Text and images: Tijs Kierkels



Working towards an annual plan for all elements

# More scope for better quality crop with ion-specific steering

*Roel Klapwijk (front) and Ruud Kaarsemaker: "With an annual plan for the elements you can build up your own database and learn a lot about the effects of your nutrient supply."*

**In Next Generation Growing, fertilisation is not the main focus of attention, although it can be a good tool for accepting higher humidity and therefore achieving additional energy savings. But ion-specific nutrient management offers even more scope for achieving a better quality crop.**

It works almost like a reflex: if the concentration of an element in the slab rises, you add less of it to the nutrient solution. That's logical, right? "Not really," says Ruud Kaarsemaker of the Groen Agro Control laboratory. "The concentration rises because the crop isn't absorbing enough of the element. If you then reduce the concentration, it absorbs even less. So you have to think about it the other way round: how do you get that uptake to rise? Think about it from the point of view of the plant, not the slab."

## Element-specific

What we are talking about is ion-specific fertilisation (or element-specific nutrient management). To do this you need to analyse both the nutrient solution and the drain water, for example once a week. The difference in concentrations of elements between the nutrient solution and the drain is the uptake by the crop. "The measurements are the first step. You match these against your cultivation targets throughout the year. Then you adjust the nutrient supply," he says.

This is the simple version of the story, because it involves twelve elements, each with its own function. To grow a resilient crop, for example, you need to steer it with magnesium, nitrogen, chlorine and sulphur. To avoid blossom-end rot and to produce fruits with a long shelf-life, you need to monitor calcium, potassium and magnesium. A properly functioning water balance depends on boron and potassium. And so on.

## Save up to 15% more energy

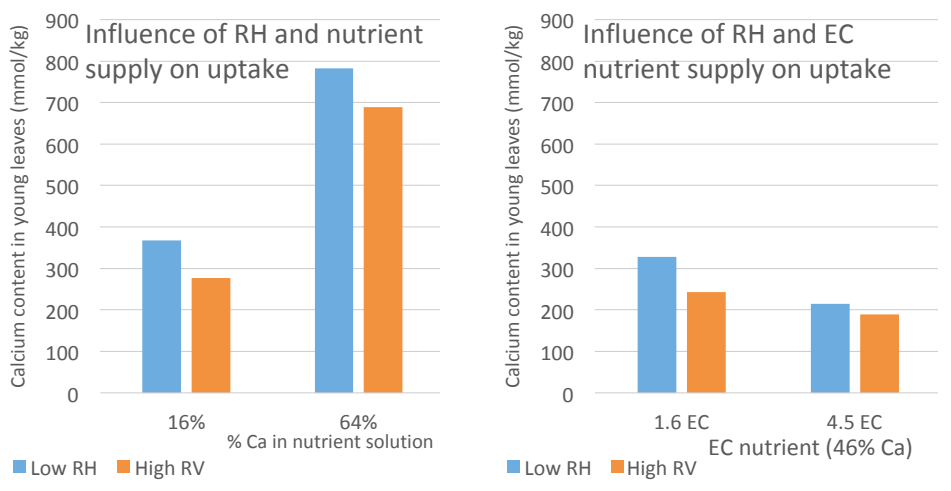
Paying more attention to optimising nutrient uptake can lead to better quality and extra energy savings. As Kaarsemaker observes, fertilisation has been something of a poor relation in Next Generation Growing up to now. "And yet you could save anything up to 10 to 15 percent more by optimising the nutrient supply, not least because it enables you to accept higher humidity for longer," he says.

High humidity can lead to problems such as marginal necrosis, scorching of the shoot apex, leaf curl and blossom-end rot, as not enough calcium reaches the parts of the plants that are transpiring less. The solution in winter: "Inhibit transpiration by increasing the EC. That stimulates uptake and makes the plant more generative."

## Prevent blossom-end rot

Besides increasing the EC, you also have to increase the calcium content *(figures 1A and 1B)*. "There is often a misconception that you activate the plant by stimulating transpiration. But it doesn't have to be that high. If you increase the supply of nutrients, the production of dry matter increases and the fresh weight drops slightly. This makes the plant more generative. It produces the same effect as activating transpiration."

Figures 1A and 1B. Calcium uptake in cucumber



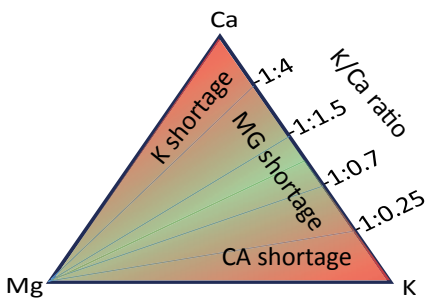

***Absorption of calcium at low and high RH in cucumber. Both the EC and the concentration in the nutrient solution affect this.***

Apart from these actions, the ratio between the cations potassium, calcium and magnesium is important. All these elements have a plus charge ($K^+$, $Ca^{2+}$, $Mg^{2+}$) in their dissolved form and compete with each other during uptake by the plant. A high magnesium content inhibits the uptake of calcium *(figure 2)*. "Early on in the crop you need magnesium for good leaf quality. That's less important later on, so there is more room for K and Ca. You often see blossom-end rot when the magnesium concentrations in the slab are on the high side. You can easily prevent that in the summer," he says.

## Competitive mechanisms

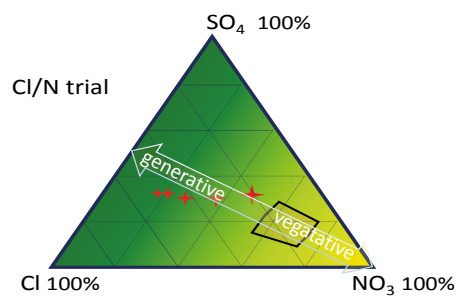
Competitive mechanisms also come into play on the anion side (the negatively charged ions), and these can also be made use of *(figure 3)*. The plant tends to absorb all the nitrate you give it. In winter, this leads to larger leaves with higher levels of transpiration. But they don't have to be that high. "Nitrate competes with chlorine ($Cl^-$) and sulphate ($SO_4^{2-}$) in plant uptake. A high sulphate content inhibits nitrate uptake, but there comes a point when the plant has taken up enough and then the sulphate concentration in the slab starts to rise. Chlorine doesn't have that problem. It is absorbed relatively easily, and you can use that to inhibit nitrogen uptake if necessary," he says.

Figure 2. Competition between cations K, Mg and Ca



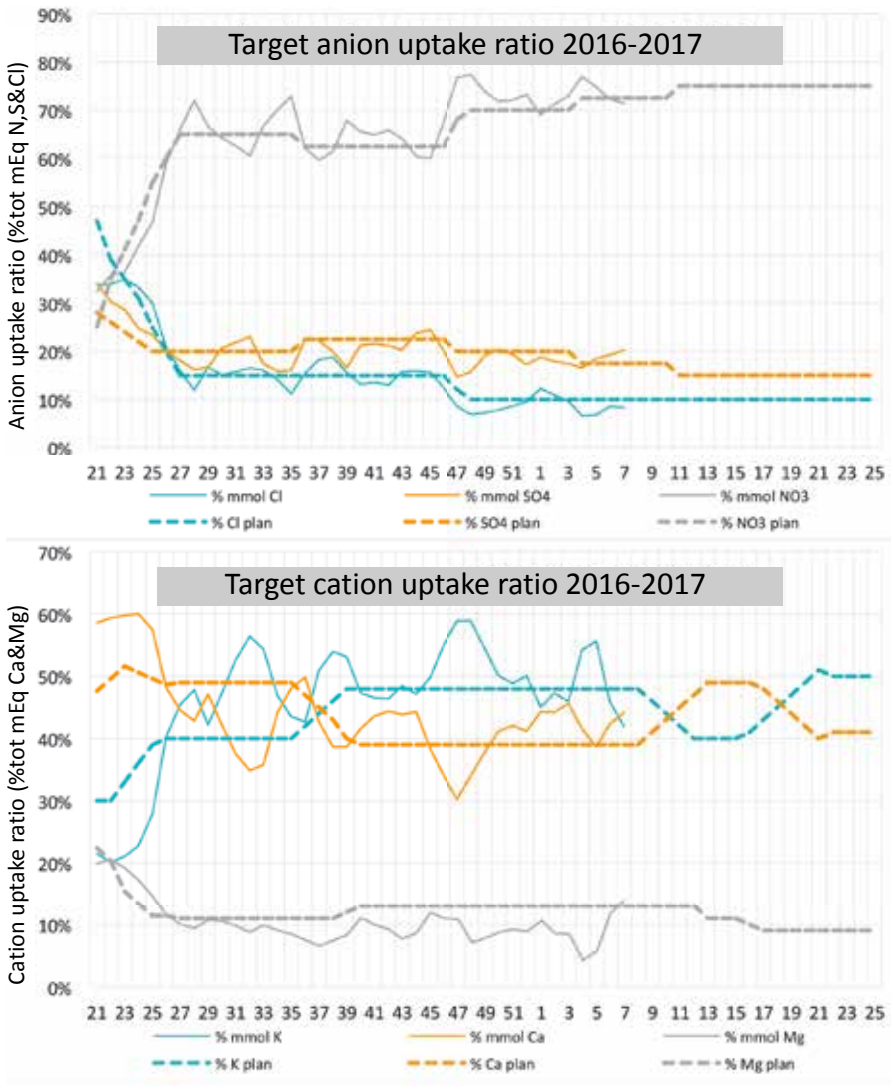

***Potassium, magnesium and calcium compete against each other in root uptake. Adjusting magnesium and potassium concentrations can prevent blossom-end rot.***

Figure 3. Competition between anions Cl, N and S




***Competition between anions (chlorine, nitrate, sulphate) at intake can be exploited to steer the plant generatively or vegetatively.***

Figure 4. Target ratio of uptake of anions and cations




***An annual plan for trace element uptake provides direction. There is much to be gleaned from the difference between planning (dotted line) and implementation (continuous line).***

Chlorine still has a slightly tarnished reputation because of tests with table salt (NaCl) in the past, but as long as you increase the chlorine content with potassium chloride (KCl) or calcium chloride ($CaCl_2$), for example, you won't have a problem. "This way you can steer the crop generatively in the winter. If you want more vegetative growth in the summer, you can leave chlorine out of the regime," Kaarsemaker says.

This summer the Improvement Centre will be running a demonstration trial with a lit tomato crop to explore the boundaries of steering with EC and the ratios of cations to anions.

## Long recirculation

The ideal strategy is an annual plan for all elements *(figure 4)*. For the cations, steering uptake according to the plan is key (because you can't see the effects in time with the naked eye). When it comes to the anions, the crop is the determining factor and you can make adjustments depending on whether you want more generative or vegetative growth.

Ion-specific steering also enables you to recirculate as long as possible, the advisor says. "When magnesium and sulphur levels rise, people start draining. They see that growth is tailing off and often blame it on an excess of exudates. But that's not usually the reason. If you take two weeks' worth of magnesium sulphate ($MgSO_4$) out of the regime, growth returns. But you really need to prevent the concentration from rising in the first place – in other words, reduce it before the crop becomes too generative."

## Summary


Better results can be achieved by managing the supply of each individual element. Ruud Kaarsemaker believes that extra energy savings of 10-15 percent can be achieved by optimising fertilisation. Ensuring the right balance between cations and anions leads to fewer calcium problems and better control of generative growth. The ideal strategy is to draw up an annual plan for the elements. Cultivation specialist Roel Klapwijk has already adopted this method.