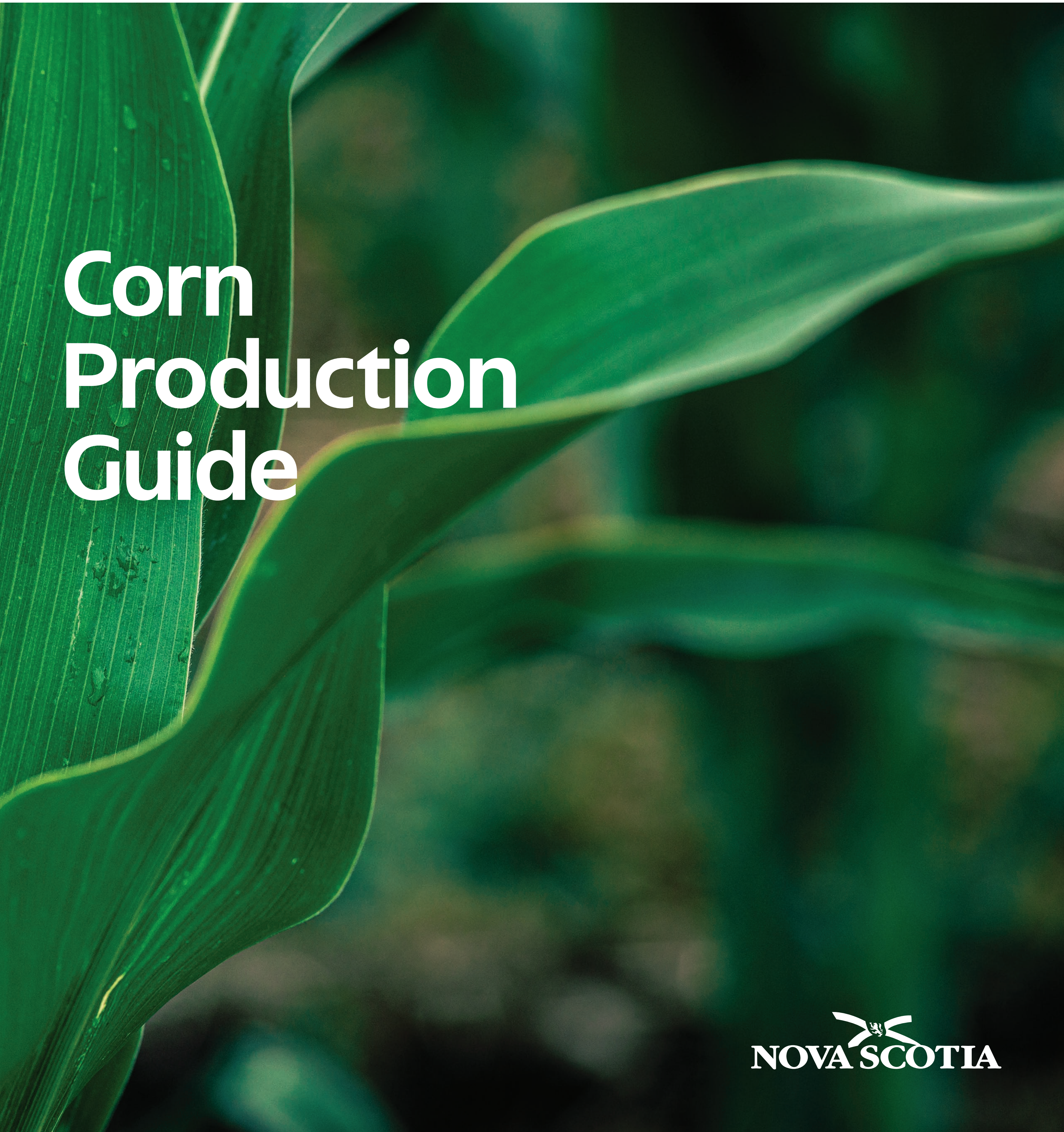
Perennia

Nova Scotia's Food Development Agency

Corn Production Guide



NOVA SCOTIA

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

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

Introduction

Corn is an important high yielding and high energy supplement for livestock feed in the Maritime Provinces. With the continuing introduction of new, earlier maturing corn hybrids and a number of different options of harvesting and storage methods to choose from, more farmers should look to both silage and grain corn as home-grown animal feed sources.

Corn Production Options

WHOLE PLANT SILAGE

The relatively cool growing season in some parts of the Maritimes is conducive to the production corn silage, even in areas where corn reaching full grain maturity isn't reliable. Silage corn will consistently produce more total digestible nutrients (TDN) per unit area than other locally grown forage crops. Good quality silage is highly palatable and very high in energy. Corn silage can be an excellent feed for all dairy and beef cattle classes, combining well with high protein forages in the diet. However, corn harvested as silage leaves fields with little stubble and may substantially contribute to soil erosion, which makes field choice an important consideration.

Figure 1. Whole plant corn silage. Photo: Caitlin Congdon, Perennia.

HIGH MOISTURE CORN

High moisture corn has been grown by dairy and beef farmers who have adequate fibre and protein supplies from high-quality forages and are looking to high moisture corn as a highly suitable energy supplement. From a soil conservation point of view, high moisture corn on sloping or sandy soils leaves the stalks in the field to reduce soil erosion and help maintain soil fertility and organic matter.

The term "high moisture" corn refers to either grain or whole ears harvested and stored at a high moisture content; 24 to 33% moisture for shelled grain and 25 to 40% for whole ears.

High Moisture Shelled Corn - The grain is shelled from the ear and ensiled in a well-managed, oxygen limiting silo to provide feed for both cattle and hogs.

High Moisture Ear Corn (snapplage or cobbage) - Two harvest methods are available. A forage harvester can be equipped to pick and chop the ears, which are then ensiled. A combine can be used to harvest the corn. This grain is then ground at the silo. This grinding step is essential in all concrete upright silos, bunker silos and piles of ear corn stored on a slab to ensure proper packing, air exclusion and ensiling results. Grinding of "combined or picked corn" as opposed to corn that has been harvested with a snapper head-forage harvester can be accomplished at the silo by putting the corn through a forage harvester with the proper screens in place, or a commercial portable roller or hammer mill/blower combination specially designed for this purpose.

Figure 2. High moisture ear corn, also referred to as snapplage. Photo: Caitlin Congdon, Perennia.

DRIED GRAIN CORN

Artificial drying of grain to 15% moisture is necessary for the safe storage of grain corn. Shelled grain corn is a suitable feed for all livestock classes and can be incorporated into "on-farm" rations or sold as a cash crop.

To properly mature good crops of dried corn, careful consideration has to be given to field selection in terms of soil texture that allows early warm-up and planting, plus the previous crop or crop rotation (refer to next sections).

CLIMATIC REQUIREMENTS

Corn is a crop that is at its climatic limit in the Maritimes. Coastal areas have a long growing season but the cooler temperatures do not provide sufficient heat for higher heat unit corn to reach maturity. Corn is a heat-loving crop that requires temperatures above 10°C to germinate and grows best at high temperatures. Early planting of corn in the Maritimes is difficult, as wet spring conditions can delay field work and soils are slow to warm to the optimal temperature needed for germination and vigorous growth. Good drainage helps reduce both these problems. Corn is a long-season crop that must reach maturity before the fall frost. Grain corn will continue to dry down after a killing frost but no more dry matter accumulates. It is important to select a hybrid that will mature in your area based on the corn heat unit (CHU) rating for the hybrid and the geographic region (Figure 3).

Corn Heat Units (CHU) are calculated from daily maximum and minimum temperatures. They provide a way of rating corn hybrids and geographic regions, thus providing a basis for selecting hybrids with a maturity rating suited to the location. CHUs for a specific location can be calculated using historical weather data and the equation for daily CHUs. If a negative number is calculated for the daily CHU accumulation, it should be considered as "0". An online corn heat unit calculator is available on [Perennia's Farm Data Tools] web application and can be used with a network of on-farm weather stations across the province.

$$CHU = [1.8(\textit{daily min temp} - 4.4) + 3.3(\textit{daily max temp} - 10) - 0.084(\textit{daily max temp} -10)2]/2$$

The Maritimes have been divided into zones for corn production based on the CHUs available in the region (Figure 3). The Annapolis Valley, Truro and Shubenacadie areas have enough CHUs for consistently maturing early grain corn hybrids. These areas are designated as Zone 1 (>2500 CHU). They have the greatest potential for corn; both grain and silage corn can be consistently produced.

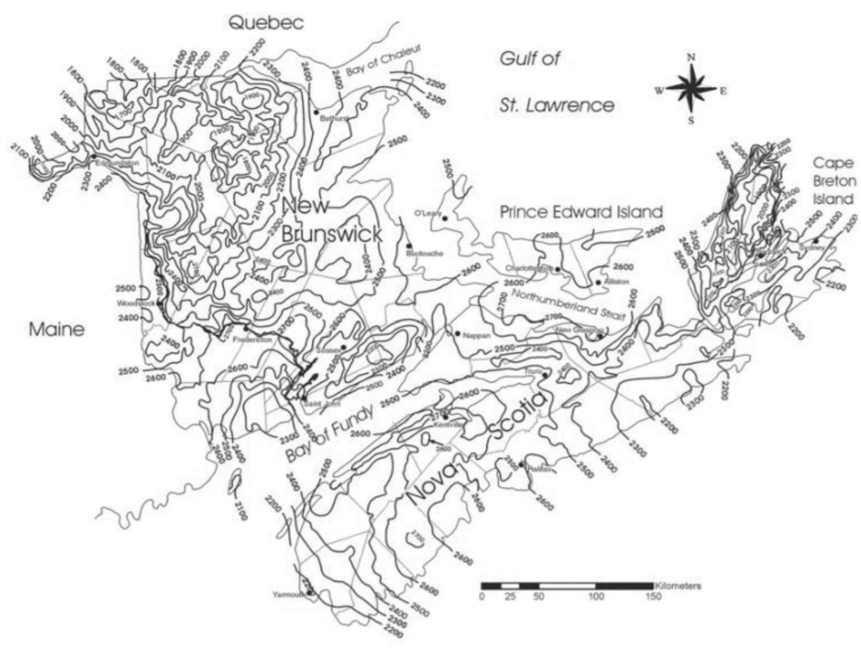


Figure 3. Average crop heat units for grain corn and soybean production in the Maritime Provinces for the 1971-2000 period, Bootsma et al., 2006.

Corn grown for silage is harvested at approximately 50% moisture in the grain or 30 to 35% whole plant dry matter before grain maturity is reached, thus requiring fewer CHU. Areas designated as Zone 2 (2300-2500 CHU) are suitable for high moisture ear corn or silage. Areas designated as Zone 3 (2200-2300 CHU) produce an acceptable silage with only the earliest hybrids. Areas designated as Zone 4 (<2200 CHU) are risky for corn production.

The calculation of CHU for the various locations in the Maritimes is based on the average data for a 30-year period. When using this information, keep in mind that some years may be better than indicated but some years may be worse. When evaluating the performance of a hybrid on your farm, check the CHU accumulated that season and compare them to the long-term average before making a decision.

CROP PLANNING

There are many key points to consider when selecting fields to grow corn.

1. With good cultural practices, successful corn crops are produced on most well-drained Maritime soil types. Choose fields with good, natural drainage or improved drainage (ditches or tile drains) for corn. Well-drained soil is important for grain corn as the harvest may extend into the early winter when excess moisture affects travelling over the field. Poorly drained soils are not suitable for corn.
2. Although corn is tolerant of pH readings as low as 5.5, fields should be limed to above pH 6.0 for best production and nutrient use efficiency.
3. Areas or fields known to have significant bird or raccoon damage can seriously affect grain yields.
4. Fields with greater than 5% slope can present serious erosion problems, especially in silage corn production. If ear corn or grain corn are grown on sloping land, maintain crop residue on the surface over the winter months by planting cover crops or practice appropriate conservation tillage.
5. Fields subject to early fall frost should be avoided where possible.
6. Fields reasonably close to the silage storage area reduce transportation time and expense. Corn silage is 65 to 70% water.
7. Distance to manure sources should be considered in choosing cornfields. Corn is one of the most efficient utilizers of the nutrients in manure. Spring incorporation of manure is the best method of utilization. Fields that allow early travel in the spring are an advantage.
8. Corn, along with other cereals, offers an excellent opportunity to clean fields of certain weeds. Attention must be paid to a planned approach to weed control. The potential residual effects of certain herbicides on subsequent crops and groundwater quality must be taken into consideration.

CORN AS A ROTATION CROP

Many farmers find that corn offers advantages in a cropping rotation system beyond its yield advantage.

Some points to consider are:

1. Corn makes excellent use of manure. Large amounts can be applied without fear of lodging and as manure can be incorporated, the nutrient value is maintained for the crop.
2. Corn production allows for a break in the forage crop cycle. A sod bound condition can be broken with a year or two of corn.
3. A wide range of possible chemical and cultural weed control options are available to clean up fields for other crops such as small grains or legume forages. A well-designed crop rotation rotates both crops and weed control methods, so no one species of weed has a chance to build up or develop chemical resistance.
4. Corn production spreads the workload on many farms. It is planted later than spring cereals and harvest is a single operation later in the fall after work on other crops is finished.
5. Corn provides a high energy feed to balance the protein produced by good quality forages.
6. The most practical rotation usually involves one to two years of corn following a soybean crop and preceding cereals for a three to four year rotation. Continuous corn, particularly on sloping ground, leads to soil degradation and ultimately erosion, as well as disease issues. Rotations with forage crops lessen this problem.

HYBRID SELECTION

New hybrids are continually being evaluated by the Maritime Corn Performance Committee at various locations across the Maritimes to select early maturing hybrids with strong stalks, high yielding ability and tolerance to insects and diseases. Many corn hybrids are available but only those on the performance list have proven their ability to perform satisfactorily and consistently under Maritime conditions. See the Corn Guide for the Maritime Provinces published annually on the Perennia website for more information.

CHOICE OF SILAGE HYBRIDS

Yield, maturity and lodging resistance are important considerations in choosing a hybrid for silage making. Corn at ½ to ¾ milk line has the correct balance of starch accumulation, digestibility and dry matter to make the best silage (Figure 4). At this stage, the whole plant contains 65 to 70% moisture. The highest yielding hybrid, which generally reaches this stage before frost damage occurs, is the best option. It is a common error to choose late-maturing hybrids that look attractive due to vigorous growth characteristics.

Good quality silage requires that grain formation be well advanced by harvest time. Silage made at the proper moisture level will give the least amount of trouble from freezing, spoilage and silo structure deterioration. If corn silage is frosted in the fall, harvest should occur very rapidly. Yeasts and bacteria native to the plant will quickly colonize the plant and interfere with the ensiling process.

Figure 4. Corn at the 1/3 to 1/2 milk line stage, approaching the appropriate time to harvest for whole plant corn silage. Photo: Caitlin Congdon, Perennia.

Figure 5 shows the relationship between three-year average dry matter yield and CHU rating for silage hybrids in the Maritime Corn Test in 2024, which suggests that similar yields can be achieved with hybrids at different CHU ratings. Especially in areas that are prone to early fall frost, it may be possible to choose a lower CHU hybrid without a significant yield penalty.

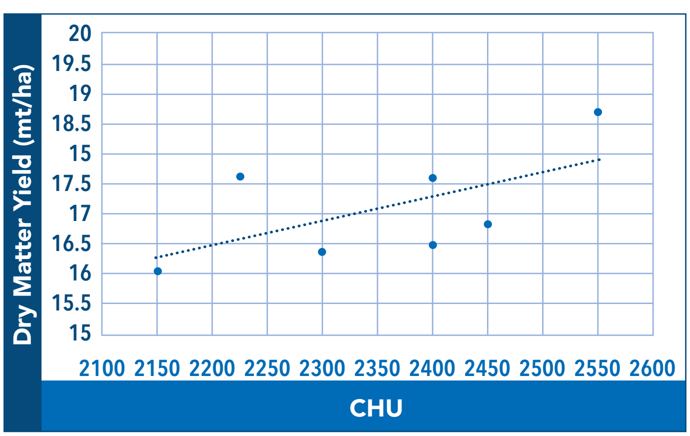


Figure 5. Three-year average dry matter yield vs CHU for silage hybrids in the Maritime Corn Test, 2024.

CHOICE OF GRAIN HYBRIDS

The most important characteristics of a hybrid for grain production are early maturity, high yielding ability and resistance to lodging and stalk breakage. Figure 6 shows the relationship between three-year average grain yield and CHU rating for grain hybrids in the Maritime Corn Test in 2024. When choosing a grain hybrid, if data shows that a similar yield can be achieved by planting a 2250 CHU hybrid versus a 2450 CHU hybrid, the lower CHU hybrid would be the safer choice. In Nova Scotia, the difference between 2250 and 2450 CHUs can be around 10 to 14 days in the fall, a time period during which there could be significant weather events that could impact the yield and maturity of the corn crop. Fall frost damage can generally be avoided by choosing hybrids with a heat unit rating no greater than the heat unit accumulation indicated for the growing region. Corn that is frozen before maturity produces grain of inferior quality (test weight) and requires additional expenditures to dry to a level safe for storage. When the corn plant freezes, starch accumulation in the kernel and the moisture removal ceases because the natural processes within the plant stop.

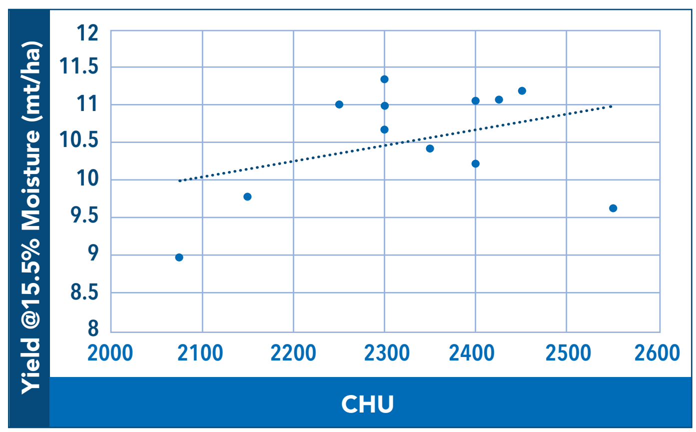


Figure 6. Three-year average grain yield at 15.5% moisture vs CHU for grain hybrids in the Maritime Corn Test, 2024.

Stalk strength is important as combines often miss ears on lodged or broken plants. Most breakage results from weakening of the stalk-by-stalk rot, corn borer infestation or stalk cannibalization by stressed plants. Stalk strength and resistance to root lodging are given major consideration in breeding programs. Hybrids are rated for stalk strength or standability to enable the farmer to give this factor due consideration in choosing a hybrid. Hybrid traits are available for the tolerance of the plant to some herbicides and insects. Selection of an appropriate trait that corresponds with the issues being faced on an individual farm can be an excellent tool for the management of weeds or insect pests. Liberty Link and Roundup Ready traits offer tolerance to certain herbicide active ingredients, while various Bt-traits offer resistance to insects such as European corn borer and Western bean cutworm. Hybrids with more than one Bt-trait associated with them are referred to as stacked or pyramid traits. For more information, see the Corn Trait Table published annually by the Canadian Corn Pest Coalition.

Field Operations

PREPARING THE SEEDBED

Conventional tillage operations should produce a level, friable seedbed, free of large chunks of soil. A well-prepared seedbed will absorb moisture, permit aeration and warm up rapidly, encouraging fast, uniform germination and emergence of corn seedlings. Excessive tillage should be avoided since it may lead to soil compaction, pooling on the surface and erosion. When an excessively tilled seedbed dries out following a rain, crusting and cracking of the surface layer frequently occurs, resulting in poor emergence and a reduced plant population. Consistent two-inch seed depth gives the best results in emergence. At this depth, moisture availability and temperature tend to vary much less. This also allows the nodal roots to develop at the correct three-quarters of an inch depth. Even emergence of the plants is key in producing yield and managing pest pressures.

TILLAGE EQUIPMENT SELECTION

There are several options for tillage equipment and conservation planters that are utilized in the Maritimes. Primary tillage implements such as chisel plows or off-set disc harrows are used on corn or grain stubble to produce quicker initial tillage results than the conventional moldboard plowing practice. The chisel plow or off-set discs are sometimes referred to as "conservation tillage implements." These implements can leave higher amounts of crop residue on the soil surface of sloping fields (greater than 5% slope) to minimize potential soil erosion losses.

In terms of secondary tillage implements, many farmers rely on "S" tine harrows with rolling crumblers or roller-harrow combination units, rather than the traditional disc and spring tooth harrows which often leave seedbeds overworked and fluffy. However, disc harrows are still necessary on some heavier textured soils or in fields coming out of forages. When using a disc harrow, consideration should be given to limiting the number of passes and rolling prior to planting, if necessary.

Whichever tillage system is utilized, the seedbed produced should:

- permit early planting
- maintain or improve the soil structure
- destroy weeds germinated prior to planting
- permit uniform depth and placement of seed and fertilizer
- provide conditions for rapid seed germination, soil warming

NO-TILL CORN

No-till corn production can have some challenges in the Maritimes, including slower warm-up of our cool, moist soils. However, it can offer a number of advantages as well, including minimizing soil disturbance and reducing the number of equipment passes over the field.

No-till corn planting may need to be delayed seven to 10 days later than planting on conventionally tilled fields because the soil takes longer to warm up and dry out. No-till corn can achieve similar yields to conventional corn, depending on soil type, environmental conditions and other factors. On sandy and gravely loams or where corn has followed crops other than corn, yield differences caused by zero-tillage have been smaller. Corn yields with chisel plowing have been similar to those following moldboard plowing on sandy loam soils but not on silt loam, clay loam or clay soils. However, where corn is grown following crops other than corn on fine-textured soils, chisel plowing has resulted in yields similar to those after moldboard plowing.

No-till corn planting can be advantageous in certain conditions. Its advantages are reduced tillage, less time and machinery required at planting, less fuel used, reductions in erosion, conservation of soil moisture and building of organic matter. Some of its drawbacks are that it is not suitable on all soils, especially heavy, slow warm-up soils, difficulty in getting fertility placed throughout the plow layer and possible build-ups of insect or weed problems.

STRIP-TILL CORN

Strip-till corn production offers a middle ground between a conventional tillage system and no-till. A 10-inch-wide strip is worked in the fall or spring, allowing the soil to warm up more quickly than in a no-till system, which is extremely beneficial in areas with a short corn production season such as the Maritimes.

Since only a narrow strip is being cultivated, there are benefits to improved soil structure and soil biological activity over a conventional tillage system. Considerations for a strip-till system include options for fertilizer placement, adjustments to weed management and the importance of GPS capabilities on the corn planter tractor. Strips can be pulled either in the fall or spring, depending on soil type and farm management decisions. Strips pulled in the fall may require a freshening pass in the spring.

Figure 7. Yetter strip-till unit. Photo: Caitlin Congdon, Perennia.

SEEDING DATE

In general, planting can begin when the mid-day soil temperature has reached 10°C or higher for two consecutive days at a depth of three centimetres. Depending on location and type, soils of the Maritime area normally reach this temperature between May 7 and May 20. Planting corn in soil that remains below 10°C for eight to 10 days can result in seed rot, insect damage to seed, delayed germination and irregular emergence. Corn planted later than the first week of June is unlikely to produce satisfactory yields or maturity levels. Early planting usually results in greater maturity at harvest, even if no yield increase occurs. Early seeding of corn results in:

- greater maturity at harvest time
- shorter, stronger stalks with less lodging
- silage with a higher percentage of grain
- lower grain drying costs

Frost damage to early seeded corn does not necessarily mean loss of the crop or the need to replant immediately. The growing point of a corn plant remains protected below the soil surface for three to four weeks after planting, up until the sixth leaf stage. Although frost may kill the first one to five leaves, usually new leaves continue to emerge from the protected growing tip with little overall final yield reduction. If no new leaves emerge within three to four days after frost, the damage is severe and replanting is necessary. Replant using the earliest maturing hybrid available.

Key considerations for assessing corn stands after a frost:

1. Growing point is below ground until the plant has five visible collars. This is six-leaf corn.
2. Tissue damage may be significant after frost events but often growing points can be undamaged.
3. Growing points when unaffected should be firm and yellow or light green in colour.
4. New growth will emerge from the whorl and recovery should be complete. In some cases, the new growth gets obstructed by a dead tissue "knot" but this is mostly cosmetic and rarely causes a lasting problem.
5. When frost damage is severe and soils dry and loose, damage may have moved down the stem and killed the growing point. Careful evaluation of these situations should be made in the day or two following the frost events if replanting is necessary.

Figure 8. Assessing the viability of corn plants after early season frost. Photo: Maizex.com

SEEDING RATE AND DEPTH PLACEMENT

A uniform plant stand is essential for successful corn production. Therefore, the planting machinery must be properly maintained, correctly adjusted and operated with care and precision. A seeding rate of 69,000-89,000 plants/hectare (28,000-36,000 plants/acre) for grain or silage corn is usually suitable for optimum corn production in the Maritime Provinces. To allow for germination losses and insect injury to seedlings, plant 15% more seeds than the intended final population. For extremely early seedings, a 25% overplanting may be warranted. The required plant populations can be obtained by various combinations of kernel spacing and row width. On-farm agronomy trials conducted by the Atlantic Grains Council showed that a seeding rate of 28,000 seeds/ac resulted in higher yields of both silage (Figure 9) and grain (Figure 10) than seeding rates of 32,000 and 36,000. Because of the higher cost per acre to plant more seeds, there is a higher economical return with a lower seeding rate. Corn seed companies may recommend seeding rates based on individual corn hybrids, which was not taken into consideration in the Atlantic Grains Council trials.

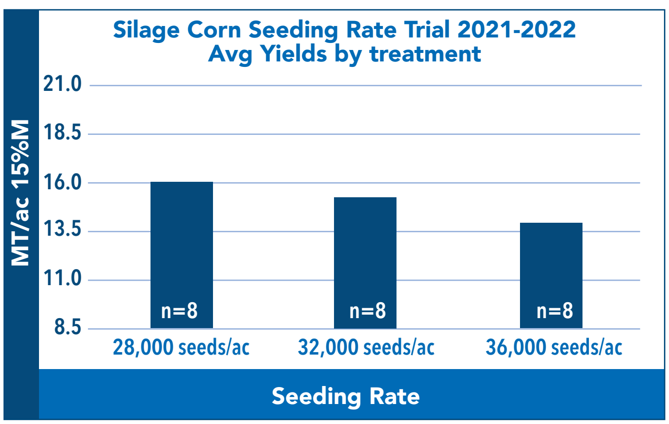


Figure 9. Silage yield by treatment, Atlantic Grains Council on-farm agronomy, 2022.

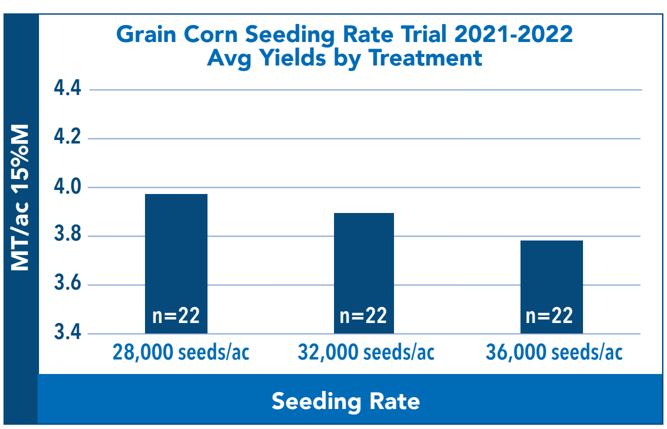


Figure 10. Grain yield by treatment, Atlantic Grains Council on-farm agronomy, 2022.

Too deep a seed placement often occurs in cornfields, particularly those with fluffy, over-tilled seedbeds. Deep planted corn emerges slower and has poor seedling vigour, which ultimately negatively affects yields.

CORN PLANTER OPERATION

Regardless of the type of planter, it is of great importance to check and adjust its performance ahead of time so that corn planting can proceed with confidence as soon as soil and climatic conditions permit. Calibration can be divided into a number of steps.

1. Make Sure that the Planter is in Good Condition

Check all moving parts on the planter for wear, breakage, loose-fitting sprockets and gears, and so on. Tighten any loose nuts and bolts. In the case of a plate-type planter, make sure the cut-off and knockout pawls are not worn, are moving freely and have adequate springs. Hopper bottom plates should be checked and replaced if worn.

Where a finger-type plate-less planter is used, all parts should be checked over as above. Fingers should be checked for freedom of movement and thoroughly cleaned. Fingers should not be oiled. A dry lubricant such as graphite is added to the seed for lubrication of the finger mechanism.

If a drum-type air-planter is used, a further check is needed to ensure that the hopper, metering drum and seed tubes are airtight and that all seals and gaskets are in good condition. Cut-off wheels should turn freely; they and the brush should be free from damage. Check fan bearings and drive belts for wear.

With a unit-type air or vacuum-planter, fans, hoses and electrical connections should be checked for leaks, wear and dirt. Fans should be run and operating pressure checked.

2. Seed-Plate Selection

Most older corn planters use circular rotating plates, which are available in 16, 20 or 24 cells, with various cell sizes and shapes. Seed and seed plates must be matched for accurate planting. Consult the table of suggested plates printed on the hybrid bag or tag and then check the seed for fit in the plates. The seed should be loose enough in the cell to avoid damage but with room for only one seed per cell. With the plates in place and the planter in raised position, rotate the drive wheel and collect several dozen kernels. Check seed for damage before making a final plate selection.

Most new corn planters are plate-less and can plant all seed sizes even if they are mixed together. This offers an advantage in speed and planting accuracy.

3. Adjust to Required Planting Rate

Corn planters with or without plates have settings to plant at different rates. Read the operator's manual and make the suggested setting, then drive the planter with the openers up but with some tension on the drive wheels to check the number, spacing and condition of seeds dropped by each planter unit.

Corn planters operate most accurately when driven slowly. However, by using 24 rather than 16 cell plates and round rather than flat seed and larger cell seed plates, it is possible to plant at higher speeds. The plate-less planters are designed to operate at faster speeds than the plate models are.

4. Calibrate in Farmyard or Laneway

Planting accuracy may be affected by planting speed and other field factors. For this reason, a calibration run should be carried out at full planting speed, over an area where the kernels can easily be found and counted. A laneway or gravel area is very suitable for this. The seed treatment that is to be used in actual planting should also be used for this calibration run.

Refer to the table below to check the proper seed spacing for the particular population desired (Table 1).

Table 1. Seed spacing required for specified populations.

No. of plants / ha*	Seeds required /ha*	No. of plants /ac*	Seeds required / ac*	Distance between seed 76 cm (30") rows
45,000	52,000	18,218	21,053	25 cm (9.8")
50,000	58,000	20,242	23,482	22 cm (8.6")
55,000	64,000	22,267	25,911	21 cm (8.2")
60,000	69,000	24,281	27,935	19 cm (7.5")
80,000	91,000	32,388	36,842	14.35 cm (5.65")
90,000	102,000	36,437	41,295	12.95 cm (5.1")
100,000	114,000	40,485	46,153	11.6 cm (4.6")

*Allows for 15% non-germination. Use higher rates for very early planting. (plants per ha x 0.4 = plants per acre; cm x 0.4 = inches.)

In the field, tension can be removed from the closing wheel and the closing wheel can be strapped up. Inspection of the formation of the v-trench, seeding depth uniformity and seed spacing are possible.

Nutrient Requirements

Corn is a highly productive crop when properly managed, however, serious yield reductions occur when plant nutrients are not in sufficient supply. Over-fertilization is costly, inefficient and can have serious environmental consequences. Excess nitrogen can be leached into groundwater if more is applied than the crop can absorb. Phosphorus contaminated runoff water and eroded soil can cause eutrophication of surface water bodies. In order to ensure that both an adequate supply of nutrients is applied to optimize yield and over-fertilization does not occur, a soil test must be taken. The only reliable means of determining the nutrients available in the soil is soil testing. A well-managed corn crop can remove large quantities of nutrients from the soil (Table 2). Silage corn removes more nutrients from the field than grain corn, since a larger portion of the plant is being harvested. With grain corn, while the plant would take up a significant quantity of nutrients, the majority of the nutrients in the stalk and leaves would remain in the field and therefore the nutrients would return to the soil through decomposition.

Table 2. Crop nutrients removed by corn with a yield goal of 44 t/ha (silage at 67% moisture).

Element	Amount Removed (kg/ha)
Nitrogen	215.6
Phosphorus (P_2O_5)	70.4
Potassium (K_2O)	162.8
Calcium	44
Sulphur	26.4

In addition to the above nutrients, seven micronutrients are required for proper corn growth, although the micronutrients are required in smaller quantities. The soil itself can supply a significant portion of the crop's nutrient requirements by the biological breakdown of organic matter.

The amount of fertilizer required for corn is influenced by a number of factors such as the soil's ability to supply nutrients, the previous crop and fertility program, whether manure has been added or will be added, the type of manure, its nutrient content, the soil type and its drainage characteristics, the soil pH, climatic conditions, planting date and corn population.

From soil tests, previous cropping information and manure analysis and any other sources of nutrient credits, specific fertilizer recommendations can be made accounting for nutrients from all sources.

LIME

Soils in the Atlantic Provinces are naturally acidic, so the application of limestone to correct the pH is necessary for optimal corn production. The pH range for corn is 5.8 to 6.5, with levels above 6.0 preferred. On acid soils with a pH below 5.8, important crop nutrients are chemically tied up in the soil and unavailable to the plant, therefore, crop growth is restricted. In addition to this, toxic levels of aluminum and manganese may further restrict growth at low pHs. The optimal pH for crop growth is also the optimal pH for many soil microorganisms responsible for the release of many important crop nutrients from the soil organic matter.

Either calcitic or dolomitic limestone should be applied according to soil test recommendations. Use dolomitic limestone, which supplies magnesium and calcium, if the soil magnesium levels are low. The only reliable means for determining the type and amount of limestone to apply is by a soil test.

NITROGEN

Nitrogen is essential for the proper growth and development of corn. A lack of nitrogen causes browning of the lower leaves, yellowing and stunting of the plant, reductions in yield and a lowering of the plant's protein content (Figure 11). Excessive amounts can increase lodging and contaminate groundwater with nitrates.

Figure 11. Nitrogen deficient corn in late July 2022 showing browning of the lower leaves, yellowing of the whole plant and stunted growth. Photo: Caitlin Congdon, Perennia.

Silage crops harvested in the Maritimes remove from 110 to 180 kg N/ha. A number of experiments suggest that 90 to 160 kg N/ha will produce good silage yields in most situations where no manure is applied or legumes plowed down. Application rates above this are normally unprofitable. Growing dry grain corn or high moisture ear corn repeatedly on the same field may require less nitrogen since some would be returned in the corn stalks each year, but is not recommended as it causes significant concerns for a build-up of disease and pest pressures, as well as being potentially damaging to soil health.

Under dry conditions or on light soils, early growth may be delayed if urea or urea mixed with diammonium phosphate is banded at high rates (greater than 25 kg N/ha) near the seed. No more than 50 kg N/ha should be banded if ammonium nitrate is used as the source of nitrogen. When higher rates are required, the nitrogen should be broadcast and incorporated prior to planting or sidedressed/topdressed. To prevent fertilizer burn, topdress only when plants are thoroughly dry. Ammonium nitrate is normally well suited to topdress and sidedress application since it is less susceptible than urea to volatilization losses. In contrast, urea can be used as a pre-plant application when incorporated. Topdress or side-dress applications should be made at the four to six leaf stage and serve to provide the plant with nitrogen right before the period of rapid uptake, increasing nutrient use efficiency and reducing losses to volatilization or leaching.

Controlled-release fertilizers have a coating added around the granules to delay the release of the fertilizer into the soil in a controlled manner. This will protect nitrogen from loss if the fertilizer is applied before the crop is ready to absorb the nitrogen or it can extend the timing of nitrogen release over a period of time. Urease or nitrification inhibitors slow down the processes that change fertilizer nitrogen into the plant available form. Since the plant available form is most prone to losses via leaching and denitrification, fertilizers with these products should be more environmentally friendly. Preliminary results from research conducted at Dalhousie's Faculty of Agriculture in 2023 show that there was no significant yield loss when using enhanced efficiency nitrogen fertilizers versus urea (Lynds 2024).

Applications of manure can be an excellent source of nitrogen, especially when minimal bedding is used and when stored and handled properly. Nutrient availability of manure varies by livestock species, diet, application method and timing. Manure should be tested to get an accurate idea of the nutrient content so that it can be properly credited to the balance of nutrients required by the crop.

Legumes plowed down in the form of forage stands or cover crops can also supply considerable amounts of nitrogen. Corn is a crop that is well adapted to the utilization of this nitrogen source since the period of highest nitrogen demand corresponds closely to the period of rapid mineralization of organic nitrogen. Specifically, the demand for nitrogen is highest during the period of rapid elongation of the corn crop. Normally, soil temperature and moisture conditions are conducive to soil nitrogen mineralization during this period. Protein seed crops such as soybeans do not supply as much fertility to the following crop since much of the nitrogen is removed as protein in the seed.

Nitrogen credits from legume forages or cover crops vary by species and biomass. For the most accurate credit estimate, samples of the cover crop should be analyzed for nitrogen and carbon content and biomass estimated in metric tonnes per hectare. Table 3 shows the calculation of the amount of N accumulated in the above-ground biomass to the time of cover crop termination for various levels of crop growth and N concentration. Nitrogen concentrations decline as the plants mature but biomass production typically increases as the plant reaches full bloom. If the N concentration is less than 2.5%, there is unlikely to be any N credit to the following crop regardless of the N accumulation since the C:N ratio will be high enough to inhibit N release. The ranges of biomass and N concentrations are rough estimates; much will depend on the planting dates and growing conditions, particularly for grain legumes planted after cereal harvest. For the most accurate results, weigh the biomass from a known area and send the biomass to a local lab to be analyzed for nitrogen content.

Table 3. Nitrogen in above-ground biomass at various levels of biomass accumulation and N concentration, showing typical ranges for various legume types for biomass and N concentration, Nitrogen Credits for Legume Cover Crops Factsheet, Perennia, 2023.

Biomass	N Concentration	2.5%	3.0%	3.5%	4.0%	4.5%	5.0%
2.0 T/ha		50	60	70	80	90	100
2.5 T/ha		63	75	88	100	113	125
3.0 T/ha		75	90	105	120	135	150
3.5 T/ha		88	105	123	140	158	165
4.0 T/ha		100	120	140	160	180	200
5.0 T/ha		125	150	175	200	225	250
6.0 T/ha		150	180	210	240	270	300
Legend:	**Grain Legumes (Peas, Soys, Beans)** **Red Clover, Alfalfa** **Hairy Vetch**	**Vegetative →** **Full Bloom ●**					

PHOSPHORUS

Phosphorus is especially important for early growth and early maturity. It is essential to band some phosphorus at planting, so it is readily available to young plants with their limited root systems. As the plant develops and the root system expands, most of the total required phosphorus is taken up by new roots growing throughout the soil. A high level of phosphorus throughout the plow layer is necessary at later stages of growth. On soils with high levels of phosphorus, all of the required fertilizer phosphorus can be banded. Where soils are low in this nutrient, a portion of the required phosphorus should be broadcast and plowed down or disked in, if possible, before planting. Cattle manures are usually low in phosphorus and do not provide much benefit for early growth.

Insufficient phosphorus results in slow growth and small plants. Phosphorus-deficient plants may appear dark green with reddish-purple leaf margins and tips (Figure 12). Cold, wet soils can temporarily restrict phosphorus uptake by the plant even though the soil contains adequate phosphorus. Fixation by the soil of some of the phosphorus applied as fertilizer in chemical forms not readily available to the plants means that application rates must exceed crop removal rates. However, as soil phosphorus levels build up, more and more of the "fixed" phosphorus becomes available to plants. Thus, high testing soils require only a small amount of phosphorus banded at planting.

When phosphorus is banded with a small amount of nitrogen, the plant will make more efficient use of phosphorus. Soil pH is also very important to phosphorus availability. Phosphorus becomes relatively less available as soil pH deviates from 6.5. The application rates of phosphorus may vary from 25 to 170 kg/ha depending on the field's soil test level.

Figure 12. Phosphorus deficient corn plant showing reddish purple leaves. Photo: Benefits of Phosphorus for Corn Production, Bayer Crop Science, 2022.

POTASSIUM

Corn harvested as silage removes large quantities of potassium from the soil since corn stalks are high in this nutrient. Potassium is equally available to the plant, whether broadcast or banded. However, no more than 55 kg of K_2O/ha should be banded to avoid fertilizer burning and subsequently poor corn emergence. Insufficient potassium results in browning of lower leaf edges, lower yields, poorly filled ears and increased susceptibility to stalk rot and lodging (Figure 13). Usually when deficiency symptoms occur, it is too late to correct the problem in the present year's crop.

Figure 13. Potassium deficient corn plant showing browning of leaf edges. Photo: Benefits of Potassium for Corn Production, Bayer Crop Science, 2022.

Removal rates vary from 130 to 280 kg of K_2O/ha. Maritime soils contain potassium in mineral form, which is slowly made available to plants. If corn is grown continuously, plant-available soil potassium may decline rapidly. Only soil testing can determine how rapidly this is occurring. If soil test potassium is declining or is already low, fertilizer additions should be increased until a reasonably constant soil test potassium level is maintained. Generally, applications of 56 to 168 kg of K_2O/ha are adequate for good yields. Lower rates will be sufficient on grain cornfields where the stalks are plowed in. Much or all of the potassium requirements can be met by manure applications.

Maintaining or improving the soil test level of potassium can improve yields by improving the efficiency of nitrogen use.

MAGNESIUM

A magnesium fertilizer is only required on soils testing very low in available magnesium (Mg). The most economic source of magnesium is dolomitic limestone, which will raise the soil pH and supply the required magnesium. If dolomitic limestone is not applied and magnesium is required, a soluble magnesium source can be added to the fertilizer.

SULPHUR

Historically, acid rain events contributed enough sulphur back into the soil that there was not a frequent requirement for additional sulphur fertilizer. However, reductions in acid rain events have resulted in the need to consider sulphur fertilizer on corn. Research conducted by AAFC-Harrington and the Atlantic Grains Council in 2019-2022 showed that 35 to 45 kg/ha of sulphur boosted both grain corn yields and test weights. Manure may be able to provide sufficient sulphur for corn, which can be determined by doing a manure analysis.

MICRONUTRIENTS

Micronutrient deficiencies in corn are uncommon since most soils can supply the small quantities needed for proper growth. However, crops should be monitored for unusual symptoms. The application of manures on corn land will normally provide sufficient micronutrients. Additional micronutrients should not be applied unless soil and plant tissue analysis, as well as visual symptoms, have confirmed that a deficiency exists. Applications based on speculation are unwise and are potentially toxic to the plant. Contact your local Soil or Field Crops Specialists if you suspect a problem.

For a detailed description of fertility deficiency symptoms, see Perennia's Nutrient Deficiency Guide.

PLANT ANALYSIS

Plant analysis can be a useful method for diagnosing a suspected nutrient deficiency. The mid-third portion of the ear leaf at the time of silking is the proper tissue used for analysis. Difficulties in the interpretation of the results arise when samples are not taken at the proper stage. Samples should be taken from at least 20 plants in the sample area. A soil sample should be taken at the same time in the same area. Table 4 shows the normal maximum and critical concentrations for corn.

Table 4. Interpretation of plant analysis results for corn, Agronomy Guide for Field Crops Pub.811, OMAFRA, 2017.

Nutrient	Units	Critical Concentration**	Max. Normal Concentration***
Nitrogen (N)	%	2.5	3.5
Phosphorus (P)	%	0.28	0.5
Potassium (K)	%	1.2	2.5
Calcium (Ca)	%	N/A	1.5
Magnesium (Mg)	%	0.1	0.6
Sulphur (S)	%	0.14	N/A
Boron (B)	ppm	2	25
Copper (Cu)	ppm	2	20
Manganese (Mn)	ppm	15	150
Zinc (Zn)	ppm	20	70

*Values apply to the mid-third of the ear leaf sampled at silking.
**Yield loss due to nutrient deficiency is expected with nutrient concentrations at or below the "critical" concentration.
***Maximum normal concentrations are more than adequate but do not necessarily cause toxicities.

MANURE AS FERTILIZER

Manure applications are highly recommended on cornfields. Besides supplying plant nutrients, it helps improve soil organic matter levels, especially when it contains significant amounts of bedding. The added organic matter helps to retain water and fertilizer nutrients, to maintain soil structure and to reduce erosion. Manure benefits coarse-textured sandy soils by increasing water holding capacity and fine-textured clay type soils by promoting stable, structured units.

The use of manure on corn can realize substantial savings in fertilizer costs, especially when the cost of disposing of the manure in other ways is considered. It is best utilized on fields that require additions of phosphorus and potassium as well as nitrogen. The time of application is very important. Since manure must fully decompose to release all of its nutrients, only about one-half of the total nutrient content of the applied manure is available during the first year. If manure is applied in the fall or winter, a further 50% of the nitrogen is lost to the crop. Spring applied and incorporated manure supply the most nutrients for crop use. Phosphorus in spring-applied manure is of little benefit for early growth, so fertilizer phosphorus should always be banded at seeding. Liquid manure can also be injected directly into the soil as a sidedress application after the corn has emerged if the proper equipment is used.

Nutrient value from manure should be determined through a manure analysis. By applying manure, commercial fertilizer applications can be reduced and production costs lowered accordingly.

General Fertilizer Recommendations for Corn Crops

FERTILIZER PLACEMENT

Broadcast applications - Broadcast pre-plant applications of fertilizer should be worked into the seedbed if possible. Disking or harrowing usually mixes only the top part of the soil, which may later dry out, preventing roots from feeding in this zone. Phosphorus and potassium may be broadcast in the fall and plowed under without serious loss. Fall application of nitrogen is not recommended as losses will be significant. Broadcast applications of up to 70 kg of actual nitrogen/ha may be made after the crop has emerged 25 to 30 centimetres. Some leaf burning may occur but is usually not serious if the nitrogen is applied when the leaves are dry. Nitrogen moves quickly into the soil with the first rain. Broadcast applications containing phosphorus must be worked into the soil since this nutrient is very immobile. Potassium can be broadcast on the surface on soils testing high in this nutrient. However, on lower fertility soils, it should be incorporated into the plow layer.

Banding - On high fertility soils, much or all of the fertilizer required for corn can be applied at planting time and should be banded five centimetres to the side and five centimetres below seed depth.

Banding phosphorus usually aids the early growth of corn, especially on acid soils and applying nitrogen with phosphorus in the band increases phosphorus uptake. Plant injury may result from banded rates greater than 50 kg of N/ha, 100 kg of phosphorus/ha and 60 kg of potassium/ha. On light, sandy or droughty soils, or under dry conditions, the urea form of nitrogen should not be used at banded rates in excess of 25 kg N/ha. This same restriction applies to fertilizers containing a mixture of urea and diammonium phosphate. Urea, a very common source of fertilizer nitrogen, presents no problems as long as the above banding precautions are observed.

Banding is also an effective method of fertilizing in no-till or strip-till systems.

Topdress - Topdressing fertilizer refers to applications made once plants have emerged. This allows for nutrients to be delivered at the time that they will be most beneficial to plant growth and subsequently reducing the amount of fertilizer that is wasted due to leaching or volatilization because the plant at that time cannot take it up. A top-dress application is at a lower rate than pre-plant, since the plant has already received a portion of the nutrients needed and mitigates burning the plants or nutrient loss through leaching or volatilization since the application is not cultivated into the soil.

Fertilizer is costly and should not be wasted. Fertilizer applications based on soil tests are more efficient and return more profit.

Integrated Pest Management

WEED MANAGEMENT

Weed management is important for obtaining potential yield and maintaining a high-quality crop. Weeds can compete with the crop for nutrients and resources like water, especially during the crop seedling stage. The critical weed-free period refers to the growth period during which it is imperative to maintain weed-free conditions to allow the crop the best chance for growth and development.

Weeds can be spread in many ways, including wind, in livestock manure, harvested with the crop or on equipment. It is important to minimize the spread of weed seeds by cleaning off equipment between fields and maintaining the proper settings on harvesting equipment.

Weed management should be undertaken with an integrated approach, including cultural, chemical and physical practices.

Spring cultivation may control many germinating annual weeds. Optimum planting time and seeding rate with an appropriate fertilization program will allow the crop to compete with any weeds. Herbicides are available for pre-plant, pre-emergent and post-emergent applications, depending on the target weeds.

Figure 14. Corn plants growing under significant weed pressure. Photo: Perennia.

With the number of herbicides and methods of application recommended for corn, excellent weed control can be achieved if the herbicide spray program is planned in advance. To plan successfully, keep the following points in mind:

1. A knowledge of the specific weeds present in each field allows the selection of the best treatment for these fields. Keep a record of these weeds and be prepared to change treatments if one or more particular weeds start to build up. Watch for chemical-resistant weeds.

2. Whenever possible, leave a second window of opportunity for weed control in-crop. If a pre-plant incorporated (PPI) or a preemergence (PRE) treatment is applied, a post-emergence (POST) treatment can be applied later if necessary. If the possibility of PPI or PRE-treatments is ignored and only a post-emergence herbicide is applied, there are no other options if that treatment fails to give satisfactory weed control. Growers should be aware that PPI and PRE-treatments are slightly prone to either leaching or runoff, respectively.

3. Understand the residual potential of chemical controls so that this does not restrict your cropping options. Field crops following corn in the rotation (e.g. alfalfa, timothy, barley, etc.) are quite susceptible to moderate levels of residual atrazine. Required plant-back intervals are often included on herbicide labels.

4. There are several corn traits available today that give the plants tolerance to certain herbicides. It is important to include other modes of action in the herbicide program to prevent or delay chemical resistance in weed populations. Mixing a broad-spectrum burndown product with a residual herbicide has proven to be a very good strategy. Many products contain multiple modes of action, which is also a good resistance management practice.

5. It is extremely important when handling herbicides to take every necessary precaution to avoid spills, excessive application, leaky booms, back-siphoning or overloading sprayers to help avoid water contamination. Controlling soil erosion helps in preventing herbicide contaminated soil from moving into aquatic systems. Read the label, follow directions when storing and handle herbicides, and always avoid skin and eye contact and inhalation of vapours.

The critical weed-free period for corn is from emergence to the eighth leaf stage. If weeds are present during this period, yield losses are significant (Figure 15).

It may be necessary to apply a broad-spectrum residual product pre-emergent in many fields, followed by a burndown type product in the crop if weed pressures warrant. This burndown product may take advantage of the corn hybrid's traits; for example, Liberty on Liberty Link corn or glyphosate on glyphosate-tolerant corn.

Crop	Weed	Yield Loss	
		1 plant/m²	5 plants/ m²
Corn	**Annual Broadleaves**		
Corn	Giant ragweed	13%	36%
Corn	Lamb's-quarters	12%	35%
Corn	Pigweed	11%	34%
Corn	Cocklebur	6%	22%
Corn	Ragweed	5%	21%
Corn	Wild mustard	5%	18%
Corn	Velvetleaf	4%	15%
Corn	Lady's thumb	3%	13%
Corn	Wild buckwheat	2%	7%
Corn	Eastern black nightshade	2%	7%
Corn	**Annual Grasses**		
Corn	Giant foxtail	2%	10%
Corn	Proso millet	2%	10%
Corn	Fall panicum	2%	10%
Corn	Barnyard grass	2%	7%
Corn	Green foxtail	2%	7%
Corn	Yellow foxtail	1%	5%
Corn	Old witch grass	1%	5%
Corn	Crabgrass	1%	3%
Soybeans	**Annual Broadleaves**		
Soybeans	Cocklebur	15%	41%
Soybeans	Eastern black nightshade[1]	14%	40%
Soybeans	Giant ragweed	14%	40%
Soybeans	Lamb's-quarters	13%	38%
Soybeans	Pigweed	12%	36%
Soybeans	Ragweed	10%	33%
Soybeans	Velvetleaf	6%	23%
Soybeans	Wild mustard	5%	20%
Soybeans	Lady's thumb	4%	15%
Soybeans	Wild buckwheat	4%	15%
Soybeans	**Annual Grasses**		
Soybeans	Volunteer corn	4%	15%
Soybeans	Giant foxtail	3%	12%
Soybeans	Proso millet	3%	12%
Soybeans	Barnyard grass	3%	12%
Soybeans	Fall panicum	2%	10%
Soybeans	Green foxtail	2%	8%
Soybeans	Yellow foxtail	1%	5%
Soybeans	Old witch grass	1%	4%
Soybeans	Crabgrass	1%	4%

[1]Eastern black nightshade in soybeans reduces its quality.
Crop losses assume that the weeds have emerged with the crop.

Figure 15. Soybean and corn yield losses due to weeds at known populations, OMAFRA Pub 811, pg. 279.

Corn Insects

SEED-CORN MAGGOTS AND WIREWORMS

Most commercial corn seed can be made available with an insecticidal seed treatment targeting things like seed-corn maggot, wireworm and corn rootworm.

Wireworms are often numerous in land that has been in sod for several years, particularly wet, heavy soils. Crop rotation is recommended for wireworm control, especially those including crops that act as a biofumigant like mustard and buckwheat. Chemical controls may be used in the form of seed treatment (such as Poncho 600) or a granular insecticide if the planter is equipped with insecticide boxes (such as Force).

ARMYWORM

Armyworms are attracted occasionally to weedy and grassy corn for egg-laying. If armyworm larvae move into cornfields, spray the border row and adjacent areas. Normally, armyworm infestations are limited to localized areas, and they rarely cause any economic damage to field corn.

POTATO STEM BORER

This occasional pest of weedy corn fields bores into plants at ground level early in the season. It has one generation and is sometimes confused with the later appearing European corn borer. It is a pest of grassy fields and difficult to control with insecticides. Maintain weed-free fields, borders and fence rows by plowing, cultivation and with the use of herbicides.

CORN EARWORM

Corn earworm can be a major pest in corn in Nova Scotia. Earworms feed almost exclusively on the tips of the ears, leaving no visible damage on the husks or leaves. The earworm has a wide host range, feeding on many cultivated crops and weeds. Elsewhere in its range, it is also known as the cotton bollworm, tomato fruitworm or tobacco budworm. This pest migrates from the Southern United States as a moth. If the moth appears late season, it is a minor pest, only feeding on the kernels at the tip of the cob. If feeding occurs earlier, much more feeding damage takes place. This damage is then left open to infection by fungi. This pest is very hard to scout for as the moth will lay its eggs over a period of time and individually on the silks of plants. Timing of an insecticide is very hard with this insect. The Vip3A Bt-protein is effective against corn earworm.

Figure 16. Corn Earworm feeding on the tip of a corn cob. Photo: Caitlin Congdon, Perennia.

FALL ARMYWORM

This southern migrant deposits eggs in bunches anywhere on the exposed corn plant from mid-July through October but is most prevalent in September. On small plants, the larvae feed in the whorls and leaves. Later in the season, the larvae attack tassels, silks and ears. They are highly cannibalistic, consume corn borers in the stalks and are usually found at either end of the ear. Control is difficult but the foliage can be sprayed early in the season to save the whorls and leaves in severe infestations. An additional application may be needed for ear protection. Pheromone attractant traps for monitoring adult activity will help time insecticide applications.

EUROPEAN CORN BORER

This insect is the major cause of stalk breakage in the Atlantic Provinces. Generally, adult moths emerge in late June through early July, producing one generation a year (uni-voltine ecotypes). There are also bi-voltine ecotypes, which produce two generations per year. Yield loss in silage corn is seldom high enough to warrant chemical control. However, if grain corn is grown repeatedly in the same field, large populations will develop. Newly emerging tassels should be examined in mid to late July for borers or feeding injury, and if more than 75% of the plants are infested, insecticide should be applied. A light infestation does not justify spraying. Control is effective only if the borers are destroyed before they enter the stalk. One properly timed application before young larvae descend the stalks is sufficient. Pheromone traps can be used for monitoring adult activity. It is most important to select a hybrid with good stalk strength. In addition, farmers should plant as early as feasible to obtain as early a harvest as possible. Harvest as soon as suitable moisture levels are reached to reduce losses from dropped ears and broken stalks, which occur during autumn storms. It is important to note that as of 2018, populations of European corn borer resistant to some of the Bt-proteins found in transgenic corn have been found in Nova Scotia and subsequently in other parts of Canada. Stalk destruction is an effective method for reducing the overwintering population of European corn borer larvae. Stalks should be flail mowed following harvest or shredded with a chopping corn head on a combine. For more information on European corn borer in Nova Scotia as well as considerations for pest control, check out this [Perennia factsheet.]

Figure 17. European corn borer entry hole and frass.

WESTERN BEAN CUTWORM

Western bean cutworm (WBC) in Nova Scotia can either overwinter on some of the sandier fields or migrate in from the Southern United States. Adult WBC moths have a white band along the margin of each wing and each wing has a "full moon" and boomerang-like mark. Newly hatched WBC larvae have dark heads and spots along their bodies, somewhat resembling European corn borer larvae. As they enter the third instar, their heads lighten and bodies change to a tan-pink colour, with subtle longitudinal stripes. Eggs are laid in masses of five to 200 eggs, typically on the upper surface of corn leaves close to the tassel. The larvae will move to the ear soon after hatching and feeding on the pollen. When they get to the ear, they will burrow into the ear and cause a lot of damage through feeding. The damaged ear is then left open to infection by ear moulds. Control of WBC is available from genetic traits containing the Vip3A Bt-protein and timely sprays once thresholds have been met. For more information on WBC, please refer to [OMAFRA and the University of Guelph's factsheet.]

Figure 18. Western bean cutworm feeding on the tip of a corn cob. Photo: Caitlin Congdon, Perennia.

CORN ROOTWORM

Corn rootworm (CRM) is a serious pest of continuous corn systems. Northern corn rootworm is the primary species present in Nova Scotia, though Western corn rootworm is present in areas of Ontario, Quebec and New Brunswick, as well as large parts of the North Central and Northeastern United States. Both Northern and Western corn rootworm have one generation per year. Eggs overwinter in the soil and hatch into larvae in the spring. There are three larval instars which feed on the roots of the corn crop for four to six weeks before pupating in the soil. Adults emerge from the soil five to 10 days after pupation, feeding on the foliage of the corn plants throughout the summer. Adults lay eggs in the soil during late summer and fall.

Root feeding in the spring causes goose-necking and increases the risk of lodging later in the season. Root feeding may also lead to loss of yield by reducing uptake of nutrients and water from the soil.

Multiple Bt-resistant populations are widespread throughout Ontario and the United States. Crop rotation is the number one method of management for corn rootworm.

BT-TRAITS

Bt-traits were commercialized in the mid-1990's and have been an effective way to manage susceptible corn pests. Various Bt-proteins are available, each targeting specific insect pests. It is important to understand which Bt-proteins are expressed in a corn hybrid so that the appropriate pest is being targeted and so that unexpected injury can be reported. For a full list of the Bt-traits available in Canada and potential resistance issues, refer to the list of Bt-Corn products available in Canada, updated annually by the Canadian Corn Pest Coalition.

Resistance management is critical for the continued efficacy of Bt-traits. Stacked traits contain two or more proteins targeting different insect pests; for example, one above and one below-ground. Pyramid traits contain more than one protein targeting the same pest, so they are good for resistance management. Non-Bt refuge plants are essential for resistance management as they provide a location for susceptible insects to feed and breed, continuing the susceptibility of the genetics in the population. Most Bt-hybrids are available with a 5% integrated refuge, meaning that they are included in the bag with the Bt seed and do not need to be planted separately. In the absence of integrated refuge, structured refuge needs to be planted in a strip or block next to the Bt-corn. Structured refuge is usually required to be 20% of the total planting.

MISCELLANEOUS INSECTS

Corn leaf aphids are generally present and abundant in many fields in late August. Populations of two predators, the transverse ladybeetle and the seven spotted ladybeetles, increase rapidly when aphids are present and prevent appreciable corn injury.

Two-spotted mites may also become numerous in some years after long dry spells. These insects produce webbing on the underside of the leaves, leaf curling and stippling. Moist weather conditions, predacious mites and insects generally keep the mites controlled.

Sap beetles, five-to-six-millimetre reddish-brown insects with two pale yellow spots on each side of the back, feed on decaying plant materials, sap oozing from plants and fungi. In corn, they may enter the injured ear tips and corn borer holes but they are not themselves injurious.

BIRD AND RACCOON DAMAGE

Birds may cause considerable damage to cornfields, especially to grain corn and early establishment. Damage occurs during emergence when the seedlings are pulled out of the ground and during grain filling and ripening when birds such as blackbirds, starlings, cowbirds and crows feed on the grain. The ears are damaged either by direct feeding or by ear rot resulting from the invasion of secondary organisms once the husks have been loosened. Feeding may be made worse by insect infestations in the cob.

Raccoons can be difficult pests to control and can cause significant damage in localized areas. One strand of electrified wire placed approximately ten cm above the ground around the perimeter of the field will normally deter raccoons from entering a field. The fence must be placed in a weed-free area and should not be further than 60 to 90 centimetres from the outside corn row.

Diseases

Corn grown in Maritime Canada suffers from a few destructive diseases and, especially given favourable conditions, can damage corn crops.

Eyespot - One of the most common diseases of corn, eyespot is a fungal disease that attacks the leaves and stems of corn. It creates round or oval-shaped white lesions which can in severe cases cover much of the plant, giving it a frosted look from a distance. Eyespot is most severe in wet seasons and fields with the corn debris from the previous season's crop still on the surface. Some hybrids are particularly susceptible to eyespot. Crop rotation and clean plowing of corn debris help to reduce disease severity.

Gibberella Ear Rot - Gibberella Ear Rot shows in the presence of pink or white mould on the ears. The pathogen overwinters on corn, wheat and barley debris. Spores produced on the debris lead to infection during silking. Ear Rot is more prevalent when cool and wet weather occurs during the first 21 days after silking. Extended periods of rain in the fall, which delay dry down, increase the severity of the disease. This pathogen produces multiple mycotoxins that are harmful to humans as well as animals. Swine are very susceptible to these mycotoxins. Corn hybrids differ in susceptibility, but truly resistant hybrids are not reported. Corn hybrids with tight husks may be more susceptible. Crop rotation to non-grass crops is important in decreasing inoculum in the field. Fall tillage may help bury the inoculum where appropriate. Applying fungicides at silking has proven to be useful in decreasing the initial infection. Mould growth is stopped when temperatures drop below 9°C.

Ear Rot is particularly bad under wet conditions when the harvest of corn is delayed beyond the normal time. Where birds and insects have damaged the corn by opening the cob to the weather, the disease severity may be higher.

Figure 19. Giberella ear rot in corn. Photo: Caitlin Congdon, Perennia.

Smut - Galls can appear anytime throughout the growing season on any above-ground plant part. Young, actively growing tissue is especially susceptible. Galls commonly develop on ears, leaves, stalk or tassels and are initially covered with white to silvery tissue. Later, dark masses of spores develop inside the galls. This disease can be managed with resistant hybrids, crop rotation and by maintaining proper soil fertility.

Figure 20. Smut in corn. Photo: University of Minnesota Extension.

Northern Corn Leaf Blight - Northern corn leaf blight thrives under wet, humid, cool weather typically found later in the growing season. The tan lesions of northern corn leaf blight are slender and oblong, tapering at the ends ranging in size between one to six inches. Lesions run parallel to the leaf margins beginning on the lower leaves and moving up the plant. They may merge and cover the entire leaf. Spores are produced on the underside of the leaf below the lesions, giving the appearance of a dusty green fuzz. Spores can be transported by wind long distances from infected fields. If lesions begin early (before silking), crop loss can result. Late infections may have less impact on yield. Northern corn leaf blight can be managed through the use of resistant hybrids.

Figure 21. Northern corn leaf blight. Photo: Cornell CALS.

STALK ROTS IN CORN - ANTHRACNOSE, GIBBERELLA AND DIPLODIA

A number of different fungal pathogens cause stalk rots. The incidence of stalk rots increases when plants are stressed by high temperatures coupled with the presence of moisture. Given the high humidity common to the summer months in the corn growing areas of Nova Scotia, corn can be highly susceptible to these fungi. Stalk rots are also enhanced by conditions that support drought stress, leaf diseases, insect feeding, low fertility or compaction. Control measures to reduce the effects of stalk rots include selecting resistant hybrids, maintaining balanced soil fertility, minimizing crop stress, controlling insects, managing corn residue and scouting fields for a timely harvest.

Anthracnose - The anthracnose pathogen overwinters on diseased tissues, produced when the weather begins to warm up in the spring. Ideal conditions for disease development are high humidity and temperatures of 21 to 27°C. Spores can be spread by wind and rain.

Anthracnose can infect both the leaf and stalk of the corn plant. The infection can originate in the leaves and spread to the stalk or spread from the roots into the stalk.

Anthracnose stalk lesions appear as narrow oval water-soaked areas that run vertically on the stalk. The lesion will turn reddish-brown, and finally black. Shiny black blotches, which often merge, are a distinguishing characteristic of this disease. Scouting for this disease requires the removal of leaves and leaf sheaths from the lower part of the stalk in order to inspect it properly. Infected stalks will have degenerated pith tissue on the inside, usually with only the vascular bundles remaining. Diseased tissue is usually dark gray to brown in colour.

Figure 22. Anthracnose Stalk Rot in corn. Photo: Pioneer.com.

Giberella - The Giberella pathogen over-winters tissue residue in the field, producing spores the following year. Infection moves from the roots of the plant and spreads to the stalk, especially when the plant is stressed. Giberella stalk rot usually affects the root, crown and lower internodes of the corn plant.

If the inside of the stalk is made up of disintegrated pith and is pink or reddish in colour, it can be characterized as Giberella rot. The outside of the stalk will often present small black spots, which are the perithecia of the fungi.

Figure 23. Giberella stalk rot in corn. Photo: Pioneer.com.

Diplodia - Similar to Giberella, Diplodia fungus thrives in warm, wet weather. Diplodia stalk rot appears first when plants die suddenly at the point of mid to late ear fill. Dark brown lesions can be found extending in either direction from the node. Small black spots (pycnidia) may develop just beneath the stalk epidermis near the nodes. The black dots are not easily removed, unlike those of the Gibberella fungus.

Diplodia causes rotted stalks that are disintegrated and brownish in colour, which causes the stalk to easily break.

Figure 24. Diplodia stalk rot in corn. Photo: Pioneer.com.

Stalk rots can be effectively managed with a combination of disease or stress-resistant hybrids, balanced soil fertility and reduced crop stress through proper plant population, irrigation, soil management, foliar disease and weed control. Control of insects that damage the stalk, creating entry points for disease, is vital. Management of residues is important to limit the source of material on which to overwinter.

There are a number of general preventative measures to help minimize corn disease:

1. Plant hybrids resistant to eyespot.
2. Plow under old corn stalks and leaves to help kill overwintering disease fungi.
3. Rotate corn with other crops to prevent disease buildup.
4. Minimize plant stress by (a) avoiding plant populations that are too high for the hybrid grown; (b) maintain high soil fertility, good soil structure and good drainage.

Harvest and Storage

HARVESTING CORN FOR SILAGE

The object of silage production is to produce plants with a high proportion of well-developed ears on which most of the kernels have reached the ½ to ¾ milk line before fall frost (Figure 25). At this stage of maturity, starch accumulation is almost maximized but digestibility is maintained, whole plant dry matter is approximately 30 to 35%, which is ideal, and the silage will be most acceptable to livestock. At this moisture, proper packing in the silo is also maintained.

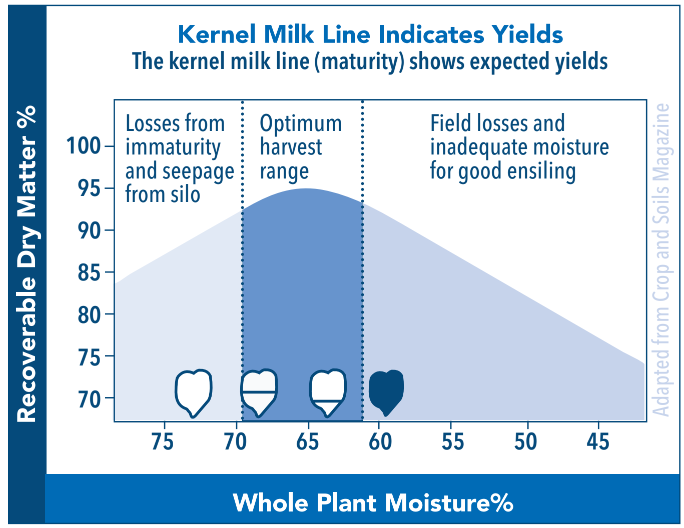


Figure 25. Relationship between corn milk-line and whole plant dry matter, North Dakota State University, "September Means Corn Silage Harvest."

Frosted corn harvested for silage after reaching the physiological maturity stage is often too dry to ensile well, resulting in a mouldy, unpalatable product.

The cutting knives and ledger plates on silage harvesting machinery must be kept sharp and adjusted to cut the corn plant and ear into pieces about six to 11 millimetres in length. The finer cut, needed when the crop is over mature and frosted, permits tighter packing, thereby excluding air and reducing the possibility of spoilage.

Figure 26. Corn silage being harvested with a self-propelled harvester. Photo: Shane Wood, Perennia.

Immature silage will seep when ensiled, resulting in significant deterioration of concrete silo walls and a loss in silage nutritive value. The silage juices damage the silo by eroding the concrete as they wash down the walls and are forced hydraulically to penetrate the concrete wall or staves. These two processes weaken the silo and reduce its useful life. The silage moisture content at which seepage will occur depends upon its height and width. The potential for seepage of silage effluent increases rapidly at moisture contents above 72%, even at greatly reduced heights.

Silage effluent is rich in nutrients and can cause significant environmental problems if not adequately contained.

Ideally, the choice of hybrids and the planting and harvest schedule should permit the corn to be harvested prior to the normally expected first killing frost in the area. If a corn crop is heavily frosted while kernels are still in the milk stage, several days of drying in the field are advisable before harvest. However, if kernels are dented before frosting, it is best to harvest immediately. As the frozen plant dries out after frost, some yield loss occurs, the nutrient content decreases, especially N, K, Ca and Mg and the feeding value is reduced. Yeasts, moulds and bacteria will start to grow on the plant in the field, which hampers the ensiling process after harvest.

STORING CORN SILAGE

The type of silo to be used should be investigated thoroughly before a corn program is initiated. The most efficient and economical setup depends on the size of the herd, amount of corn, type of animal housing and other management factors. Before making any investment in silos or mechanization, it is wise to visit and study as many operations as possible. Avoid buying or building equipment that may not be readily adaptable to long-range plans. Corn silage ensiles easily if it is harvested at the correct moisture, chopped to the correct length, packed well and covered properly to exclude air. Almost any type of airtight structure can be used. See Figure 27, Figure 28 and Figure 29 for details on silo types, capacities and details of filling.

CONCRETE TOWER SILO CAPACITY FOR HIGH MOISTURE CORN

Silo Diameter	x	Settled Depth	Whole Shelled Corm			Ground Shelled Corn			Ground Ear Corn		
(metres)		(feet)	25%	30%	35%	25%	30%	35%	30%	35%	40%
4.9 x 15.2		16 x 50	227	249	275	238	267	301	205	237	276 16 x 50
4.9 x 18.3		16 x 60	274	301	333	288	323	365	249	287	335 16 x 60
4.9 x 19.8		16 x 65	298	327	362	313	351	397	271	313	365 16 x 70
5.5 x 16.2		18 x 50	289	318	351	303	340	384	263	303	353 18 x 50
5.5 x 18.3		18 x 60	350	384	425	367	412	466	318	366	429 18 x 60
5.5 x 21.3		18 x 70	410	451	499	431	484	547	374	434	506 18 x 70
6.1 x 18.3		20 x 60	434	477	528	456	512	579	396	459	535 20 x 60
6.1 x 21.3		20 x 70	510	561	620	536	602	680	466	541	631 20 x 70
6.1 x 24.4		20 x 80	585	644	713	616	692	782	536	622	727 20 x 80
7.3 x 18.3		24 x 60	632	694	768	663	745	841	578	670	781 24 x 60
7.3 x 21.3		24 x 70	742	816	902	780	876	989	681	770	992 24 x 70
7.3 x 24.4		24 x 80	852	938	037	896	1007	1132	784	910	1063 24 x 80
7.3 x 27.4		24 x 90	963	1059	1172	1012	1138	1285	887	1030	1204 24 x 90
9.1 x 24.4		30 x 80	1346	1480	1637	1413	1587	1791	1242	1442	1681 30 x 80
9.1 x 27.4		30 x 90	1521	1673	1851	1597	1794	2025	1405	1633	1905 30 x 90
9.1 x 30.5		30 x 100	1697	1867	2064	1781	2001	2258	1569	1824	2128 30 x 100
9.1 x 33.5		30 x 110	1872	2060	2278	1965	2208	2592	1734	2016	2352 30 x 110

1 tonne = 1000 kg = 2200 lb. = 1.1 ton
***Percent moisture**
SOURCE: OMAF Factsheet 100/732 Tower Silo Capacities

Figure 27. Concrete tower silo capacity for high moisture corn

CONCRETE TOWER SILAGE CAPACITY FOR HIGH HAYLAGE AND SILAGE

Diameter Silo	x	Settled Depth	Alfalfa Haylage				Corn Silage		
(metres)		(feet)	60%	50%	40%	30%	35%	30%	
4.9 x 15.2		16 x 50	109	137	181	261	191	224	16 x50
4.9 x 18.3		16 x 60	135	169	224	323	235	275	16 x 60
4.9 x 19.8		16 x 65	147	185	245	354	258	300	16 x 65
5.5 x 15.2		18 x 50	142	178	236	339	247	288	18 x 50
5.5 x 18.3		18 x 60	176	221	293	421	304	353	18 x 60
5.5 x 21.3		18 x 70	211	264	351	504	361	419	18 x 70
6.1 x 18.3		20 x 60	224	281	372	533	381	442	20 x 60
6.1 x 21.3		20 x 70	288	337	446	639	453	525	20 x 70
6.1 x 24.4		20 x 80	314	394	522	746	526	607	20 x 80
7.3 x 18.3		24 x 60	338	423	559	796	560	647	24 x 60
7.3 x 21.3		24 x 70	407	511	674	956	667	767	24 x 70
7.3 x 24.4		24 x 80	479	600	790	1118	737	888	24 x 80
7.3 x 27.4		24 x 90	551	690	908	1281	880	1009	24 x 90
9.1 x 24.4		30 x 80	796	993	1297	1813	1343	1480	30 x 80
9.1 x 27.4		30 x 90	920	1146	1494	2079	1547	1706	30 x 90
9.1 x 30.5		30 x 100	1046	1301	1692	2346	1754	1934	20 x 100
9.1 x 33.5		30 x 110	1173	1457	1891	2614	1962	2165	30 x 110

1 tonne = 1000 kg = 2200 lb. = 1.1 ton
*Percent dry matter.
Capacitis for grass silage may be estimated by increasing the alfalfa haylage by 10, 15 and 20% for the dry matter contents of 50, 40 and 30% respectively.
SOURCE: OMAF Factsheet 100/732 Tower Silo Capacities

Figure 28. Concrete tower silage capacity for haylage and silage.

Horizontal Silo Capacities (Tonnes of Dry Matter per Meter Length)			
Width (m)	Height (m)		
	2.5	3.0	3.5
5	2.5	2.8	3.3
6	2.9	3.4	4.0
7	3.5	4.1	4.7
8	4.0	4.7	5.5
9	4.6	5.5	6.2
10	5.2	6.0	7.0
12	6.5	7.5	8.6
14	7.8	9.0	10.3
16	9.2	10.6	12.0
18	10.7	12.3	13.9
20	12.2	14.0	15.8

Figure 29. Horizontal silo capacities.

Silage bags and stand-alone piles are also options for storing corn silage, particularly for short term or overflow storage. Silage bags are available in various sizes to suit the needs of the farm and can be sealed to allow for proper fermentation and preservation. Stand-alone piles can be more challenging to ensure proper air-tight sealing and should be formed on a concrete slab to minimize losses to spoilage or contamination.

Figure 30. Horizontal bunker silo being filled with corn silage. Photo: Shane Wood, Perennia.

Harvesting Grain Corn

Corn growers use a variety of methods to determine when their crop is mature. Kernel moisture is often used to determine when to harvest. Growing degree days, or even calendar days accumulated after emergence or after silking, have been catalogued as a means of predicting the date of maturity. Kernel black layer formation at the base is an accepted indicator of physiological maturity (maximum dry weight) (Figure 31).

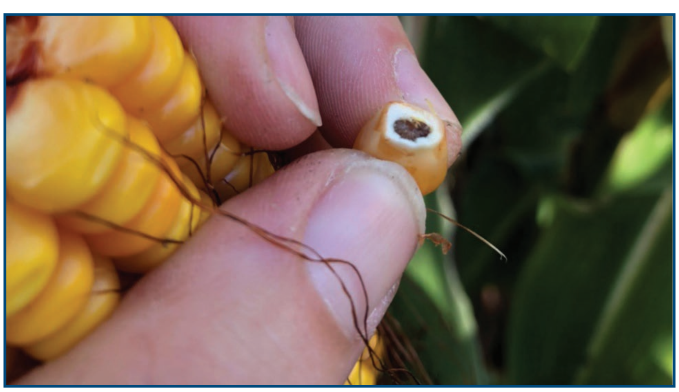


Figure 31. Black layer, indicating physiological maturity. Photo: Caitlin Congdon, Perennia.

The main problem associated with using the black layers is variability in the colour and time of its appearance. Workers, especially those lacking experience, are often unable to tell just when the layer has formed.

Another visual indicator of corn maturity is referred to as the milk line method. When an ear of corn is broken in half, the tip of the ear contains kernels with their smooth or endosperm sides exposed. As the ear approaches maturity, a "line" can be seen on the smooth side of the kernels. This line is called the milk line or the starch layer and it marks the boundary between the solid and liquid portions of the maturing endosperm.

Corn is said to be "ripe" when there is no milk left in the kernel. This suggests that the disappearance of kernel milk must be a useful indicator of corn kernel maturity.

In the Maritime Region, it is suggested that to assess maturity adequately, slice kernels lengthwise and assess for moisture, milk line and black layer. If maturity looks good, then shell off some kernels and take them to a grain center, feed testing lab or some other place that has an electric tester that will measure kernel moisture accurately (even above 25%).

A number of options are available to farmers interested in harvesting and storing grain corn. The choice of a system must fit both the corn hybrid's achievable maturity in the area and the requirements for an animal feed or a product for sale. The most common methods are as follows:

Grain combine fitted with corn head - This arrangement provides flexibility in harvest. The grain should be less than 32% moisture at harvest for optimum results. The combine, properly equipped, is a well-balanced, efficient machine that can operate under more extreme conditions than pull-type equipment.

Normally, only the grain portion of the corn is harvested. It may be artificially dried or stored in a silo. If the corn is to be fed to cattle, the combine can be adjusted to harvest the whole cob with the grain kernels. Slight modifications to the cleaning area of the combine are necessary but the ensiled product is free of stalk, silk and trash, making it a high-value product for ruminants.

Snapper head equipped forage harvesters - Forage harvesters can be equipped with special corn heads that pick or snap the cobs from the corn plant, similar to the action of a corn picker. The cobs and kernels, however, are then ground by the harvester. A 13-to-

19-millimetre recutter screen is installed to ensure proper particle size of the meal before it is blown into a wagon or truck for transport to the farmer's silo. The high moisture cob meal is a good feed for ruminant animals. Forage harvester produced cob meal has one disadvantage from picker husker or combine type cob meal in that often the cobs are not husked properly and varying amounts of trash can travel into the chopper. This lower value material will dilute the feeding value of the cob meal. Despite the fact that this harvest method offers obvious advantages to farmers already equipped with silage or haylage equipment, grinding either in the field or going into the silo requires large amounts of power and slows the harvest.

Storing Grain Corn

DRY STORAGE

Artificial dryers - Shelled grain corn with a moisture content above 15.5% will not store properly. A wide range of dryers and techniques are available to dry corn to that level. The most common types are the in-bin batch type dryers and continuous flow type dryers. The in-bin dryer is the most popular where small amounts of corn are to be handled due to its low initial cost. It is inherently slower and usually of smaller capacity. Some in-bin designs can operate on a near-continuous flow basis but most operate on single loads like the batch dryer. Larger operations and grain elevators usually operate continuous flow type dryers, which can be more fully automated and operated on a more efficient basis.

When drying corn from high moisture to its safe storage state at 15.5%, it is desirable to allow a period of equalization during the process so that the moisture at the heart of the kernel has a chance to migrate to the outside. In a process called dryeration, this steeping of the hot kernels increases the capacity of the dryer and reduces stress cracking and drying costs. Drying of grain that exceeds 25% moisture is very expensive and should not be attempted unless absolutely necessary.

WET STORAGE

Silos - High moisture corn can be ensiled as shelled, ground shelled or ground ear corn. The moisture limits for ensiling either form of shelled corn are about 24 to 33% kernel moisture. For ensiling ear corn, the limits are 25 to 40% moisture.

Ground ear corn will store well in any type of storage that is sealed properly to prevent air from re-entering. High moisture shelled corn and corn cob mix (i.e. combined ear corn), however, should be rolled or ground before ensiling in "open top" concrete upright silos, bunker silos or piles made on a slab. Farmers with oxygen limiting or sealed silos have the option to process this type of corn either going in or coming out of storage, prior to feeding.

With a valuable energy supplement such as high moisture grain corn, serious quality deterioration can occur with a slow feed out rate, particularly during warm weather conditions. Careful attention should be given before building a silo/ground pile, such as herd size and daily corn feeding requirements.

Table 5. Approximate silo capacities for shelled and ground ear corn.

Moisture Content	Approximate weight of shelled corn (kg at 15.5% moisture equivalent)				
	Per 30cm of height for various silo-diameters in meters(m)				
Shelled Corn	3m	4m	5m	6m	7m
15.5	1522	2705	4226	6086	8284
24	1409	2505	3913	5635	7670
30	1321	2348	3669	5283	7197
Ground Ear Corn					
24	885	1573	2457	3538	4816
28	845	1502	2348	3381	4602
32	813	1445	2258	3251	4425
36	795	1415	2210	3183	4333

*Source: 0.1. Berge, Dept. Ag. Eng., Univ. Wisconsin. Meters x 3.3 = feet

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Effect of Enhanced Efficiency Nitrogen Fertilizers on Agronomic and Environmental Performance in Grain Corn, https://atlanticgrainscouncil.ca/wp-content/uploads/2024/03/Grain-corn-EENF-poster-Baillie-Lynds-March-2024.pdf.

Pub 811: Agronomy Guide for Field Crops, https://www.ontario.ca/page/publication-811-agronomy-guide-field-crops.

Corn Seeding Rate Trial – 2022 On-Farm Research Summary, https://atlanticgrainscouncil.ca/fact-sheets/.

OVERALL ASSUMPTIONS

- $1.43/L diesel cost[2] – 15.4 cent/litre fuel tax program discount[3] = $1.28/L diesel discounted.
- Field operations = fuel cost by implement (Table 6) + $10/ac machinery operating cost.[1]
- Number of field operations as outline by Table 6, unless otherwise stated.
- Labour is not included.
- Cost of grain drying is not included.
- On-farm grain storage (no trucking or storage costs).
- No-till scenarios assume an established system (no adjustment for yield drag during transition from conventional to no-till).
- Seed and input costs as outlined in the Guidelines for Estimating COP on NS Dykelands.1
- P&K requirements in scenarios with a history of manure are based on the recommendations "high" soil ratings from the NS Analytical Lab.

Table 1. Estimated cost of production for silage corn, per acre.

	Conventional Tillage, No Manure	Conventional Tillage, Manure	No-till, Manure
Yield (Tonnes/ac)	12.57	12.57	12.57
Crop Production Costs per acre			
Conventional Tillage	$38.83	$38.83	
Seed	$115.20	$115.2	$115.2
Planting	$12.18	$12.18	$12.18
Herbicide	$40.00	$40	$40
Spraying	$21.28	$21.28	$21.28
Fertilizer	$291.00	$200.65	$200.65
Fertilizer Application	$10.54	$10.54	$10.54
Harvest Costs per acre			
Chopping & Hauling	$27.68	$27.68	$27.68
Packing	$8.78	$8.78	$8.78
Silage Plastic	$1.56	$1.56	$1.56
Total Cost/Ac	**$567.05**	**$506.52**	**$467.69**

Table 2. Estimated cost of production for grain corn, per acre.

	Conventional Tillage, No Manure	Conventional Tillage, Manure	No-till, Manure
Price per Tonne	$207	$207	$207
Yield (Tonnes/ac)	3.15	3.15	3.15
Profit/ac	$95.34	$155.87	$194.7
Crop Production Costs per acre			
Conventional Tillage	$38.83	$38.83	
Seed	$115.2	$115.2	$115.2
Planting	$12.18	$12.18	$12.18
Herbicide	$40	$40	$40
Spraying	$21.28	$21.28	$21.28
Fertilizer	$291	$230.47	$230.47
Fertilizer Application	$10.54	$10.54	$10.54
Harvest Costs per acre			
Combine & Grain Cart	$27.68	$27.68	$27.68
Total Cost/Ac	**$556.71**	**$496.18**	**$457.35**

SILAGE AND GRAIN CORN ASSUMPTIONS

- Average yields for Nova Scotia.[4]
- Herbicide: soil applied residual + in-crop application of glyphosate.
- Seeding rate: 32,000 seeds/ac.
- No manure Fertilizer: 115-110-110 20S (NS analytical lab recommendations for “moderate” soil levels of P&K).
- With manure fertilizer: 115-55-55 20S (NS analytical lab recommendations for “high” soil levels of P&K).
- Packing costs, silage costs as calculated by Guidelines for Estimating COP on NS Dykelands.[1]

Table 3. Number of Field Operations and Litres of Fuel per Acre per Operation. Guidelines for Estimating Crop Production Costs on NS Dykelands, 2023.

Number of Field Operations & Litres Fuel Per Acre Per Operation												
	cultivator or tandem disk	high speed disk	harrow or land roller	air drill	row planter	SP sprayer	swather	hay rake	hay bine	round baler	spin spreader	combine & grain cart
	2.3	**3.5**	**1.1**	**2.6**	**1.7**	**0.5**	**1.8**	**0.26**	**1.48**	**1.32**	**0.42**	**6.0**
Wheat	1	1	1	1		4						1
Winter wheat	1	1	1	1		4						1
Soybeans	1		2	1		2						1
Barley	2		1	1		3	1					1
Corn (Grain)	1	1	1		1	2					1	1
Corn (Silage)	1	1	1		1	2					1	1
Dry Hay (Alfalfa Grass)								2	2	2	1	
Silage (Alfalfa-Grass)								2	2	2	1	
Other	0	0	0	0	0	0	0	0	0	0	0	0

Table 4. Price per metric tonne for various grain crops, Statistics Canada Farm Income and Prices, February 2025.

Crop	Price/mt
Wheat	304
Barley	197
Grain Corn	207
Soybeans	440*
***Soybean price for PEI.**	

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