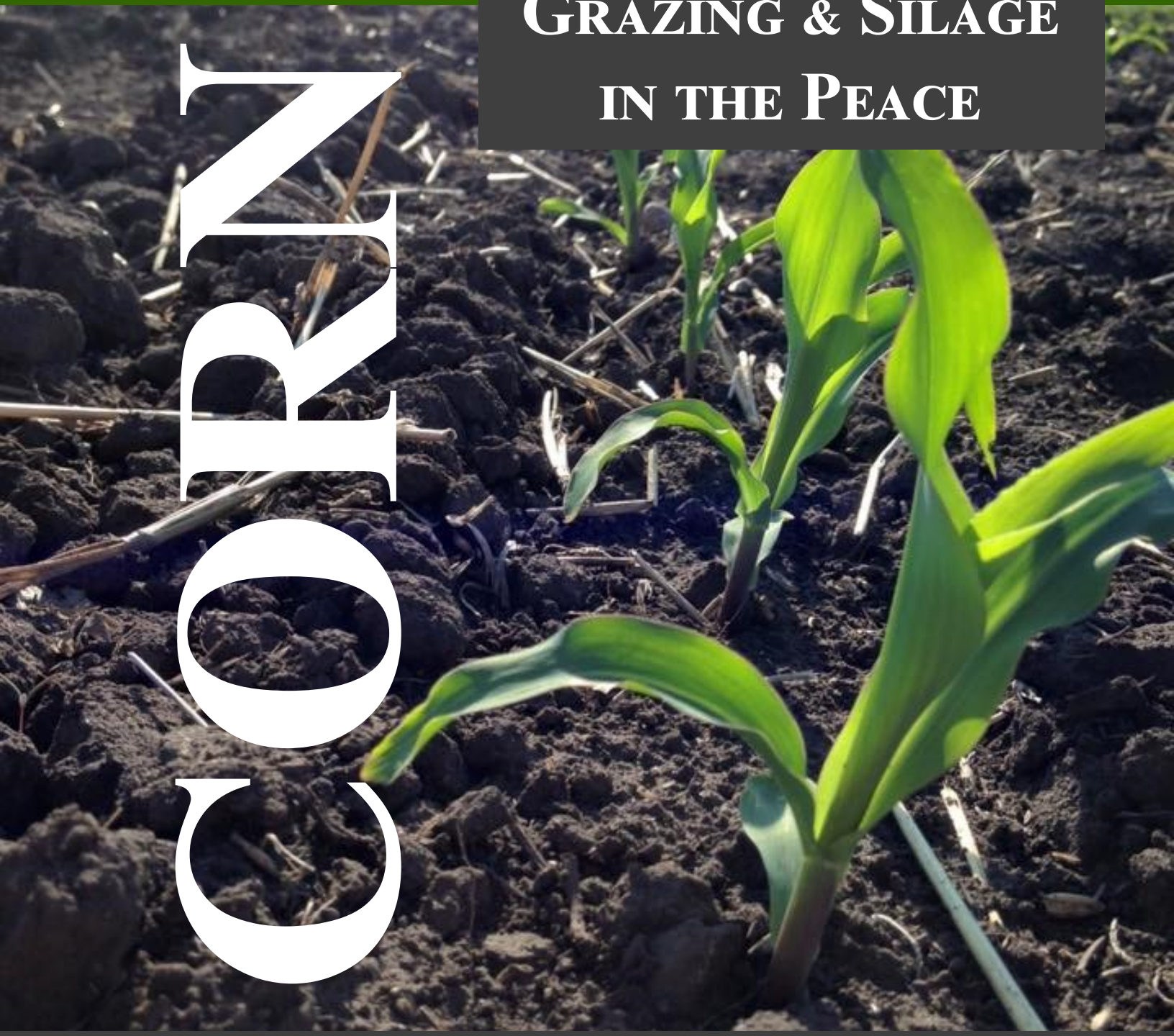
Field Guide for Grazing & Silage in the Peace



PCBFA
PEACE COUNTRY BEEF & FORAGE ASSOCIATION

"Local Information for Peace Country Producers"

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Author

The Peace Country Beef & Forage Association (PCBFA) Corn Production Extension guidelines and recommendations are based upon research and extension activities conducted across the Peace by PCBFA and from studies elsewhere in Canada & the USA. In the future, the Corn Guide will be revised and updated with information such as herbicide options, benefits of using higher seeding rates, and cost-benefit analysis of open pollinated corn varieties versus hybrids. The research trials and demonstrations and extension activities at PCBFA are being funded by the Agriculture Opportunity Fund (AOF) and our local Municipal Districts and Counties. *-Akim Omokanye, PhD*

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Some Key Terms used in this guide

Hybrid - a cross between any two corn lines that differ genetically
Husk - a protective covering that surrounds the corn cob
Kernel - the seed of a corn plant
Silk - long fibers at the end of an ear of corn that catch pollen
Tassel - branched flower at the top of a stalk of corn
Earlage - a valuable feedstuff that contains both roughage (husks and cob) and concentrate (corn grain)

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Introduction

In order to reduce the winter feed costs for livestock operations, options such as swath grazing of annual crops, stockpiling of perennial forages, bale grazing and bale processing have been common practices for extending the grazing season in the Peace Region. As livestock producers try to reduce their cost of production, many look at alternative ways to reduce their feed costs. Corn is an option for producers looking to extend the grazing season into the fall and winter months and reduce feed costs per cow per day. Corn acreage in the Peace River Region for livestock feed has steadily increased over the past number of years. This is because PCBFA corn research (including on-farm studies) and extension events have shown that:

1. Corn has the potential to produce up to 7-10 tons of forage dry matter to the acre in the Peace.
2. Corn is a high energy feed with protein levels that will normally match the nutritional needs of a dry cow in mid and late pregnancy.
3. Corn has an advantage as a winter grazing crop because it stands above the snow, and it stands up in windy conditions (with minimal leaf loss) as well as providing a windbreak for cattle grazing it.
4. By replacing other forms of feed with standing corn in late fall and during winter, labour time, machinery use and associated costs are reduced as no summer feed harvesting is required and winter supplemental feeding is limited.
5. Corn can be planted in parts of the Peace for corn silage or grazing.

Field Day highlighting cattle grazing corn in the Peace Region

By incorporating the use of low-cost field feeding systems into both the cow-calf winter feeding programs and backgrounding programs, beef producers can potentially manage risk more effectively. The direct input cost for growing corn is higher than oats, barley and triticale per acre. This is expected because of the higher cost associated with corn seed and fertility. Corn has a high fertility requirement, but fertilizer costs can be reduced where corn grazing takes place for a few years in a row and soil fertility is improved with the natural fertilizer produced by the cattle, making growing corn more affordable.

Cow grazing days per acre and cost per cow-per day are closely related to the maturity and yield potential of a corn crop. A mature corn crop with good yield potential will result in a higher number of cow grazing days and a lower cost per cow-per day. Some producers in the Peace with years of experience grazing standing corn have reported as low as $0.50 to $0.88 per cow-per day.

This guide is designed to be used as an extension resource. It contains information on topics that matter such as hybrid selection, fertility, plant populations, planting tips, weed control, corn grazing and silaging under the Peace Country conditions. Producers can achieve high corn yields by making sure the plant has access to sufficient plant nutrients and in the right proportions during the whole growing season. A balanced fertility program is therefore an important step towards obtaining higher yields. Knowing the growth stages of corn allows producers to time field operations properly to meet the short window of opportunity in the Peace. Matching an area's available corn heat units, to heat unit requirements of corn hybrids or varieties in the market, will go a long way in maximizing the potential of using corn to extend the grazing season.

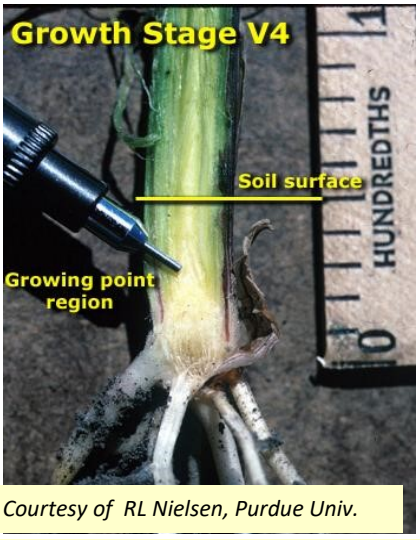
Growth and Developmental Stage

Corn is a tall, warm-season annual cereal crop which bears starchy kernels on large ears. The corn plant is a North American native. Corn is grown widely throughout the world in a range of agroecological environments. More corn is produced annually than any other grain. About 50 species exist and consist of different colors, textures and grain shapes and sizes. A typical corn plant can be anywhere from 5 feet to 12 feet tall. Understanding a corn plant's development and its critical growth stages is essential if you are to achieve high forage yields and quality, as well as to optimize your profitability. The growth stages of corn allow producers to time field operations or crop management properly. Consistent staging descriptions can help apply herbicides at the right time and avoid crop damage. Corn growth stages will also allow producers to assess seedlings for frost damages and harvest for silage.

Corn growth stages are divided into vegetative (V) and reproductive (R) growth stages (Figure 1). Corn seed begins germination when the seed contains at least 30% moisture. The vegetative growth stages start with the corn plant's emergence (VE) when the growing point is normally 1 to 1.5 inches below the soil surface (Picture 1). The growing point remains below the soil surface for three to four weeks, protecting it from physical injury, including frost, insects or grazing animals.

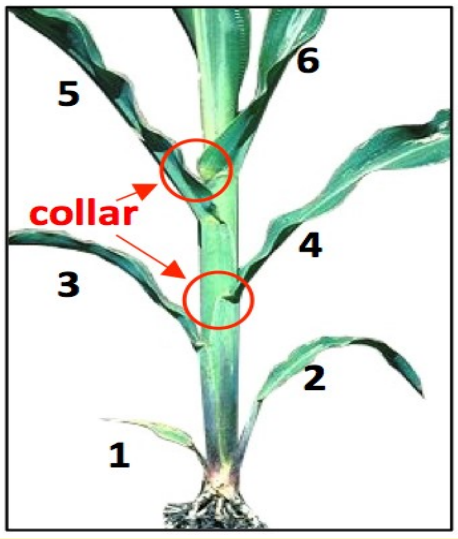
Leaf stages are usually described, using the leaf collar method, as "V" stages. The leaf collar is the light-colored collar-like "band" located at the base of an exposed leaf blade, where the blade comes in contact with the stem of the plant (Picture 2). Determine leaf stage by counting the number of leaves on a plant with visible leaf collars, beginning with the lowermost, short, rounded-tip true leaf, and ending with the uppermost leaf with a visible leaf collar eg. V1=one leaf with visible leaf collar. After the VE stage, each vegetative stage is determined by counting the visible collars in the sequence V1, V2, V3...VN until Tasseling (VT).

Reproductive growth stages start with silking (R1, Picture 3). A corn plant may have one ear, or as many as eight. Husks (a special kind of leaf) enclose and protect each ear. An ear consists of a corncob covered with rows of kernels, the seeds of the corn plant. An even number of rows usually grow on the ear (e.g. 8, 10, 12, or more rows of kernels). Each kernel has what looks like a silk thread that runs from the kernel up the row, and sticks out of the husk at the end of the ear. This thread is called the corn silk.



Courtesy of RL Nielsen, Purdue Univ.

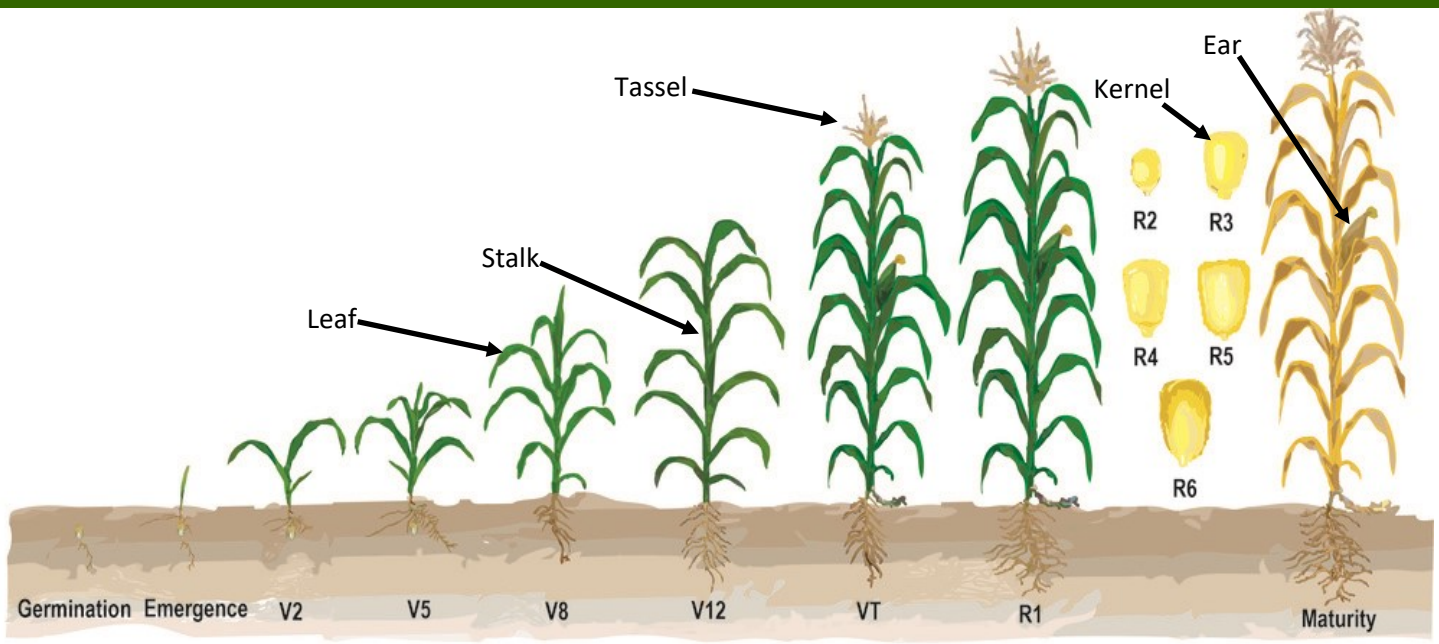
Picture 1. Corn seedling growing point



Picture 2. V6 according to the collar method

Picture 3. Corn silking stage (R1)

Corn 101: Growth & Developmental Stages



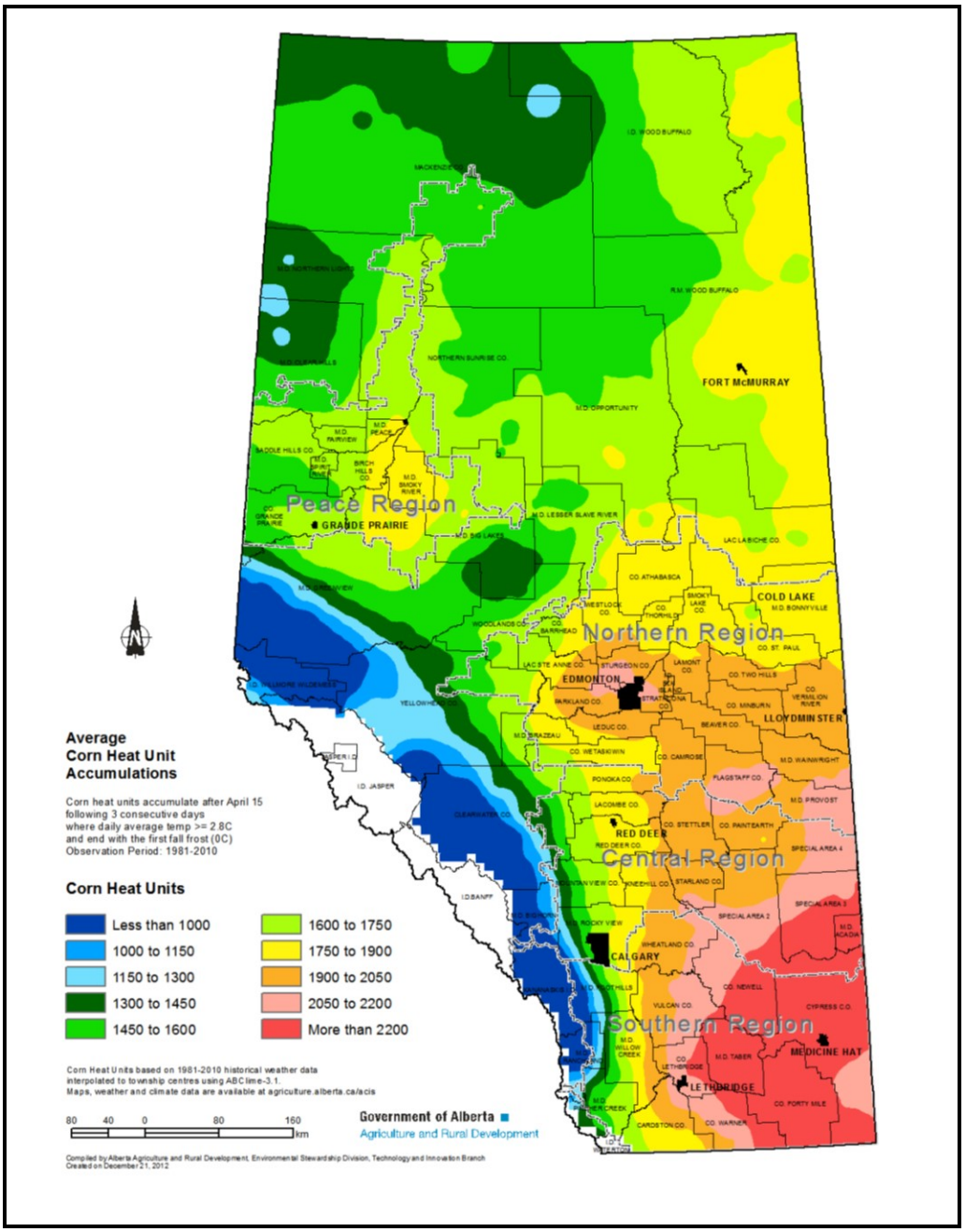
Vegetative Growth Stages		Reproductive Growth Stages	
Vegetative Stage	**Description**	**Reproductive Stage**	**Description**
VE (Emergence)	Germination & Emergence	**R1 (silking)**	Any silk is visible
V1 (first leaf)	Both V1 & V2 growth stages occur about one week after the plant emerges	**R2 (blister)**	Kernels are small, white and shaped like a blister. Endosperm (kernel fluid) is clear. Cob is close to full size. Silks darken & dry.
V2 (second leaf)		**R3 (milk)**	Kernels are yellow on the outside but contain a milky white inner fluid (starch accumulation).
V3 (third leaf)	About 2 weeks after the plant emerges, the V3 stage begins. ***A frost (light freeze) or hail may destroy the exposed leaves but will not damage the growing point below the soil surface, so damage to the plant above the soil surface at this time usually results in very little reduction in yield.***	**R4 (dough)**	Kernel has thickened to a pasty (doughy) consistency from the earlier milky state (starch has continued to accumulate and kernel moisture content has decreased).
V(n)	nth fully expanded leaf with the leaf collar	**R5 (dent)**	Most kernels are dented or denting due to the starch hardening at the top of the kernel. Drying kernels show a small, hard, white layer on top.
VT (Tasseling)	Stage VT occurs a few days before silking. The plant has reached full height and the pollen shed begins.	**R6 (physiological maturity)**	Milk is no longer visible. Grain black layer.

Figure 1. Corn plant development
Source: University of Illinois Extension

Heat Units for the Peace

The amount of heat required for corn to reach maturity is measured using Corn Heat Units (CHUs). The CHU is a measure of how heat affects the growth of corn. CHUs are an index developed to help producers select the appropriate crop varieties for their region. The daily CHU is the average of the daytime and nighttime CHU values and are accumulated over the growing season to determine the total value of available heat units for that area.

The CHU calculation assumes no growth occurs during the night when temperatures are below 4.4°C and during the day when temperatures are below 10°C. Also the calculation uses 30°C as the optimum daytime temperature because warm season crops develop fastest at 30°C. There is no optimal temperature for night since the nighttime temperature seldom exceeds 25°C.



Accumulated CHU from last date of spring frost to first fall frost for the Peace Country, Alberta stations are shown in Table 1.

Average CHU accumulation in Alberta is shown in Figure 2.

Hail damage: Hail damage is minimal on plants less than V7. Within a few days growth should occur within plant whorls. New leaves will become visible quickly within a couple of days if air temperature is warm. The first signs of damage on a growing point are a change to a light red or brown within about 4-6 days. If the growing point changes color, then the plant will likely not yield well and may even die.

Figure 2. Average CHU Accumulation
Source: http://www.agriculture.alberta.ca/acis/climate-maps.jsp

Frost-free Period

The frost-free period is the number of days between the last date of 0°C in the spring and the first date of 0°C in the fall. It provides a measure of the period during which plant growth should occur uninterrupted by frost. The frost date is the date when the air temperature drops to 0°C. The frost date varies from year to year. Within any given area, local conditions may cause a variation in the frost dates by as much as several weeks. Table 1 shows frost dates for Alberta Peace Country locations.

Corn is very susceptible to frost. You can lose a crop if you plant too early. It's better to wait until all danger of frost has passed and the soil warms up to the 10°C needed for seed germination. When thinking about the effects of frost injury to corn, it is important to recognize that the extent of crop injury depends quite a bit on whether the field experienced lethal cold temperatures or a "simple" frost. Our experience has shown that lethal cold temperatures in the Peace for corn are those at or below 0° C. A "simple" frost is that which occurs at temperatures warmer than 0° C.

Table 1. Freezing dates and corn heat units for Alberta Peace Country station locations

Station location	Average date of last spring frost	Average date of first fall frost	Corn heat units (CHUs)
Stations have data for 11 or less years during the period 2005-2015**			
Beaverlodge RCS	14-May	10-Sep	1832
Brownvale AGCM[1]	19-May	07-Sep	1816
Cleardale AGDM	23-May	25-Aug	1542
Fairview AGDM	15-May	04-Sep	1798
Fort Vermilion	18-May	14-Sep	2148
Grande Prairie Airport	15-May	05-Aug	1863
High Prairie Banana Belt	20-May	04-Sep	1783
High Prairie AGDM	20-May	06-Sep	1795
Jean Cote AGCM[1]	15-May	21-Sep	2002
Kinuso[2]	26-May	10-Sep	1726
La Glace AGCM[1]	16-May	29-Aug	1540
Manning AGDM	22-May	31-Aug	1711
Peace River Airport	16-May	16-Sep	1967
Rycroft AGCM[1]	19-May	06-Sep	1856
Savanna AGCM[1]	15-May	17-Sep	1879
Spirit River Auto[3]	14-May	17-Sep	1844
Teepee Creek AGCM[1]	15-May	26-Aug	1678
Valleyview AGDM	14-May	16-Sep	1997
Long-term Average Stations have data for 13 or more years during the period 1971-2000*			
Beaverlodge CDA	23-May	09-Sep	
Fairview	15-May	18-Sep	
Falher	24-May	11-Sep	
Fort Vermilion CDA	23-May	02-Sep	
Grande Prairie Airport	18-May	11-Sep	
High Prairie	30-May	06-Sep	
High River	09-Jun	31-Aug	
Peace River Airport	21-May	08-Sep	

** Source: Alberta Agriculture & Forestry (2003). Agroclimatic Atlas of Alberta: Agricultural Climate Elements. Revised Jan. 16, 2015. [Available online] http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sag6301*

**Calculated from Alberta Agriculture & Forestry, http://agriculture.alberta.ca/acis/alberta-weather-data-viewer.jsp

1, only 2008-2015 weather data available and used.

2, only 2012-2015 weather data available and used.

3, only 2007-2015 weather data available and used.

Spring Frost Damage

Patience is the key as a proper assessment of frost damage cannot be made for several days after frost; until you can determine if new growth is occurring from damaged plants. Various symptoms help growers identify when low temperatures have produced spring frost damage to corn. These symptoms include:

- Leaf tip burn- most often seen on the youngest (top) leaves.
- Darkening of leaves - Within the first 24 hours after frost, corn plants will take on a darkened, almost black appearance due to the destruction of cell membranes and the release of cell contents from damaged corn leaves (Picture 4).
- Plants turn brown - When plant cells have been destroyed, the damaged leaf portions will dry up and begin to turn brown within a day after frost. Some lower plant parts (pseudo stem) may remain intact and stay green.

Corn 101: Will My Corn Recover from a Spring Frost?

Frost Damage: Stage of development less than 5 leaf tips:

At young developmental stages, corn is not very susceptible to aboveground damage by frost or lethal cold temperatures because the growing point region of a corn plant remains below ground until about the 5-leaf collar stage (V5) and, thus, is reasonably protected from the effects of aboveground frost. So, the effects of frost damage to corn especially in late May or early June (a few days or weeks after seeding corn) are usually minor and limited to death of aboveground plant parts. Corn can easily recover from this type of damage early in its development and suffer little or no yield loss whatsoever. *Effect of freezing air temperatures on corn with less than 5 leaf tips will be minimal.*

Picture 4. Frost damage
Courtesy John Prinse, 2015

While corn leaves may blacken and wither within a day after frost occurs, the true extent of plant damage may not yet be visible. The bottom line on diagnosing the severity of frost or low temperature injury to corn is that you generally need to wait 3-5 days after the weather event before you can accurately assess the extent of damage or recovery. Recognize that cool days following a frost event may slow the plants' recovery and delay your ability to assess their health. After 3-5 days, recovery of surviving plants should be evident (Picture 5), while those plants that are truly dead will not exhibit signs of recovery & dead plants will still look dead.

Picture 5. Recovery (7 days after frost)
Courtesy John Prinse, 2015

Frost Damage: Stage of development more than 5 leaf tips:

1. If only the leaves are damaged but the whorl appears healthy (Picture 6) plants will recover fully.
2. If the lower half to 2/3 of the corn plants are not damaged by frost (Picture 7), they will likely survive.
3. If lower part of the pseudo stem is still green but the rest of the plant is dead (Picture 8), then the plant can potentially survive, although this is unlikely.
4. If the growing point is damaged the plants will not recover.

Picture 6. Leaf damage, whorl healthy
Courtesy University of Guelph, 2013

Another way to assess if a plant will survive is to split the below ground portion of the plant in half. A brown discoloration in the interior of the plant at the growing point indicates the plant will not survive while a white or light green color indicates a live plant with a chance to continue development.

Picture 7. Lower part of plants undamaged
Courtesy University of Guelph, 2013

After frost, wait to apply post-emergence herbicides & fertilizers. Weeds won't be controlled and corn won't metabolize the herbicide, which will lead to greater risk of injury. Keep in mind - if corn was at the V2 growth stage when frost set in and ends up losing two leaves because of frost injury, when that plant resumes growth and two new leaves are produced the plant is now at V4, not V2. This is a common misunderstanding that can have detrimental effects, especially if you apply a herbicide when the corn plant is actually at V6 or V7, but you thought it was only V3-V5; pay close attention to growth stages to avoid this problem.

Picture 8. Lower part of pseudo stem green
Courtesy University of Guelph, 2013

Hybrid Selection Criteria

Hybrid selection is a critical component for achieving high corn forage yields. Maturity is of primary importance in selecting a hybrid that will produce an ideal, mature corn crop during a normal growing season for a particular area before a killing frost hits. Look for corn hybrids that have proper maturity for the Peace (early growth type)- those that require low heat units. Corn development is driven primarily by temperature, especially during the planting-to-silking stages. Select a corn hybrid that will match the CHU rating for your geographical locations/area (Table 1 , Figure 2). Hybrids must be well-adapted and suited specifically to the area where they will be grown.

The CHU rating is an indicator of how many heat units are required for the grain to reach maturity. On average, 150-200 fewer CHUs are required for grazing or silage corn to reach 65 per cent whole plant moisture (35 per cent dry matter) as compared to grain corn. This system allows producers to select hybrids that have a high probability of reaching half-milk stage for silage or grazing maturity before a killing frost hits. Corn varieties or hybrids with lower CHUs are best for the Peace Region. This will ensure that corn matures at least 10 days to 3 weeks before the average first killing frost date hits in August/September.

Select an early-maturing silage corn variety. Silage varieties of corn are more palatable and better suited to grazing than grain corn. *Silage-only and dual-purpose (grain, grazing & silage) corn hybrids are available on the market.* Stresses that occur during the season may reduce the yield potential of corn. Therefore, it is crucial to select a high-yielding hybrid that has the potential to do extremely well in your particular field. *Choose top hybrids that have strong ratings for silage yield and quality.*

Select hybrids that have the following trait package: drought tolerance, tip cover, drydown, harvestability, early flowering, excellent stalk strength, excellent disease resistance, suitable for early planting and cold soils, very high yield, designed for silage or grazing or good dual purpose and excellent ear size.

All corn plants have the ability to produce more than one cob. Some hybrids produce multiple cobs more than others. Hybrids that do not produce many double cobs are more likely to have a greater ability to flex the primary ear size. In a high yielding environment, yields will be maximized if producers aim to produce one good ear per plant. Therefore, the decision should not be to select a hybrid on its ability to double cobs, but rather on its overall yield performance whether this is done by a single cob or more.

Producers growing corn for the first time should choose two or three hybrids on the basis of test information and grow them to find which one is best for that farm and the management practices used by the producer. Producers who grow corn regularly and have established preferences should review hybrid selection every year, because new hybrids are continually coming on the market. It is a very good idea for producers to conduct their own strip tests of new hybrids, and obtain their own yield and performance information. *PCBFA is able to assist producers with strip-tests and monitoring from planting through to forage yield determination and feed testing.*

Proven Yield Potential

It is crucial to select a high-yielding hybrid that has the potential to do very well in the Peace and in your particular location or field. The potential for profit is much greater if the producer looks at multiple corn forage yield results from research trials and from producers with corn grazing experience before making any hybrid selections. In the Peace, local producers with corn grazing experience, PCBFA and seed companies are continuously evaluating newer hybrids coming into the market, as well as continuously evaluating the better known, proven hybrids. Over the years, PCBFA has provided data on several corn hybrids with different CHUs at different locations across the Peace; please check out past PCBFA annual reports by contacting our office or on our website (http://peacecountrybeef.ca/publications).

Check with local seed representatives for their publications of demonstration plots and hybrid evaluation trials as many conduct their own hybrid testing programs.

High Energy and High Fiber Digestibility

Select corn hybrids with high energy and high fiber digestibility potential. Corn forage produces more digestible energy per acre than other forages. Nutritionally, corn silage (at half milk-line stage) is palatable when ensilaged properly, and high in energy, as it typically contains about 50% corn grain. Corn silage production is most profitable when yield and dry matter digestibility are highest.

Best Hybrid for Grazing

Corn maturity is very important. Very early corn hybrids may lead to too much grain and a risk of acidosis. Corn hybrids that mature too late will give poor dry matter production and have a risk of falling over after frost. The best hybrid is one that can reach half milk-line stage with 150-200 CHUs later than an area's total annual accumulation. Select a tall plant with high ears and above average stalk strength (unless wind is an issue, then average ear height may be better). You may want to consider alternating planter boxes with 2 varieties of different maturities or a commercial option with 2 hybrids mixed together.

Field scale corn production for grazing near Valleyview, Alberta

How Much Land Do I Need?

To calculate how many acres you require for corn grazing, determine how long you plan on grazing and the number of cows to be grazed. ***It is calculated that corn for grazing will give you 250 cow days per acre.***

> Assuming you have 200 cows, and you want to graze them for 30 days, the formula is:
> 30 days x 200 cows = 6000 cow grazing days
> Based on 250 cow-days per acre, you would require:
> 6000 cow grazing days/250 cow days per acre = 24 acres of corn.

Location or Field Selection

Corn performs best on deep, well-drained, medium to coarse textured soils, but producers have successfully produced corn on a wide range of soil types. The most important consideration for land selection is drainage. Corn production will be limited if drainage is inadequate. Select a well draining field.

Tillage

Corn prefers well-tilled land. Tillage helps the soil warm-up, but care needs to be taken so as not to dry up spring surface soil moisture. Planting no-till corn can be successful if the land has minimal plant debris or if the land is not rutted from the previous harvest operation. Studies have shown that corn planted with no-tillage, following corn, has averaged 6-15% lower yield than with conventional tillage in most situations. Subsoiling or deep tillage can reduce compacted soils with a hard-pan, this can help to raise corn yield.

Fertility Considerations

Corn fertility requirements are best determined by soil testing. Soil test recommendations take into account the yield goal or the crop yield potential for the soil type, the fertility level of the specific soil, and projected crop nutrient removal. Nitrogen (N) fertilizer recommendations are based on the yield potential of the crop.

- Pre-plant N soil test – soil samples should be collected before planting to a depth of 12” (0-6” & 6-12”).
- Set a forage yield goal. The yield goal should be set so that it falls in the upper ranges of what is believed attainable for your land and the hybrids or varieties to be planted. Studies by PCBFA have shown that up to 10 ton DM/acre of corn forage can be attained in parts of the Peace. This yield may be higher in places like Fort Vermillion, Jean Cote and Valleyview areas because of their slightly higher CHUs.
- Work out a fertilizer program to provide the necessary nutrients for your target forage yield and then calculate what amounts of fertilizer to apply to reach that goal. The following shows the amount of N, Phosphorus (P), Potassium (K) and Sulphur (S) required to produce a ton of corn forage or silage:

  N – 8 lbs N/acre
  P – 4 lbs P/acre
  K – 8 lbs K/acre
  S – 10 to 20 lbs S/acre

> **Calculation example**:
> 20 tons of silage yield/acre (@35% DM) requires:
> N - P - K - S (lbs/acre) = 160 - 80 - 160 - 20

Of special note is that silage removes more nutrients from the field. Fertility cost accounts for a high percentage of the total input costs for corn production. With continued grazing the majority of required nutrients will be provided by manure and urine. Manure can also be applied, but care needs to be taken not to apply excessive manure, as excess N will delay maturity. Micronutrients may also need to be applied, consult soil tests and an agronomist for recommendations.

Fertilizer placement is important since seedling plants must have access to the nutrients. The standard fertilizer placement is 2 inches beside & 2 inches below the seed (Figure 3). Salt damage from too much fertilizer too close to the seed can occur. Broadcasting urea on the surface can result in significant losses of nitrogen if not incorporated into the soil. This is particularly so for high residue conditions. Phosphate & potash phosphate (P) and potash (K) requirements are applied with the planter or drill as a starter fertilizer.

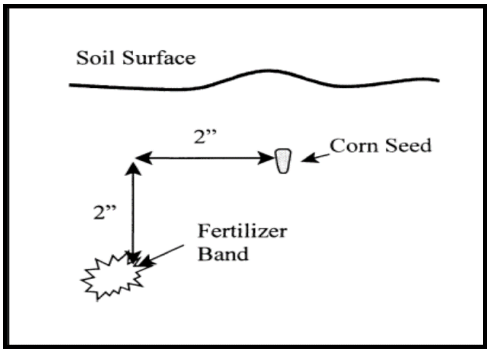


Figure 3. Standard fertilizer placement

Commercial fertilizer can be used to supplement manure, from grazing or applied. Rates should be based on soil test results and the nutrient content of the manure, keeping in mind that only 50 to 60 percent of the nitrogen in manure becomes plant-available the first year, and that applying manure based solely on crop N requirements may supply P in excess of plant needs.

Picture 10. Purple corn
Courtesy RL Nielsen, Purdue Univ.

Purple Corn: Why is my young corn stunted and purple?

When corn plants emerge, it's not uncommon for seedlings to have a purplish tinge or some uneven early growth (Picture 10). Phosphorus deficiency symptoms have been characterized as an accumulation of purple pigments in leaves. Purple seedling color can also result from the expression of genes for anthocyanin pigment formation.

How can producers tell the difference between genetic purpling and symptoms of P deficiency? First, examine the color of plants over the entire field. If the purple color is uniform through the field, the cause is probably genetic. If purpling is quite erratic, this may indicate that P is limiting to plants in those areas. If plants are beyond the seedling stage (more than six to eight leaves) and purpling is observed, then P deficiency is likely. P deficiency often results from conditions such as cool temperatures, too wet or dry soil, compacted soil, herbicide damage, insect damage, and root pruning by side-dressing knives or cultivators. Acidic soil can also intensify phosphorus deficiency symptoms by reducing root growth, which is critical to P uptake.

Surface application of P fertilizer will limit availability to the top couple inches of soil, since P is not mobile. P injected as a side-dress treatment increases the availability to the root system, however, be careful not to prune roots. Any concerns about purple seedling color in your corn field or if you need assistance with what can or should be done about it, contact an agronomist, seed company representative or a PCBFA agrologist.

Planting Date

Corn should be planted when soil temperatures are near 10°C and are expected to rise. In soils below 10°C, seeds readily absorb water but will not initiate root or shoot growth. This may lead to increased early season diseases, insect feeding, and herbicide injury if poor soil conditions persist. Therefore, it is better to wait until soil conditions are suitable for planting to ensure good germination and seedling establishment.

- In the Peace, the best time to plant corn is approximately May 10-25 (Table 1 shows frost-free dates). Experience has shown that planting from May 10 - 15 is ideal for most parts of the Peace.
- Yields are reduced more when corn is planted too late rather than too early. If you do not plant in the optimum May 10-25 window, consider that yields will be reduced, and the corn may be short of reaching the half milk-line stage before the killing frost hits in August/September.

Planting Depth

Proper seed planting depth is critical for optimum corn root and plant development. Shallow planting corn can delay or inhibit the development of "brace roots", which are the primary tools for water and nutrient uptake. "Brace roots" grow from nodes above the soil surface (Picture 11), and are so called, based on the observation that they appear to help brace the plant from falling over as they enter the soil some distance away from the stalk, so have a better angle from which to brace the plant.

Picture 11. Corn Brace Roots

Some planting tips:

- Plant seed to a depth of 1.5 - 2 inches (3.5 - 5 centimeters) or into moisture. This depth is optimum for brace root development. If corn is planted too shallow and the topsoil becomes dry, a condition called 'rootless corn syndrome' can develop. Plants can fall over due to the lack of brace root development in the dry soil. Symptoms of irregular planting depth can be uneven emergence and varying plant height.
- Plant slow at 4 - 5 mph. Slower planting speeds produce more uniform seed placement (Picture 12) and ensures seed to soil contact. High speed will cause uneven plant spacing, which may result in misplaced and missing plants (see Picture 13).
- Check planter out: make sure spacing is proper, check disc openers for wear and get seeder settings from manual or corn seed company representative.

Key Planting Objectives

- Uniform depth and spacing of seed placement - 1 ½ to 2 inches (never plant shallower than 1½ inches)
- Delivering the correct number of seeds/acre - 30,000 to 32,000 plant population per acre.
- Creating the best possible environment for seeds to germinate rapidly & emerge uniformly (10° C soil temp).
- Seedbed quality, seed quality and planter type and settings are important.
- Seeding speed influence these objectives, as well as planter condition.

Planter versus Seeder

Corn can be seeded with a corn planter or other seeders including air seeders. Seed distribution in the row is generally less uniform for air seeders than with corn planters with finger pickup or vacuum seed distribution systems. Air seeders can be used to plant corn , but air seeders do not provide enough:

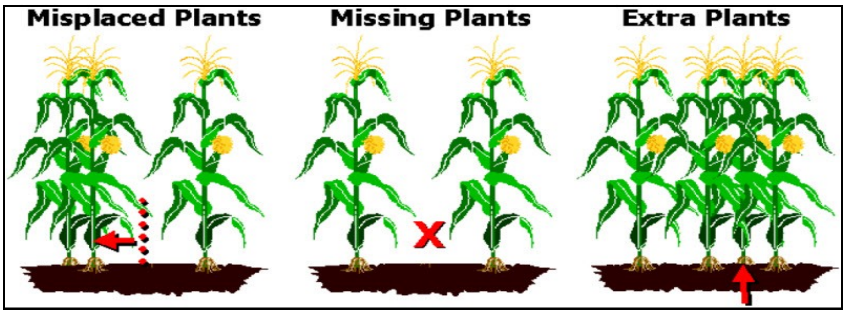
a) uniformly placed seed depth.

b) properly spaced seed placement - corn will not compensate like other crops such as wheat and canola do with an air seeder. By their very nature, corn plants hate each other. When planted too close together, they battle to the death for supremacy.

c) even emergence - if one seed emerges a day behind its cousin, the big cousin views it as a weed and expends a lot of expensive energy trying to kill it. That's why a successful corn stand needs perfect uniformity of seed distribution within the seed row.

Picture 12. Uniform plant spacing with a corn planter

Where possible, a corn planter should be used. Although manufacturers have had success adapting air systems to corn, planters are typically required to achieve the seed singulation that a corn crop needs. With corn planters, it is important to tune up your planter before you hit the field, as good kernel spacing is key to achieving high yields.



Picture 13. Types of Non-Uniform Plant Spacing.
Courtesy DuPont Pioneer

Misplaced plants
-May decrease yield relative to a uniform stand.
Missing plants
-Will decrease yield relative to a uniform stand.
-Yield of adjacent plants will increase, but not enough to compensate for the missing plant.
Extra Plants
-May increase yield slightly if stand is below optimum.
-Yield of doubled plants as well as adjacent plants will decrease, but the yield of the extra plant will compensate for this reduction.

Misplaced seed is known to cause yield loss.

Seeding Rate and Plant Populations

An initial target of 30,000-32,000 kernels (seeds)/acre is a good starting point for us in the Peace. Please note you may need to adjust seeding rate depending on weather, soil conditions and genetics. When seeding in wet - cool temperatures, increase plant populations by 10% and reduce seeding rates if water is limiting (to allow plants more access to available moisture) or if soil conditions are poor.

Thirty inch (30") rows are most common for corn production in the Peace. You can use narrower row spacing. The seeding rate should be about 10 - 15% higher than desired harvest population. Extremely high plant populations will lead to increased lodging, smaller ears, lower number of kernels per ear, and lower yields. Table 2 can assist with calculating the plant stand per acre. Count the number of plants within a specific row width & length and multiply this number by 1,000 for plants/acre.

Table 2. Target plant populations & spacing between rows and kernel stands.

Population desired (plants/acre)	Seeds required/ acre (allowing for 10% loss)	Population check	
		Row spacing (inches)	Inches between kernels
28,000	31,111	15	13.4
		20	10
		30	6.7
		32	6.3
30,000	33,333	15	13.4
		20	10
		30	6.7
		32	6.3
32,000	35,200	15	13.4
		20	10
		30	6.7
		32	6.3
34,000	37,400	15	13.4
		20	10
		30	6.7
		32	6.3

Assuming a 10% average loss. Check seed tags for actual percent germination.

Higher plant populations increase competition among plants for water, sunlight, and soil nutrients reducing individual plant yield. Higher plant population leads to slower maturity and higher moisture requirements.

However, higher plant populations have been found to increase the yield per unit area by optimizing the following yield components: number of ears per unit area, number of kernels per ear, weight of each kernel.

Weed Control in Corn: Herbicide Decisions

Weeds compete with corn to reduce yields, cause harvesting losses and produce seed that increases weed seeds in the soil seed bank. Even a light infestation of weeds can reduce yields by 10 to 15 percent. Heavy infestations may reduce yields as much as 50 percent if left unchecked during the season.

Herbicide programs typically include soil-applied and foliar-applied (post-emergence) products. Soil-applied herbicides prevent early weed competition and protect yield potential. Post-emergence applications target weed species that are not controlled by soil applications. Some post-emergence herbicides only control weeds emerged at the time of application. Others control emerged weeds and provide residual herbicide activity against later emerging weeds.

A well-designed weed management plan protects corn from weed competition, minimizes herbicide injury potential, and delays or prevents herbicide-resistant weed development.

Herbicide timing is crucial… Spray early, stay on top of your weeds.

- *A clean field at planting is essential for starting the corn crop off right. This can be achieved by using tillage, herbicides or some combination of the two.*
- *Identify your field's number 1 weed (which could be a glyphosate-resistant weed) and work with your seed company representative/local agronomist or PCBFA to pick the best product by weed……subsequently, a burn-down with residual chemistry that is targeted to the specific weed spectrum for the field may be used. Use of a soil-residual herbicide will help to both start the crop off clean and to manage the field for any potential glyphosate-resistant weeds.*
- *Consult the Alberta Crop Protection Guide (the "Blue Book") and follow herbicide label instructions.*

When is the right time? - Weed competition in corn is most damaging early in the growing season. Corn yields can be reduced by weeds when allowed to grow past 4 inches. Herbicides should be applied before weed canopy exceeds 4 inches for consistent weed control and maximum corn yield. Weeds allowed to exceed 4 inches in height can cause significant yield loss.

What is the right Herbicide? - Herbicide timing is crucial… Spray early, stay on top of your weeds. Please Consult the *Alberta Crop Protection Guide* (the "Blue Book") for registered herbicides and an up-to-date guide for the selection and application of chemicals to protect your crop.

For Roundup Ready® (RR) Corn hybrids, Label Use Recommendations include:

- annual weeds: Apply 0.67 L/a of Roundup® once or twice as needed
- perennial weeds: Apply 1 L/a + 1 L/a sequential applications
- Use 10-20 gallons per acre water
- Applications can be made from the 1 to 8 leaf stage of corn
- A maximum of 1.5-2 L/a can be used per season

There are several formulations of glyphosate available and labeled for use on RR corn. Rates and use patterns vary by formulations, and labels should be checked prior to using any herbicide. Sequential applications of glyphosate are very effective for control of a broad spectrum of both grass and broadleaf weeds. Because glyphosate has no soil residual properties, multiple applications are usually required to provide a level of weed control that will not allow competition to reduce yields.

Volunteer canola in corn field.
Courtesy of Calvin Yoder, AAF, 2015

Managing Roundup Ready® Canola in Corn

Most of the corn seeded in the Peace is RR which provides a good system for controlling weeds. Volunteer RR canola is a common weed on fields where corn is grown. Managing volunteer RR canola in RR corn requires a broadleaved herbicide that can be mixed with glyphosate and be safely applied prior to seeding corn or applied in-crop.

Selecting a corn herbicide should be based on weeds present, crop stage, crop tolerance and price. There are a number of broadleaved herbicides that can be tank mixed with glyphosate and used on corn as pre-seed or in-crop applications. Tank mixing a broadleaved herbicide with glyphosate will improve control of a number of weeds including volunteer RR canola. Herbicides that can be tank mixed with glyphosate and applied prior to seeding corn include: Heat®, Pardner®, Conquor®, MCPA and 2,4-D. Some herbicides that are registered on corn and can be tank mixed with glyphosate include Pardner®, Buctril® M, 2,4-D, MCPA, Banvel® and a newer herbicide, Armezon®. Bromoxynil which is the main active ingredient of Pardner® is a good option and tends to be safer, although it can cause some leaf burn. Although Banvel®, 2,4-D and MCPA are registered for use on corn, agronomists prefer not to recommend them as they can cause stunted growth and poor brace root development resulting in lower yields.

PCBFA in collaboration with Alberta Agriculture & Forestry and DuPont Pioneer™, has an on-going trial on herbicide options for managing RR canola in corn. Preliminary results are available in PCBFA's 2015 Annual Report (www.peacecountrybeef.ca). Full report on findings will be available in the spring of 2017.

Other Herbicide Options:

There are several pre-plant and pre-emergence residual herbicides available for corn. These herbicide programs are key to managing glyphosate-resistant and other difficult-to-control weeds. It's important to know the strengths and weaknesses of each product in terms of the spectrum of weeds controlled. Possibly, no other crop has as many weed control options as corn. There are currently several different herbicide brand names labelled for weed control. Table 3 shows some herbicides that can be used on field corn hybrids or varieties. *Please Consult your Crop Protection Guide (the "Blue Book") for registered herbicides and up-to-date guide for the selection and application of chemicals to protect your crop.*

Table 3. Herbicide Options for Weed Control in Corn

Product	Comment
Accent®	Until 8 leaf stage
Aim® EC	pre-seed or pre-emergence; as a burnoff
Armezon®	1 to 7 leaf stage
Banvel® II	up to 6 leaf stage
Bassagran® Forte	any stage
Buctril® M	4 to 6 leaf stage
Dual II Magnum®	Pre-emergent or pre-plant incorporated
Dyvel® DSp	2 to 5 leaf Careful
Eradicane®	Pre-emergent
Heat®	Pre-emergent
Laddok®	any stage
Liberty® (Liberty Link corn only)	up to 8 leaf stage
MCPA	up to 15 cm. Risk of injury increases as corn increases in size
Pardner®	5 to 10 leaf stage
PrimeExtra® Magnum II®	Pre-emergent
Round-up® brand herbicides (pre-emerge)	Pre-emergent

Corn Diseases

To effectively manage corn for disease, it is preferable to prevent or manage a disease outbreak when the disease is at low levels, as opposed to attempting to deal with a disease in which significant damage has already occurred. Planting disease-resistant varieties (is strongly recommended) and crop rotations can all reduce the likelihood of any disease outbreaks in the future. Field scouting for disease throughout the growing season is important and this can provide information on what diseases are present, the severity, and potential for crop loss if untreated.

Growing corn in the same field for successive years may be desirable for a number of reasons. There are risks however, in not rotating other crops through the field, as the population of corn disease organisms can increase over time, increasing the likelihood of a large outbreak of disease with subsequent crop loss.

Hybrid selection is critical when growing corn after corn. It is strongly recommended that producers use varieties that are resistant to a disease (including Fusarium). Use of hybrids resistant to other stalk rot diseases usually display resistance to Fusarium stalk rot. Any practice that can reduce stress or injury to the plant, especially the roots, can reduce the likelihood of damage attributed to Fusarium stalk rot.

Estimating Plant Population & Determining Forage Yield

Plant Population:

- Measure 1/1,000 of an acre for the length of row needed (Table 4).
- Count the number of plants in the measured area.
- Count in at least 6 representative places across the field. Do not intentionally avoid areas in rows with gaps; include these in areas assessed.
- Multiply the average number of plants by 1,000 to obtain the final plant population per acre.

Table 4. Feet of row representing 1/1,000 of an acre at different row widths

Row spacing (inches)	Row length (1/1,000 acre)
15	34 ft. 10 inches
20	26 ft. 2 inches
22	23 ft. 9 inches
28	18 ft. 8 inches
30	17 ft. 5 inches
36	14 ft. 6 inches
38	13 ft. 9 inches
40	13 ft. 1 inch

Corn Forage Yield:

Corn forage yield can be estimated by:

- Measure 1/1,000 of an acre (Table 4) to give size plot needed.
- Cut/harvest all corn stands in at least 6 representative places (6 measured 'plots').
- Yields from the measured plots should be weighed to estimate the wet yield per acre.
- The raw corn forage wet weight from 1/1000 of an acre divided by 2 will give you the estimated yield in tons per acre (see Table 5 for guide).
- Once you determine the dry matter of the sample (using the microwave method), you can then multiply the yield by the % dry matter (DM) to get an estimate of dry matter yield per acre.

Table 5. Corn Silage Tonnage Conversion Chart (when collected off of 1/1000 of an acre)

lbs Collected	Tonnage Equivalency	lbs Collected	Tonnage Equivalency
15.0	7.50	26.0	13.00
15.5	7.75	26.5	13.25
16.0	8.00	27.0	13.50
16.5	8.25	27.5	13.75
17.0	8.50	28.0	14.00
17.5	8.75	28.5	14.25
18.0	9.00	29.0	14.50
18.5	9.25	29.5	14.75
19.0	9.50	30.0	15.00
19.5	9.75	30.5	15.25
20.0	10.00	31.0	15.50
20.5	10.25	31.5	15.75
21.0	10.50	32.0	16.00
21.5	10.75	32.5	16.25
22.0	11.00	33.0	16.50
22.5	11.25	33.5	16.75
23.0	11.50	34.0	17.00
23.5	11.75	34.5	17.25
24.0	12.00	35.0	17.50
24.5	12.25	35.5	17.75
25.0	12.50	36.0	18.00
25.5	12.75	36.5	18.25

Example:

17'5" of a 30" corn row weighs 53 pounds

Divided by 2 = 26.5 tons per acre yield

26.5 tons/acre X 33% Dry Matter (DM) = 8.75 ton DM per acre

Note:

If your sample was wetter (23% DM) and your weight of yield was the same (26.5 tons) your dry matter yield would be quite a bit less

26.5 tons/acre X 23% (DM of sample) = 6.1 ton DM yield per acre

Silage (Storage)

The goal in making corn silage is to efficiently harvest and store the maximum amount of digestible nutrients per unit of land area. One of the most important factors influencing corn silage quality is moisture content at time of harvest. Silage moisture at harvest is not difficult to determine and should be monitored, if possible, to prevent harvesting of the crop outside of the desired moisture range. A microwave oven can be used to determine the moisture content fairly rapidly. Ensure that you obtain representative sample (whole plants), and cut or chop into half ($^1/_2$) inch pieces, keeping leaves and stems uniformly mixed. If silage moisture is above ideal levels then harvest should be delayed if possible.

Silage DM yield and moisture content are directly correlated with the stage of development of the grain. Table 6 provides guidelines of potential varying stages of grain maturity. The ideal moisture content (65-70%) for ensiling corn closely coincides with the stage of development that ensures near maximum production of total digestible nutrients (TDN)/acre, maximum yield and quality, and stack fermentation. That stage of development will be approximately at R5 (Table 6), between one-third and two-thirds milk-line. Corn silage DM yields are also maximized near 65% moisture.

Table 6. Corn reproductive stages and their moisture content

Stage	Moisture % Whole plant
Silking (R1)	80-85
Blister (R2)	80-85
Late Milk (R3)	75-80
Early Dent (R4)	70-75
Half ($^1/_2$)Milkline (R5)	65-70
Mature (R6)	55-65

Corn that is chopped when it is too wet will lose nutrients through seepage. Corn that is chopped when it is too dry is difficult to pack, which allows oxygen to enter and disturb fermentation. This enables yeasts and molds to grow and increases heating.

Frost may force the decision to harvest corn as silage with late maturing hybrids or late plantings. If frost comes during the one-third and two-thirds milk line period, the whole-plant moisture content should be sufficient for normal ensiling.

Evaluating Corn Silage

Sampling at harvest gives advanced knowledge of the quality of silage stored in the pit/pile. A producer can inventory and plan for purchasing supplemental feedstuffs based on forage quality needs.

Once the silage has undergone an adequate fermentation, usually in 3 weeks, a sample should be obtained for forage analysis to develop a feeding program. Evaluation of the silage pH and fermentation acids can provide feedback on whether the fermentation process occurred under ideal conditions.

In general, pH values for corn silage should be in the 3.5 to 4.3 range, lactic acid levels should be in the 4-6% range, acetic acid 2% or less, propionic acid 0-1%, and butyric acid less than 0.1%. Ammonia N levels should be less than 5%. While some fractions can show significant change during the fermentation following ensiling, crude protein and fiber fractions (Acid Detergent Fiber (ADF) and Neutral Detergent Fiber (NDF)) show little change from forage sampled at harvest where forage was ensiled properly and normal fermentation occurred. Analysis will change when:

a. Forage is ensiled at too high a moisture content and seepage occurs (crude protein and non-fibrous loss resulting in higher fiber).
b. Forage is ensiled too dry and heats excessively (ADF and acid detergent fiber insoluble nitrogen increase).
c. Fermentation is faulty so that excessive mold growth occurs.

Silage preservatives and inoculants

Most preservatives and inoculants are aimed at promoting lactic acid production, reducing dry matter losses during storage, reducing heating, and increasing bunk life. In some cases, one or more of these benefits has occurred in controlled studies, but not in all trials. Likewise, some improvement in cow milk production has been found in some studies, but not in others.

Research has included organic acids, such as propionic or acetic-propionic mixtures or their salts, certain enzymes alone or in combination with antioxidants, as well as silage inoculants containing one or more types of bacteria. When used, these products should be added according to the manufacturer's directions. The products cannot, however, overcome poor practices for ensiling, harvesting at the proper dry matter, packing, feeding, or managing silos.

Earlage

Earlage is a valuable feedstuff that contains both roughage (husks and cob) and concentrate (corn grain) and is an opportunity for livestock producers who want an energy dense feed that has significant fiber content. Earlage harvest is conducted at, or soon after physiological maturity when the grain moisture is approximately 30 percent and is harvested using the same forage harvesters used in the silage making process but uses a snapper corn front (similar to those used on conventional grain harvesters) to remove the cob portion of the plant. In this way it is similar to corn silage, though earlage has an advantage in that earlage harvest leaves the stalk and the leaves in the field.

The grain, the core of the cob and some husk is chopped and processed by the forage harvester and then transported and stored under the same process as whole plant silage. Optimum moisture content for earlage should be 35-40 percent. Earlage yields will vary widely, and will depend heavily on the amount of corn on the cob, as the cob and husk make up approximately 20 percent of the dry matter weight of earlage. It may be treated with a proven silage inoculant to improve the feeding efficiencies of this high quality product. This is not a common practice in the Peace, but an option for producers looking for high quality silage.

Corn near Guy, AB

Corn Grazing

Fencing and Facilities

Use electric fencing with a high quality energizer to divide paddocks. Make sure that your fence is well grounded. Ensure that debris/stalks cannot contact the fence and short out the system. Clear alleyways through the corn for the fencing before turning the cattle into the corn. Blading off the fencerow is a popular method. A front end loader with the bucket tipped down slightly will do the job.

Run a second fence ahead of your current paddock. This will hold animals to a smaller area if they break out and makes moving easier.

Cows will obtain their water requirements from snow, provided it is not too hard. Provide a water source if fresh snow is unavailable or if calves are on the cow.

Cattle winter grazing corn in the Peace

Grazing

Grazing your herd on corn can lower winter feed costs, reduce operating expenses and save time. Whole plant corn grazing has high energy feed with protein levels that will normally match the nutritional needs of a dry cow in mid and late pregnancy.

When grazing corn, limiting access the cows have to the standing corn is important. Cows can overload on grain if they can free choice pick and choose between corn cobs and stalk. Move the fence every 2-3 days or properly size out paddocks for 2-3 days of grazing at a time. The best way to manage grazing corn and increase utilization is to move through paddocks every 1-2 days.

Know how much area you need to give at a time...
An average beef cow or growing animal will consume 2% of body weight per day,
so 1500 lbs cow = 30 lbs dry matter

It is important to size paddocks correctly to manage feed value variances (150-300 cow days/acre). Cattle will feed on the cob (grain) first, then foliage and then stalk (if left long enough cattle will eat stalk). Check the cows and calves regularly to make sure they are not getting too much grain. Watch their feces; if the manure is too runny, they may be getting too much grain. Stretching your moves out beyond 3 days could make the "ration" tough to manage, especially in terms of nutrition.

More grazing tips:

- Beware of mature grazing corn, due to the risk of acidosis, bloat, lameness, etc., if not rationed out properly. Silaging a potentially mature crop may provide a better return on your investments as it will make it easier to supplement the corn forage.
- Wait until the ground is frozen before turning the herd into the field. This will reduce the losses from trampling feed into the mud.
- Have a backup feeding plan in case of bad weather or excess snow.

Nutritional Considerations

Whole plant corn grazing has high enough quality to meet (and often exceed) the requirements of a beef cow in mid-pregnancy (Table 7). Take a whole-plant representative feed sample from your corn field and have a wet feed test analysis completed. Compare the feed analysis to the requirements of cows grazing (Table 8) and provide supplements if necessary for a balanced feed ration.

Preparing corn forage samples for feed tests

- When protein is low, feeding some good alfalfa hay or other protein source to the cows every 2-3 days will help to improve protein content. If it's needed, supplementation will provide protein for a healthy rumen, as it will allow better utilization of less digestible stalks at the back end of the grazing period.
- Feed a complete 2:1 winter mineral (with salt) to make up for lower calcium levels in the corn. Also, supplementing with alfalfa grass hay if required will help to meet the calcium requirements.
- Be prepared to supplement if there is a cold snap. Cows forced to clean up stalks during extremely cold periods can lose body condition and impaction can become a concern.
    - ◊ Feed high quality hay or range pellets in the evening.
    - ◊ Move into a new paddock if you can.

Table 7. Average (2010-2015) corn forage quality (% DM basis) from 130 corn samples analyzed from PCBFA on-farm trials and demonstrations across the Peace.

Nutrient	Value
Crude protein (CP, %)	10.5
Ca, %	0.27
P, %	0.21
Ca:P	1.41
Mg, %	0.24
K, %	1.38
NDF, %	53.8
ADF, %	30.8
Total digestible nutrients (TDN, %)	64.4
Metabolizable energy (ME, Mcal/kg)	2.32
Digestible energy (DE, Mcal/kg)	2.86
Net energy for lactation (NEL, Mcal/kg)	1.43
Net energy for maintenance (NEM, Mcal/kg)	1.47
Net energy for gain (NEG, Mcal/kg)	0.87
Relative feed value (RFV)	127

PCBFA Field Day, July 2016, Touring Corn Trials

Table 8. Suggested nutrients requirements for beef cows from NRC (2000) and AAF (2004)

Nutrient		Requirement	
	Growing & finishing calves	Dry Gestating cows (544 kg)	Lactating cows (544 kg)
Protein			
CP, %	12-13	7-9*	11
Macro-minerals			
Ca, %	0.31	0.18	0.42
P, %	0.21	0.16	0.26
Mg, %	0.10	0.12	0.20
K, %	0.60	0.60	0.70
Na, %	0.06-0.08	0.06-0.08	0.10
S, %	0.15	0.15	0.15
Trace-minerals			
Cu, ppm	10	10	10
Zn, ppm	30	30	30
Fe, ppm	50	50	50
Mn, ppm	20	40	40
Energy			
NE_M, MCal kg^{-1}	1.08-2.29	0.97-1.10	1.19-1.28
NE_G, MCal kg^{-1}	0.53-1.37	NA[Y]	NA
TDN, %	65-70[W]	55,60[Z]	65

*, 7% for middle 1/3 of pregnancy, 9% for late 1/3 of pregnancy.

[Z], 55% for middle 1/3 of pregnancy, 60% for late 1/3 of pregnancy.

[Y], NA, not available.

[W], for 6-10 months old growing bulls.

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