Prevention of Weeds FIELD CROPS

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Stratégie phytosanitaire

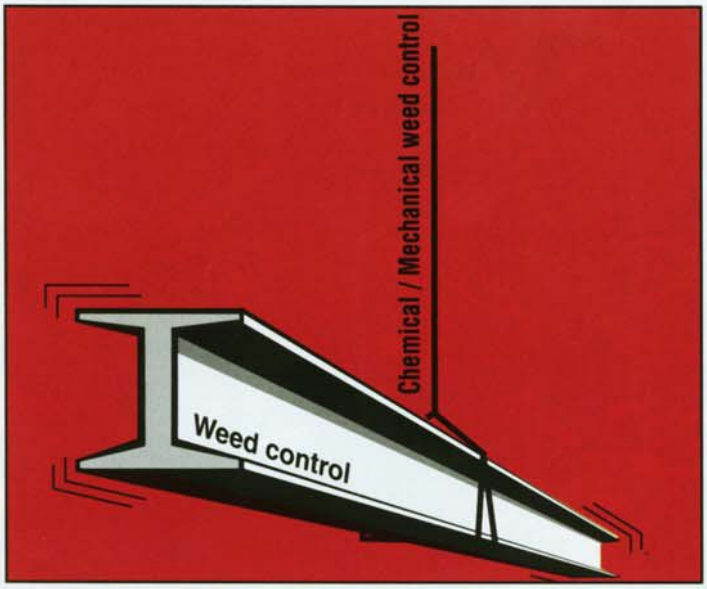
Introduction

"An ounce of prevention is worth a pound of cure". That's a well-known adage, but it isn't used very much when it comes to the fight against weeds.

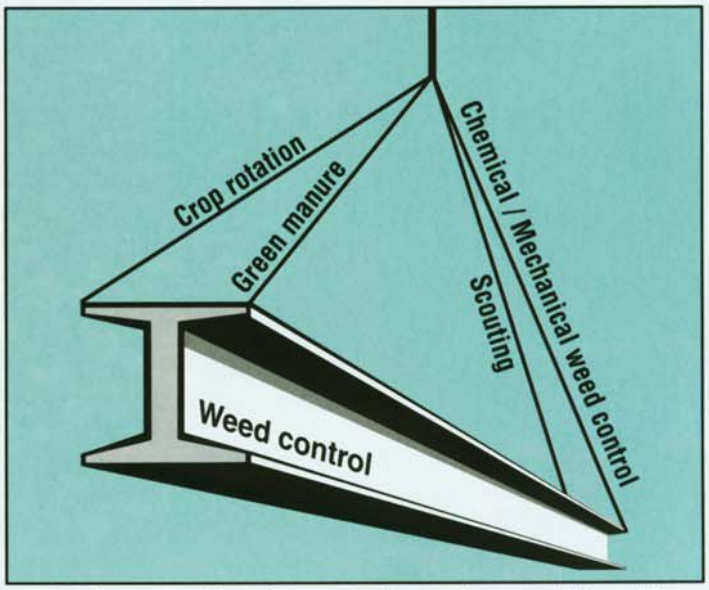
Many producers know how to control weeds using chemical or mechanical weeding systems. Much fewer know about and use preventive measures to control weed infestations. Too often we see in our countryside:

- a lack of maintenance of uncultivated land
- seeds from weeds left in the field after harvesting
- crop rotation abandoned in favour of mono- or bi-culture farming systems

At first glance, weed prevention is not as impressive as mechanical or chemical weed control. But the reality is that a good preventative program is invaluable in the fight against weeds.



Without prevention: weed control hangs by a thread.



With prevention: integrated weed control is solid and stable.

A good weed prevention program offers crop producers the following advantages:

- Reduces the encroachment of particularly invasive weeds, such as velvetleaf, on the farm
- Decreases pressure from weeds
- Reduces the risk of loss of weed control, since control methods are diversified
- Eases the need for chemical herbicides or mechanical methods of intervention
- Limits the risk of weeds developing a resistance to herbicides

In the end, the prevention of weed encroachment translates into savings in time and money and gains for the environment and for health.

This document describes methods of preventing weed infestations on the farm. These methods are valid for all forms of agriculture, except for mentions of fertilizer and pesticides which are excluded from organic farming.

Summary of preventive measures

Limiting sources of infestation

Uncultivated fields

Uncultivated fields have become the primary sources of weed contamination:

- Around farm buildings
- Edges of ditches and water-courses
- Manure piles
- Small, difficult to cultivate fields
- Around electrical poles and pylons
- Vacant urban lots
- Edges of roads, highways and railroads
- Land surrounding harbours

Abutilon and smartweed proliferate in the area surrounding a corn field.

These areas contain numerous weed plants in excellent position to invade farm fields:

- The wind carries the seeds of weeds, such as milkweed and dandelion, sometimes over great distances.
- Water carries the seeds of several types of weeds. They can float for many kilometres without losing their viability.
- Perennial plants spread and encroach on farmland little by little via their rhizomes and roots (e.g. reeds).
- Several types of annuals produce seeds that scatter just a few tens of centimetres from the mother plant. After a few years, these plants can be found in the fields.

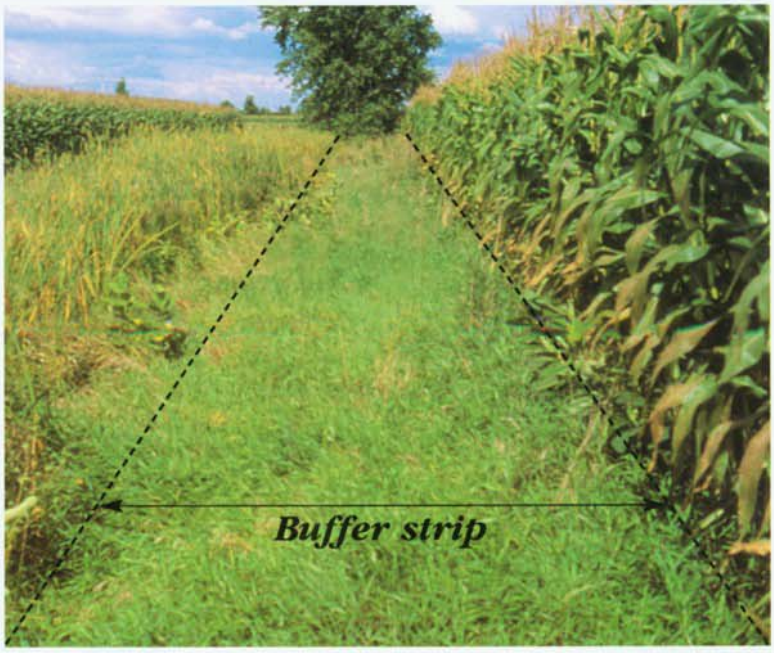
▲ Base of a badly maintained electricity pole, leaving room for milkweed and golden rod.

Reeds beginning to invade a field ▲

A good way to get rid of this problem would be to convert these uncultivated zones (except for protected areas). Some of this land would lend itself to the production of specialized crops on a small scale. In other situations, it would be advantageous to replace undesirable plants with grass or buffer strips. At the very least, these areas should be cleared of weeds on a regular basis before they can produce viable seeds.

▲ **The start of an invasion of a field by weeds localized on a piece of uncultivated land.**
Photo: David Girardville.

A buffer strip limits weed encroachment
Photo: David Girardville. ▼



The combine harvester

The combine harvester can be a significant spreader of weed seeds. The combine goes from one farm to another and disperses the seeds from weeds during the harvest period. One inspection found over 700 000 weed seeds on a single combine, 80% of which were found on the exterior of the machine.

Several types of weeds have seeds during the harvest period. During threshing, these seeds can be found in the harvested crop, on the field or on the thresher. In all cases, they can infest the field the following years. The risk of dispersion is higher with cereals and soybeans. These crops are threshed at ground-level, where several species of weed are in seed. Several weed seeds ripen after threshing (e.g. lamb's quarters, foxtails, etc.).

The combine harvester is a significant spreader of weed seeds.

The most common annuals during harvest

Broad-leafed annuals	Annual grasses
Velvetleaf	Wild oats
Nightshade	Giant foxtail
Ragweed	Barnyard grass
Lamb's quarters	Yellow foxtail
Pigweed	Green foxtail
Wild radish	

Places to clean on a combine:

1. Grain pan/table
2. Opening of stone trap
3. Base of the elevator and base of the return
4. Concave and threshing cylinder
5. Sieve
6. Straw walker
7. Straw spreader
8. Wheels and axles

Adapted from: Gestion intégrée des mauvaises herbes en grandes cultures, 2002. ITA Sainte-Hyacinthe, Stratégie phytosanitaire - SLV-2000.

Limiting sources of infestation (continued)

Here are some ways to prevent the spreading of weed seeds when threshing:

- Clean the thresher, especially when the combine arrives from another farm infested with weeds. At the very least, clean the exterior of the machine. Use a high-pressure washer, compressed air, a vacuum and a broom. There should be a broom on every combine. Gather and burn the seeds.
- Always start threshing with the least infested fields.
- Start threshing in the middle of the field and progress to the edges of the field, where there are generally more weeds.
- Carefully pull up velvetleaf and other encroaching weeds and burn them.
- Bypass large clumps of weeds (such as annual grasses in grain).
- If the seeds are cleaned using a sieve, adjust the combine to minimize the spread of weed seeds.
- Install a seed recovery device.

Manure

Manure from dairy cattle contains about 75 000 weed seeds per tonne. Species frequently found are lamb's quarters, pigweed, mustard, yellow foxtail and dandelion. Theoretically, one 20 tonne application of manure per hectare adds 150 weed seeds per square metre, or more than 1 million seeds per hectare!

Manure will only contain weed seeds if the bedding, feed or hay used to feed the livestock contain them. To eliminate this source of infestation:

- Pay more attention to the feed. It is an error to think that commercial feed grain is free from weed seeds. It can be a significant source of contamination if the grain is infested and has not been milled finely enough. The simplest solution is to mill the seeds finely. This will destroy 98 to 100% of weed seeds. If, afterwards, the seeds are heated to pellet them, the quantity of viable weed seeds in the feed grain will become almost zero.
- Make sure that hay and grain produced on the farm contains little or no weed seeds. Clean the grain if necessary (see page 19).
- Prevent the presence of weed seeds in straw by using good weed control practices. Make a visual inspection of purchased straw by shaking it. Sawdust does not contain weed seeds.

The type of production and the storage of manure also have an impact on the quantity of weed seeds.

Composting considerably reduces the number of viable weed seeds in manure. The key to success is to reach a fairly high temperature over a period of days. A temperature of 50°C for 3 days will completely destroy species such as pigweed and barnyard grass. As the exterior of the compost mounds are often colder than the interior, it is beneficial to turn them over.

Viability of weed seeds after passing through a cow's digestive system and then having been in stored manure for 3 months

Weed seeds	Viability of the seeds after 2 days in a cow's digestive system	Viability of the seed after 2 days in a cow's digestive system and 3 months in stored manure
Velvetleaf	100%	0%
Pigweed	37%	13%
Lamb's quarters	83%	31%
Green foxtail	95%	0%

Adapted from: Zimdahl, 1993.

Manure from cattle tends to contain more viable weed seeds than manure from chickens because of their different digestive systems. The liquid manure from pigs contains virtually no viable weed seeds.

A large amount of weed seeds are killed after 3 months of storage of both liquid and solid manure. The longer the storage period, the less viable the weed seeds become. That is why manure spread in the spring contains more weed seeds than manure spread in the fall.

Chickens are the livestock animals which destroy the most weed seeds. Photo: MAPAQ.

Crop Seed

The use of certified seeds considerably reduces the risk of spreading weed seeds.

Maximum number of weed seeds permissible in 1 kg of crop seed

		Certified No. 1	Ordinary No. 1
Crops	Wheat	3	10
	Barley, Oats	4	25
	Corn	0	4
	Soybean, Beans	0	1
Green manure	Vetch, Buckwheat	4	25
	Mustard	200	600

Source: Ministry of Justice, Canada, 2001. Regulations on Seeds.

Mustard seed presents the highest risk of spreading weed seeds. As it is the most widely used green manure in Quebec, it would be best to obtain the highest quality possible.

Birds

Birds spread relatively little weed seeds. Sometimes they even reduce sources of infestation in the years following their consumption of seeds left on the plant. However, velvetleaf seeds can survive up to 3 days inside a bird's digestive system, which allows a potential spread of the weed over several hundred kilometres. In addition, bird seed mixes regularly contains seeds from proso millet, an annual grass that is becoming more and more widespread in Quebec.

Managing soil and fertilization

Soil

Weeds display certain indications about the state of the soil, as shown on the following page.

Certain species are characteristic of the soil in field crop farms: lamb's quarters, pigweed, mustard and wild buckwheat. A dominant presence of these species generally indicates soil that can be considered balanced for field crops (rich, well drained, well structured and slightly acidic).

On the other hand, if the soil conditions change, other species of weeds will become more present. For example, wild radish will replace mustard if the soil becomes acidic. Fields with an excess of nitrogen will see more species such as oak-leaved goosefoot. Yellow nut sedge will proliferate in humid areas, as well as marshpepper smartweed. Changes in the weed population give indications about how to correct imbalances in the soil.

Fertilization

Here are the important points on the effects of fertilization on weeds:

- Mineral fertilization with phosphorus and potassium have little effect on weed populations.
- Organic fertilization with pig manure lowers the emergence of annual weeds by 10 to 20% compared with mineral fertilization.
- Compared to solid manure, liquid manure promotes the presence of some weeds (lamb's quarters, wild buckwheat, chickweed).
- There is no appreciable difference in the effect on weeds between the use of liquid pig manure or liquid cow manure.
- Apply finely shredded fresh manure on hayfields. A certain number of seeds will germinate, and will then be killed by mowing.
- Apply composted manure to cultivated crops since it contains less viable weed seeds.

Band applications of fertilizer reduce weed growth between the rows and nonpoint-source pollution.
Photo: David Girardville.

- Apply fertilizer to each side of the crop row, a few centimetres deep into the soil. This way, the nitrogen will be outside of the weed germination zone, benefiting the crop to the detriment of the weeds.
- Spread the fertilizer in two applications for high demand crops such as corn and wheat. By dividing the applications, weed growth is reduced, thereby reducing the negative impact of weeds on the crop. Generally, part of the fertilizer is applied at pre-emergence and the other part at post-emergence of the crop, when it is in full growth. For corn, choose post-emergence applications of nitrogen in bands over broadcast applications prior to seeding. Use liquid manure or mineral fertilizer at post-emergence since solid manure does not mineralize quickly enough.

Chemical and mechanical weeding

No one form of weed control is effective against all weeds. Weeds that are not dealt with will therefore have a tendency to spread throughout the farm. For example, the exclusive use of broad-leaf herbicides will promote the development of annual grasses. On the other hand, the flex-tine harrow and the rotary hoe may promote the development of large seedling annuals (velvetleaf, jimsonweed, wild buckwheat, and on a lesser scale, ragweed and wild mustard). Prevention and the diversification of weed control methods are the best ways to prevent this situation and are a part of integrated weed control.

Link between soil and weeds

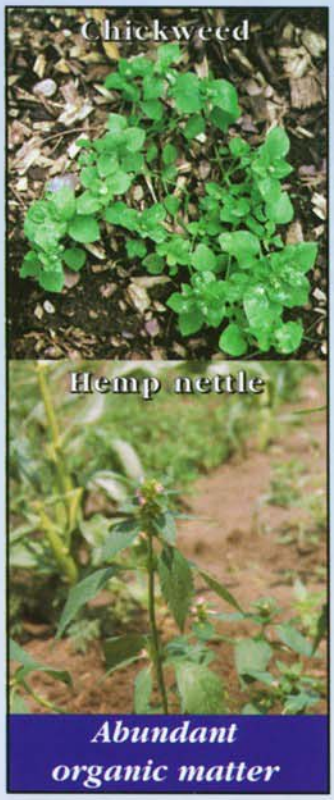
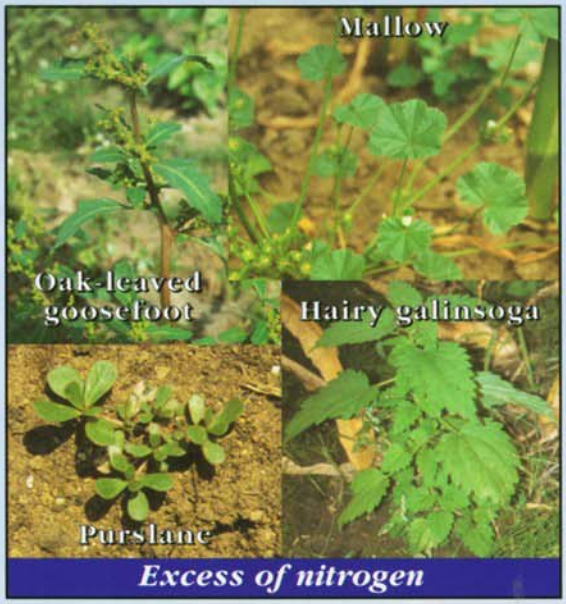
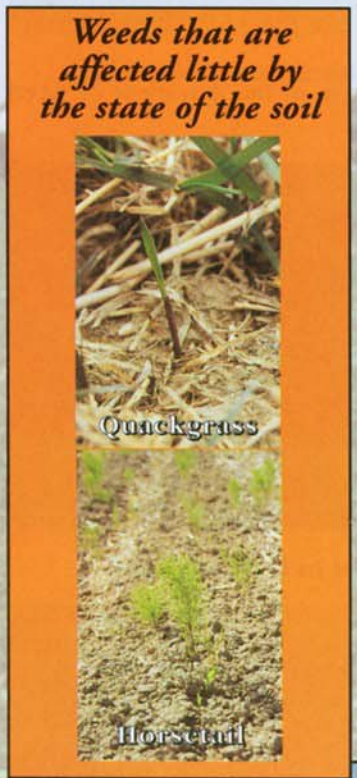
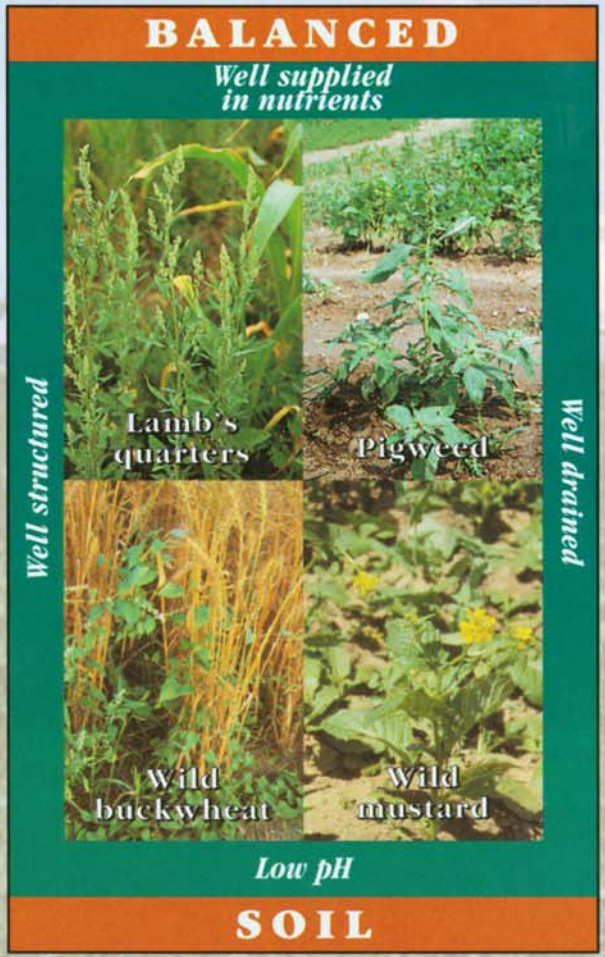
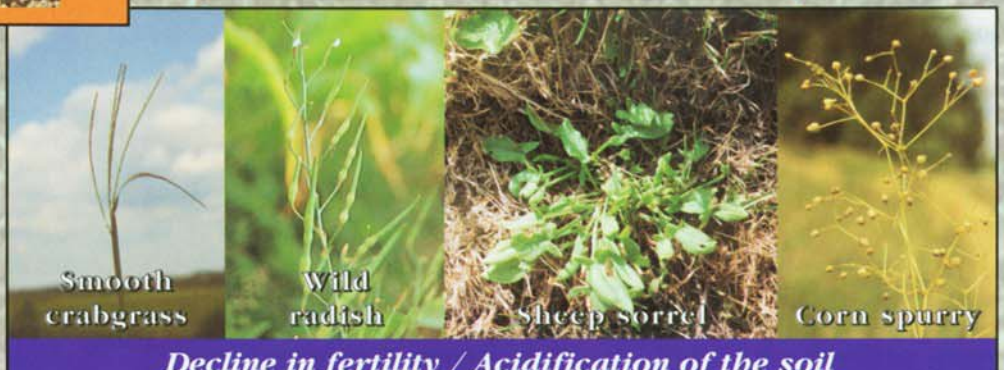


Photo: Romain Néron and Claude J. Bouchard, MAPAQ. ◀









Establishing balanced crop rotation

Establishing balanced crop rotation is a great help in preventing weed infestations. The positive effects of preventive measures against weeds increases with the inclusion of these 5 activities:

1. Increase the number of crops

Crop system	Corn	Corn Soybean	Corn Soybean Spring cereals	Corn Soybean Spring cereals Winter cereals	Corn Soybean Spring cereals Winter cereals Hayfields
Potential weed prevention level	Very low	Low	Moderate	High	Very high

Source: Personal observations of Yvon Douville.

The more diversified the rotation, the greater its contribution to weed control. For example, a 2-year rotation of corn and 1-year of soybean can reduce the number of giant foxtail by 35% compared to a corn monoculture. A corn/soybean/wheat rotation will diminish the presence of this weed by 80%.

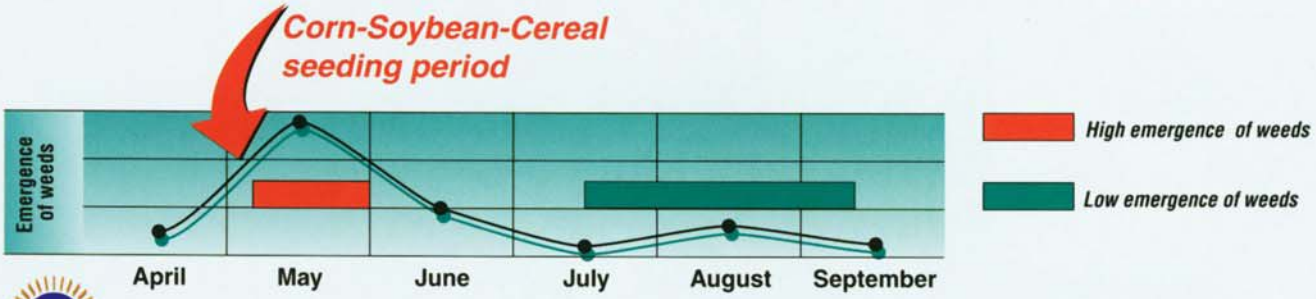
Hayfields favour the development of well structured soil, which in turn promotes crop growth to the detriment of weed growth. Reproduction of weeds through seed sets is limited by the cutting of hay.

A hayfield is an efficient way to reduce weed infestations ...

... as long as it is not in bad condition!

2. Break the weed cycle

Corn and soybean are seeded very shortly before the burst of weeds germinating. Since the development of these crops is somewhat slow, they are very vulnerable to the emergence of heavy populations of the more rapidly growing weeds in the spring.



Adapted from: *Gestion intégrée des mauvaises herbes en grandes cultures*, 2002. ITA Saint-Hyacinthe, Stratégie phytosanitaire - SLV-2000.

It would be advantageous in Quebec to seed crops in August and September, a period of low germination for weeds. These crops, well developed by the following spring, would cut the light off from weeds which would otherwise germinate abundantly. Unfortunately, end-of-summer crops are very limited. The survival of winter cereals is doubtful in many regions. It is better to seed them in September than in August. However, it is possible to successfully establish hayfields in August. A minimal alternative is to establish a green manure crop in August or September. Another possibility is to use false seeding (stale seedbed), as described on page 15; which would delay the seeding of the crop for a few days in the spring.

3. Include more competitive crops

Corn and soybean are among the least competitive crops against weeds. Corn closes over the rows only in July, and soybean allows many weeds to grow during the summer.

Competitiveness of crops against weeds. The seed spacing is 76 cm for corn and beans, and 15–18 cm for other crops.

Competitiveness	
Excellent	Hayfields Winter cereals
Very good	Barley, rye, oats, mixed spring cereals Canola, peas, buckwheat
Good	Spring wheat Pelleted barley
Moderate	Corn Soybean
Weak	Beans

Source: Personal observations of Yvon Douville.

Barley completely covers the ground in 4 weeks, leaving little light for weeds.

Spring rye is very competitive with weeds.

4. Improve the crop rotation sequence

Farm 1	Farm 2
4 years of hayfields 3 years of corn 2 years of cereals 1 year of soybean	4 years of hayfields 1 year of corn 1 year of soybean 1 year of corn 1 year cereals + green manure 1 year of corn 1 year of cereals
SAME CROPS, SAME LENGTH OF ROTATION BUT IT WILL BE EASIER TO PREVENT WEEDS ON FARM 2	

Source: Douville and Jobin, 1995.

5. Include crops that do not use the full growing season

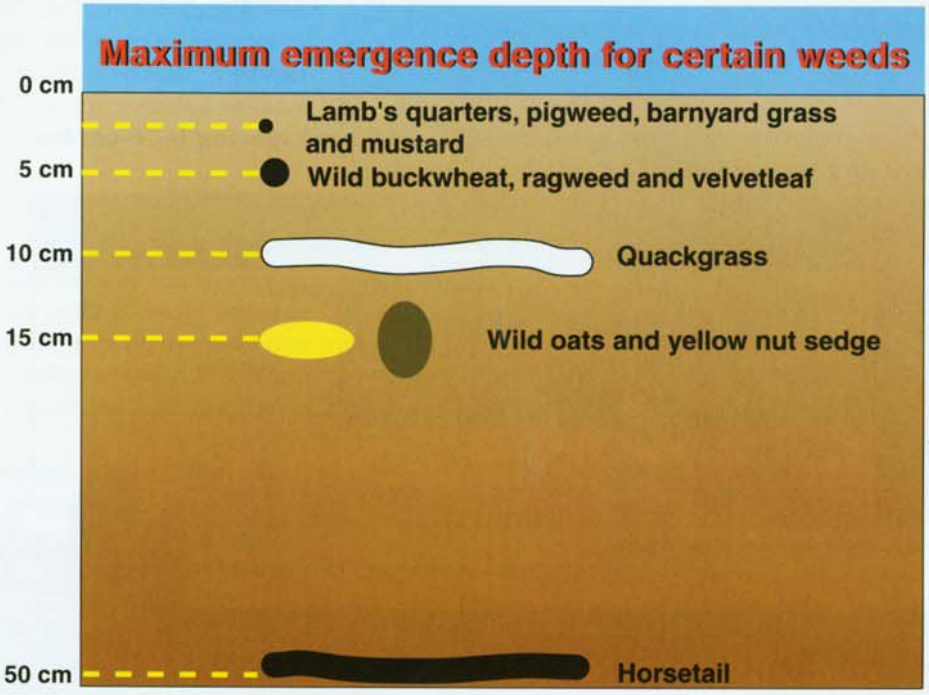
Corn and soybean are both harvested late in the fall. It is therefore impossible to seed down green manure or do a short-term fallowing.

Spring and winter cereals allow green manure to be seeded, get better value from manure, and have increased natural competition against weeds. The same applies for peas.

Working the soil properly

The way the soil is worked plays an important role in weed prevention.

A vast majority of weed seeds emerge from a depth of 5 cm or less. The concentration of weeds in the first few centimetres of soil is therefore very important and will have a direct influence on the number of weeds emerging in spring.



Short-term impact

In the short-term, plows leave the least amount of weed seeds to germinate the following year. Plowing leaves almost half the amount of weed seeds in the first five centimetres of soil than do the chisel plow, direct seeding or ridge tilling. The crop residue left on the surface by the reduced tillage has little impact on the emergence of weeds, unless present in large quantities. For example, soil that is 63% covered in corn residue reduces the emergence of lamb's quarters and pigweed by 60%, of velvetleaf by 10%, and has no impact on giant foxtail. In general, the emergence of weeds is not delayed by the presence of crop residue.

Distribution of weed seeds in the soil profile, by method of cultivation

Depth (cm)				
0 to 5	37%	61%	74%	> 70%
5 to 10	25%	23%	9%	Not available
10 to 15	38%	16%	18%	Not available

Source: Swanton and Shrestha, 2001.

Long-term impact

Over the long term, reduced soil tillage is more advantageous than plowing for the prevention of annual weeds. It reduces annual grass seed production without, however, having any effect on the production of broad-leafed annual seeds. Seeds from annual grasses lose their viability more quickly than seeds from broad-leafed annual weeds when they are concentrated in the first two or three centimetres of soil.

Number of weed seeds produced per square metre by cultivation method

Weeds			
Annual grasses	7300	3700	5700
Broad-leafed annuals	400	400	400

Source: Kegode *and al*, 1999.

Perennial weeds are also influenced by soil cultivation. They react differently, depending on their method of reproduction.

Perennial with rhizomes or surface tubers (quackgrass, yellow nut sedge). These perennials tend to become more numerous where soil is tilled because their underground structures are spread by the soil cultivation equipment.

Perennials with deep rhizomes (horsetail). These perennials are unaffected by the method of working the soil.

Perennials with seeds spread by the wind (dandelion, milkweed). These species tend to increase in minimum tillage systems.

Minimum tillage often promotes the development of perennials, such as curled dock.

Long-term changes in weed population, by cultivation method

Weeds			
Pigweed	–	+	+
Lamb's quarters	+	+	–
Annual grasses	+	–	–
Quackgrass, Yellow nut sedge	+	+	–
Dandelion	–	–	+
Horsetail	0	0	0

Sources: Légère and Samson, 1999; Schreiber, 1992; Thomas and Frick, 1993.

\+ Increase
– Decrease
0 No effect

Remember...

- *The combination of several methods of working the soil can be helpful in weed prevention. For example, plowing can be used to efficiently decrease short-term weed pressure, and can be followed by several years of minimum tillage.*
- *The timing of soil cultivation can have an impact on the presence of weeds. Autumn plowing can reduce the density of annual grasses by 75% compared to spring plowing, without any notable decrease in the broad-leafed annuals. On the other hand, spring plowing allows efficient control of perennials in light soil.*

Implementing quality seeding

The importance of quality seeding

Often the importance of seeding in order to prevent weeds is downplayed. A good seeding will promote the rapid and even emergence of the crop. The crop can then compete better with weeds. A proper seeding will also facilitate mechanical or chemical intervention because of the uniform growth of the crop.

Uneven emergence in soybean.

Obtaining good seeding — general principles

1. Prepare the seedbed well. Work the soil in dry conditions in order to prevent surface compaction and the development of annual grasses. Work only the soil surface (5 cm or less) in order to avoid bringing weed seeds to the surface. The rotary tiller is probably the tool that brings the most weed seeds to the surface. It penetrates to 15 cm and turns the soil over on itself. The vibration cultivator does not have a similar negative effect.
2. Seed soon after working the soil. By delaying seeding after tilling, weeds can emerge and get a competitive advantage.
3. Adjust the seed drill so as to seed at a uniform distance and depth.
4. Do not seed too quickly! Too fast a forward speed is often the cause of uneven seeding.

Obtaining good seeding — principles specific to each crop

Corn

- Seed as soon as possible in the spring. However, corn does compete against weeds better if seeded later in the spring. The warmer soil promotes the growth of corn to the detriment of weeds. Also, many weeds have already germinated at this point. In the case of late seeding, a false seeding (stale seedbed) is recommended.
- Aim for 75 000 seeds/ha with a seed spacing of about 18 cm.

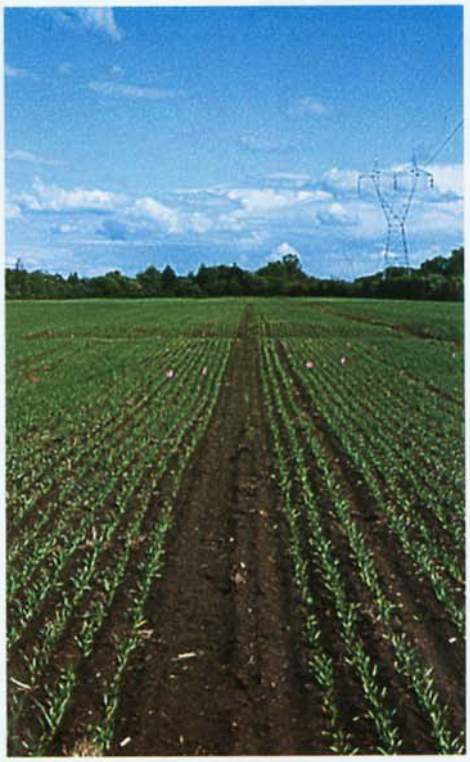
Soybeans

- Use the false seeding (stale seedbed) method. Soybeans benefit greatly from this method because of their weak competitiveness. Note that soybeans sustain practically no loss in yield because of a later seeding date.
- Use a precision seed drill. This allows even spacing and placement depth in the row. Seeding soybeans with a grain seed drill is often unsatisfactory (seeds on the surface, lack of uniformity in the spacing).
- Choose a wide, bushy cultivar. It will be more competitive that a slender plant that develops in height. For mechanical weeding, choose a cultivar with a fairly high first seed-pod so as to be able to throw earth in the rows when cultivating.
- Seed in 76 cm rows in thermal zones where it has been shown that there is no loss in yield using this technique (for zones of approximately 2600 CHU). Seeding in 76 cm rows facilitates mechanical weeding or the use of banded herbicides.

It is strongly recommended to seed soybeans in 76 cm rows if planning to use mechanical weeding methods.

Cereals

- Seed as soon as possible. The cooler temperatures of early spring are harmful to the germination and development of weed species such as lamb's quarters and ragweed. Do a false seeding in the fields where an early seeding is possible.
- Maintain a high seeding rate (10% higher than the recommended rate). High density seeding always promotes a better fight against weeds.
- Seed slowly and carefully. Avoid leaving unsown rows.
- Opt for dense-leafed cultivars. They increase competition against weeds from 7 to 14% compared to less competitive cultivars.
- Reduce the distance between rows if your seed drill allows it. Seeding in 10 cm rows rather than in 15 to 18 cm rows decreases the pressure from weeds by about 10% while increasing yield from 5 to 15%. Avoid diagonal-seeding, which takes twice the time.



Unseeded strip in this barley.

A problem with seeding this cereal.

False seeding (stale seedbed)

False seeding diminishes weed pressure. It consists of working the soil 7 to 10 days before seeding in order to promote the emergence of weeds. The weeds are then killed by lightly working the soil just before the actual seeding.

False seeding is generally done with a vibration cultivator. It doesn't cost much, and it is quick and easy to do.

The effectiveness of false seeding depends a lot on atmospheric conditions. If rain follows the first working of the soil, and the weather then becomes warm, a high proportion of weeds will germinate. An abundant emergence of weeds has, in certain cases, allowed a 67% reduction in weed pressure. On the other hand, the effectiveness of a false seeding is limited in cold weather.

In practice, false seeding is mainly used with the soybean crop and for other crops sown later in the spring.

A vibration cultivator is often used to do false seeding.

Soil worked by a vibration cultivator. ***This machine is used to promote the germination of weeds, in order to till them afterwards.***

Inter-seeded cover crops and green manure

Inter-seeded cover crops and green manure are useful mainly to improve the soil: increasing organic matter, improving soil structure, etc. Properly used, they can also help prevent weed infestations. Some green manure and inter-seeded crops produce substances which reduce the growth of weeds (allelopathic effects), especially during the first weeks of spring. By improving the soil, they also contribute by giving a competitive advantage to the crops to follow. Finally, by rapidly covering the soil surface, they limit weed growth.

Green manure: *Plant that follows or precedes the main crop, whose primary purpose is to improve the soil. The most common example in Quebec is white mustard sown in August after a cereal crop. This is autumnal green manure. It is also possible to seed a green manure in the spring before the crop, or even for the entire growing season, but this is not commonly practised.*

White mustard is the most commonly used green manure in Quebec. Photo: Pierre Jobin.

Inter-seeded crops : *Plant that is present at the same time as the main crop, whose primary purpose is to improve the soil. The plant can be seeded at the beginning of the season or around the month of August. This is not widely practised in field crops in Quebec.*

Aim for high biomass

A green manure or inter-seeded cover crop must attain an above ground biomass of at least 2 000 kg/ha on a dry matter basis for effective repression of weeds. This corresponds to a green manure of white mustard that is well emerged, reaching a height of about 50 cm. As a general rule, it is easy to attain this biomass level with autumnal green manure, but it is much more difficult with inter-seeded cover crops.

Inter-seeded cover crop of ryegrass and crimson clover in corn. ▶

Buckwheat as green manure. Photo: Anne-Marie Coulombe.

Choosing the right species

No species seems to be more able than the others in helping to prevent weed infestations, except possibly buckwheat and rye. Choose the species based on its ability to produce high biomass. For autumnal green manure, several species have proven themselves: white mustard, radish, cereals and vetch. All these species are equally effective if planted early in the season, in which case other plants such as buckwheat and clover can also be seeded.

The discharge from the combine harvester is often sufficient to establish a green manure well supplied with grain or canola. It is enough to work the soil surface as soon as possible after harvest. This practice promotes the emergence of several weeds, which will be killed by winter. Using the discharge from the combine harvester is probably the most economical way to establish a green manure.

Oil radish as green manure.
Photo: David Girardville.

Preventive effect of green manure and inter-seeded crops on weeds the following spring

	Species	Use	Effect on weeds: Broad-leafed annuals	Annual grasses	Autumn annuals	Perennials
Green manure	White mustard Canola Oil Radish Cereals Hairy vetch	Seeded in August–September, killed by winter	✪	✪	✪	✪
Green manure	Yellow sweet clover	Seeded in spring–summer, mechanically or chemically killed the following year	✪	-	-	✪
Inter-seeded cover crops	Winter rye Oats Buckwheat-oats	Seeded in corn in May, mechanically or chemically killed in June	○	○	○	○
Inter-seeded cover crops	Ryegrass Crimson clover	Seeded in corn in July, killed by winter	✇	✇	✇	✇
Inter-seeded cover crops	Crimson clover	Seeded in barley in the spring, killed by winter	✇	✇	✇	✇

✪ Moderate preventive effect (more than 25% repression)

○ Negligible preventive effect (less than 10% repression)

✇ Weak preventive effect (10–25% repression)

\- No data

Sources: Blackshaw, 2002; Hurle, 1993; Teasdale *et al.* 1991; Williams, 1998; Personal observations of Yvon Douville.

Destruction

A green manure is as efficient in preventing weeds whether it is left on the surface or worked into the soil, in the fall or in the spring. The producer can choose one or the other of these methods, as suits the particular cropping requirements.

Seeding of the main crop

The effects of green manure and inter-seeded crops endure only a few weeks in the spring. It is therefore wise not to delay the seeding of the main crop too much.

Suspected case of re-infestation by mustard seeds.

And if the green manure becomes a weed...

Sometimes buckwheat or white mustard can be seen growing in a field the spring after they were sown as a green manure. These plants can germinate from seeds which did not germinate the year they were sown, or seeds which were produced by the plant during the season.

In order to avoid this problem, use top-quality certified seeds. Also, make sure the green manure does not produce seeds in the fall. Pay particular attention during mild autumns when the green manure can take advantage of a longer growing season without being killed by the frost. One solution is to destroy the crop when it flowers in the fall. Another solution is not to seed green manure too early.

In the case of buckwheat, a good approach is to avoid working the soil in the fall. Seeds on the surface of the soil will germinate, and the first frosts will kill the seedlings.

Using short-term fallowing

A short fallow period (2 to 5 weeks) followed by a green manure is a good strategy to reduce infestations of perennials, notably quackgrass. The fallow period consists of working the soil several times to get rid of any source of infestation. The work is done at the beginning of July to the beginning of August when hot and dry weather conditions prevail.

Here are the steps for a short fallow period:

1st pass

The aim of the first pass is to destroy the hay plants or the crop stubble. Use disk tillage with offset disks, or a modified plow which will work the soil to 8 cm deep. If using offset equipment, the disks should be separated by 23 cm rather than 28 cm.

Quackgrass rhizomes concentrate in the first few centimetres of soil. Photo: Anne-Marie Coulombe.

The goal of the fallow period is to eliminate quackgrass by drying out the rhizomes. Photo: Pierre Jobin.

2nd pass

The second pass is made right after the first one. Use a heavy cultivator to a depth of 8 cm in order to bring the roots and rhizomes to the surface. Some producers add a rod weeder behind the cultivator to bring even more rhizomes to the surface.

3rd pass

Wait one to two weeks after the second pass so the rhizomes can dry and the weed plants die. At this point, any re-growth of weeds will be present in the field. These re-growths will be killed by an additional pass of the heavy cultivator or the vibration cultivator with the clod-buster removed.

4th pass

If needed a fourth pass is made after a drying out period.

The chisel plow tends to penetrate too deeply into the soil to be used for the fallow work. And cultivators equipped with rollers tend to spread the roots and rhizomes by cutting them up into small pieces.

Follow the short fallow period with a autumnal green manure or a fall rye crop. Green manure or rye will rapidly cover the terrain and will limit the re-establishment of perennial weeds.

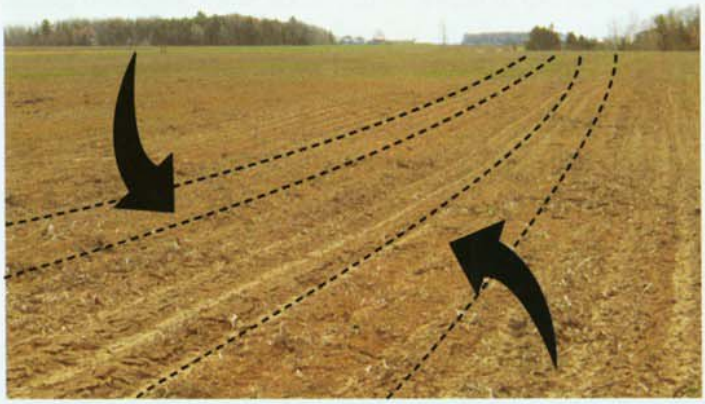
A fallow period might seem expensive, since it requires 3 or 4 passes with soil preparation machinery. However, generally it is done only once every 3 or 4 years for the same field.

Harvesting without re-infestation

Modern combine harvesters discharge weed seeds directly into the field.

Some older combine harvesters were equipped with a drum cylinder which separated weed seeds from the grain. The widespread use of herbicides and the wish to save time in the field has probably relegated this tool to the dustbin.

Modern combine harvesters have no mechanisms to recover weed seeds.



Concentration of weed seeds in bands, following a pass with the combine harvester.

Today, producers of field crops would greatly benefit from having combine harvesters equipped with a device that would separate weed seeds from the harvest. In effect, weeds don't get treated and are present at harvest. Until then, here are some other possibilities and solutions.

The seed recuperator

An American farmer in his eighties came up with a system to recuperate weed seeds. He installed a two-wheeled device at the back of his combine harvester which picks up trash from the combine, which then falls onto a conveyor and then passes over a vibrating sieve. The weed seeds fall into a 65 bushel tank, allowing them to be gathered and then burned.

The drum sieve

The seed sieve is an easy way to gather weed seeds. The combine harvester is adjusted to discharge the minimum possible amount of weed seeds back into the field. The grain is then sifted at unloading, and the recuperated weed seeds are burned.

The sieve is an important asset in the elimination of weeds.

The windrower/swather

With this tool, cereals are cut and windrowed about one week earlier than when using a combine harvester. This is enough to limit the formation of seeds from several types of weeds. Often, these weeds have a significant growth spurt several days before harvest.

Early harvest with the combine harvester

The principle is the same as for windrowing above. The cereal is harvested between 18 and 19% humidity, and the cereal is dried.

Ensilage

Ensilage is one of the most reliable methods for killing weed seeds. It takes only a few weeks in a silo to destroy the viability of weed seeds.

Scout the fields regularly

Scouting the fields consists of visiting them in order to make notes about the weeds so as to maximize control of them.

Why scout?

If it were practised more regularly, scouting would save producers many a headache. There are considerable advantages to regular scouting when it comes to weed prevention. Scouting allows:

1) The development of an integrated pest management strategy aiming for reduction in herbicide use and optimization of any interventions made.
2) Identification of the most common weeds in the field.
3) Discovery of the presence of new types of weeds in the field.
4) Localization of particularly nasty weeds at harvest time (e.g. velvetleaf and jimsonweed).
5) Evaluation of the level of control achieved by phytosanitary interventions (chemical, mechanical, cultivation practices, etc.)
6) Target cropping practices to influence weed growth.
7) Observe all other important elements for farm management: state of the crop, soil conditions, presence of harmful pests, etc.

This producer will benefit amply from the time he spends scouting his fields.

When to scout

Theoretically, scouting can be done at any time during the season. In practice, with the size and spread of field crop operations, it is often necessary to limit the scouting to 2 or 3 well-targeted visits:

1) An early post-emergence scouting: 3 to 4 leaves for corn and small grain crops, 1 trefoil leaf for soybean.
2) A late post-emergence scouting: 6 leaves for small grain crops, 10 leaves for corn, 5 trefoil leaves for soybean.
3) A scouting at (or a little before) harvest.

▲ **Early scouting.**

Late scouting. ▶

Scouting at harvest
in corn ▶
in small grain. ▼

What to look for when scouting

Take note of the following:

- The infestation level, according to the type of weed (broad-leafed annuals, annual grasses, perennials)
- The primary species present
- The date of the visit, the field number and the stage of the crop
- The control measures taken

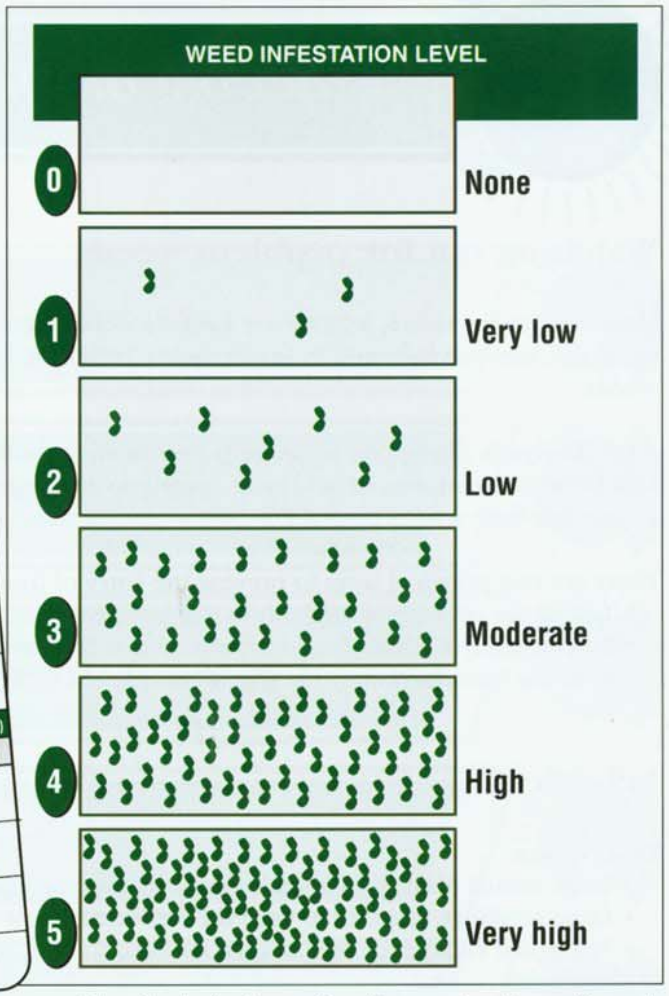
Other useful information to add is:

- The distribution of weeds in the field (ends, center, sides, etc.)
- The growth stage of the weeds

WEED SCOUTING (SEE END OF BOOKLET)				
STAGE *6 leaves*		BROAD-LEAFED	GRASSES	PERENNIALS
INFESTATION LEVEL (0 TO 5)	CENTER OF FIELD	*3*	*1*	*0*
	ENDS & SIDES	*5*	*3*	*1*
	SPRING	*Lamb's quarters*	*Green foxtail*	
	FALL	*Ragweed*		*Quackgrass*

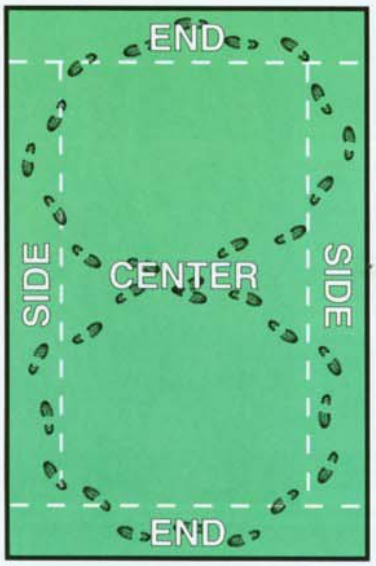
PHYTOSANITARY CONTROL (MECHANICAL AND CHEMICAL)		
DATE	STAGE	CONTROL (PRODUCT/QUANTITY/OBSERVATION)
May 25	*Lamb's quarters 2 leaves*	*Flex-tine harrow : 8 km/h Medium efficiency*
June 5	*Pigweed 2 leaves*	*Buctril 1 L/ha*

Scout sheet properly filled out. Field booklets are available through your regional agri-environmental club, and also at MAPAQ service centers (French only).

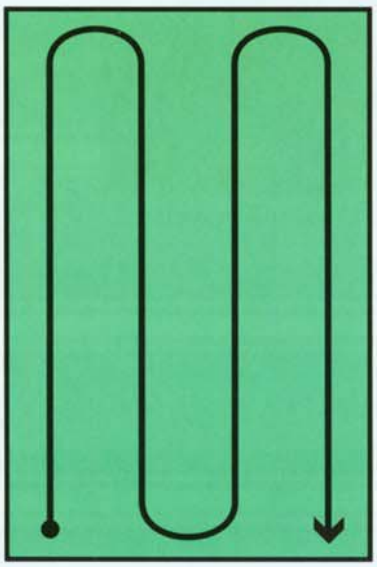


Simple technique for the evaluation of post-emergence weed levels. Choose the illustration which most resembles the situation in your field. Use a management strategy corresponding to the level of infestation.

How to walk the field



Scouting in an '8'



'Back and forth' scouting

Depending on the crop, walk in an '8', a 'W', a zig-zag, or up and down the field. This technique gives a good sampling of the whole field: the center, the ends and the sides. In some fields, it may be necessary to scout particular zones separately: organic soil zone, low spots, etc.

Of course the greater the number of stops, the more precise the scouting. Stop at least 5 times in the center of the field, though 10 to 15 stops would be better for getting an accurate representation. Stop 2 or 3 times in the ends and sides.

At harvest, the most practical method of scouting is to examine the weeds directly from the combine harvester. The types of weeds should be noted as well as their distribution and their relative abundance.

Source: Coulombe and Douville, 1999 and adaptation of Gestion intégrée des mauvaises herbes en grandes cultures, 2002. ITA Saint-Hyacinthe, Stratégie phytosanitaire - SLV-2000.

Watching out for problem weeds

There are several weeds which have become considerably widespread over the last few years. Unknown by producers a few years ago, they have started to invade fields. Velvetleaf, nightshade, jimsonweed and milkweed are entering this category of weeds.

All these weeds (except for milkweed) have been introduced into Quebec from its southwest corner. It is a region characterized by its concentration of field crop operations, its proximity to the United States, and its elevated thermal units. These weeds are making their way to central Quebec, spreading more slowly up the north shore of the St. Lawrence River.

There are two principal ways to prevent the entry of these weeds in your fields:

- Use all the preventive methods in this booklet.
- Be constantly vigilant. *Producers situated at the limits of the weeds' spread zones should pay particular attention to prevent the introduction of the species and to act before they propagate themselves.*

Velvetleaf

Description

- Large annual plant, growing to more than 2 metres tall in corn
- Large seedlings, resistant to both the flex-tine harrow and the rotary hoe
- Sequential emergence over several months, complicating both mechanical and chemical weed control
- Has a preference for soil particularly rich in nutrients

Velvetleaf one month after the seeding of the corn.

Distribution

- In the southwest of Quebec since the 1980s
- Progressing through central Quebec
- Especially present in corn and soybean

Flowering velvetleaf.

Damages

- Loss of yield
- Threshing problems

Prevention

- Regular scouting, making note of the exact locations of the infestations
- Manual destruction of the plants:
  Cut the base of the plant delicately; to prevent seed spillage, place in a bag and burn them. Eliminate plants with green seeds as well, because they may succeed in ripening. Do not throw ripped-out plants on the edge of a ditch for fear seedlings might emerge there next year. Never thresh a velvetleaf.
- Include a grain or hayfields in the rotation

Stunted velvetleaf, having no chance to reproduce itself in small grain.

Nightshade

Description
- Annual plant, approximately 1 metre high, having black berries

Distribution
- Southwest Quebec
- Mainly in soybean, sometimes in corn

Damages
- Loss of yield
- Problems when threshing
- Toxic berries
- Downgrades the harvest

Prevention
- Regular scouting
- Riparian buffer strips

Adult nightshade. Toxic berries.
Photos: Romain Néron and Claude J. Bouchard, MAPAQ.

Jimsonweed

Description
- Large annual, nearly 2 metres tall with a very hard stem, 5 cm in diameter
- Large seedlings, resistant to the flex-tine harrow and the rotary hoe

Distribution
- Southwest of Montreal
- Primarily in corn and soybean
- Preference for nutrient rich soil, particularly nitrogen

Damages
- Loss of yield
- Problems when threshing
- Toxic leaves and seeds

Prevention
- Regular scouting
- Moderate fertilization
- Riparian buffer strips
- Green manure
- Manual cutting of the plant (with gloves on), followed by burning since this plant is toxic to the touch

Jimsonweed ripped from a field on August 15th.

Jimsonweed one month after corn is seeded.

Milkweed

Description
- Perennial plant more than 1 to 1.5 metres high
- Reproduction by roots and by seeds which are carried by the wind
- Deep roots, which limit the effectiveness of mechanical or chemical treatment

Distribution
- Practically everywhere in Quebec in uncultivated land
- Not demanding in terms of soil

Damages
- Loss of yield
- Problems when threshing

Prevention
- Regular scouting
- Give more value to uncultivated lands

Flowering milkweed in mid-June.

Milkweed dispersing seeds in early October.

Germination of milkweed in the spring.

The root system of milkweed can penetrate very compacted soil.

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