Water and Food Security

The challenge to feed the world

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What are the solutions? The experts discuss

Agriculture uses 70% of world's freshwater resources, but leaves 900 Million hungry. To feed 9 Billion people in 2050, we will need to produce more and better while consuming less.

In 25 years 3 billion more people will live in cities

A great job is done helping farmers to produce their own food

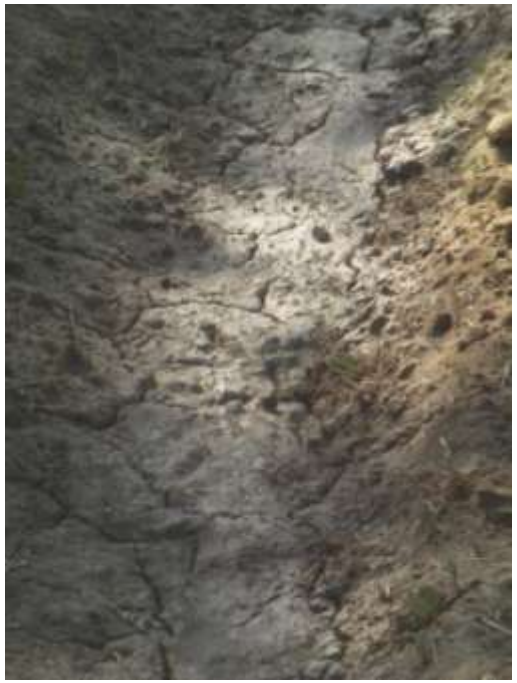
But how can we feed all these people in the cities?

Industrial solutions and innovative technologies are necessary to meet this challenge

Relation between water, soil, pests and crop productivity

The problems are related

- Poor water quality (high saline content) induces a poor quality soil
- Poor quality soils have a reduced water retention capacity
- Low water retention capacity of the soil prevents development of the roots
- Poor root quality reduces plants resistance to pests (like root knot nematodes)
- Poor soil quality increases pest attack probability
- These interconnected problems reduce crops productivity



In order to break this vicious circle, water quality has to be improved

Planet Horizons Technologies' systemic solution

The cutting-edge technology Aqua-4D® electromagnetic water treatment is a key for a substantial improvement of food production

How to improve crops yield in poor water / soil conditions ?

Problems are

- Too high salt contents in water (brackish water)
- Poor soil conditions, sandy or salty or both
- Most plants die or have extremely low productivity
- Low water retention in soil creates significant water loss and dries out soil quickly
- The salt crystallizes in the water and clogs the interstices of the soil . The water does not reach the roots

Presently offered solution

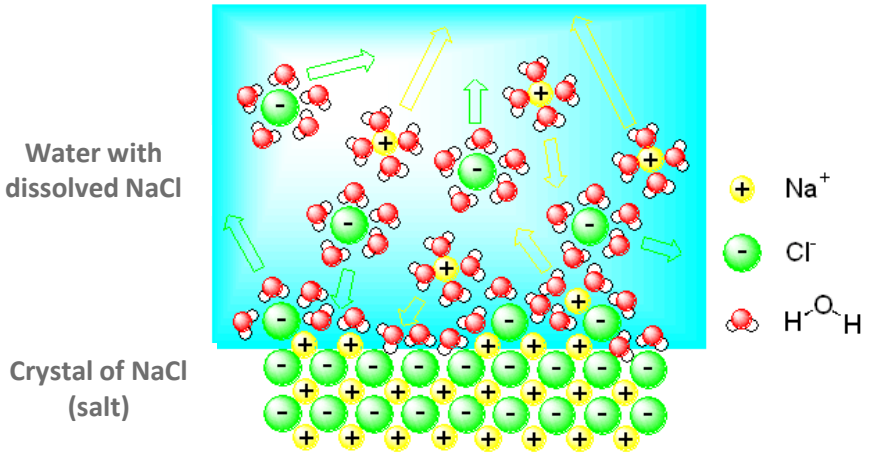
Reverse osmosis is an answer to brackish water problems:

- All minerals are filtered out by membranes
- The required minerals (fertilizers) need to be added afterwards
- Investment and operational costs are high
- Negative impacts on the environment

Aqua-4D® - solution and advantages

Direct usage af brackish water

- The Aqua-4D system replaces Reverse Osmosis (RO) systems up to a certain level of salinity
- The salts will not crystallize, not clog the interstices of the soil, existing salts are dissolved
- The salts remain dissolved, and can be adsorbed by plants and be infiltrated into the groundwater
- Investment 2 to 3 times lower, operational costs up to 1000 times lower than RO
- Need for fertilizers significantly reduced



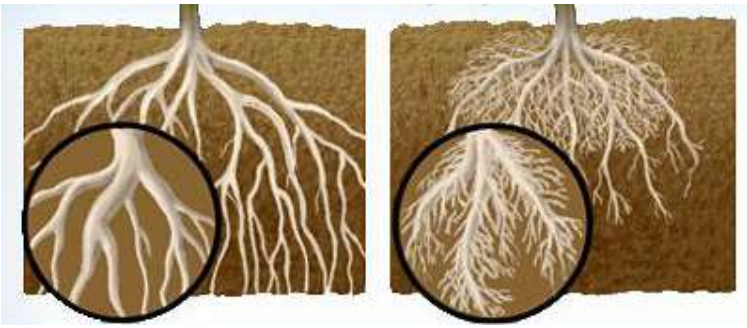
Results have been proven in practice for several years

Aqua-4D® - solution and advantages

Relation between water retention and root development

- Root development always follows the water.
- If water seeps into the soil quickly, the roots will be longer and more rigid (left image)
- Aqua-4D alters the behavior of water in the soil, increasing the capillary effect
- This allows the water to penetrate into the minute pores and increase the water retention in the soil

- With Aqua-4D root development is enhanced. The development of hairy flexible roots allows better nutrition assimilation (to the right)



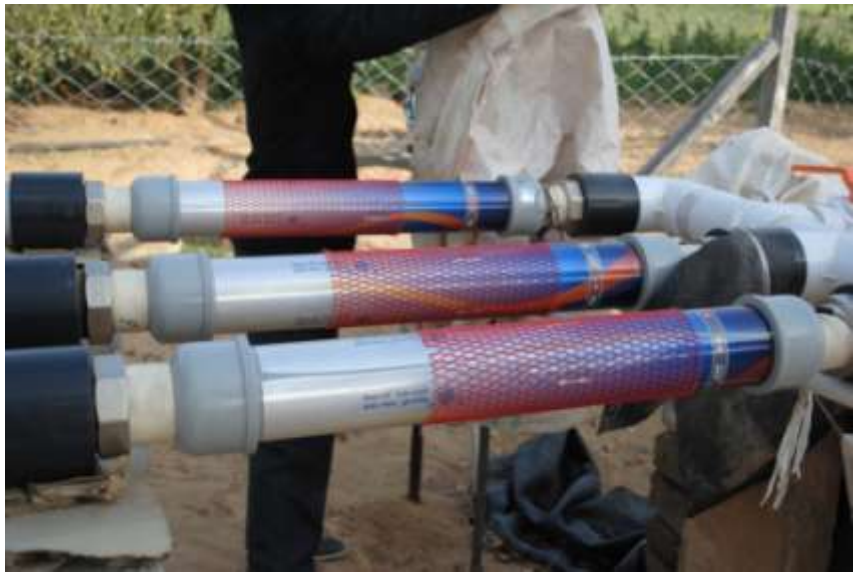
Better water retention in soil → healthier roots → increased harvests

Aqua-4D® project in India‘s desert

Context of the project

India will have to produce additional food for 200 million people, and improve the supply of food for much of the current population. This is a big challenge because a large proportion of agricultural land is already being exploited.

The Aqua-4D installed, solves simultaneously the problems of brackish water and poor soil quality. The treated water flow here is 65 m3 / h. The irrigated area is 8 ha. High yield is achieved at a much lower cost than the alternative method of RO



The systemic solution Aqua-4D® is a change of paradigm in agriculture in arid areas

Aqua-4D® project in India‘s desert

Field irrigated with untreated water

Field irrigated with Aqua-4D® treated water

The difference of the development of the crop is flagrant already after one month after sowing

Aqua-4D® project in India‘s desert

Field irrigated with untreated water

Field irrigated with Aqua-4D® treated water

Soil irrigated with Aqua-4D® has a higher humidity 5 days after the last irrigation than soil irrigated with untreated water 1 day after the last irrigation

Aqua-4D® project in India‘s desert

Root development with untreated water Long rigid roots, no soil around the roots, no structure of hairy roots

Root development with Aqua-4D® treated water

Flexible roots, soil adhering to roots, hairy roots

Aqua-4D® has a significant beneficial effect on root development

Aqua-4D® project in India‘s desert

Analysis of wheat before harvest

Without water treatment

- Degree of germination 40 %
- Plant height average
- 1.5´ (45 cm)
- 3 wheat corns per plant
- 3 to 30 grains per corn

With Aqua-4D® water treatment

- Degree of germination 100%
- Plant height average
- 2.5 ´ (76 cm)
- 8 wheat corns per plant
- 32 to 42 grains per corn

In this case the harvest will have more than doubled

Problems caused by Nematodes

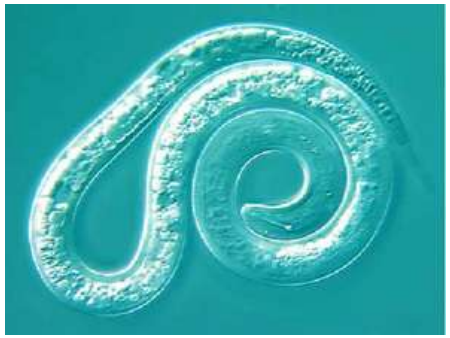
Problems

- Root knot nematodes destroy 18 % of the worldwide crop production
- They attack the roots of plants and thus weaken them until they die
- The problem is everywhere, in greenhouses and open fields, and is exacerbated in intensive cultures or monocultures
- Fighting nematodes is complicated because keeping the balance of microbiological life in the soil is essential

Solutions currently available

- Chemical nematicides are increasingly banned because potentially dangerous to human health
- Steaming and solarization of the soil have limited effects
- Rotation of crops, which is not always practical
- Soilless cultures, which are very expensive. Furthermore, they are not immune to nematodes.

Root knot nematode under the microscope



Root knot egg mass

Aqua-4D® - solution and advantages

Economic solution without toxic products

- Usually nematode population increases exponentially during a crop cycle
- Aqua-4D reverses the trend by gradually decreasing their proliferation
- Return on investment within one crop season
- The Aqua-4D effect is observed in all soil conditions, water and climate.
- As there is no biocide effect, microbial life in soil is not affected

Installation in Sicily for 22 m3/h

Aqua-4D® offers the only environmentally friendly universal system to control nematodes

Aqua-4D® - solution and advantages

Without water treatment

Same location
Same soil
Same crop

With Aqua-4D® water treatment

Aqua-4D ® acts on the reproduction cycle of nematodes and reduce their population to an acceptable level for the plants, without the need for nematicides

National Competence Center for Nematology Switzerland

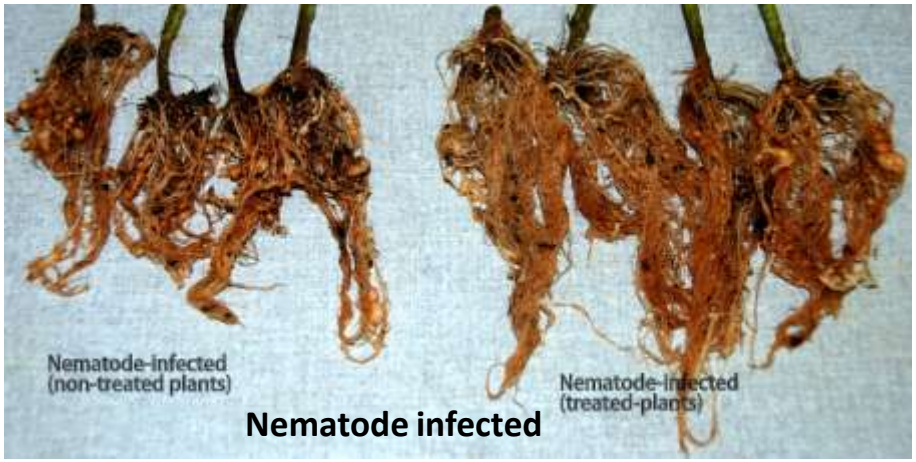
Summary of the report

A prototype greenhouse experimental set up was developed by ACW to evaluate the potential of the AQUA-4D system for root-knot nematode control. Under controlled greenhouse conditions **we found a clear reduction in root galling (damage) and significantly reduced numbers of egg masses** (= females producing new nematode eggs) on tomato roots. The test nematode species was the highly pathogenic and virulent tropical species *M. enterolobii* inoculated onto host plant (cv. Oskar) carrying a tropical root-knot nematode resistance gene. A range of parameters measuring plant growth / vigor and stress in relation to nematode penetration and reproduction revealed a measurable response of the host plant to treatment of the irrigation water with the AQUA-4D system. **This was the first scientific proof that electromagnetic water treatment can have an effect on root-knot nematodes, reducing damage on the host plant.** However, several questions remain on how this effect was achieved. A further important result was that only numbers of root-knot nematodes in soil were reduced by the AQUA-4D system, but the free living saprophagous nematodes (bacterial and fungal feeders) were not affected. This is an important pre-requisite of an environmentally benign nematode control system.

Project manager *Dr Sebastian Kiewnick, Agroscope Changins-Wädenswil - Research Station ACW*

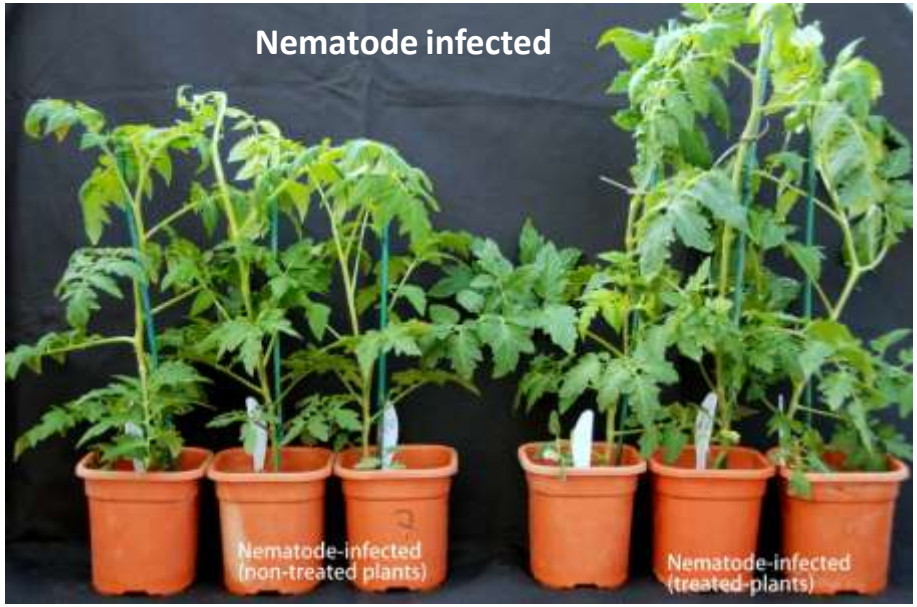
Division of Nematodology, Volcani Center, Israel

Result on roots



Non treated plants Treated plants

Result on plant growth



Non treated plants Treated plants

Aqua 4D® controls the activity of the nematodes to the benefit of the plant's growth

Additional benefits with Aqua-4D®

- Saving up to 30% the amount of fertilizer without yield loss
- Prevention and elimination of biofilms in irrigation networks
- Prevention of clogging of drips, jets and pipes
- Environmentally friendly
- No maintenance

Installation 45 m3/h in Morocco

Aqua-4D® concept

Two basic modules:

- An electronic device to generate preprogrammed electromagnetic signals
- Tubes specially designed to transmit signals in the water. According to the maximum flow to be treated, one or more tubes can be connected in parallel

An almost unlimited use ....

- Flow rates capacity from 0 to 4150 m3/h
- The Aqua-4D® technology works with a wide range of water chemistry.
- Effects are obtained with all pipe materials such as steel, copper, plastic …
- The efficiency is observed over several kilometers of pipe from the point of treatment.

Economic advantages of Aqua-4D® I

Reduced initial investments

- Allows development of crops on land with poor quality soil, as in arid areas
- Allows use of poor quality water and to reduce investment costs in water treatment
- In brackish water conditions, the investment into water treatment is reduced by more than 50% by a complete replacement or a substantial downsizing of the RO System.

Increased crop yields

- Losses due to nematode attacks are avoided
- In conditions of poor soil and/or poor water, harvests yield can be increased substantially
- More crop varieties can be cultivated, allowing an optimized answer to market demands

Benefits are achieved in all situations of crop production, but economies vary according to the specific situation

Economic advantages of Aqua-4D® II

Reduced operational costs

- Replacement or downsizing of RO systems reduces operational costs substantially
- The dosage of fertilizers is reduced by 30%
- Replacement of chemical nematicides
- Water usage reduced thanks to higher water retention capacity in the soil

Protection of equipments and collaborators

- Piping systems remain free of scaling, corrosion and biofilm
- Clogging of nozzles and drippers is reduced
- Need to handle toxic products is reduced or eliminated

All these benefits lead to a better image of the producer towards the market.
Contributes to the meeting of regulations forbidding usage of chemicals

Aqua-4D® : A physical water treatment to make agriculture more profitable

- Irrigation with brackish water without nuisance for plants
- Solution to eliminate the problem of nematodes without chemicals
- Good quality production with poor soil and water conditions
- Significant reduction in fertilizer usage
- Inhibiton of deposits and blockages due to fertilizer, limestone, biofilm, iron , manganese ...

Ecological and sustainable solution to help increase food security

Irrigation installation for 280 ha in Tunisia. Treated flow: 520 m3 / h

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