

Extra potassium is not always the solution against blotchy fruit

Nutritional elements play a crucial role in fruit quality. But the primary cause of the problem is sometimes not the deficiency of a particular element as would commonly be expected.

Written by Peter Visser

Consultants from NovaCropControl in Oisterwijk regularly observe problems with fruit quality in tomatoes, such as uneven colouring. This is particularly observed in new varieties, which

respond differently than growers are used to. For example, with more recent breeding material that includes virus resistances. These newer varieties often have not yet developed the quality characteristics as strongly as the previously cultivated susceptible varieties.

Symptoms of fruit quality problems are often quickly attributed by growers to a deficiency of a particular nutrient in the fertilization—most commonly potassium or calcium. This is often indeed the case, but in practice such nutrient deficiency turns out not always to be the actual cause. There are multiple factors that can influence fruit quality. By increasing the dose of a specific nutrient while the actual cause lies elsewhere but continuing to increase nutrient levels in the hope that this will

Mouldy calyxes

In addition to uneven colouring, there are several other fruit-related quality issues that the NovaCropControl consultants regularly encounter. One such issue is crown mould, where scorched calyx petals begin to mould in more humid environments, such as inside flow-pack packaging. Analyses of calyxes identify an excess of manganese as the primary cause of crown mould. Manganese (Mn) toxicity leads to scorching of the green parts of the fruit cluster. Even with the same manganese concentration in the irrigation water, some varieties appear to absorb the element more easily and are therefore more sensitive. During growing periods with wetter outdoor conditions such as spring or late autumn

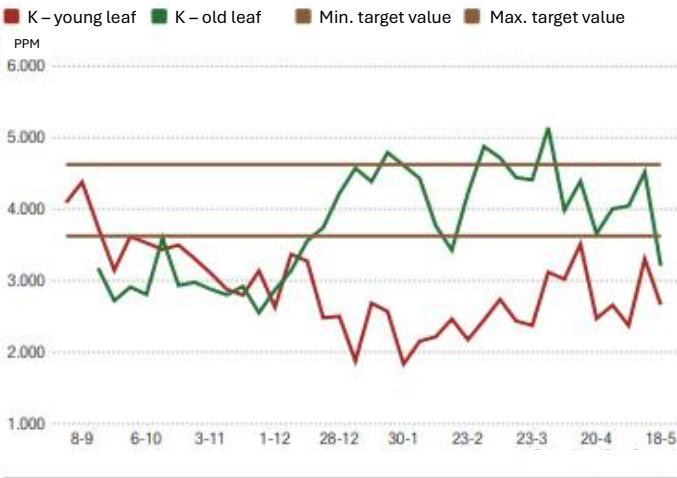
it is advised to be extra cautious and monitor Mn levels closely. Blossom-end rot is a true calcium deficiency. Smits presents a plant sap analysis of fruits affected by blossom-end rot, showing higher potassium levels and significantly lower calcium levels. As a result, the K/Ca ratio in this example is twice as high as in healthy fruits. “That clearly indicates a calcium deficiency. This issue is further aggravated by low silicon levels. Silicon is a so-called synergist that facilitates calcium uptake.” Roma-type plum tomatoes in particular seem prone to blossom-end rot. “These are ‘world champions in potassium uptake,’ which can sometimes prevent the plant from absorbing enough calcium.”



Dehydrated fruits occur when there are problems with water and nutrient transport from the roots to the top of the plant.

Plant Sap Analysis Potassium

Example potassium as result of an inactive plant



Source: NovaCropControl



eventually solve the problem can actually cause an imbalance in the plant's nutrient levels, which in turn leads to other problems. It is therefore important to carefully analyse the underlying cause of the decline in fruit quality. In particular, the potassium/calcium ratio plays a key role. A relatively high calcium level, for example, can lead to gold speckling. While too little calcium increases the risk of blossom-end rot. High potassium levels make the fruit more prone to cracking, while low potassium levels increase the likelihood of uneven ripening.

Blotchiness of fruits

In cases of uneven colouring caused by potassium deficiency, a characteristic symptom is a white rim in the flesh of a tomato, visible when the fruit is cut open. However, it doesn't have to progress that far. Plant sap analyses are several weeks ahead of visual plant observations, allowing growers to anticipate and respond in time to signs of a developing potassium deficiency. These analyses, however, show that in many practical cases, spotted fruits are not caused by a lack of potassium. Sjoerd Smits from NovaCropControl explains: "Potassium is a mobile element that can be transported from older leaves, where it is stored, to young leaves and fruits. So if plant sap analyses show that sufficient potassium has built up in the older leaves and remains at the right level there, but the values in the young leaves and fruits fall below the target value, then there must be

another reason for this besides a low potassium supply in the nutrient solution" he says (see graph). "Even though the plant's reaction may appear the same." Consultant Jeroen Versteegen from NovaCropControl adds "There are various other possible causes besides insufficient supply for example, problems with potassium transport due to an inactive plant. We often see that plant temperature has a major effect on what happens inside the plant, both in summer and in winter." Especially with the current trend toward more energy-efficient cultivation, mistakes in this area are more easily made. If the plant does not transport enough water and nutrients because roots and older leaves are too cold and inactive then fruits and young leaves may receive too little potassium. Relatively more warmth at the top of the plant due to lighting can further amplify this effect if there is still demand from active plant growth at the top.

Problem indicators

If the sugar content in young leaves increases, it can be an indication that the plant is out of balance, especially in winter crops. A plant's growth and maintenance are highly dependent on temperature. The warmer the plant, the more water it transpires and the more glucose it consumes.

At lower temperatures, the plant breathes more slowly and burns fewer sugars. Additionally, the internal transport of sugars slows down, making redistribution within the plant less efficient. As a result, sugars can accumulate in the young leaves, which may indicate a problem with the transport of nutrients.

↑Hollow fruits, caused by insufficient calcium transport during a temperature dip at the top of the plant.

Photos: NovaCropControl

Cracked fruits

Cracked fruits are a fruit quality issue that can have various causes — such as excessively high root pressure due to too much boron. But more often, it's the result of a combination of low calcium levels in relation to high potassium levels. This calcium deficiency is sometimes easily overlooked as a possible cause in practice. Smits explains: "When fruit quality declines, many growers immediately think of potassium deficiency. That's why you still hear the old saying: 'K = Quality.' But if potassium is increased while calcium is already too low, things go wrong on two fronts. Too much potassium causes the fruit to swell excessively, making it prone to cracking. And with too little calcium, the cell walls

become weaker and less firm, making the fruits even more prone to cracking. It is therefore essential to maintain balance. "Prevent issues by staying on the right track through careful management of climate, irrigation, and nutritional elements such as potassium and calcium," Smits advises. This involves anticipating trends seen in plant sap analyses. "Because based on certain visual symptoms or fruit problems, you often don't yet know the exact cause." With the help of plant sap analyses, growers can intervene in time and make adjustments to fertilization and climate control. Although the above examples are specific to tomatoes, the principles also apply to other fruiting vegetable crops.

Versteegen presents graphs from a real-world tomato cultivation case as an example, where the potassium (K) concentration in the irrigation water is more than sufficient at around 10 mmol/l, and the levels in the drain are also adequately high. Plant sap analyses show that measurements of all leaves stay close to the desired target values up until November. But when temperatures drop, the values begin to diverge. The levels in the older leaves rise, while those in the younger leaves drop. Sufficient availability in both irrigation water and drain, combined with a lack of replenishment from the older leaves, indicates a transport problem caused by an inactive plant. Already in October, a rising trend in sugar levels in the young leaves was observed. Based on this early warning, the grower could have taken action to prevent uneven colouring by adjusting the climate settings.

Preventing temperature drops

A temperature drop at the top of the plant can be another cause of uneven colouring, often resulting from opening the screen too early when there is a large temperature difference between the space above the screen and the cultivation area below. Symptoms include poor coloration with green vascular tissue in the fruit, hollow fruits (incomplete filling of the locules), and a bumpy fruit skin (the so-called "golf balls"). Just like with uneven colouring, a transport problem is involved here as well, but with a different effect. In such a temperature drop situation, both the well-coloured and poorly coloured fruits are found to contain sufficient potassium in fruit analyses by NovaCropControl. Versteegen explains: "So the transport of this element is functioning properly. But calcium levels are lower, resulting in a higher K/Ca ratio." During a temperature drop, the upper parts of the plant become too cold, which stops transpiration and reduces the transport of immobile calcium. Smits adds: "Meanwhile, the roots continue to push, causing cells to rupture. This leads to vascular bundle damage." In addition to adjusting the screen control settings, some growers are also experimenting with a heating tube at the top of the crop. Follow-up plant sap analyses can show whether such an extra measure is effective.

Dehydrated fruits

Another cause of unevenly coloured fruits is drying out, previously also referred to as "water stress." This is visible through brown veins on the outside of the fruit. Plant sap data in such cases resemble that of a temperature drop, but here, both calcium and potassium levels start to diverge between young and old leaves as winter approaches and temperatures fall. This is a signal that a problem is occurring with water and nutrient transport from the roots to the top of the plant. Versteegen explains: "The fruit acts like a water reservoir. If water is no longer being transported from the roots, the plant starts extracting it from the fruits instead." When such a shortage occurs, cells in the fruit dry out and subsequently die. In this case, poor plant activity is due to insufficient irrigation or inadequate root development, not low temperatures.



Blotchiness caused by a Potassium deficiency can often be recognised by the white rim in the fruit flesh at the border (seen in the lower fruits).