

# Future of Cannabis Cultivation - Part 2

**Achieving Higher Dried-Flower Yields and Consistent Quality: Grodan and F1SeedTech's Hybrid Seed Trials in Cannabis Cultivation**

**Rooted  
in science**



**Designed to grow  
together**



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Grodan, in ongoing research trials in Canada together with F1SeedTech, has achieved significantly higher yields of dried flowers and maintained stable levels of THC and terpenes, without requiring extra inputs such as energy and water. The new findings will be used by both companies to further enhance their guidelines and advice for licensed cannabis growers in North America and beyond. "Uniformity, predictability, and repeatability are key if growers are to be able to scale up profitably. Our trial data shows that it is possible to achieve this by combining our steerable stone wool growing media with F1 hybrid seeds," states Grodan's Frank Janssen, R&D Project Management in Grodan's Applications & Development department.

In the fast-moving cannabis sector, speed and scalability are of the essence. Grodan and F1SeedTech share a commitment to helping licensed growers stay ahead of the rapid advancements. "Some cannabis growers come from a background in the legacy market, so they are looking for help to professionalize and scale up their operation. Other growers have moved into the industry from other crops. They are discovering that cannabis is a whole different ball game, requiring different strategies," says Chad Rigby, Crop Specialist for Grodan in Canada.



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## Rooted in science

In both those cases, Grodan can provide advice and support that is rooted in science thanks to its long-standing expertise in various Controlled Environment Agriculture (CEA) crops. "Meanwhile, we are continuously expanding our knowledge in cannabis and other high-tech crops by conducting research programs with valued and equally experienced partners such as F1SeedTech. The company's F1 hybrid varieties provide the stability required for truly scientific research and performance testing aimed at high-level optimization," Janssen adds.

Cultivation starting from seeds rather than from cuttings offers a lot of benefits for licensed cannabis growers, according to Maikel de Bresser, Operational Manager at F1SeedTech. "Above all, using the same variety every time enables them to optimize their growing conditions to achieve uniform and consistent results, especially when using Grodan's stone wool growing media," he says. "As a clean and uniform growing medium stone wool

provides the optimal basis for stable and repeatable outcomes, because all the plants react in the same way to any changes made to the growing conditions."

In previous trials at Wageningen University & Research (WUR) in the Netherlands, the two companies have demonstrated that Grodan's stone wool growing media support consistent plant growth and health thanks to precise steerability of the root zone. "The results from such trials enable us both to offer detailed and dependable guidance to our customers on how to maximize the potential of a particular variety in the most efficient way. This ensures the best balance between cultivation costs and final yield," continues De Bresser.



## Transferring knowledge in North America

As a next step in their collaborative partnership, the two companies are now conducting a series of research trials at the CRIC Labs research center in Montreal, Canada. “Needless to say, North America is a very significant, mature and regulated cannabis market. Conducting fundamental research at the state-of-the-art CRIC facility helps us to factor in the local product lines and configurations to enhance the practical application of the findings for local growers,” explains Rigby. “Additionally, it strengthens the knowledge transfer in this region. For example, in May 2024, we organised an event at the research location for customers from Quebec area. Besides presenting the trial results so far, we also invited a number of external experts to share their market insights.”

De Bresser adds: “CRIC Labs is one of the most high-tech laboratories offering a highly controlled environment, and is therefore the ideal location for us to push our F1 hybrid varieties to the limits. This allows us to generate valuable data and insights into their performance under high-tech indoor conditions. Besides this, it is a great showcase for our research because existing and potential customers from throughout North America are able to visit the center and see the F1 hybrid varieties first-hand.”

## Validating and building on the previous results

The research program started in mid-2023 and will run until the end of 2024. “To ensure comparability of the results between all trials in this phase of the program, we are using the same two F1 hybrid ‘auto-flowering’ varieties as we used in our European trial with Grodan. Intensive breeding over the past eight years has helped to overcome the lower THC values and disappointing flower quality that previously gave auto-flowering genetics a negative reputation. Today’s auto-flowering

genetics offer many benefits over short-day crops,” says De Bresser.

In the European trial, the research partners concluded that it was possible to boost the gross margin in cannabis cultivation by at least 15% by shortening the cycle. This increased the total number of crop cycles per year to 5.5, resulting in an annual total dried-flower production of 6 kg/m<sup>2</sup> (1.23 lb/ft<sup>2</sup>). Moreover, the THC level was consistently high across the various production batches.

These previous findings have been validated in the first half of the current program. “We are now using this knowledge to identify the most efficient and optimal growing conditions for each F1 hybrid variety on Grodan’s stone wool growing media,” he states.

With a couple more months still to go before the end of 2024, Rigby is more than pleased with the progress made so far. “We have adapted certain parameters in each growth cycle. And each time, it has delivered improved results. For example, over the course of the first three trials, we increased the dried-flower yield from 1.2 kg/m<sup>2</sup> (0.24 lb/ft<sup>2</sup>) per cycle to 1.7 kg/m<sup>2</sup> (0.34 lb/ft<sup>2</sup>) per cycle.” Based on a 66-day cultivation period, this results in an annual dry flower yield of 9 kg/m<sup>2</sup>. (1.84 lb/ft<sup>2</sup>) (see Table 1).

**Table 1.** Learnings and developments from Trial 1 till Trial 3

*Data collected during August-October 2023 (Trial 1) and March-June 2024 (Trial 3)*

Parameter	Unit	Trial 1	Trial 3
Dry flower yield per cult. area	kg.m <sup>-2</sup> (lb.ft <sup>2</sup> )	1.2 (0.24)	1.7 (0.34)
Transplant to harvest	days	53	66
Cycles per year	-	6.5	5.5
Dry flower yield per year <sup>#</sup>	kg.m <sup>-2</sup> .year-1 (lb.ft <sup>-2</sup> year <sup>-1</sup> )	7.8 (1.56)	9.4 (1.87)
Total THC	%	21.6	20.1

*# 1000 PPFD*



## The sweet spot for energy efficiency

One factor that helped to boost the yield was an increase in the light level. “However, the light cannot be increased indefinitely. At some point, the plant won’t be able to make optimum use of all the light it receives, meaning that some light – and therefore some energy – is being ‘wasted’. We want to identify that ‘sweet spot’ to help growers to maximize the dried-flower yield and quality while also minimizing their resource use,” explains Janssen. “Therefore, we analyzed the light use efficiency (LUE) ratio to tell us how effectively the plants were converting the light energy into biomass through photosynthesis and, by extension, how growers could potentially further optimize their productivity from an energy perspective (see Table 2),” he continues.

**Table 2.** Effect of light level on yield and THC level  
Data collected during March-June 2024 (Trial 3)

Parameter	Unit	800 PPFD	1000 PPFD
Dry flower yield per year <sup>#</sup>	kg.m <sup>-2</sup> .year <sup>-1</sup> (lb.ft <sup>-2</sup> .year <sup>-1</sup> )	9.0 (1.81)	9.4 (1.87)
Light use efficiency	g.m <sup>-2</sup> .mol <sup>-1</sup>	0.51	0.44
Total THC	%	19.6	20.1

<sup>#</sup>5.5 cycles per year, transplant to harvest 66 days

For F1SeedTech, this trial has reaffirmed that its auto-flowering varieties are very capable of handling 18-hour days with light intensities of up to 1,000  $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$  for the whole cycle. De Bresser: “We are continuing to explore these parameters in the remaining cycles of this research program. We will use our conclusions to develop a roadmap so that growers know exactly what they can expect in terms of yield and efficiency when they use different light intensities in combination with our F1 hybrid varieties on stone wool growing media.”

## Testing the limits of EC for yield

Under high light conditions, it can be challenging to maintain the right balance in the root environment to safeguard plant health. This is because the increased rate of photosynthesis causes more transpiration in the plant, leading to greater water and nutrient uptake.

“Our stone wool growing media are uniquely designed with excellent drainage and aeration. This enables growers to precisely control the root zone, maintaining a consistent water content and delivering water efficiently without waterlogging (see Graph 1),” comments Rigby. “Additionally, root zone conditions can be continuously monitored, measured and analyzed using our [GroSens sensors and systems](#). Therefore, we are also using this

trial to see what happens under different irrigation conditions and with different treatments, in particular related to the EC levels.”

“We started this research program with the same irrigation strategies as in our previous trial in Europe. However, in the first ‘commissioning’ cycle at CRIC, we discovered that the plants were ‘hungry’ and needed more nutrition than expected to sustain growth,” adds Janssen. “So we decided to experiment with two different EC levels: a ‘low’ level, which is actually the standard level, and a ‘high’ level to really test the limits.”

The team can already conclude that the higher EC level produces a significantly higher dried-flower yield (see Table 3). “We’re now at the equivalent of one extra kilo per year, and further optimization will probably increase this even more. The bottom line seems to be that these high light intensities – in combination with optimal climate and CO<sub>2</sub> conditions – enable the plant to take up more nutrients and grow faster,” he states.

**Table 3.** Effect of EC level on yield and THC level  
Data collected during November 2023-February 2024 (Trial 2)

Parameter	Unit	Low EC (2.7 mS/cm)	High EC (3.7 mS/cm)
Dry flower yield per year <sup>#</sup>	kg.m <sup>-2</sup> .year <sup>-1</sup> (lb.ft <sup>-2</sup> .year <sup>-1</sup> )	6.3 (1.29)	7.7 (1.57)
Total THC	%	20.4	19.5
EC use efficiency	g.(mS.cm <sup>-1</sup> ) <sup>-1</sup>	1.36	1.22

<sup>#</sup>6.1 cycles per year, transplant to harvest 57 days, 1000 PPFD

“However, with nutrients getting more expensive every year, growers don’t want to ‘over-feed’ their crops unnecessarily. Therefore, we also calculated the EC usage efficiency: the yield of dried flowers in relation to the amount of nutrients provided,” explains Rigby. “And we saw that while the plants could cope with the high EC level, we may have been ‘oversupplying’ because the EC efficiency factor was dropping slightly. We’re now focusing on fine-tuning this in the rest of the program.”

**Graph 1.** Graphic illustrating the result of a structured irrigation strategy





## Investigating the link between EC and THC

“Across the different growing cycles and treatments, we’ve observed that the THC percentages and terpene profiles remain consistent and stable within varieties, with no significant differences,” says De Bresser. “Interestingly, at a more detailed level, the high EC strategy resulted in the highest dried-flower yield, while the low EC strategy produced the highest THC level. This tells us that the optimal setting for these varieties will be somewhere between the low and high EC levels, and we are keen to investigate this further in the remaining cycles within the current program of work.”

## Scaling up profitably

So how can these findings help today’s licensed cannabis growers to scale up their business profitably? “In this trial, with a focus on the efficiency ratios, we have shown that

it is possible for growers to achieve more yield without increasing their relative spend on inputs such as light and nutrients,” states Janssen. “Moreover, when you factor in the gains demonstrated in [our previous trials](#) – such as better plant uniformity resulting in less waste, and the labour savings associated with a more steerable and predictable crop – this approach can actually decrease a grower’s operational costs.”

The labour savings are intensified by the use of F1 hybrid seeds, according to De Bresser. “In addition to improving the consistency and repeatability of crop performance, our varieties mean that growers no longer have to be bothered with managing their mother plants and selecting cuttings. This frees up both time and space that can be used for production instead. And the extra logistics costs are minimal, because our seeds can be shipped easily across the globe. This gives all growers worldwide the opportunity to start working with our varieties and increase their profitability,” he says.





## Supporting sustainability

Moreover, the topic of sustainability is increasingly important to everyone nowadays, and cannabis companies are no exception. The findings from these trials can ultimately help to give licensed cannabis growers a competitive edge, comments Rigby: "Our research will be used to further fine-tune our precision growing guidelines to help customers use every input in the most efficient way possible. This enables growers to demonstrate they are reducing their environmental footprint and minimizing the negative impact on the planet."



## Future outlook

Based on the results so far, both companies are enthusiastic about the future. "For us, this research highlights that 'day-neutral' or 'daylength-independent' genetics should be considered as a serious alternative to short-day genetics, offering shorter cycles, more cost efficiency and easier growing management. In fact, we believe that auto-flowering varieties from F1 hybrid seeds will, in many cases, be the preferred starting material over clones in the future," reflects De Bresser.

"At CRIC we have shown that, by combining F1 hybrid seeds with our stone wool growing media in a high-tech CEA facility, we can control the crop extremely precisely for uniform, predictable and repeatable results, delivering benefits for licensed cannabis growers who want to scale up professionally," agrees Rigby.

"By optimizing the growing conditions supported by consistent genetics in combination with our consistent stone wool growing media, we have already achieved a strong upward trend in terms of yield. But there is always more work to be done, and I believe we have the potential to push the boundaries to 9 kg/m<sup>2</sup> (1.84 lb/ft<sup>2</sup>) or even 10 kg/m<sup>2</sup> (2.05 lb/ft<sup>2</sup>) on an annual basis, by further fine-tuning the parameters and perhaps by trialling new pre-commercial F1 hybrid varieties," adds Janssen.

The research partners are keen to allow the entire industry to benefit from the insights resulting from these trials. "Licensed cannabis growers won't have to 'reinvent the wheel', because we will use our joint findings to develop clear and practical guidelines for creating optimal growing conditions using F1 hybrid seeds in combination with Grodan's stone wool growing media," states De Bresser.

"Additionally, we plan to share our insights through more customer presentations at seminars and events. And of course, we remain committed to further enhancing our understanding of the various parameters through these and other research activities to continue to optimally advise and support our current and future customers," concludes Rigby.

### More information?

Find out more about our vision and our solutions .

[Visit our website to read more.](#)



## Designed to grow

Grodan is the global leader in supplying [soilless rootzone management solutions](#) for Controlled Environment Agriculture. These solutions are applied to the cultivation of vegetables, medicinal crops and flowers such as tomatoes, cucumbers, sweet peppers, eggplants, roses, gerberas and cannabis.

At Grodan, we aim to help feed and treat the world's growing population by innovating solutions from our stone wool growing media to enable 'more-with-less' growing. Through the method known as out-of-soil, our [stone wool substrates](#), [sensor systems](#), [software](#) and expertise support the reliable, informed growing of healthy, fresh, high-quality produce. Our material is 100% recyclable and supports growing methods that use up to 50% less water, 20% less chemical plant protection products and 75% less land. Sustainability plays a prominent role within Grodan, from manufacturing stone wool substrates to [recycling solutions and services](#).

Grodan has more than 50 years of cultivation experience. We pioneered the development of hydroponic growing methods in the 1960s, and today, our soilless rootzone management solutions are used in large-scale commercial greenhouses and indoor facilities in over 70 countries across the globe. The North America head office is located in Milton, Canada.

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