Water Conservation
FACTSHEET

BRITISH COLUMBIA
Ministry of Agriculture, Food and Fisheries

Order No. 619.000-1
Revised February 2002
Agdex: 550

SOIL WATER STORAGE CAPACITY AND AVAILABLE SOIL MOISTURE

SOIL WATER STORAGE

For irrigation the soil water storage (SWS) capacity is defined as the total amount of water that is stored in the soil within the plant's root zone. The soil texture and the crop rooting depth determine this. A deeper rooting depth means there is a larger volume of water stored in the soil and therefore a larger reservoir of water for the crop to draw upon between irrigations.

Knowing the soil water storage capacity allows the irrigator to determine how much water to apply at one time and how long to wait between each irrigation. For example, the amount of water applied at one time on a sandy soil, which has a low soil water storage capacity, would be less than for a loam soil, which has a higher soil water storage capacity. This is assuming the crop's rooting depth is the same for both soils. Applying more water to the soil than can be stored results in a loss of water to deep percolation and leaching of nutrients beyond the root zone.

Only a portion of the total soil water is readily available for plant use. Plants can only extract a portion of the stored water without being stressed. An availability coefficient is used to calculate the percentage of water that is readily available to the plant. The maximum soil water deficit (MSWD) (also referred to as the management allowable deficit) is the amount of water stored in the soil that is readily available to the plant. The crop should be irrigated once this amount of moisture has been removed from the soil. Once depleted this is the amount that must be replenished by irrigation. It is also the maximum amount that can be applied at one time, before the risk of deep percolation occurs. However, in some cases leaching of salts is desirable and extra irrigation would be desired.

IRRIGATION

Sprinkler irrigation system operation allows the soil moisture to deplete up to the maximum allowable depletion and then refills the soil profile up to field capacity. The irrigation interval is determined by how long it takes the soil water storage to be depleted to the maximum allowable depletion. The irrigation interval can be a number of days or weeks depending on the climate.

Drip irrigation systems are designed and operated to keep the soil moisture content at a level above the maximum allowable depletion by applying water very frequently. An allowable depletion of 25% should be used for agricultural drip systems and 30% for landscape systems.

HOW TO DETERMINE THE SOIL WATER STORAGE AND THE MAXIMUM SOIL WATER DEFICIET

Step 1 Determine the crop rooting depth, RD (m), Table 1
Step 2 Determine the available water storage capacity of the soil, AWSC (mm/m), Table 2
Step 3 Calculate the total soil water storage, SWS (mm)

SWS (mm) = RD (m) x AWSC (mm/m) **(Equation 1)**

Step 4 Determine the availability coefficient of the water to the crop, AC (%), Table 3
Step 5 Calculate the maximum soil water Deficit, MSWD (mm)

MSWD = SWS (mm) x AC (%) **(Equation 2)**

Table 1

Effective Rooting Depth of Mature Crops for Irrigation System Design			
Shallow 0.45 m (1.5 feet)	**Medium Shallow** 0.60 m (2 feet)	**Medium Deep** 0.90 m (3 feet)	**Deep** 1.20 m (4 feet)
Cabbages	Beans	Brussels Sprouts	Asparagus
Cauliflower	Beets	Corn (sweet)	Blackberries
Cucumbers	Blueberries	Eggplant	Grapes
Lettuce	Broccoli	Kiwifruit	Loganberries
Onions	Carrots	Peppers	Raspberries
Radishes	Celery	Squash	Sugar Beets
Turnips	Potatoes	Saskatoons	
	Peas		
	Strawberries		
	Tomatoes		
	Tree Fruits (spacing 1m x 3m)	Tree Fruits (spacing 2m x 4m)	Tree Fruits (spacing 4m x 6m)

Table 2

A Guide to Available Water Storage Capacities of Soils			
Textural Class	**Available Water Storage Capacity (AWSC)** (in. water / in. soil)	(in. water / ft. soil)	(mm water / m soil)
Clay	0.21	2.5	200
Clay Loam	0.21	2.5	200
Silt loam	0.21	2.5	208
Clay loam	0.20	2.4	200
Loam	0.18	2.1	175
Fine sandy loam	0.14	1.7	142
Sandy loam	0.12	1.5	125
Loamy sand	0.10	1.2	100
Sand	0.08	1.0	83

Table 3

Availability Coefficients	
Crop	**Maximum Percent (%)**
Peas	35
Potatoes	35
Tree Fruits	40
Grapes	40
Tomatoes	40
Other crops	50

SOIL WATER TERMINOLOGY

Available soil moisture
Is the difference between the amount of water in the soil at field capacity and the amount at the permanent wilting point. Referred to as the available water storage capacity in Table 2.

Saturation
Occurs when all the voids in the soil are completely filled with water. Although there is plenty of water available to the crop at saturation, water uptake is seriously curtailed by the lack of oxygen in the soil at soil water contents greater than field capacity.

Soil texture
Refers to the relative percentage of sand, silt and clay sized particles in the soil material.

Soil structure
Structure is the arrangement of soil particles and soil aggregates into recognizable particles or lumps. Aggregates occur in almost all soils, but their strength, size and shape varies between soil typed.

Deep percolation
Water that drains beyond the plant root zone.

Field capacity
The water content of the soil where all free water has been drained form the soil through gravity. Sandy soils may drain within a few hours but fine textured soils such as clay may take a few days to drain. Proper irrigation brings soil moisture up to filed capacity.

Permanent wilting point (PWP)
The soil moisture content at which the plant will wilt and die. While there still may be water in the soil, the plant is not able to extract sufficient water from the soil to meet it's needs.

Maximum soil water deficit (MSWD)
Only a portion of the available water is easily used by the crop. The maximum soil water deficit is the amount of water stored in the plant's root zone that is readily available to the plant. To prevent plant water stress an allowable depletion factor is used to calculate the manageable allowable depletion. This factor varies but is usually around 50%.

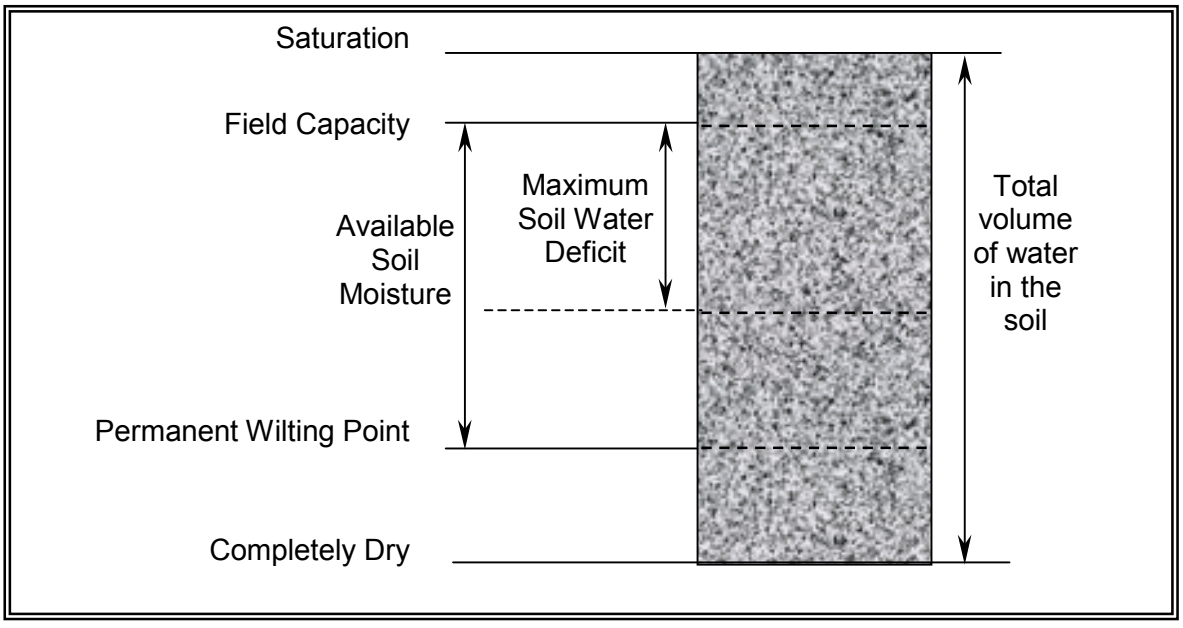


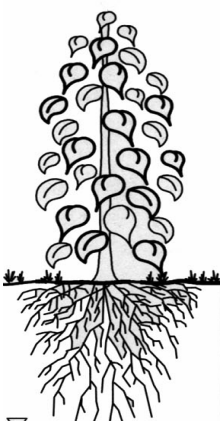
Figure 1 Soil Water Moisture Terms

Example:

For a mature corn crop in a loamy sand soil.

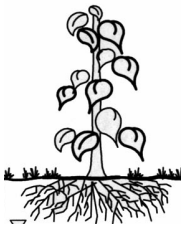
Rooting depth (Table 1)	= 0.90 m
Soil Water Storage Capacity (Table 2)	= 100 mm/m
Availability coefficient (Table 3)	= 50%

SWS = 0.90 m x 100 mm/m = 90 mm (Equation 1)
MAD = 90 mm x 50% = 45 mm (Equation 2)



For the same crop in the early summer the rooting depth may be only 0.3 m, therefore:

SWS = 0.30 m x 100 mm/m = 30 mm (Equation 1)
MAD = 30 mm x 50% = 15 mm (Equation 2)



When irrigating the mature crop more water is needed to fill the root zone.
When the crop is immature the irrigation amount required will be less.

FOR FURTHER INFORMATION CONTACT
Janine Nyvall, Water Management Engineer
Phone: (604) 556-3113
EMail: Janine.Nyvall@gems5.gov.bc.ca

RESOURCE MANAGEMENT BRANCH
Ministry of Agriculture, Food and Fisheries
1767 Angus Campbell Road
Abbotsford, BC CANADA V3G 2M3