AGRI-FACTS
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Irrigation Scheduling for Silage Corn in Southern Alberta

Irrigation management is about controlling the rate, amount, and timing of applied irrigation water in a planned and efficient manner. With good irrigation management, a silage corn crop can have high yield and quality potential.

Irrigation management

The goal of irrigation management is to use available irrigation water effectively in managing and controlling the soil moisture environment of crops to do three things: promote the desired crop response, minimize soil degradation, and protect water quality.

Proper irrigation management requires a good understanding of a number of factors:

- soil fertility (crop nutritional requirements)
- soil-water-plant relationships
- crop type
- crop sensitivity to water stress
- crop growth stages
- availability of a water supply
- climatic factors that affect crop water use such as rainfall, temperature, humidity, and net radiation
- irrigation system capabilities and limitations

Equipped with such knowledge, an irrigator can develop a workable, efficient, and profitable irrigation scheduling program.

Depletion of soil water to less than 60 per cent of available can result in reduced silage yield and quality.

Strategies

A workable and efficient irrigation management strategy should be crop-specific. Crop-specific irrigation management strategies mean available water is used efficiently to meet a specific crop's water requirements for maximum water productivity.

Generally, the goal is to ensure that water is available at germination and in early development by applying light, frequent irrigations (if there is no rainfall). This method promotes vigorous growth and replenishes and increases available soil water content in the entire root zone during the pre-silking growth stages. Such a strategy will allow modern sprinkler irrigation systems to meet crop demand during the peak water-use period, which typically occurs during the silking and kernel-formation growth stages.

Crop-specific irrigation management strategies are usually applied to adjust for the following differences among crops:

- effective root zones
- sensitivity to water stress
- types (cool verses warm season)
- vulnerability to diseases at various crop growth stages
- response to soil fertility levels
- plant population/densities
- physiologic maturity (timing of last irrigation)
- potential income

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Silage corn water needs

Silage corn (maize) is a C4 (warm-season) crop, which means it requires both warm soil and high air temperature to grow steadily and achieve greater yield. Cool temperatures slow down the progress to corn maturity, whereas warm temperatures hasten maturity. Corn growth increases at increasing rates with maximum daily temperatures from 10 to 30°C, then at decreasing rates to 50°C.

Silage corn uses a significant amount of water for growth and cooling purposes. The water requirement for silage corn depends on variety, growth stage, canopy density, climatic conditions, and irrigation and crop management.

Typically, silage corn requires 500 to 550 mm of water per growing season when grown under optimum conditions (i.e. well-fertilized, well-irrigated, seeded in suitable row spacing, pest free, and uniform and optimum canopy with a plant population of 74,000 to 81,500 plants/ha or 30,000 to 33,000 plants/ac).

When silage corn is seeded into warm soils (greater than 10°C) with available water between 60 and 100 percent in early May in southern Alberta, silage corn will germinate, grow rapidly and reach a peak water use of approximately 7 mm per day around mid-July when the crop is nearing the end of the vegetative growth stage. The timing of crop growth stages will depend on crop variety/hybrid, seeding date, climate and other environmental factors. During the reproductive stages (tasseling/silking, blister and milk), the crop will require 4 to 7 mm per day (Figure1). Crop water use declines to 2 to 3 mm per day during ripening.

Typically, the roots of silage corn grow to an effective water extraction depth of 100 cm in a well-developed soil. Root distribution is concentrated near the surface; hence, silage corn obtains more than 70 per cent of its water from the upper 50 cm of the 100-cm active root zone. The active root zone changes from a few millimeters at emergence to a maximum depth of 100 cm at the tasseling and silking growth stages.

Irrigation scheduling strategy

Effective silage corn irrigation scheduling uses soil water levels in the root zone as a measure for starting and stopping irrigations. Adequate soil water is critical for silage corn during the emergence, vegetative (pre-tasseling), silking, and fruit-formation (i.e. blister, milk, and dough) growth stages.

Ideally, soil water content in the 0 to 50-cm depth should be greater than 60 per cent of readily available water at planting.

Silage corn needs to have water for germination and root development during the early stages of growth. If seeded in a dry seedbed (less than 60 per cent of available in the 0 to 50-cm depth) in early May before irrigation water is available, the first and subsequent irrigations (15 mm per

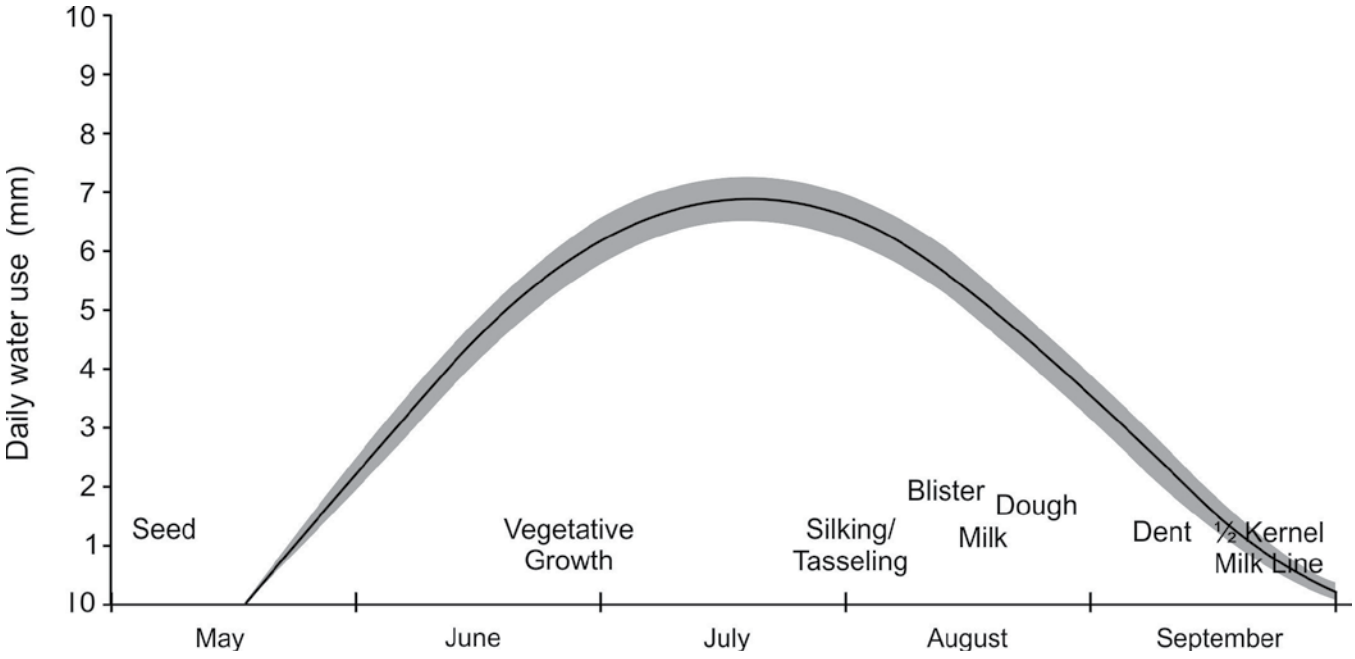

Figure 1. Daily water use during different growth stages of irrigated silage corn in southern Alberta. Shaded area indicates variation in silage corn water use depending on plant type, cultivar, and climatic conditions.

irrigation event) should be applied as soon as irrigation water is available. These irrigations should be light and frequent to maintain a moist soil surface to prevent crusting and encourage rapid emergence and early root development. Ideally, irrigation should be applied before seeding if dry soil conditions prevail.

If well-fertilized, a pest-free silage corn stand will reach maximum silage dry matter yield and quality if ample water is available in the root zone during the emergence, leaf production (vegetative), tasseling, and silking growth stages. To ensure that ample water is available to silage corn during the vegetative through silking growth stages, available soil moisture should not be depleted to less than 60 per cent in the upper 50 cm of the 100-cm root zone.

Any irrigation applied during the vegetative through silking growth stages should start when the available soil water is near 65 per cent of available to prevent the available soil water from being depleted to less than 60 per cent in the 0 to 50-cm depth. Maintaining available soil water above 60 per cent in the upper 50-cm depth during the vegetative through silking growth stages necessitates light and frequent irrigation applications.

Irrigation water applied during early growth stages should meet crop water requirements and build up soil water to near field capacity in the 50 to 100-cm zone to ensure that ample water is available for use during the peak water-use period (i.e. from late June to mid-August as in Figure1).

Silage corn is most sensitive to inadequate soil water during the tasseling and silking growth stages. Inadequate soil water during these stages results in moisture stress, which may desiccate silks and pollen grains, causing poor pollination, seed set, and barren ear tips; hence, poor silage yield and quality.

Silage corn roots reach maximum extension at the tasseling to silking growth stages. To ensure that soil water is adequate throughout the root zone during these stages, the monitoring depth of the root zone should be maintained at 50 cm and then increased from 50 to 100 cm at the blister kernel growth stage, and soil water should not be depleted to less than 60 per cent of available.

The timing of the last irrigation to refill the root zone for silage corn depends largely on the soil texture, prevailing weather conditions, and availability of irrigation water. The final irrigation to refill the root zone may be applied between the dough and dent growth stages, a week to 10 days before harvest.

A decision on the timing of corn silage harvest should be based on the actual whole plant (5-10 plants) silage moisture content. The whole plant moisture content at harvest should be between 62 and 70 per cent (ideally at 65 per cent moisture content or 35 per cent dry matter content). This target silage moisture content range at harvest results in better animal performance and lower feed costs.

Soil texture

Irrigation amounts required to replenish the root zone once the allowable soil water depletion level is reached will vary with soil texture and growth stage (Table 1).

Table 1. Soil texture-based estimation of total available water and water amounts per irrigation event for silage corn during the growing season.

Soil texture	50-cm root zone (vegetative, tasseling and silking growth stages)		100-cm root zone (blister, milk, dent, and half kernel milkline growth stages)	
	Total available water (mm)	Water required to replenish soil to field capacity at 40% allowable depletion (mm)	Total available water (mm)	Water required to replenish soil to field capacity at 40% allowable depletion (mm)
Loamy sand	57	**23**	114	**46**
Sandy loam	70	**28**	140	**56**
Loam	90	**36**	180	**72**
Sandy clay loam	76	**30**	152	**61**
Silt loam	100	**40**	200	**80**
Clay loam	100	**40**	200	**80**
Silty clay loam	110	**44**	220	**88**
Sandy clay	86	**35**	172	**69**
Silty clay	106	**43**	212	**85**
Clay	96	**39**	192	**77**

Conclusion

Using suitable irrigation strategies with silage corn can mean a healthy crop with high yield and quality potential. In addition to ensuring that the silage corn crop is well-fertilized and well-protected from pests, growers are encouraged to properly manage irrigation by regularly monitoring soil water to ensure that the availability of water does not become a limiting factor in producing a high-yielding silage corn crop.

Applying irrigation just before the available soil water is depleted to 60 per cent and replenishing available soil water near field capacity in the appropriate root zones will greatly assist in producing a high quality and high-yielding corn silage.

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