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Guide to Ultra-High Precision Spraying

Technical User Guide



Table of Contents

1. Introduction 3
   1.1. Foreword 4
   1.2. Weeding 5
   1.3. Broadcast Spraying 7
   1.4. High Precision Spraying 8
   1.5. Ecorobotix Ultra-High Precision (UHP) 9
   1.6. ARA, the Ultra-High Precision Sprayer 14
2. How can I Integrate my UHP into my Weeding or Crop Care Strategy? 15
   2.1. Application Modes 16
3. The Golden Rules 19
   3.1. Check the Crop Growth Stage 21
   3.2. Adjust to the Weed Density 22
   3.3. Set the Target Volume 23
   3.4. Choose the Herbicide and Its Dosage 24
   3.5. Adjust the Safety Zone 25
4. Integration and Spray Mixture Preparation 27
   4.1. Integration of UHP into the Crop Management Program 28
   4.2. Spray Mixture Preparation 29
5. Experience feedback 30
   5.1. Gebr. de Zeeuw, Netherlands 31
   5.2. SCEA La Madrague, France 32
   5.3. Sarl Pavillard, Switzerland 33
   5.4. Hannes Besenthal, Germany 34
   5.5. VCS AGRONOMY, United Kingdom 35
   5.6. S.C.A. PRIMACOOP, France 36

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Guide to Ultra-High Precision Spraying

1. Introduction

1.1. Foreword

Why This Guide?

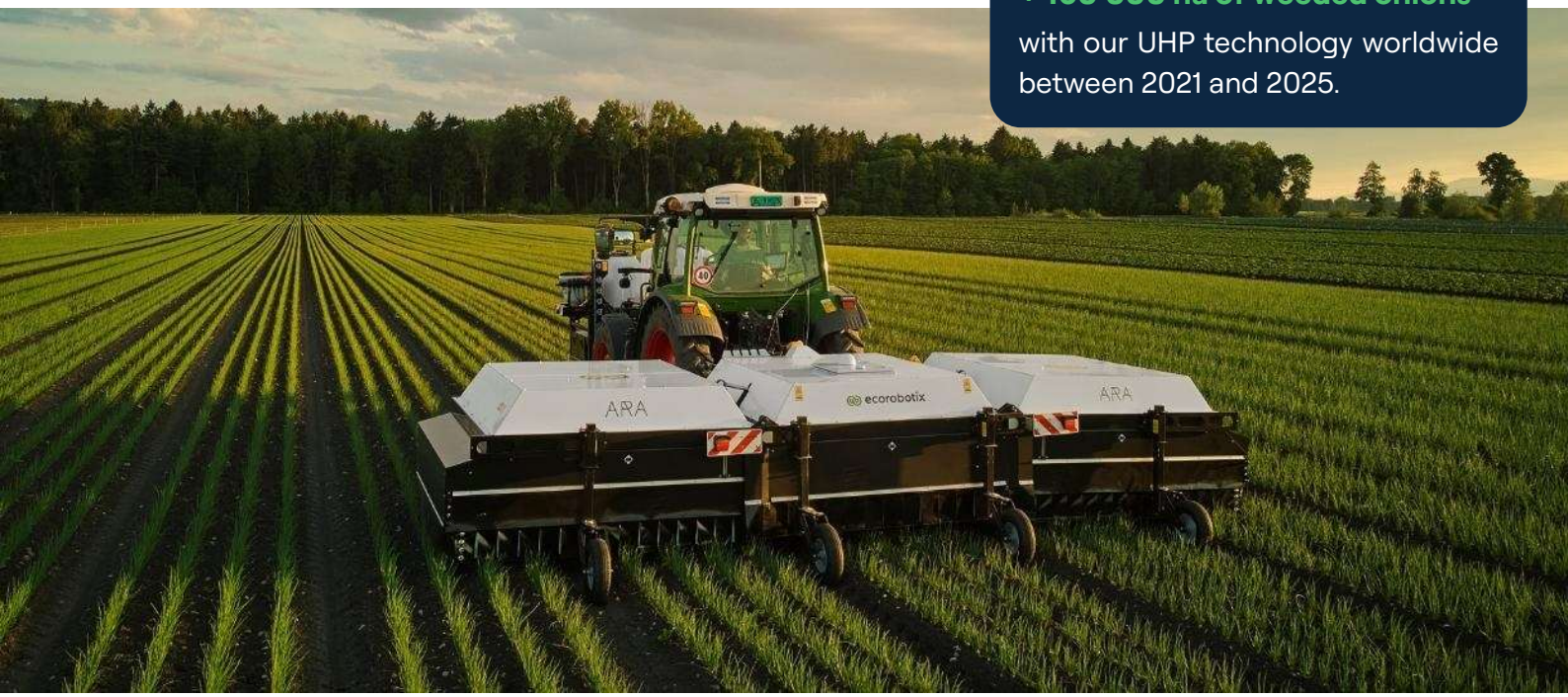
This guide aims to present Ultra-High Precision (UHP) spraying and to show how this technology represents a major advance for modern agriculture. You will discover the challenges that UHP helps to solve, the concrete benefits it provides in weed management, as well as the agronomic results obtained thanks to ARA.

It also describes in detail the five golden rules of UHP, which are essential to guarantee optimal use, offers practical advice for preparing your spraying missions, and illustrates these principles through real case studies demonstrating the technical and economic advantages of this technology.

Who is Ecorobotix?

Ecorobotix is a Swiss company that relies on more than ten years of experience in the field of artificial intelligence applied to agriculture. Today, it stands out as the world leader in Ultra-High Precision spraying. Its solutions help farmers reduce their costs, improve the efficiency of their treatments, and optimize their yields. Thanks to the unique combination of UHP and AI, each drop of product is applied with extreme precision, which makes it possible to limit environmental impact while increasing crop productivity.

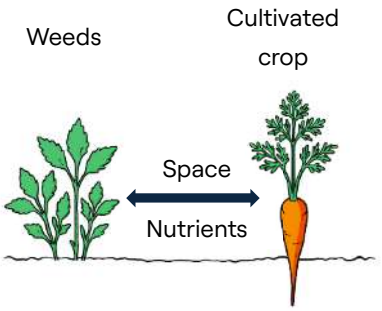
+ 160'000 ha of weeded onions
with our UHP technology worldwide between 2021 and 2025.



1.2. Weeding

Principles

Why weed?



Weeding is an essential step in the technical itinerary, as it makes it possible to control weeds, those undesirable plants that compete directly with the crop. Their presence is far from insignificant: it reduces yield, alters the quality of the harvest, and decreases profitability.

Without intervention, weeds take up water, light, and essential nutrients, particularly during the early growth stages, when the crop is most vulnerable. Certain species can also encourage the appearance of diseases or complicate the harvest by slowing down its progress. In this sense, weeding is a key operation to ensure the proper development of crops and to guarantee the overall performance of the production system.

How to weed?

The effectiveness of weeding depends both on the chosen strategy and on the technologies available on the farm. The cost and implementation vary from one approach to another, and no single method on its own allows durable control of weeds. In practice, it is the combination of several techniques that ensure effective and lasting control of weed pressure.

Manual	Pulling out weeds by hand or with the help of tools. A precise method, but very demanding in terms of time and labor.
Mechanical	Use of tools that cut, pull out, or bury the weeds. Effective, but its efficiency depends on soil conditions and the growth stage of the weeds.
Chemical	Application of substances that act on the vital functions of undesirable plants, causing their degeneration. Fast and effective, but subject to environmental and regulatory constraints.
Thermal	Destruction of plant tissues through heat (flame, laser, hot water, or hot oil). Reduces the use of chemical products but requires high energy consumption.

Challenges

The different weeding solutions offer varying levels of effectiveness. Each has its place in modern agriculture, but they also present constraints and limitations that are important to know to plan interventions efficiently.

Manual Weeding



- High labor cost.
- Recruitment difficulties.
- Demanding and time-consuming work.

Chemical Weeding



- Environmental and health impact.
- Variable effectiveness and/or appearance of resistance.
- Increasing regulatory constraints.
- Phytotoxic stress on the crop.

Mechanical Weeding



- Limited working windows.
- Average precision.
- Soil disturbance.
- Return of the seed bank.

Thermal Weeding



- Limited working windows.
- Low work rate.
- High costs.
- High energy consumption.

1.3. Broadcast Spraying



Advantages

Spraying remains today the most widely used method to control weeds in conventional agriculture. It offers the possibility to apply plant protection products quickly and efficiently. Compared to other weeding solutions, it presents several major advantages that explain its widespread adoption.

Efficient	Versatile	Flexible	Economical
Speed and Effectiveness.	Weeding and crop care.	Less sensitive to weather conditions.	Low operating cost.

Challenges

Spraying, although effective and widespread, presents significant limitations.

1) It remains highly dependent on chemical inputs, a significant part of which disperses into the environment. This drift contributes to ecological and health impacts that are increasingly criticized by public opinion.
2) On the crop itself, contact with the active substance can cause phytotoxic stress, slow down growth and reduce the yield and quality of the crops.
3) Producers also must deal with two major issues: the gradual withdrawal or restriction of many molecules, which lead to technical dead ends, and the emergence of resistances that reduces the effectiveness of available products.

Despite these drawbacks, spraying often remains the reference solution in the absence of an economical alternative. It must now be used in a more precise and reasonable way.

Environmental Impact	Technical Constraints	Phytotoxicity Stress	Social Pressure
Consumption and drift of chemical inputs.	Molecule removal and increasing resistance	Risks for the crop, yield and quality affected.	Spraying practices increasingly criticized.

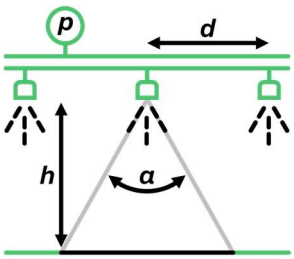
1.4. High Precision Spraying



What if It Were Possible to Keep the Advantages of Spraying While Reducing Its Limits?

Precision spraying addresses this issue by allowing plant protection products to be applied only where they are truly needed. This is also referred to as **localized spraying** or **spot spraying**.

A "spot" corresponds to a targeted area on the ground that receives the product. Its size depends on several parameters: the spraying angle **(α)** and pressure **(p)**, the height of the boom **(h)**, and the spacing between the nozzles **(d)**. In the direction of travel, the length of the spot is determined by the opening time of the solenoid valves and by the tractor's speed.



In Practice, Different Technologies Use This Principle to Perform Precision Spraying

Some are based on prior mapping, for example using drones, which identify infested areas and generate treatment maps that are then used by the sprayer. This approach makes it possible to target applications but shows technical limitations.

Other technologies work in real-time detection, thanks to optical sensors that analyze the vegetation and activate the nozzles according to predefined thresholds. These systems reduce the use of plant protection products, but the size of the treated zones remains large and does not allow each weed to be targeted individually. Of course, there are different levels of precision depending on the onboard sensors, the type of nozzles, and their spacing.

It is precisely at this stage that **Ultra-High Precision (UHP)** developed by **Ecorobotix** marks a breakthrough. While other technologies still treat larger or smaller zones, UHP makes it possible to go down to just a few tens of square centimeters, allowing each weed to be targeted individually.

1.5. Ecorobotix Ultra-High Precision (UHP)



Reduce Plant Protection Products. Yes, but While Maintaining Effectiveness.

Precision spraying helps reduce the use of plant protection products, but its resolution remains too limited to prevent the crop itself from being affected, creating a risk of phytotoxicity. Its lack of precision also makes it impossible to use natural, alternative, or non-selective molecules, which are becoming more and more important given the gradual withdrawal of many substances from the market. A more revolutionary solution is therefore necessary.

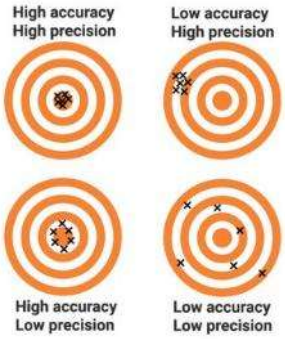
What is Ultra-High Precision (UHP)?

Ultra-High Precision brings this revolution. It enables farmers to apply a wide range of plant protection products, including non-selective herbicides, only where they are needed. Its unmatched accuracy guarantees optimal efficacy while protecting the crop. Unlike conventional precision spraying, UHP drastically reduces the volumes applied, input and labor costs, and significantly limits phytotoxicity. It deposits the active substance exactly at the desired location, no more, no less.



How Ultra-High Precision Works?

Ultra-High Precision (UHP) is based on four core pillars that ensure every drop of product is applied exactly where it's needed, no more, no less.



1) **Accuracy**: the ability to place the spray exactly at the center of the target.
2) **Precision**: the ability to consistently repeat this centered spray.
3) **Resolution**: determined by the nozzle spacing and the opening time of the solenoid valves, it defines the size of the spray spot.
4) **Detection capability**: the ability to reliably identify and distinguish each individual weed.

Ultra-High Precision spraying stands out through advanced detection capability, high spraying accuracy and precision, as well as high nozzle resolution.

Below, a comparison highlights the difference in scope of action between the main technologies, from conventional spraying to Ultra-High Precision.

Use Cases		Broadcast	Low Precision	High Precision	Ecorobotix UHP
Spraying	**Spray accuracy and precision**				
	Spray targets accurately and precisely in ridges	✗	✗	✓	✓✓
Weeding	**Reduction of plant protection products**	✗	✓	✓✓	✓✓✓
	Ability to accurately protect the crop				
	Control problematic weeds	✗	✗	✗	✓
	Use alternative non-selective or organic molecules	✗	✗	✗	✓
	Significantly reduce phytotoxicity on the crop	✗	✗	✓	✓✓
	Size based decision making				✓
Crop care	**Reduction of plant protection products**	✗	✓	✓✓	✓
	Size based decision making	✗	✗	✗	✓
Thinning	**Thinning**	✗	✗	✗	✓

Effects and Advantages of Ultra-High Precision

Reduction of Phytotoxicity



By applying the herbicide in an ultra-localized way, the active substance has little to no effect on the crop. The reduction of residues simultaneously ensures a harvest that is more respectful of consumer health.

Reduction of Plant Protection Products



By spraying only where the chemistry is truly necessary, and therefore effective, the use of plant protection products can be reduced by up to 95%, thus minimizing environmental and health impact.

Gain in Effectiveness



UHP targets weeds directly, so the right amount of product reaches the plant, minimizing losses from drift or evaporation and improving control efficiency.

Reduction of Manual Labor



UHP allows the use of non-selective herbicides and alternative solutions, ensuring effective control even against resistant weeds, while avoiding the need for manual weeding.

Alternative to Chemistry



UHP spraying makes it possible to use nonselective plant protection products of natural origin in established crops, offering an alternative when no synthetic molecules are available on the market.

Regulatory Advantage



Access to demanding certifications such as “Zero Residue” and qualify for environmental subsidies linked to input reduction. Enhances production value while improving the profitability of investment.

Agronomic Results

Treatment Effectiveness

UHP ensures maximum weed control. In the example, seven-leaf amaranths are destroyed ten days after the UHP treatment.



Figure 1 – 7-leaf amaranths comparison
Anne et al., 2024, Frontiers

Crop Vigor

Crops treated with UHP show greater vigor compared to a conventional treatment. This difference is explained by the reduction of phytotoxicity caused by herbicide products, made possible by ultra-local application.

This picture compares two bean plots on the same field: on the left, the UHP treatment; on the right, the broadcast treatment.



Figure 2 - Plots of beans comparison

Harvest Quantity

The combination of better treatment effectiveness and a less stressed crop results in a measurable increase in yields. Yield increases of up to **15%** have been observed depending on crop conditions.

Effect of Weed Control Strategies on Yield, Ecorobotix Trials, 2025

Carrot, 2025

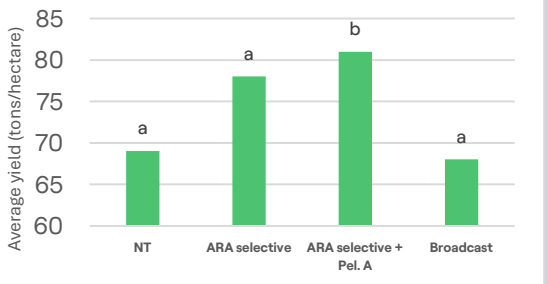


Figure 3 – Comparative Carrot Yields,
p = 0.0312, Tukey test, letters indicated Statistical differences

Onion, 2025

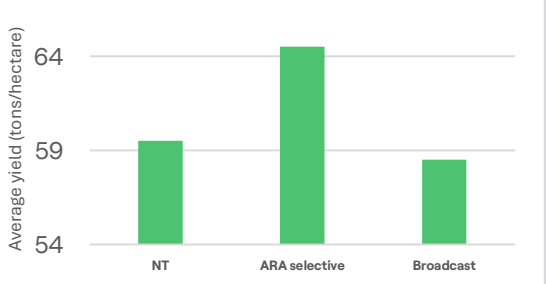


Figure 4 – Comparative Onion Yields
Tendency to yield increase

Legend : **NT** = not treated ; **Pel A** = pelargonic acid treatment with ARA ; **ARA selective** = selective treatment with ARA ; **Broadcast** = selective treatment with conventional sprayer

Harvest Quality

A win-win combination: Higher quality for both the producer and the consumer.

Spot spraying contributes to converge each plants full potential. By reducing chemical stress, crops grow more uniformly, develop more quickly, and can develop higher nutrient content. The result is a healthier, more balanced crop with no plant protection product residues and superior harvest quality.

A **healthy** product free from plant protection products



Better uniformity of sizes



Larger-sized produce

Earliness

UHP treatments often lead to an earlier harvest, allowing crops to reach maturity faster and more uniformly. This results in earlier market availability, offering farmers a competitive advantage and the opportunity to capture better prices. In addition, harvesting can take place under optimal conditions, reducing field losses and ensuring better product quality.



Figure 5 – Comparison of endive plots

1.6. ARA, the Ultra-High Precision Sprayer

Ultra-High Precision is not limited to weeding. The same technology makes it possible to apply, with great accuracy, a wide range of plant protection products, not only herbicides, but also fungicides, insecticides, or biocontrol solutions. This versatility ensures that each product acts only where it is needed, while reducing the volumes used.

This increased precision limits phytotoxicity, preserves crop vigor, and improves the overall performance of treatments. In context of the gradual withdrawal of molecules and increasing resistances, UHP offers producers unique flexibility to secure and reinforce their technical itineraries while reducing their costs.



- 156 high-precision spray nozzles spaced 4 cm apart.
- 6 × 6 cm spot size.
- A 6.20 m working width.
- Up to 4 ha/hour at a speed of 7.2 km/h.
- Operates day and night.
- 1.5 to 2 m adjustable wheel spacing.
- Double front tank of 600 L water tank & 300 L mixture tank.

Targeting	Treating	Protecting
Plant-by-Plant identification ensures reliable detection.	Treats only what's needed, nothing more.	Preserves the crop and reduces phytotoxicity.

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Guide to Ultra-High Precision Spraying

2. How can I Integrate my UHP into my Weeding or Crop Care Strategy?

2.1. Application Modes

Weeding

Weeding is a key step to ensure both harvest quality and high yields. With a UHP sprayer, two weeding strategies can be implemented:

Maintenance Strategy

The maintenance strategy consists of keeping the field clean from the earliest growth stages of the crop. It relies on several successive treatments throughout the season to continuously control weed emergence.

This approach helps maintain a healthy field while minimizing phytotoxicity that would be induced by a conventional treatment.

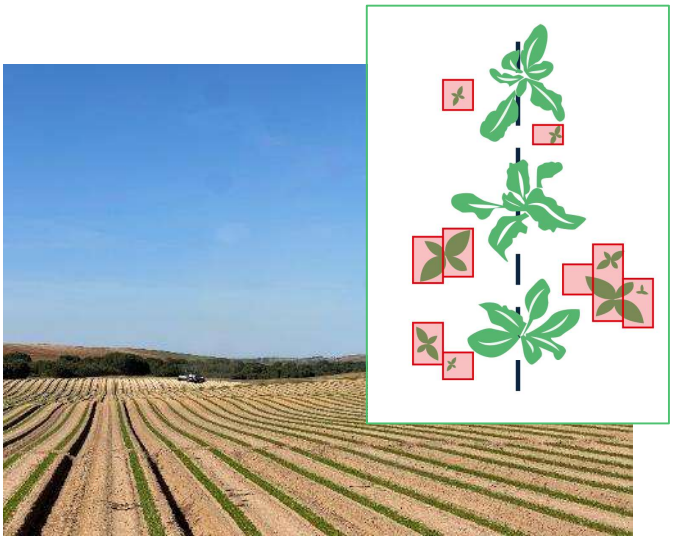


Figure 6 - Maintenance treatment on 3-leaves carrots

Catch-up Strategy

The catch-up strategy aims to control weeds that were not eliminated during an initial pass, whether mechanical or chemical.

UHP technology allows intervention later in the season by applying spot-spraying as close as possible to the crop while protecting it with a safety zone.

This approach enables the use of higher doses or non-selective products, ensuring high effectiveness even in an already well-established crop.



Figure 7 - Catch-up treatment against volunteer potatoes in carrots.

Crop Care

Beyond weeding, Ultra High Precision opens new perspectives for crop care. It enables the ultra-localized application of plant protection products on selected crop plants of a wide range of crop protection products directly onto the crop, while reducing environmental dispersion.

Fungicides, Insecticides, Foliar Fertilizers, Biostimulants, and Biocontrol

By targeting only the crop, you apply the product precisely where it is needed to maximize treatment efficiency.

- Save up to 90% of sprayed products (depending on crop size)
- Optimize fertilizer and biostimulant application while reducing input costs
- Limit environmental impact and nutrient leaching in the soil



Figure 8 - Application of foliar fertilizer only on smaller crop plants.

The advantage of using **ARA** for crop care lies in its ability to target only the plant to be treated, regardless of its growth stage or the issue encountered. Thanks to UHP technology, no product is wasted outside the target, which maximizes application efficiency.

Thinning

Beyond weeding and crop care application, Ultra High Precision opens new perspectives for thinning. It involves reducing the number of excess plants in a seeded crop row in order to achieve optimal spacing and density.

Main objectives of thinning :

1) **Optimize** spacing and density:
    - To maximize marketable yield
    - For uniform development and visual quality of products
2) **Reduce** manual work



Figure 9 - Unthinned lettuce

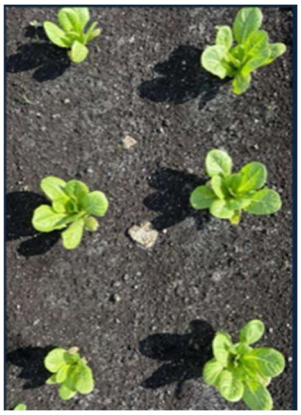


Figure 10 - Thinned lettuce

Thinning parameters depend on several factors, such as crop growth stage, seeding distance, presence of multiplants, agronomic goals. Below, a parameters recommendation table:

	Main Recommendation	Alternatives
Optimal Spacing	According to seeding distance and density objectives	
Minimal Spacing	-20% of the optimal spacing fits most situations	Lower minimum spacing offers more flexibility for density optimization
Safety zone	0.75" fits all situations	<0.75" offers more precision but may induce slight phytotoxicity
Multiplant Removal	OFF fits all situations	ON eliminates most of the overlapping plants
Crop Growth Stage	Lettuce BBCH 10 - 12	Lettuce BBCH 12+ depending on seeding distance
	Brassica BBCH 10 - 11	Brassica BBCH 11+ depending on seeding distance
Speed	2.5 mph fits all situations	Up to 3.5 mph for wider seeding patterns (e.g. 4" spacing)

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Guide to Ultra-High Precision Spraying

3. The Golden Rules

This chapter provides practical guidance for making the most of your UHP sprayer. It brings together key points to consider, usage tips, and technical recommendations to help you integrate Ultra-High Precision technology effectively into your weeding program.

Beyond technical parameters, the goal is to ensure consistent results in the field, optimizing treatment efficiency while protecting your crops. By following these best practices, you will maintain reliable performance and fully benefit from the precision that defines UHP.

It is therefore strongly recommended to carefully adhere to the principles described below.

1

Check the Crop Growth Stage

Make sure the crop is not too young and that conditions allow reliable detection by the machine.

2

Adapt UHP to Weed Density

Identify the type and density of weeds present in the fields to adjust your treatment strategy accordingly.

3

Set the Target Volume

Define the quantity of product to be applied per hectare, based on the growth stage and sensitivity of the weeds.

4

Choose the Herbicide and its Dosage

Select the appropriate herbicide and dosage according to your objectives and the target species.

5

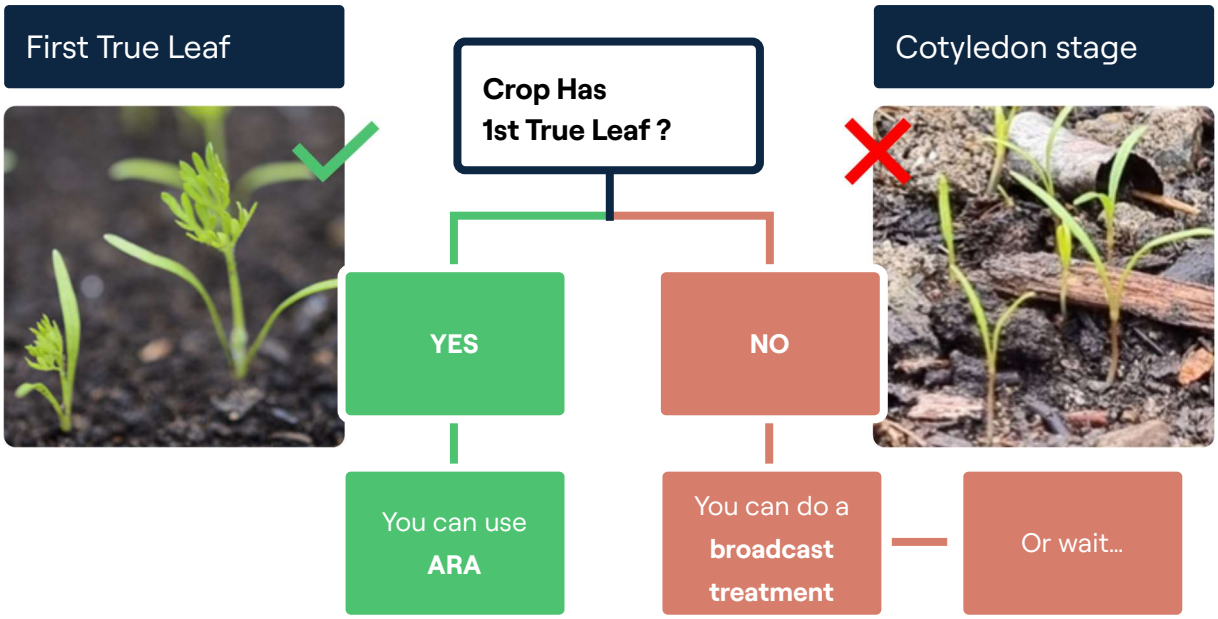
Set the Safety Zone

Set the safety zone around the crop to the minimum necessary, depending on your weeding objectives.

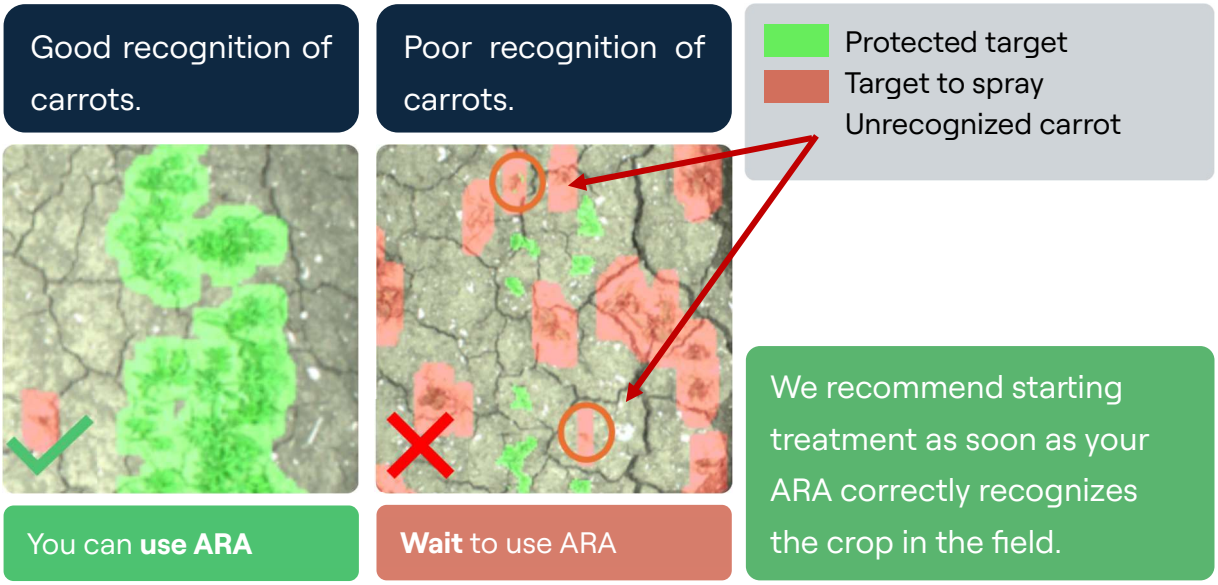
1 Check the Crop Growth Stage

Effective weddings start with a well-protected crop. It is therefore essential that the crop is properly recognized by the machine. Ecorobotix guarantees crop recognition from the first true leaf stage; treatment before this stage is not recommended.

Recognition by ARA is guaranteed only for commercial crops integrated and validated by Ecorobotix. Reliable recognition cannot be ensured for non-approved crops or varieties.



Even when detection is confirmed, it remains essential to verify the recognition of your crop using the images generated by ARA. These images are directly accessible from the user interface once you are in the field. In order to see the best possible detection with the outline of each plant, you must set a safety zone of 0 cm.



2 Adjust to the Weed Density

The benefits of an UHP sprayer are maximized when weed pressure is low. The higher the density, the more difficult it becomes to protect the crop effectively from collateral effects caused by the application of plant protection products. That is why it is recommended to perform pre-emergence treatment to limit weed density and fully benefit from UHP precision.

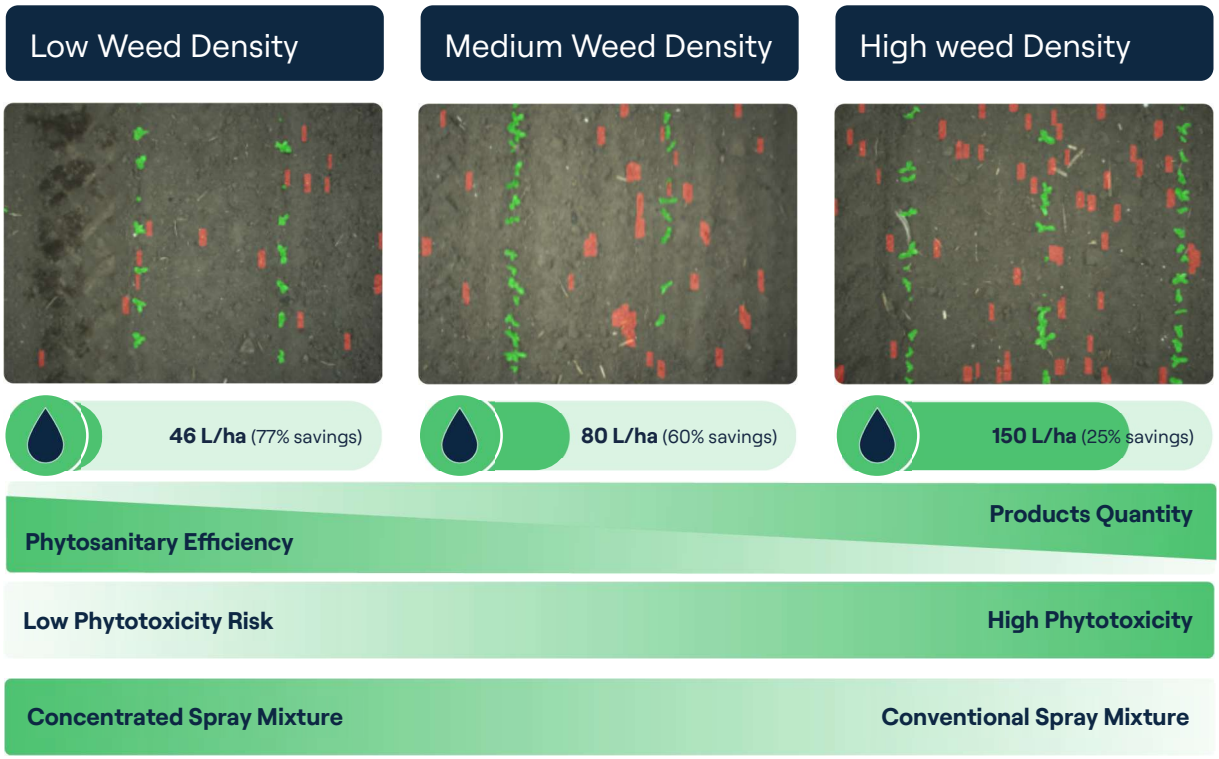
It is also advised to intervene as early as possible in post-emergence contexts to keep the field clean from the beginning of the crop cycle.

In case of heavy infestation

If the weed density is such that almost all nozzles are triggered, a broadcast treatment may prove more economical and more effective. This treatment helps reduce weed pressure and optimize the use of the UHP sprayer for subsequent passes. If broadcast treatment is not possible (for example, due to the absence of an effective herbicide), it is essential to define an appropriate safety zone to protect the crop while targeting weeds as accurately as possible.



Spraying Strategy According to Weed Density

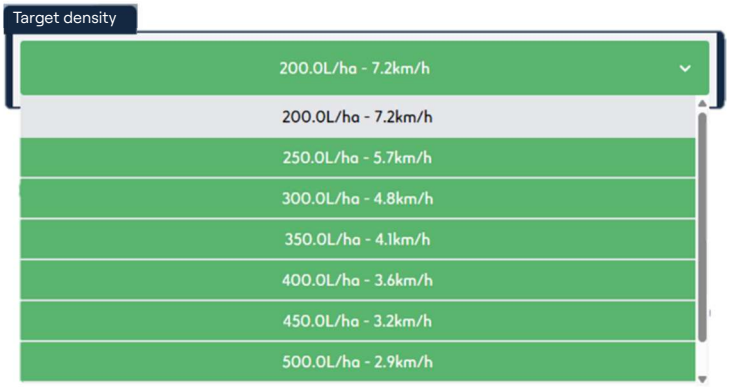


3 Set the Target Volume

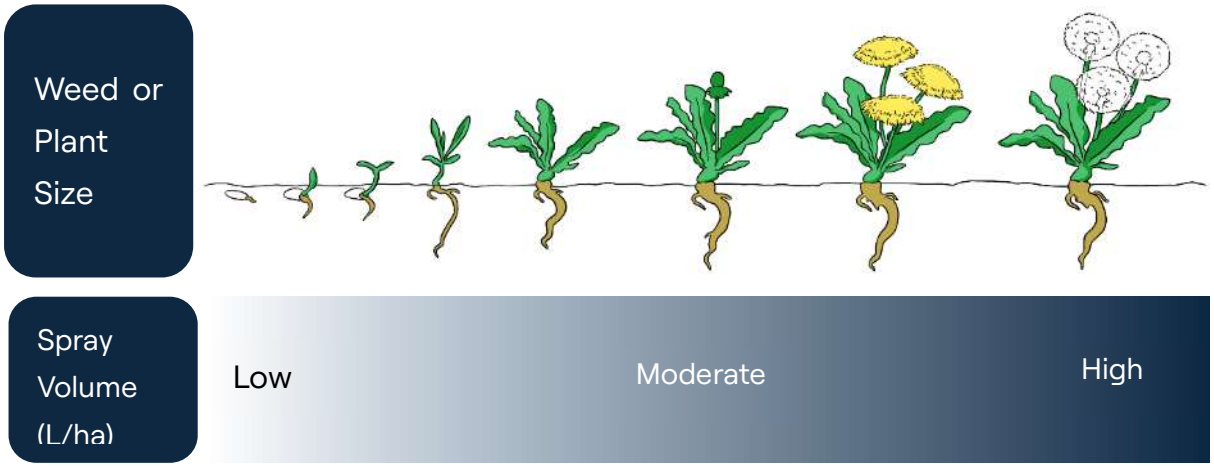
The **target density** plays a decisive role in the quality of the treatment and must be adapted to the type of weeds present in the field. Before each operation, the machine prompts you to define this volume (expressed in L/ha). It must be adjusted according to the type and size of the weeds observed.

When weeds are young, a low target density, around 200 L/ha, is generally sufficient. The greater the leaf mass, the higher the volume must be to ensure good penetration of the active substance. Certain problematic weeds (regrowth, nightshade, amaranth, datura, etc.) require a higher level of coverage, especially at advanced growth stages.

The selected target density corresponds to the flow rate that the machine would apply during full-field treatment. It serves as a reference for calculating the actual consumption and the savings achieved (see Spray Mixture Preparation).



Adjust the Target Density According to the Weed Size



4 Choose the Herbicide and Its Dosage

How to choose the right herbicide

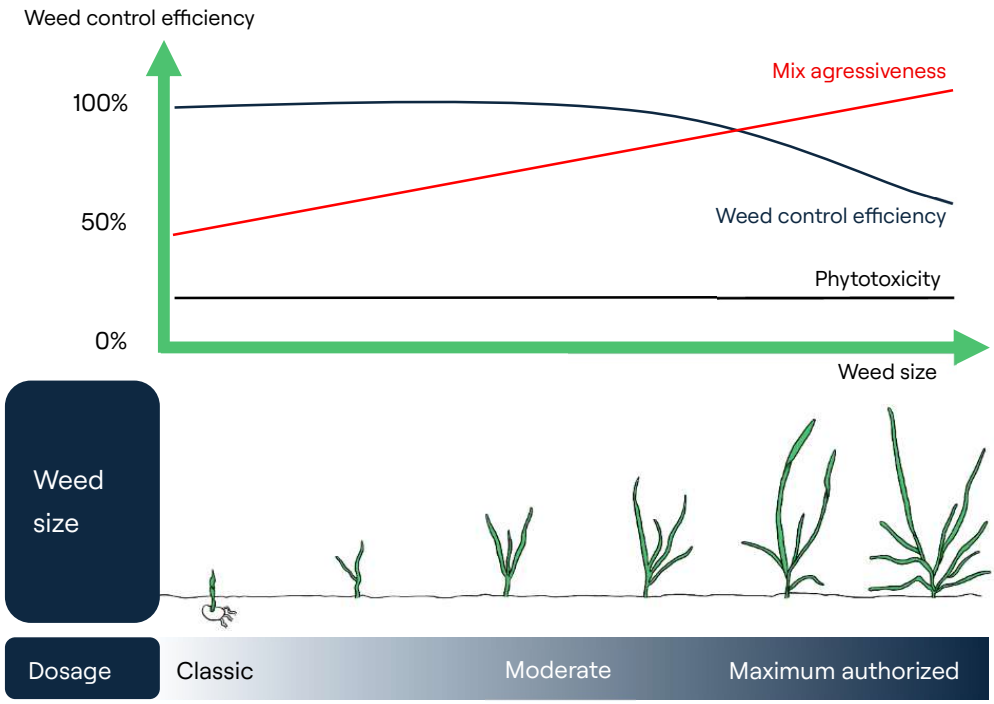
The selection of herbicide depends on the species present in the field:

- Whenever possible, always prioritize a **selective herbicide** when it is available and effective for your crop, as it limits the risk of phytotoxicity in case of contact with the crop.
- Alternatively, a **non-selective herbicide** may be used when selective products are no longer sufficiently effective or unavailable, but it presents an increased risk for the crop and therefore requires the implementation of an appropriate safety zone (see part 5 of the Golden Rules).

Adjust the dosage

Once the herbicide has been chosen, adjust the dosage according to the growth stage and resistance level of the weeds. An appropriate dosage ensures effective weed control in a single pass, thereby reducing the number of interventions, workload, and mechanization costs.

Dosage adjustment reference according to weed size



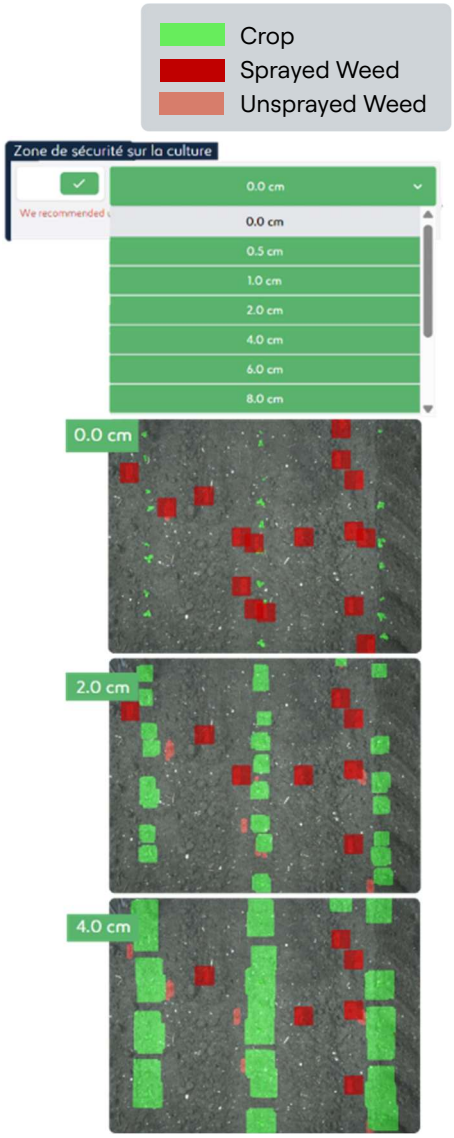
UHP technology maintains optimal weed control efficiency, even on well-developed weeds, while keeping phytotoxicity on the crop to a minimum.

Make sure that the selected herbicide and its dosage comply with your country's regulations.

5 Adjust the Safety Zone

What is a safety zone?

The safety zone is a virtual extension around the detected crop. Its size, expressed in centimeters, can be adjusted in the user interface. Once set, the UHP sprayer does not spray within this zone or on the crop itself.



Advantages and limitations

The safety zone protects the crops from burns or phytotoxic stress caused by the application of low-selectivity or non-selective products. However, the larger the safety zone, the farther the spray is applied from the crop, which may reduce weed control effectiveness within the row.

What to consider when adjusting the safety zone?

The safety zone must balance crop protection with weed control efficiency.

A zone that is too wide reduces the risk of phytotoxicity but leaves more weeds in the row; a zone that is too narrow increases efficacy but raises the risk of crop contact.

- **Product aggressiveness and selectivity**: The less selective the herbicide or the more likely it is to cause damage at low doses (e.g., glyphosate, glufosinate), the larger the safety zone should be. Conversely, with a selective herbicide that is well tolerated by the crop, the zone can be reduced.
- **Row spacing**: If row spacing is narrow, it is preferable to reduce the safety zone to avoid missing too many weeds close to the crop line.

A safety zone set to 0 cm does not mean it is deactivated. With this setting, the sprayer never applies any product directly onto the crop.

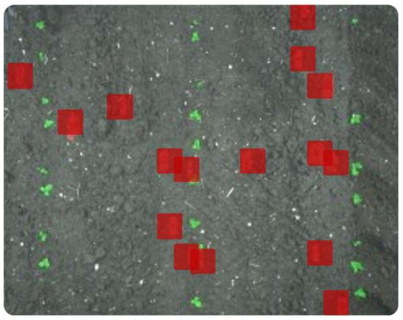
Beware of spray mist!

When weed density is high, the simultaneous opening of many nozzles can cause mist formation. Under these conditions, protecting the crop becomes more difficult, and the safety zone alone is no longer sufficient to prevent the product from reaching the crop directly.

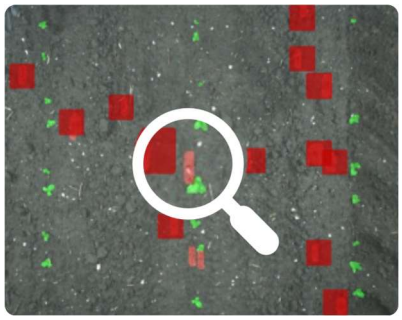
Weeding Efficacity

Safety Zone

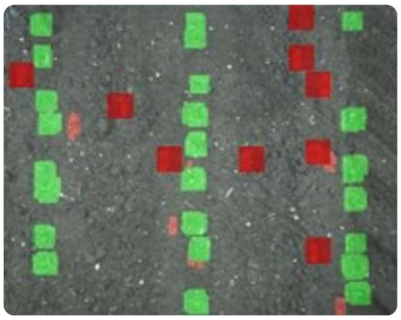
Early-stage crop, 36 cm row spacing



Safety zone disabled
16/16 weeds targeted (100%)
2 crop plants partially sprayed (8%)

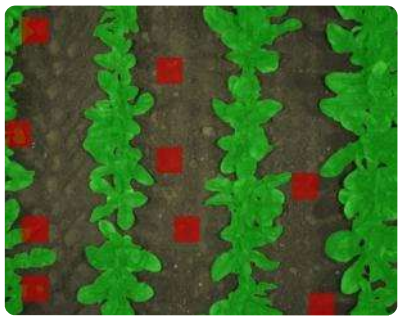


Safety zone of 0 cm
13/16 weeds targeted (81%)
No crop plants sprayed

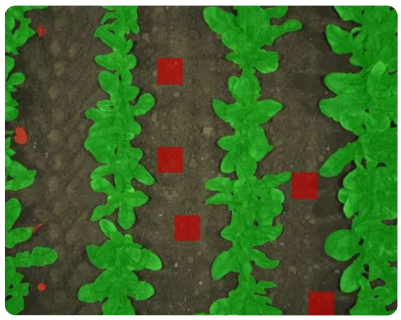


Safety zone of 2 cm
9/16 weeds targeted (56%)
No crop plants sprayed

Advanced-stage crop, 25 cm row spacing



Safety zone disabled
9/9 weeds targeted (100%)
4 crop plants partially sprayed (9%)

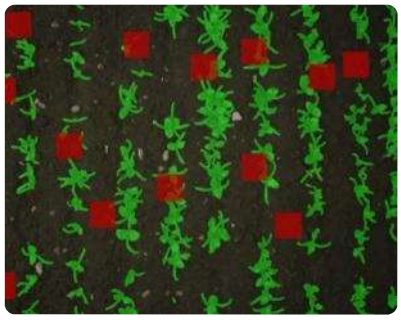


Safety zone of 0 cm
5/9 weeds targeted (55%)
No crop plants sprayed

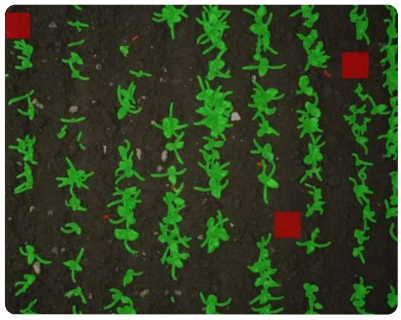


Safety zone of 2 cm
3/9 weeds targeted (33%)
No crop plants sprayed

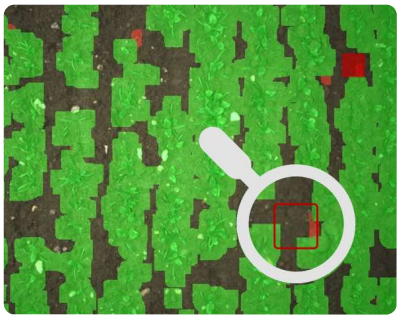
Early-stage crop, 12.5 cm row spacing



Safety zone disabled
13/13 weeds targeted (100%)
15 crop plants partially sprayed (12%)



Safety zone of 0 cm
3/13 weeds targeted (23%)
No crop plants sprayed



Safety zone of 2 cm
1/13 weeds targeted (8%)
No crop plants sprayed

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Guide to Ultra-High Precision Spraying

4. Integration and Spray Mixture Preparation

4.1. Integration of UHP into the Crop Management Program

To achieve truly effective localized weeding, UHP must be integrated into a comprehensive weed management strategy. The goal is not to replace all other practices, but rather to combine UHP with complementary solutions (pre-emergence treatments, mechanical weeding, selective full-field herbicides, etc.) to optimize efficiency, reduce costs, and limit weed pressure throughout the entire crop cycle.

At Sowing



A full-field treatment with a pre-emergence herbicide is generally recommended to control early weed growth before crop emergence. This step reduces competition from weeds at early stages and prepares the field for subsequent interventions.



Additionally, **mechanical tools** can be used as a complementary measure. They help reduce the surface weed seed bank, but caution is advised: such operations can also stimulate germination of buried weed seeds.

Note: If the initial pre-emergence treatment proves insufficient, a conventional post-emergence application may be required to maintain field cleanliness until the UHP can be used effectively.

During the Crop Cycle





In years particularly favorable to weed development, it may be necessary to perform an initial post-emergence full-field herbicide treatment to quickly reduce weed pressure.

It is essential to view **UHP as a complementary tool** to be integrated within a comprehensive **weed management strategy**. When combined with other solutions, such as pre-emergence applications, mechanical weeding, or conventional full-field spraying, spot spraying helps maximize treatment efficiency while reducing the use of plant protection products.

4.2. Spray Mixture Preparation

How to estimate the required spray mixture volume

For any treatment, the following parameters must be known:

- A = Area to be treated
- Vol = Desired spray volume
- C = Average consumption per hectare
- D_{ha} = Recommended active compound dosage per hectare
- V_{res} = Residual volume of the sprayer

Practical Case:

- A = 4 hectares (field area)
- Vol = 250L/ha (spray volume)
- C = 37 L/ha (consumption)
- D_{ha} = 3 L/ha (Aclonifen dosage)
- V_{res} = 12 L (residual volume)

Estimate the average consumption per hectare

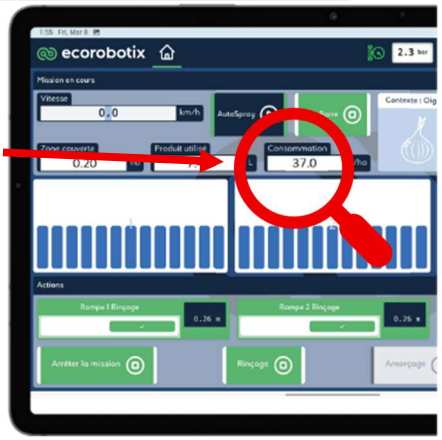
To accurately estimate the average consumption per hectare, it is possible to perform a recognition run with the machine empty, over approximately one hundred meters in an area representative of the weed infestation of the field.

It is important to use the **same settings** as those planned for the upcoming treatment (spray volume, safety zone, etc.).

Calculate the required water volume

The user interface indicates an average consumption C = 37 L/ha after the recognition run. The required water volume (V_{water}) is calculated as follows:

$$V_{water} = (A * C) + V_{res} = (4\ ha * 37\ L/ha) + 12 = 160\ Liters$$



Adjust the plant protection product volume

To determine the **saving factor (E)** in water and plant protection products, divide the average consumption from the recognition run by the spray volume selected in the user interface: $E = \frac{C}{Vol} = \frac{37\ L/ha}{250\ L/ha} = 14.8\%$

The volume of plant protection products required for the treatment can then be calculated:

$$D_{phyto} = D_{ha} * A * E = 3\frac{L}{ha} * 4\ ha\ * 14,8\% = 1.78\ liters$$

The treatment is therefore carried out with **160 liters of water and 1.78 liters of aclonifen for a 4-hectare** spraying area.

Reminder: The pH of the water directly affects both treatment effectiveness and machine longevity. For optimal results, the pH should be maintained between 5 and 7. If necessary, it can be adjusted using an adjuvant, such as ammonium sulfate.

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Guide to Ultra-High Precision Spraying

5. Experience feedback

5.1. Gebr. de Zeeuw, Netherlands



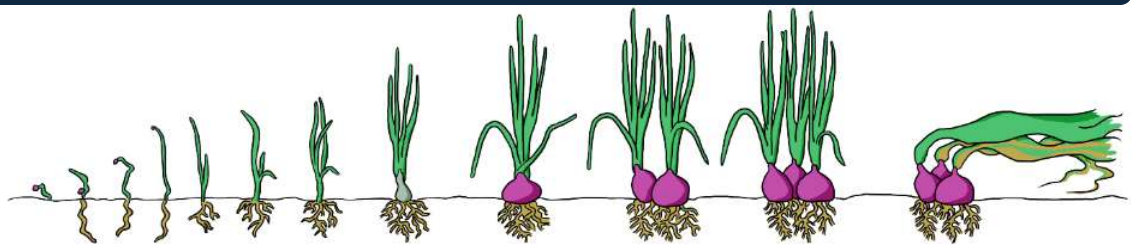


Jaap and Hans de Zeeuw cultivate around 600 hectares in the Netherlands, in the Noordoostpolder region. About 200 hectares are dedicated to potatoes, 80 to onions, and 80 to carrots.

The brothers did not hesitate to invest in an **ARA** to eliminate potato regrowth in onion fields and significantly reduce manual weeding, which is both costly and labor-intensive.

"We initially invested in **ARA** to target potato regrowth in onions. Today, we use **ARA** both to target all weeds in onions and carrots for post-emergence treatments, and for specific applications on potato regrowth in onions, carrots, and chicory."
Jaap de Zeeuw, Co-manager, Gebr. De Zeeuw

Catch-up and Maintenance Strategy



Benefits

- Elimination of manual weeding
- Significant savings in plant protection products
- Increased weed control efficiency



Technical data

- **Mode of use**: Catch-up and maintenance treatments
- **Main molecules used**: Isoxaben, Prosulfocarb, Pendimethalin, Glyphosate
- **Safety zone setting**: None or 0 cm if using a non-selective product
- **Target density**: 200–250–300 L/ha
- **Problematic weeds**: Potato regrowth, common groundsel

5.2. SCEA La Madrague, France



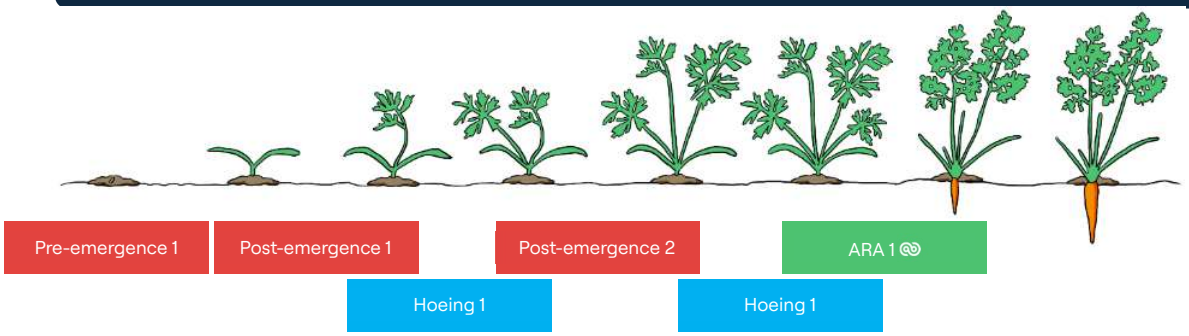


In the heart of the Landes de Gascogne Regional Natural Park, the Domaine de la Madrague cultivates 900 hectares of carrots with high standards — producing responsibly while preserving soil, water, biodiversity, and natural balance.

The estate has integrated **ARA** into its crop management strategy to better target weeding operations, reduce product use, and improve efficiency without impacting biodiversity.

"Even after several conventional treatments, some plots still remained weedy, which made harvesting more difficult and increased manual sorting at the factory. We needed to find a solution to complete the weeding process without harming the crop."
Antoine Proffit, Director of Plant Production

Catch-up Strategy



Benefits

- Reduced labor costs for carrot sorting
- Better control of field weed infestation
- Increased harvesting efficiency
- Improved effectiveness against problematic weeds



Technical data

- **Mode of use:** Catch-up treatments
- **Main molecule used**: Bifenox
- **Safety zone setting**: None
- **Average actual spray volume**: 35 L/ha
- **Problematic weeds**: Black nightshade
- **Working speed**: 7.2 km/h
- **Daily capacity**: ± 20 ha/day
- **Target density**: 200 L/ha
- **Actual mixture savings**: 82%

5.3. Sarl Pavillard, Switzerland



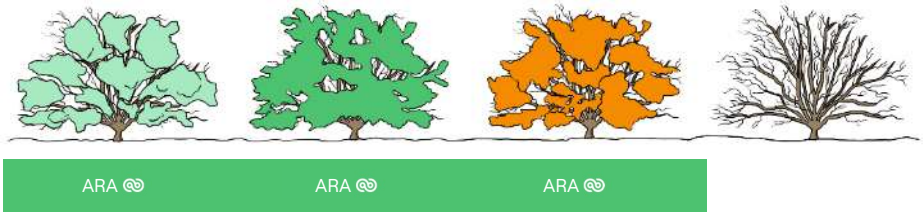


Located in French-speaking Switzerland, in a village near the Jura, the “Champ du Bois” farm manages 230 hectares of natural grasslands and produces both cereals and beef.

Sarl Pavillard is the complementary contracting business providing agricultural services. Committed to ensuring optimal forage quality, they chose **ARA** technology to precisely target **dock weeds (Rumex)**.

“Thistles and dock weeds have no forage value and lead to a decrease in both yield and forage quality. Using **ARA** to specifically target these plants makes it possible to treat the problem only where it occurs, while maintaining a high level of safety for the operator."
Nicolas Pavillard, Manager, Sarl Pavillard Agricultural Services

Catch-up Strategy



Benefits

- Increased forage yield per plot
- Improved forage quality
- Allows better use of drivers during periods of lower field activity



Technical data

- **Mode of use:** Targeted treatments for dock and thistle
- **Main molecule used**: Metsulfuron-methyl
- **Average actual spray volume**: 10 L/ha
- **Target density**: 400L/ha
- **Working speed**: 7.2 km/h
- **Daily capacity**: ± 20 ha/day

5.4. Hannes Besenthal, Germany



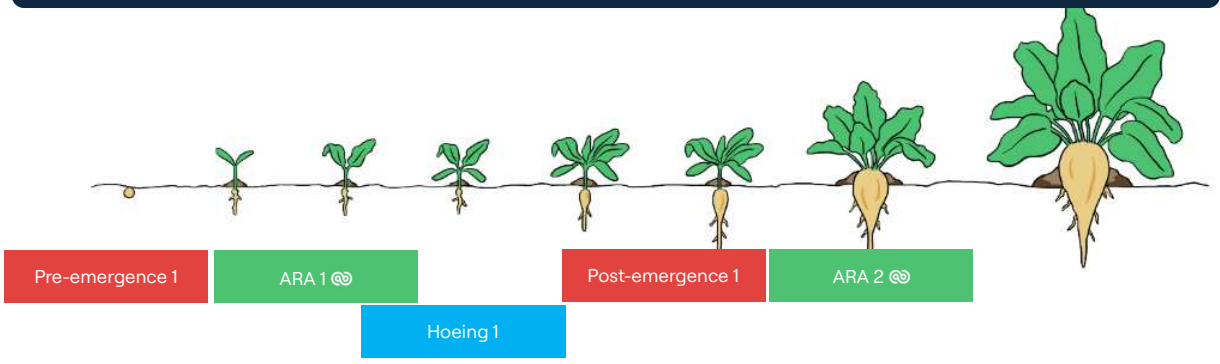


In the Niedersachsen region, Hannes Besenthal manages around 200 hectares of cultivated land, including 50 hectares of potatoes, nearly 40 hectares of sugar beets, and about 30 hectares of onions.

With the primary goal of reducing manual labor and increasing weeding efficiency, the farm decided to invest in ARA technology in 2023.

"The advantages of ARA are numerous: less manual work, significantly less stress on the crops, and the possibility of achieving a truly clean field. Each operation allows us to save between 60 and 90% of products.Plant protection products are used only where they are truly needed, which also supports environmental protection."
Hannes Besenthal, Farmer

Catch-up and Maintenance Strategy



Benefits

- Visible reduction of crop stress linked to phytotoxicity
- Significant decrease in field weed infestation
- Major savings in plant protection products
- Increased yields



Technical data

- **Mode of use**: Catch-up and maintenance treatments
- **Safety zone setting**: None
- **Target density**: 200 L/ha
- **Problematic weeds**: Mugwort, mayweed, potato regrowth

5.5. VCS AGRONOMY, United Kingdom



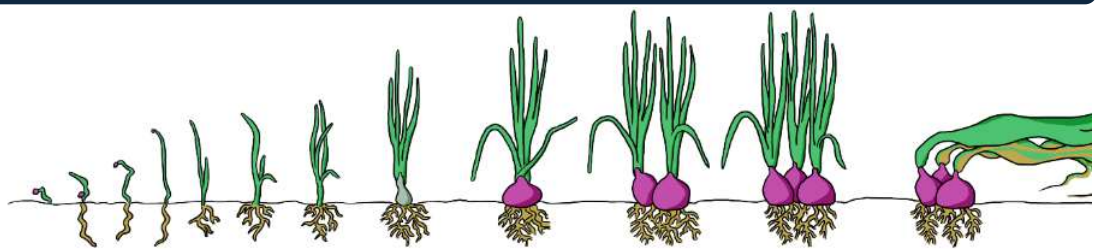


Based in Brandon, in eastern England, VCS Agronomy is a group of agronomists responsible for managing around 20,000 hectares of vegetable and cereal crops.

VCS has integrated **ARA** to replace all post-emergence treatments in onions, with a dual objective: reducing herbicide costs and improving crop vigor.

"We have treated more than 1,750 hectares of onions with **ARA**, which has allowed us to achieve savings of up to 96% on raw chemical inputs. Of course, this depends on weed pressure and crop growth stage, but we are very satisfied with the results."
Angus Hill, Agronomist & Farm Support Consultant

Maintenance Strategy



Pre-emergence 1 | ARA 1 | ARA 2 | Hoeing 1 | ARA 2

Benefits

- Up to 96% savings in plant protection products
- Yield gains of 10 to 15%
- Visible reduction of crop stress



Technical data

- **Mode of use:** Maintenance treatments
- **Target density:** 300 L/ha
- **Working speed:** 4.8 km/h
- **Molecules used:** Bentazone, fluroxypyr, clopyralid, and adjuvants
- **Safety zone setting:** Activated up to the 4-leaf stage in onions

5.6. S.C.A. PRIMACOOP, France



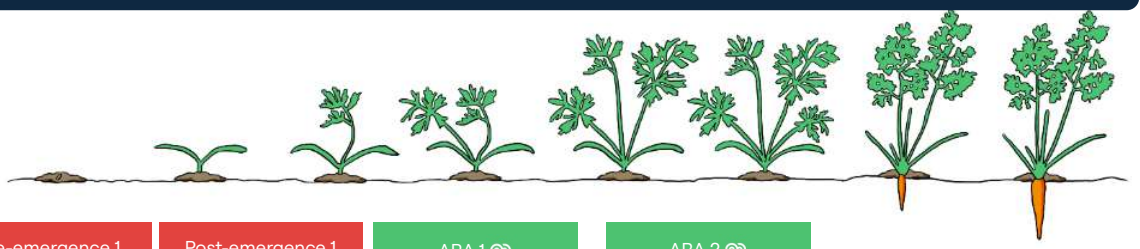


Founded in 1994, S.C.A. Primacoop was created by a group of endive producers located in the heart of the vegetable-growing region of northern France. Their goal was to combine the responsiveness and quality of direct production with the efficiency of a dedicated commercial team.

Each year, a total of 32,000 tonnes of endives are produced and marketed under the "**Perle du Nord**" brand, which distributes all of the cooperative's production.

"We carried out further tests this year — same plot, same variety, same sowing date — and the results are clear: the crop cycle is much more advanced when treated with **ARA**. The benefit is being able to harvest earlier, under better conditions, and to sow immediately after wheat under optimal circumstances."
Laurent Henaut, Endive Technician, S.C.A. Primacoop

Catch-up Strategy



Benefits

- Gain in maturity and improvement of harvest conditions
- Increase in yields by 2 to 3 tons per hectare
- Optimization of crop rotation
- Significant reduction in plant protection products



Technical data:

- **Mode of use:** Maintenance treatments
- **Main molecule used**: Rimsulfuron
- **Safety zone setting**: None
- **Target density**: 200 L/ha
- **Working speed**: 7.2 km/h