

## Breakthrough in organic cultivation

In recent years, Van der Knaap's R&D team has been focussing on developing a sustainable cultivation system in order to cultivate organically without using the soil. This has resulted in a bioreactor that converts protein into nitrate nitrogen ( $\text{NO}_3^-$ -N). The nutrient solution produced with the reactor is free of organic residues, fungi and bacteria. After several years of testing, the organic nutritional solution is now available to growers.

### Nitrogen

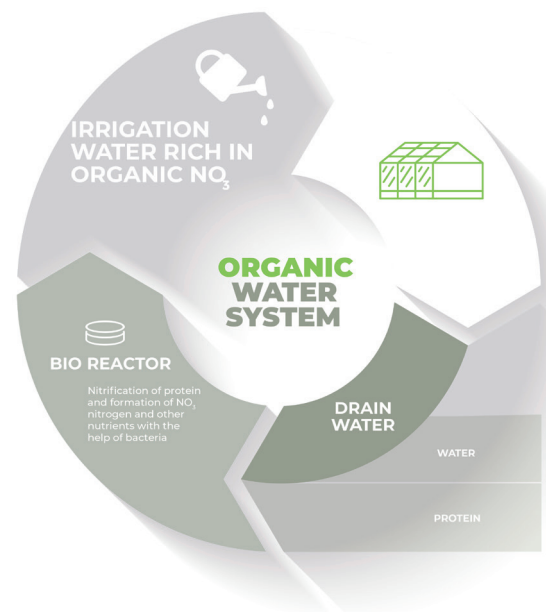
In the bioreactor that Van der Knaap developed, residual protein and amino acids are converted into nitrate nitrogen ( $\text{NO}_3^-$ -N) by using specific bacteria. In crops cultivated in the soil, the soil bacteria convert nitrogen into nitrogen that can be absorbed by the plant. However, there is often insufficient nitrogen available when the plant needs it or too much when the plant does not need it. With the nutrient solution the bioreactor produces, drippers can deliver exactly the right amount of nitrogen. This facilitates precise controlling.

### European law

In North America and Canada, the organic nutrient solution system is now being used satisfactorily by several organic vegetable growers. European law is different, however. Products that are grown in this way are not considered organic, despite the advantages of growing on substrate. With cultivation in the soil, there is always emission of water and nutrients into the soil. With cultivation on substrate, everything can be collected and reused and the yield is generally much higher. Over the past two years, we have grown a variety of vegetable crops, soft fruit and lettuce in our test centre 'de Kas' using the common cultivation method, but with organic nutrients from the bioreactor.

### Outdoor cultivation

The organic nutrients can also be used in current organic soil cultivation. The production that these growers achieve is often 50-60% of results in substrate cultivation. With our organic nutrients, this could increase to 80-90%.



*Schematic representation of the sustainable cultivation system*

### Natrex®: sodium remover

In substrate cultivation, growers are faced with higher sodium values in the drain water during cultivation. Van der Knaap has developed a sodium remover for this purpose under the name Natrex®. Natrex® selectively extracts a large proportion of the sodium present, so that this water can continue to be recycled. The crop protection products stay in the system. Other useful nutrients also remain in the water that can be reused for cultivation.

### More information?

For more information about the cultivation system or about the trials in 'de Kas', please contact the Research & Development department via [rd@vanderknaap.info](mailto:rd@vanderknaap.info) or +31 (0) 174-296606.



*Bell peppers grown with organic nutrients from the bioreactor*

## Trials in 'de Kas'

# Vegetables grown with organic nutrients

Over the past two years, we have been growing a variety of vegetables, soft fruit and lettuce in our test centre 'de Kas' with organic nutrients made from residual protein and amino acids in the bioreactor developed by Van der Knaap.

## Organic nutrients

Research was carried out into cultivation results in terms of growth and production, as well as the differences in substances and taste. As a rule, a conventional nutrient solution contains six macro and six micronutrients. With organic nutrients, however, the spectrum of micronutrients is much larger. All these micronutrients instigate different processes in the crop, resulting in differences in the levels of vitamins, antioxidants and carotene. In several trials, we examined the nutrients and components of the organically cultivated products compared to the non-organic products. In the case of tomatoes, we noted that the products grown with organic nutrients contained higher concentrations of substances and tasted better.



Tomatoes grown on coco substrate

## Tomatoes

### In substrate and in the soil

Between October 2018 and November 2019, we performed two tomato trials in 'de Kas'. In one of the trials, tomatoes were grown entirely organically on Forteco Power

substrate slabs, with full use of recirculation water. The plants were fed nutrient solution from the bioreactor with drippers. These tomatoes were compared, for their flavour and the substances they contained, with tomatoes grown in a conventional substrate crop at a commercial company. At the same time, there was also a trial with tomatoes grown in the soil in 'de Kas'. Instead of mineral nutrients, these plants were also given organic nutrients from the bioreactor with drippers. The variety 'Axiany' was used for both trials.

## Results

In terms of content, the tomatoes grown on coco and fed with organic nutrients scored very well; both the vitamin C and the carotene content were higher than the commonly grown tomatoes. The taste test was carried out by an independent institute. The Brix value, acidity, bite and firmness were examined, among other things. Here, too, the organically grown tomatoes on coco with organic nutrients scored higher. The cultivation trial with tomatoes grown in the soil was also successful. With the organic nutrient water, virtually the same production was achieved in the soil as in the substrate test. The organic nutrient solution is administered directly to the root of the plant with drippers, allowing it to absorb the substances directly.

## Bell Peppers

From October 2018 to November 2019, a trial with bell peppers was carried out in 'de Kas'. For this trial, we examined whether we could grow bell peppers entirely organically on Forteco Power substrate slabs using organic nutrients from our bioreactor

with 100% reuse of drain water. The results of this trial were compared with bell peppers grown during the same period with mineral nutrients.

## Results

Crop registrations, fruit analyses and taste tests showed no significant differences with conventionally grown bell peppers. The only thing that stood out was the high vitamin B content in the organically grown bell peppers. This shows we can grow organic bell peppers successfully.

## Hydroponic lettuce

In April, a trial was started for cultivation on water, instead of on substrate. The aim of this trial is to find out whether the organic nutrient solution can also be used to grow hydroponic lettuce.

The trial results show that it is possible to grow lettuce that holds its own compared with traditionally grown lettuce. Depending on the type of lettuce, the shelf life of the organically grown lettuce is actually better than lettuce grown on mineral nutrients. For the time being, it also appears that, in certain seasons, savings in cultivation time are possible. In terms of weight, cultivation with organic nutrients is currently also slightly ahead of lettuce cultivated with mineral nutrients. The trial will continue until the end of 2020.





# Flavourful strawberries and blueberries

In the past year, various trials were carried out to test the nutrient solution from the bioreactor developed by Van der Knaap. A trial with blueberries has been running in 'de Kas' since 2017, and since mid 2019 also with strawberries.

### Blueberries

As a result of increasing consumer demand for blueberries and a shift in professional horticulture from cultivation in the soil to substrate cultivation, blueberry cultivation on substrate is increasing significantly worldwide. Originally, blueberry cultivation mainly used to take place in the soil. However, there are several important advantages to be achieved with substrate cultivation, such as improved fruit quality, higher production and recirculation possibilities.



### Blueberries on coco

In 2017, a rooting trial was conducted with blueberry cuttings to determine the best rooting plug. After the rooting phase, the plants were used for a follow-up trial with substrate, which will be continued in test centre 'de Kas' until the end of 2020. We are testing three different substrates: a mixture of peat and perlite (the 'standard mixture'), a mixture of coco and peat and a mixture of 100% coco. Half of the plants receive organic nutrients from the bioreactor, the other half receive mineral nutrients.

The aim of the trial is to test the

different substrates in order to determine the ideal substrate for blueberries in combination with organic nutrients. To this end, we are working closely together with customers and suppliers. The effects of the organic nutrients on the crop, but also on its substances and taste, are also being investigated.

### Results

After the harvest in July, all plants were pruned. After this, the crop ran out again. Blueberry harvests on organic nutrients and mineral nutrients were compared. The total harvest is comparable. As of December, the temperature for the crop was decreased and is now kept at temperatures of 0-7 degrees Celsius. We expect to harvest again in June/July. For the time being, we can conclude that it is possible to grow blueberries with nutrients from the bioreactor. This appeared to be a challenge beforehand, because blueberries are known to require ammonium nitrogen ( $\text{NH}_4^+\text{-N}$ ). However, the bioreactor has already converted this into nitrate nitrogen ( $\text{NO}_3^-\text{-N}$ ). It has been found that on coco and peat substrate, blueberries can be grown without ammonium nitrogen.

### Strawberries

In mid-May 2019, we started a trial with strawberries, which lasted until the end of November 2019. In this trial, strawberries were grown on gutters on coco substrate slabs, type Power. The structure of this substrate mat perfectly matches the fine root system of strawberries. The aim of the trial was to grow strawberries off the ground with biological nutrient solution from the bioreactor, and to reuse 100% of the drain water. Half of the plants received a nutrient solution from the bioreactor. The remaining plants were given a mineral nutrient solution. The differences in substances and taste were assessed during the trial with independent tests.

### Results

The results are promising. The strawberry harvest was higher on the organic nutrients. The trials for substances generally showed a higher content of vitamin C. These strawberries also scored nicely in the taste test. The follow-up trial with strawberries grown in trays with a peat-coco substrate has been in 'de Kas' since February.



The organically grown strawberries from the trial

## Potted plants grown organically

**In addition to trials with vegetables and soft fruit, the first trials with pot plants that received the organic nutrient solution from the bioreactor were also carried out in 2018 and 2019.**

### Calathea

Between June 2018 and February 2019, a trial with Calathea was carried out in 'de Kas'. Through this trial, we wanted to find out if we could grow a qualitatively similar Calathea on organic nutrients, in the knowledge that organic nutrients generally have a slightly higher sodium content than mineral nutrients. Calathea, a sodium-sensitive crop, was chosen. Five different types of Calathea were placed on two different substrate mixtures.

The difference in results between the plants on organic nutrients and those on mineral nutrients was minimal. The leaves of the Calathea, the fresh weight and the root quality were, on average, the same. It has indeed proved possible, despite a

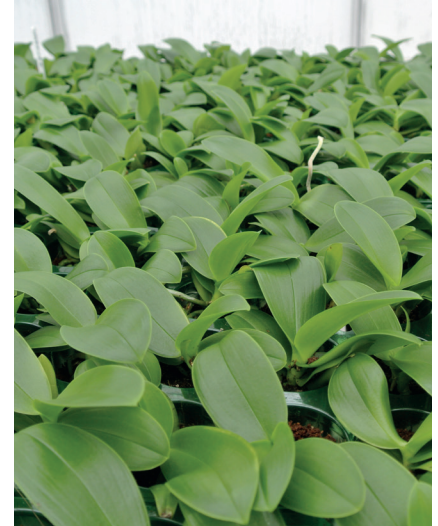
slightly higher sodium figure, to grow good-quality Calathea with the organic nutrient solution from the bioreactor.

### Orchids

In mid-2019, a new trial with orchids was started in 'de Kas', which continued until the end of November. This trial focused on the propagation of Phalaenopsis tissue-culture plants. Different rooting media were used: Fibre-Neth® Bookplug, Obturo® Bookplug and a plug-in-plug with an Obturo® PS mini plug into a Fibre-Neth® plug with a pre-formed hole. Based on this, any differences in rooting and crop development in Phalaenopsis during cultivation on different plugs were assessed. In addition, the differences in rooting and crop development between Phalaenopsis that received organic nutrients and plants on mineral nutrients were examined.

The results show that the width and length of the leaf (the youngest mature leaf was measured) and the number of active root tips were

good. It is, therefore, possible to root and cultivate good Phalaenopsis plants with the biological nutrient solution from the bioreactor.



*Orchids grown with organic nutrients from the bioreactor*

A follow-up trial with Phalaenopsis is currently taking place in 'de Kas'. Here, cultivation in pots is also carried out with organic nutrients. After 23 weeks of cultivation and the third week of cooling, the trial showed a good-quality plant on both organic nutrients and mineral nutrients. In addition, the plants in pots filled with Fibre-Neth® coco and the pots filled with loose coco substrate with bark are visibly further developed compared with the plants on the regular substrate.

### More information

Would you like to receive more information about the trials with potted plants in 'de Kas'? Please contact the Research & Development department via [rd@vanderknaap.info](mailto:rd@vanderknaap.info) or +31 (0) 174-296606.



*Calathea grown with organic nutrients from the bioreactor*

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