# Impressively high yields are reality for cannabis growers

## Grodan's ongoing research trial demonstrates the huge potential of precision crop steering and irrigation in combination with F1 hybrid autoflower seeds

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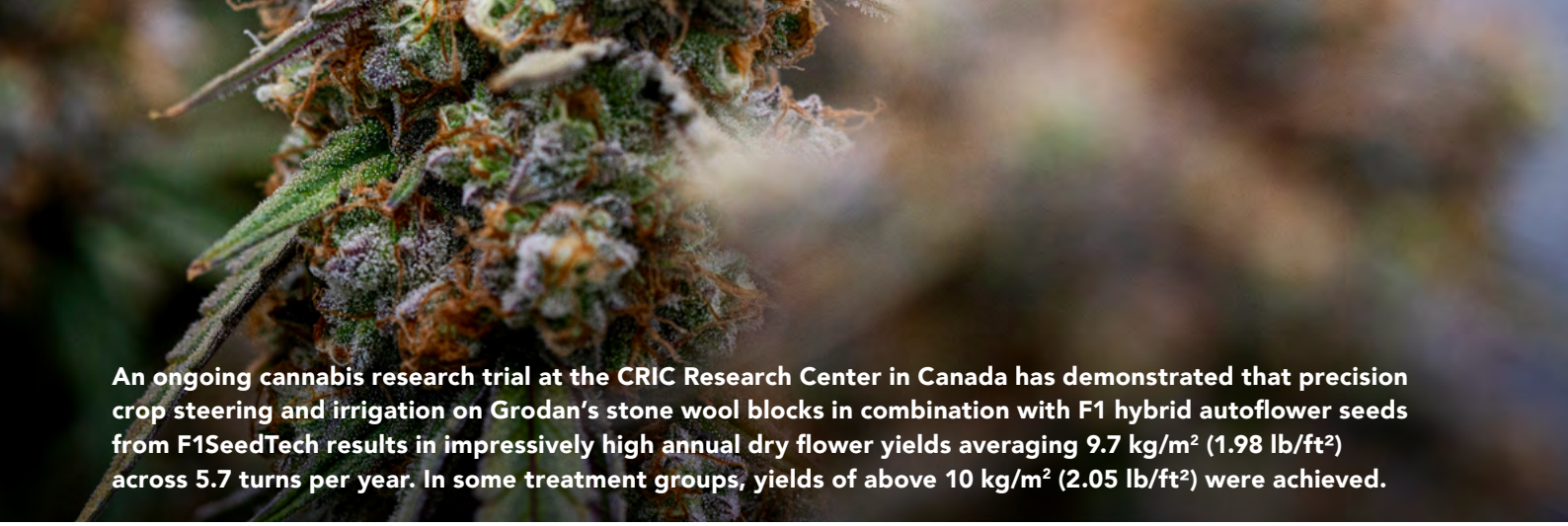


**An ongoing cannabis research trial at the CRIC Research Center in Canada has demonstrated that precision crop steering and irrigation on Grodan's stone wool blocks in combination with F1 hybrid autoflower seeds from F1SeedTech results in impressively high annual dry flower yields averaging 9.7 kg/m² (1.98 lb/ft²) across 5.7 turns per year. In some treatment groups, yields of above 10 kg/m² (2.05 lb/ft²) were achieved.**

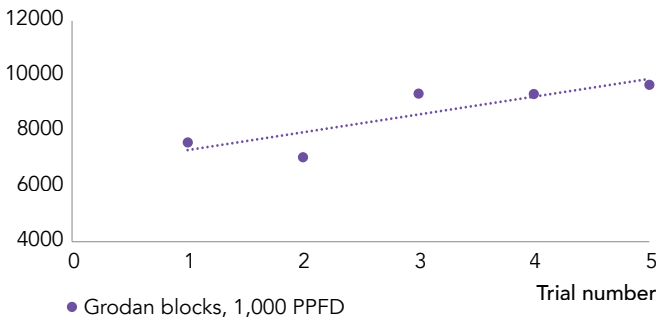
The precision crop steering and irrigation strategies applied in this trial – which focused on EC management and shot size manipulation – also have the potential to boost growers' profitability by enabling more crop cycles per year while improving resource efficiency and reducing operational costs. By sharing the scientific insights, this whitepaper aims to equip cannabis growers with actionable insights to replicate these results as they scale up and further professionalize their operations.

Grodan is conducting an ongoing cannabis project at CRIC Research Center to generate data-driven results aimed at helping growers around the world scale up and professionalize their operations profitably. In a series of research trials, Grodan is pushing the boundaries of precision irrigation strategies and production outcomes using two varieties of F1 hybrid autoflower seeds from F1SeedTech: Miss Beauty and Florence Fusion.

## Highest yielding trial so far

Trial No. 5 in the development program specifically investigated irrigation settings based on the levels of electrical conductivity (EC). It has proved to be the most successful autoflower trial so far (see Graph 1), achieving annual dry flower yields above 10 kg/m² (2.05 lb/ft²) in four treatment groups, and an average annual dry flower yield of 9.7 kg/m² (1.98 lb/ft²) across all eight treatment groups.

**Graph 1.** Average trimmed dry flowers (g/m²/year)*




*From Trials 1-5, all using the same block type, cultivar and PAR light level

The irrigation volumes were strategically adjusted by gradually increasing the shot sizes (from 1% to 3% to 4.5%) throughout the six-week flowering period.

## Results and key learnings

- Highest yielding trial so far: 4 treatment groups with dry flower yield above 10 kg/m² (2.05 lb/ft²) per year across 5.7 crop turns.
- A lower irrigation EC (2.7 mS/cm instead of 3.2 mS/cm) stimulated a higher yield.
- A gradual increase in shot sizes (from 1% to 3% to 4.5%) was beneficial for plant steering.

**Practical insights:**

- **Production boost:** Growers can boost production by strategically adjusting irrigation volumes during crop growth and development. Larger shot sizes help deliver water and nutrients more consistently, supporting healthier plant growth and maximizing flower development.
- **Improved steerability:** An optimized EC level not only increased yield, but also improved crop steerability toward more growth and flower production. This allows growers to fine-tune plant development to match production goals, such as maximizing bud density and quality.
- **Reduced nutrient requirement:** A balanced EC level reduces nutrient input, leading to cost savings and more sustainable use of resources.

Grodan has been conducting a series of trials at CRIC Research Center in Montreal, Canada, since 2023. "With the cannabis sector rapidly professionalizing, Grodan is committed to helping growers in North America and elsewhere in the world to scale up profitably. They can do this both by improving their production outcomes in terms of yield and number of crop cycles per year, and by saving costs by optimizing their use of resources such as labor, nutrients, and other inputs," says Chad Rigby, Crop Consultant for Grodan in Canada.

## Market-centric approach

"For us, this means working together with industry partners to push the boundaries of what is possible in order to improve and fine-tune the cultivation advice we provide to our customers. CRIC is a truly unique and unrivaled high-tech facility where everything can be controlled with precision. Additionally, working with CRIC enables us to tailor our research to the trends in the North American market, such as by using the Grodan Hugo blocks in these trials," he adds.

Beyond taking a market-centric approach, Grodan is also anticipating where the cannabis industry is heading, according to Rigby. This is indicated by the use of F1 hybrid autoflower seeds in the trials.

"These are still novel in cannabis growing, but they are already proving to be the new gold standard in all major crops in both North America and Europe. As cannabis production becomes increasingly competitive, growers need to become more cost-conscious, and we believe autoflower F1 hybrid seeds can play a key role in that while also delivering premium quality," he states.

"They are genetically more homogeneous from plant to plant, and this uniformity in combination with uniformity gained from Grodan stone wool improves the consistency and repeatability of crop performance. Additionally, autoflowering cultivars are not photo-periodic, which means you can work with a fixed light recipe because they always flower at a certain age. F1 hybrid autoflower seeds produce earlier flowers, which supports much higher annual yields based on approximately 5.7 crop cycles per year," comments Frank Janssen, R&D Project Management in Grodan's Applications & Development department.

Growing from seeds rather than cuttings offers other benefits for growers, Janssen explains: "They no longer have to spend time and money managing mother plants and selecting cuttings. In fact, they can turn their mother room and veg room into flowering rooms, creating valuable extra production space to further boost their annual yield."

## Investigating root zone management and irrigation based on two variables

As in its previous cannabis research trials at CRIC, for Trial 5 Grodan chose to use the single-plant 3.2-liter Hugo block.
"Our Hugo block is a popular substrate type among North American cannabis growers, with a good rooting volume," comments Rigby. The plants were laid out on tables arranged in a checkerboard block pattern in the growing room. "A randomized experimental setup is important from a scientific verification perspective because it prevents factors such as the positioning effect in the growth room from influencing the research outcomes," he continues (see Graph 2).

**Table 1.** Technical details of the trial

| | |
|---|---|
| **Key dates** | Seedlings: October 30, 2024<br>Generative stage began: November 18, 2024<br>Harvest: January 13, 2025 |
| **Lighting** | The PPFD applied was 1,000 µmol/m²/s |
| **Substrate** | Hugo blocks |
| **Irrigation strategies** | Larger shot sizes applied going from 1% to 3% to 4.5% |
| **Varieties** | Miss Beauty and Florence Fusion |
| **Data capture** | GroSens Suite |
| **Nutrient & EC strategies** | EC levels: low was 2.7 mS/cm and high was 3.2 mS/cm |

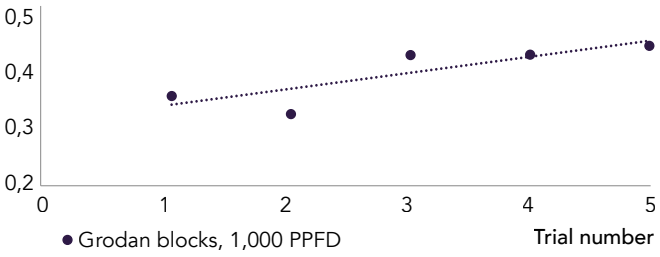
**Graph 2.** Randomized plant layout

| | | 1,000 PPFD | | | | 1,000 PPFD | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Hugo | | Hugo | | Hugo | | Hugo | |
| 1 | MB – Low WC / Low EC | MLWLE-T5-1 | FLWLE-T5-1 | MLWHE-T5-1 | FLWHE-T5-1 | MHWLE-T5-1 | FHWLE-T5-1 | MHWHE-T5-1 | FHWHE-T5-1 |
| 2 | FF – Low WC / Low EC | FLWLE-T5-2 | MLWLE-T5-2 | FLWHE-T5-2 | MLWHE-T5-2 | FHWLE-T5-2 | MHWLE-T5-2 | FHWHE-T5-2 | MHWHE-T5-2 |
| 3 | MB – Low WC / High EC | MLWLE-T5-3 | FLWLE-T5-3 | MLWHE-T5-3 | FLWHE-T5-3 | MHWLE-T5-3 | FHWLE-T5-3 | MHWHE-T5-3 | FHWHE-T5-3 |
| 4 | FF – Low WC / High EC | | | | | | | | |
| 5 | MB – High WC / Low EC | FLWLE-T5-4 | MLWLE-T5-4 | FLWHE-T5-4 | MLWHE-T5-4 | FHWLE-T5-4 | MHWLE-T5-4 | FHWHE-T5-4 | MHWHE-T5-4 |
| 6 | FF – High WC / Low EC | MLWLE-T5-5 | FLWLE-T5-5 | MLWHE-T5-5 | FLWHE-T5-5 | MHWLE-T5-5 | FHWLE-T5-5 | MHWHE-T5-5 | FHWHE-T5-5 |
| 7 | MB – High WC / High EC | | | | | | | | |
| 8 | FF – High WC / High EC | FLWLE-T5-6 | MLWLE-T5-6 | FLWHE-T5-6 | MLWHE-T5-6 | FHWLE-T5-6 | MHWLE-T5-6 | FHWHE-T5-6 | MHWHE-T5-6 |

(MB = Miss Beauty, FF = Florence Fusion). WC stands for water content. EC stands for electrical conductivity.

"Using the same two cultivars as Trials 1-4 maintained a constant variable. We took the best practices from what we had learned previously, specifically climate conditions, plant density and a fixed light level of 1,000 µmol for 18 hours (see Graph 3). This allowed us to focus on root zone management. In Trial 5, we focused on two variables: EC levels and shot size," states Janssen.

**Graph 3.** Light use efficiency (g/m².mol)

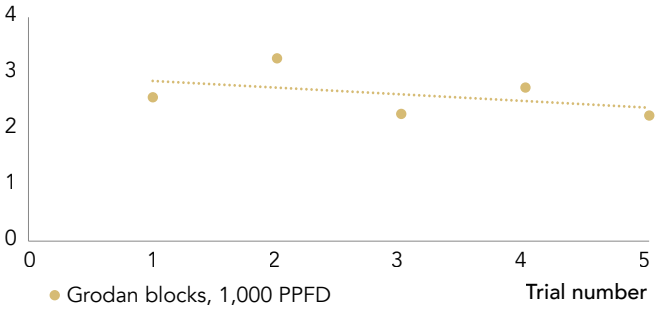



## Precision irrigation based on EC

To investigate the effect of the EC level, the plants were divided into two groups. Half received an EC level of 3.2 mS/cm, and the other half received a lower EC of 2.7 mS/cm. These values were maintained throughout the whole crop cycle, which lasted 63 days from transplant to harvest. As in the previous trials and in line with Grodan's protocol, the elemental ratio in the fertilizer recipe was changed from a vegetative mix to a generative mix on Day 20 (seven days after transplanting).

"Usually, a higher EC is more generative and will lead to more flowers, but in this trial we saw that the lower EC level gave a higher yield. What this shows, I believe, is that we provided a sufficient number of EC units: the EC level multiplied by the total water gift," comments Janssen. "It will be interesting to study this further, looking at the correlation between the water volume and the EC level. We want to discover the sweet spot for total nutrients, and the optimum balance in terms of nutrition, plant stress and water use efficiency."

**Graph 4.** Water use efficiency (g/l)




Rigby agrees that there is probably some kind of sweet spot, and definitely an upper limit. "It's a common misconception among cannabis growers that 'more equals more', with some pushing the EC really high – three or four times higher than we would recommend. This not only diminishes the yield, but also wastes fertilizer, which is neither a cost-conscious nor a sustainable approach," he says.

"Stone wool requires growers to take a more disciplined, data-driven approach, but the benefits are a more steerable substrate that allows them to optimize their crop performance – especially when they measure and monitor the EC levels in the substrate using sensor solutions like the GroSens Suite," explains Janssen.

## Adjusting the shot sizes

In the previous trials, the shot size remained the same from start to finish at 3% of the substrate volume. This time, however, the Grodan experts were keen to investigate the impact of gradually increasing the shot size as the cycle progressed, while remaining in line with the water content percentage (WC%) setpoints. The uniformity in WC% over height of Grodan blocks allows for maximum control.

"We started by irrigating the germinated plant at 1% of the substrate volume for the first couple of days to encourage root development by making the roots search for nutrients and water," recalls Janssen. "On Day 5, when the plants started growing, we increased it to 3%. Then on Day 23 after transplanting, we increased it again to 4.5%."

**Graph 5.** Optimizing the irrigation scheduling (timing, frequency, volume)


## Real-time crop monitoring and steering

For real-time insights into what was going on in the root zone, the team utilized Grodan's GroSens Suite. "Thanks to data on the plant's metabolism and transpiration from our sensors and visualization software, we could really focus on tracking and refreshing the EC based on what the plant needed and when," explains Rigby.

"The real-time feedback, in combination with the inherent steerability of our stone wool growing media, enabled us to test different precision irrigation strategies and analyze the outcomes to further fine-tune our crop steering principles. By sending specific vegetative or generative cues to the plants in the right phase of the growth cycle, it's possible to create the optimal situation for high yields and maximum water use efficiency," he adds.

"This trial once again demonstrated the benefits of stone wool when it comes to precision irrigation. The flexibility and steerability of the Hugo block and all our other substrates give growers so much more control over the root zone conditions than organic media – especially in combination with sensors," agrees Janssen. "This is particularly important for cannabis growers, because with such a short and intensive crop cycle, conditions have to be spot-on every day. In that sense, it's more like a hurdle race than a marathon. Missing just one hurdle can ruin your chances of winning."

### Key growth metrics and yield outcomes

- Four treatment groups annual dry flower yield above 10 kg/m$^2$ (2.05 lb/ft$^2$) across 5.7 harvests.
- Average dry flower yield of 9.7 kg/m$^2$ (1.98 lb/ft$^2$) per year across all eight treatment groups.
- Average dry flower yield per plant: 325 g (0.72 lb).
- Cannabinoid (THC) levels: 20% ± 1%.

## Replicating the results at scale

The good news for commercial growers is that these results can already be replicated at scale in a controlled environment agriculture (CEA) setting, according to Rigby. "Most of today's high-tech greenhouses will have the right infrastructure to achieve similar results. If your facility can maintain the optimal setpoints for temperature, humidity, $CO_2$ and light, if your system can deliver multiple irrigation events per day at the required volumes, if you can precisely control the root zone and if you have the right genetics, there is no reason why you can't achieve a similar boost to your production and also profitability," he states.

## Areas for further investigation

"Stemming from the results of this trial, we're keen to investigate the correlation between EC level and yield, to try to quantify a sweet spot for water use efficiency," says Rigby."

Another area we would like to explore in relation to root zone management is dry-backs, especially in combination with shot size," comments Janssen. "In this trial, all plants achieved overnight dry-backs of 10-20%. In practice, cannabis growers often push their plants harder, using higher dry-backs of 25%-30%. Thanks to the controllability of our stone wool growing media, we're perfectly positioned to test whether the results of such high dry-backs make them worth the potential risks, or whether a lower – and therefore less risky – dry-back level could make life a little easier for growers without reducing the yield and quality – in terms of bud quality, cannabinoid and terpene levels."

In the longer term, the team is also planning to run trials with new cultivars, according to Janssen. "Once we have established the optimal crop steering principles, we will be able to move on to the final piece of the puzzle: achieving higher levels of cannabinoids and terpenes by testing new F1 hybrid day neutral or short day cultivars," he says.

"Right now, our focus is on exploring what's possible in terms of both yield and the more efficient and sustainable use of inputs, before turning our attention to potency. But I think it's pretty safe to say that both yields and potency will be higher five years from now," comments Rigby.

## Great potential

"The work we're doing at CRIC is testament to our commitment to continuous improvement. We've seen incremental increases in yield and efficiency as our trials program has progressed, and we expect to continue to do so as we apply our new learnings going forward," states Janssen.

"There is still some skepticism in the cannabis world about the ability of autoflowers to produce the necessary quality and quantity to be commercially viable. However, in this trial – which has been Grodan's highest yielding cannabis trial so far – we've demonstrated that autoflower F1 hybrid seeds hold great potential in combination with precision irrigation," explains Rigby.

"We've not only achieved an unbelievably high yield, but the plants themselves also look amazing. Seeing is believing, which is why we're happy for growers to visit our growth chambers at CRIC and see the results with their own eyes," he adds. "And we will continue to push the envelope to drive further discoveries and developments over the coming months and years, to help cannabis growers complete more crop cycles per year, reduce their operational costs and scale up profitably.

**Rooted in science**

## Reach out

For more information about the trial results, advice on optimal precision irrigation strategies for your setup, or to arrange to visit the growth chambers at CRIC, get in touch with our technical experts.

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# 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 Nort America head office is located in Milton, Canada.

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