

# Fertilization has a huge impact on pest and disease susceptibility

## *Vitality starts with a balanced nutrient recipe*

**Fertilization and crop vitality are often seen as two separated systems. But for a healthy and resistant crop one should fertilize much more precisely. Research and practical experiences conclude that less nitrates and more calcium are a good start.**

The switch in horticulture to products with as less pesticide residues as possible is in a rapid. At more and more greenhouse vegetable production companies is growing without pesticide residue a specific objective. Besides, more attention goes to microbial activity in the root zone of hydroponic cultivations and the support from natural resources.

### **Mildew susceptibility can be measured**

In a recent finished study of Hofland with 'green applications' against mildew (in potted gerbera), NovaCropControl conducted sap analyses as a standard. That made it possible to search for correlations between minerals and mildew susceptibility in the huge data set. Also here a strong relation with the K/Ca and the nitrate- nitrogen ratio has been found. Also sodium, zinc, copper, molybdenum and aluminium seem to have influence on the mildew susceptibility. Surprisingly the iron levels seem to be higher when mildew infestation is higher as well. Possibly this has a relation with the higher amount of chlorophyll in the leaf. In tomato and other vegetables it becomes more clear that there is a strong relation between 'chlorophyll' level of the plant (SPAD- level) and the susceptibility of the plant for powdery mildew. With a handheld SPAD- analyzer the grower can anticipate three weeks earlier on a possible powdery mildew infestation. Up to now we have to wait for the first spots on the leaves.



When searching for a more resistant system, fertilization often is being excluded. But the composition of nutrients in the plant can have a significant effect on a plants resistance, says researcher Jantineke Hofland-Zijlstra of WUR Horticulture in Bleiswijk. Malnourished plants are more susceptible ofcourse, that's commonly known. But biotrophic funghi like mildew extract nutrition from the plant, and they will attack faster when some elements are in excess.

The fertilizer recipes which were set up at the time hydroponics were developed, are still being used nowadays. But meanwhile we grow different varieties and the cultivation techniques changed rapidly as well. NovaCropControl's plant sap analyses indicate that a plants nutrient balance often is disturbed. De composition of nutrients in a plant can be very different from what one expects based on drain- and substrate analyses. For example; we find excesses of nitrates everywhere, which are not being converted into protein nitrogen. In the fertilizer recipe, the nitrate feed can be reduced with 25 to 50 procent without any problems, depending on the cultivation type, says Sjoerd Smits of Hortinova.

### **Nitrates are blocking plant vitality**

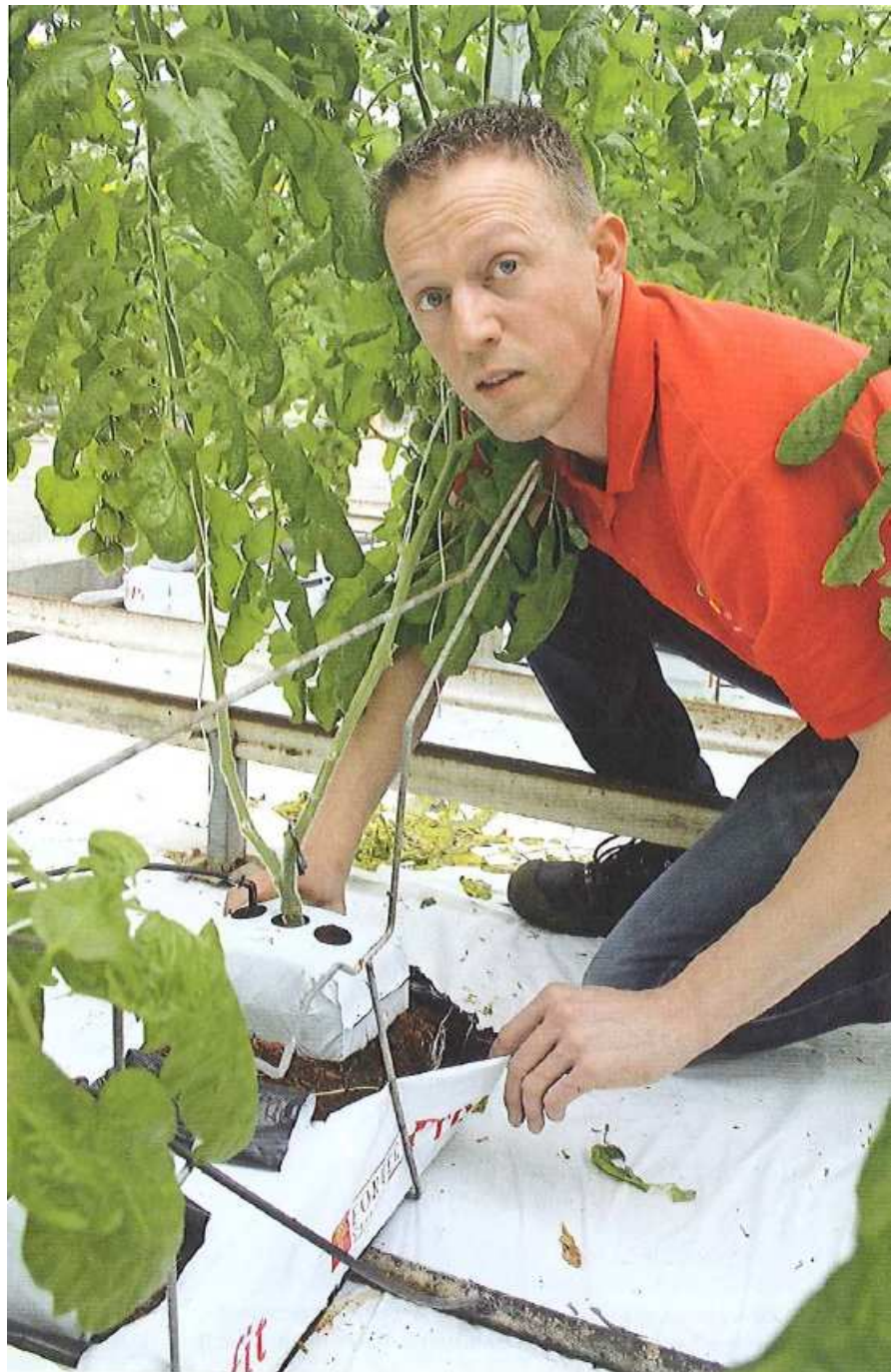
According to Smits the excess of nitrates is very harmful because it weakens the plant. Cells become large and cell walls thinner. It is like radiologist Philip Callahan describes in his book 'Tuning into nature': pests and diseases are the garbage collectors in nature. So you should take care that your plants do not need to be cleared away. Nitrate reduction plays a key role to accomplish that. A nitrate excess is an obstacle to create a vital plant. "Who is not willing to lower nitrates, has no place in our method to feed the plant a balanced nutrient recipe. You cannot increase plant vitality without tackling the nitrate levels"

By the thousands of plant sap samples that Hortinova sends in for sap analysis, more and more signs of the negative influences of high nitrates appear. It mainly concerns the nitrate-nitrogen/protein- nitrogen ratio. We clearly see that problems occur when more than 60 percent of the nitrogen is present in the nitrate form. In a bell pepper cultivation it turned out that on three locations the moment of excessive growth of aphid populations took place at the moments when nitrate- nitrogen levels peaked (see graph 1). Thijs Gipmans of Gipmans Plants in Venlo experiences the same in the cultivation of herbs in pots. Nitrate obviously has an effect on aphid infestation. Aphids were often a problem. In the cultivation of herbs we cannot use pesticides. Since we dramatically lowered our nitrate numbers two years ago, that changed. Due to lower nitrate levels, we increased brix levels of our plants. That is why the plant is not attractive anymore for the aphids. We barely suffer from aphid infestation anymore.

#### **Better taste of tomatoes by nitrate reduction**

Tomato grower Mark van der Werf of Greenco in Helenaveen cannot say for sure that the reduction of the nitrate input is linked to the lower disease susceptibility. When you are working so much on plant vitality it is difficult to draw conclusions about the effect of one measure. But it is clear that you increase aphid and caterpillar susceptibility with high nitrate levels. In the past we often had aphid infestation early in the season. In the cucumbers it became a drama sometimes, but that time we did not lower nitrate levels. Now we quickly have control of a starting aphid infestation, that is remarkable. He was one of the first growers that optimized nutrient availability by using enriched soil biology (by the Natugro-concept), and working on a more resistant crop.

In the snack tomatoes that he is growing for Greenco now, he significantly reduced the nitrate levels. Normally you feed tomatoes 20 to 25 millimol. We try to head for 15 millimoles by substituting nitrates by chloride and sulphate. In the plant sap analyses, nitrate is only 10 percent of the total amount of nitrogen. According to Hortinova, 10 percent is the lower limit, but we still find nitrate in the drain water, so we would like to go lower. We do not dare to go lower because we do not want to increase chloride further, it is a growth inhibitor.



The nitrate reduction has another, even more important, advantage: the sugar level (brix) of the snack tomatoes increased by as much as 2 points. The tomatoes in the illuminated cultivation now have brix levels of 9.5. That expresses itself by a richer flavor. The first harvested non-illuminated tomatoes have brix levels of 8.5 – 9 already.

By osmosis, nitrate attracts water into the cell while it does not contribute to the cell structure, like protein- nitrogen. At the same time the produced sugars are being diluted, Smits explains. The effect of nitrate reduction on aphids is also based on the increased sugar levels in the plant sap. Aphids and other sucking insects suffer from the higher sugar levels, because they cannot avoid the conversion into alcohol and being poisoned or predated sooner.

## Fertilizers and mildew

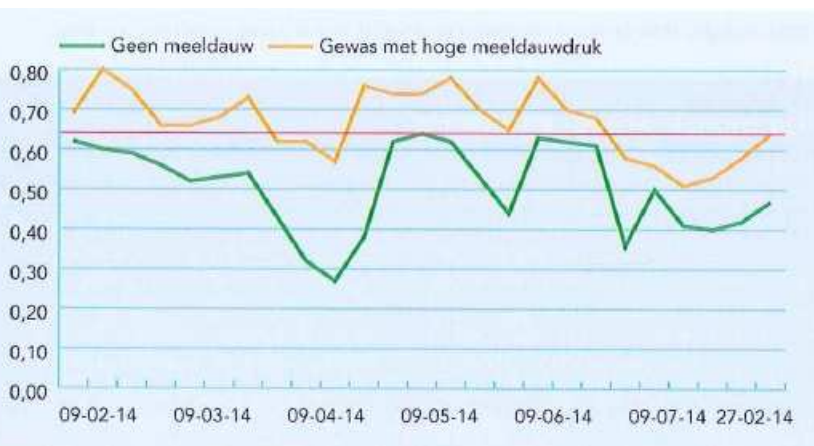
Nitrate also seems to have a negative effect on the mildew susceptibility. In tomato, Hortinova strictly focuses on the critical limit of 60 percent nitrate-nitrogen in total- nitrogen in the leaf. Above that limit the mildew pressure rapidly increases (see graph 2). The solution for the fact that nitrate is being taken up by the plant easily, is simply to lower the feed. But the conversion in the plant can also be stimulated. This conversion takes place by the presence of the nitrogenase enzyme. For the production of this enzyme, molybdenum is needed. It turned out that the uptake of molybdenum is being improved by a better soil life. Besides, micro organisms in the root zone make other nitrogen forms available through denitrification. Stimulating soil life can help with lowering nitrate levels in the plant.

The potassium-calcium ratio is another important balance for the resistance of a plant. By the antagonistic uptake and the difference in absorbability of K (easy) and Ca (difficult), the potassium feed has to be lowered a lot when calcium levels in the plant sap become too low. Calcium is important for firmness of cell walls and resistance against biotrophic fungi like powdery mildew. Gipmans often faced this disease in cultivation of herbs in pots, especially during the winter period. But since the K/Ca ratio has been lowered dramatically we do not see the mildew anymore. We still use the same varieties and the climate is the same as well. The only change is the feed of potassium, Gipmans says. Because we have an ebb and flow system, 80 percent returns as drain. Then it is difficult to know how much potassium and calcium has been taken up. But through plant sap analyses we dared to lower the potassium feed drastically. Nowadays we barely find potassium in our drain water, but still we know that the plant has taken up enough of it.

Van der Werf feeds 0.3 mmol silica as a standard. That is from the time when I grew cucumbers. Silica results in firmer cells, but also has a role in the natural resistance of plants (see 'Hormonal resistance and nutrition'). For Greenco adjusting the fertilizer levels and stimulating soil life works as one system. But fertilization is still the neglected one. A lot of research is still needed on that. We have to change our minds rigorously, but that is something you do not just do at a production company. For that, you need a research facility, van der Werf says.



Graph 1: Green line: grower 1, yellow line: grower 2, blue line: grower 3. The moments with extreme aphid infestation (red circles) occurred at 3 pepper production companies when the NO3 share in Total N was high (above 60%) Source: Hortinova.



Graph 2: Green line: no mildew, yellow line: high mildew pressure. A high mildew pressure often comes together with a high NO3/Total N ratio in a tomato crop. 60% seems to be the critical limit. Source: Hortinova.