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Irrigation Scheduling for Timothy Hay 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 timothy hay 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, wind speed, and net radiation
- irrigation system capabilities and limitations

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

Depletion of soil water to less than 60 per cent of available can result in reduced timothy hay 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 for a healthy crop stand and replenishes and increases available soil water content in the entire root zone during the establishment year.

In the following years of production, applying light, frequent irrigations promotes vigorous spring growth, high yield, and a desired plant appearance. The aim of the light, frequent irrigation strategy is to replenish and increase available soil water content in the entire root zone.

Such a strategy will allow modern sprinkler irrigation systems to keep up to crop demand during the peak water use period, which typically occurs during the heading growth stage in late June-early July (for the first cut) and late August-early September (for the second cut).

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

- effective root zones
- sensitivity to water stress

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- types (cool versus 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

Timothy water needs

Timothy is a cool-season grass that is most productive during spring and early summer under cool, long day light conditions with abundant moisture. Timothy is more productive under a 21/16°C day/night combination than under warmer (27/21°C day/night) summer conditions. The optimum timothy growing condition is when daily high temperatures range from 15 to 21°C. As temperatures rise above 21°C, timothy tends to become dormant.

Re-growth after defoliation is variable and usually slower than the first cut crop due to high summer temperatures greater than 28°C. Because of the temperature differences between spring and summer, the first cut timothy hay crop uses water more efficiently and generally yields 50 per cent more than the second cut hay crop.

The water requirement or evapotranspiration (ET) for timothy hay depends on cultivar selection, growth stage, canopy density, harvest date, climatic conditions (especially temperature and photoperiod), and irrigation and crop management. Timothy uses water for growth and cooling purposes.

Timothy grown under optimal conditions (well-fertilized, well-irrigated, well-drained soils, pest-free stand, and uniform and optimum canopy) requires 500 to 550 mm of water per growing season in southern Alberta. The first cut hay crop consumes 60 per cent (300 to 330 mm) of the seasonal water use and the second cut hay crop consumes the remaining 40 per cent (200 to 220 mm).

Timothy needs to have water for germination and early growth. If available soil water is kept between 60 and 100 per cent, timothy will germinate and grow rapidly into a full stand in the year of establishment.

If available soil water is near field capacity and adequate and balanced fertilizer is applied the following spring, timothy will emerge from dormancy faster, and reach a peak water use of nearly 8 mm per day in late June for the first cut.

If adequately fertilized and fully irrigated immediately after the first cut, timothy will re-grow slowly in July. As the nights become cool in August, timothy will grow faster than in July and reach peak water use of 6 mm per day in late August for the second cut. The timothy peak water-use periods occur during the full head and the flowering growth stages in the production years (Figure 1).

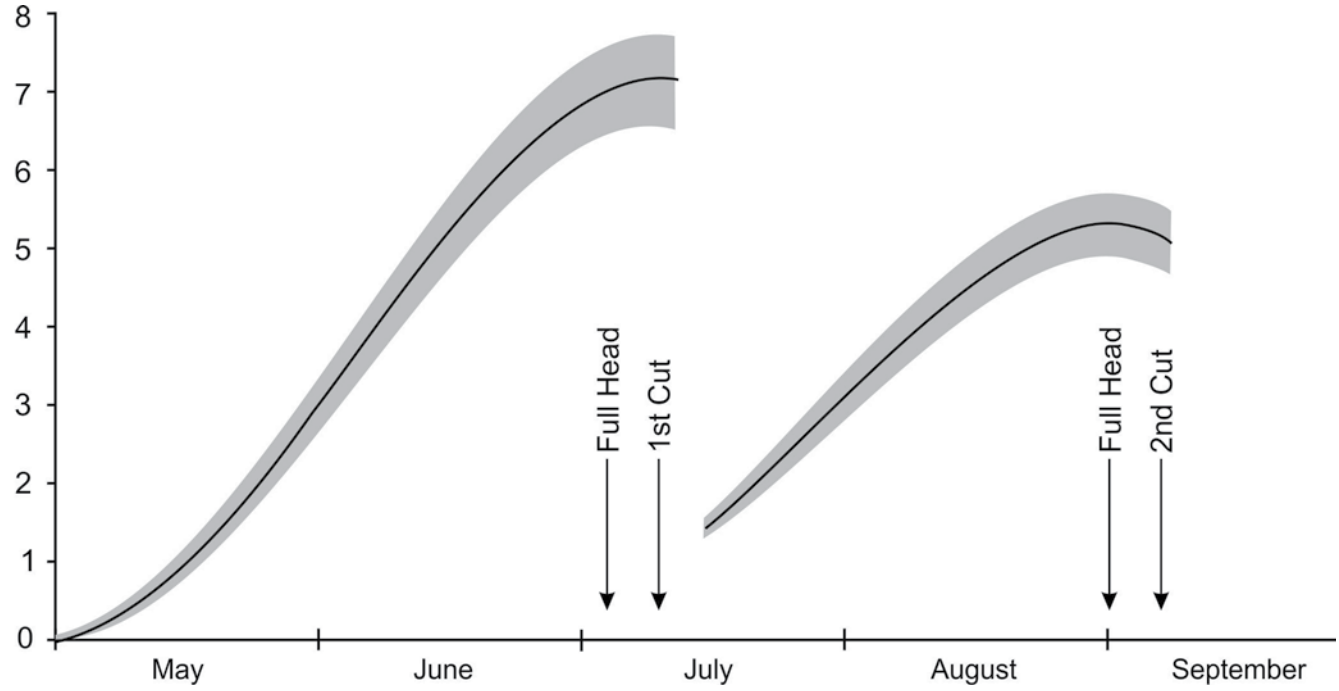

Figure 1. Daily water use for the first and second cuts during different growth stages of irrigated timothy hay in southern Alberta. The shaded area indicates the variation in timothy water use depending on cultivar, plant density, and climatic conditions.

Typically, the roots of timothy grow to an effective water extraction depth of 50 cm in a well-developed soil. Root distribution is concentrated near the surface; hence, timothy obtains nearly 70 per cent of its seasonal water from the upper 25 to 30 cm of the active root zone. The active root zone changes from a few millimetres at emergence to a maximum depth of 50 cm at the end of the establishment year.

Irrigation scheduling strategy

The availability of adequate soil water for emergence, stand establishment, and achievement of maximum, high quality yields is crucial for producing a profitable timothy hay crop.

Establishment year

The establishment of a high-yielding, pure timothy stand requires careful attention to fertilizer and irrigation water management. Effective irrigation management for timothy uses soil water levels in the root zone as a measure for starting and stopping irrigations to maintain adequate soil water.

Adequate soil water is critical for timothy during emergence and stand establishment in the year of establishment. Irrigations applied before emergence should maintain a moist soil surface to prevent crusting and encourage rapid emergence and early root development.

Ideally, soil water content in the 0 to 30-cm depth should be maintained at greater than 60 per cent of available during the emergence, early vegetative, tiller, and boot growth stages in the establishment year. This irrigation strategy results in light, frequent irrigations (12 mm per irrigation event) designed to recharge the 30-cm root zone. To prevent runoff, irrigation water application rates should not exceed soil intake (infiltration) rates.

Once timothy roots grow to the water extraction depth at the full head growth stage, the depth of root zone for irrigation should be increased from 30 to 50 cm. Irrigations should be scheduled to maintain soil water at greater than 60 per cent and to fill the 0 to 50-cm depth to field capacity at the early heading growth stage and during the remainder of the growing season.

If timothy is seeded without a companion crop, weed control using a combination of chemical and cultural methods should be used to increase soil water availability to the young timothy stand during the early stages of growth. Mowing just above the timothy plants to prevent annual weeds from smothering the timothy seedlings is one of the best weed management practices for efficient timothy water use. The final mowing should be done in the fall to a height of 10 cm to prevent damage to the corms (bulbs).

Full irrigations should always be applied immediately after weed removal by mowing or early silage harvesting of a companion crop and in the fall prior to overwintering.

Production years

Effective first cut and second cut timothy irrigation scheduling uses soil water levels in the 50-cm root zone as a measure for starting and stopping irrigations. Adequate soil water, coupled with a balanced and adequate plant fertility program, is critical for timothy growth for high yield and quality.

If well-fertilized, a pest-free timothy stand will reach maximum yield and quality if ample water is available in the root zone during the spring and summer growing periods during production years. To ensure that ample water is available to timothy for spring and summer growth, available soil water should not be depleted to less than 60 per cent in the 50-cm root zone. Any irrigation applied 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.

Irrigations should be scheduled to fill the entire root zone to 100 per cent of available soil water. A full irrigation coupled with split nitrogen fertilizer application (about 60% of the spring application) is also required just after the first cut harvesting is completed in early July. Irrigation scheduling for the second cut crop should also maintain available soil water at greater than 60 per cent in the 50-cm root zone. The final irrigation should be applied just after the second cut harvest to fill the root zone to 100 per cent of available soil water in early September.

Soil texture

Irrigation amounts required to replenish the 50-cm root zone once the allowable soil water depletion level is reached (available water at 60 per cent) will vary with soil texture (Table 1).

Table 1. Soil texture-based estimation of total available water and water amounts per irrigation event for timothy during the timothy growing season in the hay production years

Soil texture	Total available water in a 50-cm root zone (mm)	Water required to replenish soil to field capacity at 40% allowable depletion (mm)
Loamy sand	57	23
Sandy loam	70	28
Loam	90	36
Sandy clay loam	76	30
Silt loam	100	40
Clay loam	100	40
Silty clay loam	110	44
Sandy clay	86	35
Silty clay	106	43
Clay	96	39

Conclusion

Using suitable irrigation strategies with timothy can mean a healthy hay crop with high yield and quality potential. In addition to ensuring that the timothy hay 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 yield and the desired plant appearance (green color) of the timothy hay crop.

Applying irrigation just before the available soil water is depleted to 60 per cent and replenishing available soil water to near field capacity in the appropriate root zones will greatly assist in achieving a healthy stand during the establishment year and in producing a high-yielding and high-quality timothy hay crop.

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