

An international journal covering the management of weeds, pests and diseases through chemistry, biology and biotechnology

OUTLOOKS ON PEST MANAGEMENT

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COVER PHOTOS: Cotton bollworm (*Helicoverpa zea*) (Photo by Scott Bauer) and *Aedes (Ochlerotatus) sp.* mosquito on human skin both reproduced courtesy of USDA-ARS; Cocoa showing both frosty pod rot (*Moniliophthora roreri*) and witches' broom (*M. pernicioso*) on the same branch (Ecuador) (Photo by Roy Batemen); Unsprayed strip in sugarbeet showing poppies (*Papaver spp.*) (Photo by Alan Dewar)

ANNUAL WORLD BIOPROTECTION SUMMIT AND AWARDS, BIRMINGHAM, UK, MAY 2022

Robin Blake, Compliance Services International and Editorial Board Member

The Annual World BioProtection Summit and Awards saw over 100 people return in a face-to-face capacity for the first time in three years on 23–24 May 2022 at the NEC in Birmingham, UK.

Dr Sarah Harding, Communications Director at the World BioProtection Forum (WBF), welcomed participants and briefly explained the remit and recent achievements of the WBF, one of the organisers of the event. The WBF is a non-profit organisation founded by Dr Minshad Ansari in 2019 to connect the biocontrol industry and encourage collaboration between industry and academia, with the aim of connecting different stakeholders who can work together to ensure the successful development and commercialisation of biocontrol products. Achievements so far include the recruitment of more than 20 advisors, in addition to the board of directors, to help drive the organisation forwards, successful events, establishment of the Awards programme to cover the scope of biologicals in agriculture and a regulatory reform campaign started in 2021. Dr Harding finished her introduction by thanking the premium sponsors Bionema, gold sponsors Oro Agri, and other sponsors and exhibitors including AEH Innovative Hydrogel, Agri-TechE, AHDB, APIS, Dejex, Evonik, Fera, Koppert, Mathys & Squire, Medinbio, NPP, Sribio, UKRI, Valent BioSciences and Vigna Brasil.

The event was officially opened by Dr Ansari, Founder & Chairman of the WBF, and CEO and Founder of Bionema Limited, who posed the question “Can two days change the trajectory of the biocontrol industry?” Dr Ansari said how delighted he was to see 18 countries represented at the event. The world continues to face unprecedented demands on food security with over \$500 billion crop damage caused by pests and diseases annually, and whilst \$80 billion is spent on chemical pesticides annually, concerns over the impacts on human health and the environment, especially in the EU is helping drive change such as the proposed 50% reduction in the use of chemical pesticides by 2030 and corresponding desire to increase the land under organic farming. Whilst the WBF is working to drive change, the biocontrol industry in the UK/EU continues to face challenges such as the long and costly regulatory process, higher unit price and limited products in the market slowing the adoption of biopesticides and continued concerns over variable efficacy.

Session 1: The Global Challenges Facing the Biopesticide Industry

Following a few brief words from the chair, Jennifer Lewis (Executive Director, International Biocontrol Manufacturers Association), the keynote speaker was Natalie Bennett, The Rt. Hon. The Baroness Bennett of Manor Castle, and Former



Dr Minshad Ansari.

UK Green Party Leader, who spoke on “Transforming our broken food system.” The biopesticide area is one example of where change is needed, and now is a time for tremendous opportunity as it is easier to change in times of instability rather than stability. Baroness Bennett disagreed with Dr Ansari’s comments where he stated that banning all chemical pesticides will not help achieve food security needs but that it is important that those harmful to human health and the environment are taken off the market, and instead called for a ban on all chemical pesticides. Soils were highlighted as a key action area following FAO comments that we only have 50 years left of good soils before we have trashed the lot. Diversity in relation to industrial farming is also important as 50% of global calories come from just four crops and so if a rust outbreak sweeps around the world then wheat will suffer. We need a deglobalisation of our food supply, i.e. local crops grown to local conditions to enable food security needs to be met. A high percentage of British calories come from ultra-processed foods – 68% – and so to help improve public health we need a diet focused on fruit and vegetables using local varieties. Baroness Bennett also confirmed her stance against the GM/GE bill as these would still be industrial crops with no variety. “Agflation” is a huge issue for our farmers with escalating fertiliser, fuel and pesticide costs so we need to think about how we provide independent farmer-led, government-funded advice, and there is an All Party Parliamentary Group looking into this issue. Baroness Bennett concluded her talk with a look back over the last three years and how life had changed in a short space of time. People are now grasping for different ways of doing things so (for the people in the room), this is a time of tremendous opportunity.

ANNUAL BIOPROTECTION SUMMIT AND AWARDS



Rt. Hon. The Baroness Bennett of Manor Castle.

The next speaker was Dr Amanda Porter, Senior Science Advisor, Department for Environment, Food and Rural Affairs (DEFRA), who gave a presentation entitled “*Biopesticides – a Defra perspective.*” Defra have a shared desire to have lower risk, friendly alternatives in the marketplace, and recognise the important role that biopesticides have in IPM as part of the transition to lower-risk alternatives to traditional chemical pesticides. Barriers were discussed including cost, small UK market size, efficacy in broadacre crops, innovation and regulation. Registration of biopesticides under the current approach has three options: the Biocidal Products Regulation, Wildlife and Countryside Act, or the Plant Protection Product Regulation (PPPR). Dr Porter fed back that their current stakeholders had told them that using the PPPR for biopesticides is like a square peg in a round hole (as biopesticides are treated like conventional chemical pesticides). Other feedback included the possibility of being able to read across from other microbial strains, challenging whether current requirements for experimental trial permits are too precautionary, and whether existing data gaps can be bridged to address current regulations which classify all microbial pesticides as skin sensitisers due to lack of appropriate test methods.

Tristan Jervis, Senior Public Affairs & Communications Consultant, presented on the “*Progress of Biopesticide Regulatory Reform.*” Mr Jervis has been working on a public affairs campaign with the WBF to make the case for regulatory reform. We need a faster, simpler, less expensive regulatory system in the UK and we have a window of opportunity now for a best-in-class bioprotection products regulatory system that could form a stepping stone for EU reform. The current goal is to help the UK government “Build Back Better” post

pandemic, putting the regulatory system under the microscope to drive efficiency improvements. Achievements so far include various publications and an open letter to the HSE calling for biopesticide reform, securing agreement that Defra pesticide policy-focused civil servants should engage with the WBF, and securing the agreement that Dr Amanda Porter would present here today. The WBF’s commitment is to assist Defra in any way it can on the road to regulatory reform. The next phase will be a public affairs campaign which aims to produce a white paper as the main tool as an in depth case for change and reform, before taking it to the EU.

Professor Toby Bruce, School of Life Sciences, Keele University, discussed “*Innovation in crop protection: challenges and opportunities.*” Effective crop protection is key for maintaining high yields. Agricultural ecosystems are unnatural, human managed environments which makes them vulnerable to pest attack. Resistance to existing pesticides, for example, means that new options are needed. How can we make crop environments less susceptible to pests, improve plant resistance to pests and increase the impact of natural enemies to pests? Prof Bruce highlighted the example of orange wheat blossom midge (*Sitodiplosis mosellana*), a major UK wheat pest that has caused approximately 10% yield losses in recent years. Farmers would normally spray chlorpyrifos; however, that is now banned. Furthermore, in 4 out of 5 years the infestation levels have not been above the economic threshold and so pesticides have been sprayed unnecessarily. Resistant varieties are available and about 40% of UK wheat is now resistant to OWBM. A decision support system for OWBM using pheromone traps is also helping avoid unnecessary pesticide applications.

The next speaker was Dr Venkatesh Devanur, CEO, Agri Life, who presented the “*Current status of Biopesticides in Asia.*” Conscious, better informed consumers are driving a growing need for chemical and residue-free food in Asia, with demand for biopesticides considered to be more of a consumer pull than a multinational corporation (MNC) push. However, MNCs are now starting to realise the opportunity with \$5–7 Billion budgeted in the next five years for biopesticides. Higher exports and increased consumption in niche crop markets including fruits and vegetables, spices, coffee, and tea, is driving demand. The diverse Asian population exceeds 3 billion and is growing; thus there is a huge potential market for biopesticides. Opportunities exist in organic agriculture in Asia where less than 1% land is under organic use; however, it is a fragmented market with a high number of regional players. India was highlighted as having a very well defined regulatory mechanism for registration of biopesticides, as well as a Biodiversity Law that offers a level playing field to all Indian and foreign companies, with companies such as Koppert and Syngenta already active in the Indian market.

The morning session ended with a keynote presentation from Kellye Eversole, Executive Director, International Alliance for Phytobiomes Research, on “*Embracing complexity: Phytobiomes and a new vision for agriculture.*” The alliance is a non-profit, precompetitive research consortium with partners from industry, academia and government, so far from eight countries, and with the aim of coordinating a paradigm shift in agricultural research and production. Agriculture is a



Exhibition and networking.

complex system that is non-linear, has multiple interactions and variables, which adapts via learning or evolution, and can be influenced. The phytobiome, i.e. a plant in a specific ecological area that includes the plant itself, the environment and the organisms living in it, is one such example of a complex agricultural system. Examples of phytobiomes include a crop field, pasture or vegetable garden, but can also include controlled environments such as greenhouses. The vision is that by 2050, all farmers will have the ability to use predictive and prescriptive analytics based on geophysical and biological conditions for determining the best combination of crops, management practices, and inputs for a specific field in a given year.

Session 2: Innovation – The Solution (Part 1).

Innovative Technologies – Products and Services

Dr Ansari, chair, opened the afternoon session with a few brief words before introducing the first speaker, Carol Pullen, Europe General Manager, Oro Agri, who presented on “*Biocontrol Fusion*.” Grower challenges in 2022 include the war in Ukraine, changing landscape due to major acquisitions, regulatory pressure, increased agricultural input costs, logistical and supply chain challenges, fewer actives available and increased consumer demands. Global solutions exist but products need to be adapted to local practices. The biopesticide market is still growing with a 542% growth in sales over the last ten years compared to only 54% for synthetic pesticides. Biological control is increasingly seen as a combination tool with synthetics. Hybrid solutions offer a combination of conventional synthetic pesticides with biologicals to provide an effective solution for long term crop protection using less chemical active, reducing residues in the environment and acting as a strong resistance breaking tool due to multiple modes of action. Biofusion solutions, on the other hand, offer a combination of biological actives to provide increased efficacy and extended crop protection control. Oro Agri’s main product is PREV-AM®, based on orange oil, which combines a fungicide, insecticide and acaricide in one. Mixing with conventional pesticides provides immediate efficacy from the physical mode of action of PREV-AM®, and a

longer duration of effect from the conventional. This allows a new concept of defence, beyond a single target and this is appreciated by growers. The largest market for PREV-AM® in the Southern EU Member States comes from its mixture with sulfur, providing better efficacy than the commercial standard tebuconazole, and allowing the rate of sulfur to be reduced.

The next speaker was Andrea Bergamaschi, Marketing and Development Expert, UPL Ltd, who discussed “*Strategies with Vacciplant/Iodus to optimise crop spraying programs for sustainable control of vine downy mildew and wheat Septoria*.” UPL is the 5th largest multinational globally and last year launched a new business unit, Natural Plant Protection (NPP), which offers natural, sustainable solutions that combine “protection and “biosolutions”. The product Iodus, contains laminarin sourced from algae, a broad spectrum fungicide controlling Septoria and mildew, and works as an elicitor by triggering the plant’s own natural defences through induced systemic resistance and systemic acquired resistance. Iodus can be combined with sulfur) to provide a full strategy incorporating broad spectrum pathogen control with a positive impact on yield. Vacciplant combines laminarin and a reduced rate of copper which provides a similar efficacy to a full rate of copper, to stimulate the crop’s natural defence mechanisms to boost disease resistance, plant health and yields.

Dr Fatma Kaplan, CEO/CSO, Pheronym, gave an interesting talk on “*Microgravity Effect on Entomopathogenic Nematodes’ Ability to Find and Kill Insects*.” Entomopathogenic nematodes occur naturally in soil environments and use pheromones to aid their dispersal. Nematodes were sent into space onboard the International Space Station to understand how they were impacted by gravity. They found that the nematodes were able to reproduce and emerge in space, but that the infective third-stage juveniles that had developed entirely in space from the egg stage, could not adapt to Earth’s gravity and died. Dr Kaplan concluded that the study provided insights into long-term space flight for symbiotic organisms and the potential for sustainable crop protection in space.

The next speaker was Diego Ibanez, CFO and Latin America Territory Manager, Botanical Solutions Inc., who presented on “*Innovation grows on trees*.” BSI use a novel proprietary R&D platform based – Advanced Botanical Materials (ABM) – for the production of high purity and consistent, low-cost raw materials. As the platform uses tissue culture this avoids supply and quality issues associated with traditional botanicals. Their first active, ABM-01, is the basis for the company’s first biofungicide, Quillibrium®, which has been distributed by Syngenta since 2019 in key Latin American countries, and is currently undergoing US registration. The company has a strong pipeline and hopes to launch four new biopesticides between 2023 and 2026.

The final speaker of Session 2 was Daniel Zommick, Global Technical Development Specialist, Valent Biosciences LLC, who discussed “*50 Years of Sustainable Crop Protection with DiPel Biological Insecticide*”. Valent has a mission to reimagine agriculture, forestry and public health through the power of fermentation and microbiology. DiPel® is a biological insecticide containing the naturally occurring microorganism *Bacillus thuringiensis* (Bt). It was first introduced in the USA in 1971 and is now registered in over 60 countries

and used on hundreds of crops to control most agronomically important caterpillars. Advances in microbial formulations that allow wettable powders, dry flowables and emulsifiable suspensions, means that DiPel® is more effective now than it was 50 years ago. Furthermore, its long history of safe use, including as an organic crop protection tool for organic agriculture, provides an opportunity to allow it to be used in support of the EU's Farm2Fork goals.

Session 3: Innovation – The Solution (Part II). Innovative Formulations and Applications

The chair and keynote speaker for Session 3 was Prof Zhibing Zhang, University of Birmingham, who gave a talk on “*Stabilisation and controlled delivery of biopesticides via microencapsulation*”. Major challenges of biopesticide formulation include instability in processing to produce finished products, loss of activity during storage on the shelf, instability of the product to UV degradation and high production costs. Microencapsulation is a platform technology which can be used to encapsulate different types of biopesticides to achieve synergistic benefits. It is highly effective in stabilising biopesticides and achieving their controlled release, enhancing biopesticide-crop surface interactions, providing UV protection and reducing user exposure to the active for safety reasons. Microcarriers should have desirable structural, mechanical and surface properties, and formulation based on biodegradable or environmentally benign carriers is required. It is important that the microencapsulation process is cost effective and scalable.

The next speaker was Dr David Calvert, Director, iFormulate, who discussed “*Advanced formulation for biologicals*.” The perfect formulation “delivers the right active(s) to the right place in the right amount at the right time.” Even the identification of the active(s) can be difficult for biologicals. For example, *Bacillus amyloliquefaciens* is a spore forming, rod-shaped, gram-positive bacterium, of which a number of strains are used in agriculture to control fungi. All strains synthesise antimicrobial compounds (lipopeptides etc) and yet some products retain these antimicrobial compounds whilst others only contain the spores, which can make it difficult to identify the actives. Dr Calvert concluded that the challenge for biopesticides is not just stability in-can, and that efficacy will need improvement, with advanced formulation technologies from conventional crop protection technologies providing opportunities that will be increasingly adopted.

Anna Higley, Market Applications Specialist – Crop Care, Croda Europe Ltd, delivered the next talk on “*Optimising bioprotection products through innovative formulation design*.” Croda aims to provide tailored solutions, working in partnership with customers, or external parties to achieve the highest performing products. The development of formulations for microorganisms involves several aspects that must be considered such as the active ingredient, dilution, control target, formulation selection and application technology. Choosing the optimum ingredients to stabilise the formulation is important and is guided by fundamental chemistry principles including thermodynamics, phase balance and colloid science. Oil Dispersion (OD) formulations, where microbes are dispersed in an oil phase, can be beneficial as microbes tend to be hydrophobic. However, all components

of the OD formulation should be water-free; otherwise the stability of the formulation can be affected. To help speed up development work, Croda have designed several OD chassis bases, which provide high confidence in compatibility with common microbes, and surfactant choice and ratios that have been already identified for each oil.

The next speaker was Carsten Riedl, European Marketing Manager, Evonik, who presented on “*Sustainable formulation technologies for microbe based Biosolutions*.” Evonik manufacture additives for crop protection, and whilst historically, these were used in conventional plant protection products, they are increasingly being used for biopesticides. Many microbial-based biopesticides have limited shelf life, need to be stored at low temperatures and are difficult to formulate, due to the high water percentage. However, Evonik has developed BREAK-THRU® additives to enable their customers to formulate liquid and storage stable biological formulations with high biological efficacy. For example, BREAK-THRU® BP 787, is a multifunctional carrier fluid for foliar applied microbial-based agro-formulations, which is water soluble, has a very low water activity and enhances the shelf life of sensitive microbes. BREAK-THRU® S 301 is a biodegradable super-spreader based on polyethermodified trisiloxanes that enhances the shelf life of sensitive microbes and significantly reduces the surface tension of water and provides super-spreading to increase the biological efficacy of both conventional and biological plant protection products.

Dr KRK Reddy, Founder, Sri Biotech Laboratories, India, discussed “*Microbiome engineering for suppression of seed and soil borne diseases*.” The current definition of the microbiome is the set of microorganisms of a particular habitat, the optimization of which plays a key role in crop productivity. Microbiome engineering can be used to modify structures of the microbiota, including the rhizosphere, phyllosphere and endosphere, as potential ecosystems in order to improve positive interactions with the plant, and restore ecological balance to improve human health and agricultural productivity. Desirable functions to harvest from agriculturally important microbes include carbon sequestration, nitrogen fixation, insect pest control and abiotic stress mitigation.

Jasper Hubert, Senior Technical Consultant, Koppert UK, presented on “*Mechanical application of biological control agents*” and specifically macrobiologicals, of which there are 230 commercially available BCAs in horticulture. A reduction in insecticide efficacy, together with increasing pest pressure, means that biological control is a key part of IPM; however, there is a need to move from the glasshouse to the field. Growers use, on average, 12 applications of macrobiologicals per season; however, differences in carrier material, pack size and application rates, means that the perfect application is difficult to define. Manual application techniques which are commonly used in glasshouses are labour intensive, time consuming and unreliable, and therefore not readily translatable to the field. Koppert has spent five years developing “*Natutec Drive*” a release system for predatory mites and insects using existing farming equipment or bespoke units. Proof of concept trials in different crops were conducted from 2017–2020 and the technology was commercialised in 2021. Although initially limited to strawberries, the hope is that other field crops such as peas and beans, onions and leeks, and wheat, can utilise this technology too.

The final speaker of day one was Dr Jenna Ross, International Business Development Manager CHAP, UK, who introduced “*Developing Collaborative R&D In Crop Health and Protection.*” CHAP works with four industry partners, i.e. ADAS, Bayer CropScience, Frontier and Tesco, together with 12 delivery partners, e.g. academia, covering a wide range of capabilities including soil health, biopesticides, crop storage and precision technology, to develop game-changing solutions for the agricultural sector. Examples include the Plant Phenotyping and Soil Health Facility at Cranfield University, in collaboration with Agri-EPI, designed to replicate the whole crop cycle to test for optimum growing conditions using glasshouse and growth rooms; and the Fungal Biopesticide Development Laboratory, in partnership with CABI, to test and screen for potential fungal biopesticide isolates to treat existing and emerging pests and diseases impacting crops in the UK and beyond.

The evening of day one hosted the World BioProtection Awards 2022 with nine awards recognising outstanding achievements in the field of biopesticides and their impact on crop protection (see page 146).

Session 4: Technology Adoption

The first session of day two was opened by the chair and first presenter, Willem Ravensberg, Corporate Sr Regulatory and Governmental Affairs Manager, Koppert Biological Systems, The Netherlands, who discussed the “*Future outlook on microbial bioprotectants in agriculture.*” Globally, there are currently 200 microbial active substances and more than 1000 products. Scientific developments affecting microbial bioprotectants include multiple modes of action, as well as new applications such as seed treatments, bee vectors, endophytic uses, post-harvest treatment and also herbicidal potential, considered by many as the holy grail. Emerging technologies include selection using genomic techniques, gene-editing to improve properties and microbiome engineering. Dr Ravensberg believes that microorganisms are a cornerstone in crop protection, influencing factors such as plant and soil health, cropping systems, agronomic measures such as no till, reduced till and organic matter, and ecology-based resilience. Regulatory issues include risk assessment and registration procedures, Nagoya protocol and Access and Benefit Sharing, and human health risks and foodborne pathogens. A new approach should be based on real risk, which is based on both biology and ecology, and takes account of multiple uses and systems, to move towards a “one substance: one assessment” approval system. A single regulatory authority looking at microorganisms is the future dream.

The next speaker was Dean Metcalf, Managing Director, Metcalf Bio Control, Australia, who spoke about “*Trichoderma harzianum Td81b, a biological control agent for Botrytis*”. Metcalf Bio Control is an Australia company dedicated to developing effective biological controls for crop diseases. There are approximately 100,000 hectares of grapes grown in Australia and yet only 10,000 ha are wet enough to require sprays for *Botrytis* in most years as the remaining area is too dry. A biological control agent for the disease would therefore reduce unnecessary chemical pesticide use and improve the sustainability of the industry. Following multiple trials over several years, race Td81b of *Trichoderma harzianum* was found to be very effective against late season *Botrytis*.

The third speaker was Richard Glass, Innovation Sector Lead, CHAP, one of the four UK Agritech innovation centres, who summarised the “*Spraybot and the Cabbage Stem Flea Beetle projects.*” Spraybot is a precision application method for fungicides and biopesticides funded by an Innovate UK Smart Grant, which detects and maps crop disease and then can apply products at a variable rate to small areas of the crop. Field trials will be conducted from 2022–2024. For Cabbage stem flea beetle (CSFB) (*Psylliodes chrysocephala*), there is no effective control as a result of the ban on neonicotinoids and resistance to pyrethroids, which has resulted in a massive decrease in oilseed rape area. Testing and screening for potential new fungal biopesticides has revealed that the entomopathogenic fungus *Isaria fumosorosea* provides good control of CSFB adults and larvae in laboratory trials. A range of formulation types for delivery have been developed to understand spore viability and storage options, and the aim is to conduct further efficacy studies in the glasshouse and field with a wide range of crop and pest stages, formulation types, and application timings, which could be used as part of an IPM programme.

Professor David I. Shapiro-Ilan, Research Leader, USDA-ARS, presented on “*Advances in the use of entomopathogens to control orchard pests.*” Orchard crops such as pecan and peach can suffer severe losses in yield due to insect damage, particularly by wood-boring insects, such as *Synanthedon pictipes* (Lesser peach tree borer, LPTB). The use of beneficial entomopathogenic nematodes, together with protective gels such as Barricade® that protects nematodes from UV radiation and desiccation, has been demonstrated to provide similar levels of control of LPTB compared to chlorpyrifos. The microbial-based bioinsecticide Grandevo®, has been shown to control the major pest pecan weevil (*Curculio caryae*), whilst also suppressing aphid populations and reducing the impact on aphid natural enemies such as ladybirds and lacewings, which would normally also be controlled by chemical insecticides.

The final speaker of Session 4 was Prof Helen Griffiths, Pro-Vice-Chancellor for Research and Innovation, Swansea University, who celebrated 100 years of the university “*Driving Research and Innovation*”. A recent innovation audit concluded the importance of the agrifood and Smart technology sectors for Wales. SMEs are a hugely important part of the Swansea university network with over 300 Research and Innovation sponsors, with the university rated in 5th place in the UK for collaborative research income. Bionema was heralded as one such spinout success which specialises in chemical-free, organic crop protection to reduce the use of synthetic pesticides.

Session 5: Regulatory Issues

The chair and first speaker was Dr. Imme Gerke, IDRG, Germany who presented on “*International cooperation to globally harmonize biopesticide approvals and uses.*” Currently one data package is developed for every country where products are registered leading to over 66 million combinations of crop, pest, product and country uses; therefore, cooperation and harmonization are impossible and the regulators are drowning. The aim is to create one product data package for the world which would result in only 330,000 combinations. This could be achieved through the different

regions of the world all using the OECD format for dossier submissions, rather than with national and regional adaptations as currently occurs, together with Global Joint Reviews for biopesticides rather than just conventional chemicals, and the inclusion of EFSA into the GJR process.

Dr Patrick Kabouw, Global Registration Manager, BASF, Germany, provided an update on behalf of CropLife Europe, on “*Biopesticides: towards ambitious and fit-for-purpose EU policies.*” Industry has a responsibility to develop solutions that are innovative, effective and sustainable, and CLE member companies have committed to invest €4 billion into innovation in biopesticides by 2030. Whilst industry is ambitious, innovation in Europe is lagging behind due to regulatory hurdles such as longer registration time compared to other regions and regulatory pathways that are not always clear and precise. CLE case studies have revealed that whilst registration of classical biopesticides such as microorganisms, semiochemicals and botanical active substances are fit for purpose, there is a lack of clarity on how to register novel biopesticides such as fermentation material, RNA and neuropeptides. CLE are calling for evolution, not revolution, i.e. better implementation of the existing EU regulation to foster development and approval of effective and safe biopesticides. CLE welcomes the development of specific data requirements for microorganisms, and supports the development of a biochemical guidance document and forum for exchange to meet these objectives and foster the development of biopesticides adequately.

Nick Mole, Policy Officer, Pesticide Action Network, UK, discussed “*Protecting people and the planet from pesticides.*” The weight of pesticides applied in the UK has halved in the last 20 years but their potency, applied area and variety of products used, has increased. Drivers for increased use of biopesticides include trade, regulation, food security and industry pressure, whilst drivers for a reduction in conventional pesticide use include changes in legislation, Government plans such as the 25-year Environment Plan to halt and reverse biodiversity loss in the UK, and trade, as well as pressure from the public, retailers and growers. PAN wants to promote the use of “biocontrols” rather than biopesticides due a more positive public image, and they also want a strong voice in Government lobbying to drive biocontrol products forward.

The final speaker of the session was Dr Mark Whittaker, APIS, UK, who presented on “*Regulatory science: a misnomer.*” APIS is a regulatory consultancy and one of the founding members of the IBMA UK 20 years ago. Dr Whittaker believes that not much has changed in the regulations in this period and in some cases has actually worsened, e.g. in the case of secondary metabolites. In 2022 we still have a system that requires ecotoxicology data on the least sensitive species, e.g. earthworms (*Eisenia fetida*) which have no known pathogens and no adverse effects from microbial active substances have been detected in any earthworm study conducted at APIS in the last ten years; requires inadequate ecotoxicology data on the most important species such as bees; requests metabolite data on viruses; and would rather accept lower quality human safety data than embrace mainstream diagnostic techniques such as PCR. Dr Whittaker concluded by stating that regulatory reform requires only a willingness to evaluate biological systems as biologists, and that rather than following “the science”, perhaps it is enough to start with following “some science”.

Session 6: Commercialisation Investment and Acceleration

This session explored collaboration across industry, academia, investors, and public bodies, and was chaired by Ian Cox, Innovation Lead for the four UK Agri-Tech Centres, Innovate UK, who provided some brief opening remarks. He then introduced the first speaker, Ian Tracey, Founder, Anchored In Ltd, who talked about “*Entrepreneurship and how it relates to innovation.*” Mr Tracey’s aim is to match money, IP and people, sharing knowledge and helping companies grow. It is important to recognise the difference between an entrepreneur, i.e. a person who starts a business and is willing to risk loss in order to make money, and an innovator, i.e. a person who introduces new methods, ideas or products. £20 billion of innovation comes from the UK Agri-Tech sector, and the key to embracing open innovation is making sure you speak to a lot of people and then collaborating with them. There are three types of innovation: (1) Market Leader which has an increased market focus; (2) Need Seeker which has an increased customer focus; and (3) Tech Driver which has an increased technology focus.

The next speaker was Simon Elsworth, Head Syngenta Professional Solutions – EAME, Syngenta who discussed “*Unlocking the commercial value of biologicals through industry partnerships and acquisitions.*” The Syngenta Group is composed of four business units – Syngenta Crop Protection, Syngenta Seeds, Adama and Syngenta Group China – and has approximately 53,000 employees in over 100 countries with 2021 sales of over \$28 billion. We are in a period of unprecedented change, e.g. total active substances renewed in the EU are foreseen to be less than 110, and impact of Green Deal, but there are also opportunities such as digital technology. Industry partnerships between multinationals and smaller bio-companies are key as more complex solutions require more diverse expertise and experience to deliver dependable solutions. Various partnering structures exist within Syngenta from higher risk projects such as venture capital and R&D collaborations through to lower risk commercialised/ later stage projects that include distribution agreements and licensing; mergers and acquisitions can happen at any point. Considerations include finding the right partner for your business with common values, building relationships that understand each other’s priorities and concerns, trust and confidence, being realistic and keeping a long term view.

Dr Owen Jones, MD & Partner at Lisk & Jones Consultants Ltd, UK, then presented “*Recent advances and investment in the field of Semiochemicals / Pheromones for insect pest control.*” Pheromones are a type of semiochemical used for communication within a species and whilst pheromone lures to disrupt mating in Lepidoptera have been very successful and are currently the largest category of pheromone-based products sold globally, moving to other insect orders is a challenge both in terms of chemistry and in terms of understanding pest behavioural responses to the treatment. Producing pheromones biotechnologically can make a huge difference both in terms of molecular complexities and in terms of cost. New broad-acre markets in maize, soybean, cotton and rice are opening up, and as a consequence very significant investments are being made in companies targeting these markets including BioPhero, M2i, Provivi and Semios. A recent

market report by Fortune Business Insights has suggested that the current use of pheromones in IPM at the end user level was worth US \$2.55 billion in 2019 and expected to grow to US \$7.8 billion by 2027.

The final speaker was Anna Gregson, Partner, UK & European Patent Attorney, Mathys & Squire UK, who discussed “*Patenting of Microorganisms: Systems and Concerns.*” Intellectual Property is important to protect innovation, recover R&D costs, encourage investment and keep competitors out of the market. It is commonly assumed that natural products cannot be patented; however, the reality is that many countries allow claims to natural products if there is an associated technical effect capable of industrial application. Even in countries with a strict approach, modification and related subject matter are potentially patentable. It is also commonly assumed that microorganisms (MOs) cannot be patented, but the reality here is that MOs and microbiological processes are potentially patentable in many countries, particularly if isolated and industrially applicable. In other countries, non-naturally occurring MOs may be protected. Specific considerations include self-replicating products, different protection that may be available in different territories, and complex products, thus it is important to have an IP strategy.

Session 7: Investor Ready Pitch

Session 7 was designed to support innovators and entrepreneurs in their efforts to raise investment for product development and commercialisation, and in this regard, two companies were invited to present their cases: (1) AG BIO SYSTEMS PRIVATE LTD: Invest in Futuristic Bio Ag Innovation – World Class Bio herbicides; and (2) AEH Innovative Hydrogel: Solution for a sustainable agriculture. Following pitches by both companies, a panel of “WBF Dragons” consisting of Pedro Carvalho (KTN Manager – AgriFood, Innovate UK), Ian Cox (Innovate UK), Simon Elsworth (Syngenta) and Ian Tracey (Anchored In Ltd) quizzed the presenters, before conferring and awarding the prize to Dr Beenish Siddique, Founder and CEO of AEH Innovative Hydrogel.

The conference was closed by Dr Ansari who thanked the speakers, sponsors and audience for their participation and attendance. He praised the excellent quality of the talks and thanked key individuals who helped put the event together. The take home message is that this event can be considered as a single conference, one-stop shop, including investor pitches, to connect the biocontrol industry and allow for successful commercialisation.

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