The three stages of lettuce growing

Predictability and repeatability on a commercial scale

Steerable

Switch to clean

Grodan's stone wool is completely clean at the start, providing a blank canvas that gives growers full control over the root zone environment.

This brochure explains how to get the best out of Grodan's stone wool growing media in the three stages of lettuce production: seeding & germination, propagation, and cultivation & harvest.

Grodan®

Part of ROCKWOOL Group

Understanding the Substrate

Electrical Conductivity (EC)

- Grodan's stone wool growing media are 'clean at the start' substrates that do not come pre-loaded with plant nutrition. This gives growers complete control over what they provide to their crops.
- Because each substrate has a starting EC of 0, it is essential to provide nutrients during the initial saturation.
- The optimal EC will vary depending on the crop variety and seasonal climate conditions. A higher EC (2.0-3.0) is recommended in cool and mild conditions, while a lower EC (1.5-2.5) is more suitable in warm or extreme conditions.

Water and Nutrient Availability

- Stone wool growing media have a uniform fibre structure and no cation exchange properties, meaning there is no chemical reaction or bonding between the substrate and the fertilisers provided. As a result, 100% of the water and nutrients are accessible to the plant.
- The steerability of Grodan's substrates allows for vigorous, controlled dry-backs (reduction in moisture content in substrate between irrigation events). These encourage stronger root development, supporting faster growth and better resistance to disease pressure.

Optimise growth with the Grodan wetting instructions

Grodan stone wool growing media are providing your crop with a clean, disease-free start. However, the initial wetting of Grodan products is crucial to the success of the growing process. It forms the foundation for the root development and growth of lettuce plants. To guarantee success rate, it is essential that you follow these instructions.

To learn more about the Grodan wetting instructions, scan the QR code.

Initial Saturation

The initial saturation of Grodan's growing media is crucial to the success of the cultivation process. Wetting forms the foundation for root development and plant growth. To achieve optimal results with your Grodan products, it is essential that you follow the wetting guidelines.

Option 1: Saturating Using Overhead Irrigation

In the case of overhead irrigation, sowing can be performed before or after saturation of the plugs or blocks.
If sowing is done before saturation, the seed coatings will generally be well saturated. However, if sowing is performed after saturation, then a light misting is recommended for easier germination of the seed.

- It is advised that the wetting line should contain five spray beams.
- The distance between the beams should be 50 cm.
- The belt speed should be 5 cm/second with a water pressure of 2.5 bar (measured at the spray beam.
- The nutrient solution temperature should be around 18-20 °C.

- These variables are interdependent. In other words, a change in one will require a change in all to achieve the desired outcome.
- Applying water with too much pressure after sowing can risk washing seeds out of the seed holes.
- During the initial wetting, take care to create a uniform water content and EC distribution throughout the substrate.

Option 2: Saturating by Submersion

If the initial wetting is done by submersing the substrate, then sowing should be performed after submersion to ensure that seeds do not float out of the seed holes. When submerging the sheets of plugs or strip of blocks, allow the substrate to sink fully, and only remove it once the air bubbles have ceased (for a full saturation).

A light misting is then recommended to properly wet the seed coatings.

Option 3: Other Saturation Methods

It is also possible to use other saturation methods such as ebb & flood. Please contact your distributor, Grodan Account Manager or Grodan's Customer Service for more information.

Validating Full Saturation

Whichever saturation method you use, it is important to validate full saturation as follows:

To evaluate if the blocks have been correctly saturated, select ten blocks from the wetting line. Weigh each block individually and obtain an average weight.

Table 1 provides guidance for common types of Grodan's stone wool growing media, showing the substrate dimensions of sheets/blocks and their expected minimum average weights.

Table 1: Average weights of Grodan products when fully saturated:

Product	Unit Dimensions	Saturation
AO Sheet	25 x 40 mm	>3,840 grams
AO Sheet	36 x 40 mm	>4,060 grams
AO Sheet	50 x 40 mm	>4,250 grams
MM Block	40 x 40 mm	64 grams
MM Block	50 x 50 mm	123 grams

Stage 1: Seeding and Germination

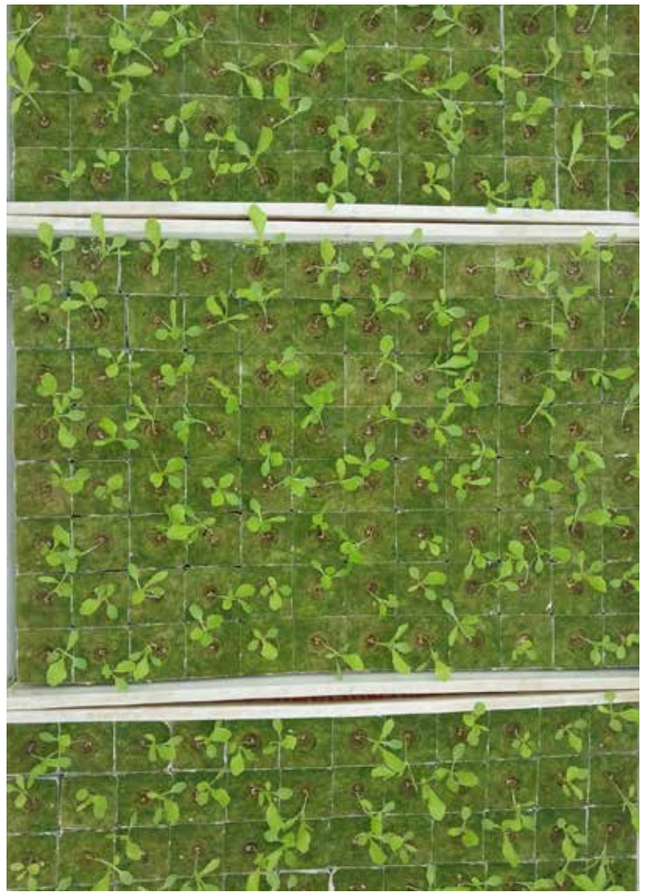
1-3 days

Goal: To ensure full saturation and provide nutrients.

While fertiliser is not necessary for germination to occur, applying fertiliser at the start ensures that nutrients are available during initial root development, and also makes it possible to delay the second irrigation (in Stage 2). This delay will help getting better root development and healthy roots.

Generally, it is unnecessary to apply a top dressing (sand or vermiculite on the top of the products). While a designated germination room is not essential, it offers more control to increase the germination speed.

Once the seeds have germinated and the seedlings begin to grow, they can be placed in the greenhouse.



Control Points

- Germination temperature: 15-18 °C, depending on the variety
- Water temperature during initial wetting: around 18-20 °C
- EC during initial wetting: 1.5-3.0
- pH: 5.5-6

Stage 2: Propagation

8-18 days

Goal: To strengthen root development through controlled dry-back.

Thanks to the uniform fibre structure and as 'clean at the start' substrates, Grodan's stone wool growing media enable aggressive dry-backs and rapid re-saturation. Water and nutrients remain evenly distributed and fully accessible to the plant's roots at all times.

Stage 2 is the first opportunity to actively manage moisture levels in the stone wool substrates.

When moving plants into the nursery, do not irrigate immediately. First, confirm the need for water by weighing the block or sheet to check whether the target WC% has been reached.

During propagation

Apply new water and nutrients once the WC drops to 70%. It is acceptable to fully re-saturate the substrates. However, controlled dry-back is essential, because keeping the substrate constantly wet will lead to lazy roots, slow growth and higher disease risk.

As plants develop, their water demand will increase. Because the WC will drop to 70% more quickly, the irrigation frequency should be adjusted accordingly as the crop matures (see Table 2).

Table 2: When to irrigate – weights indicative of 70% WC:

Product	Unit Dimensions	70% Water Content
AO Sheet	25 x 40 mm	3,200 grams
AO Sheet	36 x 40 mm	3,400 grams
AO Sheet	50 x 40 mm	3,560 grams
MM Block	40 x 40 mm	50 grams
MM Block	50 x 50 mm	88 grams

Control Points

- EC: max. 1.8 (overhead irrigation) / max. 2.5 (ebb & flood)
- pH: 5.5-6
- Temperature of seedlings in the greenhouse: 18-21 °C (during the day) / 13-16 °C (at night)
- Temperature of irrigation water: 15-18 °C

Stage 3: Cultivation and Harvest

15-21 days

Goals: To continue the irrigation strategy based on the WC% in the substrate. To increase watering frequency as the plants mature, while increasing the dry-back percentage between watering events.

Different growing systems will require different irrigation approaches in this stage. Nevertheless, regardless of the growing system, the strategies implemented in Stages 1 and 2 have laid the groundwork for the plants to grow faster in production.

Case 1: Continuous Irrigation

In the case of traditional systems such as deep water culture (DWC) and some nutrient film technique (NFT) systems, the roots are continuously provided with water. This means that the WC% in the stone wool growing media cannot be used as a control point.

While the control over water content is sacrificed in such cases, stone wool still offers multiple benefits. These include cleanliness in the system, control over the air/water ratio, and the fact that the growing media retain their firmness for the duration of the crop cycle, supporting both manual and automated handling and harvesting.

Case 2: Intermittent Irrigation

In the case of production systems that allow intermittent irrigation events, the goal each morning is to refresh the nutrients and re-saturate the media to 100% water content (or as close as possible). When the plants are more mature and active, this will require multiple irrigation events.

The importance of Dry-back between irrigations

Dry-back is still important and will continue to encourage new roots to develop as they seek water. The minimum water content of the substrate should be 60% (see Table 3).

Table 3: Dry-back based on weights on a scale indicative of 60% water content:

Product	Unit Dimensions	60% Water Content
AO Sheet	25 x 40 mm	2,800 grams
AO Sheet	36 x 40 mm	2,960 grams
AO Sheet	50 x 40 mm	3,100 grams
MM Block	40 x 40 mm	43 grams
MM Block	50 x 50 mm	75 grams

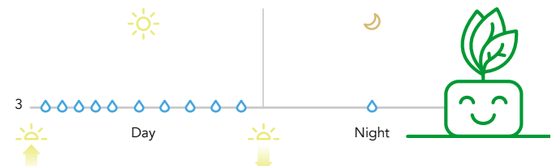
Guidelines for Irrigation Frequency

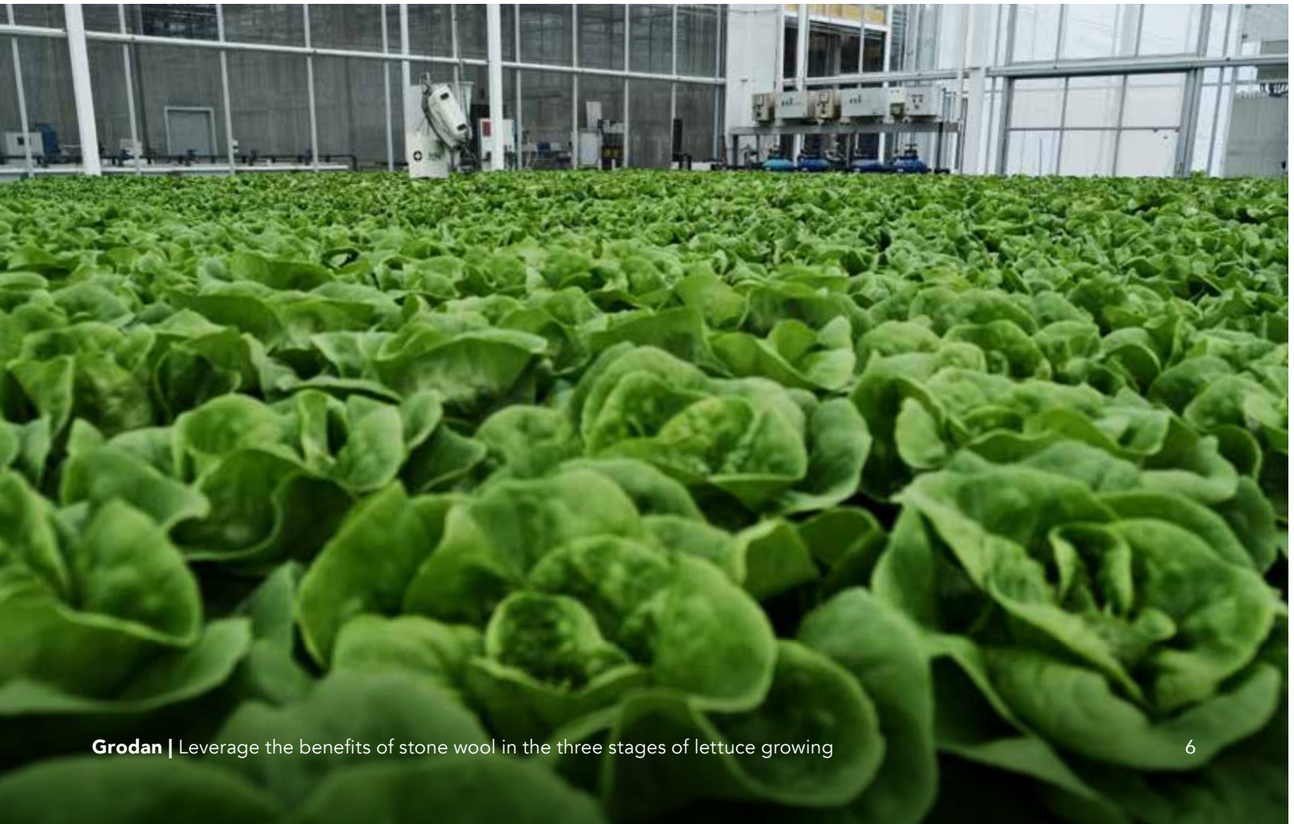
- It is acceptable to irrigate before transpiration.
- To compensate for the dry-back, irrigate with a very high frequency in the morning.
- It is advisable to irrigate with a high frequency in the afternoon.

Control Points

- EC: max. 2 (NFT and overhead irrigation) / max. 2.5 (ebb & flood)
- pH: 5.5-6
- Environmental temperature: 18-21 °C
- Temperature of irrigation water: 15-18 °C (and absolute max. 22 °C)

Irrigation strategy for lettuce grown in Grodan stone wool MM blocks





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 and gerberas.

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 head office is located in Roermond, the Netherlands.

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