

Steering plant balance by irrigation control

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Plant balance is critical for achieving a good production over the year. Plants that are too vegetative or too generative don't perform that well. The art of growing is to keep the plants in balance, and to correct when things tend to go wrong. Plant balance depends especially on plant stage and seasonal conditions. The grower can steer and correct the balance with various 'tools' including climate control, irrigation and plant management.

Recap

Plants that are too vegetative don't carry a lot of fruit. Vegetative tomato plants are characterised by large leaves, thick stems, large pale flowers and generally slow fruit development. Generative tomato plants typically have small leaves, thin stems, small dark flowers. They don't have enough leaf area to make the fruit grow. In both cases, the annual production suffers.

Generally, mild conditions have a vegetative effect, whereas harsh stressful conditions have a generative effect. The weather especially has a strong influence. Hot summer conditions are stressful on the plants, and can make them too generative. A grower can correct the plants by adequate climate control (if possible), irrigation control and plant management.

Plant balance can be assessed by accurate observations through crop registration, for instance using CropRecord. Trends will show up in an early stage, so that corrective measures can be taken in time.

Irrigation regime

Plants do best in a stable root-zone environment with fairly stable water content and EC in the growing medium. Variations can have a strong impact on how the plants grow, and can therefore be used to steer the plant balance. Generally speaking a wet root-zone and a low EC both stimulate vegetative growth, whereas a dry root-zone and high EC stimulate generative development.

Variations in water content and EC in the root-zone can be created in many ways. The total daily supply of water (actually nutrient solution) is not changed, but the dosing and timing of irrigation is varied. Possible variations are, for instance, the start & stop times, number of cycles per day, cycle volume, cycle frequency, start of drain, drain volume, water content & EC of the substrate (growing medium), and overnight dry-back (water loss).

EC (or CF)

The EC (or CF, basically the concentration of nutrients) determines how easily water is taken up. Pure water or nutrient solution with low EC is taken up easily, whereas nutrient solution with a high EC is hard to take in. A low EC causes lush and therefore vegetative growth. High EC causes stress on plants and therefore has a generative action.

Daily supply & drain

Plants take up water for transpiration (the largest amount), and a bit for growth and filling up fruit. The required amount can be calculated. However, it is necessary to give more water than strictly needed to ensure that even the largest plants get enough, and also the plants with a poor dripper. Oversupply is also needed to 'flush' the growing medium. Therefore, the daily supply must be much higher than the daily uptake, for instance 30% higher, leading to 30% drain. Obviously, more drain means more expenses for water and fertilisers, and more waste or more recycled water to treat.

Steering by drain

The drain percentage has a strong steering effect on the plant balance. This happens through controlling the wetness and the EC of the substrate. Limited drain (due to limited supply) means the growing medium is dry, which has a generative effect. Limited drain also (generally) causes an increase in EC. Higher EC restricts plant water uptake, also having a generative effect.

Ample drain (due to ample water supply) makes the root-zone wet, which steers the plants vegetatively. Ample drain will (generally) reduce the EC in the substrate, making water uptake easier for the plant. Both have a vegetative effect.

Volume of irrigation cycle

The required daily supply can be given in many small irrigation cycles or in fewer larger cycles per day. This creates differences in water content, drain volume and also EC. See what happens in the morning when the slab is dry and irrigation starts. A small amount of water will be easily absorbed and distribute in the slab, so there will be little drain. In contrast, a very large irrigation cycle in the dry growing medium will partly drain out immediately. The average water content in the slab will remain low. If the next irrigation cycle is a long time later and again a large amount, the same will happen again. So large cycles far apart will result in more drain, and a dryer growing medium. The EC will be higher. This all has a generative effect. Smaller more frequent irrigation cycles result in less drain, higher water content and lower EC. This has a vegetative effect.

Overnight dry-back

The need for watering at night depends on the water holding capacity of the growing medium, and also on the weather and other conditions. A growing medium with good water holding capacity along with the correct substrate volume should not need irrigation at night. It is normal that the growing medium dries back overnight and has its lowest water content early in the morning. The amount of dry-back (water loss) has an effect on the plant balance. Much dry-back (low water content early in the morning) has a generative effect. Not so much dry-back (higher water content at night and early morning) has a vegetative effect. So the grower can use this too to steer the plant balance.

Start and stop time

Start and stop times control the amount of dry-back overnight. An early start in the morning or a late stop in the afternoon will lead to a wetter root-zone and therefore have a vegetative effect. A late start and early stop will do the opposite and have a generative effect on plants. Make sure that no irrigation is supplied when the crop is not transpiring. When the crop is not active (not transpiring) at the start and the end of the day, irrigation can be harmful. The recommendation is: 'transpiration before irrigation'.

Stages and seasons

Young plants naturally tend to grow vegetative. The weather conditions are mild in spring, which also stimulates vegetative growth. To steer plants in generative direction, the growing medium is kept dryer and EC higher.

In mid-summer the weather conditions stimulate plants in generative direction. Older plants can be too generative. To steer plants in vegetative direction, the grower can give smaller irrigation cycles, and a lower EC.

Growing medium

The growing medium has a large impact on the plant balance. Growing media with a good water holding capacity (e.g. peat, coco coir, sawdust) are, on average, rather wet and thus have a vegetative effect. Growing media with a limited water holding capacity (pumice, sand) are on average rather dry, and thus have a generative effect on plants. It requires some extra effort to steer the plants in the opposite direction than what the growing medium does.

For maximum performance, the total volume of the growing medium should be available to the roots. Some growing media are sensitive to drying out, sometimes irreversible. The dried part is unavailable for roots, effectively reducing the root volume.

Total control

Grodan rockwool has been developed for optimal water holding and water retention capacity. Obviously it has a very consist composition that allows very accurate control of irrigation, dry-back and hence vegetative and generative steering. Grodan has also developed a comprehensive system for irrigation control, based on the use of a water content meter. This meter can be used in some other media too (e.g. coco coir, peat). However, these media are much more variable. Some batches may be quite controllable, whereas others are not at all.

Other aspects

It is important to be aware of the many other effects of irrigation as well. For instance, irrigation with too low EC can cause unwanted swelling and hence cracking of fruit. It can also cause deficiencies and physiological disorders. Be aware of all subtle details and don't make large sudden changes in EC or in irrigation regime.

This article focused on plant balance. Of course, there is much more to say about optimal irrigation control. Grodan (rockwool company) has detailed recommendations for each situation and each crop.

Table 1. How the irrigation regime can influence the plant balance

Irrigation variables	Steering in vegetative direction	Steering in generative direction
Volume of irrigation cycle	Small cycles (but many) → wetter root-zone	Larger cycles (but fewer) → dryer root-zone
Frequency of irrigation cycles	More cycles (although small) → wetter root-zone	Fewer cycles (although larger) → dryer root-zone
Start time in morning	Earlier start → wetter	Later start → dryer
Stop in afternoon/evening	Later stop → wetter	Earlier stop → dryer
Water content	Higher (wetter substrate)	Lower (dryer substrate)
Water loss overnight	Low (wetter substrate)	High (dryer substrate)
EC in root-zone	Low	High