Biodiversity Impacts of Integrated Pest Management (IPM) solutions – a life cycle based assessment comparing two approaches

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The use of insecticides in agriculture can be seen as a potential source of damage to biodiversity. Therefore, the assumption that a substitution of certain insecticides by mating disruption (MD) via pheromones could have a positive impact on the conservation of biological diversity is obvious. New fermentation-based production processes for MD pheromones are developed in the European OLEFINE project.

The Fraunhofer team assesses the sustainability of this new product using Life Cycle Assessment (LCA). One relevant aspect is the biodiversity impact of MD compared to conventional insecticides. Two impact assessment approaches are applied to assess MD for several crops produced in different countries.

The approach developed by *Chaudhary & Brooks (2018)* uses species richness as an indicator for biodiversity and distinguishes between three land use intensity levels (intensive, light, minimal). The method developed by *Lindner et al. (2020)* assesses the impact on biodiversity for different kinds of land use in the form of an aggregated index that includes multiple dimensions of management intensity, one of which is the use of pesticides. It is generally possible to isolate the role of pesticides, though not insecticides specifically, and the results depend on the other intensity dimensions, too.

Chaudary and Brooks (2018)

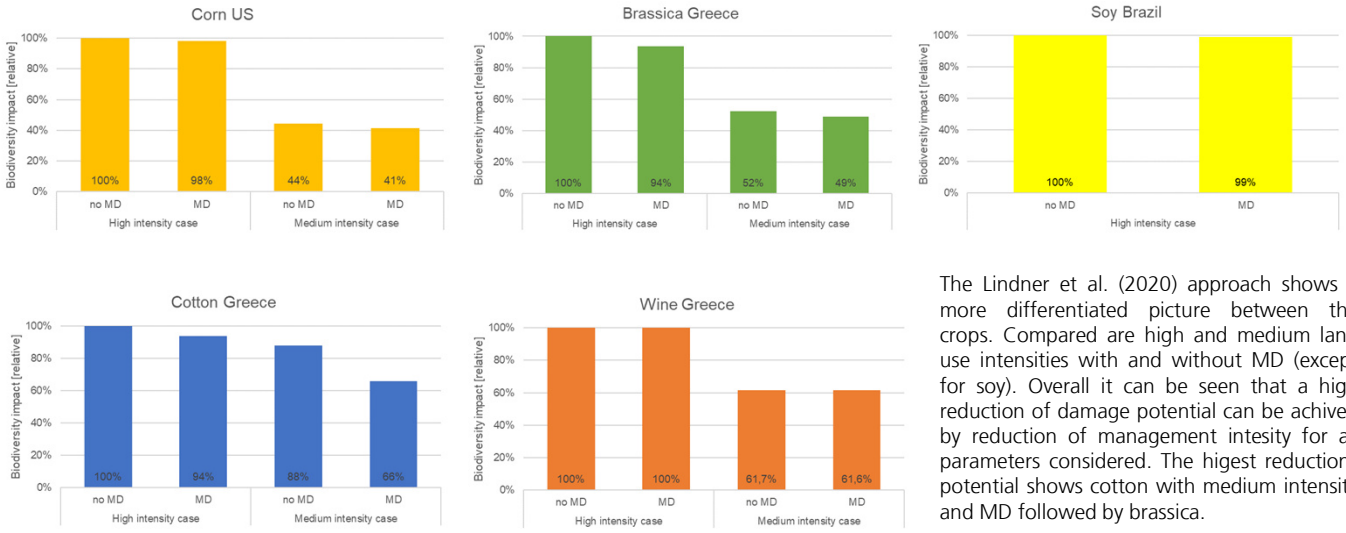
Crop	Biodiversity impact saving potential	
	Intensive → light	Light → minimal
Corn US	1%	6%
Wine Greece	1%	7%
Brassica Greece	1%	15%
Cotton Greece	1%	7%
Soy Brazil	1%	5%

The assessment with the Chaudary & Brooks (2018) approach shows a certain potential for saving biodiversity impact. This is not an isolated effect of pesticide use, but due to a difference in management intensities associated with integrated pest management (IPM).

For all crops, 1% saving potential was calculated for a change of intensive to light land use untensity, while IPM is considered as light. Higher potential was found for a change from light to minimal. Brassica cultivation in Greece shows a high reduction potential. It has to be noted that the minimal scenario does not reflect only IPM but an almost zero management of fields which can be considered as unlikely in practice.

Lindner et al. (2020)

Potentially reduced damages to biodiversity value (reference: intensive without MD)



The Lindner et al. (2020) approach shows a more differentiated picture between the crops. Compared are high and medium land use intensities with and without MD (except for soy). Overall it can be seen that a high reduction of damage potential can be achived by reduction of management intesity for all parameters considered. The higest reductions potential shows cotton with medium intensity and MD followed by brassica.

Summary

- Some reduction of biodiversity impact can be achieved with to the substitution of conventional insecticides with MD techniques.
- Both approaches are too coarse for MD specific assessment, even though the Lindner et al. approach is a bit more refined.
- The impact reduction potential depends on the overall management system in which MD is embedded.
- In cases of very high intensity agriculture, MD alone is unlikely to change the overall picture.

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References:

Chaudary & Brooks 2018: Abhishek Chaudhary and Thomas M. Brooks. Land Use Intensity-Specific Global Characterization Factors to Assess Product Biodiversity Footprints. Environmental Science & Technology 2018 52 (9), 5094-5104

Lindner, J.P.; Fehrenbach, H.; Winter, L.; Bischoff, M.; Blömer, J.; Knüpffer, E.: Biodiversität in Ökobilanzen – Weiterentwicklung und vergleichende Studien. BfN-Skripten 575 (2020). Bundesamt für Naturschutz (BfN), Bonn - Bad Godesberg 2020. ISBN 978-3-89624-336-2 / DOI 10.19217/skr575

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