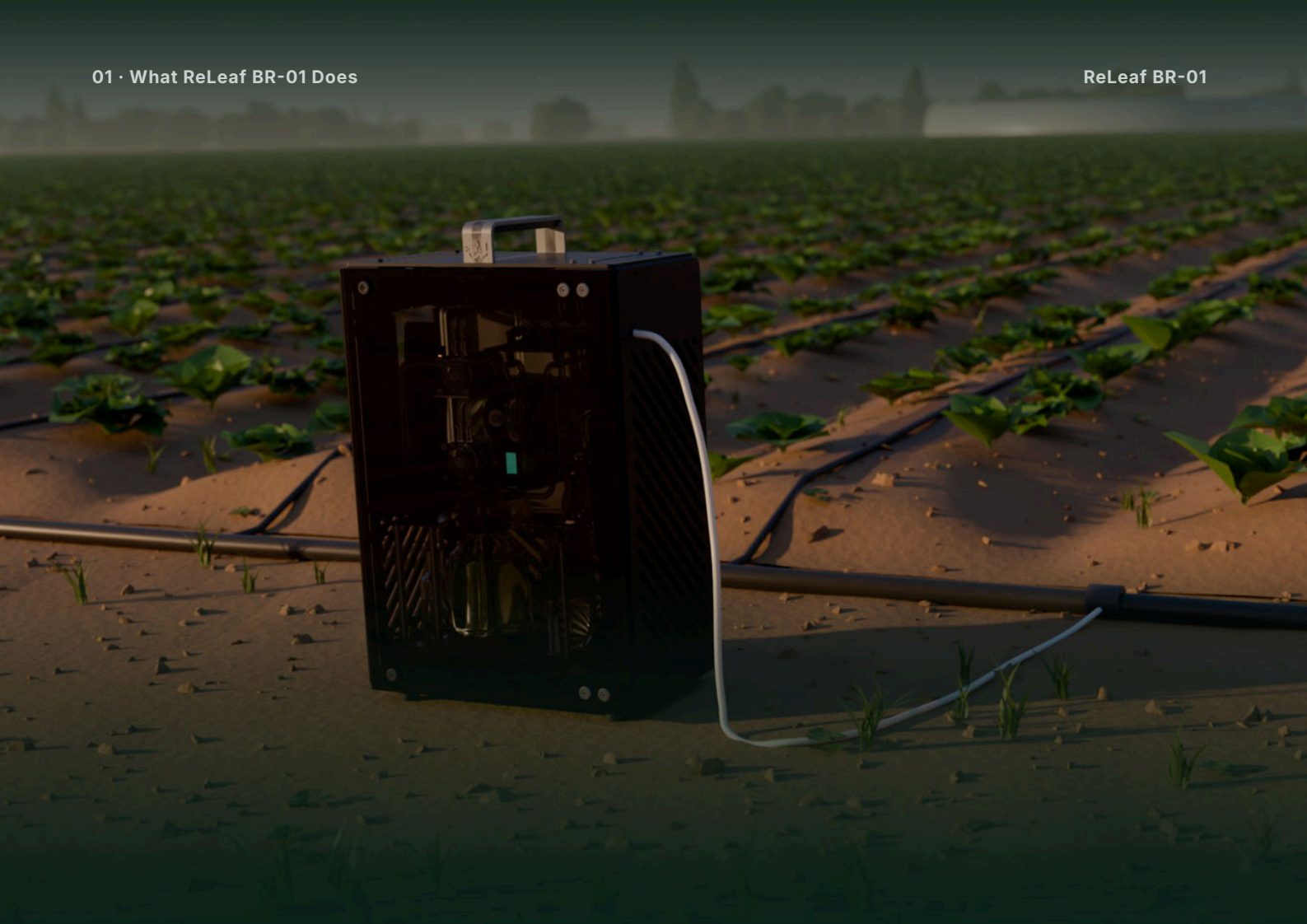


ReLeaf BR-01

OPTOGENETIC · MEMBRANE-CONTAINED · SINGLE CARTRIDGE

**On-site crop protectant,
made fresh and
dosed by light.**





Section 01

Protectant made where it is used.

How it works

Inside, engineered *Bacillus subtilis* secretes the protectant, ACC deaminase. A hollow-fiber membrane keeps the bacteria in and lets only the protectant out, to the field.

Why on site

Many peptide protectants degrade in storage. A bottle filled months ago can't answer this week's drought. Made fresh beside the crop, the dose follows the conditions.

The bacteria stay in the loop. Only what they secrete leaves.

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02	Key Features	04
	Optogenetic light chamber switches protectant production on and off	
	Hollow-fiber membrane holds the bacteria inside, lets only the protectant through	
	In-line photometer measures culture density continuously, without opening the system	
	Culture cartridge arrives sealed and opens itself once seated	
	Inside the machine every part that touches the culture, labeled	

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SECTION 02

Key Features



01 · OPTOGENETIC LIGHT CHAMBER

Green light turns protectant production on. Red light turns it off.

CcaS-CcaR

● green ~535 nm on

● red ~670 nm off

WHAT IT MEANS FOR YOU

You set the dose with light, not with a chemical you have to buy and store.

The green signal comes from ReLeaf's Predict stage when it forecasts plant stress.

02 · HOLLOW-FIBER MEMBRANE

One barrier holds the bacteria in and lets the protectant through.

PES hollow fiber

containment and delivery in one part

WHAT IT MEANS FOR YOU

Nothing alive leaves the machine. Only the protectant reaches your crop.

Its 0.2 μm pores are narrower than any *B. subtilis* cell (0.25–1.0 μm), so the cells stay in while the protectant passes through.



SECTION 02 · KEY FEATURES



03 · IN-LINE PHOTOMETER

Culture density is read continuously, without opening the system.

OD600 flow cell

● amber LED

reference and sample sensors

WHAT IT MEANS FOR YOU

You never open the unit to check on the culture. The screen tells you it is healthy.

It reads around the clock for the whole run, with no sampling.

04 · CULTURE CARTRIDGE

Refills arrive sealed and open themselves once seated.

sealed inoculum

opens on insertion

single use

WHAT IT MEANS FOR YOU

A refill takes minutes. No lab, no open culture, no skill needed.

It drops into the reservoir port from above and clicks into place.



SECTION 02 · KEY FEATURES

Inside the machine

Every part that touches the culture, and what it is there for.

1 Peristaltic pumps

Move the culture and the protectant

2 In-line photometer

OD600, read in line

3 Probes

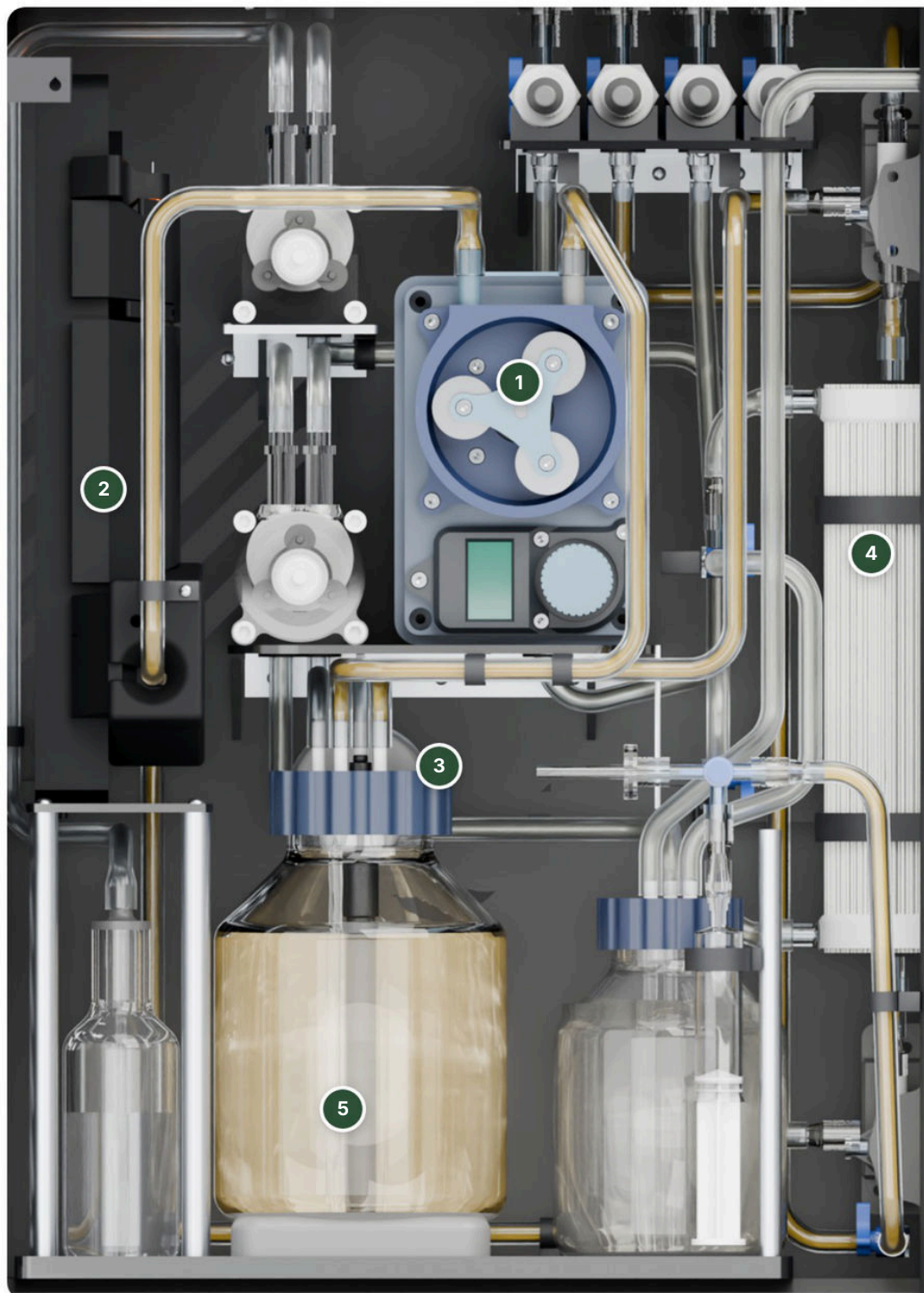
Temperature and pH

4 Hollow-fiber membrane module

PES membrane, cells stay inside

5 Culture reservoir

Stirred, temperature held



Door open.

Also inside: the green and red LEDs of the light chamber around the culture, and the aeration membrane. The 7-inch control screen is shown on page 11.

The culture cartridge drops into the reservoir port from above (page 14: refilling).

SECTION 03

Questions Growers Ask

The questions growers ask first, answered plainly.

01 Is it safe to have engineered bacteria on my farm?

Yes. The bacteria stay sealed inside, behind a membrane whose 0.2 μm pores are smaller than any *B. subtilis* cell. Only the protectant reaches your field.

02 Is it legal where I am?

Keeping engineered organisms on a farm is regulated, and the rules differ by region. Check yours before operating: **ask your local agricultural authority.**

03 What do I actually have to do each day?

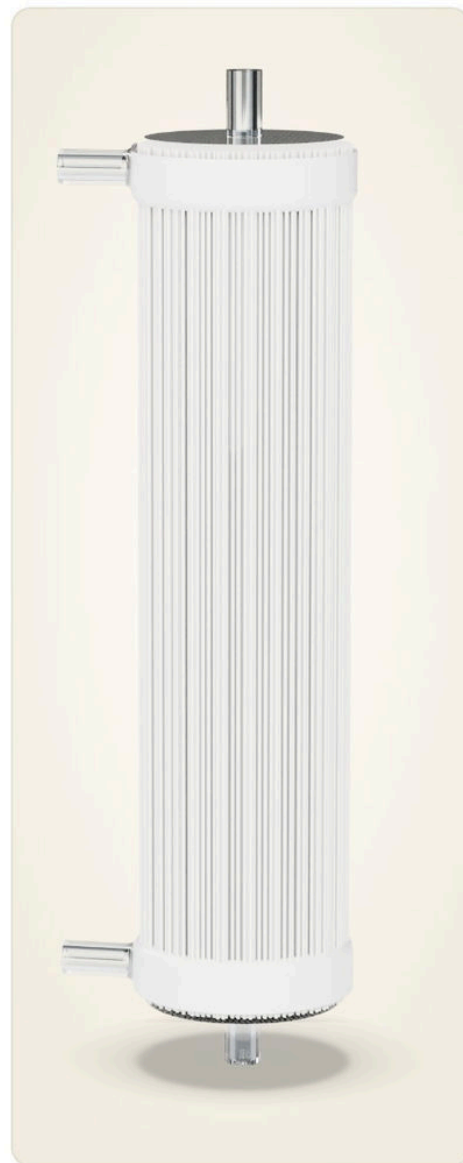
Glance at the screen. A green banner means nothing to do; amber or red tells you what needs attention (page 12: alarms).

04 What happens if it stops working mid-season?

It stops safely and raises an alarm. Flashing red means containment: do not open it. Contact **us through page 17** (response time: **within two working days**).

05 What does it cost to run?

About US\$360 a season: cartridges, power, and a few minutes a week (page 15: costs).



0.2 μm

Membrane pores. The cells stay in; the protectant passes through.

SECTION 04

Safety and Handling

The culture inside is alive. The machine keeps it there, and these six things keep that true.

	01 Intended use	It makes crop protectant for your irrigation line. The culture is only the means.
	02 The culture is alive and contained	Do not open the chamber or break a line mid-run. The culture stays in a closed loop for the whole run.
	03 Light	Chamber LEDs are bright: keep the door interlock in place. Do not look into the lit chamber.
	04 Electrical and water	Mains power beside a wet process: never hose the unit down.
	05 Cartridge and cleaning solution	Wear gloves and eye protection. Never refit a used cartridge: each one is single use.
	06 Local rules	Keeping engineered organisms on a farm is regulated. Check your local rules first: ask your local agricultural authority.

IF THE SCREEN FLASHES RED · CONTAINMENT

1

Stop. Leave the run stopped.

2

Do not open the unit or break a line.

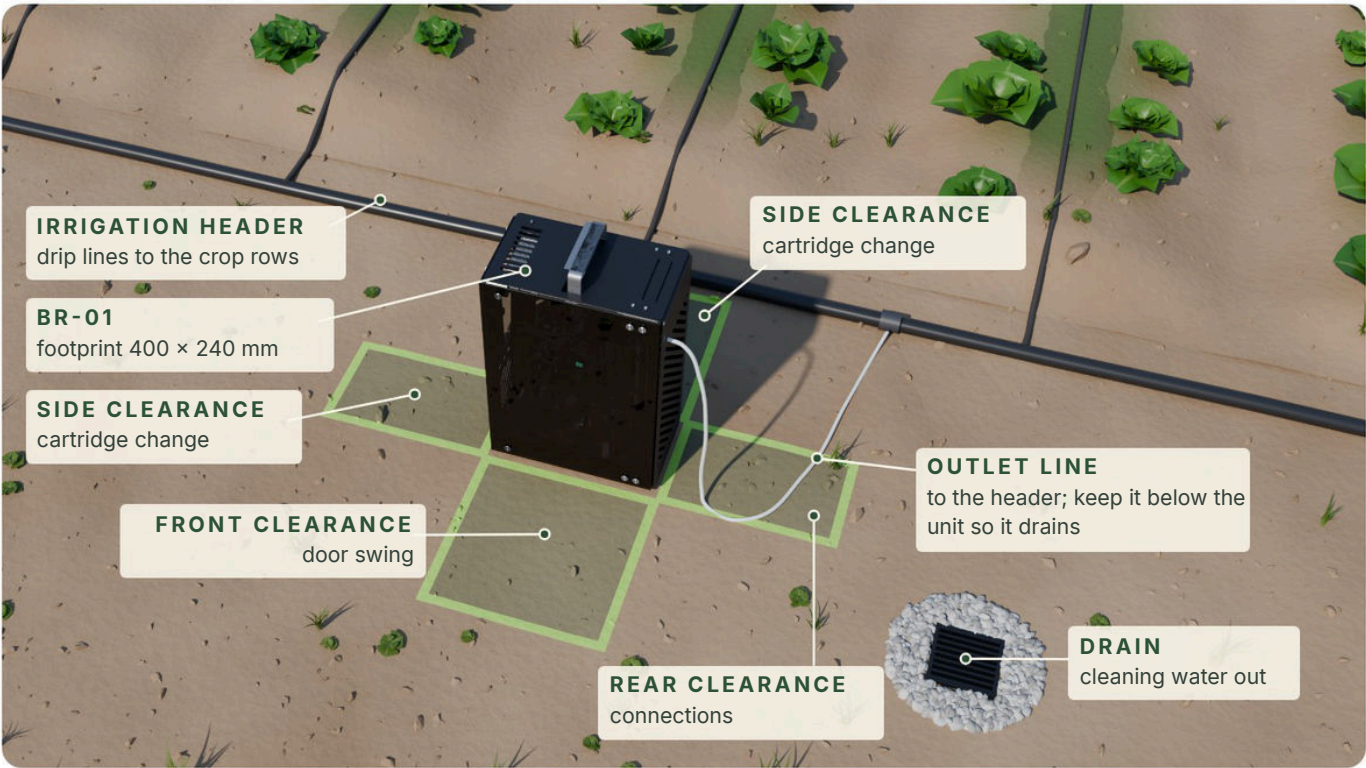
3

Contact **us through page 17** and follow the instructions there.

SECTION 05

Setting Up

Choosing where to put the unit.



The unit to scale on a typical site.

Before you set it down, check

- ☐ **Level, firm ground**
no slope, no soft soil
- ☐ **Shade or a roof**
out of midday sun
- ☐ **Power within reach**
no extension across a
walkway
- ☐ **Water and a drain**
supply in, drain out

Clearance needed

WHERE	ROOM FOR	CLEARANCE
Front	Door swing	600 mm
One side	Cartridge change	400 mm
Rear	Connections	150 mm

Leave room to open the chamber door and swing a cartridge clear on at least one side.

SECTION 05 · SETTING UP

Power, water, and the outlet line



Rear, with all three connections made.

1 Outlet line

Run the outlet to your irrigation header or tank. Keep the line below the unit so it drains. It carries protectant only; the culture stays inside the unit.

2 Water inlet

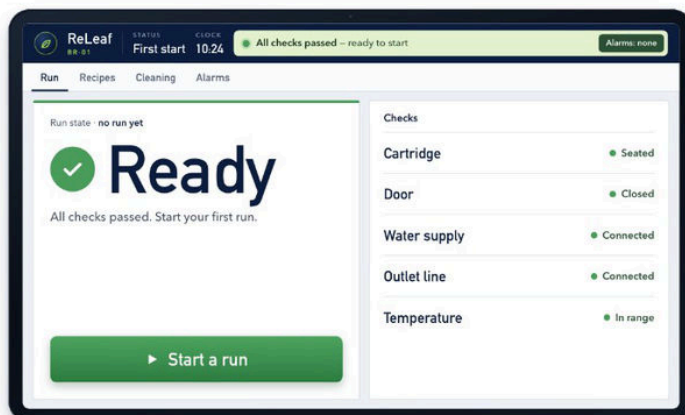
Connect the inlet hose and open the tap. Water is only drawn when a cycle calls for it.

3 Power

Plug into a grounded, weatherproof outdoor socket. Keep the plug and socket clear of standing water.

Starting it for the first time

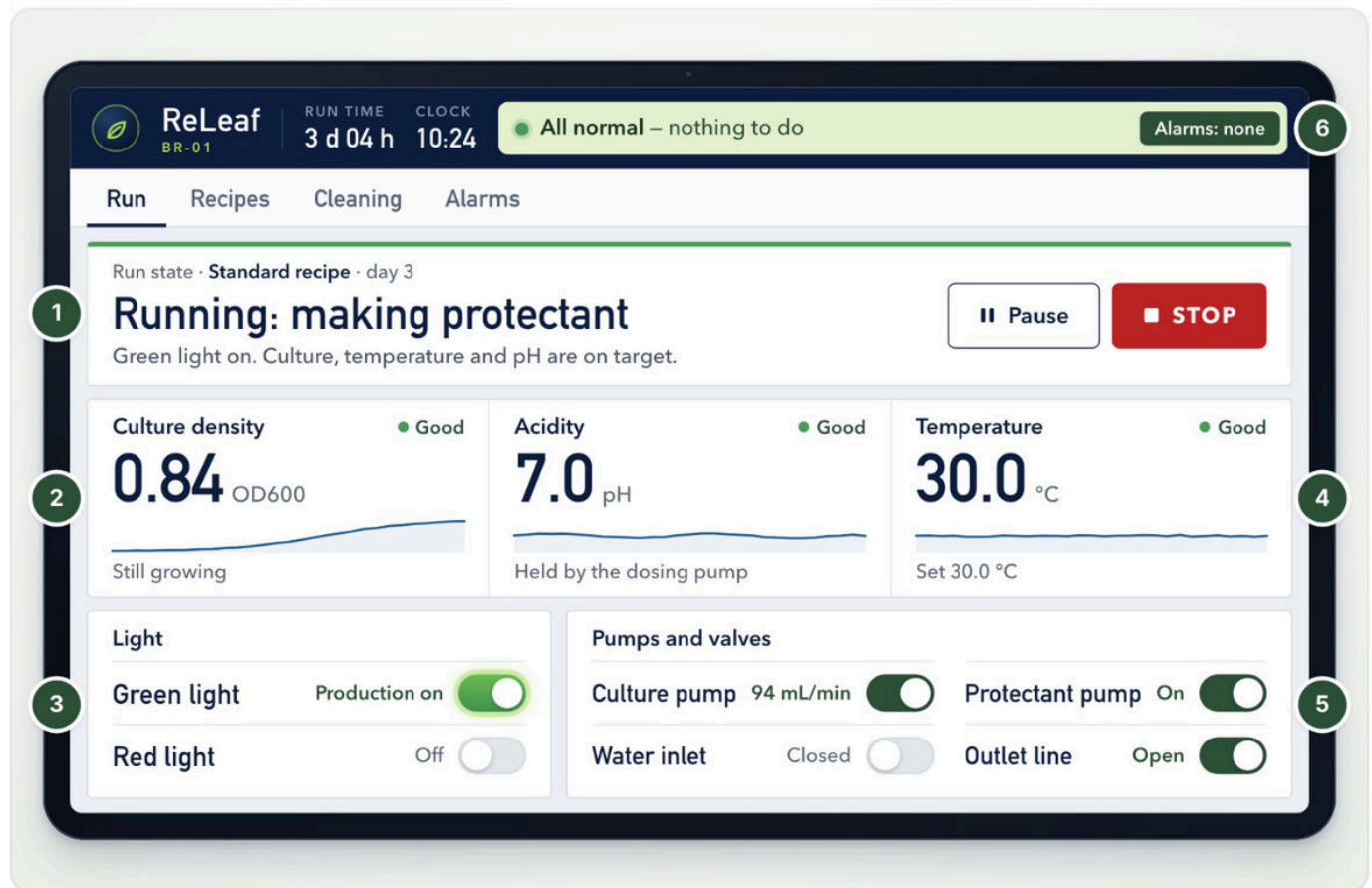
With power, water, and the outlet line connected, switch the unit on. It runs its checks, and the control screen shows **Ready**. Cold start to first dose: **about 5 hours**. Then start your first run from the screen (page 12: starting a run).



The ready screen at first power-on.

SECTION 06 · OPERATING THE UNIT

Reading the control screen



The 7-inch control screen during a run, its six regions numbered.

- | | | |
|---|--|--|
| <p>1 Run state, pause and stop
Pause or stop the run here.</p> | <p>2 Culture density, OD600
Read in line, with no sampling.</p> | <p>3 Light, green and red
Green: production on. Red: off.</p> |
| <p>4 Temperature
The chamber against its setpoint.</p> | <p>5 Pumps and valves
What is running, open, or closed.</p> | <p>6 Alarms
Colors explained on page 12.</p> |

The three things worth looking at every day



Density

Tells you the culture is healthy and working (region 2). Read in line, so nothing is opened to check it.



Temperature

Tells you the chamber is holding its setpoint (region 4). Out of range, the run stops with a red alarm.

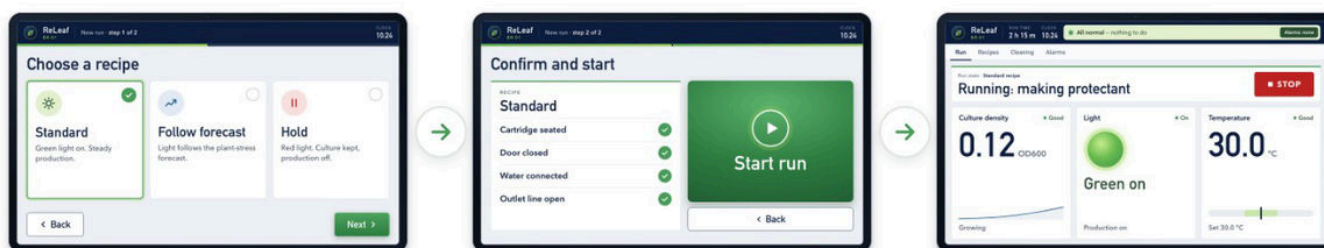


Alarms

When the screen reads **Alarms: none**, there is nothing to do (region 6).

SECTION 06 · OPERATING THE UNIT

Starting a run and watching it through

**01 Choose a recipe.**

Tap **Start a run** on the ready screen, pick the recipe for this run, then **Next**.

02 Confirm and start.

Check the recipe and that all checks pass, then tap **Start run**.

03 Run in progress.

The run screen shows the density, the light, and the temperature, with **Stop** at hand.

While the run is going

The culture loop stays closed for the whole run. The screen shows the culture density, the light state, and the temperature, so nothing needs to be opened to check on it. **Green banner: there is nothing to do.** The same screen opens on your phone too, over the farm Wi-Fi.



The chamber, seen through the door.

Alarms and what each one means

	Amber	Attention soon	Cartridge low, filter due, supply pressure drifting.
	Red	Run stopped	Line break, door opened, temperature out of range.
	Flashing red	Containment	Stop, do not open, follow the containment steps on page 8.

SECTION 06 · OPERATING THE UNIT

The same screen on your phone

The BR-01's control screen is a web page that the unit serves itself. Open it on a phone, tablet, or laptop on the farm Wi-Fi and you get the same page: the same banner, the same alarms, the same controls. Check a run from the field or the office without walking over to the unit.

What you can do from your phone



Nothing to install

Open the address shown on the control screen in any browser on the farm Wi-Fi.



Every readout, every control

The page on your phone is the page on the unit, not a cut-down copy.



Any device

Phone, tablet, or the laptop in the office. It scales to the screen.

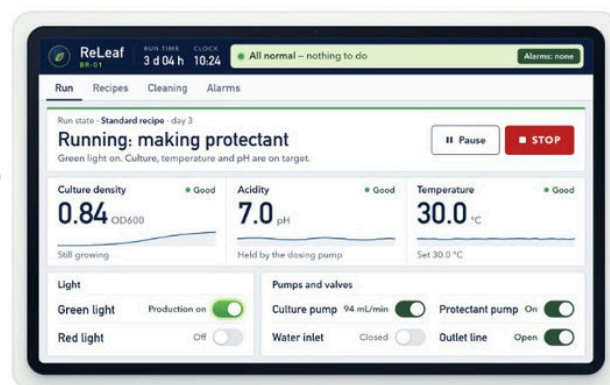
One page, wherever you open it.

It works on the farm network. It is not reachable from outside it.

Connecting

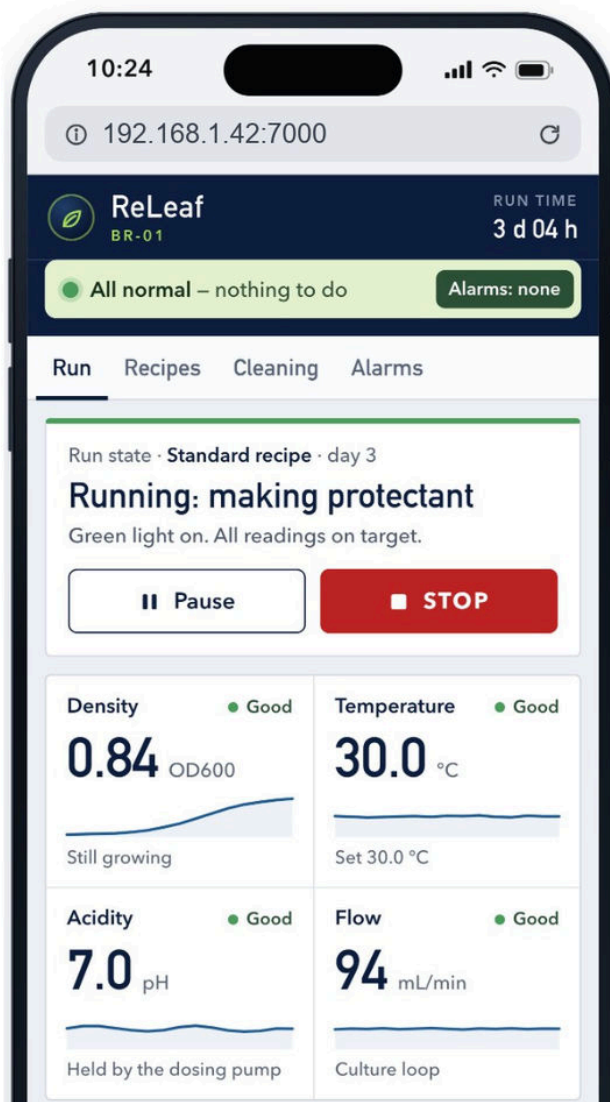
- 01 **Join the farm Wi-Fi.** Use the same network as the unit.
- 02 **Open the address shown on the screen.** Type `http://<unit IP>:7000`.
- 03 **Bookmark it.** The same page opens next time.

ON THE UNIT



FARM WI-FI

ON YOUR PHONE



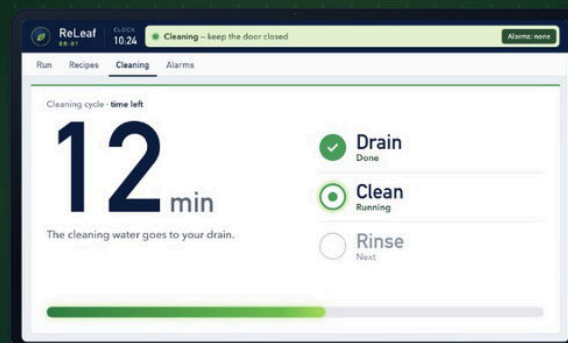
Section 07

Refilling the Culture Cartridge

The screen tells you when a cartridge is due. The change itself takes a few minutes: **about 10 minutes**.

First, run the cleaning cycle

Start the cleaning cycle from the screen and let it finish; the screen counts down the time remaining. The cleaning water goes to your drain. Wear gloves and eye protection when you handle the cleaning solution (page 8: safety).



The cleaning cycle, counting down.

Then fit the new one



01 Open the dock.

Only once the cleaning cycle has finished.



02 Lift the spent cartridge out.

Keep it closed (see below).



03 Seat the new one until it clicks.

The seal opens as it seats.



04 Close, confirm on the screen.

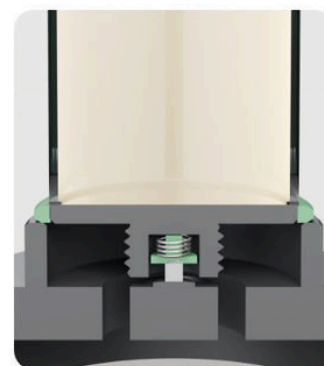
Shut the dock and confirm the new cartridge.

Inside the cartridge

It arrives sealed with the culture inside and opens into the reservoir port once seated. **Single use.**

Disposing of a used cartridge

A used cartridge has held live culture. Keep it closed, and dispose of it as your local rules for engineered organisms require: **return it sealed to your distributor. Never refit a used cartridge.**



Cutaway: the port's pin lifts the valve as the cartridge seats.

SECTION 08

Running Costs and Support

What is in the box



- 1 Main unit with control screen
- 2 Two culture cartridges
- 3 Inlet hose and outlet line
- 4 Cleaning solution, one season
- 5 Printed quick-start card

Cost per season

2 cartridges

per season

About 40 kWh

of power per season

About 10 minutes

of your time per week

Price per season: **US\$360 (NT\$11,400).**

Warranty

Every unit comes with a **12-month warranty**. Cartridges and the membrane are consumables. Ask us for the full terms.

Maintenance calendar



EVERY DAY

Glance at the screen.
A green banner
(**Alarms: none**) means
nothing to do.



EVERY WEEK

Wipe the door window.
Check the outlet line
is clear.



EVERY CARTRIDGE

Run the cleaning cycle
before the new one goes
in.



EVERY SEASON

Replace the inlet filter.
Book the annual
membrane check.

IF SOMETHING GOES WRONG

The unit stops safely and raises an alarm. **Red:** the run has stopped.
Flashing red: containment alarm; do not open the unit.

ONE PLACE TO ASK

2026.igem.wiki/gems-taiwan

Response time: **within two working days**

Section 09

Specifications

PHYSICAL

Dimensions, W × D × H	400 × 240 × 620 mm
Weight, empty	15 kg †
Weight, running	18 kg †
Enclosure rating	IP54 †
Mounting	Free-standing, level ground †

POWER

Supply voltage	110 to 240 V AC †
Frequency	50/60 Hz †
Max power draw	150 W †
Standby draw	2 W †
Plug type	Grounded, to local standard †

PROCESS

Culture volume	1 L working volume
Output rate	1.4 L/day †
Run time per cartridge	About 150 days †
Cold start to first dose	About 5 h †
Outlet fitting	½ in male, 16 mm barb †

OPERATING RANGE

Ambient temperature	5 to 40 °C †
Humidity	20 to 90 %, non-condensing †
Supply pressure	0.1 to 0.4 MPa †
Water quality	Potable, filtered to 100 µm †
Network	Farm Wi-Fi, local only

CONSUMABLES AND REPLACEMENT PARTS

PART	CODE	INTERVAL
Culture cartridge	CTG-01	2 per season
Hollow-fiber membrane module	HFM-02	Annual membrane check
Tubing and pump set	TPS-03	Every season
Cleaning solution	CLN-04	Every season
Flow cell cuvette	FCC-05	Every 2 seasons
Inlet filter	FLT-06	Every season

† Design target, not yet measured. Subject to change.



Front elevation, door closed.

Three ways to take the next step



2026.igem.wiki/gems-taiwan

01 See it run

Book a demo, on site or on video.



2026.igem.wiki/gems-taiwan

02 Get a quote

Unit, cartridges, and a first-season plan.



2026.igem.wiki/gems-taiwan

03 Read everything

The full wiki and engineering notes.

Support and ordering

Orders and quotes: 2026.igem.wiki/gems-taiwan

Support: [the same address](https://2026.igem.wiki/gems-taiwan)

Response time: [within two working days](https://2026.igem.wiki/gems-taiwan)

On-site crop
protectant, made
fresh and closed
by light.

PREDICT · PRODUCE · PROTECT

