

# Prescription maps: A tool to control volunteer corn in soybean

Sandra Flores-Mejia<sup>1</sup>; Laurence Durocher<sup>2</sup>; Stéphanie Mathieu<sup>3</sup>; Gabriel Verret<sup>1</sup>; Josianne Caron<sup>1</sup>; Dana Elramahi<sup>1</sup>; Samar Ziadi<sup>2</sup>; Victor Morin<sup>2</sup>.

<sup>1</sup>Centre de recherche sur les grains, Inc. (CÉROM), Saint-Mathieu-de-Beloeil, QC. <sup>2</sup>XLKEY, Sainte-Marie, QC.

<sup>3</sup>Direction régionale de la Montérégie. Ministère de l'Agriculture, des Pêcheries et de l'Alimentation (MAPAQ). Saint-Jean-sur-Richelieu, QC.

## Introduction



Volunteer corn (*Zea mays* L., ZEAMX), especially those with herbicide-tolerant traits, presents an increasing challenge for Quebec growers, particularly in soybean (*Glycine max*) production. Its presence can lead to yield reductions, grain contamination and harvest delays. Moreover, the risk of GMO kernel contamination threatens the marketability of identity-preserved soybean crops<sup>(1-2)</sup>.

Drones are increasingly used in agriculture for scouting and creating prescription maps that accurately identify weed infestations within fields. These maps enable precision sprayers to apply herbicides only where needed, allowing for targeted spot-spraying. This approach has the potential to significantly reduce overall herbicide use<sup>(3-4)</sup>.

## Objectives



1. Developing an operational pipeline to generate prescription maps to identify voluntary ZEAMX in soybean fields.



2. Evaluating the accuracy and effectiveness of precision spraying for ZEAMX control compared to conventional broadcast spraying.

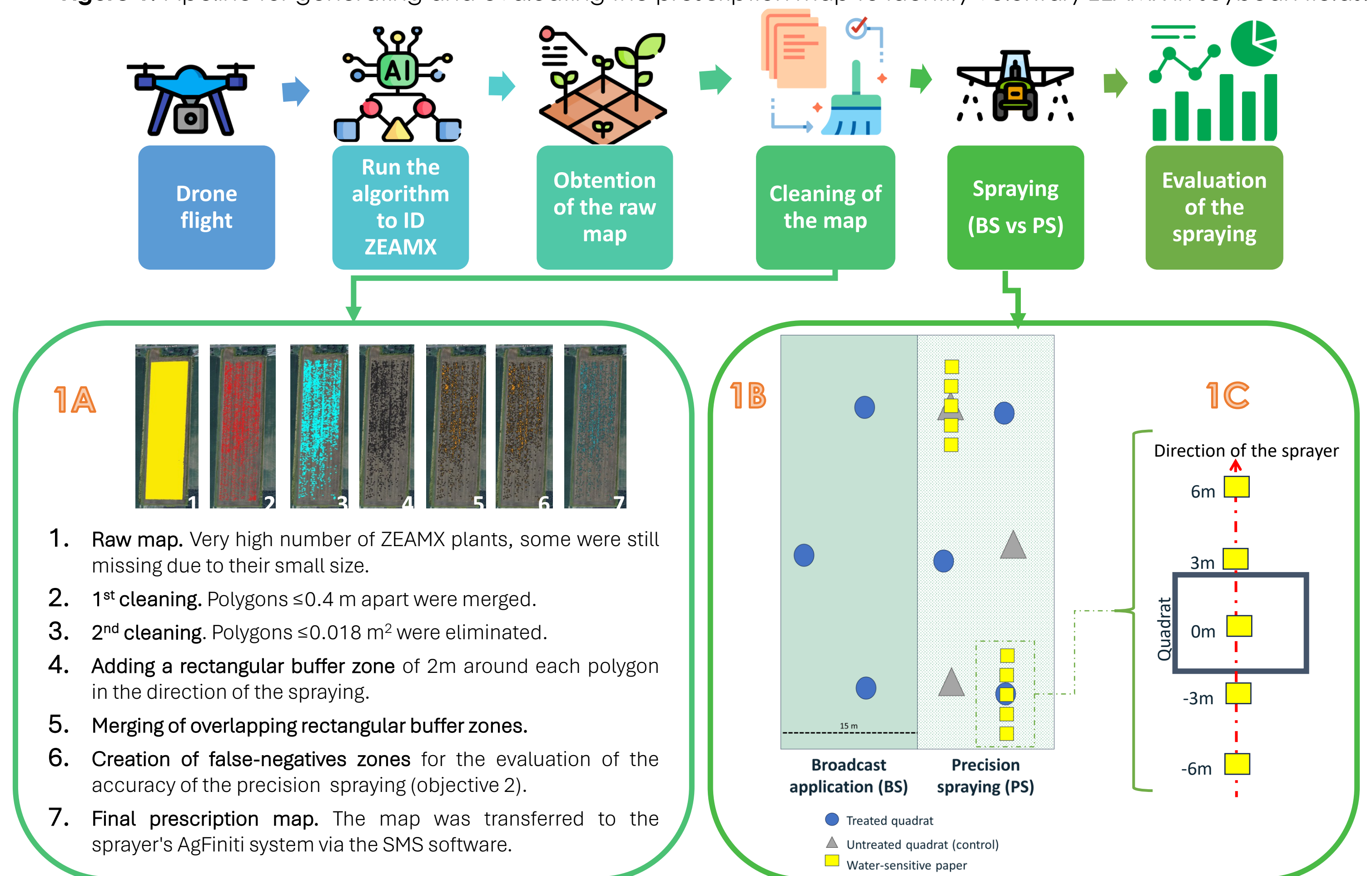


3. Identifying potential barriers to the adoption of this technology.

## Materials and Methods

- A DJI Matrice 350 RTK drone with a Zenmuse P1 camera was used to obtain the orthomosaic of the field at 12 m of altitude on June 20<sup>th</sup> 2025. The operational pipeline for the obtention of the prescription map is described in **Figures 1** and **1A**.
- The prescription map was evaluated by comparing broadcast spraying (BS) and precision spraying (PS) treatments. Each treatment covered half the sprayer's width (~15 m) and included three treated quadrats (1m x 1m) with ZEAMX. The PS treatment also included three untreated quadrats as controls (**Figure 1B**). This design was replicated four times.
- The herbicide used was CONTENDER (clethodim, 0.19 L/ha) at a rate of 161.3 L/ha. The sprayer was a Hardi commander 5500 with 10 sections.
- To assess the precision and quality of the PS treatment, water-sensitive papers were installed on one treated and one untreated quadrat of each repetition (**Figure 1C**).
- Spraying efficacy was evaluated based on the % of control and herbicide damage of ZEAMX (0% no damage to 100% dead plant), at 24h before and 6 weeks after treatment (WAT).

**Figure 1.** Pipeline for generating and evaluating the prescription map to identify voluntary ZEAMX in soybean fields.



## Results and Discussion



Currently, generating a prescription map through our pipeline requires approximately 12 days. Additional steps (2 to 5 in **Figure 1A**) were required to minimize the treated area and reduce herbicide use with the section-control sprayer. To significantly reduce this timeframe, we are investigating advanced deep-learning approaches, including YOLOv4<sup>(5-7)</sup>, and the use of individual nozzle control sprayers.

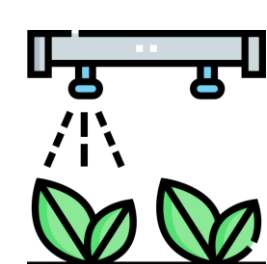
Treated quadrats were sprayed with **91.6 % accuracy for both BS and PS**. However, most control quadrats were unintentionally sprayed (accuracy of 8.3 %), suggesting issues with map alignment, GPS precision<sup>(8)</sup>, or nozzle control timing. Supplementary validation showed a distance of over 8.5 m of distance between the GPS coordinates obtained via the LTE network of a cellphone and the tractor's RTK system, which may have caused a misalignment when manually creating the untreated quadrats.



The initial plan was to conduct trials on four farms using the same sprayer (John Deere 4045r) and operator. Due to technical difficulties, the trial was relocated to a single farm with a sprayer featuring section control (Hardi commander 5500). Support from John Deere and Agritex confirmed that the original sprayer could read the map but not actuate nozzles as instructed. A nozzle-level control upgrade could solve this, though its cost may hinder widespread adoption of this technique.



The **% of ZEAMX control** at 6 WAT for the treated quadrats was **85.9 % for BS and 90.5 % for PS**. ZEAMX showed an **average herbicide damage of 82.5 %** for both BS and PS, mostly dependent on the phenological stage of ZEAMX at the time of the spraying, which may need to be taken into consideration for future stages of the project.



Despite achieving over 85 % ZEAMX control in quadrats, PS plots showed residual weeds, likely due to polygon reduction during map creation and post-spray ZEAMX germination. While reducing polygons saves herbicide, when using a sprayer with section control, it can compromise effectiveness. Individual nozzle control could provide greater precision and further reduce herbicide use.

## Conclusions

- High spraying accuracy (91.6 %) and strong ZEAMX control (90.5 %) in treated quadrats highlight the potential of PS to achieve effective weed management with less herbicide than BS.
- Prescription maps are compatible with some section-control sprayers. Nonetheless, the use of sprayers with individual nozzle control could greatly reduce prescription map creation time, while increasing spraying accuracy and herbicide savings. However, upgrade costs may be a limit for the widespread adoption of this technology in the short term.

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