Banded Herbicide Application

Implementation
Benefits
Conditions for success

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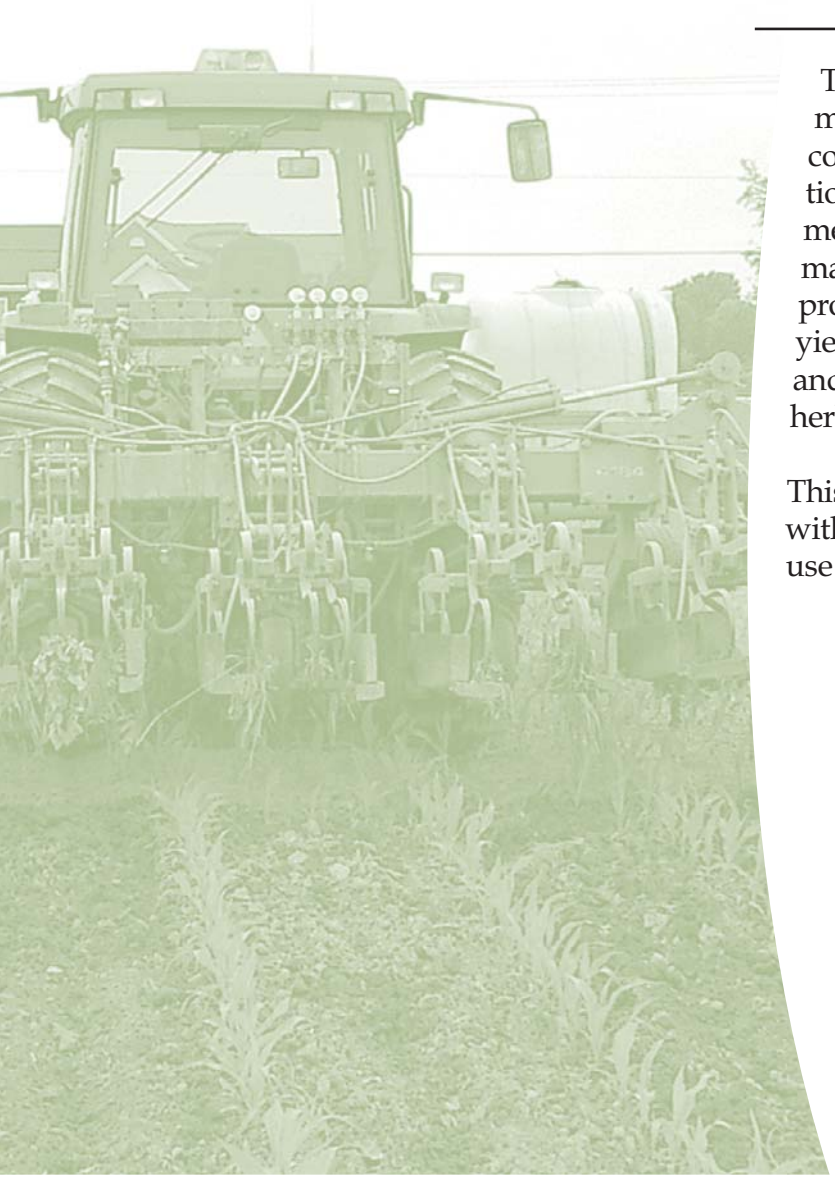
Stratégie phytosanitaire



Introduction

This document addresses an effective method of reducing the use of herbicides in corn and soybean: banded herbicide application. This method is used in combination with mechanical cultivation for integrated weed management. Properly applied, it helps reduce production costs without jeopardizing crop yield. It also helps reduce both environmental and health hazards associated with the use of herbicides.

This document was prepared in collaboration with Quebec growers who have adopted the use of banded herbicide application.

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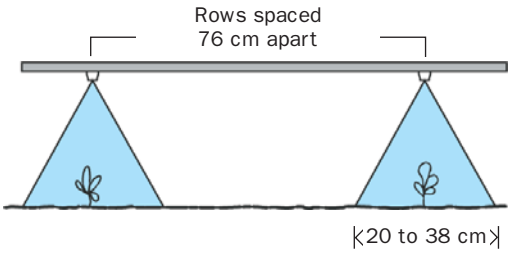
Banded herbicide application

Proper weeding requires a combination of herbicide application and mechanical cultivation between the rows. There has to be a slight overlap between the chemical treatment and the cultivation to avoid the risk of leaving a band of soil untreated.

Banded application involves spraying the herbicide directly onto the crop row over a certain width. For corn and soybean, this width can be anywhere from 20 to 38 cm (8 to 15 in) for a 76 cm (30 in) spacing between the rows. The herbicide rate applied on the band is the same as that prescribed for broadcast application. However the quantity of herbicide product used per field planted hectare is considerably less because the treated area is smaller.

Banded herbicide application over a given width



The relationship between the band width and the percentage of surface area treated for rows spaced 76 cm (30 in) apart

Band Widths		Percentage of Surface Area Treated
cm	in	
20	8	27 %
25	10	33 %
30	12	40 %
38	15	50 %

For soybean, banded application of herbicide calls for the rows to be spaced far enough apart to allow for cultivations without damaging the plants. Therefore, its use is limited to climatic areas that guarantee high yields under these conditions.

The options

Growers have a number of options, depending on the equipment used.

Options based on the timing of the banded herbicide application

Timing of Application	Equipment Used
Pre-emergence (at seeding)	Seeder equipped with a sprayer
Post-emergence	Cultivator equipped with a sprayer Modified "Conventional" boom

Seeder equipped with a sprayer

When the banded application is done at seeding, the herbicide used must have residual activity in the soil. As for broadcast applications, the choice of herbicide depends on the weed species present in the field the previous year. In this regard, consult a recent recommendation guide of registered herbicide treatments.

To activate pre-emergence treatments, whether these are broadcast or banded, approximately 15 to 25 mm of rainfall is required within three weeks following the application.

Incorporating the herbicide into the soil by using a rotary hoe or a tine cultivator improves the effectiveness of the herbicides when spraying is followed by a dry spell.

Banded application at seeding

Photo : Gilles D. Leroux

Crop rows can be sprayed again, at time of cultivation, if there are weed escapes.

Cultivator equipped with a sprayer

A contact herbicide can be used for post-emergence band spraying at the same time as the inter-row weeding with a conventional or heavy-duty cultivator (depending on soil type and amount of crop residues). The timing of spraying relative to the stage of weed development is key to obtain effective weed control.

Banded herbicide application at time of corn cultivation

Photo : Jean-François Ménard, Club Sol en Main

There are publications, such as *Mechanical weeding equipment for field crops* (Coulombe and Douville, 2000), that provide growers with information about the type of cultivator that is best suited to their type of soil and about the most suitable timing of intervention.

"The key to successful banded application is to cultivate at the right time and to properly adjust the cultivator."

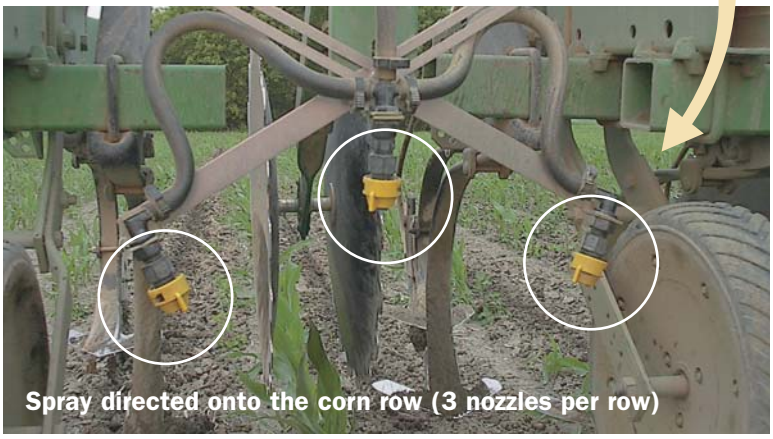
Michel Bourgeault, Saint-Germain-de-Grantham (this grower has been using banded herbicide application for 10 years)

The herbicide treatment can be applied directly over the crop row. This spraying technique requires rectangular nozzle spray (even) tips.

Spraying with nozzle over the corn row

Photo : Jean-François Ménard, Club Sol en Main

Using 2 or 3 nozzles per row (spray directed onto the crop) reduces the pressure on the corn whorl. This reduces the risk of damage to the crop. The nozzles used are hollow cones (conejet).



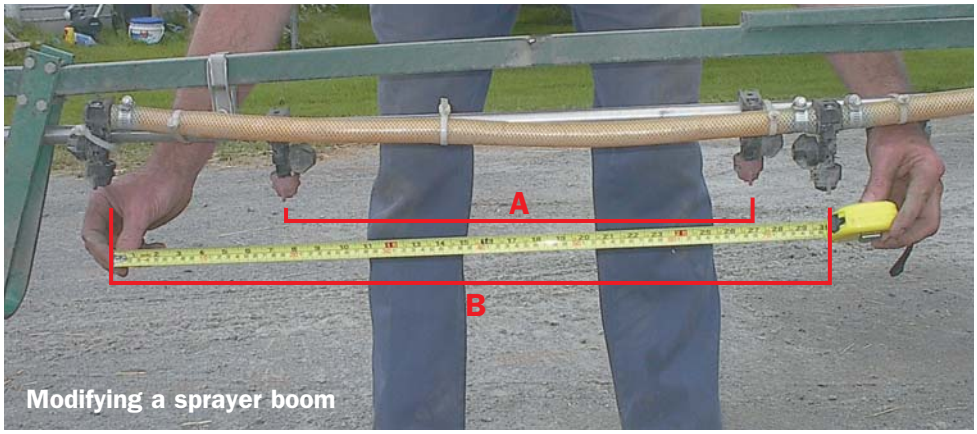
Spray directed onto the corn row (3 nozzles per row)

Photo : Jean-François Ménard, Club Sol en Main

Modified “conventional” boom

A conventional broadcast boom can be modified for banded herbicide spraying in levelled fields. Bumpy terrain may interfere with the treatment by destabilizing the machinery or changing the height of the nozzles over the ground. Mechanical cultivation between rows must be used to complete the herbicide treatment.

The spacing between nozzles must correspond to the spacing between the crop rows, being 76 cm (30 in) for corn or soybean. If a band spraying system is installed on the boom, the original system can still be used if needed.



Modifying a sprayer boom

Photo : Jean-François Ménard, Club Sol en Main

A: normal spacing between nozzles for broadcast application (50 cm)
B: new spacing between nozzles for banded application (76 cm)

Banded application with modified boom

Photo : Jean-François Ménard, Club Sol en Main

The equipment

Banded herbicide application means that less herbicide spray solution is used per unit of planted area. This means that a greater area will be sprayed with a given sprayer tank.

Regardless of which option is chosen, certain accessories will be required. When the spraying equipment is mounted on the seeder or the cultivator, the following components are generally found:

- one or more tanks
- a pump
- a pressure regulator
- nozzles
- nozzle body with a diaphragm check valve for drip free shutoff
- an anti-drift device that keeps the fine herbicide droplets on target
- hose line
- guiding mechanism for precise row cultivation

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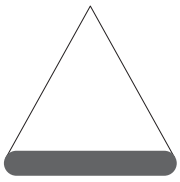
Banded herbicide application at time of cultivation

Photo : Jean-François Ménard, Club Sol en Main

Standard flat fan



Even flat fan

Selection of nozzles

Standard flat fan nozzles are used for broadcast spraying. The spray volume tapers off at the edge of the spray pattern, so these nozzles should be overlapped to produce a uniform delivery pattern across the entire width of the boom. These nozzles are not recommended for banded applications.

Nozzles used for "broadcast" spraying are not suitable for banded applications and vice-versa.

The rectangular spray (even) tip is specifically designed for banded applications. The nozzle tip delivers full volume to the outside edge of the spray pattern.

In general, **rectangular spray** (even) nozzles are recommended for banded applications, but a wide variety of nozzles can also be used.

Hollow cone nozzles (conejet) are recommended for banding with 2 or 3 nozzles over the row.

Rectangular spray nozzle (even) model

Photo : Jean-François Ménard, Club Sol en Main

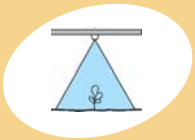
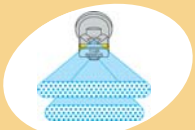
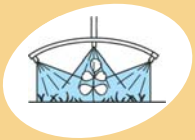
For crops grown on ridges, direct seeding or soil tilled with a chisel plow, rectangular **double spray** nozzles are the most effective when there are crop residues on the ground.

Banded application is also possible under the crop canopy by using two drop pipes (nozzles mounted on extensions attached to the boom) located close to the ground. **Deflected spray** nozzles, with a spray angle of 85°, can then be used to spray near ground level.

When choosing the appropriate nozzle model, it is important to take a number of factors into consideration: the spray volume in relation to the band width, the pressure, the nozzle output and the spray vehicle speed. Once all of this information is available, the manufacturer's recommendations must be followed.

It is best to select a nozzle model with a spray angle of 80° or more. This way the boom can be lowered and the risk of drift reduced.

Use and general description of different nozzle models recommended for banded herbicide application

TYPE OF NOZZLE	Rectangular Spray	Double Rectangular Spray	Hollow Cone Spray	Deflected Spray
Number of nozzles per row	1 nozzle	1 nozzle	2 or 3 nozzles	2 nozzles
Spray position	Above the row	Above the row	Directed onto the crop	Under the crop canopy
Illustration of the spray pattern [1]				
OPTIONS				
Seeder equipped with a sprayer	X			
Cultivator equipped with a sprayer	X		X	X
Modified conventional boom	X		X	X
Sprayer equipped with a seeder or cultivator (for reduced soil tillage systems)		X		

1. From Spraying Systems Co. 2002. Reference to the name of a company or business should not be taken as a recommendation by the authors or the publisher.

Adjusting the sprayer

Nozzle height

It is best to spray the herbicide on a wider band and to gradually reduce the band width once the technique is properly mastered.

The nozzle height must be adjusted based on the desired spray angle and application width. A wide band allows for overlap between the spraying and the cultivation, which helps avoid leaving untreated areas.

For example, if the desired application width is 30 cm (12 in) and the spray angle is 80°, the nozzle height must be 18 cm from the soil or weed canopy.

Approximate nozzle height based on the band width and spray angle (80° and 95°)

Band Width		Nozzle Height (cm)	
cm	in	80°	95°
20	8	13	10
25	10	15	13
30	12	18	15
38	15	23	20

From Spraying Systems Co. 2002. Reference to the name of a company or business should not be taken as a recommendation by the authors or the publisher

Pressure

Banded application is done at pressures ranging from 150 to 250 kPa (20 to 40 lb/in^2). Depending on the method of application and the nozzles used, it is important to follow the nozzle manufacturer's recommendations, as well as those on the herbicide label.

Volume of spray solution

Banded application based on a broadcast application volume of 150 litres per hectare requires precision, i.e. a recently calibrated sprayer and nozzles in proper working condition.

Given that banded application makes it possible to reduce the surface area treated, the spray volume per hectare must be adapted. For instance, 200 litres per hectare for broadcast application is equivalent to 100 litres per hectare for a 38 cm (15 in) banded application. In this case, there is a 50% reduction in the volume of spray solution required.

For pre-emergence treatments, it is recommended that the volume of spray solution be greater than 230 litres per hectare for broadcast application of the herbicide. Thus, the calculation for banded application must be based on this volume.

The benefits of banded herbicide application

The following are the main reasons that growers claim for adopting banded application:

- **Savings ($$$) from using lesser quantities of herbicide**
  Spraying 25 cm (10 in) bands represents herbicide cost reductions of approximately two-thirds or 66%.
- **Time savings**
  Cultivation makes several interventions possible at the same time (weeding, spraying and fertilizing), which means less time spent in the field.
- **Less risk to the environment**
  Reducing the use of herbicides reduces the risk of contaminating the environment.
- **Reducing the amount of water used per hectare**
  Reducing the surface area that is treated reduces the volume of spray solution required.
- **Reducing soil compaction**
  Reducing the number of passages through the field reduces the risk of soil compaction.

Cost considerations

Given that reducing costs is an important factor in adopting new weeding strategies, where does banded application stand? The installation of the necessary equipment on a seeder or cultivator is affordable. The cost of acquisition of equipment for banded application (pump, tank, support, hose, nozzles, etc.) can range in the order of $2,000 to $3,000 depending on the components and number of rows treated.

Moreover, the costs of banded application are considerably lower. For instance, with grain corn, the average cost of banded application (excluding the product) is $2.81 per hectare. The average cost of broadcast herbicide application (excluding the product) is $9.56 per hectare. The difference is attributed to the fact that banded herbicide application takes place at the same time as seeding or cultivating. Given that the costs of traction and labor are already included in the seeding or cultivating, they need not be accounted for banded application.

"Year after year, profit margins fall, which means we have to cut production costs. Just as we are splitting nitrogen into two applications, which results in better investment on our equipment, we combine banded herbicide application with cultivation."

Luc Ducharme, Saint-Pie-de-Bagot

For a given type of cultivator and same number of passages, the saving increases as the treated band width is reduced.

There are several ways to achieve significant savings over broadcast spraying ($116.63/hectare), namely:

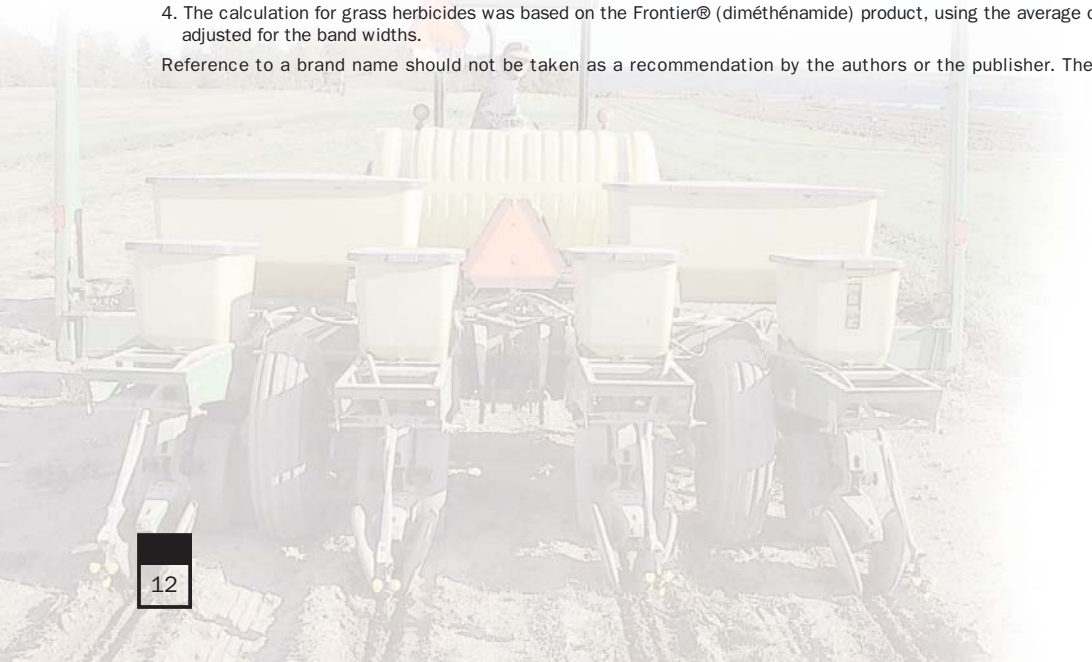
- banded application of 38 cm (15 in) combined with a conventional cultivator ($76.88/hectare): savings of **34%**
- banded application of 30 cm (12 in) combined with a conventional cultivator ($65.60/hectare): savings of **44%**
- banded application of 30 cm (12 in) combined with a heavy-duty cultivator ($83.90/hectare): savings of **28%**
- banded application of 25 cm (10 in) combined with a heavy-duty cultivator ($76.86/hectare): savings of **34%**

Average costs of different banded herbicide application strategies for grain corn with or without mechanical weeding ($/hectare)

Element	Broadcast [1]	Band Width [2]								
	76 cm (30 in)	38 cm (15 in)			30 cm (12 in)			25 cm (10 in)		
Spraying	9.56	2.81	2.81	2.81	2.81	2.81	2.81	2.81	2.81	2.81
Products										
Broadleaf herbicide [3]	52.19	26.10	26.10	26.10	20.60	20.60	20.60	17.17	17.17	17.17
Grass herbicide [4]	54.88	27.44	27.44	27.44	21.66	21.66	21.66	18.05	18.05	18.05
Weeding	No. of passages	No. of passages			No. of passages			No. of passages		
	0	1	2	1	1	2	1	2	1	2
Conventional cultivator	-	20.53	41.06	-	20.53	41.06	-	41.06	-	-
Heavy duty cultivator	-	-	-	38.83	-	-	38.83	-	38.83	77.66
TOTAL	116.63	76.88	97.41	95.18	65.60	86.13	83.90	79.09	76.86	115.69

1. The costs associated with spraying operations calculated from CRÉAQ, 1998 (Agdex 740/825).
2. The costs of weeding operations were revised in 2002 by Guy Beauregard, MAPAQ.
3. The calculation for broadleaf herbicides was based on the Marksman® (atrazine/dicamba) product, using the average doses recommended in CPVQ 2000b, and adjusted for the band widths.
4. The calculation for grass herbicides was based on the Frontier® (diméthénamide) product, using the average doses recommended in CPVQ 2000b, and adjusted for the band widths.

Reference to a brand name should not be taken as a recommendation by the authors or the publisher. There may be equivalent products.



The conditions of success

In order to ensure successful banded herbicide application and to control weeds, the following conditions must be met:

1. be aware that every option has benefits and drawbacks. Herbicide application at seeding, for example, can reduce the risk of drift, since the spraying takes place closer to the ground. Spraying while cultivating can be more localized, depending on the weed infestation within a given field. The pros and cons of each option have to be assessed for every situation and farm;

2. choose the fields that were the least infested with weeds in the previous year;

3. choose well-drained fields for more flexibility in the timing of weed cultivation;

4. use the appropriate equipment for both spraying and cultivating. The cultivator has to be right for the type of soil and the presence of crop residue (conventional or heavy-duty cultivator);

5. use rotation of both crops and herbicide groups to avoid the advent of resistant or more difficult-to-control weeds; and

6. start with a treated band of 38 cm (15 in) and reduce the spray width once the technique has been mastered.

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