Crossroads Resource Center

7415 Humboldt Ave. S. / Minneapolis, Minnesota 55423 / 612.869.8664
kmeter@crcworks.org www.crcworks.org

Tools for Community Self-determination

A glimpse into a possible future of LED technology for growing greens:
Visiting the "world's most sustainable greenhouse" near Rotterdam

by Ken Meter, Crossroads Resource Center

Rob Baan and his business partners hope to define the future of micro-greens production at the Koppert Cress greenhouse near Rotterdam, in the Netherlands (www.koppertcress.com). During an early April, 2012, tour arranged by Erasmus University economist Jan Willem van der Schans,[1] Baan proudly showed off the firm's 11-hectare (27-acre) greenhouse. Here he aims to create the most sustainable indoor production system in the world.

Koppert Cress greenhouse near Rotterdam, viewed from the middle of the building. Photo © Ken Meter, 2012.

[1] Van der Schans also is affiliated with the Rural Sociology Department at the University of Wageningen, which paid my travel costs to the Netherlands so I could serve as keynote speaker for their April, 2012 conference, "Agriculture in an Urbanizing World."

The greenhouse is massive. Its roof towers more than 7 meters (twenty feet) above the floor, with fully automated glass louvers, run by mechanical levers, that can open or close vents across the greenhouse simultaneously. This high headroom leaves ample space for Baan to expand his growing technology vertically as he improves his technique. The greenhouse draws upon LED (light-emitting diode) lamps to help control plant production, but more fundamentally relies upon natural light flowing through the glass ceiling. Its wide footprint allows Baan and his 160 employees to expand production easily.

Yet the Koppert Cress greenhouse is more than an expansive growing space. It is a deeply integrated set of growing and mechanical systems that reduce the environmental impact of raising greens. Baan hopes this will give him a competitive edge in global markets, especially when combined with his location, a 45-minute drive from the Schiphol airport near Amsterdam. Surrounding that global airport are hundreds of firms that can convey fresh foods and flowers directly to cargo jets bound for world markets.

At the current time, Koppert Cress offers 18 varieties of cress, 33 microgreens, 16 specialty items, and four distinct mixes that combine small quantities of selected greens designed for high-end chefs. Indeed, Koppert Cress was designated in 2010 as the official James Beard House Purveyor of rare Micro-Greens, Micro-Vegetables, and Specialties. This recognition from one of the foremost centers of gourmet cooking brings great credibility.

Koppert Cress ships boxes of fresh micro-greens globally in easily stacked packages. Photo © Ken Meter, 2012.

Baan begins his interview by asserting, "Forget about growing food in the cities. The infrastructure we need is already in place here in Rotterdam. I can grow greens and ship them anywhere in the world cheaper than any new urban farm could. They would have to build the distribution capacity from scratch. That makes no sense when we have it all available right here."

He continues by drawing a diagram that shows his strategic approach: he attracts interest from gourmet chefs globally to prepare menus featuring his high-end micro-greens. They request his products from their wholesalers, who in turn ask Kopper Cress to supply their warehouses. Baan strives for lucrative markets—the kinds of restaurants where wealthy patrons can spend hundreds of euros for a meal that is custom-prepared from the world's freshest ingredients. He supplies what he considers the best micro-greens available to those chefs. By being the first in the world to develop such a comprehensive approach, and by positioning his firm as the most sustainable on the planet, Baan hopes to attract brand loyalty that commands high prices and a powerful place in the market.

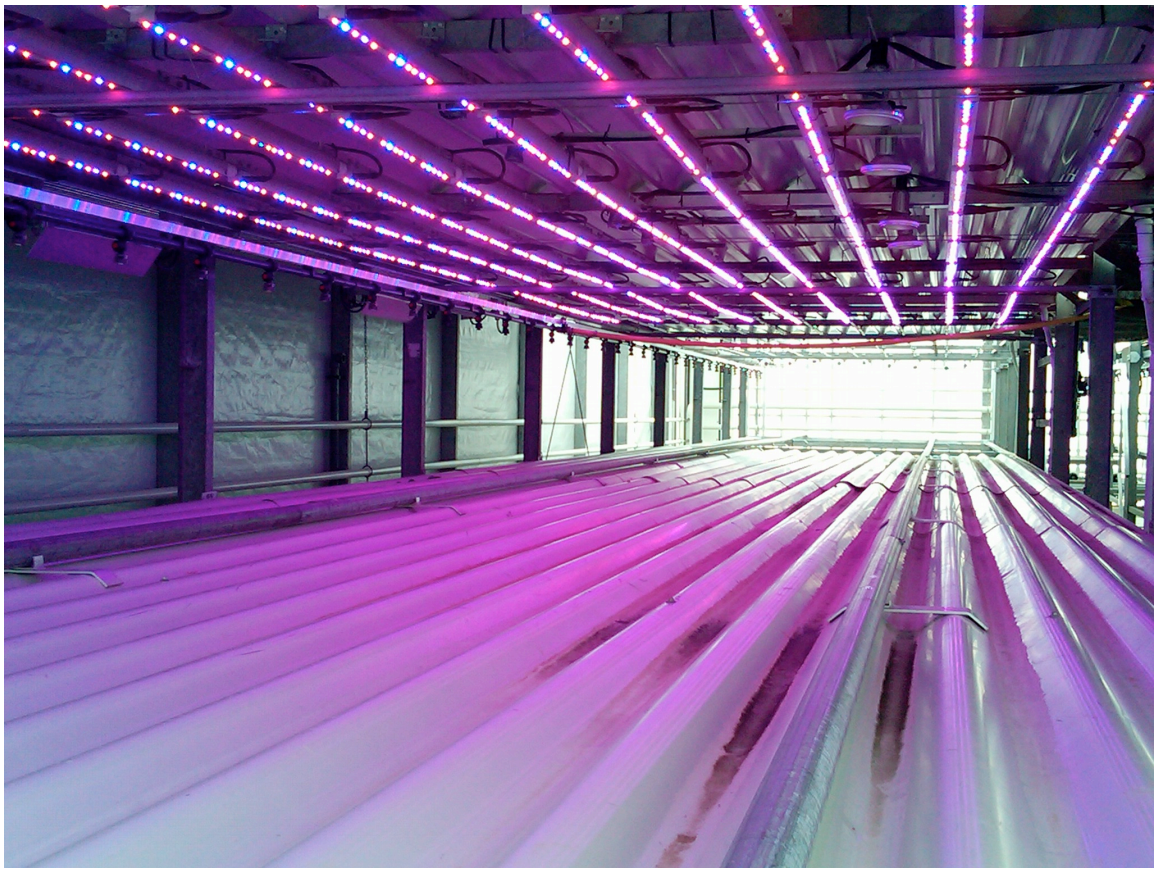
These greens can have striking flavors: As part of what Baan calls his "Architecture Aromatique," Baan ships stackable boxes of fresh greens by air. He waxes eloquently about the piquancy of his colorful greens, delighting to show how the taste of one green makes subtle changes as it interacts with the mouth where it is chewed.

Clearly, this gourmet approach is not for everyone. It depends on the ability of a businessperson to invest millions of euros to develop scientifically rigorous, effective production systems. It depends on the social investment of a Dutch government that has built highways, airports, and distribution capacities that command global respect. The model also depends upon private investment from nearby firms that can service the needs of a firm such as Koppert Cress. This approach would not work for a small community business. Yet there are technical lessons to be learned here.

Because his visitors were interested in LED-light technology, Baan leads them on a whirlwind visit of the production facility. Long, wide trays full of plants in bright-green and maroon colors spread out on both sides of a long aisle. Lines of tiny bright lights glow from near the roofline. Large portions of the greenhouse are still empty, awaiting new technology that is still under development.

Baan points out that he is now on his ninth generation of LED approaches. His earlier models relied intensively on LED lighting to control production, but he found this was generating too much heat, and costing too much electricity. Still, he keeps his original production line on display to show how his designs have progressed.

This early design used red and blue LED lights to exert maximum control over the plant's growth. Red light, Baan told us, is what plants require to grow. Since plant leaves are typically green, light close to the green spectrum is reflected off of the plant surface, doing very little to promote growth. By focusing only the red spectrum, Baan found he could achieve strong growth while spending relatively little on energy, since LED lights run more efficiently than incandescent lamps or compact fluorescent bulbs.



An early design for a LED-light growing area at Koppert Cress. Photo © Ken Meter, 2012.

Yet Baan also balanced that with applications of blue LED light: when exposed to the blue spectrum, he says, plants will develop a stronger, more intense flavor profile, but will not expend energy growing new leaves or fruits. In the chamber shown above, Baan can vary the amounts of red and blue light precisely to achieve whatever affect he wants. He can slow down plant growth to give it time to develop full flavor (and also to time it properly for sale), or he can lavish red light on the plants if he wants rapid growth.

Rob Baan demonstrates how micro-greens respond to red or blue LED lights. Photo © Ken Meter, 2012.

Holding a small pot of greens in front of the lights, Baan shows his visitors how his micro-greens respond to varying hues of LED light. Yet since growing greens in this chamber ultimately proved too expensive, Koppert Cress has now moved to a system that features smaller, more scattered LED lights, placed high on the beams of the greenhouse structure, augmenting natural light. Young seedlings are started inside intensely lit growth chambers; soon Baan will be able to move each tray of plants up through five levels as they grow, bringing them more directly into contact with sunshine at each new level.

While LED bulbs are well-known for disbursing less waste heat than other lighting options, Baan adds that they still give off enough heat that he wants to channel it away from his greenhouse so he can exert more precise command over the growing environment. Each LED bulb, then, is surrounded by a water jacket. This water circulates past the glowing lamp as it shines; this heated water is then diverted through pipes to a warm storage tank where it can be used either (a) to heat the greenhouse itself if the weather is cool, or (b) to be pumped below ground to be stored as warm groundwater, for later use. This will saves tens of thousands of euros in heating costs per month, he continues.

These new lights, as shown below, are far brighter per lamp, but much more widely distributed than the earlier lamps. They are also far cheaper to run—yet the installation costs are immense. The investment in the entire operation totals $24 million, Baan adds.

Ninth-generation LED lighting at Koppert Cress greenhouse. Photo © Ken Meter, 2012.

To see how this growing cycle plays out let us return to the plants themselves. Each plant begins its life as a seed purchased by the factory from custom growers—also partners in the Koppert Cress operation. When ready to be planted, these seeds are washed in bulk inside a specially designed machine. This removes potential contaminants, and also softens up the seed shell, prior to germination.

Next, the seeds are dispersed onto a hygienic cellulose medium, developed especially for Koppert Cress by a Scandinavian pulp processor. Cut remnants of lumber are mashed and washed carefully to create this growing medium, which Baan prefers to soil because there is little risk of contamination, mildew, or mold. Since it retains water well, the plants will remain in this medium all the way to the final customer. This means there are no transplanting costs. The cellulose is porous enough to allow the plant roots to penetrate, and to absorb the hydroponic nutrient solutions Koppert Cress has formulated for its micro-greens. The medium retains enough moisture that shipping is simplified, with less moisture loss than in soil. Once again, Baan likes this medium because of the control it gives his technicians over the growth process. Each seedling is subject to the same nutrients, temperatures, light profiles, and moisture as all others, so the final product is very consistent.

Seeds are placed on cellulose growing medium inside plastic trays. Photo © Ken Meter, 2012.

These seedlings start in a humid growth chamber. As they grow, they grow nearly identically:

Seeds grow nearly identically inside plastic trays. Photo © Ken Meter, 2012.

These trays are spread out along large flat surfaces under the proper light regime for each stage of growth.

Seeds grow on massive tables. Photo © Ken Meter, 2012.

Under the black tarp, young seedlings begin to germinate. Photo © Ken Meter, 2012.

An entire flat of micro-greens, over fifty meters in length, can be shifted from one level to another, or from one side of the greenhouse to another, to put each flat in the ideal growing conditions. A small tractor that can be operated by one grower rolls each flat out of one level and onto the next, minimizing labor costs.

Micro-green seedlings are can be shifted from one platform to another, or eventually, up to higher levels in the greenhouse, as needed. Photo © Ken Meter, 2012.

Finally, each tray of micro-greens is sorted into boxes for shipment. Koppert Cress features several mixes of micro-greens tailored to specific markets: The photo below shows special mixes of borage, different colored shiso greens, as well as lemon-flavored greens, each stacked and ready for palletizing for shipment.

Micro-green boxes stacked and ready for shipping. Photo © Ken Meter, 2012.

Rob Baan is as eager to show the overall system in place at the Koppert Cress greenhouse as he is the plants themselves. For a major selling point has become the fact that the operation is LEED platinum certified. Not only does Koppert Cress make use of waste heat from the LED lamps, it also recycles as much water as possible—an effort Baan says is made even more efficient because nutrient solutions can easily be reused, since they are not passed through soil. Solar photovoltaic panels help power the operation.

When asked how he feels the plant is positioned in the event of escalating oil prices, Baan says, simply, "We rely on electricity whenever possible." He believes this is relatively insulated from fossil fuel costs.

Koppert Cress factory near Rotterdam. Photo © Ken Meter, 2012.

A schematic diagram located inside the factory (see below) shows how water systems work. The red zone underground is water that has been heated using heat from the greenhouse's LED bulbs and other heat sources, which is pumped below ground during warm weather so it may be reused in cooler weather. The diagram includes an inside joke: The system is nicknamed "Ketel None," a play on a vodka brand name, because the system aims to lower fossil fuel use to none.

Baan says the temperature of the stored water may range as high as 40° C. He also expresses exasperation, since Dutch regulations do not currently allow him to store warm water underground. He is working strenuously to obtain a variance from current codes so he can

prove the concept of his system. He adds that authorities have been quite cooperative in the past, but he has to work hard to make a thorough case to them.

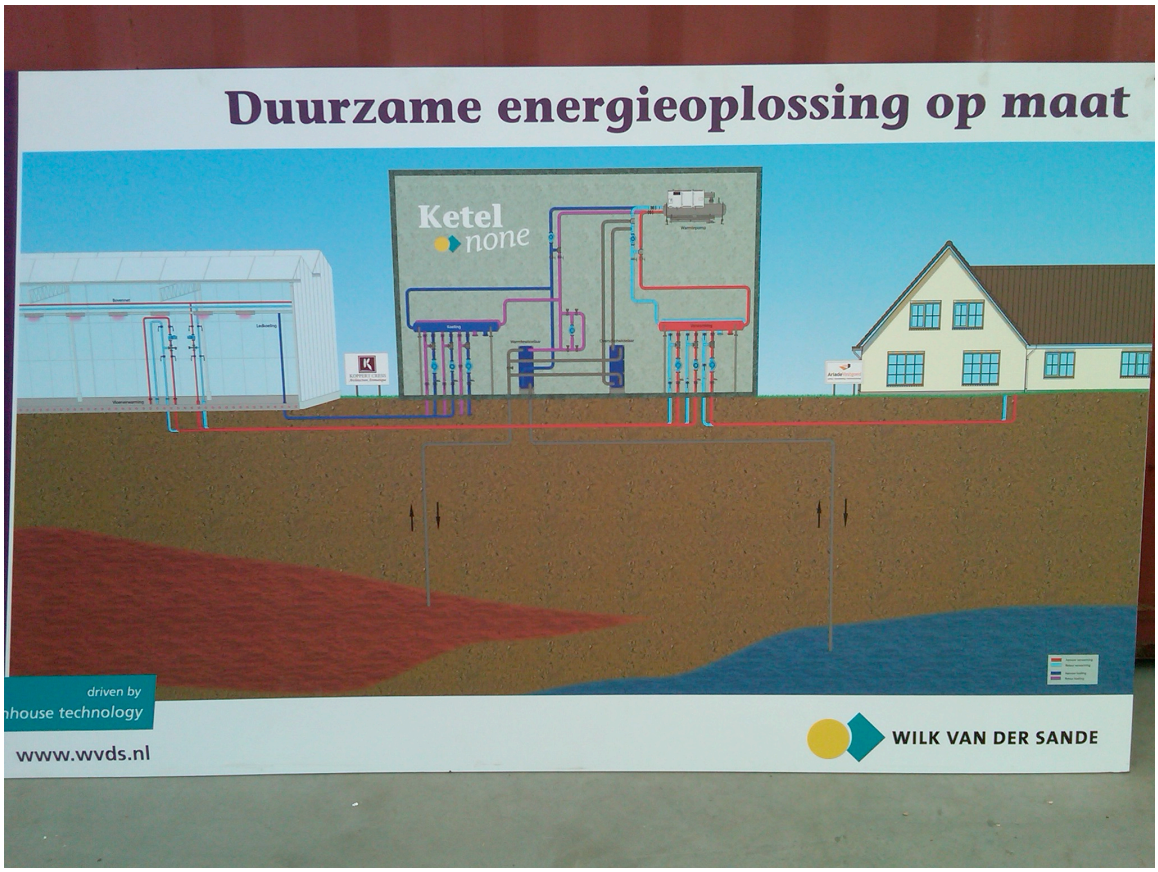


Diagram showing water flows through Koppert Cress factory. Photo © Ken Meter, 2012.

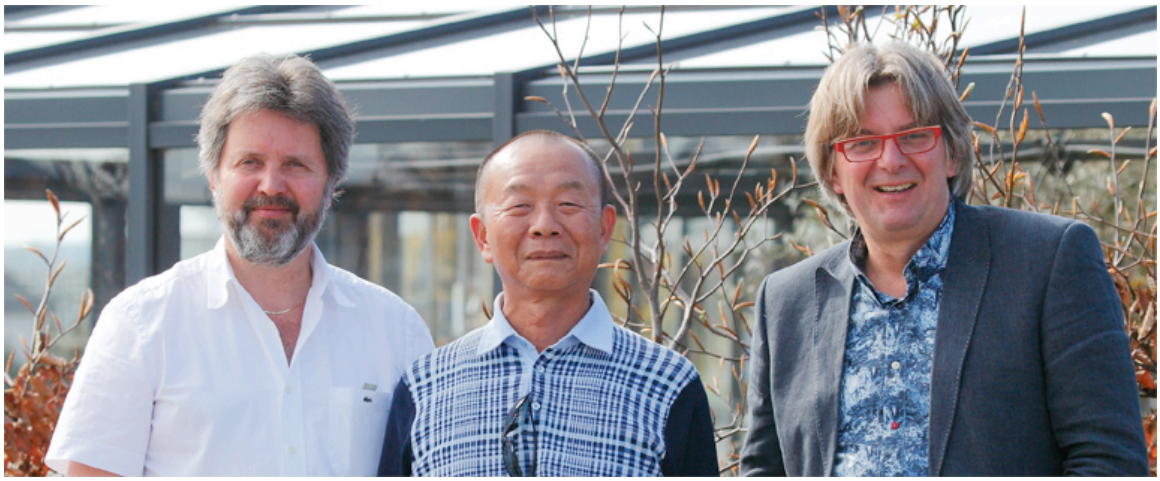
As shown in the diagram above, heated water from the greenhouse may be pumped into holding tanks in a central building, where it can be stored for later use, or pumped either into the adjacent office building, or stored as hot water underground (red patch below ground to left of diagram). In cold weather, this warm water will be sent back to the greenhouse to keep plants warm. In turn, cold water can pumped up from the blue reservoir on the right hand side if the weather gets hot.

Baan is only one of three partners in Koppert Cress, the firm's web site gives him credit for being the investor who launched the firm in 2002, by purchasing a predecessor.

Rob is considered the marketing and communications leader of the firm, which boasts on its web site that "Rob is constantly occupied with creating new products." Other partners include Theo Cuppen, manager of the seed companies and head of international logistics and finance, and Altai Lin, the manager of a variety of production locations in China and Vietnam.

In October, 2006, Koppert Cress opened a franchise operation in the United States, a 30,000-square-foot greenhouse located in Cutchogue Long Island, New York. Baan says the firm is also considering expansion into Japan and Germany.

At the other extreme, Baan shows his visitors a photograph of a prototype micro-production chamber, outfitted with trays and LED lamps, that would allow a restaurant to produce its own micro-greens in house, using Koppert Cress technology. He says this will be unveiled soon.



Theo Cuppen, Altai Lin, and Rob Baan lead the firm. Photo courtesy of Koppert Cress.

Contacts:

Koppert Cress
de Poel 1
2681 MB Monster
The Netherlands
www.koppertcress.com

Ken Meter
Crossroads Resource Center
7415 Humboldt Ave. S.
Minneapolis, Minnesota 55423 USA
www.crcworks.org