

# LED lighting systems will be more efficient



An in-line LED lighting system is already being tested.

Many growers want to improve the efficiency of artificial lighting. LED light is potentially 50% more energy efficient than traditional lights and in the Netherlands the first field trials with LED technology are taking place in commercial greenhouses. But there are still many questions to be answered and the research continues.

By Florentine Jagers op Akkerhuis

**M**ost growers who use artificial lighting in the greenhouse use high-pressure sodium lamps (HPS), because the light spectrum emitted from these lamps fits best to the Photosynthetic Active Radiation (PAR) required by plants for photosynthesis. However, the efficiency of these traditional lamps is very low because the lamps produce enormous amounts of heat. It is estimated that only 30% of the energy put into the lamps is actually used by plants for growth. This implies an undesirable loss of energy as well as the heat which affects the greenhouse climate.

Growers therefore want to improve the efficiency of their lighting system and the new technology of Light Emitting Diodes (LED) offers interesting possibilities. As a part of the Dutch Innovation program 'The greenhouse as energy source', the Dutch technical consultancy company KEMA presented in 2004 a

'roadmap for the horticultural business towards artificial lighting with LEDs'. This stimulated the research and development of the use of LEDs for artificial lighting in greenhouses in the Netherlands.

Several prototypes of LED lighting systems have since been developed for greenhouses and will be presented during the Horti Fair 2007 in Amsterdam and they will be tested in greenhouses over the coming months. However, the implementation of LEDs in greenhouses is still at a very early stage so it is expected that it will take several years before the technology is ready for commercial use in horticulture. The use of LEDs in laboratories with 'in vitro culture' could be used earlier because the efficiency of LEDs is comparable to fluorescent light. Also the use of LEDs in multi-layered cultures is already being considered as an interesting alternative.

## Advantages of LED

A LED is a small electronic device, which emits light of a specific wave length without producing heat (infrared). The colour of the emitted light depends on the composition and the condition of the material used, and can be infrared, visible or near-ultraviolet. Some important advantages of this light are:

- LEDs produce more light per Watt
- LEDs can emit light of an intended colour, for example the light which induces plant growth
- LEDs can be focused on the target
- LEDs can be dimmed
- LEDs have an extremely long life span (up to 50,000 hours)
- LEDs produce no heat on the source side
- LEDs can pulsate which can increase the energy efficiency by 30%

LED technology is developing rapidly, as the energy efficiency is interesting for many applications, such as traffic lighting and office lighting. The production of LEDs is still quite expensive, but some important technological steps have been made in the last year and as a result the price is falling.

## Questions

The use of LEDs to promote the growth of plants has posed many new questions. One of the most important is, which wavelength exactly is the best for the growth and the development of plants? Until now, artificial lighting has been based on a wide spectrum in the PAR-range with wavelengths between 460 and 720 nm. There is little experience with the effects of more red or more blue light on growth or on flowering. Is it possible to develop a device with a spectrum which is suitable for more than one crop? Researchers also want to calculate how much light, or more specifically how many photons with a certain wavelength, induce growth and development.

Another item of research is the efficiency of the LEDs. At the moment the amount of light per Watt electricity is still disappointing. The output of a LED is still less than half the output of the traditional HPS lamps. As a result LEDs are still much too expensive so technical companies are working hard to improve this aspect. Another problem is that while LEDs produce no heat on the front side of the lamp where the light is emitted, a lot of heat is produced at the back of the device. This needs cooling for two reasons. Firstly, the longevity of the LED decreases when the temperature is higher. Secondly, the wavelength moves when the LED becomes warm. The cooling devices which are available at the moment are still too big for greenhouse applications. Also, it has to be seen how beneficial insects in the greenhouse react to LED lighting and its affect on working conditions and safety, for example the human eye, have to be examined.

## Expectations

In 2004 the researchers from KEMA predicted that LEDs would be ready for commercial use between 2010 and 2015. According to the manufacturers of lighting systems this prediction has not changed although some niche applications will be introduced earlier. In the coming year experiments in laboratories as well as in greenhouses will offer more insight into the possibilities. Some larger initiatives, such as the plans of Flow Magic (see below) are followed with interest. ■

### LED LIGHTING TO MEASURE

Inventor Johan van der Ende of Flowmagic in Kwintsheul, the Netherlands, believes in the possibilities of LEDs and is ready to start despite many questions remaining unanswered. Flowmagic already has two years of experience with LED lighting on Danish trolleys for multi-layered culture. Further to this, Van der Ende, together with his son Mark, has developed the so-called Cluster LED 32 and the Cluster LED 160. These are devices with respectively 32 and 160 LED lights, which can be put together using different coloured LEDs. "Our philosophy is that one learns best by just doing things," says Van der Ende. "We talk with growers about their crop and their expectations concerning lighting. In our showroom they can see the effects of several LED lamps. Together with our customers we develop a device with a mixture of LEDs with different colours to suit the expected needs of the crop. After the light is installed we follow the results closely. We need to know how the plant reacts under the new circumstances. Of course, we know that you cannot simply replace a high pressure sodium lamp with a Cluster LED." In the past months they have installed Cluster LEDs in a limited number of commercial greenhouses, for pot plants, tomatoes and sweet pepper. The latest development by Flowmagic is an in-line-LED system, which will be introduced at the Hortifair.



The Cluster LED 32 is a device comprising 32 LED lights of different colours which vary depending on the needs of the crop.