



The Precision Revolution:

Foundations of Precision Spraying
in Agriculture

PREVIEW





INDEX

About Upstream Ag Insights	3
1. Introduction	5
2. Trends and Drivers of Precision Spraying Adoption	9
3. Types and Approaches of Precision Spraying	16
4. Use Cases for Precision Spraying Technology	24
5. Precision Spraying Workflow	30
6. Adoption Challenges for Precision Spraying Technology	37
7. Adoption Chain Challenges in Precision Spraying Technology	41
8. Benefits of Precision Spraying	45
9. Current Adoption by Region	49
10. Precision Spraying Market Overview	59
11. Precision Spraying Landscape and Company Details	63
12. Other Precision Spraying Solutions and Augmentative Companies	77
13. Incumbent Position	83
14. Impact on the Broader Industry Ecosystem	103
15. Future of Precision Spraying	118
16. Conclusion	123



About Upstream Ag Insights





Upstream Ag Insights is a weekly publication dedicated to providing timely and insightful news, alongside in-depth analysis, at the crossroads of innovation and business within the agriculture sector.

Our mission is to equip you with strategic frameworks and comprehensive perspectives on emerging trends and transformative developments in agriculture, empowering you to make informed and effective decisions for your business.

The newsletter was founded in January of 2020 and is read by 20,000 individuals from over 120 countries including executives, venture capitalists, leading agtech entrepreneurs and the most ambitious agribusiness professionals that aspire to grow their career and have maximum impact on the industry.

The following report was done as a co-development between Upstream Ag Insights and the AgTech Advisory Collective.

About AgTech Advisory Collective

The AgTech Advisory Collective unites a global network of independent experts in agricultural technology to drive impactful change in modern farming. With extensive industry knowledge and an international presence, we support agtech companies globally from launch to scale, providing local knowledge, strategic insights, technical guidance, and connections in key markets. Our mission is to build lasting partnerships that empower innovation, increase efficiency, and foster a sustainable agrifood system—benefiting farmers, consumers, and the planet.

About the Report

Precision Spraying technology is transforming the agricultural landscape, offering innovative solutions to challenges like herbicide resistance, rising input costs, and the environmental impact of traditional spraying methods. This report serves as a foundational guide to the various types of precision spraying technologies available, from Green-on-Brown (GoB) systems that target weeds on fallow land to advanced Green-on-Green (GoG) solutions capable of differentiating weeds from crops in growing fields. By exploring these technologies, we aim to provide agribusiness professionals and growers with a comprehensive understanding of how precision spraying works, the companies leading innovation in this space, and the potential impact on modern farming practices.

In addition to highlighting the opportunities these technologies present—such as significant cost savings, improved weed management, and enhanced sustainability—this report looks at the challenges that must be overcome for broader adoption. By laying this foundation, the report equips readers with the knowledge needed to assess precision spraying's role in the industry and to prepare for its evolving impact on the future of agriculture.



Precision Spraying, also known as See & Spray or Targeted Spraying, is a suite of technologies in agriculture with the potential to reshape weed management practices. As agribusiness professionals and growers face rising challenges—such as weed resistance, input costs, and environmental impact—targeted spraying technologies offer a compelling solution to improve outcomes across the board.

At its core, the concept of Precision Spraying seems straightforward: the technology “sees” a weed and directs the sprayer to apply herbicide only to the targeted plant, without spraying the surrounding crops and soil. But this simplicity in concept belies the technology’s complexity in practice. The effectiveness of Precision Spraying varies widely depending on crop types, regional growing conditions, weed pressure, and the specific solutions used.

Precision Spraying provides significant opportunities for the agriculture sector by optimizing the application of herbicides, contributing to:

- **Improved Agronomic Practices:** By reducing the volume of chemicals applied, Precision Spraying aligns with best practices in sustainable agriculture, allowing farmers to manage weeds without over-relying on broadcast applications, and even potentially decreasing weed seed banks and total control levels.
- **Healthier Crops and Enhanced Yields:** Limiting herbicide exposure to crops reduces the risk of chemical stress, improving plant health and potentially higher yields.
- **Reduced Weed Resistance:** Targeted spraying helps manage herbicide resistance by allowing tailored applications that limit the development of resistant weed strains.
- **Cost Savings:** Precision Spraying minimizes chemical use, leading to cost reductions in herbicide purchasing and application.

Given the dynamic nature of agriculture, it’s crucial to view Precision Spraying technology not just as a new tool but as a holistic shift in weed and agronomy management. While promising, the technology’s adoption requires careful consideration of various factors, including weed species, climatic conditions, and equipment capabilities.

This report aims to offer agribusiness professionals a comprehensive view of Precision Spraying’s benefits, limitations, and best-use scenarios to facilitate informed decision-making.



Types and Approaches of Precision Spraying

The development of Precision Spraying technology has led to a range of innovative approaches, each tailored to specific use cases and operational needs. These methods—Offline Precision Spraying, Online Boom Precision Spraying, Ultra-Precise Precision Spraying, UAV Precision Spraying and Robot Precision Spraying—each bring unique benefits and limitations, influencing their adoption based on factors like weed type, field conditions, and desired precision. Here's a breakdown of each type:

1 Offline Precision Spraying

Offline Precision Spraying leverages drones or satellite imagery to generate weed maps across fields. This method begins with an aerial scan, typically performed by a drone, which identifies weed locations and densities. Using this data, a prescription map is created that specifies exactly where herbicides should be applied. The prescription map is then uploaded to a sprayer equipped with Variable Rate Application (VRA) capability, which applies herbicide precisely according to the mapped weed locations.

Use Case

- Primarily suited for GoB scenarios, such as fallow fields, although it can be adapted for limited GoG applications.
- Useful for larger fields or cases where weeds are spread out, making targeted application more effective than a blanket spray.

Pros

- **Affordability:** Compared to other solutions, Offline Precision Spraying is relatively inexpensive as it doesn't require additional hardware on the sprayer.
- **Waste Prevention:** By mapping weeds beforehand, growers know the exact volume of herbicide required before entering the field, reducing chemical waste.
- **Cloud-Based Processing:** AI models can process imagery in the cloud, eliminating the need for onboard processing power on equipment.

Cons

- **Complexity and Delay:** Requires expertise in drone or satellite operation, which can introduce logistical challenges. There's also a 2-3 day delay between mapping and application, which may reduce accuracy if weed conditions change.



- **Lower Image Resolution:** Aerial images may lack the resolution of ground-based systems, impacting the precision of weed identification.

Example Providers





Comprehensive Benefits of Precision Spraying in Agriculture

Precision Spraying technology brings considerable advancements across multiple dimensions in agriculture. From cost savings and environmental stewardship to improved agronomic strategies, this technology has the potential to reshape weed and crop management fundamentally. Below is an in-depth exploration of the various benefits, with a focus on financial impacts, sprayer design innovations, agronomic improvements, and data and regulatory implications.

Financial Benefits

- 1 **Significant Savings in Herbicide Costs:** Precision Spraying can reduce herbicide use by over 50%, representing substantial savings on a farm's total herbicide expenditure. By targeting only the weeds rather than applying herbicides across entire fields, farmers can drastically cut costs without compromising weed control effectiveness.
- 2 **Environmental Impact Reduction:** Lowering herbicide usage also provides significant environmental benefits, as less chemical runoff enters the surrounding ecosystems. Reduced herbicide application translates to a smaller chemical footprint and aligns with growing regulatory and consumer demand for sustainable farming practices.

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Crop Injury

Cobra Herbicide Postemergence on Double-Crop Soybean

	Broadcast	See & Spray
Spray Savings	NA	80%
Soybean Injury Index		
7 DAT	36	8
14 DAT	29	7
21 DAT	15	3
28 DAT	7	1
Soybean Yield (bu/acre)	42	46

Trial Notes:

- 1 Cobra applied at 12.5 fl oz/acre + COC at 1%v/v
- 2 All soybean injury and yield data were statistically different ($p < 0.05$)
- 3. Trial ID: BRT-24-ISA-DC (Purdue Univ.)

Source: Purdue University, John Deere Agronomy Summit, December 2024

- 3 **Spraying Efficiency Gains:** Precision Spraying reduces the frequency and duration of refilling, allowing farmers to cover more ground with less product. This efficiency not only saves on input costs but also conserves fuel and labor.



Australia



Adoption Status

High Adoption - Early Adopter Market:

Australia is a global leader in adopting precision spraying technology. Its farmers have embraced these solutions early, particularly GoB systems, which have proven effective for managing fallow land in the region's no-tillage farming systems.

Homegrown Innovation and Localized Focus:

Several companies, including WeedIt and Bilberry, have concentrated their initial efforts on Australia, tailoring their technologies to the specific needs of its farming landscape. This has fostered a high degree of familiarity and trust in these solutions.

Drivers for Adoption

1. No-Tillage Dominates Due to Dry Climate:

The arid conditions in Australia make no-tillage farming the norm. Fields often remain fallow for extended periods (5+ months), necessitating effective weed management during this time. Precision spraying aligns perfectly with this need, offering cost and input efficiency.

2. Low Weed Density Maximizes Savings:

With low weed density in many regions, Precision Spraying significantly reduces herbicide use. This enhances the cost-effectiveness of precision spraying, making it an attractive choice for broadacre farms.

3. Large-Scale Broadacre Farms Simplify ROI Calculations:

Australia's expansive farms make it easier to demonstrate the economic benefits of precision spraying. The ability to scale savings across thousands of acres helps justify the investment in these systems.

4. Severe Weed Resistance Problems:

Widespread herbicide resistance, particularly to glyphosate, has created an urgent need for more precise weed control. Precision spraying reduces reliance on blanket applications, enabling targeted management of resistant weeds.



5. Experience with GoB Facilitates GoG Adoption:

The long history of using GoB solutions has created a foundation for quickly adopting GoG technologies. Farmers are already familiar with the value of precision spraying, making the transition to more advanced systems smoother.

6. Open Mindset Toward Innovation:

Australian farmers have a reputation for being early adopters of new agricultural technologies. This innovative mindset has driven the rapid uptake of precision spraying, as growers are willing to experiment with and invest in emerging solutions.

Adoption Challenges

1. Low-Yield Crops and Relatively Low Herbicide Costs:

The region's focus on lower-yield crops, combined with relatively low herbicide costs compared to markets like North America or Western Europe, reduces the financial incentive for precision spraying in some cases.

2. Lack of Regulations and Subsidies for New Technologies:

Unlike regions such as Western Europe, Australia lacks strict regulations or subsidies to drive the adoption of precision spraying. This means farmers adopt primarily for economic reasons, with fewer external pressures or incentives.

3. Lower Budgets and Limited Government Support:

The absence of significant government subsidies for agricultural technology reduces the financial resources available for investment in new equipment. This often leads to longer equipment life cycles, slowing the turnover necessary for rapid adoption.

Australia is a high-adoption market for precision spraying, driven by unique factors like no-tillage farming, low weed density, and the need for efficient fallow land management. The innovative mindset of Australian farmers and the severe weed resistance challenges have further propelled adoption. However, challenges such as low-yield crops, limited governmental support, and longer equipment lifecycles mean that adoption relies heavily on clear and immediate economic benefits. Continued innovation in affordable and adaptable solutions will be key to sustaining Australia's leadership in precision spraying technology.



Precision Spraying Market Overview

The precision spraying landscape is constantly evolving. Below are insights into the key organizations in this space, along with an overview of the main use cases their products support.



Providers of Online Boom Precision Spraying Technology

This overview highlights the key entities in online precision spraying and the solutions they offer, specifically targeting the row crop and broad-acre markets with solutions for boom sprayers.

Precision Spraying Entities Upstream

COMPANY	PRODUCT
JOHN DEERE	See & Spray Ultimate, Premium
CNH INDUSTRIAL	AUGMENTA SenseApply
AGCO <small>Your Agriculture Company</small> PTx Trimble	WeedSeeker Precision bilberry
Greeneye TECHNOLOGY	Greeneye Sprayer
BASF BOSCH	ODE <small>THE SMART SPRAYER</small>
WEED-IT <small>PRECISION SPRAYING</small>	Quadro
EXXACT ROBOTICS	3S Spot Spray Sensor
DAT <small>Remote Ag Solutions</small>	Ecopatch
DeepAgro	Sprai
SOLINFTEC	Solix
Carbon Farm	Smart Striker X
SAVEFARM <small>PUVERIZAÇÃO SELETIVA</small>	SaveFarm
Aotecnic	SenseSpray
ATAR	Smart Sprayer



Company	John Deere
Description	John Deere has integrated Blue River Technology into its product offerings, developing advanced precision spraying solutions for both GoB and GoG use cases, emphasizing row crop markets.
Country	United States (Santa Clara, California)
Product(s)	<ul style="list-style-type: none"> • See & Spray Select (GoB) - Launched in 2021 • See & Spray Premium (Retrofit) - Launched in 2023 • See & Spray Ultimate (GoG) - Launched in 2022
Year Founded	2011 (Blue River Technology acquisition in 2017)
Investors	Blue River Technology raised approximately \$30 million before being acquired by John Deere. Key investors included Khosla Ventures.
Use Cases	<ul style="list-style-type: none"> • GoB and GoG precision spraying. • Band spraying and canopy spraying for fungicides, insecticides, and micronutrients.
Distribution Channels	<ul style="list-style-type: none"> • John Deere dealerships with strong field demonstrations through dealers or direct outreach.
Strategic Partnerships	  partnerships for agronomic and integrated solutions.
Target Market <i>(Crops, Countries)</i>	<ul style="list-style-type: none"> • Crops: Corn, soybeans, cotton. • Countries: Primarily North America, with expansion to South America and localized products in Europe.
Business Model	<ul style="list-style-type: none"> • Pricing: \$143,500 for See & Spray Ultimate; \$25,000 for See & Spray Premium retrofit. • Yearly Fee: \$3/acre for corn, \$4/acre for soybeans and cotton, and \$1/acre for non-crop areas (pricing to change in 2025 to \$5/acre for non-sprayed areas).
Market Adoption <i>(if public)</i>	<ul style="list-style-type: none"> • Approximately 1 million acres covered (per John Deere sustainability report). • Estimated 200 units in the market as of today, with a sales projection of around 1000 units in the near future.
Retrofit <i>(Y/N)</i>	Yes (for See & Spray Premium, available for model year 2018 and newer sprayers).
Operating Speed	Up to 15mph for Ultimate, 12mph for Premium.
Night Spraying <i>(Y/N)</i>	Limited; only available for See & Spray Select.
Dual Tank <i>(Y/N)</i>	Yes (available on See & Spray Ultimate only).
Type: Section/Patch/Spot	Precision spraying with precision at the nozzle level (spot accuracy).



We are still in the early stages of commercializing precision spraying solutions, and wide-scale adoption remains a distant goal. However, it's already clear that this technology creates significant value and is poised to become a crucial tool in the farmer's and agronomist's toolbox. Below, we explore how this technology could evolve and the impact it may have on spraying systems.

Expanding Use Cases

As highlighted in this report, the applications of precision spraying are vast. Most current solutions focus narrowly on spotting weeds, but there is significant potential to broaden these use cases. Expanding functionalities will make precision spraying more versatile and improve its ROI. Here are a few high-interest examples:

- **Selective Weed Spraying:** Targeting individual weed species with customized treatments.
- **Band Spraying:** Spraying specific areas, such as crop rows or between rows, for fungicide and insecticide applications.
- **Online Variable Rate Spraying:** Dynamically adjusting spray rates based on the crop canopy during application.
- **Insect and Disease Detection:** Although further in the future, this functionality could allow targeted spraying for pests and diseases.

Adding these use cases will increase the versatility of precision spraying, making it more valuable for diverse agricultural needs.

Achieving Higher Precision

The risk of missing weeds remains a significant concern for precision spraying solutions today. However, as more systems are deployed, the vast amounts of data collected will continuously refine and improve detection models. Over time, this process will enhance accuracy, increase hit rates, and enable the detection of even smaller weeds.

Another aspect of achieving higher precision is the ability to identify individual weed species and provide tailored treatments for each. This ties directly to selective spraying use cases and highlights the need for sprayers to be equipped with multiple tanks. These tanks can hold various herbicide mixes, ensuring that the right mode of action is available for different weed species.



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