In this post, I share my experience with the semi-closed glasshouse. There is much confusion on how best to grow crops in a semi-closed glasshouse, and this series of articles tries to clear up confusion, inspire new discussion and educate.

Vegetative and Generative Steering in a Semi-Closed Glasshouse

What is it?

Tomato plants have survived in the wild for thousands of years. Like other fruiting plants or tree species, they have adapted to climate conditions by first building an assimilate factory through growing leaves. Once the plant has enough leaves, there is enough photosynthesis taking place to produce fruit, which is expensive in terms of assimilate distribution. The fruits eventually fell off the vine or were eaten by animals, who spread the seed and ensured the survival of the species. Weather conditions affect the hormonal system of the plant and adversity (e.g. cool nights, drought) will trigger a shift from vegetative to generative growth. A grower can make use of this natural phenomenon to subtly change the climate, light, and irrigation strategy to help the plant generate the right impulses at the right time to reach its maximum potential yield.

Indicators

In principle, there are two conditions of plant growth. If a plant is converting too much of its photo-synthetic quota to leaves (vegetation) we will want to influence the plant growth with generative impulses. If the plant has a big fruit load, we will want to make sure that plants have enough vegetation to sustain such fruit load and enforce vegetative actions onto the plant. Vegetative plants distinguish themselves from generative plants in many ways. Figure 1 tables the various characteristics given to vegetative and generative tomato plants. While this seems simple enough to recognize, any grower remembers the time when they first learned this and how confused they were about it.

Underneath the generative characteristics, the table lists typical vegetative actions a grower can take to balance the plants (and vice versa). A plant that is too vegetative will put too many assimilates into leaves and less in fruit. On an annual basis, this can result in 20% less production. A generative plant puts more of its energy into fruit. This can overload the plant which results in high production for some weeks but then it drops off quickly. Similar yield losses will occur over a year. Hence the importance of a good grower. Growers can instantly recognize a generative or vegetative plant and use tools such as plant registration to notice and confirm subtle changes to the plant they see.

Generative		Vegetative
Thin head	8-11 mm	Thick Head
Short distance from top to first flowering truss	15-20 cm	Long Distance from top to flowering truss
Short leaves	37-44 cm	Long leaves
Weak truss		Strong truss
Trus Curling		Truss pointing upwards
Short distance between trusses	20-28 cm	Long distance between trusses
Short Internodes		Long Internodes
Flowers open quickly		Less flowers open
Vegetative Actions		**Generative Actions**
Dry-Down less than 10%	10%< Dry Down >15%	Dry-Down more than 15%
Lower 24 Hour Temperature	18< 24-Hour Temp > 20	Higher 24 Hour temperature
Low Day-Night Difference	3C< D/N Difference >6	High Day-Night Difference
Low EC	4.5< EC Drain > 5.5	High EC
No Prenight		Cool, long Pre-night
Short Irrigation Cycles	80ml < Cycle length >120 ml	Long Irrigation Cycles
More Nitrogen		Less Nitrogen

Figure 1; Generative and Vegetative characteristics and pointers on how to negate the extremes

The information in figure 1 is basic knowledge for professional growers. What is less well known is that when a plant grows in high light and low humidity environment, it responds to this generative action with vegetative growth. There is an immediate generative consequence to the action but in the long-term, this generative action stimulates vegetative growth because the plant is trying to adapt to the new environment by creating bigger leaves. Similarly, lowering the 24-hour temperature will have an immediate vegetative impact, but if the period of low 24-hour temperatures is extended, the fruit will stay longer on the plant and become larger, putting more strain on the plant. More assimilates translocate to the fruit, so this vegetative action has long term generative consequences. It is the balance between generative and vegetative growth that is important. Recognizing these trends early is essential because once a plant is too extreme on either side, the plant has changed its hormonal system and it is difficult to change back. In this respect, a plant is a bit like a large container ship. If it goes off course by a fraction, there must be an immediate reaction otherwise it is difficult to get the ship back on course. If by the time harvesting begins, the plant is either too vegetative or too generative, the grower will battle the crop for the rest of its life. If the crop is well balanced, it needs only small corrections for the rest of the crop. Hence it is important to get the plants on the rails in the first 3 months.

VeGe Indicator

To help determine if a tomato crop is generative or vegetative, I have developed a VeGe Indicator (see figure 2). It serves as a tool to help growers determine if their visual observation is congruent with more objective measurements. It considers head width, distance from the top of the plant to the first flowering truss, the distance from the first flowering truss to the next truss underneath and the Leaf Area Index (LAI). The head width is recorded in mm, all other measurements are in cm. Enter the actual measured values from crop registration in the yellow cells. Underneath it is the guideline for each measurement. You can change the guidelines, for instance, the head width for a snacking tomato crop can be 7-9 mm instead of 8-11 mm. The calculated value in the red cell is the VeGe Indicator. A value above 100 means the plant is vegetative, below 100 the plant is generative. A copy of this calculator can be downloaded from my website https://img1.wsimg.com/blobby/go/14bfaeb8-3320-4e9b-be8c-3cb70fd45d0b/downloads/VeGe%20Indicator.XLSX?ver=1575533995332.

The calculations show for instance, that if the VeGe Indicator is too vegetative (score is too high), the action of more de-leafing results in lowering the score (generative action).

VeGe Indicator	100

	Measured
Head Width	9.5
Top to Flow	17.25
Truss Height	23.75
LAI	2.15

Guideline	Min	Max
Head Width	8	11
Top to Flow	14.5	20
Truss Height	20	27.5
LAI	1.8	2.5

Figure 2; VeGe Indicator calculator.

The Semi-Closed Glasshouse

Are things any different in a semi-closed glasshouse when it comes to vegetative and generative steering? Yes and no. How to create vegetative or generative actions does not change. What is different is that the continuous air movement creates a constant vegetative impulse. The leaves are encouraged to transpire all the time! The plant will make larger leaves and will direct its sugars there, instead of to the fruit. Growing in a semi-closed glasshouse is growing in a vegetative environment. Add to that that the fact that most semi-closed glasshouses are in warmer climates with high sunlight, one can understand why the plant only wants to make leaves. So how do we fix this? We have already talked about reducing fan speed in previous posts, but there are many other tools that we will discuss in future posts.

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