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Report of the OECD Risk Reduction Seminar on Evolving Digital and
Mechanical Technologies for Pesticides and Pest Management

26 June 2019
OECD Conference Centre
Paris, France

IOMC

INTER-ORGANIZATION PROGRAMME FOR THE SOUND MANAGEMENT OF CHEMICALS

A cooperative agreement among FAO, ILO, UNDP, UNEP, UNIDO, UNITAR, WHO, World Bank and OECD

Environment Directorate
ORGANISATION FOR ECONOMIC COOPERATION AND DEVELOPMENT
Paris 2020

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Foreword

This report summarises the discussions and outcomes of the *OECD Risk Reduction Seminar on Evolving Digital and Mechanical Technologies for Pesticides and Pest Management*. The one-day seminar was held on 26 June 2019 at OECD headquarters in Paris, France, one day before the annual meeting of the OECD Working Group on Pesticides (WGP). The seminar was the fifteenth in a series of risk reduction seminars organised by the WGP.

The Seminar was chaired by Warren Hughes (New Zealand), Chairman of the WGP. Fifty-four experts participated, representing OECD member countries, the European Commission, partner countries, the Business and Industry Advisory Committee to the OECD, and research institutes/universities. The list of participants can be found at Annex 2.

The seminar was organised as governments are eager to understand the regulatory implications of new digital and mechanical technologies for the application of pesticides that have the potential to reduce human and environmental exposure to pesticides. These technologies include, for example, prediction and detection tools such as sensors and remote imaging, non-chemical weeding with electricity or lasers, and spraying via low flying drones rather than aircraft.

The seminar was organised by a steering group which included Warren Hughes, Eric Liégeois (European Commission), Peter Brander (Canada), Yukiko Yamada (Japan) and OECD Secretariat from the Environment Directorate and the Trade and Agriculture Directorate.

This document is being published under the responsibility of the Joint Meeting of the Chemicals Committee and the Working Party on Chemicals, Pesticides and Biotechnology, which has agreed that it be declassified and made available to the public.

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Introduction

Background

The focus of the seminar was on evolving digital and mechanical technologies such as precision agriculture machinery, data collection, and data processing. These technologies will lead to more precise application of pesticides, offering alternatives to pesticides use. Expected positive consequences will be a reduction in pesticide use and/or a reduction in human and environmental exposure allowing farmers/growers to better manage their farm inputs.

These evolving technologies will assist the agricultural sector to not only become more productive, but also to minimise the use of pesticides by applying them more precisely when and where needed. Some of these technologies may pose challenges to pesticide regulatory agencies due to a lack of appropriate risk assessment methodologies and ad hoc management policies as regulators have a lack of knowledge and understanding of these technologies and whether they enhance risk reduction techniques or create additional problems.

Purpose and Structure of the Seminar

This Seminar provided an opportunity for experts in OECD governments and stakeholders (e.g., farmers and developers of new mechanical and digital technologies) to share their knowledge, experience and possible concerns associated with these evolving technologies.

The main objectives of this WGP Seminar were to:

- better understand these technologies and their strengths and weaknesses;
- identify the benefits and challenges to the agricultural sector from the use of these technologies;
- identify potential impacts on current regulatory systems for the management of pesticides;
- exchange information on countries' current activities in this area including from the perspective of regulators, industry, farmers/growers and other stakeholders; and
- make recommendations to the WGP for possible future work.

The seminar began with a series of presentations that focused on:

- describing the technologies and how they are employed;
- the experiences of stakeholders who develop or use these products, in terms of the benefits, challenges and problems encountered;
- new areas of research and development as well as for regulatory purposes; and
- the experiences of governments related to how they regulate such products, or plan to regulate such products.

There was a short discussion after each set of presentations and a more general discussion at the end of the seminar.

Summary of Presentations and Discussions

(Note: the PowerPoint presentations can be found at:

<http://www.oecd.org/chemicalsafety/pesticides-biocides/seminar-on-pesticide-risk-reduction.htm>)

1. Introduction

Opening and welcoming remarks Richard Sigman, OECD Secretariat

The Secretariat gave an introductory presentation to provide background and context for the Seminar. He noted that OECD brings policy makers and stakeholders together to exchange ideas, share experiences and develop policy approaches to address common challenges. Such work is carried out by committees and working groups which include a broad range of perspectives due to the multidisciplinary approaches taken. For the OECD's work on chemicals, input is sought from and co-ordinated with government officials and the Secretariat who work with OECD committees in the areas of environment, agriculture, innovation, governance, and trade. The OECD's Environment, Health and Safety (EHS) Programme works to harmonise chemical safety tools and policies, focusing on pesticides industrial chemicals, biocides, manufactured nanomaterials, GMOs, testing and hazard/risk assessment, risk management and prevention of chemical accidents. Within the EHS Programme, the OECD Working Group on Pesticides (WGP) helps governments to co-operate in assessing and reducing the risks of agricultural pesticides by sharing the work of pesticide registration and developing tools to monitor and minimise risk to health and the environment. Such work focuses on: chemical and bio-pesticides as well as pesticides based on RNA interference; preventing the illegal trade of pesticides; the electronic exchange of pesticide data; assessing pesticide effects on insect pollinators; developing tools to assess pesticide residues; and addressing issues associated with minor use pesticides. Today's risk reduction seminar was organised by the WGP. As with all previous seminars, this seminar follows a similar structure: introduction and background to the topic; presentations by governments and stakeholders; group discussion; and conclusions and recommendations to the next WGP meeting. The seminar was organised by a Steering Group made up of New Zealand (Chair), the European Commission, Canada, Japan and the Secretariat.

Structure of the seminar Warren Hughes (New Zealand), Seminar Chair

The Chair welcomed all attendees and invited speakers to the seminar. A brief oversight of the structure of the seminar was given – it has been structured into four sessions covering different topics, followed by a round table discussion. At the end of the seminar, there would be a closed session for regulators to reflect on the day. The Chair advised that this seminar was an opportunity for regulators to get ahead of the curve with these new technologies. Understanding of their implications in a regulatory context is important and thereby any regulatory oversight required would be fit for purpose. He concluded by hoping all attendees enjoy the seminar and gain insight and understanding of these new technologies.

2. Overview

Spot Farming – Giving sustainable intensification a face Jens Karl Wegener (Julius Kühn-Institute (JKI))

Sustainable intensification is described as the desirable goal for agricultural production to increase agricultural productivity while using less input and without adverse environmental impacts. Increasing criticism on current agricultural production systems as well as demographic changes related with labour shortages in rural areas pose major challenges to agriculture all over the world. In this context, digitalization and autonomous machinery provide new opportunities to adapt agriculture to future demands. However, it is unknown what changes are necessary for a sustainable intensification of cropping systems and how future agriculture could look like under consideration of new technologies. Here we developed a concept for future cropping systems with focus on the requirements of crops and landscapes. In this concept, the agricultural area is classified into individual spots according to their site-specific characteristics. The resulting spot farming approach is completely managed by an autonomous robot system on the level of individual plants. High precision sowing, fertilization and pesticide application could reduce agronomic input and could increase yields. In addition, small robots contribute to soil protection. Furthermore, the spot farming approach considers landscape properties and has the potential for a higher biodiversity and more structural elements as well as an increased social acceptance. The evaluation of the concept according to agronomical, technical and economic aspects showed that the combination of modern technologies and a reorganisation of agricultural landscapes could contribute to the goal of sustainable intensification. More information: Wegener, J.-K.; Urso, L.-M.; von Hörsten, D.; Hegewald, H.; Minßen, T.-F.; Schattenberg, J.; Gaus, C.-C.; Witte, T.d.; Nieberg, H.; Isermeyer, F.; Frerichs, L.; Backhaus, G.F. (2019): [Spot farming – an alternative for future plant production](#). Journal für Kulturpflanzen 71(4): 70-89. ISSN 1867-0911, DOI: 10.5073/JfK.2019.04.02

3. Mechanical Technologies

New ground spraying technologies supporting risk reduction Chris Bursiek (John Deere Crop Care Platform)

The application of plant production products continues to evolve with the development of new technologies. Technology advancements allow for the reduction in the size of management zones, leading to application decisions moving from field to sub field level, all the way down to the plant level. One such technology is Pulse Width Modulation (PWM), that when incorporated into a nozzle body can allow for both on/off and rate control at the individual nozzle level. *See & Spray*TM technologies allow for plant-level application decisions. These types of systems can sense the plant, decide on treatment, and then act on the decision. Advancements in application technology allow for reductions in overall plant protection products applied while achieving similar pest control levels as conventional even application systems. For bush, tree and vine crop sprayers, technologies are available to sense the presence of the plant and density of the leaf mass, enabling to spray only the plants and not spacing between plants. As application technologies continue to enable the ability to transition from even application across a whole field to smaller site-specific applications, opportunities exist to evaluate current risk and toxicology assessments. When technology advancements come to market, the need for plant protection labels to allow producers to utilize such technologies is important, along with encouraging adoption of technologies.

Romi – Robotics for Microfarms

Peter Hanappe (Romi-Project; Sony CSL)

The ROMI robot is designed for small market farms that grow a wide variety of vegetables using agroecological methods (permaculture, bio-intensive agriculture). The primary objective of this platform is to help and assist farmers in physically demanding tasks. We are currently focusing on weeding as a first application. This task takes more than 25% of working time and is responsible for many musculoskeletal disorders. In the long term, we hope that the introduction of small and affordable robots will promote a sustainable local agriculture by making market farms more attractive.

The robot is inspired by the tools that can be found in FabLabs. The heart of the robot is a numerical control (CNC) that moves a mechanical weeding tool between crops. This CNC is installed on a motorized frame that moves along the vegetable beds. The robot divides the beds into zones of 80 x 80 cm. For each zone, it takes a photograph, discriminates between the crop and the weeds by relying on their development stage (weeds are less developed and smaller than the crop). It then hoes the soil surface while sparing the crop. Initial tests have shown that a weekly passage of the robot is sufficient to maintain the weed population under control.

In parallel to the weeding robot, the ROMI team is working on a 3D plant scanner for phenotyping. The objective is to install this tool the robot and use it in the fields for crop monitoring. The robot will analyse witness plants in 3D and inform the farmer of their health status. The project also develops aerial devices to obtain whole-farm views and compute health maps of the crops.

The ROMI robot aims to be an adaptable platform that users can modify according to their needs. That is why its hardware design and its software are released under free licenses.

Acknowledgments: This project has received funding from the European Union's Horizon 2020 research and innovation under grant agreement program No 773875. It project is developed in partnership with CNRS-ENS Lyon, Inria, Iaac-FabLab Barcelona-Noumena, Humboldt University in Berlin, Chatelain Maraîchage, France-Europe Innovations and Sony Computer Science Laboratories. <https://romi-project.eu>

Digital Agriculture: Producing more with less in a Sustainable Way

Janet Williams (Bayer Cropscience)

D. Schaefer¹, A.C. Chapple¹, S. Lauck-Birkel¹, C. Leake¹, P. A. Schmidt¹, R. Sur¹, S. Van Wert², A. Zahlen¹

Digital agriculture has emerged as one of the most promising technologies to enable sustainable use of resources while satisfying global demands for quantity and quality of food and feed. Digital tools, such as drones, sensors and robotics, are already used by farmers with both large and small-scale operations to reduce inputs and optimize yields.

Digital solutions also give new options for reducing plant protection product use per field, by providing more targeted, optimized and timely applications that further minimize potential human and environmental exposure, while maintaining product efficacy. Likewise, risk management measures can be adapted to local conditions such that vulnerable areas within and adjacent to the field are best protected. This can be achieved by a real-time, site-specific risk evaluation which uses digitalized equipment to diagnose crop status, current weather conditions, and relevant geographical and agronomical parameters (soil type, crop variety, distance to water body and non-target areas, topography of the field, nozzles etc.). The collected data may be used to ensure that the application meets the specified protection goals or to decide which mitigation measures must be implemented. Tailored mitigation options can be integrated into digital platforms and assist farmer's in decision-making.

Digital solutions are able to document that applications were made with appropriate mitigation, as specified on the label. Since mitigation options are selected more efficiently and exactly where and when necessary, the flexibility for the farmer increases significantly. This, however, requires that digital solutions are evaluated and approved by regulatory authorities and become part of the labels of plant protection products. A joint regulatory authority and industry effort to digitalize regulatory information is fundamental to the implementation of digital farming solutions in the regulatory process. An industry standard for a machine-readable label format is a key enabler.

To make such an approach possible and sustainable, a shift is required from overall worst case risk assessment based on regional scenarios to a site-specific in-field risk evaluation integrating tailored risk mitigation measures.

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4. Digital Technologies

Qualimetre®

A forecasting tool for mycotoxins for wheat and corn

Xavier Leprince, Syngenta

Mycotoxins are produced by several *Fusarium* species during cultivation of wheat and maize grain. In order to develop a predictive model in support of grower integrated pest management strategies that prevent or limit mycotoxin formation, Syngenta has organised large field surveys in France since 2000 capturing agronomic and climatic data. We have also taken grain samples for mycotoxin analysis. The importance of the agroclimatic factors and their interactions on the mycotoxin levels in grain has been assessed in detail. For example, it is clear that climate at the time of flower is the major factor for deoxynivalenol (DON) in wheat. The main agronomic criteria are residue management and the variety sensitivity to this mycotoxin. For DON, zearalenone and fumonisins in maize, the climate from flowering stage until harvest is more significant. Factors vary between each mycotoxin, however the main agronomic criteria are the harvest condition (date and grain moisture), corn borer infestation and the sensitivity of the plant variety to each of the mycotoxin forming fungi or moulds. Over the years, the database has been used to develop models that predict mycotoxin risk before harvesting based on climate conditions in a given year. Predictions are based on different agro-climatic statistical models specifically configured according to the different regions of production in France. This approach is called Qualimètre®. This mycotoxin level forecasting service started in France in 2004 for wheat and for maize in 2006.

A grid is now available to estimate the risk based on varietal susceptibility, previous crop and climate conditions. Forecasting has been shown to be accurate when compared with measured levels of mycotoxins over 17 years and with more than 17000 samples of wheat.

This tool helps farmers to decide if fungicide application is necessary at wheat earing and flowering stages in order to manage the risk as a component of integrated pest management strategies.

Digital Farming in Crop Protection
Roslyn Chua, Global Digital Product Lead, Crop Protection
Bayer AG / The Climate Corporation

Each cropping system has its unique challenges. In Wheat, yields have been relatively flat in the last 15 years in the United Kingdom, France, and Germany. This can be attributed to shorter rotations, increasing weed and disease resistances, and less investment in breeding/traits when compared to other field crops. Bayer experts' analysis estimates that 45% of the genetic potential of wheat is lost due to the sub-optimal weed and disease management. This represents a 1 ton/hectare opportunity for digital farming crop protection in Winter Wheat. In Corn, factors contributing to the yield potential are Weather (27%), Nitrogen (26%), Hybrid (19%), Previous crop (10%), Plant population (8%), Tillage (15%), and Growth regulators (4%). In summary, 2/3 of the contributors to yield variability in corn are predictable with the use of digital farming technologies.

Different cropping systems have different optimization potential. It is critical to find the critical parameters impacting productivity to create the most significant impact on the use of Digital Farming technologies. There is no one-size fit all solution in the digital farming landscape.

Because of the vast opportunities in different cropping systems, there is now a sea of offerings in Digital Farming – from Blockchain, food safety track and trace to crop and farm management software – farms today are spoilt with the universe these choices provide. While these tools offer vast potential for farms to select the best solution fitting their exact farm, they also represent a challenge in terms of onboarding and learning different tools.

Digital farming solutions allow outcomes to be measured and proven in each field or hectare. In practice, data¹ is only collected from farms when there is an opportunity to improve quantifiable results. Digital farming solutions follow four main steps, and most offerings in the market are categorized into these four main buckets – analyze data, visualize data, advice, and implement & measure outcomes. For example, in Canola in Canada, satellite maps are analyzed and visualized into Fungicide Scripting maps. Historical and forecasted weather along with user-entered data on the growth stage is analyzed to predict the growth stage and the ideal timing for the Fungicide application. The combination of growth stage and Fungicide Scripting maps are then aggregated into advice which hectare can be optimized with a Fungicide application and which hectare should not be sprayed with Fungicide. The return-on-investment on the application is then measured and compared at the end of the season, proving the value of the tool to farms. In Winter Wheat in Europe, data on seed varieties' disease susceptibilities, historical and forecasted weather, scouting results, and management practices are analyzed. Field-specific disease risks are then visualized informing the users the ideal time to spray a field, how many sprays are required, the dose rate of Fungicide to be used and in fields with high variability, a Fungicide scripting map is also provided to recommend the optimal distribution of dose rates in various zones in the field. The applications of Fungicide are then measured against the yield result as well as compliance with regulatory requirements.

¹ Data used for agronomic models are treated as personalized data. The use of this data is governed by European Union's requirements for General Data Protection Regulation (GDPR).

Digital farming tools today are now linking data and insights into actionable advice with measurable outcomes for each field. The field-specific result also takes into account different baseline scenarios comparing the impact of each agronomic practice as well as taking into account broad expectations in agriculture beyond yield or return or investment. More and more tools are quantifying crop quality, compliance with production system requirements, and carbon footprint impact in addition to measures of productivity. However, not all advice is experienced consistently in every field, every hectare, and every year. Currently most tools are focused on a single input decision and are not accurately predicting the whole system around the crop, a goal for future developments. Also, most conversations on digital farming are still centered on the technology rather than the results these technologies provide.

Bayer's approach in digital farming is to ensure that we are providing the best solution with a quantifiable outcome to our customers and also connecting the different components of the digital farming ecosystem. With Climate FieldView™, users can seamlessly collect, store, and visualize critical field data, monitor and measure the impact of their agronomic decisions on crop performance, and manage their field variability by building customized fertility and seeding plans to optimize yield and maximize profit. Also, Climate FieldView™ has 50+ partners who are leveraging the FieldView™ platform to bring their digital innovations to farms. With our collaborative approach with various partners, our users today have the convenience of only onboarding into a new system once.

Digital farming solutions are fit for purpose and adoption in the market is due to the measurable benefit in productivity and sustainability; these tools are targeted toward providing this potential benefit to each field and each farm. The digital farming industry thrives because of the quantifiable outcome it's contributing to farmers, stakeholders, society, industry, and the environment.

Legal Considerations arising from Digital Technologies and Agricultural Data
Leanne Wiseman, Griffith Law School, Griffith University; Australian Centre for
Intellectual Property in Agriculture (ACIPA)

The digital transformation taking place on farms, and in agriculture more generally, and the enormous amounts of valuable farm and agronomic data now being generated, collected and shared brings with it untold potential for the future of agriculture. While much of the focus to date is on the benefits of Ag data sharing, little attention is being paid to the increasingly complex legal environment in which farmers find themselves when adopting digital farming technologies.

The lack of laws and regulations around the legal, social and ethical considerations of agricultural data sharing has left a gap for private actors to set the rules that govern agricultural data sharing. Currently, it is the data licences of the agricultural technology providers that regulate the way in which agricultural data is collected, managed and shared. An analysis of Australian farmers' attitudes to sharing agricultural data with a range of stakeholders (Wiseman, L., and Sanderson, J., *The legal dimensions of digital agriculture in Australia: an examination of the current and future state of data rules dealing with ownership, access, privacy and trust*) revealed a wide range of farmers' concerns (such as privacy and security; competition/market issues; surveillance and risk and liability). These concerns are common to farmers around the world.

While attempts have been made to encourage best practice in Ag data management through the adoption of voluntary principles and Industry codes of practice in the US, NZ and more recently in the EU, and with the extension of unfair terms legislation in Australia, farmers still have concerns in the way their data is being managed. There is a need for further efforts to expose and highlight the current data licensing practices, and the competition and privacy implications so that best practice can be developed. This in turn, will lead to the better management of farm and Ag data by agribusinesses, researchers and governments and thus earning farmers' trust and engagement in the future of smart farming.

5. Stakeholder (e.g. farmers/growers/manufacturers) Views

Evaluating Drone Application Technology in Crop Protection: FMC's Experience in China and USA

John T Andaloro, Xuan Li and Edward Lang FMC

Rarely in agriculture has a crop protection technology been so rapidly adopted in such a short period of time. In 2018, China's farmers placed their trust in unmanned aerial vehicle applicators (drones) at an extraordinary level to protect approximately 18 million hectares of cropland. This represents an unprecedented growth for a new application method in just a five-year period: almost twice the China hectareage sprayed compared to the prior year in 2017 but still less than the anticipated 30 million hectares predicted to be sprayed in 2019. The accelerated rise of drone technology in China agriculture has presented a complex dilemma: rapid adoption of unmanned aerial pest control provides partial alleviation to China's farm labor shortage but insufficient time to adequately research, develop, and deliver a refined product to the market that's undergone satisfactory quality control.

Certainly, aerial technology used to apply crop protection products has been commonly known for decades, with both fixed wing airplanes and single rotor helicopters. In addition, nozzle types and low/ultra-low spray volumes used in these traditional aerial spray systems that produce fine droplet sizes do not vary that much from that of the current drone application systems. However, leveraging the wealth of knowledge from a half century of fixed wing and single rotor copter experience to counter-rotating, multi-rotors on light weight drones is complex. Validated spray models that predict the path, dispersion, and eventual fate of a droplet under varying environmental conditions and spray system parameters are required to deliver a quality application with a comfortable understanding of potential off-target drift. Better integration of the drone and the spray system is imperative. Providing Best Management Practices that mitigate biological, environmental, chemical, and spray system variables are needed. The same effort dedicated to creating pesticide product label guidance for drift reduction for manned fixed-wing aircraft needs to be undertaken for multi-rotor drone use. Improvements in drone technology have proliferated (RTK, remote sensing, variable rate spraying, autonomous flight) over the past few years while minimal attention has been made to optimizing how the spray system mounted and integrated to various drone models can deliver a quality spray. Standardizing basic spray system components for the different multi-rotor drones such as length of fixed boom relative to rotor width, nozzle distance from rotors, drone height from canopy, spray pressure relative to drone speed, nozzle configuration, nozzle types, orifice size, etc., are fundamental to maximizing spray accuracy and uniform distribution of pest control products. The variation of these spray system configurations that exists in the market today is alarming and at times counter to achieving a quality pesticide application.

What is at stake? Depending on your view, ranging from the aggrandized to the pragmatic: ensuring food security in developing countries, reduced pesticide longevity by accelerating pest resistance, or just simply missing an astounding opportunity to implement a more efficient and safer step change in delivering crop protection. Traditional back pack spraying operation often requires the applicator to walk through freshly sprayed foliage throughout the entire pesticide application process. Government subsidies through China's "Zero

Pesticide Growth” directive not only made this technology affordable to the consumer but very importantly also directly improved farmer safety. Developing an optimized drone spray system should offer excellent pest population control while minimizing applicator safety.

The use of drone technology for pest control in agriculture has the potential for delivering remarkable benefits to growers and the agricultural community. Overall, five years’ experience in China, two years of grape pest control in California, and a growing library of observations from many other countries is convincing evidence that the use of unmanned aerial vehicles for pest control is not only very popular but also has great practical potential. The challenge is to ensure that iterative technical advancements in drone plus spray system optimization keep pace with the dramatic increase in drone use. The same challenge exists for creating parallel regulatory and operational guidance documents. Moreover, drone pilots and spray service providers need quality training and certification. Meeting the challenges above requires integrating the expertise of drone manufacturers, crop-protection agchem companies, country regulators, and academic experts. It also demands the coordination and alignment of current projects underway by a multitude of national and international agencies who are developing processes to guide the safe use and maximize the pest control capabilities of unmanned aerial vehicles as a new pesticide application method.

Digital and mechanical technologies addressing plant health – How to meet both farmer and consumer demands?

Marie-Cécile Damave (Agridées)

In France as in most developed countries, agricultural issues such as GMOs, water, pesticides, animal welfare and biodiversity have become societal issues. Driving forces in farming are changing from farmers and other upstream stakeholders to consumers, retailers and other downstream stakeholders. Agribusiness was techno-push, from farm to fork, and has no other choice than switching to market-pull, from fork to farm. Synthetic chemical pesticide use has become a major societal concern, pushing the Government of France to develop a national strategy to reduce it by 50 percent by 2025. Considering French agriculture is too dependent on these pesticides, many call for a “zero pesticide agriculture”. This pressures the farming community to explore alternatives. Precision agriculture brings solutions in this direction. It combines technologies and practices towards more efficient and environment-friendly farming. It belongs to wider concepts of sustainable agriculture, agroecology, and climate-smart agriculture.

AgTech and FoodTech are booming world wide, in Europe and in France in particular, with new startups and businesses as well as traditional groups developing new products and services specializing in Big Data and algorithms, artificial intelligence, robotics, machinery, imagery, digital platforms... Agridées has monitored these developments since 2014². We found that digital is connecting multiple technologies used in farming and across the food chain, both in animal and plant production, questioning pre-existing business models and extension services. Precision farming is becoming a reality, as an increasing number of solutions are available for farmers to manage sanitary, weather and economic risks more accurately, more efficiently and more timely. Predictive models are now emerging. Precision farming includes breeding, animal and plant health solutions and monitoring, feed and nutrition, weather monitoring, machinery equipped with sensors, Internet of Things... they all converge to customized agriculture for each individual (plant and animal) to optimize production and market release. In addition to economic and environmental performance, digital farming also addresses societal performance: digital platforms better match supply and demand, and digital tools (such as block-chain) are developing to improve traceability, transparency and visibility across the food chain.

Trust is a key word in the success of the digital transition of agriculture: low tech and high-tech products and services are adopted if they are useful tools and not gadgets, with solid returns on investments, and accessible thanks to good connectivity and training. Data transparency and security needs to be addressed so that the farming community trusts digital tools. Transmitting the information that good practices are being used at all stages of the food chain has the potential to build trust among downstream stakeholders for food products. Recordings rather than claims on how and where food comes from and is produced and processed can reassure consumers in a society where “bashing” agricultural practices is becoming very popular. Smart agriculture practices and technology therefore

² Position paper (2017): “All actors of the digital transition of agriculture” (in French “Tous acteurs de la transition numérique agricole”) <https://www.agridees.com/publication/acteurs-de-transition-numerique-agricole/>

needs to be encouraged at each step of the value chain, and visible down to the consumer level. Farmer efforts can therefore be valued while consumer needs, concerns and preferences can be better understood and addressed.

6. Regulatory Views

Status of Unmanned Aerial Vehicles (UAVs/Drones) for Pesticide Application Ed Messina (US Environmental Protection Agency)

The Environmental Protection Agency is responsible for developing and implementing national policy to complement the legal framework of pesticide use in the United States. As part of this responsibility, the EPA is in the process of updating its regulatory paradigm to account for pesticide applications made by unmanned aerial vehicles. To develop suitable national policy for this still relatively new technology, EPA is engaging stakeholders to fully understand the benefits, uncertainties, challenges, and issues associated with this currently limited and potentially expanding use.

Engagements to date have included discussions with other regulatory agencies such as the US Federal Aviation Administration to ensure regulatory alignment, aircraft companies to respond to requests for regulatory approval, pesticides companies to provide clear and consistent regulatory guidance, and state/tribal/International pesticide co-regulators to consider and address locality- and country-specific scenarios. Questions that remain to be answered include those associated with pesticide labeling, data needs for information risk assessments, adequacy of existing risk assessment exposure scenarios, pesticide drift, and user/by-stander safety.

Once a more complete set of information is available, EPA is confident that it will collaboratively identify a suitable approach that both ensures adequate protection and, where appropriate, continues to allow the use of a novel technology.

The challenges, regulatory and policy environment Grant Stark (Health and Safety Executive, UK)

The presenter began by highlighting the need for regulators to view new technological developments within the wider political context. This included helping agricultural production addressing the challenges of: demographic change; working with a scarcity of resources; climate change; and minimising food waste. A combination of use of big data, artificial intelligence, robotics and automation, sensing technologies and genetics had the potential to revolutionise pesticide use, resulting in more precise applications. Regulators must ensure that their regimes do not impede/actively encourage the new technologies, whilst ensuring chemicals continued to be applied in a safe and sustainable fashion.

There was a need, however, to draw on the lessons from the introduction of new technologies elsewhere and identify whether there were any potential unintended adverse consequences (noting issues such as use of personal data, responsibility for automated decisions, etc). The need for a considered approach may create tensions in an environment of fast-moving technological development, and it may be unrealistic to expect that regulatory regimes are immediately able to embrace all new technologies. Regulators could reduce the risk of this occurring by engaging in horizon-scanning activities, understanding a different community of stakeholders and being prepared to consider whether their regimes should be adapted to ensure the new technologies can be controlled appropriately and deliver benefits for society.

Turning to the issue of drones, the presenter outlined a range of policy, legal and scientific issues that were being considered before authorisation could be granted for this method of application. Key issues included: configuration of the drone (number and power of rotors and position relative to nozzles) and its influence on vertical and horizontal spray drift and crop interception; handling, filling and cleaning practices (and the need for work protocols); and use of relatively low water volumes on product efficacy and worker protection. Work to date had demonstrated the importance of promoting collaborative activity amongst stakeholders and creating a welcoming regulatory environment by being prepared to offer elevated levels of support. The presenter also noted the need to ensure that users were trained appropriately in any unique risks that may be associated with this new method of application.

Risk Mitigation - Use of unmanned aircrafts for aerial application of pesticides in Japan

Hidetaka Kobayashi Ministry of Agriculture, Forestry and Fisheries, Japan

Dr Kobayashi gave a presentation concerning the new regulations of the aerial application of pesticides using unmanned aircraft, including helicopters and "drones" (multirotors), in Japan. For aerial application of pesticides, both manned and unmanned helicopters have been approved for a long time and some data have also been accumulated. Due to a labor shortage and ageing farmer populations, it is necessary to increase efficiency in agriculture including the application of pesticides. New regulations are necessary to increase efficiency of pesticide applications by adapting new technology including "drones".

Summary of Discussions, Ideas and Recommendations for Possible Future Work

Summary

Mechanical Technologies

There is a range of mechanical technologies being developed. New types of nozzles allow width modulation, rate of spray and finer spray resolution. Sensor technology can identify the weed or pest that allow for targeted application of a pesticide, instead of broadcast application of the pesticide. Then there are mechanical weeding technologies, which can reduce work pressure in particular for small farms.

These can all significantly reduce the amount of pesticides that need to be applied, as well as reduce pesticide exposure to humans and the environment. This has several advantages including reducing the potential for spray drift and worker exposure, reducing environmental loading and potential reducing costs to the farmer. However, further work is required on these technologies so that they can work in sub-optimal conditions. In relation to drones, rules need further development on qualifications of the drone operator, airspace, and understanding the differences between drones and standard aerial application including spray drift, residue and efficacy profiles.

Digital Technologies

Using digital technologies for better forecasting can help farmers determine when (and how) to spray to manage a pest/disease. Data on soil cultivation, varietal susceptibility sensitivity and weather conditions can be combined to provide information to support farmers' decisions on the optimal method, timing, place and amount of pesticides application thanks to data analyses and algorithms. There is a range of systems available to collect such information including, inter alia, sensors in the field and drone as well as satellite imaging.

Such technologies should lead to a quantitative reduction in spraying and a qualitative increase of pest management allowing farmers to move from calendar based spraying to target spraying based on an informed decision scheme. Some of the challenges or questions that arise from the use of these technologies include ownership of data, along with transparency, privacy and security of information: e.g., a farmer may have many years of agronomy-relevant information that may constitute his own farming practices that he/she would not like to share with commercial service providers like digital companies. A code of good practices could, in this sense, be very useful to protect farmers' interests/rights.

Stakeholder Views

New technologies need the “buy-in” from the consumers. This requires investment in communication efforts to explain the technologies, the benefits that arise from their use, and a description of how they fit within the wider ecosystem.

Regulator Views

Regulators fully support new technologies that reduce the risks of pesticides, but any reduction in exposure from the use of such technologies should be integrated into exposure estimates and models utilized in the regulatory risk assessment process. In order to increase the uptake of these technologies, the benefits should be sufficiently known and appropriately communicated. There is a significant focus by regulators on drone technologies as they might reduce operators’ exposure and applied quantities but they might also increase releases to certain environmental compartments. There are a number of challenges in part due to a lack of understanding of these technologies. These include spray drift, operator exposure, operator training, and formulation technology for drone-based applications. In addition, regulators need to know whether the risk profile for drone technologies is significantly different when compared to existing aerial technologies.

Conclusions / Recommendations

Sustainable agriculture and societal buy in are important drivers for new technologies. Robotic technologies allow for precision application of pesticides – reducing the carbon footprint, bringing environmental benefits and reducing pesticide use. Digital technologies allow for predicting the pest population and identifying pests and diseases. However, who owns the data generated for these technologies as well as how such data are used and shared are issues that need to be resolved. Drone use in certain countries or regions is expanding significantly and there is a rapid evolution in this area. While there are clear benefits to these technologies there are also challenges which will need to be addressed.

Recommendations:

Information exists that can support a better understanding and fill in gaps in exposure and risk assessments of these promising technologies. This information needs to be exchanged between all parties. A mechanism needs to be developed to support this exchange between regulators to validate assessment models and assumptions regarding equivalence between drones and more conventional application equipment as regards operators, consumers and environmental exposure.

The benefits and challenges of drones need to be identified, in part, for risk communication purposes.

Regulatory requirements (or guidance) should be developed to promote harmonisation across countries.

Annex 1 - Seminar Programme

ORGANISATION
FOR ECONOMIC
CO-OPERATION
AND DEVELOPMENT



ORGANISATION DE
COOPÉRATION ET
DE DÉVELOPPEMENT
ÉCONOMIQUES

**OECD Pesticide risks reduction Seminar:
Evolving Digital and Mechanical Technologies for Pesticides and Pest**

26 June 2019

*OECD Conference Centre, 2 rue André-Pascal,
75016 Paris*

Preliminary Draft Programme

Chair: Warren Hughes (New Zealand)

Time

9.00 am	<p>Introduction</p> <ul style="list-style-type: none"> • Opening and welcoming remarks – <i>OECD Secretariat</i> • Structure of the seminar – <i>Seminar Chair</i> • Tour de table - <i>participants</i>
9.25 am	<p>Presentations</p> <p>1) Overview</p> <ul style="list-style-type: none"> • Overview presentation on the new technologies - <i>Jens Karl Wegener (Julius Kühn-Institute (JKI))</i>
9h45 to 11h10	<p>2) Mechanical Technologies</p>

	<ul style="list-style-type: none"> • Presentations about the technologies (e.g. in-field imaging robots/drones, mechanical/electrical/laser weeding, spraying UAVs) and their strengths and weaknesses <ul style="list-style-type: none"> – <i>Chris Bursiek (John Deere Crop Care Platform)</i> – <i>Peter Hanappe (Romi-Project; Sony CSL)</i> – <i>Janet Williams (Bayer Cropscience)</i> <p>Coffee Break</p>
11h10 to 12h15	<p>3) Digital Technologies</p> <ul style="list-style-type: none"> • Presentations about the technologies (e.g. prediction tools, image computing, data-driven decision making (artificial intelligence) and their strengths and weaknesses <ul style="list-style-type: none"> – <i>Xavier Leprince (Syngenta)</i> – <i>Roslyn Chua (Bayer CropScience)</i> – <i>Leanne Wiseman (Griffith University, Australia)</i>
12h15 to 13h15	Lunch
13h15 to 14h00	<p>4) Stakeholder (e.g. farmers/growers/manufacturers) Views</p> <p>Presentations about impacts of technologies in their sectors</p> <ul style="list-style-type: none"> – <i>John Andaloro (FMC)</i> – <i>Marie-Cécile Damave (Agridées, France, part of International Farmer representative body)</i>
14h00 to 15h00	<p>5) Regulatory Views</p> <p>Presentations about regulatory impacts</p> <ul style="list-style-type: none"> – <i>Ed Messina (EPA, US)</i> – <i>Grant Stark (CRD, UK)</i> – <i>Hidetaka Kobayashi (MAFF, Japan)</i>
15h00 to 16h15	<p>Round-table Discussions and Coffee Break</p> <p>The Seminar should aim to answer the following questions:</p> <ol style="list-style-type: none"> i. What is the future of such technologies <ul style="list-style-type: none"> • What are the barriers to wider use of these technologies? • What relevant new technologies were not discussed during the presentations? ii. How will these technologies change existing practices:

		<ul style="list-style-type: none"> • What could be the benefits and drawbacks of such changes? (with focus on risk reduction) • What will be the impacts on industry practices? • What will be the Impacts on regulatory requirements? <p>iii. Policies, procedures and regulations:</p> <ul style="list-style-type: none"> • What regulatory requirements, guidance and processes are currently in place and apply to such technologies? • What are the gaps? • What are the differences between countries? • Are there opportunities for harmonization between regulators? <p>iv. How could OECD support governments and stakeholders achieve greater risk reduction through the use of these technologies?</p> <p>Coffee Break</p>
16h15 16h45	to	<p>Summary of the discussion and Ideas for follow-up</p> <p>Conclusions</p> <p>The Seminar (Chair) will conclude on the roundtable discussions.</p> <p>Recommendations</p>
16h45 17h30	to	<p>Closed Session – Regulators Only</p> <p>Discussion regulatory challenges and issues</p>
17h30		<p>Finish</p>

*Annex 2 – List of Participants***Participants list for the OECD Pesticides Risk Reduction Seminar : Evolving Digital and Mechanical Technologies for Pesticides and Pest Management**

Allemagne/Germany	Dr. Jens Karl WEGENER Director and Professor Julius Kühn-Institut (JKI)
Australie/Australia	Mr. Alan NORDEN Executive Director Registration Management and Evaluation Australian Pesticides and Veterinary Medicines Authority (APVMA)
Canada	Dr. Richard AUCOIN Executive Director Pest Management Regulatory Agency Health Canada
	Mr. Peter J. BRANDER Chief Registrar and Director General Pest Management and Regulatory Agency (PMRA) Health Canada
Chili/Chile	Mr. Eduardo AYLWIN Advisor Chilean Food Safety Agency Ministry of Agriculture
Corée/Korea	Professor HeeRa CHANG Professor Department of Applied Biotoxicology Hoseo University Environmental Chemistry, Department of Applied BioToxicology,
	Dr. JaeHo OH Senior Researcher Food Safety Risk Assessment Division NIFDS, Korea Ministry of Food and Drug Safety

Dr. Sangsoon YUN
Pesticide and Veterinary Drug Residues Division
Ministry of Food and Drug Safety, Korea

États-Unis/United States

Mr. George HERNDON
Deputy Director
Field and External Affairs Division
U.S. Environmental Protection Agency (EPA)

via WebEx

Mr. Edward MESSINA
Deputy Director, Programs
Office of Pesticide Programs
US Environmental Protection Agency

Japon/Japan

Dr. Yukiko YAMADA
Senior Advisor
Ministry of Agriculture, Forestry and Fisheries

Dr. Hidetaka KOBAYASHI
Deputy Director
Plant Products Safety Division, Food Safety and Consumer Affairs
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Lettonie/Latvia

Mr. Vents EZERS
Head of Unit
Plant Protection Department
State Plant Protection Service of Latvia

Lituanie/Lithuania

Ms. Raimonda GRIGAITĖ
Adviser
Plant Protection Products Authorisation Division
The State Plant Service under the Ministry of Agriculture of the
Republic of Lithuania

**Nouvelle-Zélande/New
Zealand**

Mr. Warren HUGHES
Principal Adviser ACVM
Assurance Directorate
Ministry for Primary Industries

	Ms. Sarah LESTER Adviser (Agricultural Chemicals) Assurance Directorate Ministry for Primary Industries
Pays Bas/The Netherlands	Mr. Rob VAN DRENT Policy Officer Board for the Authorisation of Plant Protection Products (Ctgb)
République slovaque/Slovak Republic	Ms. Bronislava SKARBOVA Senior Counsellor Department of Plant Production Ministry of Agriculture and Rural Development of the Slovak Republic
Royaume-Uni/United Kingdom	Mr. John DALE Team Leader Pesticide Active Substances and Operational Policy Health & Safety Executive
	Dr. Christine SNAITH Head, Plant Protection Products Chemicals Regulation Division Health and Safety Executive
	Mr. Grant STARK Chemicals Regulation Division Health and Safety Executive (HSE)
UE/EU	Mr. Eric LIEGEOIS Policy Officer Pesticides Unit E.4. Pesticides and Biocides DG Health and Consumers (SANCO)
	Mr. Jeroen MEEUSSEN Coordinator European Union Minor Uses Coordination Facility
Costa Rica	Mr. Roger RUIZ ZAPATA State Phytosanitary Service Ministry of Agriculture and Livestock

Comité consultatif Mr. Craig DUNLOP
économique et industriel Regulatory Policy Team Leader
(BIAC)/Business and Syngenta Crop Protection AG
Industry Advisory Switzerland
Committee (BIAC)

Mr. Marcello GIANNUZZI
Global Product Stewardship Director
FMC Corporation Switzerland

Ms. Brenda HARRIS
Regulatory & Government Affairs Leader
Corteva Agriscience
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Dr. Peter HORNE
FMC Agricultural Solutions
Stine-Haskell Research Center
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Dr. Ray MCALLISTER
CropLife America
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Philipp-Andreas SCHMIDT
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Crop Protection Policy Lead
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Organisation des Nations Unies pour l'alimentation et l'agriculture (FAO)/UN Food and Agricultural Organization (FAO)	Mr. Mario YARTO Agricultural Officer Secretariat of the Rotterdam Convention Food and Agriculture Organization of the United Nations (FAO) Italy
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Bayer CropScience Limited	Ms. Janet WILLIAMS Head of Regulatory Science – UK & Ireland Bayer CropScience Limited United Kingdom
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Griffith University	Dr. Leanne WISEMAN Associate Professor Griffith Law School Griffith University Australia
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