Despite the difficulties of phenotyping for insect resistance, the advances in modern genomic techniques and the reduction in cost of marker assisted selection (MAS) make exploiting existing natural variation or the introgression of resistance genes from related or wild species an achievable prospect. Induced variation, such as that available from mutagenized populations, offers a further conventional breeding approach for crop improvement.

Transgenic approaches, such as the use of endotoxins found in the naturally occurring soil bacterium *Bacillus thuringiensis*, have been an important tool for crop protection. However, within the EU, rigorous safety regulation and authorisation is required before a modified crop may be cultivated or sold. Only one GMO, Bt corn MON810, is currently authorised for cultivation within a limited number of EU countries.

New breeding techniques, such as CRISPR, offer precise genome modification of single or multiple gene targets, rapidly accelerating targeted plant breeding. Though considered a powerful approach for future crop improvement, in 2018 the Court of Justice of the European Union (ECJ) ruled that crops created using these technologies should also be subject to the 2001 Directive governing GMOs. This ruling makes it likely that much of the potential benefit in crop protection that could be gained from these innovative methods will be lost.

A novel pre-breeding strategy to reduce dependence on insecticides for virus yellows control in sugar beet

Lucy James – RSK ADAS

Virus yellows remains a key threat to the UK beet industry because the maritime climate favours the overwinter survival of the aphid vector. At this time, there is no available host resistance protecting against virus yellows and the industry relies entirely on insecticidal control of aphid vectors. Currently, the UK beet industry invests up to £7M/year on insecticides for aphid control, without which virus yellows could cause annual losses of up to 40% of the national crop. Recent EU restrictions on neonicotinoid use in flowering crops, as well as the development of insecticide resistance in aphids elsewhere in Europe, threatens to increase the incidence of virus yellows in UK-grown sugar beet. It is therefore critical that alternative crop protection strategies are developed and implemented. A vital component of future control strategies is the development of virus yellows resistant or tolerant sugar beet varieties. To enhance the resistance/tolerance gene pool, our team (BBRO, ADAS, SESVanderHave, and MariboHilleshög) have invested in the development of several sugar beet relatives that show resistance or tolerance to the effects of virus yellows. The project aims to develop these heritable resistance/tolerance traits further, by crossing selected beet relatives with modern commercial breeding lines. New lines are being rigorously tested in the field for virus yellows resistance or tolerance, plant vigour and yield. Genetic testing is also being carried out to develop molecular markers for marker-assisted selection of virus yellows resistance/tolerance and to identify genes controlling these traits. This five year pre-breeding project, started in 2014, is part funded by Innovate UK, the UK's innovation agency, and will ultimately accelerate production of new varieties that provide host protection against the virus yellows complex.

Aphid resistant wheat: is it probable or even possible?

Gia Aradottir – Researcher, Biointeractions and Crop protection, Rothamsted Research

Cereal aphids have long been problematic in wheat production. They are hard to spot in the crop and although they don't often cause direct damage in the UK, they transmit the barley yellow dwarf virus that does cause yield losses, often up to 30%. Resistant wheat varieties are not commercially available to the two aphid species of economic importance in the UK, the bird cherry - oat aphid and the English grain aphid.

We have screened over 1000 wheat lines, ranging from wild relatives to commercial wheat varieties, for resistance to cereal aphids and in this talk I will discuss the progress we have made in identifying aphid resistant germplasm and the potential for breeding for aphid resistance.

Crop tolerance as a component of IPM

Steve Ellis – Consultant, RSK ADAS

A declining chemical armoury, greater regulation of chemical use, more costly insecticides and insecticide resistance mean that future pest control will become increasingly reliant on integrated pest management. We will become less reliant on chemical control and more skilled at targeting chemical applications and using cultural control. This will require credible, robust thresholds which take into account the potential for a crop to tolerate the impact of pest attack. Collaboration between ADAS entomologists and crop physiologists has developed pest thresholds which incorporate the ability of the crop to tolerate pest damage. This paper will provide examples of where an understanding of crop tolerance will help to improve pest risk assessment in both cereals and oilseed rape and discuss how the entomology/physiology collaboration will evolve to rationalise insecticide use and integrate this with cultural control.

Horizon scanning and overview from a crop breeding perspective

Phil Howell – NIAB

Pests and diseases have the potential to severely impact both the yield and quality of our crops. Varietal resistance will become more important as the future will bring stricter crop protection regulation and uncertainties around climate change. Breeding for resistance, tolerance and escape is achievable for many crop pests and diseases, but in practical terms this can be at the expense of yield and quality, thus slowing down the overall rate of varietal improvement. The RL and similar systems have an important role in helping breeders to set their priorities. Modern technologies can help breeders react relatively quickly to new challenges, whether these are raised by pests or policy.

Recommended Lists: Looking Beyond Headline Yields

Jenna Watts – Crop Production Systems Senior Scientist (Cereals & Oilseeds Recommended Lists) AHDB

The Recommended Lists for Cereals and Oilseeds (RL) are a valued source of independent information for the industry. The RL is managed by a project consortium of AHDB, BSPB, MAGB and nabim.

Treated yield is important for recommendation but so are other characteristics. To become recommended, a variety must first complete 2 years of National List trials and then be selected to enter RL trials as a candidate variety. Recommendation decisions are made following the candidate year(s), normally on the basis of 3 years of data. Whilst treated yield is important in the evaluation of varieties, very few varieties are recommended on yield alone; instead, varieties are judged on their balance of features. When this balance is considered some characteristics are of higher importance than treated yield, e.g. *Septoria tritici* for winter wheat. It is also possible for a variety with a lower treated yield to gain a specific recommendation if it has a desirable trait e.g. resistance to Turnip Yellows Virus.

In December 2017, RL Look Ahead activities began with the aim of examining how people use RL and to identify how the variety trialling project can be improved. It has considered more than 600 survey responses, as well as feedback from numerous stakeholders at events throughout 2018. Mainly growers (52%) and agronomists (19%) responded to the survey. Although treated yields and gross output were considered to be very important by growers and agronomists, many other features were considered slightly more crucial, with disease resistance rated highest.

- The Look Ahead activity has generated a wide range of points to be considered. Four working groups have been established to provide advice on the direction on the RL:
- The recommendation process: This group will look at how the RL strikes a balance between quality, yield, agronomics, disease and economic performance.
- The number and location of trials: with 60% of survey respondents expressing a strong interest in regional performance data, this group will look at how trials are distributed and analysed to provide robust local information.
- New traits and breeding advances: A wide range of traits were suggested for measurement within the RL. This group will look to develop a flexible system that is able to prioritise and fast-track the traits most likely to bring the biggest rewards.
- Communication and knowledge exchange: The potential to use digital tools, such as Harvest Results interactive, and enhanced regional event activity will be explored by this final group.

Each working group will develop an action plan for consideration by the RL Board in summer 2019. Further information on developments will be made available later in 2019.

Posters

Agricology - sustainable practical farming.
Katie Bliss and Lydia Moore (Organic Research Centre)

Agricology is a collaboration of farmers, researchers and advisers who are working towards a more resource efficient, resilient and profitable farming systems based on agroecology principles. We bring together the latest advice on transitioning to sustainable farming practices by sharing key learnings through online resources and events in the field. Each month we publish a farmer or grower profile showcasing the use of agroecology in practice to enhance their agricultural system; demonstrated through videos, images, ideas and practical tips. We also provide showcase guest blogs and research hubs for researchers to share what they are learning directly with the farming community and have a growing library of over 300 resources.

For practical tips and expert advice join the conversation @agricology or visit our website to learn more about putting agroecology into practice with our friendly community of farmers and researchers. We also run field-based events and are active participants in many of our partner conferences – all details and content is shared on our website. Sign up to our newsletter for a round up of all our activities and resources.

The circadian clock and insecticide susceptibility in Spotted Wing Drosophila
Bethan Shaw[1], Herman Wijnen[2] and Michelle Fountain[1] ([1]NIAB EMR, East Malling, Kent, ME19 6BJ, [2]University of Southampton, Southampton, SO17 1BJ)

The circadian clock is responsible for time keeping within organisms and influences not only behavioural patterns, but also physiological rhythms including toxin susceptibility. Understanding the 'chrono-toxicity' of a pest species could result in a higher impact of pesticides if applied when xenobiotic tolerance is at its lowest. *Drosophila suzukii* (Matsumura) is a global horticultural pest, and identifying peaks and troughs in insecticide susceptibility could contribute to improving integrated pest management practices. Research in the USA has detected changes to tolerance to Malathion (Hamby et al., 2013), however this is not approved for use within the UK. Within this study we focused on approved products commonly used to target *D. suzukii* in soft- and stone-fruit. To determine whether time of application influences mortality, sub-lethal doses of cyantraniliprole, lambda-cyhalothrin, pyrethrum and spinosad were directly applied to groups of adult *D. suzukii* at different times of day. We found no influence of time on mortality or oviposition for any of the four pesticides applied. Although this may not be seen as a positive result, this conclusion reassures growers that current practices are still the most effective and methods do not need altering in regard to timing of application.

References

HAMBY, K. A., KWOK, R. S., ZALOM, F. G. & CHIU, J. C. 2013. Integrating circadian activity and gene expression profiles to predict chronotoxicity of *Drosophila suzukii* Response to Insecticides. PLoS One, 8.

Using RFID technology to track *Deroceras reticulatum* (grey field slug)
Emily Forbes, Andy Brooks, Matt Back, Tom Pope and Keith Walters. (Harper Adams University, Newport, Shropshire TF10 8NB)

Larger *Arion spp*. of slug have previously been tagged with passive Radio Frequency Identification (RFID) tags. Here we report work that investigates the potential for using RFID technology to track the movement of individual slugs of the smaller species *Deroceras reticulatum* (Muller) in the field both above and below the soil surface. Small RFID tags (0.8 mm) were implanted beneath the body wall behind and below the mantle of fully grown *D. reticulatum.* The effect of tag insertion on survival, feeding, egg laying and locomotor behaviour (velocity and total distance travelled) was investigated under controlled environment conditions in the laboratory over a 28 day period. No significant differences in egg production between tagged and untagged slugs were recorded throughout the experimental period. After a 14 day recovery period following tag insertion, no significant differences in the survival rate, amount of lettuce consumed or locomotor behaviour were recorded.

Identification of variation in feeding preferences of the cabbage stem flea beetle in *Brassica napus*
Jessica Hughes (John Innes Centre)
The cabbage stem flea beetle (CSFB) is a pest of most Brassicaceae but is particularly problematic for oilseed rape. Restrictions on the use of neonicotinoid pesticides and confirmation of resistance to alternative pyrethroid pesticides has led to a dramatic rise in CSFB numbers in the UK. As a result, farmers have been left with limited control for CSFB and are increasingly concerned about growing oilseed rape in the future. As a major UK break crop, reduction in the growing area of oilseed rape would be detrimental to the economy and UK farming.

Utilising a captive population of CSFB at the John Innes Centre, I present some initial results and progressions from during the first year of my PhD, including:
a) Identification of feeding preferences of adult beetles to different lines of Brassica napus,
b) Results from a successfully piloted assay that assesses larval damage and adult beetle fecundity, on a range of host plants, specifically *Sinapis alba, Brassica juncea* and *Brassica napus.*

Pyrethroid insecticide resistant grain aphids (*Sitobion avenae*) are 28% more susceptible to the parasitoid *Aphidius ervi* – a potential biocontrol agent.
Little D., McNamara, L. and Jackson G.E. (University of Edinburgh)

Over 30% of Scotland's most damaging cereal aphid, the grain aphid (*Sitobion avenae*) is now resistant to pyrethroid insecticide. These aphids are important as they transmit potato viruses, such as PVY and pyrethroid insecticide has therefore been used extensively to control these important vectors. These aphids contain the kdr (knock-down resistant) mutation (L1014F) in their sodium channel gene. The most prevalent clonal type carrying this mutation is termed SA3, which as yet has only been found in heterozygotes. A preliminary investigation in to the susceptibility of this clone to the parasitic wasp *Aphidious ervi* in comparison to a non-resistant Aberdeenshire clone, was carried out in a controlled environment. This demonstrated a 28% increase in mummification rates in the insecticide resistant clone. The rate of population increase and vigour of the insecticide resistant clone was also lower than that of the susceptible clone. This suggests that the insecticide resistant clone is less able to resist the parasitoid and indicates its possible use as a biocontrol agent. Further controlled environment studies are currently underway with alternative potential biocontrol

agents and field trials will be carried out during the summer of 2019 to investigate the extent of aphid mummification in a spring barley crop.