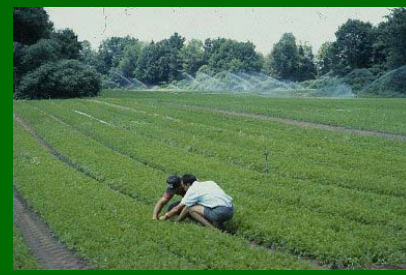




HORT MATTERS



OMAFRA SPECIALISTS IN HORTICULTURE AND SPECIALTY CROPS

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Impact of Dry Conditions on Potato Yield

Eugenia Banks - Potato Specialist

Potatoes are a cool weather crop that require about an inch of water a week to produce the highest possible yield. There are two main reasons that potatoes are more sensitive to water stress than most other crops:

- **A shallow root system:** Potatoes have a relatively shallow root system with most of the roots in the top 12 inches of soil.
- **Soil type:** potatoes do well in sands and sandy loams, soils that have low to medium water-holding capacity.

High yields of high-quality potatoes can only be achieved by maintaining high levels of available soil moisture throughout the growing season. Without regular rainfall, frequent irrigation is necessary. Soil moisture becomes critical when the available soil water drops below 60-65 per cent. The impact of water stress will depend on the severity, timing and duration of moisture stress.

The table below shows the crop growth stages of potatoes and the amount of available water required for a high yield of good quality potatoes. Research in the US has shown that yield losses will occur if available soil water drops below required levels for more than five days.

Growth Stage	Soil Available Water Requirement	Yield Losses If Available Water Below Required Levels
Growth Stage I Sprout Development	75% available soil water	Short periods of drought stress do not reduce yield
Growth Stage II Vegetative Growth	75% available soil water	5%
Growth Stage III Tuber Initiation	80% available soil water	10%
Growth Stage IV Tuber Bulking	90% available soil water	40-60% Highest demand for water. Adequate water is necessary for high yield. Dry conditions favour tuber malformations
Growth Stage V Tuber Maturation	60-65% available soil water	Water deficit causes tuber dehydration

If there is insufficient rainfall, irrigation is required to keep the available soil water in the root zone above the allowable depletion level. This ensures that the crop will not suffer water stress and will produce maximum yield.

For more information on dry conditions and low water visit our website at www.ontario.ca/crops and click on the Adverse Weather button.

Tracing Irrigation Water with Blue Dye and a Shovel

Peter Zwart – Horticulture Nutrition

The Vegetable Open House at the Simcoe Research Station provided us with an opportunity to use blue dye to see where the irrigation water goes. A drip irrigation system under plastic was set up in a pepper crop. The drip tape had 0.23 U.S. gallons per hour emitters spaced at 12". We used a Dositron™ fertigation injector to add Blazon™ dye to the irrigation water. We then ran the system for 1, 2, 3, 4, and 6 hours to show the effect of various irrigation times on water distribution in the soil. The results are pictured on the right.

What you can't tell from the pictures is that the top 6" of soil was fairly loose, corresponding to tillage depth. This also happened to be where the majority of the pepper roots were. Below this layer, the soil was more dense. You can see this in the 1 and 2 hour photographs on the right, where the looser layer of soil is dry. The dryness and the pattern of blue dye indicate that 2 hours of irrigation does not wet the entire soil volume of the rooting zone.

At 3 hours, the soil volume of the upper layer was entirely wetted and the blue dye from the emitters had spread laterally and almost met. It appears that the actual wetting front was a bit ahead of the blue dye, indicating a small amount of binding of the dye to the soil. The dye is mostly held in the upper layer, with just a few fingers breaking into the lower layer. This is a nice demonstration of water following the path of least resistance. It doesn't move into the more dense layer until the top layer is full, and the water has nowhere else to go.

At 4 hours and beyond, a significant amount of water was leaching into the lower layer, below the root zone and out of reach of the crop. Three hours appears about optimum in this case.

Before we start making too many generalizations, let's think about some of the factors affecting optimum irrigation system run-time. There is irrigation frequency, emitter volume and spacing, crop stage, crop type, crop rooting depth, and soil factors. Of course there is the weather which is less important if the crop is grown under plastic as was the case at this site.

How then, do we sort through all these factors and figure out how long to run the system? One of the sensor-based technologies would work well here. A sensor placed in the root zone close to an emitter would tell you when to turn the system on because it's getting dry. Another sensor placed just below the tilled layer would tell you when to turn the water off because it's leaving the rooting zone. If you prefer a low-tech, low-cost, show-me approach, a regular soil probe can be used.



After the irrigation system starts, every hour you can pull a soil core from the area beneath a few emitters. Tap the soil out of the probe onto a piece of paper or plastic and find the depth of the wetting front. You should be able to find it either by the colour change or by feel. If you do this through a few irrigation cycles, you'll soon get a good idea of how long you should run the system to get the water down to the right depth for your particular situation.

In this pepper field, normal irrigation time was 4 hours. A 25% savings in water, energy, and fertigation nitrogen costs could be seen by using one of these monitoring techniques. On the other hand, under-irrigating could be costing you in reduced yield and quality, for instance from calcium deficiency disorders. It might be worth the time to pencil out a few of these scenarios and get an idea of whether you can afford **not** to have some sort of monitoring method in place.

Effects of Dry Conditions on the Tomato Plant

Janice LeBoeuf - Vegetable Crop Specialist

Field tomatoes are a long season crop with high water requirements. An average cultivar requires about 40 cm (15.7 in) of water over the growing season, with the need for moisture increasing until full fruit load is developed. The most critical times for moisture are during flowering, fruit set, and fruit sizing.

When tomatoes experience moisture stress:

- fewer flowers develop per truss, lower numbers of fruit are set (lower yield)
- total soluble solids increase (higher soluble solids means higher recovery in the processing plant and generally improved taste of fresh or processed tomatoes)
- fruit size decreases (lower yield; may result in unmarketable fresh market fruit and greater harvest loss in mechanical harvesting of processing tomatoes)
- blossom-end rot increases and loss can be significant in susceptible varieties (affected fruits are unmarketable; can lead to black specks and high mould counts in processed product; if severe, loads or fields of processing tomatoes can be rejected; Agricorp offers a salvage benefit for processing tomato fields severely affected by blossom-end rot)
- plant canopy temperature increases (an additional stress to the plant; associated with reduced transpiration and photosynthesis therefore reduced growth; at fruit temperatures above approximately 30°C, development of red colour is inhibited)

Tomatoes are more tolerant of moisture stress than crops such as pepper and cucumber. They can adjust their physiological processes to conserve water while maintaining some growth. Early exposure to moisture stress makes the plant more tolerant of moisture stress later in the season. While this allows the tomato plant to survive where some crops would suffer irreversible damage, prolonged water stress does reduce yield as the plant uses energy to make these adaptations.

Although the plant can survive dry conditions, optimal yield and quality will not be achieved. Irrigation of tomatoes can result in higher and more consistent yields, better quality, less blossom-end rot, and less cracking.

Fields with good soil structure and higher organic matter will hold more moisture and allow roots to penetrate better. Compacted layers will limit the spread of roots. In tomato, 85 per cent of the root system is typically in the upper 30 cm (12 in) of soil, but tomato roots can extend beyond 1 m (39 in) in depth. Cover crops can be grown and the residue used to mulch the soil, reduce water loss, and moderate soil temperatures. However, this requires advance planning and could have a detrimental effect in a wet spring. In irrigated fresh market tomato production, plastic mulches can be used to conserve water. Minimizing tillage can also reduce moisture loss.

In the early 1980s, Dr. C.S. Tan at Agriculture and Agri-Food Canada found that the marketable yields of processing tomato were directly related to seasonal evapotranspiration (ET; plant water consumption). Below 88 mm of ET, tomato produced no marketable yield on a Fox sandy loam. Above 88 mm, yield increased linearly, to an optimum when 300-400 mm of water was available to the crop.

Optimum seasonal ET would be expected to be higher with current higher yielding varieties and production practices. Recent research on processing tomatoes in Ontario has shown yield increases of up to 81 per cent on a range of soil types with the use of properly scheduled irrigation. However, under dry conditions irrigation is most critical on the lighter textured soils with low water holding capacity. It is estimated that approximately 40 -50 per cent of the processing tomato acreage is being irrigated in 2007.

For more information on dry conditions and low water go to the OMAFRA Adverse Weather page.