Water management

Water for citrus growth and development

Water is the basic component of plant cell tissue. It is water, above all, which controls the growth and development of citrus trees. Most of the water absorbed by the plant comes from the soil. Nutrients present in the soil are dissolved in water, taken up by the tree, and supplied to all parts of the plant through translocation.

Water is needed by the plant for transpiration. An adequate water supply during the growth stage has a significant influence on plant development, fruit quality and yield.

In most citrus-growing areas, rainfall is unevenly distributed at different parts of the year, with marked dry and wet seasons. To stabilize fruit production and quality, it is necessary to supply adequate irrigation in the dry season, and proper drainage during the wet season. It is important to provide the right amount of water at different growth stages, to enhance the growth of citrus trees (Fig. 5-1).

Water tension meter

Use of a water tension meter to show when irrigation is needed

Soil moisture is expressed by “Bars” (1 Bar = 0.987 atmospheric pressure or 1 kg water head). When soil is soaking wet and saturated with water, it contains free water, and the soil tension is 0 atmosphere. After one or two days of drainage, the soil water is at a level called “field capacity”, and the soil tension is 0.33 atmosphere. If soil moisture falls to 15 atmosphere (-15 Bar), that is the “permanent wilting point”.

In general, the optimum range of soil moisture is between 0.5 and 1.5 atmospheric pressure. For best management of soil moisture, it is recommended that a water tension meter should be buried 30 cm deep at the edge of the canopy (Fig. 5-2). The tension meter reading is from 0 to 100 cBar, with a 100 cBar reading equivalent to 1 atmospheric pressure. If the reading is 70 cBar (-0.7 bar) or less, the trees must be irrigated.

Irrigation methods

Irrigation for citrus orchards should match, not only the growth and development stages of the trees, but also the topography of the orchard. This includes soil properties, for example whether the soil is a clay, loam or sand. It should also take into account environmental factors such as temperature, humidity, photoperiod and wind. The amount of irrigation water needed depends on the water-holding capacity of the soil, the amount of rainfall, and the rate of transpiration of the trees. Three methods can be used to irrigate orchards.
Surface irrigation

If the orchard is flat and water is easy to obtain, surface or furrow irrigation is used. Furrows should be filled with water and then drained, to ensure that the entire root system receives a sufficient amount of water.

Sprinkle irrigation

Sprinklers may be either fixed or movable. Gravity is used, but the water pressure should be maintained at 15 - 100 psi (pounds per square inch). Sprinklers may be used to water the trees once each growing season, or may be used a few times (Fig. 5-3).

Sprinklers have the disadvantage that the facilities may be costly to install. Furthermore, sprinkle irrigation has a higher water loss in evaporation, and may cause soil erosion. Its efficiency is reduced if the wind is blowing strongly, or if there is an increase in relative humidity, which results in a higher incidence of diseases.

Trickle/mist irrigation

This system can irrigate at a low water pressure (less than 15 psi), without being affected by the topography or slope. Water is distributed evenly, and deep into the root system. It saves water, and has a low installation cost.

However the many irrigation tubes and pipes used may cause inconvenience when growers are mowing weeds or applying fertilizers and pesticides.
Water requirements at each growing stage

The growth of citrus trees can be divided into the vegetative and the reproductive growth stages. Vegetative growth includes the growth of roots, stems, leaves and new flushes. Reproductive growth includes flower bud initiation, differentiation, flowering, fruit set and fruit development. Water requirements at the different stages are summarized below.

Flowering, fruit set and new flush development

This growth stage must have optimum soil moisture. Even a slight water deficiency means that leaves are smaller, and shortens the flush. Severe water deficiency results in poor leaf development, incomplete flowering, poor fruit set and a high rate of fruit drop. If rain does not fall at this time, it is important to provide irrigation and maintain good soil moisture. The water tension reading should be 30 - 60.

Fruit development

This is marked by the end of physiological fruit drop. The remaining fruits now begin to develop, and the leaves of new flushes have fully grown.

It is during the late fruit development stage that citrus trees need their greatest amount of water. This is because of the high transpiration rate, especially if temperatures at this time are high. Water deficiency would influence photosynthesis, and water requirements of the fruit are very high at this stage. The water tension reading at this time should be between 60 and 90.

Fruit maturing stage

At this stage of fruit development, it is not the number of fruit but their quality which is most important. A high soil moisture content promotes vegetative growth. This tends to have a harmful effect on fruit quality and flower initiation. In order to inhibit vegetative growth and improve reproductive growth, soil should be kept fairly dry, without any irrigation.

After harvest

After the fruit are harvested, the tree requires a small amount of irrigation to restore tree growth. A little irrigation water will help increase photosynthesis in the leaves. It will also promote flower differentiation, and avoid water and nutrient stress.

Some final points about irrigation

Whatever method of irrigation growers choose, they should pay attention to the water source and water quality. Irrigation not only provides plants with water. When the water penetrates into the soil, it also makes air exchange and enhances the growth of roots.

If the soil is very dry, irrigation water should be applied after fertilizer applications. This will increase the efficiency of nutrient uptake by the trees.

Fig. 5-3. Sprinkler irrigation makes economical use of water.