Regulatory challenges for new pesticide technologies - Green-on-Green optical spot sprayer technologies - herbicide tolerance trait stacking

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Key words

OSST, green-on-green, optical sprayer, pesticide regulation, GMO herbicide tolerance, HT trait stacking

Take home message

- Rural Research and Development Corporations, machinery manufacturers and pesticide companies will need to work together to deliver an effective outcome to support the APVMA in delivering effective green-on-green optical spot spraying technology (OSST) regulation determinations
- Strategic herbicide tolerance (HT) issues are currently managed through informal ad-hoc discussion by the peak industry bodies through informal consultation with herbicide registrants and breeders
- Key issue is the strategic deployment of the finite resource of potential HT traits, both GM and non-GM to maximize the long-term sustainable use of the technology within a farming systems context
- There is a need for a formal industry feedback mechanism into the regulatory process beyond the initial consultation period during regulatory assessment to manage strategic farming systems issues.

Background

Weed control is one of the major costs to crop production and a major determinant of crop and pasture rotation and management. The impact can be very specific to particular weed problems in different crop and pasture production systems, and these can differ greatly across regions. The economic costs of weeds to Australian producers are also a key driver of practice change, as is the importance of managing herbicide resistance to sustain viable agricultural production. New herbicide, and precision application technologies, plus plant genetic solutions, contribute to the tools available to industry. The rapid advancement of some of these technologies and stacking of herbicide tolerance technologies presents some challenges to the regulatory framework needed to best support industry in the future. Green-on-green spray technology is on the precipice of widespread commercialisation, but will growers be able to realise its potential without significant investment and delivery of registered pesticide label registrations? Crop phytotoxicity, environmental and residue studies will potentially need to be assessed under different criteria from traditional Good Agricultural Practice (GAP) studies, which is what is currently reflected on pesticide labels.

Optical spot spray technologies and permits for use

Industry use of optical camera spot spray technology (OSST) for use in fallow has been widely adopted in Australia. Today the technology is considered industry best practice for fallow weed management, both in reducing herbicide costs, but also in ensuring there are no weed escapees which result in the increased risk of herbicide resistant weed patches in paddocks.

The origins of OSST using NIR reflectance for fallow weed management actually started in Australia in the mid-1980's but was commercialised following North American investment. The Grains Research and Development Corporation (GRDC) invested in a project with the New South Wales Department of Primary Industries (NSW DPI) over 10 years ago to establish an industry Australian

Pesticides and Veterinary Medicines Authority (APVMA) permit, for legal use of a range of herbicide products with OSST. This permit was held by Crop Optics Australia, the then Australian Agent for WeedSeeker spraying systems. This APVMA permit 'PER11163' expired in February 2019. Following considerable negotiation, Grain Producers Australia (GPA) today holds an APVMA permit PER90223 for the legal use of optical Green-on-Brown OSST, for the use of a range of herbicides for summer weed control. In addition, Nufarm Australia has registered a number of herbicide products for use with Green-on-Brown optical camera spot spray technologies.

Technology development of crop sensors, including OSST is accelerating (Rainbow, 2022). There is a significant commercial focus on Green-on-Green optical camera technologies for spot spraying of weeds within a growing crop, combined with the existing Green-on-Brown capability (Figure 1). The European company *Bilberry* has been first to market with Green-on-Green detection of broadleaved weeds such as radish, turnip, blue lupin, thistle or capeweed in wheat, barley and oat cereals. In addition, drone weed mapping solutions such as *Single Shot* for aerial weed detection have also been developed. These enable planning for weed control options to be managed separately prior to the spray operation.

	Availability	Green on Brown	Green on Green
Weed Seeker & Weed Seeker 2 (Owned by Trimble)			
WeedIt & Weed-It Quadro (Licenced by Nufarm-Croplands in Aust/NZ)			
SenseSpray (AgTechnic)			
Bilberry (Licenced to Agrifac, Dammann, Miller and Goldacres Australia)			
Bosch – SmartSprayer (Investment by BASF – licenced to Amazone, Stara & AGCO)			
Carbon Bee –SmartStriker (licenced to Kuhn, Berthoud)			
Greeneye Technology (Investment by Syngenta)	*Availability in Australia unknown*		
John Deere - See and Spray (Includes IP from John Deere owned Blue River Technologies, plus includes University of Southern Queensland IP with previous investment by SRA, CRDC & HIA)			*See & Spray Ultimate* Limited USA Release 2023
AutoWeed (James Cook University IP - Previous investment by Sugar Research Australia)	*Limited availability*		
Agerris- VIIPA (University of Sydney IP – Previous investment by Hort Innovation Australia)	*In development*		
Agrointelli (incorporating RoboWeedMaPS fitted to Robotti platform)	*In development*		
Ecorobotics (Investment by BASF)	*In development*		

Figure 1. Green-on-Brown and Green-on-Green OSST*
*information based on publicly available information October 2022

Regulatory challenges for Green-on-Green OSST

The potential of Green-on-Green OSST to use new chemistry or higher rates to kill weeds in crop, also opens up the risk of off-label chemical use as the specific technology use is not currently specified on pesticide labels. One of the options being discussed by some optical sprayer developers and users of Green-on-Green in-crop OSST, is the potential use of existing registered herbicides at higher than registered rates, or, in some cases, using broader spectrum herbicide products in crops

for which they are not currently registered for use in. This concept has also been previously trialled by a number of groups using Green-on-Brown sprayers but with mixed results. A very real potential industry risk posed by Green-on-Green OSST if used in this way, is potentially exceeding maximum residue limits (MRLs) in resulting crop grain or fodder product, or residues being detected in crops the following season.

As international trade and pesticide MRL compliance becomes more complex, today more than ever, there is a need for increased industry management and efficiency in managing pesticide access and trade risks. There is a need for a broad industry discussion on options on how this can be best managed in the future, particularly with the new risks presented from the introduction of new technologies, such as Green-on-Green OSST.

The APVMA regulates crop, animal and human safety, plus risks to the environment, to the point-of-sale. Green-on-Green OSST will require a re-consideration of absolute crop-safety requirements due to the opportunity for new models of herbicide application in-crop. This becomes a difficult consideration for the regulator as to what constitutes crop safety and acceptable risks of crop loss. In addition, the risks from concentrated product use of higher herbicide rates when using Green-on-Green OSST could result in a difficult quantification of cumulative or concentrated plant and grain residue levels, depending on what percentage of a crop field is sprayed.

The current regulatory framework for chemical label extensions to maximise the efficacy and efficiency of Green-on-Green OSST is a time consuming and costly process, which will discourage many pesticide manufacturers, particularly for older generic herbicide products. An unclear regulatory pathway for Green-on-Green OSST will likely stifle investment and slow the commercialisation of new technology in the small Australian market.

While pesticide companies are well aware of the opportunity that Green-on-Green OSST presents, the challenge is the cost of closing the regulatory gaps and delivering a legally registered label outcome for use by producers. It will take industry cooperation on addressing regulatory requirements to capture the potential widespread use of Green-on-Green OSST, while protecting Australia's trade markets and ensuring food safety standards and MRL compliance for end users. To provide cost effective registration of new products using Green-on Green OSST, there is a need to develop a geospatial OSST risk assessment model which would be used in submission of an Item 25 risk assessment to the APVMA. The in-crop OSST risk assessment model could be made commercially available to pesticide registrants to support regulatory assessment of new herbicide products. For this to be successful, industry producers, their respective Rural Research and Development Corporations, machinery manufacturers and pesticide companies will need to work together to deliver an effective outcome to support the APVMA in delivering effective Green-on Green OSST regulation determinations.

Challenges for herbicide tolerance trait stacking

A report by Rainbow (2020) commissioned by the Office of the Gene Technology Regulator (OGTR) considered the current and potential future farming systems changes, environmental risks and impacts, including the impact on producer practices of the use of cultivars with multiple genetically modified organism (GMO) herbicide tolerance traits. The report outlines an understanding of current and future potential risks from resulting farming systems change through production of genetically modified (GM) crops with multiple herbicide tolerance traits. It provides a rationale for the OGTR to consider whether some form of guidance or industry advice might be appropriate to address the issues outlined in the report.

Extending multiple HT traits into a stack would potentially enhance future positive change to farming systems, particularly if the technology offers additional timing during the crop growth period to provide effective weed control or weed seed set control, while enabling effective crop competition with weeds. The report suggests that the most critical functions of GM crop HT traits risk assessment

are adequately managed with the current regulatory processes in place with the OGTR, FSANZ and APVMA.

There is however a requirement for the broad value chain of industry stakeholders to discuss the complex strategic issues resulting from commercial investment in GM and non-GM HT stacking in the commercial landscape and its impact on farming systems. This includes herbicide resistance management and resulting international trade of agricultural product (Figure 2). There is also a requirement for a formal industry feedback mechanism into the regulatory process to manage strategic farming systems related issues, rather than consideration of individual trait or herbicide issues. It is also clear that there is both a requirement and opportunity for improved strategic guidance on crop HT stewardship for volunteer crop control.

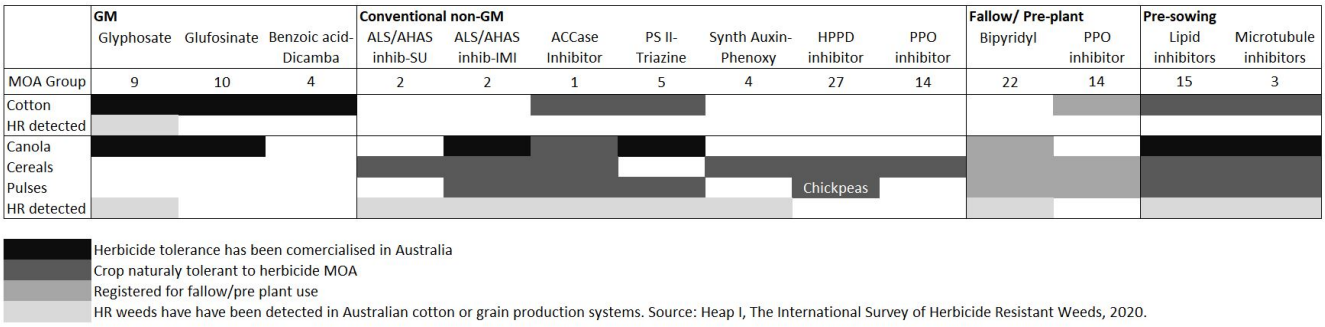

Figure 2. Herbicide resistance reported in Australian cotton and grain crops compared with current registered herbicide options in GM and non-GM crops (Rainbow, 2020).

A key issue identified in this review is the strategic deployment of the finite resource of potential HT traits, both GM and non-GM, to maximize the long-term sustainable use of the technology within a farming systems context with flexible crop rotation choices. A detailed producer survey of imidazolinone (IMI) HT volunteer control issues is warranted to further understand the reported issues associated with HT crop production and to provide insight on potential producer strategies to mitigate the issues that have been arising. Managing non-GM IMI tolerant cereal crop volunteers is becoming an increasing issue with so many crops now tolerant to IMI herbicides, including wheat, barley, canola, lentils, sorghum and maize. The issues experienced with IMI HT crops provides some insight on potential risks of volunteer management where multiple HT traits are stacked into a single crop, as the complexity of volunteer management will be potentially amplified. Additionally with multiple stacked HT traits, selection pressure for herbicide resistant weeds will be increased if all the additional modes of action technology options are utilised in one season, reducing best practice herbicide rotation options to avoid repeat use of the same mode of action in subsequent seasons. Consideration of the broader strategic issues associated with farming systems management and the integration of multiple HT traits requires a more formal process for reaching industry consensus on stewardship, particularly in the grains industry

The need for formal leadership and expert industry input

A key gap identified in the OGTR review is the need for a formal industry feedback mechanism into the regulatory process to manage strategic farming systems change related issues, rather than consideration of individual traits or herbicide use issues. A key missing link is the integration and regulation of outcomes from commercial breeding programs. It is also clear that there is both a need and opportunity for improved strategic regulatory guidance on crop HT stewardship for volunteer crop control and ensuring that product meets trade and market requirements. There are a number of options proposed which include formal expert industry input to support both the regulatory process and deliver effective technology stewardship outcomes for industry.

There has also been considerable discussion around the potential role of the cross agricultural industry National Working Party for Pesticide Applications (NWPPA) in facilitating industry

coordination on guiding the introduction of Green-on-Green OSST and producing science-based evidence on how potential risks can be managed, to the APVMA regulator. As new pesticide technologies emerge, there is clearly a need for national leadership and expert input to help navigate their regulation and stewardship.

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