

Tools for plant balance control prioritised

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Plant balance is important for achieving a good production over the year. Plants that are too vegetative don't have enough fruit on the plants. In contrast, plants that are too generative don't have enough leaves to make the fruit grow. In both cases the production suffers. Greenhouse growers have 'tools' available for keeping the plants in balance, or correcting them when they tend to go wrong.

The tool sets are (1) climate control, (2) irrigation regime and (3) plant management. These have all been discussed in detail in previous articles. The question is: which tool to choose at a certain moment? This article ranks the control actions in order.

Causes of generative or vegetative plants

Plant balance is due to how the sugars (building blocks for plant tissue) are distributed over the plant: either more to the growing point (the head) or more to the fruit. If too much goes to the head, the fruit miss out, and vice-versa.

Plant balance depends on many factors. Generally speaking, mild growing conditions stimulate vigorous leaf growth, which means vegetative growth. In contrast, harsh conditions and stress stimulate seed formation, which means generative development.

Crop recording

Whether plants are vegetative or generative is not always clear-cut. It can be a trend: plants are moving into generative or vegetative direction. Trends can be detected by looking at graphs that display plant measurements. See the Figure: a horizontal line in the graph indicates a stable condition ('balance'). If a line goes gradually up or down, it indicates a trend. To see if there is a trend requires doing plant measurements and putting them in a graph every week. This requires some form of crop registration or crop recording system, for example CropRecord™.

Need for steering

Mild spring weather with high humidity stimulates plant vigour, so makes plants vegetative. In contrast, in summer the high radiation, high plant temperature and low humidity put stress on the plants. This hampers lush growth and makes plants generative.

Season and weather have strong effects, but there are many other powerful effects: variety (some varieties are naturally more vegetative, others more generative); grafting (grafted plants are more vegetative); plant stage (young plants tend to be more vegetative); greenhouse type (plastic greenhouses give mellower conditions and thus more vegetative plants); growing system, substrate and root-zone conditions (wetter root environment leads to vegetative plants).

If all above factors work in one direction, the grower needs to force the plants in the opposite direction to achieve a balanced growth. A young grafted tomato crop in spring in peat in a plastic greenhouse will naturally become very vegetative. Flowering and fruit set has to be forced upon them by generative actions. In other words, the grower has to take control.

Long-term, short-term

Control has a time component: long-term, short-term and immediate control. Firstly, some influences on plant balance are 'given' (e.g. season and weather): they cannot be controlled by the grower. Some influence can be controlled by the grower but only in the long-term (e.g. greenhouse type). Other influences can be controlled in the medium-term, namely per season (e.g. growing medium, grafting, plant density). Other tools for plant balance control can be used during the season, such as crop management (extra stem, pruning, early harvesting). Finally there are instant control actions: climate and irrigation control. They have about similar priority. It depends on the conditions which tool is used. The result will be best when all actions steer the plants into in the same direction, instead of giving 'mixed messages'.

Climate control

Climate control includes temperature, humidity, CO₂, shading, misting and more. Again, mild conditions stimulate lush growth, and harsh conditions stimulate generative development. In summer, plants can be steered into vegetative direction by higher humidity, lower CO₂, closure of a shade screen or use of misting, or all of them.

Temperature control

Temperature affects 'everything' in plants, and therefore influences plant balance too. Obviously the general temperature regime is based on particular needs of the crop or the variety. Small variations can be introduced by the grower. We distinguish between day temperature, night temperature, 24-hour and short-term temperature. An example of the last is pre-night temperature drop.

The 24-hour temperature is crucial. Higher 24-hour temperature stimulates the rate of development, speeds up fruit ripening, stimulates earliness of production, and seems to favour distribution of sugars to the fruit. However, high 24-hour temperature also increases the respiration (burning of assimilates) and decreases the fruit size and may reduce fruit production.

High day-time temperature strongly stimulates stretching: it stimulates cell expansion and this causes length growth of the stem and increase of leaf area. Night temperature does not stimulate stretching particularly, but is just contributes to the 24-hour temperature effects mentioned above.

Limits to climate control

There are technical limits to what can be done by climate control. For instance, nothing can be done about low sun light in winter (except with assimilation lighting, but that is unrealistic in NZ). On a hot summer day it is hard to keep the temperature down or humidity up (except when there is a shade screen, fogging or evaporative cooling). Venting puts a limit to the CO₂ level that can be achieved. Therefore climate control sometimes can't do enough to steer the plant balance. Then another tool set needs to be employed, such as irrigation control, or a drastic plant management action such as pruning.

Irrigation regime

Wetness and EC (CF) of the substrate have a strong effect on plant balance too. Wet conditions and low EC make water uptake easier for the plant, and thus have a vegetative action. Dry conditions and high EC have a generative effect.

Wetness and EC are the result of the irrigation regime, i.e. the supply of nutrient solution. This involves the total amount per day, how it is spread over the day, start and stop times, timing and frequency of irrigation cycles (many small cycles or a few large cycles), etc. Supply influences the drain and dry-back, which are often used as indicators for irrigation control.

Irrigation cycles, drain, dry-back

The weather conditions (radiation, temperature, humidity) determine how much irrigation is needed. The grower can choose to give the required amount either in many small irrigation cycles or as a few large cycles. The result is quite different.

Controlling plant growth - part 8

Large irrigation cycles cannot be soaked up completely, and a part will drain out immediately. Hence the growing medium will be drier on average, and the EC will be higher. Both have a generative effect. Smaller more frequent irrigation cycles result in a wetter substrate which has a vegetative effect.

The need for watering at night depends on the water holding capacity of the growing medium, and also on the weather and other conditions. The wetness of the substrate at night has an effect on the plant balance. This wetness is indicated by the dry-back (water loss) overnight. Much dry-back (low water content at night and early morning) is stressful and therefore has a generative effect.

Overnight dry-back depends too on start and stop times. A late stop in the afternoon or an early start in the morning will lead to a wetter root-zone and therefore have a vegetative effect. However, there is a risk in irrigating when the crop is not active (not transpiring), e.g. at the end or start of the day. For rockwool, the recommendation is: 'transpiration before irrigation'.

Steering by plant management

If climate control and irrigation regime cannot do enough to control plant balance, then plant management is the next available tool set. It can be a drastic action that alters the ratio of leaves and flowers (or fruit) and thus tips the balance from vegetative to generative, or vice versa. Possible actions include keeping an extra stem, removing older or very young leaves, truss pruning, fruit thinning, and 'unloading' by early picking. Also this tool set was discussed in an earlier article.

