# Rotation

## May | 2022



Factsheet about integrated weed management

## Introduction

European crop rotations have become simplified, growing the most preferred crops more frequently with a high reliance on herbicides and reduced dependence on break crops that disturb the life cycle of weeds. Continuous production of the same crop and the repeated use of herbicides leads to resistance evolving of weeds and allows competitive weed species to proliferate. Designing a diverse crop rotation and/or specifically timing of the rotation can help to manage weeds, and prevent weed species from becoming dominant.

For practical information on crop rotation in general see the Best4Soil factsheet: <u>https://www.best4soil.</u> <u>eu/assets/factsheets/12.pdf</u>

## Applicability

Diversifying the crop rotation to control weeds can be done in many ways, the most effective change however is the integration of a perennial crop, either as forage crop (e.g. lucerne) or as a short-term pasture. Because such a crop entails strong competition and can be mown, the opportunity for the weed seedbank to replenish over several years can be strongly reduced, leading to a reduction in weed abundance in the following annual crop<sup>1</sup>.

#### Efficacy

Crop diversification in time for both arable and horticulture crops can be achieved with adaptation of the crop rotation (altering the sequence or number of crops). Rotating crops changes the growing conditions for weeds between years or even seasons while weeds that thrive in one crop will be less adapted to the other crops in the rotation. The more the crops in a rotation differ from one another (e.g. by means of nutrient demands, phenology, planting, harvest) the less likely it becomes to find single weed species that dominate the weed community<sup>2</sup>. Different crops also provide opportunities to apply other weed management tools such as mechanical weeding. Actually, a diverse crop rotation brings in diversity in many aspects of farm management, including the herbicides used. The use of diverse herbicides decreases the risk of evolution of herbicide resistance.

## Costs

The costs for a more diverse crop rotation are similar to those of a rotation of a few crops as long as the additional crops does not require crop-specific machinery. Once a diverse rotation is designed, it only requires a more diverse management over the years, whether or not with specific machinery and inputs, depending on the chosen crops. If crop-specific machinery is not available at a farm, the work can be outsourced to a contractor to avoid investments. Furthermore, the costs depend on the cost benefit balance related to the market value of new crops compared to that of crops that otherwise would be grown.

### Equipment

Apart from some differences in required machinery between crops there is no specific equipment required to diversify a crop rotation.

#### Core results

- A crop rotation including oats, wheat, field pea and barley depleted the annual weed seedbank by 87% at the end of a four-year cropping sequence, especially when integrated with an effective herbicide strategy<sup>3</sup>.
- Other studies on crop rotation highlight the legacy effects of using effective weed suppressive rotational sequences spanning a decade<sup>4</sup>.
- A review of strategies and tactics for herbicide use reduction in field crops in Canada reported successful examples of diversified rotations for weed management and reductions of herbicide use<sup>51</sup>.

MacLaren, C., Storkey, J., Strauss, J., Swanepoel, P., Dehnen-Schmutz, K., 2019. Livestock in diverse cropping systems improve weed management and sustain yields whilst reducing inputs. J. Appl. Ecol. 56 (1), 144–156. https://doi. org/10.1111/1365-2664.13239.

<sup>2|</sup> Riemens, M., Sønderskov, M., Moonen, A., Storkey, J. and Kudsk, P., 2022. An Integrated Weed Management framework: A pan-European perspective. European Journal of Agronomy, 133, p.126443.





- A meta-analysis showed that weed suppression was more supported by diversification in planting dates than crop diversification in terms of crop species<sup>61</sup>.
- Sharma et al. (2021) discuss in their review how crop diversification supports sustainable weed management<sup>71</sup>.

#### Extra information

See https://iwmpraise.eu/publications/ for all crop diversification strategies and their definitions, and for more information on integrated weed management and the following Inspiration sheet:

• Rotations and weeds in the UK



Figure 1 | Farmers use crop rotations to prevent buildup of the weed seedbank. Each year, fields have different crops.

- 3| Kleemann, S.G.L.; Preston, C.; Gill, G.S. Influence of Management on Long-Term Seedbank Dynamics of Rigid Ryegrass (Lolium rigidum) in Cropping Systems of Southern Australia. Weed Sci. 2016, 64, 303–311. [CrossRef]
- V. The Influence of Long-Term Different <sup>·</sup> Crop Rotations and Monoculture on Weed Prevalence and Weed Seed Content in the Soil. Agronomy 2021, 11, 1367. [CrossRef] Adeux, G.; Munier-Jolain, N.; Meunier, D.; Farcy, P.; Carlesi, S.; Barberi, P.; Cordeau, S. Diversified grain-based
- Rector, G., Holine Johnin, H., Herchiner, E., Yancy, F., Cancas, S., Baloch, F., Conceau, S. Diretsine agrin based cropping systems provide losses. Agron. Sustain. Dev. 2019, 39, 42. [CrossRef]
  51 Nazarko, O.M., Van Acker, R.C.; Entz, M.H. Strategies and tactics for herbicide use reduction in field crops in Canada:
- 5) Nazarko, U.H.; Van Acker, K.L.; Entz, M.H. Strategies and factics for nerolicae use reduction in neid crops in Canada: A review. Can. J. Plant Sci. 2005, 85, 457–479. [CrossRef]
- Weisberger, D., Nichols, V., Liebman, M., 2019. Does diversifying crop rotations suppress weeds? a meta-analysis. PLoS One 14, 1–12. https://doi.org/10.1371/journal. pone.0219847.
- Sharma, G., Shrestha, S., Kunwar, S., & Tseng, T. (2021). Crop Diversification for Improved Weed Management: A Review. Agriculture, 11(5), 461. doi: 10.3390/agriculture11050461

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