REPORT FROM THE AGRI-FOOD CHARITIES PARTNERSHIPS (AFCP) FORUM ON MANAGEMENT OF OILSEED RAPE DISEASES AND PESTS

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In his welcome and introduction, **Graham Jellis,** the AFCP Chairman, firstly explained that the Forum was a hybrid event, with around 25 participants in person at the University of Hertfordshire and up to 100 joining online from the UK and abroad. He expressed his gratitude to the University of Hertfordshire for hosting the Forum.

Graham explained that the purpose of AFCP is to allow the various agricultural sector charities in the UK to communicate and work together, wherever possible, to benefit UK agriculture and beyond. Further details on the AFCP and its member charities can be found on: https://www.afcp.org.uk. AFCP member charities have funded much of the research on oilseed rape pests and diseases being presented at this Forum.

Prior to the oilseed rape presentations, **Rob Edwards** from the University of Newcastle introduced the Agricultural Universities Council (AUC)-UK. The AUC was conceived in 2018 when the Agricultural Bill was published and although part of its focus was on skill development, there was no mention of the role of Universities. The AUC comprises 17 Universities and has a vision to drive high quality research and education in a World-leading UK Agri-food sector. Its aim is to represent higher education interests in agriculture and related topics and speak as one collaborative voice to industry, government and other stakeholders on issues of mutual interest. AUC objectives include, providing a forum for Agri-food 'thought leadership'; pooling resources to ensure evidence-based information and commentary for Agri-food related policy; working together to ensure a pipeline of high quality graduates, researchers and future leaders in the Agri-food sector; working with other organisations to complement and add-value to existing initiatives and groups; and facilitating professionalism of agriculture via evidence-based education and research. Activities have been paused during the pandemic but a workshop is planned in the autumn of 2021 on University led research and innovation and its impact in the Agri-food sector focussing on challenges and solutions.

Yongju Huang from the University of Hertfordshire presented the challenges and opportunities in oilseed rape disease control over 30 years of her career. From 1991, she worked on stem rot (*Sclerotinia sclerotium*) at the Chinese Academy of Agricultural Science in Wuhan. In 1999 she moved to Rothamsted and worked on Phoma stem canker (*Leptosphaeria maculans* and *L. biglobosa* often in co-infection) and light leaf spot (*Pyrenopeziza brassicae*), the major diseases of oilseed rape in the UK. Since 2011 she has continued this research at the University of Hertfordshire. The combined annual yield losses from these two diseases in the UK exceed £100 million. The presentation covered the current status and our understanding of the life cycle of these diseases, resistance and virulence genes, much of which has been conducted by Yongju and her research team funded by agricultural charities along with research councils and industry.

James Fortune from the University of Hertfordshire gave a presentation of his post-graduate research entitled 'Chemical warfare – The fungal quest to conquer oilseed rape'. His research focussed on Phoma stem canker an oilseed rape disease caused by two similar co-existing pathogens, *L. maculans* (Lm) and *L. biglobosa* (Lg). The aims of his research were to investigate the interactions between the two species and changes in phytotoxin production as a result of increased interspecific competition. The secondary metabolites (sirodesmin and its precursors) produced by Lm inhibit Lg colony growth. When Lm and Lg are co-inoculated sirodesmin and its precursors are not produced. Leaf lesions caused by Lm alone are reduced by co-inoculation with Lg to a level seen with Lg alone and DNA studies revealed that Lm levels are far lower following co-inoculation of the two species. The significance of these findings is linked to fungicide applications. Azole fungicides are usually applied at 10–20% incidence of leaf lesions from Lm. However, where both species give co-infection, lesions appear later and are smaller which could delay the application of, and control by, fungicides.

Chinthani Karandeni Dewage, a Research Fellow at the University of Hertfordshire, then gave a presentation entitled 'Disease Management in oilseed rape: insights into the *Brassica napus – Pyrenopeziza brassicae* pathosystem'. Light leaf spot (LLS) not only causes the greatest yield losses by a fungal disease in oilseed rape, but also impacts other brassica species. Control relies on a combination of fungicides and host resistance but the former is problematic because of a long asymptomatic growth phase of the pathogen and disease-forecasting measures for fungicide application are necessary. The research investigates the phenotype(s) of resistance in a range of oilseed rape cultivars some of which appear to have

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specific resistance interactions with *P. brassicae*. New sources of host resistance are needed which may arise from the secondary gene pool of *B. napus* and two main phenotypes of resistance have been identified. However, further research is needed to identify pathogen population structures and the extent of cross-infectivity between different brassica species.

In a switch from oilseed diseases to pests, **Claire Hoarau** from Harper Adams University gave a presentation on her post-graduate research into the potential of biopesticides and optimising use of conventional insecticides for control of cabbage stem flea beetle (*Psylliodes chrysocephala*). This research is jointly funded by five agricultural charities with AHDB. The aim of this project is to identify alternatives to conventional insecticides such as fungi, bacteria, nematodes and plant extracts, physically acting as biopesticides. The context behind this project is the ban of neonicotinoid insecticides in oilseed rape for flea beetle control and the absence of effective alternatives. Initial bioassays have been conducted with entomopathogenic bacteria and entomopathogenic nematodes as well as two formulations of physically active products. Promising mortality of flea beetles in the bioassays has been seen with some of the nematode species and with the physically active compounds tested. Further bioassays are planned with entomopathogenic fungi and physically active compounds plus conventional insecticides. The most active biopesticides from the lab studies will then be evaluated in field trials.

Two presentations were given from the University of Warwick. Firstly, **John Walsh** gave an overview of turnip yellows virus (TuYV) resistance sources at the University. It was stated that all aphids (*Mysus persicae*) are contaminated with TuYV and can lead to significant yield losses in oilseed rape (*Brassica napus*). *B. napus* is a hybrid of *B. rapa* and *B. oleracea* and QTLs for resistance have been identified from these two parents. **Kyle Macleod** presented his research introgressing two of the major QTLs for resistance into *B. napus*. These are being identified and refined and the quantitative mechanism is being identified.

Isabelle Sims from the University of Nottingham gave a presentation on her post-graduate research on resistance to soil-borne *Rhizoctonia solani* AG2-1 in oilseed rape. This soil-borne fungus is a necrotrophic soil pathogen with a wide host range. Control in oilseed rape is difficult via cultural and chemical seed treatment and no host resistance is known. The project investigates phenotypic differences in the response of oilseed rape cultivars to *R. solani* inoculation and differences in expression of genes involved in plant defence mechanisms. Clear differences in the response of varieties were identified. In a more susceptible variety there was up-regulation of genes including those involved in auxin signalling and salicylic acid biosynthesis. In more susceptible varieties, there was an up-regulation of genes involved in jasmonic acid signalling. Initial studies with a range of *Arabidopsis* mutants with mutations in key defence pathways showed increased growth following inoculation. Further work will investigate the role of auxins and the visualisation of jasmonates and reactive oxygen species, following inoculation. It is hoped that a better understanding of how oilseed rape responds to *R. solani* will provide a basis for breeding of new resistant crops.

Julie Smith from ADAS gave a presentation entitled '*Plasmodiophora brassicae* diversity in the UK and implications for clubroot control'. Clubroot, whilst not as damaging nationally as the diseases discussed in previous presentations, can be devastating at a local level. 10% of plants infected leads to 0.3 t/ha yield loss. Longer term challenges with clubroot include: the impact of climate change favouring infection and yield loss; a wide host range; difficulty of detection; long-term survival in the soil; limited management from agronomic strategies; the absence of fungicide and bio-control options; and no strategic advice to guide deployment of resistance. The use of cultivar resistance is the long-term strategy for the continued growth of profitable oilseed rape in the UK. However, this is currently based on a dominant single gene which is being eroded. Further, resistance-breaking strains of clubroot do occur in the UK and initial pathotyping studies have shown a diversity of clubroot pathotypes which can be used for future breeding studies. Research will also be necessary to guide the deployment of resistance as well as the establishment of strategies for integrated and long-term sustainable disease management.

Paul Gosling from ADHB gave a presentation entitled 'deploying varietal resistance in the field' He explained the role of the AHDB and the process of adding new varieties to the recommended lists. The recommended list (RL) system; provides independent information of variety performance; helps guide variety choice and crop management decisions; validates marketing claims by breeders; and can push the market in a certain direction but provide a balance between this and stifling innovation. The evolution of the RL for oilseed rape shows a gradual improvement in the yield of conventional varieties and hybrids in the last 12 years because of LLS resistance. Yield improvements are seen in new hybrids. Similar yield improvements are seen for stem canker resistance in new hybrids but not with new conventional varieties. However, growers are not necessarily choosing the new resistant varieties, particularly hybrids. The key trait for variety choice is vigour. Growers have also changed the way they grow oilseed rape due to CSFB and they minimise costs by using farm saved seed, which can only be done with conventional and not hybrid varieties. Therefore, disease resistance does not necessarily drive choice. This situation will only change once CSFB resistance varieties become available and then disease resistance will increase in importance.

Gaetan Seimandi-Corda from Rothamsted Research gave a presentation on EcoStock project entitled 'Companion plants to reduce cabbage stem flea beetle attacks in oilseed rape'. CSFB is the major of insect pest in oilseed rape and the inability to control it, due to the absence of neonicotinoids, has led to a reduction in the UK area harvested in the last 8 years. Crop damage is due to both larvae and adults, limiting the potential of biocontrol measures. Companion cropping is being investigated, offering potential ecosystem service and plant diversity benefits; disturbance of host plant location and an increase in the abundance and efficiency of natural enemies. The purpose of this project is to identify companion plants for oilseed rape adapted to UK conditions and to obtain robust evidence on their effect on CSFB. Over the last 3 years, a range of companion crops have been investigated at Rothamsted and in Germany. In a first field trial a significant

reduction in CSFB adult feeding was seen with mustard and wheat. Subsequent trials showed that straw mulch reduced adult attack and also showed benefits of some cereal companions, with oats the best option due to low sowing cost and ease to control with herbicides. It was concluded that whilst cereals such as oat can reduce adult attacks, rapid destruction of the companion crop is necessary to avoid competition with the oilseed rape. Further work is planned to investigate: additional options for companion crops; to impact on larval infestation; drilling rates of the companion crops; and how companion cropping impact natural enemies of CSFB.

The final presentation was from **Bruce Fitt** from the University of Hertfordshire entitled 'Climate change and oilseed rape diseases; impacts, adaptation and mitigation'. Climate change is a fact with gradual and continual increases in CO_2 levels and air temperatures which threaten food security through reducing global agricultural productivity. Crop diseases of major global crops also threaten food security, even with crop protection strategies. In oilseed rape, diseases such as LLS and Phoma stem canker clearly threaten oilseed rape productivity due to the absence of sufficient and effective crop protection measures and the ability of the pathogens to overcome resistance genes bred into the crop.

The presentation then addressed (1) the **impact** of climate change on crop diseases; (2) how we can be prepared for its future impacts on disease and food security? (**adaptation**); and (3) can crop disease control reduce greenhouse gas emissions now? (**mitigation**).

To assess impact of climate change, a weather-based model used to guide farmers on risk of severe disease epidemics with stem canker when applied to climate change predictions suggests a 50% yield loss in southern UK areas in the 2050s without effective disease control. However, the model predicts yield increases in the northern areas of UK, if disease is controlled. Climate change can impact the effectiveness of resistance genes. The major *Rlm* gene for resistance to *L. maculans RLm6* is temperature sensitive, with major development of Phoma leaf spot lesions at 25°C but not at 15°C. Increased temperatures also reduce the effectiveness of quantitative resistance.

For adaptation, there is a need for resistance that operates at higher temperatures and for information on other crop diseases so that predictions can guide government/industry forward planning by identifying diseases that will become more important to ensure food security. A recent report from the adaptation sub-committee that advises UK government on Climate Change indicates that we are not prepared for this because the debate is focussed on reducing greenhouse gas (GHG) emissions, rather than preparing for climate change already occurring.

As an illustration of mitigation, data were presented on the GHG emissions from growing oilseed rape, the majority of which comes from the manufacture of fertilizers and their microbial degradation to nitrous oxide (300 times more potent as a GHG compared to $C0_2$). The future development of crops that can fix their own nitrogen can contribute to GHG targets. Also effective disease control with crop resistance and fungicides has been shown to decrease greenhouse gas emissions (GHG).

There was a virtual poster session with 11 presentations on research projects funded by AFCP member charities, details of which can be found via the following link: https://www.afcp.org.uk/2021osrposters.

Ken Pallett is an Editorial Board Member of Outlooks on Pest Management and is also a Trustee Director of Perry Foundation, an Agricultural Charity in the UK which promotes education and research connected with agriculture or food production