

# CoolGrow<sup>®</sup> Linear

The unique grow light system for  
multi-layer plant cultivation



## Performance

- Market leading light efficacy up to 3.0 $\mu$ mol/J
- Up to 180 $\mu$ mol/s PPF light output per bar
- Flexible light recipes for optimal crop results



## Modularity

- Controllable light output to match cultivation stage
- Unique light distribution
- Both vertical and horizontal light setup



## Quality

- Extreme life time 50.000hrs – L90
- 5 years warranty
- IP 66 dust and water proof
- High quality and sustainable materials

## Introduction

The CoolGrow<sup>®</sup> Linear LED grow light offers a unique platform for single and multi-layer crop cultivation plant factories.

Where in traditional light setups many times a big part of the produced light isn't used in an effective way, with the CoolGrow<sup>®</sup> Linear everything becomes just that little more effective what makes the difference at the end.

By positioning the LED grow light bars as close as possible towards the crops, all the produced light is steered in the crop in the most effective way.

Also the generated heat, although less present than in other grow light technologies, will in this way make a positive contribution to the stomatal opening and plant activation.

The light intensity on the plant canopy can be determined by the distance to the crop, the number of light bars on the surface as well as by light output controls on the lamps itself.

In this way you can optimize the PPFD needed light level on the crop to the growth stage of the plants.

The CoolGrow<sup>®</sup> Linear can be installed in a horizontal setup with each lamp parallel to each other and bridged by a cable as in most tradition grow light setups, but can also be directly interconnected to each other to generate a long line of light in the grow rack installations. This last method saves a lot of cabling and delivers an overall more neat installation over the canopy.

Because we can't explain all potential cultivars and crop stages in this brochure, we limit ourselves here on potential setups for leafy greens and salads, medicinal cannabis vegetative growth and flowering and multi-layer strawberry cultivation techniques.

Of course the potential of the CoolGrow<sup>®</sup> Linear goes much wider than these, so would you have specific cultivation requests just let us know and our plant lighting experts will be pleased to advise you.



*Grow rack example with 3 layers of 8 feet by 4 feet – total growth canopy surface 96 square feet – layer height 2 feet*

*With horizontal lamp setup interconnected with loop cable  
8 lamps per unit – 24 lamps per grow rack*

*With linear daisy-chained lamp setup – 4 lines of 2 lamps in  
the length – 24 lamps per grow rack*

## Plant factory system Salads & Microgreens

Seen the compact plant structure with limited height, the overall moderate needed light level and the relatively short grow cycles most leafy greens and microgreens are ideal for multi-layer cultivation methods. As thus thousands of large and medium scale plant factories specializing on leafy greens have seen the light in the last decade based on a good commercial crop model.

Key for grow light installations for leafy greens is an as low-as-possible initial capital investment without compromising on lamp quality and crop growth result.

Next to that the operational running cost which is highly impacted by the energy consumption of the grow light system is an absolute point of attention. The light efficacy system (expressed in  $\mu\text{mol}/\text{J}$  or  $\mu\text{mol}/\text{W}/\text{s}$ ) determines seen the long photoperiod a big part of the financial efficiency of a plant factory, and can show serious variations between manufacturers and models.

As an example a typical plant factory grow light setup for butterhead lettuce with high light level PPFD  $250\mu\text{mol}/\text{sm}^2$ .

A plant factory setup with 12 grow units of 8 feet by 4 feet each (32 square feet per unit, 384 square feet total) needs a total of 48pcs of CoolGrow Linear lamps, on each shelf placed in a linear setup with 2 rows. Each lamp consumes 60 watts so the total hourly power consumption is 2.88kWh. In this example our setup runs 280 days per year at photoperiod of 16 hours per day, 4480 hours per year, so good for a daily light dose DLI of  $14.4\text{mol}/\text{d}$ .

The total annual power consumption is 12.9MW.

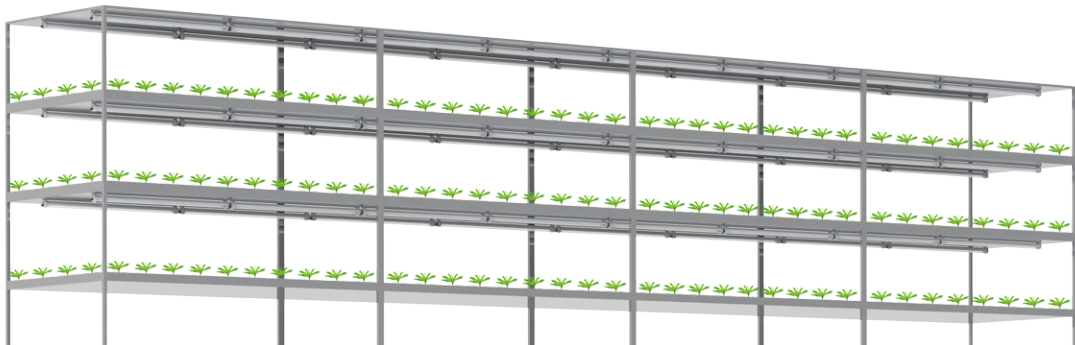
The investment cost with a depreciation on 7 years would come around 1250USD per year while the energy cost calculated at 77USD per MW would result in 993USD per year.

As a result the total cost per square foot is 5.84USD during the depreciation period, and drop down to 2.59USD after the depreciation.

The major reason of the moderate operation cost comes from the high efficacy of the CoolGrow® Linear LED grow light, with an efficiency of  $3.0\mu\text{mol}/\text{J}$  with this spectrum for leafy greens.

To demonstrate the importance of light and spectrum efficacy, a similar system with a light efficiency of  $2.3\mu\text{mol}/\text{J}$  would have a major impact on both capex and opex.

To reach a light level of  $250\mu\text{mol}/\text{sm}^2$  you would need 30% more lamps and capital, while the energy cost would raise with the same 30% overall.



Plant Factory setup butterhead lettuce 3 layers – 384 square feet cultivation area – 16.000 crops per year – light level PPFD  $250\mu\text{mol}/\text{sm}^2$

## Plant Factory system Medicinal Cannabis Veg and Flowering

While seeing daily new licenses being released and new global regions being legalized in both medicinal as recreational cannabis cultivation, the need for system efficacy in growing repeatable high end crops also grows exponential.

Classic cultivation methods are replaced by advanced multi-layer plant factories.

Shorter compact morphology, more plants per square feet with a higher overall yield, a perfect controls on plant quality and composition, prevention of pests, shorter growing cycles and more optimal use of the resources all plea for controlled multi-layer cultivation methods.

For an optimal plant balance at higher artificial light we recommend a rather broad growth spectrum, with a good balance between system efficacy, plant health and yield.

The use of far-red photons is in this case not recommended (typical wavelength 730nm) as these mainly lead to stretch and longer internodes while our aim here is to steer towards a more compact morphology and controlled growth.

The use of supplemental UV-A or UV-B photons can be considered if it fits with the growth goal, but we recommend to use this more towards the end of the cycle and separate from the photoperiod with the basic growth spectrum as the high rate of blue photons of the basic spectrum will decrease the efficacy of the UV-A and UV-B photons on the crop.

## Rooting and vegetative stage in the same grow rack setup

Both in rooting and vegetative stage the crops need a relatively high dose of blue photons in the light spectrum.

The light intensity and photoperiod needs to be adapted to the growth phase and increasingly be augmented towards the end of the vegetative phase.

In this way a stronger rooting base, thicker stems and a healthy compact crop which is tuned to go in flowering can be obtained.

To enable this the CoolGrow<sup>®</sup> Linear can be equipped with the CoolControls<sup>®</sup> digital BLE controls.

Both light intensity as photoperiod can be set in a calendar scheme running on a cloud application, while no extra cabling is needed on the lamps itself.



## Plant Factory setup for vegetative cannabis growth

In the vegetative growth phase we aim for a short growth cycle with uniform crops and a strong rooting, a high biomass with thick stems which will later lead to a higher overall yield. The photoperiod can be build up from 18 hours to 24 hours but can also be maintained in the long-day period at 18 hours over the whole cycle.

As an example a 3 layer setup with on each layer a canopy of 8 feet by 4 feet = 32 square feet per layer, 96 square feet in total.

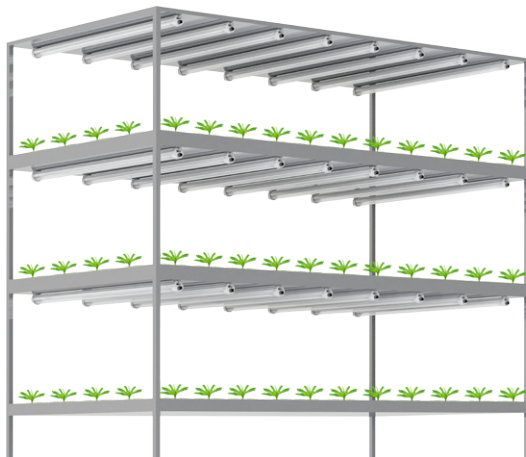
Light level PPFD 420 $\mu$ mol/sm<sup>2</sup>.

Light spectrum high blue broad spectrum – concentration on root development – short vegetative cycle with compact plants.

8 lamps CoolGrow<sup>®</sup> Linear per layer – 60 watts per lamps – 15 watt per square feet

Photoperiod 18 hours – DLI 27 mols/day.

The lamps can either be placed with 8 bars in parallel next to each other, or in 4 rows of 2 lamps in the length.



*Grow rack setup vegetative growth  
8 lamps per canopy layer  
PPFD 420 $\mu$ mol/sm<sup>2</sup>*



*Grow rack setup vegetative growth  
8 lamps per canopy layer in 4 daisy-chain lines  
with reduced cabling  
PPFD 420 $\mu$ mol/sm<sup>2</sup>*

## Plant Factory setup for flowering cannabis

2 layer plant factory setup with per layer a cultivation area of 8 feet by 4 feet = 32 square feet, 64 square feet in total.

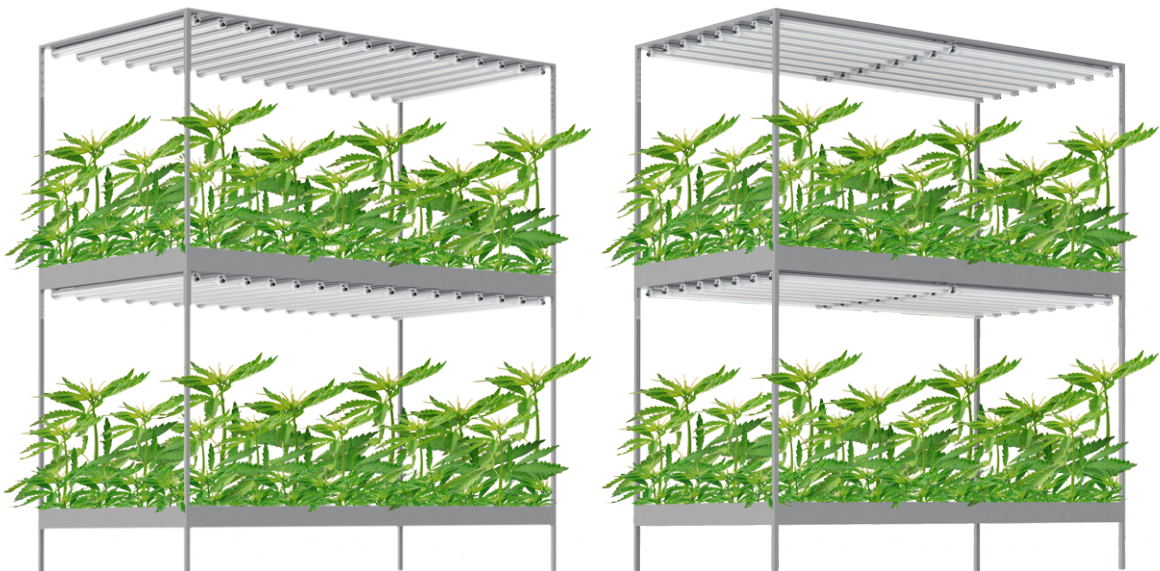
Light level PPFD 840 $\mu\text{mol}/\text{sm}^2$ .

Light spectrum broad generative – concentration on flowering and homogeneous crop development. 16 CoolGrow<sup>®</sup> Linear LED grow lamps per layer either parallel next to each other or in 8 rows over the length daisy-chained.

60 watts per lamp – 30 watts per square feet.

Photoperiod 12 hours – DLI 36 mols/day.

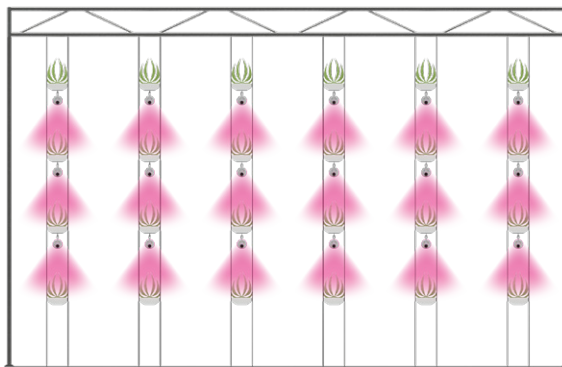
The light intensity and photoperiod can easily be controlled either by a simple dimmer (0-10 volt or PWM) or by the CoolControls<sup>®</sup> BLE digital controls option.



## Multi-layer strawberry cultivation in greenhouse or plant factory

Extension with new greenhouses, building permits, staff management on multi-locations, split processing halls,... all aspect with which we are all confronted and which we rather would avoid. Strawberry growers have already been through a major evolution over the past decades – from open field to modern gutter systems with swing system for space optimization in the greenhouse cap even up to alternating lifting gutter methods.

With the CoolGrow<sup>®</sup> Linear we aim even a bit higher and work on a bright future for strawberry growers with multi-layer cultivation in greenhouses and plant factories, with normal seasonable plantings as well early and late and real winter growth.



*Multi-layer strawberry gutter system for optimal use of space in a greenhouse*

On various locations in Belgium and the Netherlands we are conduction multi-layer greenhouse strawberry growth trials, together with our customers and under supervision of professional researchers and plant consultant.

In the first phase we aim at classic seasonable plantings in December or January, where we add an extra above the existing greenhouse setup – this means we go from the classic 8-gutter per cap setup now to 16 gutters per cap.

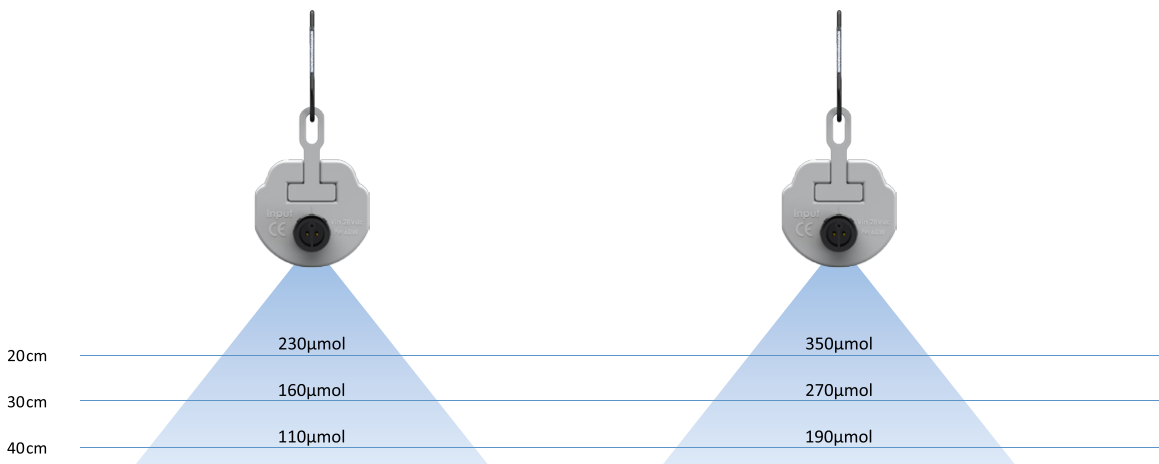
The light deficit which arises on the lower rows by the blocked light from the upper plants is compensated with CoolGrow® Linear bards daisy-chained and placed directly under the upper gutter. The plant trials are mainly conducted on Juneberry cultivars like Sonata, Elsanta, Sonsation, Clery and Malling Centenary.

Together with the market leaders in plant gutter systems and greenhouse automation we look already further in the future to enable 3-layer and even 4-layer strawberry cultivation systems.

Also plant factories or vertical farms without natural daylight show the first positive results and will be part of the future of the CoolGrow® Linear.

*CoolGrow® Linear 40W*

*CoolGrow® Linear 60W*



The CoolGrow® Linear is available in a 40 watts and 60 watts execution – the lamps need to be placed 8 to 12 inch above the canopy height of the mature grown plants.

For classic seasonable plantings and early and late plantings we recommend the 40 watt CoolGrow® Linear version as this fits perfect with the needed light intensity and daily light sum what is needed.

For real winter cultivation the 60 watts version is a perfect match, but the light intensity needs to be build-up from average 100µmol/sm<sup>2</sup> on the young plants to 250-300µmol/sm<sup>2</sup> during the production.



## Light Distribution and Heat management CoolGrow® Linear

With regards to light distribution we have opted for a wide beam 120 degrees output.

In this way you can easily obtain a perfect flat light level over the whole canopy with a limited number of light bars, what makes the system also suitable for lower crop light levels. Light distribution simulations can be made by our engineers for your project – you just need to let us know the practical details.

We do recommend to re-reflect the light losses from the sides of the grow racks back towards the canopy as this generates a major increase in useful light level and efficacy.

The limited heat generation of LED grow lights fits perfect with the cultivation of colder cultivars like microgreens and leafy greens, but also creates major climate advantages in lighted crops with high light levels like medicinal cannabis.

LEDs definitely also produce heat, but the major differentiator compared to other lighting technologies comes from the amount of heat which is generated and the kind of heat.

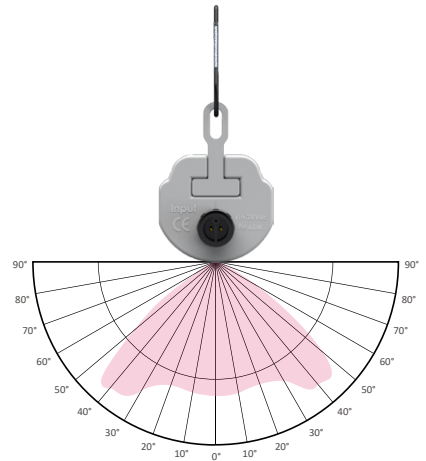
An HPS SON-T lamp of the latest generation has an efficacy around 40%. That means that a 1000 watts HPS SON-T produces 40% of light and 60% of heat or 600 watts of heat.

Since a HPS SON-T lamp becomes extremely hot, the majority of this heat loss (90%) goes to radiated heat or IR radiation. As a result this technology doesn't allow the lamps to hang too close to the crops, what would lead to tip burn and damage on the stomatae.

At higher light levels the overall lower efficiency leads directly to serious climate conditioning challenges and an increased cost not just by lower light efficiency level, but also by extra costs to keep the climate right.

Radiated heat does not have only disadvantages – the long wavelength of the IR radiated heat makes that it can penetrate deep into the canopy, what leads on many cultivars to extra activation and opening of the stomatae. The radiated heat also raises the leaf and plant temperature when it penetrates the tissue.

In general when people switch over from growing under HPS SON-T lamps to growing under LED technology, adaptations to the climate settings are an absolute must to obtain optimal results.



CFL or fluorescence lamps (many times in the format of a linear TL) are frequently deployed for micro propagation and in crops with a limited light need, but have a very low efficiency of only 20%, what means that just 20% of the energy goes to light and 80% goes to heat.

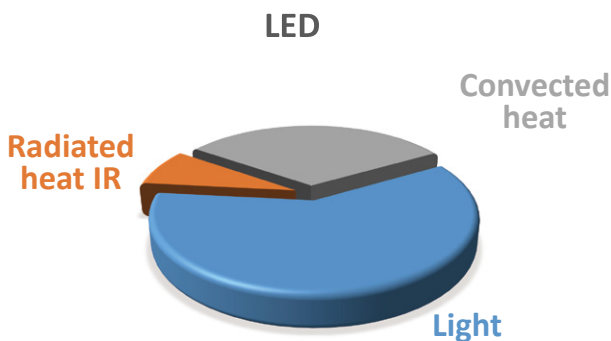
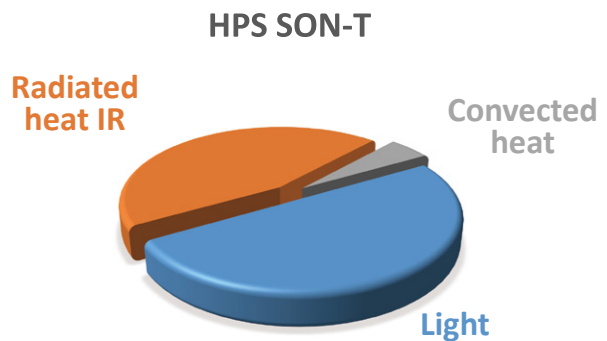
A LED grow light at this stage has an average efficiency of 50%, so still 50% of the energy applied to a lamp goes to heat.

Seen thermal design at a low temperature is an absolute must in LED grow lights to obtain a long life time, this heat goes mainly to free air convection, so heat which goes up in the air.

This makes LED grow lights ideal for plant factories and vertical farms, where the lights are placed close to the crops to obtain an optimal use of the available height of the room.

As we still want to use the heat loss in the most optimal way, we have designed the CoolGrow<sup>®</sup> Linear in this way that the chassis of the lamp will stabilize at 40°C at an ambient temperature of 23°C.

In this way we have created an artificial grow tube where the energy loss can be used in a positive way.





SPECIFICATIONS	
Light Source	CoolGrow® LED
PPF	CoolGrow® Linear 40 - up to 120 $\mu$ mol/s CoolGrow® Linear 60 - up to 180 $\mu$ mol/s
Input Power	CoolGrow® Linear 40 - 40 watt CoolGrow® Linear 60 - 60 watt
Efficacy	2.5 $\mu$ mol/J – 3 $\mu$ mol/J
Input Voltage	90-305 Vac or 249-528 Vac
Fixture Dimensions	L118 x B5.5 x H7.7 (cm) - L 3.9' x W2.15" x 3"
weight	2250 gr
Dimming	0-10V, PWM, DALI, CoolControls® BLO wireless
Light Distribution	120°
Lifetime	50.000 hours – L90
Power Factor	> 95%
Warranty	5 year



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