

# DETERMINING THE POTENTIAL BENEFITS OF LEDS ON PLANTS



## Researchers at Wageningen University in the Netherlands are studying the effects of LED lights on the growth, flowering and fruiting of vegetable and ornamental plants in controlled environments.

By David Kuack

Dutch growers who are building new greenhouses or adding new grow lights to their existing operations are comparing high pressure sodium (HPS) and light emitting diodes (LEDs) when making their decision.

“At the moment there aren’t as many growers making the switch from HPS to LEDs,” said Leo Marcelis, head of chair group horticulture and product physiology at Wageningen University in the Netherlands. “Most growers who have made the investment in HPS lamps, they’re not just going to replace HPS with LEDs. It’s growers who are starting with a new greenhouse or who are retrofitting an existing greenhouse without lamps who are looking to install LEDs.

“The other growers who are adding LEDs are the ones who already have installed HPS and want to increase the light intensity and are adding LED interlighting. They are combining HPS top lighting with LED interlighting. This is occurring especially with the tall greenhouse vegetable crops like tomatoes. The HPS lamps are installed over the top of the crop and the interlighting LEDs are installed within the canopy.”

### Many unanswered questions

With the increased grower interest in LEDs, researchers at the university are focusing more of their studies on the effects of single and combined light wavebands on plant growth, flowering and fruiting.

“Most of the research we are doing on lighting is with LEDs,” Marcelis said. “High pressure sodium lamps are still the standard for most growers so the lamps are still relevant. But for our research there is not as much being done with HPS as with LEDs. We are focusing more on LEDs. The opportunities created by LEDs, there are so many questions still unanswered about using LEDs. As growers start to put in new lights they are making the switch to LEDs. We expect more of that to occur in the coming years.”

### Focus on controlled environment crops

Marcelis said greenhouse tomatoes are the largest crop in the Netherlands, even bigger than cut flowers such as roses and potted ornamental crops such as orchids.

“Tomato is the most important crop in our research. In the Netherlands there are about 1,700 hectares of tomatoes in glass houses. About 1/3 of that area is equipped with HPS lamps. There are about 1,200 hectares of sweet peppers in glass houses with only a few hectares equipped with HPS lights. The calculations are such that the economics are not that profitable for sweet pepper and cucumber. It is more economical and profitable to light tomatoes, not sweet peppers and cucumbers. There are more growers starting to grow strawberries in greenhouses who are using LEDs to control the day length. More growers are also using LEDs for assimilation lighting.”

Marcelis said lettuce is another crop that is being studied whether it’s grown in vertical farming setups in warehouse facilities

or in greenhouse operations. Roses and phalaenopsis orchids are the most important ornamental crops being studied.

“We currently aren’t doing any projects with cucumbers or sweet peppers using LEDs,” he said. “Since there are not as many growers using lights on these two crops, we are not focusing our research on them, but this could easily change in the coming years.”

### Focused on issues important to growers

Marcelis said most of the university’s lighting research projects are on greenhouse produce because that is the area of most economic activity in the Netherlands.

“Vertical farming is attracting a lot of attention,” he said. “We are also conducting research in climate chambers which can have application to vertical farming.

“We are looking at different aspects of lighting, including light spectrum and energy savings. Energy savings is an important issue with the growers so we are doing a lot of research on that. If the light used is more efficient, then there can be energy savings. Talking to the growers, year-round production, fruit quality and energy savings are the issues they’re interested in. If growers can increase production with the same amount of light, then there is an energy savings.

“The majority of lights are used for assimilation. They are primarily used from



*Photos courtesy of Leo Marcelis, Wageningen University*



Breeding researchers at Wageningen University are working in cooperation with commercial breeding companies to screen different genotypes to determine any variation under LED lights.





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September through April. The greenhouses are equipped with climate control and the growers are measuring outside radiation. If the outside radiation falls below a designated level, then the lamps are often turned on. The growers typically choose a time frame during the day. From September through April all of the lights are used. After April then the lights might be used during relatively dark days.”

## Looking at plant processes

Marcelis said the researchers are doing a lot of studies on photosynthesis and the morphology or architecture of the plants.

“Affecting the morphology impacts the light absorption of plants and the light distribution,” he said. “We feel light distribution is a very important issue where improvements can be made. We also do work with three dimensional assimilation models. From light absorption it goes to total growth of the plant as a whole. Another area of research is the distribution of assimilates among the different plant organs.”

Marcelis said there is also some preliminary research that indicates plants can be made more resistant to diseases, particularly increasing the resistance of roses to powdery mildew.

“We have done experiments that have indicated that we can improve disease resistance. Flower induction is also very important. It can be done now with controlling photoperiod, but can it be done using different spectra?

“There is also some work being done on the quality of the plants. Is it possible to focus the light on the tomato fruit in order to increase the vitamin C content? Some of the same things can be done with lettuce. We are also starting to look at post-harvest qualities. So

we are looking at not only what can be done during cultivation, but also can the post-harvest quality of the fruit be improved. This also includes lengthening the shelf life of lettuce and cut flowers.”

Marcelis said studies are also being conducted in cooperation with commercial breeding companies and breeding researchers at the university.

“One of the projects is screening 40 different genotypes, including commercial cultivars,” he said. “One study is looking at the variation between genotypes under LEDs. The breeders will look at the variation between genotypes and try to determine why the variation is occurring. What parts of the plant are affected? Can breeders predict if varieties will do well or not so well under certain wavebands?

“There are all of these different genotypes. Some do better under white light than a mixture of red and blue. Some genotypes are showing better results under red and blue light. They all don’t respond similarly. For breeders it means there is a lot of opportunity and room for improvement. Since the focus is on using LEDs with tomatoes that is where most of the breeding research is being done.” 🌱

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