Food and Agriculture Organization of the United Nations

Technical Fact Sheet

Water and irrigation management

6

Introduction

Plants need water to grow and thrive – to dissolve elements, transport and absorb nutrients, produce energy and maintain the temperature on the surface of their leaves.

To determine the optimal amount and frequency of water supply or application for a given crop, it is important to understand how different factors affect water demand across each phase of the crop's development. The goal is to ensure the growth of an optimum root system and to stimulate good nutrient absorption, thus resulting in high productivity from vigorous and healthy crops. Hydric stress caused by over- or underwatering must be avoided.

The most common sources for irrigation water are rivers, groundwater, springs, rainwater catchment, desalinated seawater and treated wastewater. Regardless of the source, it is essential to determine the chemical properties of the water, such as pH and salinity, for better irrigation and nutrition management.

Key factors to consider

Climate

Climate and weather – including rain, radiation, temperature, humidity and wind – affect levels of water evaporation and transpiration (evapotranspiration), and consequently affect water requirements for optimized crop growth and development.

Crop type

Water requirements vary depending on transpiration rates; they are also influenced by the type of crop or produce (e.g. bulbs, leaves, fruits, flowers or tubers) and plant size (e.g. foliage and roots).

Crop stage

Crops have different water needs depending on the crop's stage of growth or development, being lower in the early stages and increasing gradually as roots and foliage develop.

Soil type

A soil's texture affects its water holding capacity. The sandier the soil, the lower its capacity to retain water and the more frequently it will require irrigation.

Figure 1. Crops with differently sized foliage – the larger the leaves, the more water needed

Irrigation and plant nutrition

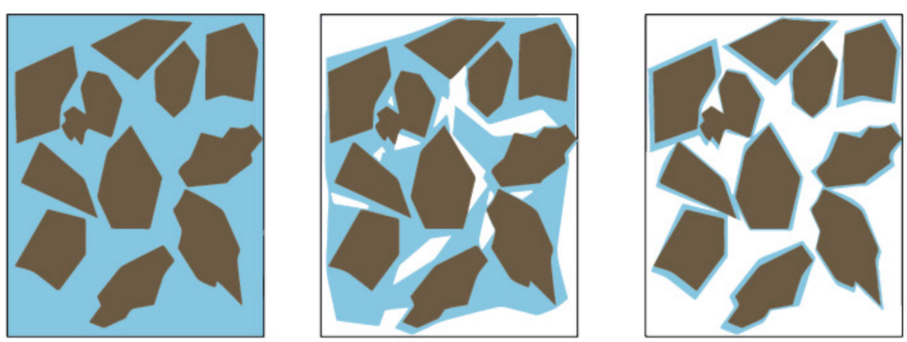
The link between water and nutrition management is fundamental, as soil nutrients must be dissolved in water for plant roots to absorb and transport them. Nutrients that are supplied through fertilizers must be dissolved in soil water so as to be accessible to plants, and if irrigation management is inadequate in this regard, the plants may show symptoms of nutritional deficiencies. When growing crops in soilless substrates or hydroponics systems, good water and nutrient management is even more critical.

Fertigation is a technique that allows water and nutrients to be supplied at the same time, resulting in greater efficiency in the use of fertilizers. Nutrients are dissolved in water before application, resulting in increased absorption, as well as quicker corrections in response to any potential imbalances or nutritional deficiencies.

Water quality and nutrition are also closely linked. If the pH of the water is not at the proper level, the availability and absorption of nutrients will be compromised, and crop yield may suffer.

Irrigation and root development

Good water management enables good root development, which increases the plants' capacity to absorb nutrients and water, resulting in higher yields. To develop properly, roots require soil that has an optimal balance of moisture and oxygen. This balance occurs at field capacity – which is when the soil is neither overwatered or saturated on the one hand (as this causes a lack of oxygen and increases the risk of soil-borne diseases), nor underwatered or at risk of reaching wilting point on the other (in which case water and nutrients are no longer available and absorption is reduced).



Saturation

All pores are full of water.
No oxygen and nutrients available

Field capacity

Oxygen, water and nutrients available

Wilt point

No water and nutrients available

Figure 2. Water management scenarios for saturation, field capacity and wilting point

In vegetable crops, root development occurs mainly during the vegetative stage of growth, which takes place before flowering, fruit set and seed development. Good water management is therefore very important during this particular stage.

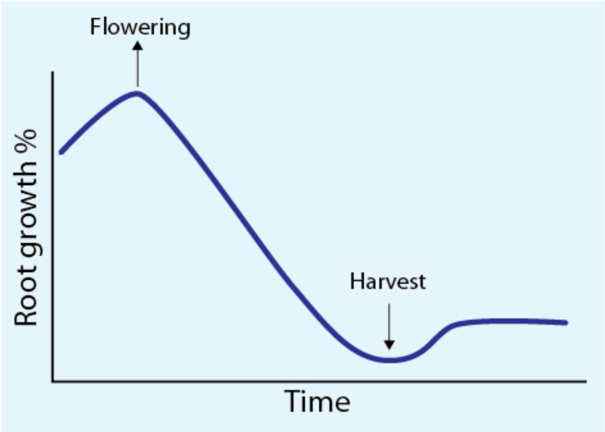


Figure 3. Root growth rate during cultivation

Figure 4. Checking soil moisture manually

Soil moisture

A variety of practices and technologies can be used to measure soil moisture and to help decide when to supply water. Moisture may be measured manually or by using tensiometers, meteorological stations or sensors. Daily inspection of the moisture in the soil, as well as regular monitoring of crop performance, are essential for avoiding fluctuations.

Irrigation and salinity

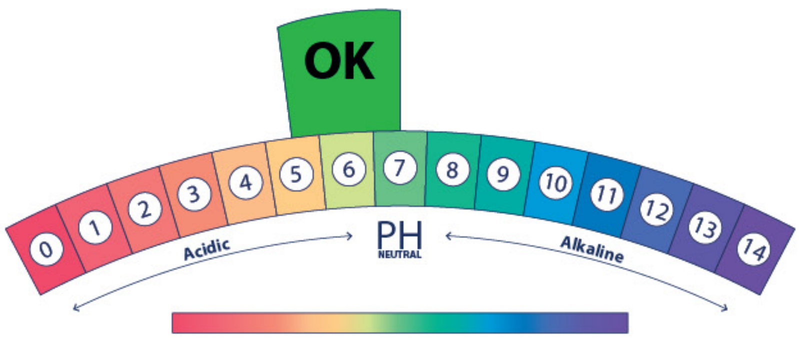
When there is not enough water in the soil (as can happen due to poor irrigation management), salts do not dissolve and instead concentrate in the soils, resulting in excess salinity. As a result, roots are unable to absorb nutrients – and even water in extreme cases.

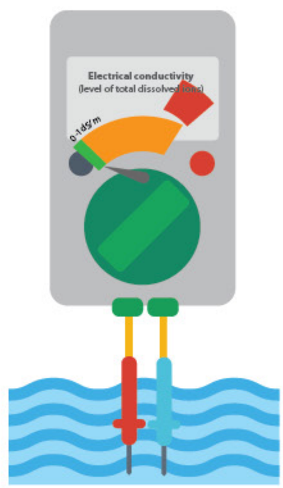
Figure 5. Excess salts in soil due irrigation mismanagement

The accumulation of salts in the soil may occur in arid climates that do not have a well-established rainy season (as rains tend to wash significant salt content from the soil), as well as in protected cultivation systems. The use of water with high salt content for irrigation and the misuse of fertilizers can further increase salt accumulation. To minimize salt concentration, both dry soils and moisture fluctuations should be avoided, good quality water should be used, and fertilizers should be applied correctly for the given crop.

Quality water for irrigation

Measuring the pH (i.e. the level of acidity/alkalinity) and electrical conductivity or EC (i.e. the level of total dissolved ions) are two important and quick ways to assess water quality for irrigation and help to improve irrigation management and plant nutrition. The ideal pH for most horticultural crops is between 5.5 and 6.5, while the EC of good quality water is between 0 and 1 dS/m. When the pH and EC values are outside of these ranges, more extensive analyses are necessary to identify the causes and take proper action. Other parameters, such as sodium, chlorides and bicarbonates should also be included for further water analysis.





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