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Editorial: Weed management in organic agriculture

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Editorial on the Research Topic
Weed management in organic agriculture

Organic crops were globally produced on 1.5% of the world's agriculture land in 2019; recently, this share has increased worldwide, particularly in Europe and the Americas, due to higher consumer demand and agricultural policies that view organic agriculture as a strategy to meet the objectives of the Sustainable Development Goals and the EU Farm to Fork Strategy (Riccaboni et al., 2021; Willer et al., 2021). Weeds are considered one of the most important issues in organic farming as their presence is a limiting factor for crop yields (Röös et al., 2018). Thus, weed management is crucial for reducing yield losses and for maintaining high quality production (Lundkvist and Verwijst, 2011). Without relying on the use of herbicides, weed control in organic agriculture is based on preventive techniques that include management of seedbanks and agronomic choices that favor crop competitiveness and the suppression of weeds (Merfield and Sabu, 2019). When weeds emerge, direct physical and mechanical control techniques can be implemented to reduce infestations. The increase in organic farming has boosted the development of more precise and automated mechanical tools, with an increasing availability of machinery equipped with sensors and advanced driving systems. In recent years, automated weeding robots have also been introduced (Scavo and Mauromicale).

This Research Topic aimed at collecting articles related to the most recent advancements in weed management techniques that can be used in organic agriculture in different cropping systems. The Research Topic includes two review and two original articles related to non-chemical weed management. The review articles summarize the knowledge related to two techniques; the false seedbed technique, which is a traditional method widely adopted in non-chemical weed management, and a new highly promising technique that relies on the use of autonomous vehicles equipped with lasers to devitalize weeds. The first review by Travlos et al. documented the effects of environmental factors and tillage on weed seed germination and emergence, which in turn can affect the efficacy

of the false seedbed. Regarding the environmental factors, temperature and soil moisture play important roles in regulating a species' dormancy cycle as they affect both the seed germination capacity and the speed of germination. The application of a hydrothermal time model has been proposed as a useful tool for determining the germination requirements, in terms of water and temperatures, of a weed species to predict its emergence. The review described the influences of timing and type of tillage on the promotion of weed emergence and on the devitalization of emerged weeds, which are the basis of the false seedbed technique. The ability to predict weed emergence as well as factors affecting its dynamics are crucial for applying sustainable weed management techniques such as the false seedbed method.

The review by Andreasen et al. described another sustainable weed management technique, laser weeding, which will most likely be an option in the future, when application costs will decrease. The authors explained the types and characteristics of laser technologies, such as the high energy and the possibility to precisely adjust the laser beam, highlighting its potential in weed control. The authors underlined the need to combine lasers with autonomous vehicles and other technologies that enable plant recognition, in order to precisely direct the laser beam to target the weeds, reducing application costs, energy consumption, and safeguarding non-target organisms. The authors also highlighted a number of disadvantages associated with the technique, such as the low driving speed resulting from the time required for weed recognition and the size of weeding robots, the risks of starting fires, and harming humans and animals. The review concluded that this technique can be successfully applied in the future, after establishing specific safety guidelines and educating the operators.

The two original articles in this Research Topic are related to the enhancement of weed suppression using agronomic techniques such as increasing seeding rate, limiting soil nitrogen input, and reducing weed seed viability with ensiling. The article by Menalled et al. described a study in which the effect of five soybean seeding densities and three levels of nitrogen fertilization were tested on weed development and crop yield in organic no-till soybean fields planted into a rolled-crimped rye mulch. The results highlighted that a high nitrogen level increased weed biomass and favored annual and nitrophilic weed species, while the soybean yield was not enhanced, most likely because of the stimulation of weed growth. The study also confirmed the effect of high crop density on weed suppression, as evidenced by the fact that light interception was the regulating factor for weed development. The soybean yield increased with seed density, with the highest profit return obtained at 527,800 seeds ha^{-1}, a higher density than those calculated for tilled organic and conventional soybean systems. The study demonstrated that crop density and nitrogen fertilization can be managed to maximize yield and to reduce weed presence.

The article by Hahn et al. evaluated the effect of different substrates (maize and wildflowers) and different laboratory ensiling conditions (ideal and stressed) on weed seed viability. Ensiling practice is often adopted for forage conservation in mixed organic farms and can potentially reduce weed seed viability. The study showed that ensiling for 8 months completely devitalized non-hardseeded species and had a lower, variable efficacy, from 5 to 60%, in hardseeded species, most likely due to seed coat thickness, different levels of maturity, and dormancy. The type of substrate did not affect the seed killing efficacy, and the ensiling conditions affected only some species; thus, changing substrates or ensiling conditions are not suitable strategies to increase weed seed killing. Ensiling also lowered seed germination, highlighting that it can be used as a further method for weed control.

The present Research Topic sheds light on some of the most effective techniques that can be used in organic farming, where the available control means are limited; these can also be valid, sustainable strategies for integrated weed management in conventional agriculture.

Author contributions

SF was the Topic Editor of the Research Topic and wrote the article. AA, GC, FV, and SK were Topic Editors of the Research Topic and edited the text. All authors contributed to the article and approved the submitted version.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

References

Lundkvist, A., and Verwijst, T. (2011). *Weed biology and weed management in organic farming in research in organic farming*. Ed. N. R. (Rijeka, Croatia: InTech). doi: 10.5772/31757

Merfield, C. N., and Sabu, (2019). *Integrated weed management in organic farming in organic farming. global perspectives and methods*. Eds. C. S. and M. R. Unni (Duxford, United Kingdom: Woodhead Publishing). doi: 10.1016/B978-0-12-813272-2.00005-7

Riccaboni, A., Neri, E., Trovarelli, F., and Pulselli, R. M. (2021). Sustainability-oriented research and innovation in 'farm to fork' value chains. *Curr. Opin. Food Sci.* 42, 102–112. doi: 10.1016/j.cofs.2021.04.006

Röös, E., Mie, A., Wivstad, M., Salomon, E., Johansson, B., Gunnarsson, S., et al. (2018). Risks and opportunities of increasing yields in organic farming. *A review. Agron. Sustain. Dev.* 38, 14. doi: 10.1007/s13593-018-0489-3

Willer, H., Trávníček, J., Meier, C., and Schlatter, B. (2021). "The world of organic agriculture," in *Statistics and emerging trends 2021* (Bonn, Germany: Research Institute of Organic Agriculture FiBL, Frick, and IFOAM).