Banded Herbicide Application in Potatoes

FÉDÉRATION DES PRODUCTEURS
DE POMMES DE TERRE DU QUÉBEC
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Stratégie phytosanitaire

Introduction

As part of integrated pest management aiming at the judicious and reduced use of pesticides, banded herbicide application, also known as banding, is a very attractive option.

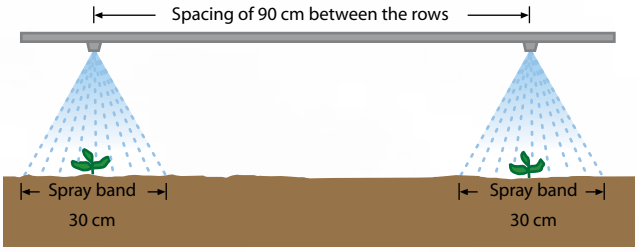
Already used in field crops (corn, soybean, etc.), this technique can also be used in potato production.

From 2001 to 2004, trials conducted in growers' fields (Île d'Orléans, Portneuf and Centre-du-Québec) and at the Deschambault Experimental Farm have demonstrated its feasibility and effectiveness. When combined with mechanical weeding and hilling, banding effectively controls weeds and provides a yield similar to that obtained through conventional production. This practice reduces the quantity of herbicide used by at least 60%. For the approximately 20,000 hectares of potatoes grown in Quebec, such a reduction would constitute a substantial gain from both an economic and an environmental perspective, especially since soil used for potato production is very vulnerable to leaching, given its generally sandy texture.

This brochure presents the advantages of banded herbicide application, along with all the technical aspects to be considered to achieve successful adoption.

Description of the approach

Herbicide banding consists in spraying herbicide only over the potato rows, covering a width of about 30 cm. The herbicide is sprayed at the time of planting, pre-emergence or post-emergence of the crop. Weeds in the space between two rows are controlled mechanically. Mechanical weeding is carried out when potato plants reach a height of 7-10 cm and hilling is done at the floral bud stage. Then, vegetative growth of potato covers the spacing between the rows, thus preventing further weed growth.

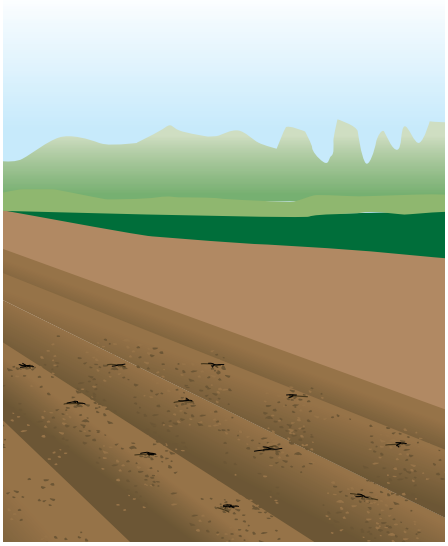


Treated and non-treated area of a potato field at the time of banded herbicide application

Options for timing of application

Herbicide banding in potatoes may be conducted at the time of planting, pre-emergence or post-emergence of the crop. The spray system must be modified or adapted depending on the timing of application.

Overview of a three-nozzle herbicide banding system installed on a planter.



Pre-emergence banding (at growth crack stage).

Post-emergence banding combined with mechanical weeder.

At planting

For herbicide banding at the time of planting, a spray system must be installed on the planter. This system is comprised of a tank, a pressure regulator, a monitor, a pump, tubing and nozzles installed behind the planting units. An investment of about $4,000 is required for a four-row planter.

Banding at the time of planting is the most advantageous option.

- Installing nozzles on the planter allows to spray herbicide on the row with precision.
- Tractor circulation in the field is reduced by one pass which saves time and money.
- The cost of installation is quickly recovered by the reduction in the quantity of herbicide used.

To ensure effective weed control along the row, it is important to choose a product with a herbicidal activity that will last for several weeks.

At pre-emergence

Pre-emergence banding requires only one adjustment to the sprayer. To spray the row only, the distance between the nozzles must be equivalent to the spacing between the rows, which is 90 cm (or 87 to 91.5 cm). If necessary, some nozzles can be blocked with discs.

The grower can also choose to install a second system of tubing and nozzles on the ramp, leaving the original system available for use in other operations.

At the pre-emergence stage, the biggest challenge to herbicide banding is centring the spray band properly on the ridge or planting row. Application at the growth crack stage is a good way to facilitate alignment over the row if planting has been precise. Make sure, however, that the herbicide chosen can be applied at the growth crack stage.

At post-emergence

At the post-emergence stage, herbicide banding is conducted at the same time as mechanical weeding, thus reducing tractor circulation in the field. The spray system (tank, nozzles, etc.) is installed on the mechanical weeder. When the weeder passes, herbicide is sprayed over the rows while weeds are removed in the spacing between the rows.

An automatic guidance system can be used to direct the herbicide spray precisely over the row.

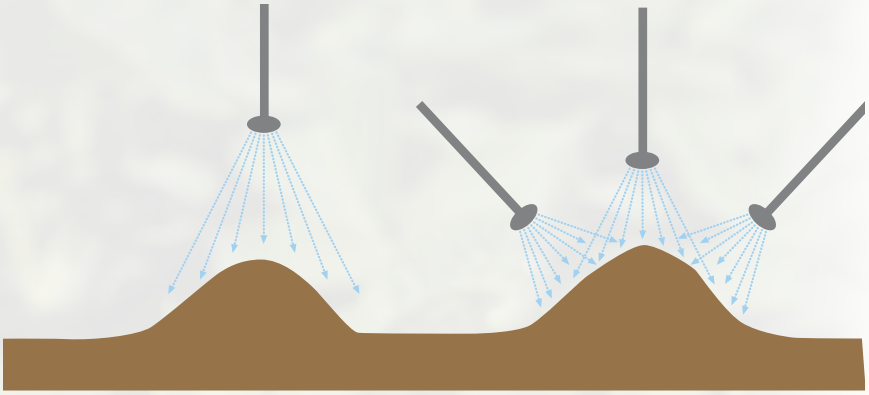
Spot treatments

The banding spray system installed on the mechanical weeder can also be used to apply spot treatments over the rows. Herbicide is then sprayed only on areas where there are high levels of weed infestations.

NUMBER, TYPE AND HEIGHT OF NOZZLES

How many nozzles?

Trials have been conducted to compare the effect of using one or three nozzles on weed control; no significant differences were observed (Table 1). However, with a single nozzle, a slight drift can compromise the effectiveness of the treatment. Using three nozzles ensures more uniform application over the row. The additional cost is minimal in relation to the precision gained. Better not to take any chances!



Herbicide banding using one or three nozzles.

Table 1.

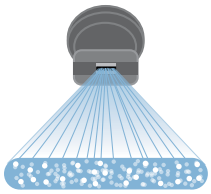
Effect of herbicide banding using one or three nozzles on weed control and marketable potato yield (cv. Superior)

	Weed control (%)		Yield (t/ha)	
Treatment/Year	2003	2004	2003	2004
1 nozzle	96.3	95.0	43.6	34.2
3 nozzles	96.5	95.0	44.1	38.4

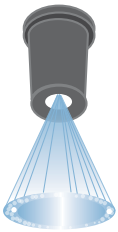
There are no significant differences between the data for each of the two years.

What type of nozzles?

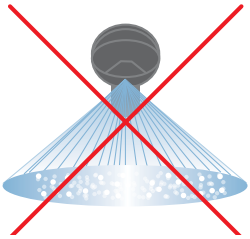
Choosing the nozzles is another important factor in success. As Leroux and Tessier (2003) noted, "many factors must be taken into account, such as: spray volume calculated on the basis of band width, pressure, flow and ground speed. When all this information is known, the user should refer to the manufacturer's recommendations."



Even-type flat spray nozzles are well suited to herbicide banding. They allow uniform herbicide concentration and distribution over the entire band width. This type of nozzle was used for the trials conducted in Quebec which results are presented in this document.



Hollow cone spray tips are also recommended, primarily for three-nozzle spraying over the row.



Broom or flat (flat cone) spray tips are not recommended for herbicide banding. They do not provide uniform application of spray mixture.

At what height?

By adjusting the height of the nozzles the grower can set the spray width to 30 cm. Tests can help determine how high above the ground the nozzles should be installed. This measurement must be precise because a variation of only a few centimetres modifies the spray width and, consequently, diminishes the effectiveness of the treatment. For a 30 cm spray width, for example, nozzles should be installed 18 cm above the ground for an 80° angle; if the spray angle is 95°, depending on the nozzles chosen, they should be installed 14 or 15 cm above the ground (TeeJet Technologies 2007).

TEST RESULTS

In Quebec

Herbicide banding trials on experimental plots were conducted by the Institut de recherche et de développement en agroenvironnement (IRDA) at the Centre de recherche en sciences animales de Deschambault (CRSAD), using mainly cv. Superior potatoes. Herbicide application on the row over a width of 30 cm at the time of planting was compared with the conventional treatment (full width) and untreated controls (manually weeded and non-weeded). Two herbicides were tested: linuron and metribuzin. Mechanical weeding and hilling were carried out for all treatments (except for the non-weeded control). Weed control and potato yield were measured.

Table 2 presents the test results for 2003 and 2004. For both weed control and yield, there were no significant differences between herbicide banding and the conventional treatment (full width).

Weed control

With a high level of weed infestation, herbicide banding at the time of planting provided an average weed control rate of 96.4% in 2003 and 95% in 2004.

Potato yield

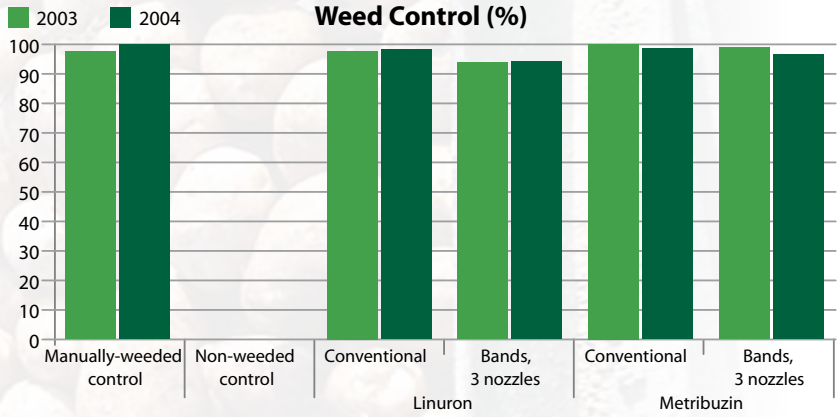
The average marketable potato yield with herbicide banding was 43.8 t/ha in 2003 and 36.3 t/ha in 2004. With a 66% decrease in the quantity of herbicide used, the yield was statistically comparable to that obtained with the conventional treatment for both years.

Table 2.

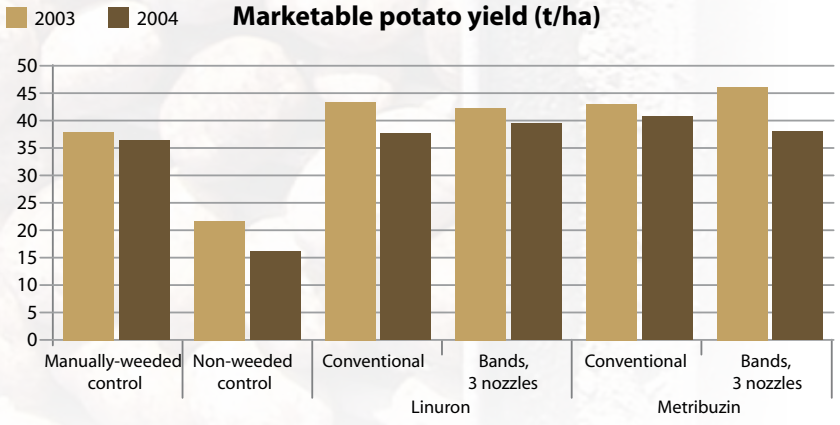
Effect of herbicide application method on weed control and marketable potato yield (cv. Superior)

	Weed control (%)		Yield (t/ha)	
Treatment/Year	2003	2004	2003	2004
Manually-weeded control	97.8 a	100.0 a	38.1 b	36.0 a
Non-weeded control	0.0 b	0.0 b	21.5 c	15.8 b
Linuron				
Conventional	98.0 a	98.0 a	43.2 ab	37.2 a
Bands, 1 nozzle	96.0 a	95.0 a	45.7 ab	36.8 a
Bands, 3 nozzles	94.0 a	94.0 a	42.1 ab	39.2 a
Metribuzin				
Conventional	99.5 a	98.0 a	42.9 ab	40.5 a
Bands, 1 nozzle	96.7 a	95.0 a	41.5 ab	31.7 ab
Bands, 3 nozzles	99.0 a	96.0 a	46.0 a	37.6 a

For each column, values followed by the same letters are not significantly different.



Weed control with herbicide banding (left) compared with conventional treatment (centre) and untreated control (right); July 6, 2004.



In Prince Edward Island

From 1995 to 1997, J.A. Ivany conducted a similar study near Charlottetown using 'Russet Burbank' potatoes. He tested the combined effect of herbicide banding (30 cm over the row) and complementary mechanical weeding on yield and on the control of three different weeds (quackgrass, corn spurry and wild radish).

At a moderate-to-high weed infestation level, the control rate of these three weeds was 92% and over with banding versus 98% with the conventional treatment. These differences were not statistically significant.

Marketable potato yield with banding (34.0 t/ha) was comparable to that obtained with the conventional treatment (35.9 t/ha). The untreated control yielded 20.8 t/ha.

Weed control and marketable potato yield (cv. Russet Burbank)

Treatment	Weed control[1] (%)	Yield (t/ha)
Herbicide banding + mechanical weeding	92 to 98	34.0
Conventional treatment	97 to 100	35.9
Untreated control	0	20.8

Source: Ivany 2002.

[1] Combined results for quackgrass, corn spurry and wild radish.

KEYS TO SUCCESSFUL HERBICIDE BANDING

Successful herbicide banding depends on various factors. It is important to consider them all carefully.

• **Mechanical weeding** and **hilling** carried out at the right time using appropriate equipment remain **key** to weed control in potato production.

• There **should not be significant weed problems** in the field. For example, if problematic species (nut grass, horsetail, quackgrass, etc.) have been present for a number of years, the situation should be corrected prior to considering herbicide banding.

• Using **cultivars with heavy vegetative growth** always makes it easier to manage weeds. This choice is essential for successful herbicide banding. Abundant plant cover quickly spreads over the spacing between the rows, thus preventing weeds from growing there (see image below). Also, plants should not collapse prematurely. Consult your crop advisor to choose the proper potato cultivar.

• Herbicide banding requires **precision,** especially in the **angle and placement of the sprays**. Un even soil can destabilize the machine and prevent the nozzles from spraying uniformly. To make weeding easier, choose a **levelled soil** with little or no disturbance.

As in the case with conventional treatments, other practices must be followed rigorously:

- weed monitoring through scouting;
- calibration of the sprayer;
- compliance with recommendations for tractor speed.

Success depends on timely and precise application of the right product!

Vegetative growth of cv. Superior (left) compared with the weak growth of cv. Andover (right); July 6, 2004.

Tips!

To become more familiar with herbicide banding:

• choose an **early season** cultivar with lush vegetative growth;

• practice the technique on a small area.

REASONS FOR PRACTICING HERBICIDE BANDING

Herbicide banding has a number of **environmental** and **economical** benefits.

Reducing the quantity of herbicides applied in the field **by over 60%** allows to:

- reduce **production costs;**
- reduce the risk of **contaminating waterways** and water tables;
- reduce risks to **human health and the environment;** and
- reduce the risk of weeds developing resistance to herbicides.

According to the Centre de référence en agriculture et agroalimentaire du Québec's economic guidelines (2006) for tablestock potatoes, the cost of applying herbicide over 80 hectares drops from $7,882 for broadcast application to $2,627 using herbicide banding. Eliminating one tractor and one sprayer pass into the field also saves $784, for total savings of $6,039.

Herbicide banding is easy. It requires no additional work and it can even be done at the same time as another operation. Installation of the equipment is inexpensive and easy.

When herbicide banding is done **at the same time as planting or mechanical weeding**, it results in:

- reduced tractor passes in the field;
- less soil compaction;
- reduced costs for tractor use (time, fuel, wear, etc.); and
- **lower greenhouse gas emissions.**

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[www.agrireseau.qc.ca/pdt/documents/PDT-herb-bandes-VF.pdf].

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