Note: 198

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Department of Agriculture and Food

Farmnote

Calculating Readily Available Water

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To schedule your irrigation with confidence you need to understand how much water your soil can hold that is available to your crop.

The soil surrounding a plant's roots stores the water it needs to live, grow and produce a crop. This water is held by the soil with increasing strength as the soil dries out.

Have a close look at the below figure, it shows the relationship between crop stress and the amount of water held in the soil.

Field Capacity is the maximum amount of water a soil can hold after drainage. **Refill Point** is the point at which the plant has used all water that is *readily available*. Beyond Refill Point, as the soil dries out, the plant needs to work a lot harder to extract water, placing stress on the crop. The area between Field Capacity and Refill Point is called *Readily Available Water (RAW)* - water stored in the soil that is easily extracted by the plant.

Unless you are trying to stress your crop (e.g. deficit irrigated wine grapes) you should aim to maintain *RAW* at all times.

The amount of *Readily Available Water* available to your crop will vary with **soil type**, **crop type**, crop **rooting depth** and **irrigation system**.

Follow the steps on the next few pages to work out your crops RAW.

Steps in identifying Readily Available Water

Step 1: Dig a hole

Dig a hole within the root zone of your crop. For perennial crops dig within the drip line in an area watered by the irrigation system. Try to dig to 1 metre or at least 30 cm past the main root zone (where the fibrous roots are).

Figure 2: Digging a hole (soil pit) in the root zone of a drip irrigated mandarin crop

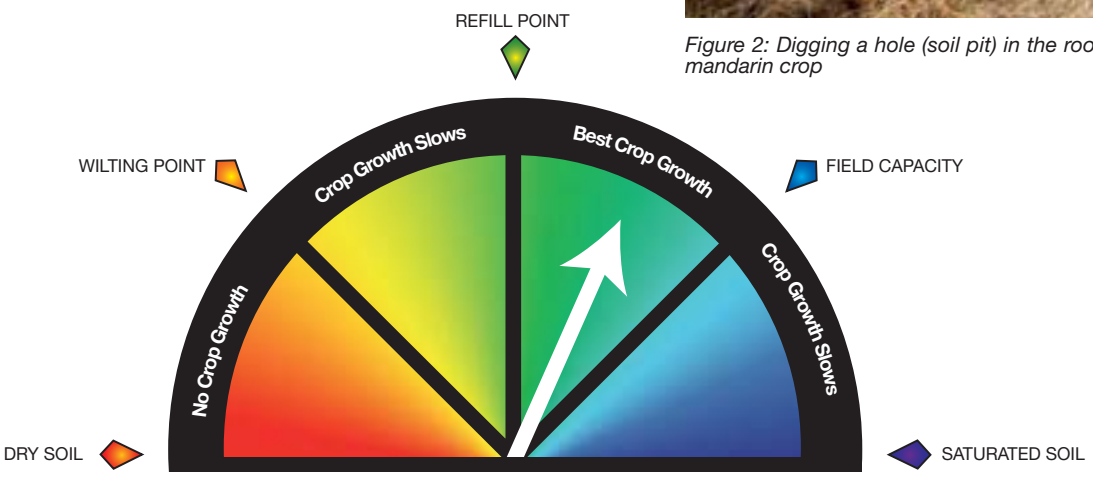
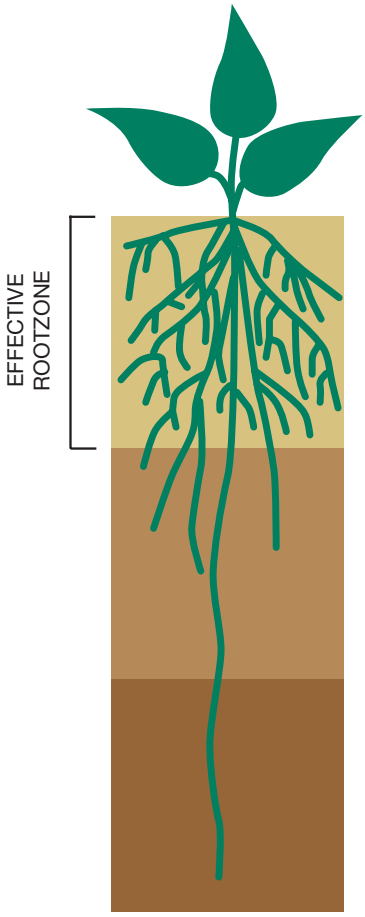


Figure 1: Relationship between soil water and crop stress

Step 2: Identify the effective root zone

The effective root zone is the area where the main mass of roots is found. This is typically one to two thirds the depth of the deepest roots. Some crops, such as irrigated pasture, citrus, bananas, avocados and low chill stone fruit, develop a mass of shallow roots with only a few roots penetrating deeper into the soil.

Figure 3: the fibrous effective root zone of a citrus tree can be seen in this soil pit in the top 0.3 meters



Step 3: Identify different soil layers

If there are different soil layers within your effective root zone measure the depth of these and calculate the thickness of each layer in metres.

Step 4: Identify % gravel/stone in each layer

Stone and gravel reduce the amount of water that can be held by a soil. A very stony soil will hold much less water than the same soil without stones. Grab three good handfuls of soil and using a 2 mm sieve remove all stone and gravel. Place the pile of stones and gravel next to the pile of soil and visually estimate the percentages of each (eg. 60% stone and 40% soil).

Figure 4: sieved soil showing the separation between soil and gravel components

Step 5: Identify soil texture(s)

Identify the texture of each soil layer within the effective root zone. The amount of water held by a soil and available to a plant varies with soil texture (see Table 1). for example, a loamy soil can hold more water that is readily available than a sandy soil.

Soil texture can be assessed in the field by the feel of a moist soil sample when worked between the thumb and forefinger. See Note 206 Soil texturing for details on how to texture your soil.

Figure 5: Forming a soil ribbon to identify soil texture

Table 1: Effect of Soil Texture on Readily Available Water Content

WaterTension*	To –20 kPa	To –40 kPa	To – 60 kPa	To –100kPa
	A	B	C	D
	Water-sensitive crops such as vegetables and some tropical fruits should be irrigated.	Most fruit crops and table grapes, most tropical fruits.	Lucerne, most pasture, crops such as maize and soybeans, and grapes**	Annual pastures and hardy crops such as cotton, sorghum and winter crops
Soil texture	Readily Available Water RAW (mm/m)			
Sand	30	35	35	40
Loamy Sand	45	50	55	60
Sandy loam	45	60	65	70
Loam	50	70	85	90
Sandy Clay Loam	40	60	70	80
Clay loam	30	55	65	80
Light clay	25	45	55	70

**Tension is 0 kPa at saturation point. The figures are only approximate.*
***Except when partial rootzone drying is being practised on wine grapes*

Step 6: Calculate your RAW

Step 1: Identify the depth of the effective root zone.

Step 2: Identify the depth of different soil layers within the effective root zone

Step 3: Determine the soil texture and % stone/gravel of each layer

Step 4: Select the crop water tension group from Table 1 and identify the RAW value for each soil texture/layer (mm/m)

Step 5: Reduce the RAW figure(s) by the % stone/gravel in the soil

Step 6: Multiply the thickness of each soil layer by its adjusted RAW value

Step 7: Add up the RAW for each soil layer to obtain the total root zone RAW

Example Calculation:

A citrus crop growing in a sandy loam soil containing 20% stone, with an effective root depth of 0.3 m and a strategy to irrigate at -40 kPa would have the following calculations.

From Table 1, the RAW for a sandy loam soil at -40 kPa = 60 mm/m

As the soil contains 20% stone we must reduce the RAW by 20%. To reduce RAW by 20%, multiply by 0.8.

Adjusted RAW = 60 mm/m x 0.8 = 48 mm/m

Hence, for a rooting depth of 0.3 m

Total Root zone RAW = 48 mm/m x 0.3 m = **14.4 mm**

If your irrigation system wets the entire cropped area you can use this figure (RAW mm) to schedule your irrigations. See Farmnote 23/1990 *'Irrigation Scheduling How and Why'*

If you irrigate with a drip or micro spray system that does not wet the entire cropped area you need to convert RAW mm to RAW Litres. See Note: 196 *'Converting RAW (mm) to litres for Drip Systems'*

Related farmnotes

Note: 206 Soil texturing: Procedure for field texturing soils

Note: 196 Converting Readily Available Water (mm) to litres for Drip Systems

Farmnote 23/1990 Irrigation Scheduling How and Why

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