Unintended consequences of 21st century technology for agricultural pest management

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C ourtier-Orgogozo et al. [1] argue that public debate and better governance are needed to properly control the use of gene editing for controlling pests in agriculture. They are correct in their assessment that this “could lead to multiple and uncoordinated releases of gene drives into the wild, which is likely to cause unpredictable ecological disturbances with far-reaching consequences”. However, the context of technology’s dark side with regard to agricultural pests includes not just altering genes, but also manipulating the external environment.

For centuries, pests, which include weeds, have been able to elude or resist even the most sophisticated control methods. Before the development of genetically modified crops, weed management involved a combination of tactics that included biological, mechanical and chemical controls [2]. Roundup Ready™ (herbicide-resistant) crops seem to replace this diversified strategy with just one approach to improve efficiency and lower herbicide use and thereby costs. This single weed control tool could be considered precise, but only because crop plants are genetically manipulated and not by specifically targeting weeds to improve yields. Further, increased selection pressure (s) often result in weed species developing resistance to herbicides—or to any other individual tactic that is used repeatedly across narrow spatiotemporal scales. Similarly, gene drive, a technology that works internally within the target organism by manipulating or knocking out specific genes, promises to drastically increase yield again, yet has several unknowns.

In contrast, external technologies aim to roam crop fields using artificial intelligence and robots to seek and destroy individual pests or weeds [3]. Various agricultural companies [4] and research groups [5] already have an interest in weed management based on advanced robotics and deep learning technologies to identify and eliminate individual weeds from crop fields using a diversified strategy [6,7]. This could eliminate the problems associated with herbicides and lower selective pressure on target weed species to evolve resistance. However, there are valid questions whether using robots in agricultural fields is a safe and reliable strategy similar to the debate on the safety of driverless automobiles, airplanes or cargo ships.

Neither gene drive, an internal technology, nor smart machines, an external technology, have been fully debated in terms of unintended consequences or unknown long-term effects [8]. The path forward has never been clear, but bumbling along using a haphazard trial-and-error method is clearly not the most prudent strategy to employ with ever more sophisticated technology. As Courtier-Orgogozo et al point out, “a wider, public debate and dynamic governance” is needed, yet not just on the “right of humans to domesticate almost any species using gene drive”, but the coordinated use of internal and external technologies for agricultural pest control.

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References