



**Practice Abstract 13 -
An IoT-Based Precision Spot-Spraying System for Targeted
Crop Protection**

13. An IoT-Based Precision Spot-Spraying System for Targeted Crop Protection

Short Summary for Practitioners in English

Problem:

European farmers need to reduce herbicide use while maintaining crop yields and farm profitability. Although spot spraying technologies are becoming available on new sprayers, replacing existing equipment is expensive and not affordable for many farms. Small and medium farms therefore need practical solutions that can be integrated into their current machinery.

Solution:

Within the FARMTOPIA project, ARVALIS evaluated a retrofit spot spraying system developed by CarbonBee that can be installed on conventional sprayers. The system uses optical sensors to detect weeds in real time and activates only the nozzles required to spray infested areas, leaving weed-free zones untreated. This technology was tested on corn and wheat under real-world growing conditions at two French farms representative of their respective regions. The evaluation covered three aspects: the accuracy of weed detection, the reliability of nozzle activation during spraying, and the economic and environmental impacts using the Systerre assessment tool.

Outcomes and results:

The weed detection algorithm achieved a detection rate of around 70% in maize while missing only 2.5% of weed plants. In grassland, blackgrass detection reached 92%, with only 1% of plants missed. Wheat results continue to improve, although weeds—which closely resemble wheat at these growth stages—pose a particular challenge. The transfer from weed detection to spraying proved highly reliable, with the sprayer correctly opening and closing the nozzles in 90–99% of cases. Depending on weed infestation, spot spraying reduced herbicide use by 75–99% in the most infested fields. Economic simulations showed that herbicide costs and the Treatment Frequency Index decreased substantially (-6 to -14%), while net margin remained almost unchanged despite slightly higher mechanisation costs and working time. Environmental indicators such as greenhouse gas emissions and energy consumption changed very little.

Practical recommendations:

Spot spraying is most effective in fields with patchy weed infestations, where large weed-free areas can remain untreated. To maximise its benefits, the system should be properly calibrated and adapted to local conditions. As retrofit systems still require a significant investment, farmers can improve cost-effectiveness by sharing the equipment through machinery-sharing groups or with neighbouring farms. Another option is to use a contractor or service provider equipped with the technology, making spot spraying accessible without investing in new equipment.

Further information

n/a

About this practice abstract and Farmtopia

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Farmtopia: The project is running from September 2023 to August 2026. The overall goal of Farmtopia (**GA No.: 101083541**) is to democratize digital farming to empower small and medium farms.

Website: <https://farmtopia.eu/>

This practice abstract was elaborated in the Farmtopia project, based on the EIP AGRI practice abstract format.

ARVALIS: As part of the Farmtopia project, ARVALIS is leading case study 8 on the evaluation of a spot spraying solution.

Website: <https://www.arvalis.fr/>

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