

# Handbook

## Hydroponics on Bonaire



### Professional cultivation of lettuce

POP Bonaire  
May 2018

## **Preface**

Jaap van der Wel is a Dutch horticulturalist with ample knowledge and experience. He came to Bonaire in 2012 to start a horticulture business. He started cultivating vegetables in the soil and since 2015 he has also been cultivating lettuce on hydroponics. He has demonstrated that year-round cultivation of lettuce is possible on Bonaire. In 2018 Jaap and his wife returned to the Netherlands to spend more time with their family.

An objective of POP Bonaire is to make the knowledge that was gained in the agriculture available to other people who work on Bonaire, now or in the future. Bonaire has a dry and hot climate. For islands with more rain and cloudy weather, it is recommendable to use plastic cover instead of shade mesh.

Jaap van der Wel was pleased to lend his cooperation in this and in five interviews and visits he explained everything he knows about hydroponics on Bonaire. POP Bonaire is extremely grateful for that.

To support this handbook a film was made that is available on YouTube. Search for the words Hydroponics Lettuce Bonaire.

This handbook was compiled with the utmost care. Application of the information takes place at your own risk.

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This handbook is also available in Dutch and Papiamentu, contact [POPBonaire@gmail.com](mailto:POPBonaire@gmail.com).



*Jaap van der Wel and his successor Ronald Hoyer*

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## **1. Introduction**

Lettuce is difficult to cultivate on Bonaire. There are many varieties that shoot quickly due to the high temperatures. They form a thick stem as a result of which the head loses the desired shape but the taste of the leaves also becomes bitterer.

In 2015 Jaap van der Wel started the cultivation of lettuce on hydroponics. After various research he found a variety that can be cultivated well in the conditions of Bonaire.

The lettuce is cultivated in trays on tables of 1.22 x 4.88 metres. The trays contain black pond foil. At the start of the cultivation the trays are filled with WEB drinking water to which nutrients are added.



## **2. Production**

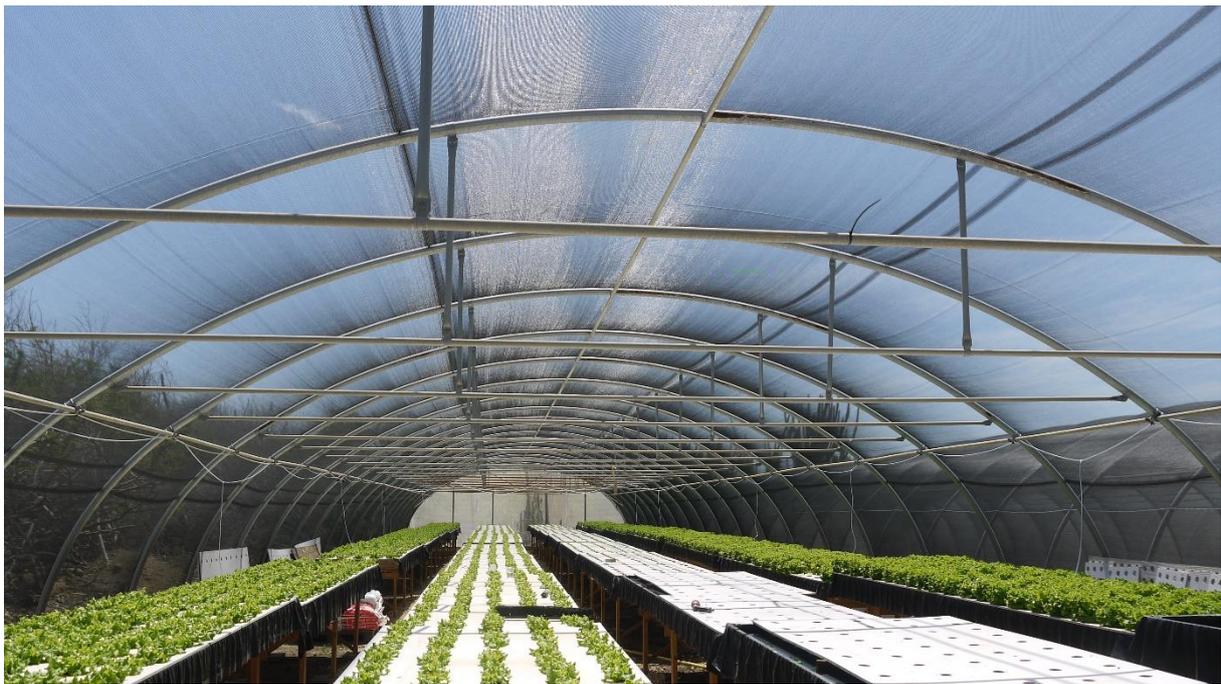
A greenhouse of 10 by 50 metres with 32 tables can yield a production of on average 800 lettuces per week. This requires approximately 25 hours of work a week, divided over 7 days.

In June 2015 the cultivation of lettuce started. In retrospect, the first year was the best year of production with lettuces of 200-220 grams. After 1.5 years the plants obtained brown roots and became weaker. The weight of the lettuces dropped to 180 grams and even dropped from 150 to 120 grams.

It appeared that the water contained bacteria and moulds like verticilium and pitium. It was necessary to work in a very clean manner and to disinfect the tables and other materials with chlorine when refreshing the water. With the present approach the lettuces have again returned to 170 to 180 grams.

A different problem during the production is the high water temperature. From July to September it is difficult, in the afternoon it is too warm, it is then about surviving. If the lettuces are too small in this period then two lettuces of 100 to 120 grams are added in a bag together.

The minimum for the market is 150 grams. The lettuce is sold for \$ 1 per lettuce and they are sold at Van der Tweel for \$ 1.20 and at the Warehouse for \$ 1.25. Fresh lettuce is delivered every working day and that gives credit with the supermarkets.



### **3. Sowing**

The grower tried 20 varieties and the only variety that grows well on Bonaire is Muir. The seeds can be ordered with Johnny's Seeds. They are delivered as pelleted seeds, hence surrounded by fertiliser. The seeds are then 0.5 cm in diameter as a result of which they can be sown easily. The seeds are stored in the refrigerator.

The seeds are ordered by email with Johnny's Seeds, they email an invoice, the grower transfers the money and the pots are sent to Bonaire via E-zone.

A pot with 5,000 seeds costs \$ 45. One pot is enough for one month of sowing. The seeds can be preserved for a maximum of 3 months, hence you cannot keep too much in stock. This is a disadvantage because at present (March 2018) the seeds are not available. Johnny Seeds can only deliver in October again.

An alternative is Tropicana of Johnny Seeds. They become less big. The grower ordered these in two colours: green and purple and puts both seeds together in one pot. They are packaged and sold together.



## 4. Cultivation

Lettuce grows in 6 weeks. The first two weeks in sowing trays and in the baby room. They are then moved to the large tables. There are 32 tables, in 4 rows of 8. The water consumption is approximately 4 litres per cultivation per plant.

The cultivation is as follows:

### Week 1: sowing

- Sow pelleted seeds on a tray in plugs.
- Sowing takes place four times a week in 200 plugs every time.
- Then 48 hours in the refrigerator at 20 degrees Celsius. Occasionally mist, this results in better germination.
- Then remove from the refrigerator and place in the shade of the roof for 2 days and then 3 days under extra black shade mesh of 50%.
- Carefully water with a soft sprinkler head multiple times a day.



### Week 2: potting in the 'baby room'

- Place the tray on the bed of nails, push downwards as a result of which the plugs release easily. Place this plug in a pot with some hydro pellets (clay).
- Place the pots on the hydro cultivation table in the baby room. These tables are emptied, cleaned and refreshed once every two months. The nutrition is then added.
- These tables have more plant holes. This is to save room.
- These tables are also in the extra black shade (50%) to protect the young plants. This is where they start forming leaves.



### Week 3: to hydroponics cultivation tables



### Week 4 & 5: plants grow

### Week 6: harvesting

- The lettuce to be harvested is sprinkled with water in the morning in order that the lettuces remain fresh longer in the shop.
- Every week 800 plants are sown and 800 are harvested. The tables where the plants were harvested are cleaned and the plants from the baby room are then placed there.



## **5. Fertilisation**

A mixture of three fertilisers is added to the water as nutrition for the plants:

A: Poly-feed pavane € 50 / 25 kg.

B: Calcium nitrate = N, € 10 / 25 kg.

C: Bitter salt € 20 / 25 kg.

These fertilisers can be ordered on pallets with Brinkman or Hortikoop in the Netherlands.

Application:

When the table is almost filled with water, 500 grams of A, 500 grams of B and 250 grams of C are dissolved, one by one, in a bowl with water and mixed well with the water of the table.



### **Previcure energy**

Every Wednesday the 8 tables that were filled with new plants the week before from Monday through Thursday are treated with Previcure energy. This is a root and growth stimulator.

The plants on these tables have then been at their definitive location for 5 to 9 days. With every table one cup of water with 10 cc of Previcure energy is added to the compartment with the aeration. Price per litre is about € 100.

### **pH**

The pH of the WEB drinking water is high. It must be reduced from 8 to 5.5 by adding 150 cc of nitric acid. This is important to all vegetables, the nutrients are then absorbed better. During the growth the pH gradually increases, this is not a problem.

### **Salt concentration**

The EC of the water becomes 1.8 after addition of the nutrients.

Optimal EC: 1.8. Maximum of 2 and minimum of 1.3.

The EC usually stays the same. In case of rain the EC will drop due to rainwater flowing in the tables.

### **Rainwater**

In case of >20 mm of precipitation the water in the tables increases by more than 2 cm. The aerial roots of the plants then hang in the water and 'drown'. This is not good for the plants. That is why the water must partly be removed from the tables until it is at the old level again.

It is then not necessary to add new fertilisers. Nor does the EC require adjustment.

## 6. Aeration

Aeration keeps the water moving and adds oxygen to the water. As a consequence there is less growth of bacteria and better root growth. Two pond ventilation pumps of the brand Hozelock cypro are used. The capacity arrives at 9,000 litres / hour.

The pump has two main tubes (4 mm) that run overhead and aerate 16 tables. The main tubes meet in order that the pressure is the same everywhere. The tubes in the direction of the tables are attached to a main tube with attachment pieces. These pieces are placed in the water in the middle of every table alongside a plant.



## **7. Diseases and pests**

There are many detrimental insects on Bonaire. That is why the greenhouses are built with shade mesh.

Despite the use of this mesh insects like the Californian thrips and mealybugs can enter. If the plants are infected then the lettuce can no longer be eaten.

The lettuce plants are during the growth treated with an organic pesticide twice, namely after 1 week and after 2 weeks on the large cultivation tables.

A safety period of 7 days applies to this pesticide. This means that treated vegetables can only be harvested after 7 days. This business applies a safety period of 15 days, hence all potential residues have degraded when the lettuce is harvested.

## **8. Cleaning after the cultivation**

The lettuce plants are in the cultivation tables for 4 weeks. After the harvest the water is drained to a collecting tank after which it is reused for mixed salad in the open soil. The table is cleaned and then immediately filled again. The tables are therefore not even empty a day.

Refresh water:

Add 700 litres of new mains water per cultivation table. As soon as the water flows into the table with the hose, 70 cc of chlorine is added in order that it mixes well with the water and arrives everywhere in the table.

Clean pots and pellets:

Immerse in a tray with 40 litres of water and 1 litre of chlorine for 5 minutes.

Then rinse in a clean tray with water.

The chlorine kills the moulds and at 30° C the chlorine dissipates after a day.

### **Residual water after cultivation**

Usually about 350 litres of water remain after a cultivation. This is drained and collected in a tank. This water is used in another greenhouse to irrigate mixed salad in the open soil.



## 9. Materials

### Materials for 1 table



The table top consists of two hardboard sheets of 1.22 by 2.44 metres. The table top will therefore be 1.22 by 4.88 metres.

- The substructure of the table under the hardboard sheets consists of:
- Three wooden beams of 9 by 3.8 cm of 5 metres long.
- Three uprights:
  - 6 feet of 80 cm with a thickness of 9 by 3.8 cm;
  - to strengthen three lateral beams of 9 by 3.8 cm of 1.22 long;
  - 2 struts of 5 by 5 cm of 1.15 long on the outer uprights for the stability, they are glued;
  - the exterior has an additional strut, see photo.



Trays on the table:

The borders are formed by assembling upright planks on the table top:

- 2 upright planks of 14 by 2.5 cm and 5 metres long;
- 2 upright planks of 14 by 2.5 cm and 1.22 metres long;
- pond foil is placed in it. This is not fixed. It must be folded in such manner in the corners that there are as little seams as possible. The foil is 2 metres wide;
- assemble and glue a worktop drain per table.



Plastic sheets with plant holes:

- These sheets are 1.22 by 2.44 metres. Holes are made in the sheets for the plants.
- Per sheet 10 x 5 holes, i.e. a total of 50. Holes with a diameter of 4.7 cm.
- Distance between the holes in the row and between the rows: 20 cm.
- Distance from the sides: short side 8.7 cm and long side 7.2 cm.
- There are a number of wooden feet under the plastic sheets in order that they do not collapse and plastic handles to lift the sheets.

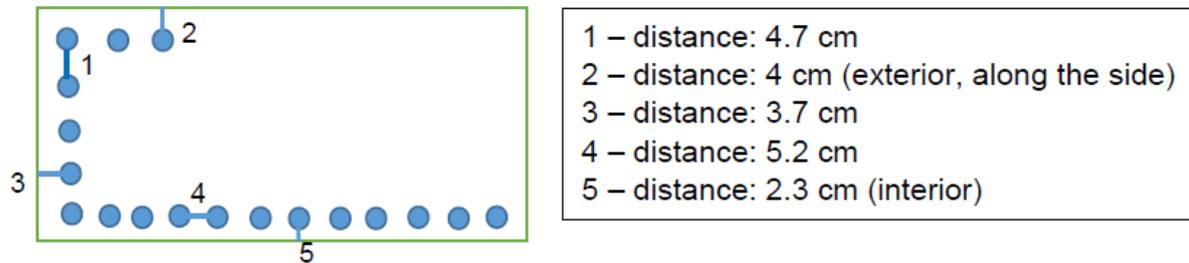


## Baby table

Sheets of 122 cm by 49.5 cm. Five times 12 holes per sheet, hence a total of 60.

A total of 14 sheets of 49.5 cm. This allows for the cultivation of 840 plants.

Diagram of the holes:



## Other materials

- Plugs: glued coconut with peat, 1.5 cm. 220 / tray. Can be ordered via [www.quickplug.eu](http://www.quickplug.eu) Growing systems.
- Pots, pellets and pesticides: Brinkman or Hortikoop in the Netherlands.

## Refrigerator

The refrigerator was purchased second-hand, the motor no longer worked. Jaap placed an air conditioning in it. It runs 24 hours per day. Electricity costs are about \$ 250 per month.

It is 20°C in the front and 15°C in the back of the refrigerator.

The refrigerator is necessary to keep the lettuce seeds at 20°C for 48 hours. As a consequence the plants germinate better.

In the refrigerator the seeds can also be stored longer.

In the part at 15°C harvested vegetables can be stored temporarily. Yardlong beans for a maximum of 3 days and lettuce for a maximum of 1 day.

## Shade mesh

This greenhouse uses shade mesh, this provides 50% shade. This is suitable for lettuce, Chinese cabbage, yardlong beans.

An additional layer of shade mesh is used for the baby room.

Purchase with Agrimat in the Netherlands. Mention with the purchase in what climate you will use it in connection with the UV resistance of the mesh.

## **Investments**

Tables \$ 10,000

Greenhouse \$ 10,000 (10 by 50 metres, 3.40 metres high)

Levelling / cleaning of premises \$ 1,000

Shade mesh \$ 1,400 (greenhouse cover is 700 m<sup>2</sup>)

## **10. Other cultivations**

Chinese cabbage is a good alternative, it grows into a nice head in 6 weeks. Chinese cabbage has the same lifecycle as lettuce. A cabbage weighs about 200 grams.

The market is small due to the import from the US, sales are now at most 100 cabbages per week.

Idea: agree with the government that Chinese cabbage can no longer be imported then sales of 300-400 cabbages per week is possible.

Another option is Romaine lettuce. There is experience with the large variety but the heart burns quickly. Potentially better with a smaller variety of Romaine lettuce. This should be examined.

Basil and mint grow well on hydroponics. Elephant's ears (tayerblad – see photo) also grow well on hydroponics. The latter must be harvested in time because if the leaves get too big they are no longer tasty.



## **11. In conclusion**

Jaap van der Wel gave the following advice:

The cultivation of vegetables requires dedication and attention. You also need to check your plants during the weekend because surprises may always occur.

If something goes wrong then you need to dive into it in order to find a solution. In the Netherlands it is common practice to ask your colleagues (or rather your competitors) for advice. This is what made the Dutch horticulture such a success.

Hence, growers, be open with your knowledge, you can help each other with it and it will make you stronger together.



*Jaap and Anneke van der Wel*