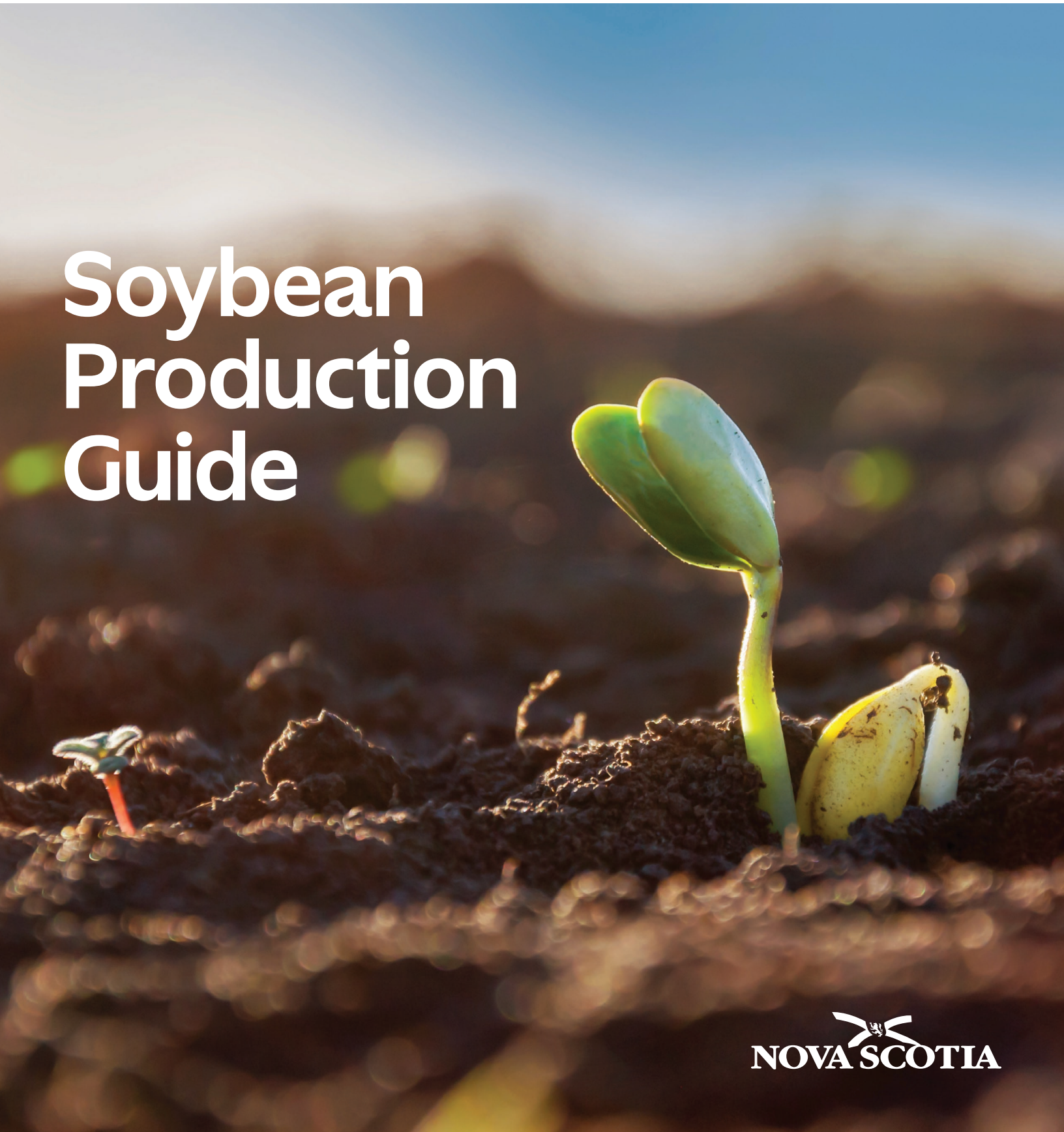
Perennia

Nova Scotia's Food Development Agency

Soybean Production Guide



NOVA SCOTIA

Information in this production guide is sourced and updated from information originally published in the following guide:

Advisory Committee on Cereal, Protein, Corn and Forage Crops (1991) *Atlantic Provinces Field Crop Guide (Pub*lication No. 100 Agdex No. 100.32) Atlantic Provinces Agricultural Services Coordinating Committee

Introduction

Soybeans are adapted to the longer frost-free areas with climatic conditions similar but not necessarily identical to those for grain corn. Early maturing varieties can produce average yields of over 3.4 tonnes per hectare with protein content of 35 to 40 per cent. Raw crushed soybeans may be included as a protein supplement in dairy, beef cattle and sheep rations without further processing, but some form of heat treatment such as roasting or extrusion is required before soybeans can be fed to poultry or hogs. Roasting soybeans for ruminant use will also increase the level of rumen bypass protein.

Most of the soybeans available are determinate-type, meaning that they complete their vegetative growth and then move into the flowering or reproductive stage. This type of soybean is suitable for oilseed harvest as the seeds will mature around the same time. Indeterminate-type soybeans continue to grow vegetatively even after they have started to flower and are specifically bred for forage harvest as they will produce more biomass than a determinate-type soybean. Forage soybeans can be a good source of high protein feed but may have limited availability in an appropriate heat unit range for Nova Scotia.

Soybeans make a good rotation crop, particularly for cereals, since they break disease cycles and can fix their own nitrogen.

Soil and Fertilizer

Soybeans should be planted in well-drained fields with good residual fertility and a pH of above 6.0 and preferably at 6.5. Their response to fertilizer application is generally low, but specific requirements for both lime and fertilizer should be determined from soil tests. Fertilizer for soybeans should be broadcast and harrowed in before seeding, if possible. Drilling fertilizer directly with the seed can seriously reduce stands.

NITROGEN

Soybeans have a high nitrogen requirement but are capable of supplying the majority of that nitrogen themselves via nitrogen fixation. Soybean plants produce structures called nodules on their roots. The nodules are home to rhizobia, which are bacteria that are able to fix atmospheric nitrogen. The nitrogen is converted into ammonium which can be taken up and used by the plant. A small amount of nitrogen fertilizer can be applied at planting to ensure that sufficient nitrogen is available in the soil for plant growth until nodules form and nitrogen fixation begins. Too much nitrogen applied at planting may hinder the formation of root nodules as well as increase the incidence of lodging and white mould.

PHOSPHORUS AND POTASSIUM

Soybeans are good at extracting and using phosphorus and potassium from the soil, so they are less responsive to applied fertilizer. Phosphorus and potassium application should be based on a soil test with the goal of maintaining adequate fertility in the soil rather than directly feeding the crop.

MANURE

Manure application to fields planned for soybeans should be considered carefully as it may present some challenges. Since nutrient removal rates for phosphorus and potassium in soybeans are generally lower than for corn, application of manure to soybean fields could result in a buildup of nutrients over time. Where both corn and soybeans are grown in rotation, manure application in the corn year would benefit both crops without leading to significant buildup of soil nutrients.

Varieties

Breeding programs for soybeans in Northern climates have given Maritime farmers a choice of varieties well adapted to local conditions. Choose a variety that will mature under the conditions which prevail on your farm. These include climatic conditions and management considerations. Protein content and herbicide traits should also be considered. For detailed descriptions of the varieties and their characteristics, consult the **Maritime Soybean Variety Trial results**, updated annually.

Seed Quality

Soybean seed should always be handled carefully. Rough handling causes cracking and reduced viability even when there is no cracking. High vigour seed is especially important for early seeding in cool soils.

Inoculation and Seed Treatment

Soybeans require inoculation with specific soybean rhizobium. Most soybean seed now comes pre-treated with a single rate of soybean inoculant. In fields without a history of soybean production, a double rate of inoculation is required. More inoculation can be added at planting using liquid or peat inoculant. By planting soybeans in rotation over time, native populations of rhizobia bacteria will build in the soil, but adding some form of inoculation will still produce a yield response.

Inoculum is available in a granular form, liquid, or as a powder in peat. Granular inoculant is applied in the seed row, while powdered and liquid inoculant is applied as a seed treatment. When properly applied, all are equally effective if they have been correctly stored. Prolonged exposure to heat and light decreases the effectiveness of the inoculant.

The inoculation on pre-treated seed does have an expiry date. If seed is kept from one year to the next, the seed should be re-inoculated. Soybean seed treatments have been shown to increase plant stands, improve uniformity and improve yields in some situations. Insecticide and fungicide seed treatments are beneficial when soybeans are planted into cooler, wetter soils, especially in no-till, clay or heavier soils, or in early planted fields. Cooler soils delay germination and emergence, allowing more time for insects and seedling diseases to attack the seedlings. Stand and yield response are dependent on the weather conditions following seeding and the level of disease and insect pressure. Wet soils tend to favour diseases such as Fusarium, Pythium, Phytophthora and Phomopsis. Insecticides provide protection against wireworm, seed corn maggot and early season aphids on the above-ground plant. When conditions are favourable for rapid emergence and little disease or insect pressure was evident, no yield benefit was found to soybean seed treatments.

Seeding Methods and Rates

A firm, level seedbed should be prepared using as few tillage operations as possible so that soil structure is maintained and compaction minimized. Light land levelling before and rolling after seeding is recommended to facilitate easier harvesting of lower pods, especially on unlevel ground. Soybeans are usually seeded with a grain drill in seven-inch rows. By blocking every second row, soybeans may be seeded in 15-inch rows. This helps decrease disease by allowing more air movement. Some of the older drills are easier to calibrate using 15-inch rows. Also, because there are more seeds per foot of row, emergence is much more even under some soil conditions. Fifteen-inch rows are easier to combine and spray. The drawback to fifteen-inch rows is that the canopy is much slower to close and weed control can be a little more challenging. Seeding rates of 130,000-180,000 seeds per acre are optimal for seven- to 15-inch row spacing. A bag of seed usually contains 140,000 seeds, while tote sizes vary. The grain drill must be carefully adjusted to prevent seed cracking and to deliver the seed to the preferred depth of 2.5 to 3.5 centimetres. Since seed is one of the higher input costs in soybean production, these factors are very important. Most soybean varieties can compensate for differences in plant stand without adversely affecting yield.

Using a planter set at 30-inch row spacing is another option for soybeans which can result in more even seed placement. The additional space between rows promotes good airflow which can reduce the incidence of white mould infection in fields where infection risk is high.

Soybean seeds germinate when the soil temperature reaches 10°C. Contrary to popular belief, the soybean is quite resistant to frost. Planting should take place between May 10 and May 31, depending on local conditions.

Weed Control

Good weed control is essential to successful soybean production. The plant does not compete well with broadleaf weeds, annual grasses or quack grass since it emerges slowly and takes several weeks to establish ground cover. Both mechanical and chemical weed control are appropriate for soybeans. The choice should depend on the weed problems and other farm management factors. For example, planting in 7-inch rows precludes mechanical weed control other than using a rotary hoe or other shallow cultivation in the very early stages of crop development.

There are many herbicide-tolerant traits on the market today. Roundup Ready or glyphosate-tolerant soybean varieties are bred to withstand the effects of glyphosate, so they have made a big difference in weed management for soybeans. Additional herbicide-tolerant traits are available including glufosinate-tolerance and Enlist soybeans, specifically designed to be used with the Enlist herbicide system which includes glyphosate, glufosinate and 2,4-D. These should be used in combination with residual herbicides to decrease the likelihood of herbicide-resistant weeds developing and keeping the crop weed-free during the critical weed-free period. The critical weed-free period for soybeans is from the first to third trifoliate stage. If soybean varieties with different herbicide tolerant traits are being used on the farm in the same year, it's important to maintain good records of which fields are safe to spray with particular herbicides. For ease of management, it may be simplest to ensure the same herbicide tolerant traits are being used across the farm.

Herbicides are available and recommended to control both broadleaf weeds and grasses in soybeans and should be selected for control of specific weeds present. Growers should select their best fields with low weed populations. Fields should be selected the year before soybeans are to be grown so that weeds can be identified and herbicide programs selected that will give control of the weed species present. Atrazine residue can severely injure soybeans. Choose fields that have not received more than 1.7 Kg/ha of atrazine the previous year, or the amount listed on the label. The proper time of application of each herbicide is stated on the label. Growers should consult these and follow recommendations carefully as in many cases, the margin between adequate weed control and crop damage is narrow.

Diseases

White mould, bacterial blight and stem canker have been observed in soybeans and could become more threatening under conditions of stress or monoculture.

CERCOSPORA LEAF BLIGHT AND PURPLE SEED STAIN

Cercospora leaf blight and purple seed stain are caused by the fungus *Cercospora kikuchii* and are fairly common in Nova Scotia.

Symptoms of Cercospora leaf blight are often confused with those of sunscald. Symptoms appear as light purple blotches on the upper leaves of the canopy. As the severity of the infection increases, the blotches will turn darker purple and then brown before leaves become necrotic and drop from the plant. Top leaves are infected first, moving lower in the canopy. Symptoms of purple seed stain are mainly discolouration of the seed. If discoloured seeds are present at high enough levels, the beans can be rejected. The edible market is particularly tight on this type of defect.

Figure 1. *Cercospora* leaf blight in soybeans. Photo: Cornell CALS – Field Crops

Figure 2. Purple seed stain in soybeans caused by *Cercospora kikuchii*. Photo: Cornell CALS – Field Crops

Epidemics of this disease are not common in Nova Scotia, so fungicides are not recommended as a management strategy.

ANTHRACNOSE

Anthracnose in soybeans is caused by multiple fungi, including *Colletotrichum truncatum* and *Glomerella glycines*.

Warm, humid conditions favour disease development. Symptoms of anthracnose include small lesions located on the leaves, petioles and stems of the plant. Severe infections will cause the lesions to expand and even girdle the stems and petioles, leading to premature defoliation. The fungi overwinter on crop residue or in infected seed, potentially leading to the damping-off of seedlings after planting.

Figure 3. Anthracnose on soybeans. Photo: Cornell CALS – Field Crops

Control methods for anthracnose include planting treated seed, crop rotation and tillage to destroy crop residues.

FROGEYE LEAF SPOT

Frogeye leaf spot is a foliar disease caused by the fungus *Cercospera sojina*.

Symptoms of frogeye leaf spot include lesions with dark brown or black centers. These lesions turn light gray or brown with red-brown edges as the disease progresses. Spores may form in the center of the lesions in conditions of high humidity. Warm, humid conditions are ideal for disease development. The fungus overwinters on crop residues.

Figure 4. Frogeye leaf spot on soybeans. Photo: Cornell CALS – Field Crops

Disease severity is usually low and rarely reaches epidemic levels in Nova Scotia. For these reasons, a fungicide application is not usually a cost-effective management option. Varieties with resistance to this disease are available.

POD AND STEM BLIGHT

Pod and stem blights are caused by the fungi *Diaporthe phaseolorum* var. *sojae* and *Phomopsis spp*. These diseases are common in soybeans in Nova Scotia.

Symptoms of pod and stem blight include small black dots (fungal fruiting bodies) on the stems, petioles and pods of the plant. The bodies may be linear, sporadic or in concentrated areas on the plant tissues. Disease development is supported by prolonged periods of warm, wet conditions, especially at the time of pod fill into maturation. The fungus overwinters on crop residues and in infected seed.

Figure 5. Pod and stem blight in soybeans. Photo: Cornell CALS – Field Crops

Applications of foliar fungicides are likely only cost-effective in fields for seed production. Control options include resistant varieties, tillage to get rid of crop residues and crop rotation. Crop rotations with cereals or corn are recommended for areas where the infection is severe.

RHIZOCTONIA DAMPING-OFF AND ROOT ROT

Damping-off and root rot are caused by the fungus *Rhizoctonia solani*.

Symptoms of Rhizoctonia infection include red lesions near the soil line on infected seedlings. These lesions expand to girdle the stems, killing the plants or severely stunting them. It is a soil-borne fungus that can survive for very long periods, making it a common and recurring issue.

Figure 6. Rhizoctonia infection in soybeans. Photo: Cornell CALS – Field Crops

Rhizoctonia can be effectively managed using fungicide seed treatments. Crop rotation with crops such as cereals and corn may be effective on fields with high infection levels, but rotation with potatoes will cause increases in infection.

WHITE MOULD/SCLEROTINIA STEM ROT

White mould is a soilborne disease caused by the fungus *Sclerotinia sclerotiroum*. It is the soybean disease with the greatest economic impact because it is widespread and often not managed enough. The pathogen exists in the soil in the form of sclerotia, producing apothecia under favourable conditions and eventually releasing ascospores that infect the plant's stems. Conditions for disease development include cool temperatures, high humidity and moist soil. The plant is most susceptible to high levels of infection as the canopies close and flowering begins and can significantly impact potential yield at this time.

Control methods include crop rotation with non-host crops such as cereals and corn and several years of good weed management. Foliar fungicides can provide effective control when applied at the appropriate stage. On-farm research conducted by the Atlantic Grains Council from 2019 to 2022 showed that there was a yield advantage to fungicide application at R1 and R2 in fields that were infected with white mould (AGC 2022). Tolerant varieties are available and are a good tool for white mould management. Cultural practices for canopy management such as wider rows, lower seeding rate and row orientation may minimize disease development conditions. Control should be approached with an integrated management plan, combining the above methods to manage white mould in Nova Scotia.

BACTERIAL BLIGHT

Bacterial blight is a foliar disease caused by the bacteria *Pseudomonas syringae*. Conditions favouring disease development include periods of cool, wet weather. As temperatures rise above 26˚C, disease development slows.

Symptoms of bacterial blight include small, angular, translucent lesions, which become necrotic with yellowish rings around them as the infection worsens. Symptoms of bacterial blight may be mistaken for those of bacterial pustules or brown spots. Severe infections may result in the leaves appearing ragged. The bacterium survives in seeds or on crop residues, dispersing through water droplets.

This disease does not cause severe disease losses and therefore does not have economic management options.

Insects

TWO-SPOTTED SPIDER MITE

Two-spotted spider mites are extremely small, spider-like pests, which can be observed with a hand lens. Spider mites live in colonies. They create thin webs on the lower surface of leaves, leaving a speckled appearance that causes the leaf to become yellow and curl, eventually turning brown and dying.

Insecticides may be used for control when hot, dry conditions cause insect outbreaks. Outbreaks will begin at the borders of fields or in areas of drought stress. Rainy conditions significantly reduce the incidence of mite problems.

Figure 7. Two-spotted spider mites on soybeans. Photo: Cornell CALS – Field Crops

JAPANESE BEETLE

Japanese beetle is an occasional pest in Nova Scotia and can cause severe defoliation in soybeans. Adults feed on the leaf tissue between the veins (see figure 8). Japanese beetles are more common in areas that have been in sod or cover crops due to the cool, moist conditions and presence of grass roots for the larvae to feed on. Areas that have sandier soils are also at a higher risk. Feeding is typically found in the upper canopy and around the field edge. Insecticide application may be warranted if defoliation reaches 30 per cent before bloom or 20 per cent after bloom.

Figure 8. Japanese beetle feeding on soybean leaf tissue. Photo: Caitlin Congdon, Perennia.

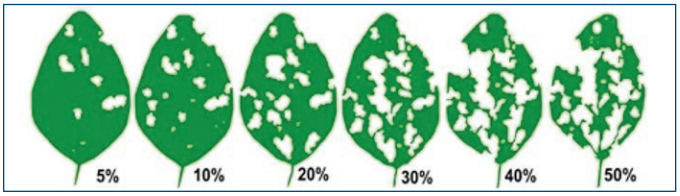


Figure 9. Soybean defoliation guide. University of Nebraska-Lincoln, CropWatch.

Harvesting and Storage

Soybeans are ready for harvest soon after leaves turn brown and fall off. This generally can be expected in late September or early October, depending on seeding date, variety and growing conditions. Moisture levels should be below 20 per cent for harvest. Combines should be adjusted according to the manufacturer's specifications to obtain a clean sample of undamaged beans. Generally, lower cylinder speeds (500 to 700 rpm) and wider concave and sieve openings are required for soybeans than for cereals. Care must be taken to harvest bottom pods that are close to the ground. Flexible cutter-bars and level fields improve the ability to harvest bottom pods.

Safe moisture levels for storage depends on air temperature and volume stored. For summer storage, moisture levels should be less than 12 per cent. For short term storage, soybeans may be held at moisture levels up to 18 per cent if the bins are adequately aerated.

Uses

The major use for soybeans produced in the Atlantic region is as a protein supplement for livestock feed. For ruminants, they may be used directly using normal milling practices for small grain with some modification to avoid excessive oil coating of milling equipment and to avoid rancidity in the oil following crushing. For feeding to non-ruminants, soybeans require heat treatment to destroy digestion inhibitors. Before soybeans are introduced to a feeding program, a livestock nutritionist should be consulted to ensure that a properly balanced ration is used. Most of the soybeans grown in the Maritimes are for export. There are very strict guidelines for purity and quality. Producers should work with their grain centre to ensure these are met.

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