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Irrigation Scheduling for Potato in Southern Alberta

Irrigation management is about controlling the rate, amount, and timing of applied irrigation water in a planned and efficient manner. With the best irrigation management practices, a potato crop can achieve high tuber 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 and efficient irrigation scheduling program.

Strategies

A workable and efficient irrigation management strategy should be crop-specific.

Depletion of available soil water to less than 65 per cent of available can result in reduced marketable tuber yield.

Crop-specific irrigation management strategies mean available water is used efficiently to meet a specific crop's water requirements for maximum water productivity.

With potato, the goal is to ensure that water is available during tuber initiation and in early tuber 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 for later use during the peak water use period, which typically occurs during the flowering and tuber bulking growth stages. Such a strategy will allow modern sprinkler irrigation systems to keep up to crop demand during the peak water use period.

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 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

Potato water needs

Potato uses water for growth and cooling purposes. The water requirement or evapotranspiration (ET) for potato depends on variety, growth stage, canopy density, climatic conditions, and irrigation and crop management.

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Potato grown under optimal conditions (well-fertilized, well-irrigated, well-drained soils, pest-free stand, and uniform and optimum canopy) requires about 400 to 550 mm of water per growing season in southern Alberta.

Potato roots grow to an effective water extraction depth of 60 cm and obtain 70 per cent of the plants' seasonal water from the upper 30-cm depth.

Water use rates for potato begin at about 0.4 mm per day when the crop sprouts (emerges) and increase to as high as 7 mm per day (Figure 1) when the potato canopy completely shades the ground and tubers are bulking. Potato water demand decreases as the crop achieves full tuber bulking and maturation.

Irrigation scheduling strategy

Effective potato irrigation scheduling uses soil water levels in the root zone as a measure for starting and stopping irrigations. Potato is more sensitive to soil water deficits than cereals and forages; therefore, an allowable depletion of 35 per cent of available (i.e. available moisture maintained between 65 and 100 per cent) is typically used to trigger irrigations.

This narrow range of soil water content, coupled with the practice that potato is grown on soils with low to medium water-holding capacities, requires potato growers to closely monitor soil water and have reliable sprinkler irrigation systems that are capable of applying light, frequent, and uniform irrigations during the growing season.

The practice of reservoir tillage, or dammer dyking, is also recommended to impede runoff and increase the uniformity of soil water content across a potato field.

Potato needs to have adequate and consistent soil water during most of its growth stages: sprouting, vegetative, tuber initiation (tuber set), tuber bulking, and maturation growth stages. To discourage damage to potato seedpieces caused by various soil disease organisms, it is recommended that producers avoid applying irrigation between planting and emergence.

Potato is most sensitive to water stress during the tuber initiation growth stage; therefore, special care should be taken to start irrigating when soil water in the top half of the root zone (0 to 60-cm depth) is near 70 per cent of available. This practice increases the number of tubers per plant.

Irrigations applied during early growth stages should meet the crop water requirement and recharge the root zone for use during the peak water use period when tubers are bulking (Figure 1).

Soil water should also be maintained between 65 to 100 per cent of available during the tuber bulking growth stage. Soil water levels outside this desirable range at this growth stage will reduce marketable tuber yield and contribute to growth deformities (such as hollow heart, knobbiness, and cracks) and disease development.

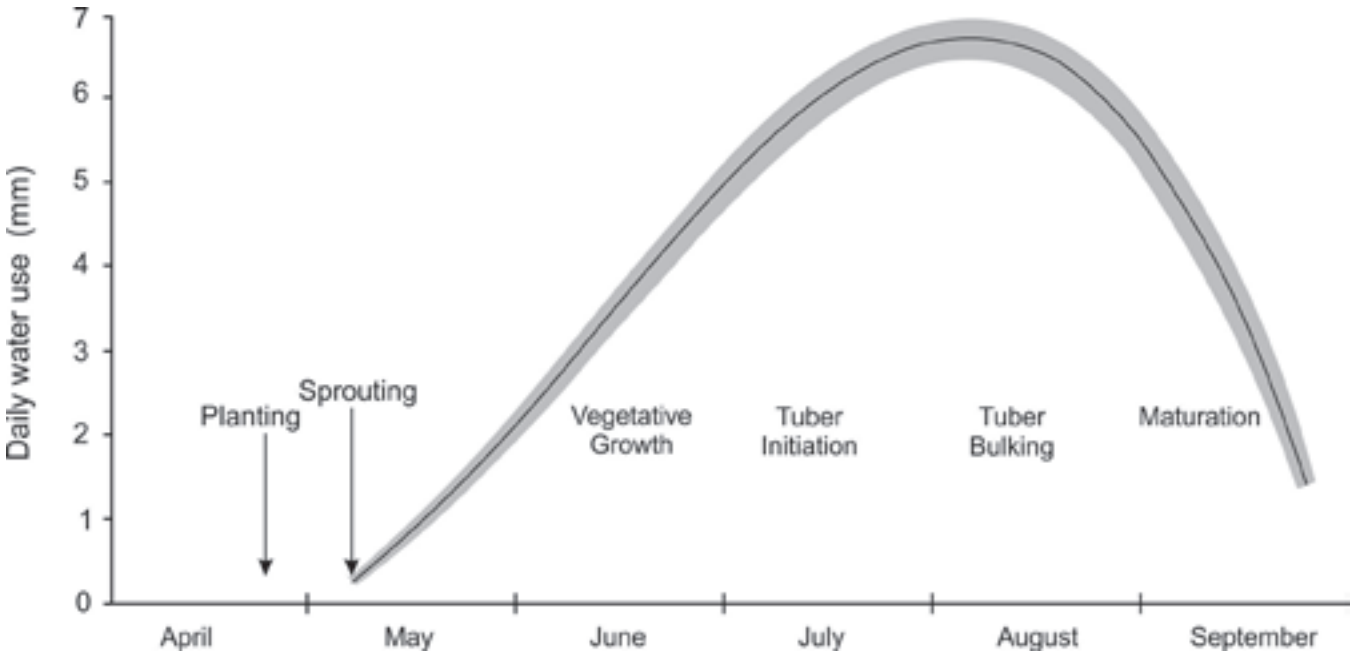

Figure 1. Daily water use during different growth stages of irrigated potato in southern Alberta. Shaded area indicates variation in potato water use depending on cultivar and climatic conditions.

Peak water use for potato approaches nearly 7 mm per day during the full flower and tuber bulking growth stage. Demand begins to decrease from late tuber bulking to maturation.

Available soil water in the root zone should be kept near 65 per cent during maturation for ease of digging during harvesting. Harvesting when the soil water is less than 65 per cent of available may increase tuber damage.

The timing of the final irrigation will depend on the potato end use and potato variety. Tuber sizes for some table varieties can be regulated by controlling soil water levels during bulking. Thus, irrigation should be stopped based on the desired tuber size determined by the marketplace.

Soil texture

The irrigation amounts at each irrigation event during the growing season will vary with soil texture and growth stage (Table 1).

Conclusion

Using optimal irrigation strategies with potato can mean a healthy crop with high marketable yield potential. In addition to ensuring that the potato 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 potato crop.

Applying irrigation just before the available soil water is depleted to 70 per cent (i.e. 30 per cent allowable depletion) during tuber initiation and 65 per cent (i.e. 35 per cent allowable depletion) for other growth stages, and replenishing available soil water near field capacity in the root zone will greatly assist in producing a high-quality and high-yielding potato crop.

Prepared by

Alan Efetha
Alberta Agriculture and Rural Development

For more information, contact

Alberta Ag-Info Centre
Call toll-free 310-FARM (3276)

Website: www.agriculture.alberta.ca

Table 1. Soil texture-based estimation of total available water and water amounts per irrigation event for potato during vegetative, tuber initiation, tuber bulking, and maturation growth stages

Soil texture	Tuber initiation growth stage		Vegetative, tuber bulking, and maturation growth stages	
	Available water in a 30-cm root zone (mm)	Water required to replenish soil to field capacity from 70% of available water (mm)	Available water in a 60-cm root zone (mm)	Water required to replenish soil to field capacity from 65% of available water (mm)
Loamy sand	34	**10**	68	**24**
Sandy loam	42	**13**	84	**29**
Loam	54	**16**	108	**38**
Sandy clay loam	46	**14**	91	**32**
Silt loam	60	**18**	120	**42**
Clay loam	60	**18**	120	**42**
Silty clay loam	66	**20**	132	**46**
Sandy clay	52	**16**	103	**36**
Silty clay	64	**19**	127	**44**
Clay	58	**17**	115	**40**

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