



PestNu

PESTNU HANDBOOK



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INTRODUCTION

PestNu (“Field-testing and demonstration of digital and space-based technologies with agro-ecological and organic practices in systemic innovation”) is a Horizon 2020, 3 year innovation action project that aims to: (i) revolutionize ICT technology and organic farming practices, (ii) reduce the dependence on hazardous pesticide and the losses of nutrients from fertilisers, towards zero pollution of water, soil and air and ultimately fertilizer use, and (iii) increase food safety and food affordability for all. The project uses novel Digital and Space-based technologies (DSTs) along with Agro-ecological and Organic practices (AOPs) in systemic innovation under circular economy along the Farm-to-Fork food production chain.

AOPs and DSTs will be field-tested and demonstrated in aquaponics, closed/semi-closed hydroponic greenhouses, and in open-field vegetable cultivation, under different conditions, soils and crops (tomato, cucumber, pepper).

Throughout the project, the following AOPs & DSTs were developed:

AOPs

- Microalgae - based biostimulant
- Biopesticide
- Biostimulant for hydroponics & aquaponics
- Integrated Fertilisation Programme (IFP)
- Plant enabler production: Automated self-controlled system for the treatment of slurry and wastewater for the production of microalgae biomass

DSTs

- AI robotic trap for real time pest monitoring
- Autonomous mobile Pestnu agrobot
- Phosphate, Standard nitrite/ nitrate, Low-cost nitrite/ nitrate and Ammonium nitrite/ nitrate analyser: Portable, energy autonomous, in-situ and real time nutrient analysers
- Agroradar – ai app
- Flow cytometer
- DSS UI



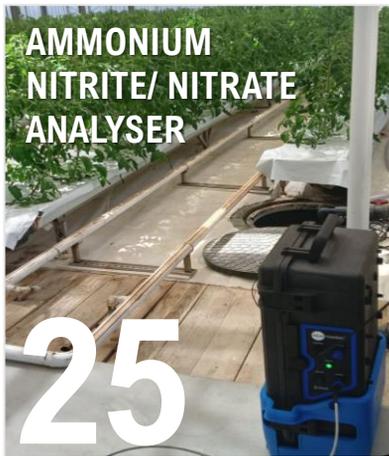
WHY PESTNU AOPs AND DSTs ARE IMPORTANT?

The use of AOPs & DSTs is expected to significantly contribute to the achievement of a series of goals. Specifically :

- Decrease of the dependency on the use of hazardous pesticides.
- Reduction of nutrients loss from fertilizers & ultimately fertilizer use; increasing their efficiency.
- Reduction of monitoring and production costs.
- Improving food yield and providing sufficient, safe, nutritious, and healthy food for all.
- Reduction of crop losses and improvement of plant quality.
- Improving the overall sustainability of food systems.



CONTENTS



FORM/ APPEARANCE	Liquid algae
COMPOSITION	1.168 g/L
DENSITY	1.09 g/mL
FREE AMINO ACIDS	20 g/L

MICROALGAE - BASED BIOSTIMULANT

DEFINITION

Bioestimulant: Substance or microorganism applied to plants with the aim to enhance nutrition efficiency, abiotic stress tolerance and/or crop quality traits, regardless of its nutrients content

Microalgae: Unicellular microorganisms capable of generating organic biomass from CO₂ and light, using water as an electron donor, oxidizing it to O₂. In the field of agriculture, they are especially beneficial because they enhance plant growth and increase tolerance to different types of biotic (i.e., insects, fungi, etc.) and abiotic stress.



✔ Product suitable for root & foliar application

FOLIAR
Spray
Others



ROOT
Fertigation
Hydroponics

INSTRUCTIONS FOR USE



- Apply to foliar or root by mixing the microalgae bioestimulant irrigation water, based on the following indications:
 - Foliar application - Relation 1:3 (microalgae bioestimulant: water)
 - Root application - Relation 1:1 (microalgae bioestimulant: water)
- The bioestimulant content can be increased, depending on the phenological stage and the nutritional requirements of the crop.
- Recommended application period for application: FROM EARLY GROWTH STAGES TO FLOWERING.

STORAGE



- ✓ AT THE ORIGINAL CONTAINER
- ✓ PROPERLY CLOSED
- ✓ IN A COOL AND SUITABLE PLACE

HANDLING



KEEP OUT OF REACH FROM CHILDREN AND AWAY FROM FOOD, DRINK AND ANIMAL FEED

DIFFERENCES BETWEEN FERTILIZERS AND BIOSTIMULANTS

FERTILIZERS

- Essential nutrients for plants.
- They do not improve stress tolerance.
- They do not improve the incorporation of nutrients.
- They are used in large quantities.

BIOSTIMULANTS

- Improve nutrient absorption.
- Improve tolerance to pests or biotic stress.
- By-product of organic origin.
- They are applied in small quantities.

Nutritional composition %	
Total Nitrogen	3.0
Nitric oxide	2.5
Ammoniacal Nitrogen	0.4
Potassium oxide	23.0
Organic Carbon	6.0
Aminoacids	12.0

BIOPESTICIDE

DEFINITION

- ✓ A biofungicide with a double action:
 1. broad-spectrum biofungicide against foliar fungal phytopathogens such as Botrytis, powdery mildew and downy mildew, among others.
 2. nutritional contribution as it is rich in potassium.
- ✓ **Circular and Sustainable origin**, as its main compound is obtained from plant by-products, and leaves no harmful residues of any kind.
- ✓ Liquid concentrated solution that is easy to apply in the field or as a dried dehydrated product.



COMPOSITION

Potassium carbonate, Organic Biostimulants (from waste or by-products of agronomic and food industries), Water.



Product suitable open field foliar application

INSTRUCTIONS FOR USE



- **Recommended method of application is Foliar spraying.**
- **Frequency and Dose:**
 - 1 preventive application at the beginning of the first risk period (First rains with moderate temperatures) of **8 mL/L** (maximum 10mL/L).
 - If symptoms of Botrytis or powdery mildew appear, repeat another application after 7 days and continue the applications with a 7-day cap if is needed.



STORAGE

- ✓ STORE AT ROOM TEMPERATURE

HANDLING



USE APPROPRIATE CLOTHING AND MASK WHEN THE PRODUCT IS CONCENTRATED. MAY CAUSE SKIN, EYE AND RESPIRATORY IRRITATION.

WHY PESTNU BIOFUNGICIDE?



- ✓ Safe for plants, wildlife and humans, and leaves no residues on crops since it is not made of chemicals.
- ✓ Tested antifungal efficacy, similar to chemical fungicides on the market.
- ✓ Nourishes and biostimulates the plant and strengthens it against abiotic stress.
- ✓ A product that may be eco-licensed and is strongly linked to the circular economy and sustainability.



BIOSTIMULANT FOR HYDROPONICS & AQUAPONICS (1/2)

DEFINITION

Biostimulants are substance or microorganism that, when applied to seeds, plants, or on the rhizosphere, stimulates natural processes to enhance or benefit nutrient uptake, nutrient use efficiency, tolerance to abiotic stress, or crop quality and yield.

The product is an organic biostimulant specially manufactured to **strengthen the plant and improve production**, while being **completely safe for fish found in an aquaponics system**. It is rich in nitrogen-fixing microorganisms, and it can be also used in conventional agriculture with great results.



COMPOSITION

Liquid organic biostimulant, rich in free amino acids, oligopeptides, beneficial microorganisms, labile organic matter, formulated with enzymatic cofactors and metabolic precursors that enhance nitrogen fixation when applied by foliar spray or increases nitrate absorption when applied through the nutritional solution.

Composition	
Free Aminoacids	12% (w/w) -14.4% (w/v)/ Aminograma Ala, Arg, Asp, Gys, Gly, Glu, Hyp, His, Iso, Leu, Lys, Met, Phe, Pro, Ser, Thr, Tyr, Va
Nitrogen	2.5% (w/w) – 3% (w/v)
Organic Nitrogen	2.5% (w/w) – 3% (w/v)
pH	5.5
Potassium oxide water soluble	1% (w/w) – 1.2% (w/v)
Total Aminoacids	14% (w/w) – 16.8% (w/v)
Low molecular weight peptides	41% (w/w) – 49.2% (w/v)
Organic material	24% (w/w) – 28.8% (w/v)
Nitrogen fixing microorganisms	✓



Product suitable for foliar application & to the irrigation nutrient solution.

BIOSTIMULANT FOR HYDROPONICS & AQUAPONICS (2/2)

INSTRUCTIONS FOR USE



- In each application, the biostimulant should be **diluted in water**.
- **The dose of application is 1.5 ml/L, applying 2.3 L/ha.**
- Foliar spraying **every 3-4 weeks**. A part of the solution may be also applied directly to the nutrient solution to help plants uptake it through the roots for better results.
- Shake before use.
- Do not mix with very alkaline products, sulfur or mineral oils.
- It is allowed to be mixed with copper in low concentrations and in all types of crops. Do not use on plum trees.



STORAGE

- ✓ STORE AT 5°C - 35°C
- ✓ KEEP IT SHELTERED FROM THE SUN AND HUMIDITY.



KEEP IT OUT OF THE REACH OF CHILDREN.
NO EATING, DRINKING OR SMOKING DURING USE
IS ALLOWED.



WHY PESTNU BIOSTIMULANT?

- ✓ Tolerance against abiotic stress in all phenological stages, especially in stages of maximum nutritional nitrogen requirements.
- ✓ Applied in small doses compare to fertilisers and reduces the amount of fertilization use.
- ✓ Completely respectful of fish in aquaponic systems.
- ✓ Enhances better flowering, fruit setting, fattening and ripening, ensuring the maximum performance and quality of the crops.
- ✓ The polyols act as regulators of cellular water balance, intervening directly in improving the tolerance of crops to drought, making plants more resistant to lack of water.
- ✓ The biopolymers, humectants and adjuvants increase the wetting power of the solution, improving the efficiency of foliar sprays.



NOTE: Although hydroponics and aquaponics are not currently classified as organic farming, they are likely to be in the future. The biostimulant is approved for organic farming.

INTEGRATED FERTILISATION PROGRAMME

DEFINITION

- An optimal fertilization plan suggesting nutrition and biostimulant application strategies (endorsed by official European certification bodies).
- Aims at producing similar or higher crop yields to that obtained with conventional fertilization practices.
- Uses fewer fertilizer units and saves water.



HOW IT WORKS?



Step 1: Determination of the amount of essential nutrients and micronutrients available and blocked in the soil, and the microbial populations of that specific soil by soil analyses.

Step 2: Development of a unique fertilization strategy (integrated Fertilization Programme – IFP) based on the specific type of soil and crop, at a precise moment included unique recommendation that adapts perfectly to the needs of the crop, taking advantage of the potential of the microorganisms of that soil.

MAIN CHARACTERISTICS/ COMPOSITION

- ✓ Biostimulants manage to enhance the development of soil microorganisms with the capacity to **unlock phosphorus, potassium and fix nitrogen**.
- ✓ **The composition of the IFP is different in each case study**, with fertilizer and biostimulant products recommendations to be further for every specific case.
- ✓ **IFP can be applied to both organic and conventional agriculture.**
- ✓ **Reduce carbon footprint and water consumption.**

INSTRUCTIONS FOR USE

- Like the composition, the instructions for use will be slightly different in each case.
- Fertinagro's technical team is in charge of giving instructions for use and the specific moment when to apply each recommended product.



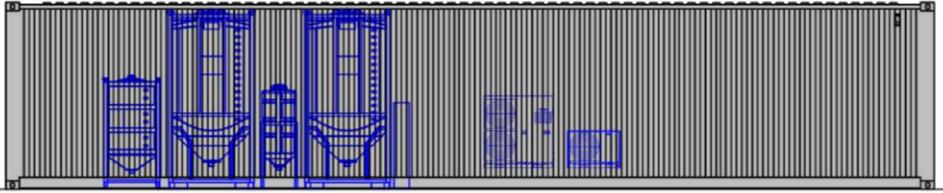
WHY IFP?

- ✓ Provides optimal nutrition and biostimulation for specific soil and crops aiming in increasing water and fertiliser use efficiency.
- ✓ Crop nutrient uptake is much more efficient, also taking advantage of soil reserves of blocked nutrients.
- ✓ A specialized team assess each case study and analyses are carried out to assure the efficiency of such a practice.
- ✓ Much more sustainable than conventional fertilization.
- ✓ Allows the farmer to know their soil, the groups of microorganisms that live in that soil and the functions they perform or can perform with the appropriate stimuli.

PLANT ENABLER PRODUCTION (1/2)

DESCRIPTION

PLANT ENABLER PRODUCTION offers a sustainable, cost-effective solution for large-scale algal biomass production, with applications ranging from biofertilizers to high-value bio-products. Its innovative design sets it apart from conventional systems, making it a promising choice for environmentally conscious agriculture.



MAIN CHARACTERISTICS

- **Containerized and Scalable:** The system employs tubular photobioreactors (PBRs), which are modular and can be easily scaled up or down. This flexibility allows for efficient utilization of space and resources.
- **Biofertilizer Production:** PLANT ENABLER PRODUCTION utilizes algal biomass to create biofertilizers. The process begins with the automatic collection of wastewater. Through the growth of fatty acid-rich microalgal biomass, the organic components are removed, resulting in a valuable biofertilizer product.
- **Automated Control:** The entire process is automated and continuously monitored. A central system (Programmable Logic Controller or PLC) connects sensors, pumps, and lighting. Data from sensors (such as pH, flow rates, and temperature) enable real-time adjustments and optimization.
- **Contaminant Removal:** The system effectively removes a wide range of contaminants, including nutrients, organic matter, and pathogens. This contributes to environmental sustainability and safe biofertilizer production.
- **High-Value Bio-Products:** Beyond biofertilizers, the grown microalgal biomass can be harvested to produce other valuable products. These may include animal feed and nutraceuticals.



ADVANTAGES COMPARED TO CONVENTIONAL PRODUCTS



- ✓ Removes a wide range of contaminants including nutrients, organic matter and pathogens.
- ✓ Can be used to produce valuable products such as biofertiliser, animal feed and nutraceuticals.
- ✓ Cost effective and requires minimal maintenance.
- ✓ An important innovation of the plant is the installation of an additional tank, inserted after the biomass collection, to convert the biomass into biofertilizer.

PLANT ENABLER PRODUCTION (2/2)

INSTRUCTIONS FOR USE

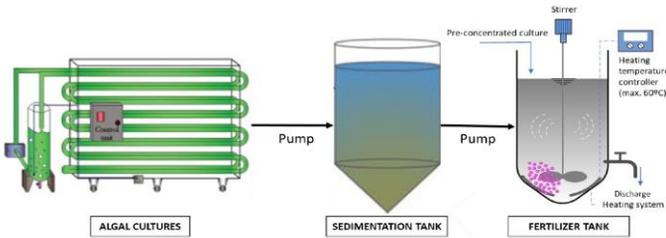
This system is equipped with a PLC capable of automating various system operations. A brief overview of the basic procedures is given below. For detailed step-by-step instructions, refer to the manual supplied with the system.

Procedures:

- A. System Flushing → Purpose: Cleans the system and fills the clean water tank.
- B1. Loading Drain Water into Loop 1 → Purpose: Loads drain water into Loop 1.
- B2. Loading Drain Water into Loop 2 → Purpose: Loads drain water into Loop 2.
- C. Growing Loop 1 → Purpose: Facilitates algae growth in Loop 1.
- D. Growing Loop 2 → Purpose: Promotes algae growth in Loop 2.
- E. Unload Harvest → Purpose: Focuses on unloading the harvested material.
- F. Total Unload (no recovery or recovery in External Tank) → Purpose: Covers the total unloading process.



**REQUIRES INSTALLATION OF A CONCRETE SLAB
USED ONLY BY EXPERIENCED PERSONNEL WHO HAVE
READ THE INSTRUCTION MANUAL.**



DIMENSIONS OF THE CONTAINER

OUTER LENGTH	INNER LENGTH	EXTERNAL WIDTH	INTERNAL WIDTH	EXTERNAL HEIGHT	INTERNAL HEIGHT	INTERNAL CARGO VOLUME	EMPTY WEIGHT (TARE)
[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[m ³]	[kg]
12.192	12.010	2.438	2.310	2.591	2.360	from 65.2 to 67.7	3,630-3,740

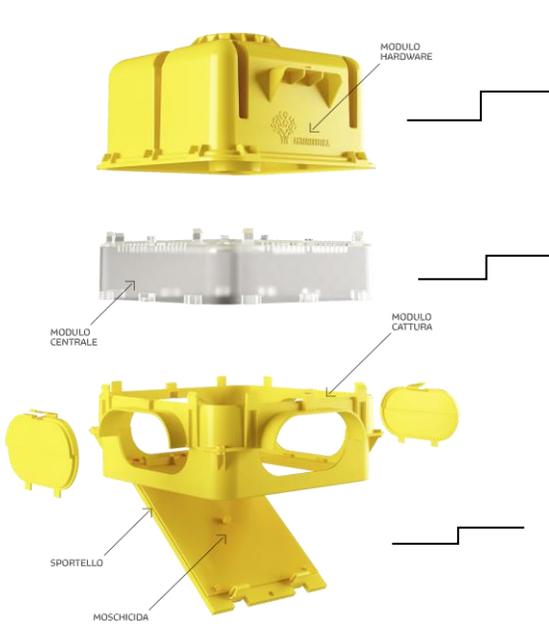
ROBOTIC TRAP (1/2)

DESCRIPTION

The Robotic trap SpyFly is a crop pest monitoring system that uses pheromone-based sexual lures to attract and capture harmful insects. It captures daily photos of these insects and transmits the images to the cloud via Wi-Fi or 4G/LTE -5G.

- ✓ Provides real-time alerts and updates on capture status to the farmer, including prompt alerts in the event of a pest threat.
- ✓ AI algorithms are employed to recognize and count the insects in the images. Additionally, the device monitors field data such as temperature, humidity, and barometric pressure.

MAIN COMPONENTS



Hardware module

Solar panel with long life battery included, GPS, temperature, humidity and barometric pressure sensors.

Central module

AI central case for the recognition of harmful insects and data insights.

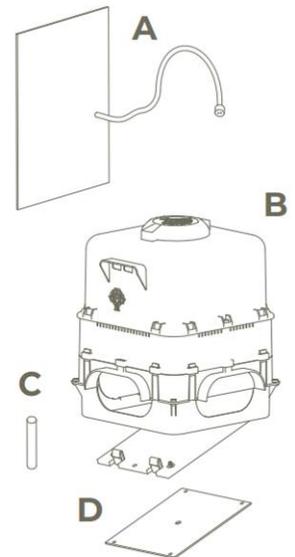
Glue paper and pheromone

Sexual, chromotropic and food lures able to attract insects.



SMART MONITORING

Control everything directly on your smartphone.



Supplied with the following components:



Solar panel (A) & Robotic trap (B)

Sold separately:
Pheromone (C) & Glue paper (D)

SpyFly is composed by:

- ❖ Pre-assembled modular case
- ❖ Camera with high definition autofocus
- ❖ LED lighting with variable brightness
- ❖ Air and soil humidity and temperature sensors
- ❖ Barometric pressure
- ❖ GPS
- ❖ Modem with built-in antenna
- ❖ Integrated rechargeable long life battery pack
- ❖ Solar panel included



ROBOTIC TRAP (2/2)

THE ADVANTAGE OF REAL-TIME MONITORING

AI

New AI with enhanced recognition

- ✓ All data and images are instantly accessible via a dedicated application on your smartphone, tablet, or desktop, reducing unnecessary farmer presence in the field by 70%.

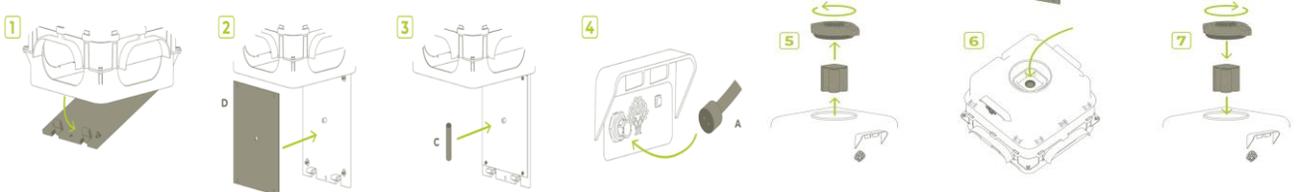
Forecasting model

Early alerts (based on thresholds) and proactive in-app notifications

- ✓ SpyFly technology proactively alerts the farmer in the event of a pest attack, mitigating risks to production, delays in response, and financial impacts.
- ✓ Each trap is equipped with sensors for weather conditions and AI technology that offers insights into insect behavior in relation to atmospheric conditions. Additionally, it incorporates solar panels for enhanced battery efficiency for outdoor usage.



READY TO USE IN 7 STEPS



- 1) Open the Catching Module door.
- 2) Insert the sticky paper at the bottom, orient it correctly, and place it in the designated slots.
- 3) Insert the pheromone into the central hole.
- 4) Connect the solar panel to the front of the machine.
- 5) Open the cap and remove the battery.
- 6) Turn on the machine using the button located in the battery compartment.
- 7) Reposition the battery and close the cap back on.

BENEFITS

- ✓ Reduction of monitoring costs.
- ✓ Reduction of crop losses and improvement of plant quality.
- ✓ Reduction of chemical pesticide applications.
- ✓ Promotes the spread of organic crops.

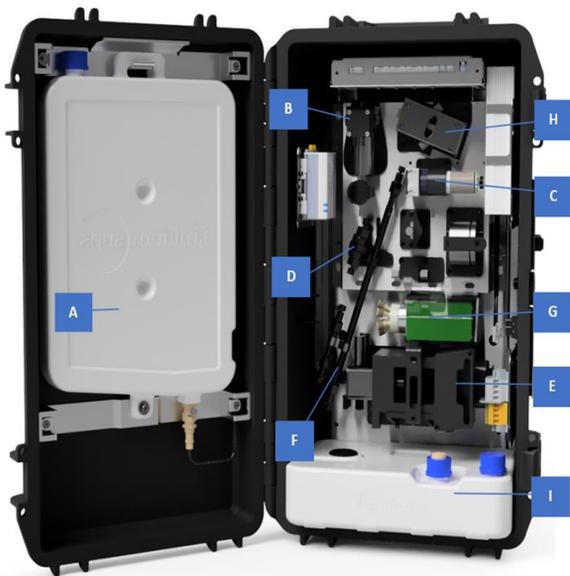


PHOSPHATE ANALYSER (1/4)

DESCRIPTION

The Phosphate Analyser is a portable ion chromatography (IC) analyser that can measure phosphate in **both freshwater and wastewater samples**. The ion chromatography separation is longer, requiring a high-pressure pumping solution, and the quantification of phosphate is achieved using an indirect UV detection method.

MAIN COMPONENTS



TECHNICAL CHARACTERISTICS

DIMENSIONS	23 cm x 36 cm x 57 cm (dxwxh), enclosure size without supporting cradle
WEIGHT	18 kg
ORIENTATION	Analyser requires to be kept vertically
POWER SUPPLY	24 V
ELUENT	Solution of 0.6 mM potassium phthalate (KHP) and 1.44 mM sodium bicarbonate (NaHCO_3) with pH adjusted to 8.8 (non-hazardous)
MAXIMUM SAMPLE FREQUENCY	15 minutes

TURNING ON/OFF THE ANALYSER

The analyser can be switched off by using the ON/OFF button.



- A. Eluent container
- B. Sample pump
- C. Peristaltic pump
- D. Transition metal trap cartridge
- E. Swashplate pump
- F. IC column
- G. Injection valve
- H. Detection cell
- I. Waste container



ANALYSER STATUS

A tri-colour status LED is visible on the front of the analyser, next to the touchscreen.

Green → analyser is carrying out analysis at the determined sample frequency.

Blue → analyser is switched off.

Red → an error has occurred.



NOTE: If an analytical cycle is in progress, wait until the cycle is completed and the swash plate pump is no longer active before turning the system off.



STORAGE & MAINTENANCE

The analyser will require maintenance after 600 analytical cycles, which will vary in time based on sample frequency.

PHOSPHATE ANALYSER (2/4)

INSTRUCTIONS FOR USE



Following the installation of the analyser (a step performed by TELLAB), three main actions are required by the users: **(i) Water sampling**, **(ii) Diluting sample and selecting dilution factor**; and **(iii) Manual start of analysis run**.

(i) WATER SAMPLING

- The analyser has a sample pump which allows the system to **automatically draw a sample** through the inlet sample tube. The pump fills in a small reservoir within the analyser from which a 1 mL aliquot is used for the analysis.
- Submerge the two sample tubes**, sample inlet and sample outlet, **at the sampling point**. These tubes can be up to 5 meters long.
- A filter is attached to the sample inlet to minimise particles to enter the analyser.
- The outlet tube allows to empty the sample reservoir with previous sample to have a homogenous fresh sample each time.

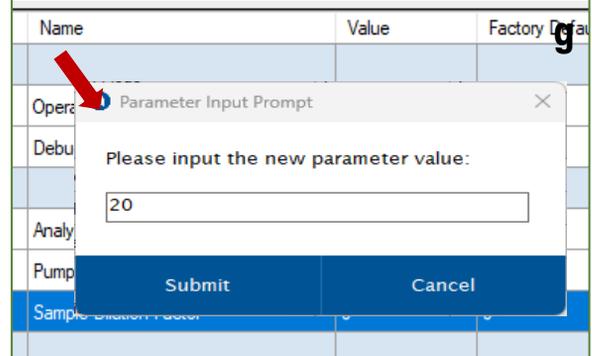
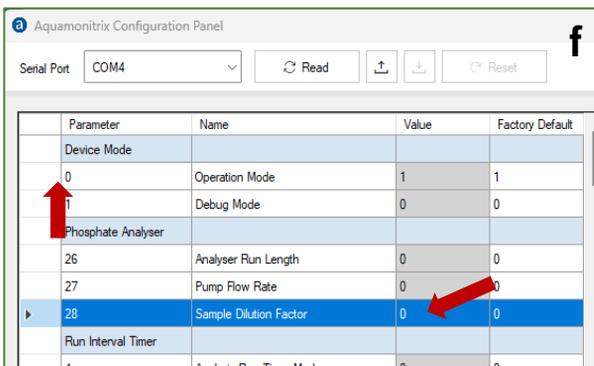
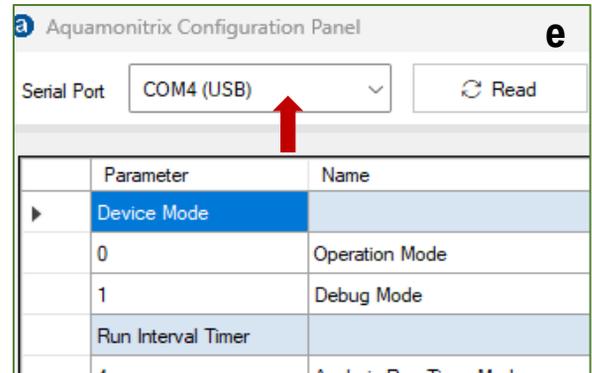
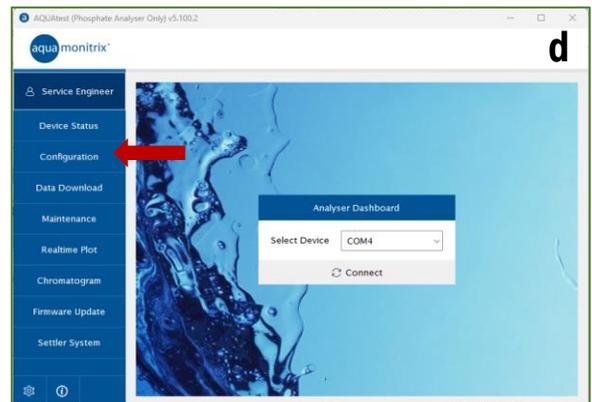
(ii) DILUTING SAMPLE & SELECTING DILUTION FACTOR

Sample to be analysed might require dilution if expected phosphate concentration is outside detection range. Dilution factor is considered by the analyser, and it requires to be updated in AQUAtest software prior to analysis.



- Open AQUAtest software .
- Sign into the “Service” account.
- Select serial port for USB cable.
- Click on “Configuration” button on the left sidebar.
- Click on “Read” button to display current configuration parameters.
- Double click on parameter 28 row “Sample Dilution Factor”.
- In the pop-up window, input the new dilution factor:

For example, a 20 times dilution (1 part sample: 19 parts deionized water) would be number 20.

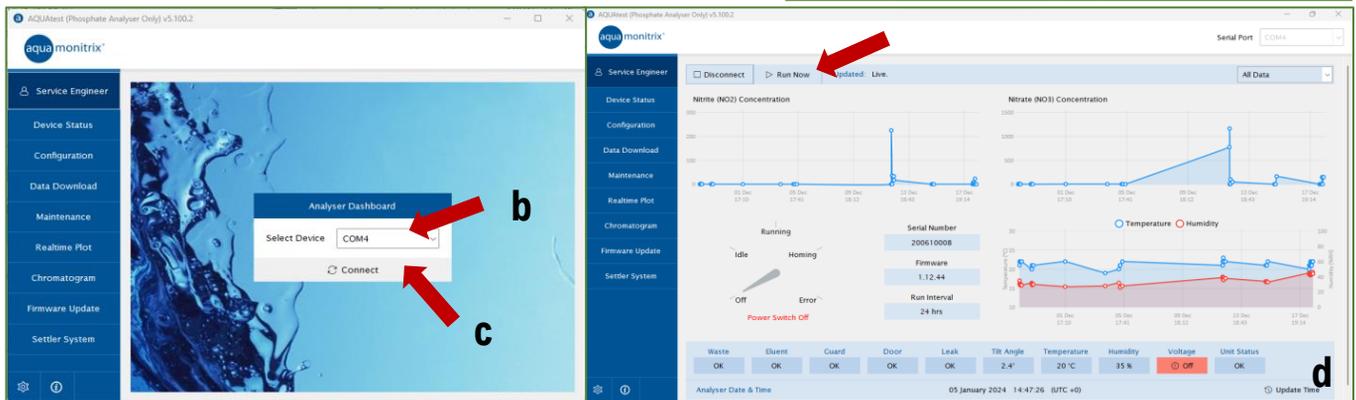
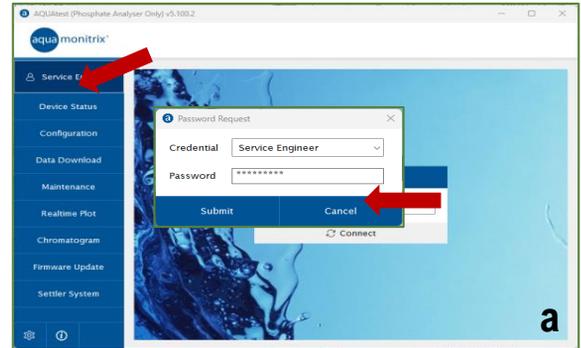


PHOSPHATE ANALYSER (3/4)

(iii) MANUAL START OF ANALYSIS RUN

Each analysis must be manually started by the user through a data cable connection and AQUAtest software.

- Open AQUAtest software and sign into the “Service” account.
- Select serial port for USB cable.
- Click on “Connect” button.
- Press “Run Now” button to start analysis.

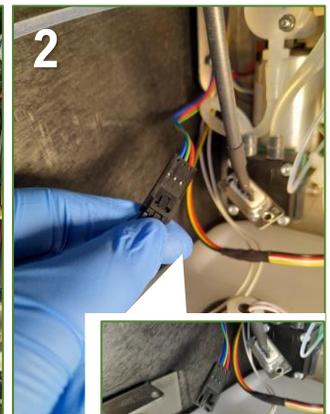


MAINTENANCE OF PHOSPHATE ANALYSER COMPONENTS

RE-FILLING THE ELUENT CONTAINER

NOTE! Phosphate eluent requires to be handled with gloves.

- On the bottom of the eluent container, disconnect the quick-release connector by pressing on the metal tab and pulling the connector down.
- Disconnect the level sensor cable by pressing down the plastic tongue and pulling both cables apart.
- Unscrew the bolt holding the eluent container in place.
- Lift the eluent container from the mounting brackets, remove the blue cap from the eluent container and refill with using the provided eluent solution.
- Close the lid tightly, mix the eluent by turning the container up and down and tapping the wall to remove any bubbles in the solution.
- Return to the mounting brackets and reconnect the tubing and cables.



OTHER NECESSARY INFORMATION

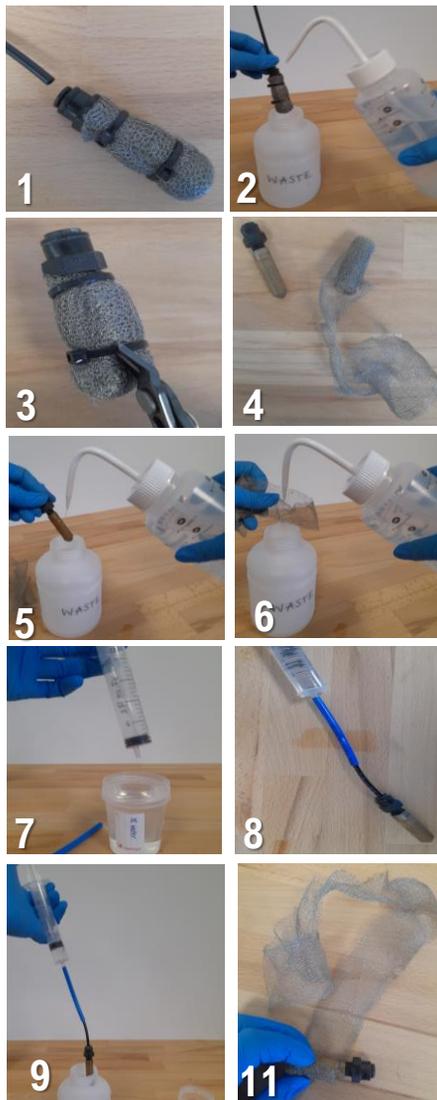
Procedure for the cleaning of the ion chromatography column is provided during installation and training of the analyser (non-hazardous solution, MSDS available).

PHOSPHATE ANALYSER (4/4)

EMPTYING THE WASTE CONTAINER

NOTE! Phosphate waste requires to be handled with gloves

- Disconnect the leak sensor cable, the waste sensor label, and the detection cell waste tubing from the waste container.
- Pull out waste container from analyser.
- Remove both lids, white lid with connector adapter & blue lid.
- Place blue lid on left opening of the container & Discard the waste inside the container.
- Swap lids, with the blue lid covering the right opening and the lid with the connector adapter closing the left opening.
- Place waste container back into the analyser, connect all cables and tubing.



WHY PHOSPHATE ANALYSER?

- ✓ High sample frequency (maximum every 15 minutes).
- ✓ No calibration drift overtime (single calibration at factory).
- ✓ Concentration data accessible through cloud portal (IoT connection).
- ✓ Non-hazardous eluent (MSDS available).



REPLACING SAMPLE TUBING & CLEANING THE INLET FILTER

The sample inlet filter will require maintenance. It can be disassembled and cleaned.

- Disconnect the inlet sample filter by pressing down on the black ring and pulling the sample tube.
- Rinse the filter with deionized water.
- Cut the cable ties around the filter.
- Unwrap the mesh.
- Rinse with deionized, use a soft brush to remove any particles attached.
- Rinse the filter with deionized water too.
- Fill a 20 mL syringe with DI water. Connect a short piece of blue tubing (sample outlet) and black tubing (sample inlet) together.
- Attach the filter to the black tubing and the syringe to the blue tubing.
- Press down the plunger, deionized water will flush through the filter. Repeat three to four times.
- Disconnect filter from tubing with syringe. Rinse the filter with deionized water once more time to remove any leftover particles.
- Wrap the mesh around the filter, covering all sides and bottom. It does not need to be extremely tight as it could cause obstruction.
- Hold the mesh around with two cable ties and cut excess plastic.
- Replace filter on sample inlet tubing.

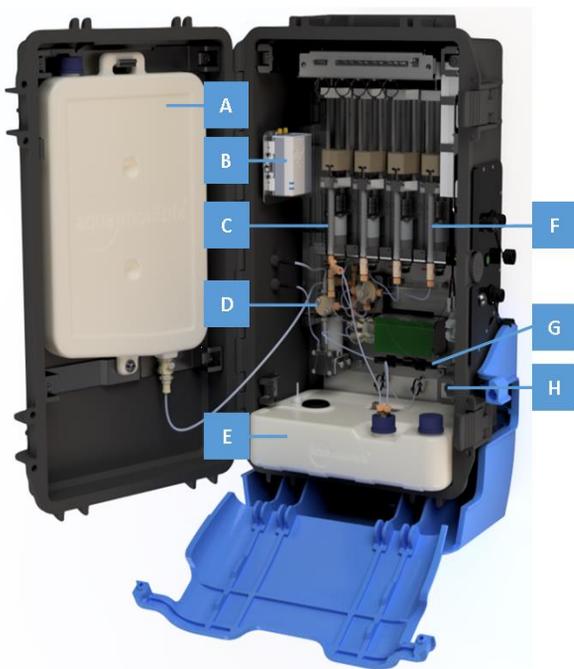


STANDARD NITRITE/ NITRATE ANALYSER (1/3)

DESCRIPTION

The Nitrite/ Nitrate Analyser is a portable ion chromatography (IC) system which provides real-time analysis of nitrite (NO_2) and nitrate (NO_3) **in fresh, brackish, and saline waters**. The system employs rapid ion chromatography with a 235 nm LED-based absorbance detector module for selective detection of both analytes.

MAIN COMPONENTS



- A. Eluent container
- B. IoT module
- C. Sample syringe
- D. Sample reservoir
- E. Waste container
- F. Eluent syringes
- G. IC column
- H. Detection cell

TECHNICAL CHARACTERISTICS

DIMENSIONS	23 cm x 36 cm x 57 cm (dxwxh), enclosure size without supporting cradle
MASS	12 kg
ORIENTATION	Analyser requires to be kept vertically
POWER SUPPLY	24 V
ELUENT	Sodium chloride (NaCl), non-hazardous and non-toxic
MAXIMUM SAMPLE FREQUENCY	15 minutes

TURNING ON/OFF THE ANALYSER

The analyser can be switched off by using the ON/OFF button.

ANALYSER STATUS

A tri-colour status LED is visible on the front of the analyser, next to the touchscreen.

Green → analyser is carrying out analysis at the determined sample frequency.

Blue → analyser is switched off.

Red → an error has occurred.



NOTE: If an analytical cycle is in progress, wait until the cycle is completed and the eluent syringe has re-homed before turning the system off.

STANDARD NITRITE/ NITRATE ANALYSER (2/3)

INSTRUCTIONS FOR USE

Following the installation of the analyser (a step performed by TELLAB), a main action is required by the users: **Water sampling**. !!! Minimal interaction required, as the system will autonomously carry out the analysis.

WATER SAMPLING

- The analyzer has a sample pump which allows the system to **automatically draw a sample** through the inlet sample tube. The pump fills in a small reservoir within the analyser from which a 1 mL aliquot is used for the analysis.
- **Submerge the two sample tubes**, sample inlet and sample outlet, **at the sampling point**. These tubes can be up to 5 meters long.
- A filter is attached to the sample inlet to minimize particles to enter the analyzer.
- The outlet tube allows to empty the sample reservoir with previous sample to have a homogenous fresh sample each time.

MAINTENANCE OF STANDARD NITRITE/ NITRATE ANALYSER COMPONENTS

RE-FILLING THE ELUENT CONTAINER

Eluent used in the analyser is 120 mM NaCl which is non-hazardous and non-toxic.

1. On the bottom of the eluent container, disconnect the quick-release connector by pressing on the metal tab and pulling the connector down.
2. Disconnect the level sensor cable by pressing down the plastic tongue and pulling both cables apart.
3. Unscrew the bolt holding the eluent container in place.
4. Lift the eluent container from the mounting brackets, remove the blue cap from the eluent container and refill with using the provided eluent solution.
5. Close the lid tightly, mix the eluent by turning the container up and down and tapping the wall to remove any bubbles in the solution.
6. Return to the mounting brackets and reconnect the tubing and cables.



EMPTYING THE WASTE CONTAINER

Waste produced by the analyser is non-hazardous and non-toxic.

- a. Disconnect the leak sensor cable, the waste sensor label, and the detection cell waste tubing from the waste container.
- b. Pull out waste container from analyser.
- c. Remove both lids, white lid with connector adapter & blue lid.
- d. Place blue lid on left opening of the container & Discard the waste inside the container.
- e. Swap lids, with the blue lid covering the right opening and the lid with the connector adapter closing the left opening.
- f. Place waste container back into the analyser, connect all cables and tubing.



STANDARD NITRITE/ NITRATE ANALYSER (3/3)



STORAGE & MAINTENANCE

The analyser will require maintenance after 600 analytical cycles, which will vary in time based on sample frequency.

REPLACING SAMPLE TUBING & CLEANING THE INLET FILTER

The sample inlet filter will require maintenance. It can be disassembled and cleaned.

1. Disconnect the inlet sample filter by pressing down on the black ring and pulling the sample tube.
2. Rinse the filter with deionised water.
3. Cut the cable ties around the filter.
4. Unwrap the mesh.
5. Rinse with deionised, use a soft brush to remove any particles attached.
6. Rinse the filter with deionised water too.
7. Fill a 20 mL syringe with DI water. Connect a short piece of blue tubing (sample outlet) and black tubing (sample inlet) together.
8. Attach the filter to the black tubing and the syringe to the blue tubing.
9. Press down the plunger, deionised water will flush through the filter. Repeat three to four times.
10. Disconnect filter from tubing with syringe. Rinse the filter with deionised water once more time to remove any leftover particles.
11. Wrap the mesh around the filter, covering all sides and bottom. It does not need to be extremely tight as it could cause obstruction.
12. Hold the mesh around with two cable ties and cut excess plastic.
13. Replace filter on sample inlet tubing.



i OTHER NECESSARY INFORMATION

- Sample and eluent syringes are consumables.
- IC column might require replacement based on number of analytical cycles and matrix complexity.
- Extra visual material for maintenance support including videos is available.



WHY STANDARD NITRITE/NITRATE ANALYSER?

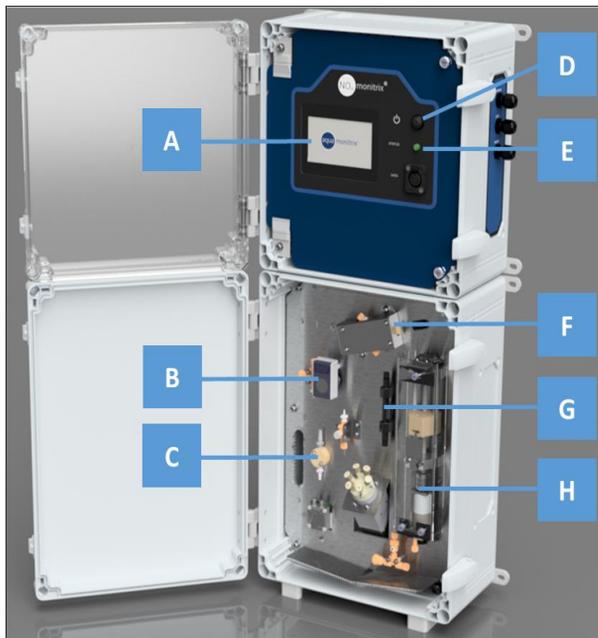
- ✓ Detection of both, nitrite and nitrate, analytes within the sample.
- ✓ High sample frequency (maximum every 15 minutes).
- ✓ No calibration drift overtime (single calibration at factory).
- ✓ Non-hazardous, non-toxic reagents used.
- ✓ Concentration data accessible through cloud portal (IoT connection).

LOW-COST NITRITE/ NITRATE ANALYSER (1/3)

DESCRIPTION

The Low-cost Nitrite/ Nitrate Analyser is a fixed ion chromatography (IC) system which provides real-time analysis of nitrite (NO_2) and nitrate (NO_3) **in fresh, brackish and saline waters**. The system employs rapid ion chromatography with a 235 nm LED-based absorbance detector module for selective detection of both analytes.

MAIN COMPONENTS



- A. Interactive touchscreen
- B. Sample peristaltic pump
- C. Sample reservoir
- D. ON/OFF button
- E. Tri-colour status LED
- F. Detection cell
- G. IC column
- H. Eluent syringe

TECHNICAL CHARACTERISTICS

DIMENSIONS	18.5 cm x 33 cm x 70 cm (dxwxh), enclosure size
MASS	12 kg
ORIENTATION	Analyser requires to be kept vertically and wall mounted
POWER SUPPLY	24 V
ELUENT	Sodium chloride (NaCl), non-hazardous and non-toxic
MAXIMUM SAMPLE FREQUENCY	15 minutes

TURNING ON/OFF THE ANALYSER

The analyser can be switched off by using the ON/OFF button.

ANALYSER STATUS

A tri-colour status LED is visible on the front of the analyser, next to the touchscreen.

Green → analyser is carrying out analysis at the determined sample frequency.

Blue → analyser is switched off.

Red → an error has occurred.



 **NOTE:** If an analytical cycle is in progress, wait until the cycle is completed and the eluent syringe has re-homed before turning the system off.

 **The touchscreen** allows quick visualisation of last measured NO_2/NO_3 concentrations, chromatogram, and management / servicing of the analyser (change of sample frequency or cleaning of the system).

LOW-COST NITRITE/ NITRATE ANALYSER (2/3)

INSTRUCTIONS FOR USE

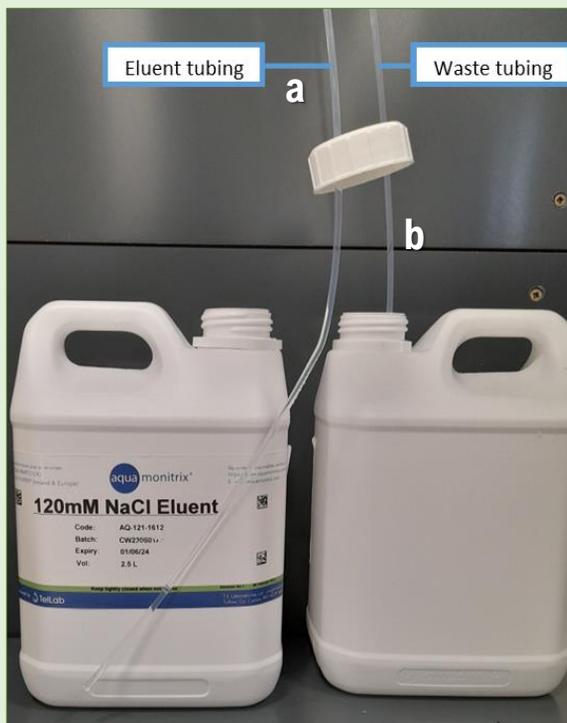
Following the installation of the analyser (a step performed by TELLAB), a main action is required by the users: **Water sampling**.

!!! Minimal interaction required, as the system will autonomously carry out the analysis.

WATER SAMPLING

- The analyser has a sample pump which allows the system to **automatically draw a sample** through the inlet sample tube. The pump fills in a small reservoir within the analyser from which a 1 mL aliquot is used for the analysis.
- **Submerge the two sample tubes**, sample inlet and sample outlet, **at the sampling point**. These tubes can be up to 5 meters long.
- A filter is attached to the sample inlet to minimise particles to enter the analyser.
- The outlet tube allows to empty the sample reservoir with previous sample to have a homogenous fresh sample each time.

MAINTENANCE OF LOW-COST NITRITE/ NITRATE ANALYSER COMPONENTS



RE-FILLING THE ELUENT CONTAINER

The eluent container for the low-cost analyser is external.

- Remove eluent tubing from empty eluent container.
- Discard empty 120 mM NaCl eluent container and replace with full eluent drum. Ensure the eluent tubing is standing straight inside the eluent drum, reaching the bottom of the container but not bending to avoid air entering the system when the eluent level is low.

EMPTYING THE WASTE CONTAINER

The waste tubing (b) from the analyser can be placed inside a drum to collect the waste which can then be discarded or directed to a nearby drain where the analyser has been installed.



STORAGE & MAINTENANCE

The analyser will require maintenance after 600 analytical cycles, which will vary in time based on sample frequency.

LOW-COST NITRITE/ NITRATE ANALYSER (3/3)

REPLACING SAMPLE TUBING & CLEANING THE INLET FILTER

The sample inlet filter will require maintenance. It can be disassembled and cleaned.

1. Disconnect the inlet sample filter by pressing down on the black ring and pulling the sample tube.
2. Rinse the filter with deionised water.
3. Cut the cable ties around the filter.
4. Unwrap the mesh.
5. Rinse with deionised, use a soft brush to remove any particles attached.
6. Rinse the filter with deionised water too.
7. Fill a 20 mL syringe with DI water. Connect a short piece of blue tubing (sample outlet) and black tubing (sample inlet) together.
8. Attach the filter to the black tubing and the syringe to the blue tubing.
9. Press down the plunger, deionised water will flush through the filter. Repeat three to four times.
10. Disconnect filter from tubing with syringe. Rinse the filter with deionised water once more time to remove any leftover particles.
11. Wrap the mesh around the filter, covering all sides and bottom. It does not need to be extremely tight as it could cause obstruction.
12. Hold the mesh around with two cable ties and cut excess plastic.
13. Replace filter on sample inlet tubing.



OTHER NECESSARY INFORMATION



- Eluent syringe is a consumable.
- IC column might require replacement based on number of analytical cycles and matrix complexity.
- Extra visual material for maintenance support including videos is available.



WHY LOW-COST NITRITE/NITRATE ANALYSER?



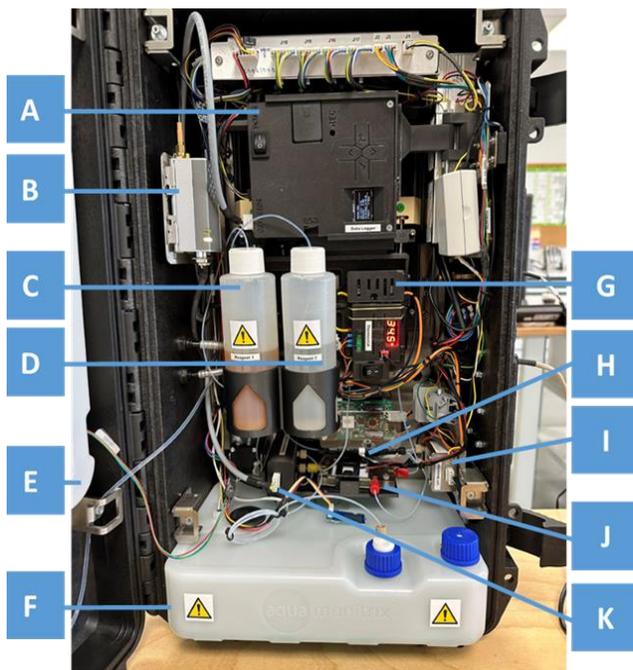
- ✓ Interactive touchscreen for visualisation of results.
- ✓ Detection of both, nitrite and nitrate, analytes within the sample.
- ✓ High sample frequency (maximum every 15 minutes).
- ✓ No calibration drift overtime (single calibration at factory).
- ✓ Non-hazardous, non-toxic reagents used.
- ✓ Concentration data accessible through cloud portal (IoT connection).

AMMONIUM NITRITE/ NITRATE ANALYSER (1/4)

DESCRIPTION

The post-column Ammonium analyser is a combined ion chromatography (IC) and colorimetric analyser which can determine the concentration of nitrite, nitrate and ammonium in both freshwater and wastewater samples. Detection of nitrite and nitrate is achieved by 235 nm LED-based absorbance detector module. Ammonium is detected by performing a colorimetric reaction on the output fluid of the nitrite and nitrate detection cell. The colour of the reactant is then measured by using a visible light photodetector at 660 nm.

MAIN COMPONENTS



- A. Data logger
- B. IoT module
- C. Reagent 1 colorimetric method ammonium detection
- D. Reagent 2 colorimetric method ammonium detection
- E. Eluent container
- F. Hazardous waste container
- G. Temperature control
- H. IC column for NO₂/NO₃ detection
- I. NO₂/NO₃ detection cell
- J. NH₄⁺ microfluidic chip with PCB heater
- K. NH₄⁺ detection cell Interactive touchscreen

TECHNICAL CHARACTERISTICS

DIMENSIONS	23 cm x 36 cm x 57 cm (dxwxh), enclosure size without supporting cradle
MASS	15 kg
ORIENTATION	Analyser requires to be kept vertically
POWER SUPPLY	24 V
REAGENTS	Eluent: Sodium chloride (non-hazardous and non-toxic) Reagent 1: Sodium salicylate, sodium nitroprusside, sodium hydroxide (hazardous and toxic) Reagent 2: Sodium hypochlorite solution, sodium hydroxide (hazardous and corrosive)
MAXIMUM SAMPLE FREQUENCY	20 minutes

TURNING ON/OFF THE ANALYSER

The analyser can be switched off by using the ON/OFF button.

ANALYSER STATUS

A tri-colour status LED is visible on the front of the analyser, next to the touchscreen.

Green → analyser is carrying out analysis at the determined sample frequency.

Blue → analyser is switched off.

Red → an error has occurred.



 **NOTE:** If an analytical cycle is in progress, wait until the cycle is completed and the eluent syringe has re-homed before turning the system off.

AMMONIUM NITRITE/ NITRATE ANALYSER (2/4)

INSTRUCTIONS FOR USE IN STEPS

Following the installation of the analyser (a step performed by TELLAB), three main actions are required by the users: **(i) Switching on of ammonium method components**, **(ii) Water sampling**, and **(iii) manual start of analysis run**.

(i) SWITCHING ON OF AMMONIUM METHOD COMPONENTS

Data logger for recording of ammonium measurements and microfluidic chip heater require to be switched on prior to starting analysis.

1. Open analyser door.
2. Turn on the power switch on the ammonium data logger.
3. Turn on the power switch on the ammonium microfluidic chip heater.



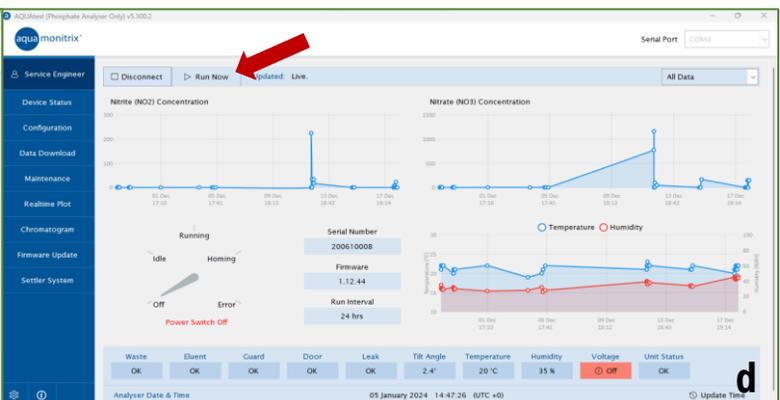
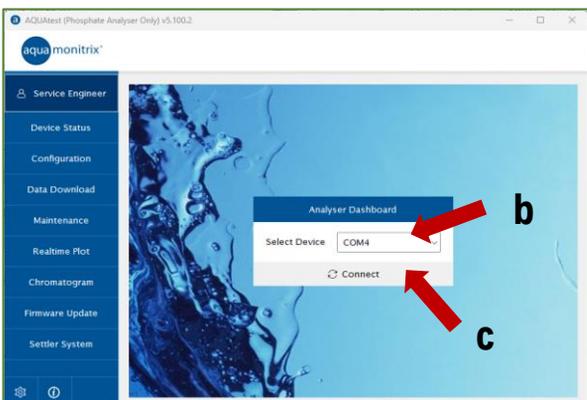
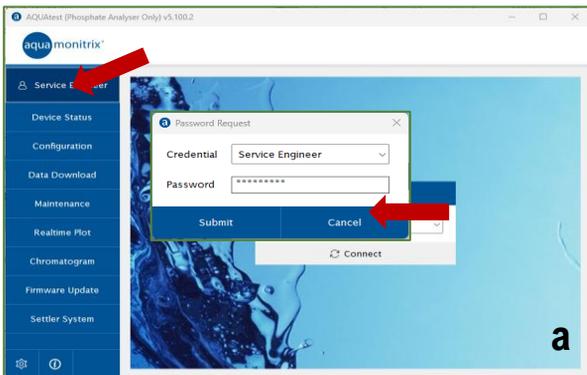
(ii) WATER SAMPLING

- The analyser has a sample pump which allows the system to **automatically draw a sample** through the inlet sample tube. The pump fills in a small reservoir within the analyser from which a 1 mL aliquot is used for the analysis.
- **Submerge the two sample tubes**, sample inlet and sample outlet, **at the sampling point**. These tubes can be up to 5 meters long.
- A filter is attached to the sample inlet to minimize particles to enter the analyser.
- The outlet tube allows to empty the sample reservoir with previous sample to have a homogenous fresh sample each time.

(iii) MANUAL START OF ANALYSIS RUN

Each analysis must be manually started by the user through a data cable connection and AQUAtest software.

- a) Open AQUAtest software and sign into the “Service” account.
- b) Select serial port for USB cable.
- c) Click on “Connect” button.
- d) Press “Run Now” button to start analysis.

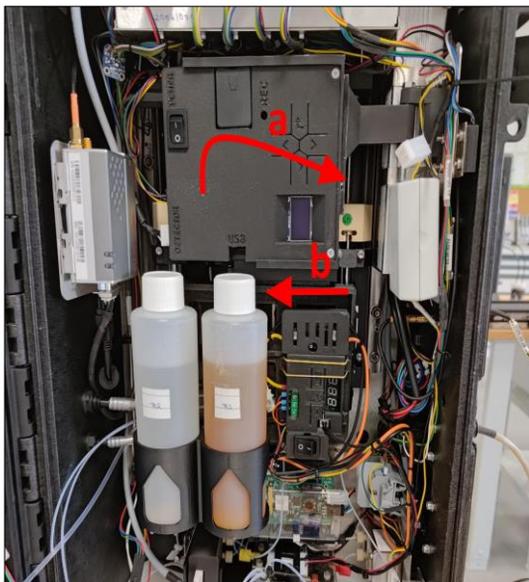
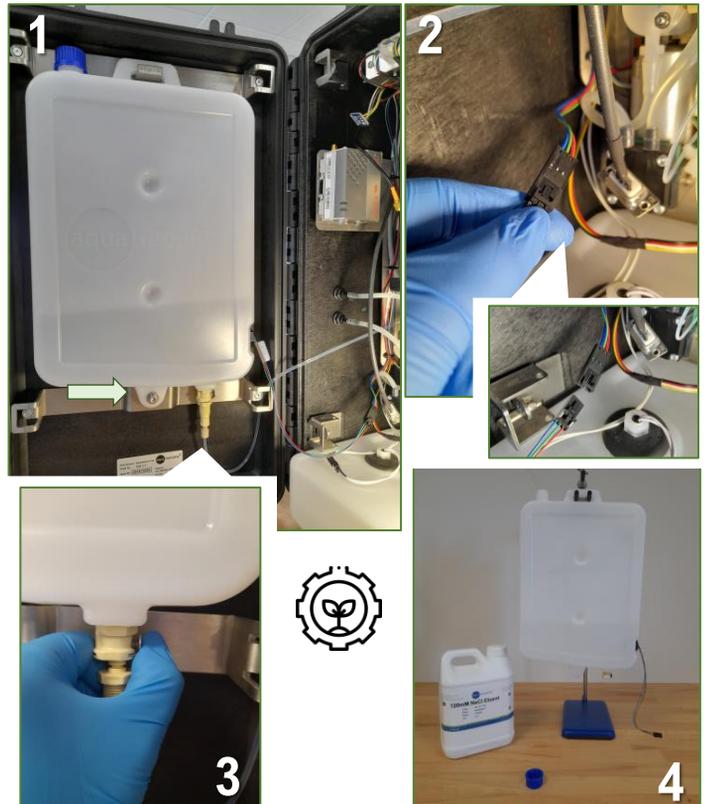


AMMONIUM NITRITE/ NITRATE ANALYSER (3/4)

MAINTENANCE OF AMMONIUM NITRITE/ NITRATE ANALYSER COMPONENTS

RE-FILLING THE ELUENT CONTAINER

1. On the bottom of the eluent container, disconnect the quick-release connector by pressing on the metal tab and pulling the connector down.
2. Disconnect the level sensor cable by pressing down the plastic tongue and pulling both cables apart.
3. Unscrew the bolt holding the eluent container in place.
4. Lift the eluent container from the mounting brackets, remove the blue cap from the eluent container and refill with using the provided 120 mM Sodium Chloride (NaCl) solution.
5. Close the lid tightly, mix the eluent by turning the container up and down and tapping the wall to remove any bubbles in the solution.
6. Return to the mounting brackets and reconnect the tubing and cables.



RE-FILLING THE AMMONIUM COLORIMETRIC REAGENT CONTAINERS

NOTE! Reagents are hazardous and toxic. Ensure full PPE is worn while handling the waste, including gloves, lab coat, and safety glasses.

- Lift the front panel (containing the reagent bottles, data logger, and thermostat) to unlatch it, and swing it outwards on the hinge.
- Slide the bottom section of the panel outwards, away from the hinge. This will allow the reagent bottles to be lifted out of their cup holders.
- Top up reagent bottles with required solutions.
- Place back on cup holders and close front panel by swinging it inwards on the hinge.

OTHER NECESSARY INFORMATION

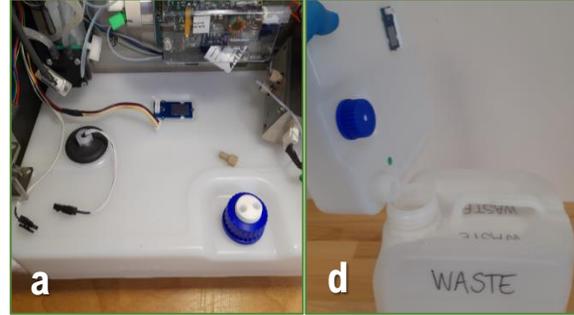
- Sample, eluent and reagent syringes are consumable.
- IC column might require replacement based on number of analytical cycles and matrix complexity.
- Extra visual material for maintenance support is available.

AMMONIUM NITRITE/ NITRATE ANALYSER (4/4)

EMPTYING THE WASTE CONTAINER

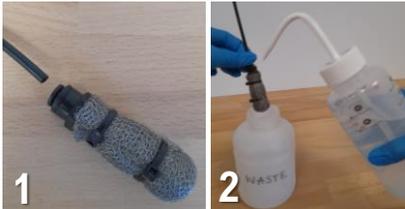
NOTE! Phosphate waste requires to be handled with gloves

- Disconnect the leak sensor cable, the waste sensor label, and the detection cell waste tubing from the waste container.
- Pull out waste container from analyser.
- Remove both lids, white lid with connector adapter & blue lid.
- Place blue lid on left opening of the container & Discard the waste inside the container.
- Swap lids, with the blue lid covering the right opening and the lid with the connector adapter closing the left opening.
- Place waste container back into the analyser, connect all cables and tubing.



WHY AMMONIUM NITRITE/NITRATE ANALYSER?

- ✓ Interactive touchscreen for visualisation of results.
- ✓ Detection of both, nitrite and nitrate, analytes within the sample.
- ✓ No calibration drift overtime (single calibration at factory).
- ✓ Concentration data accessible through cloud portal (IoT connection).



REPLACING SAMPLE TUBING & CLEANING THE INLET FILTER

The sample inlet filter will require maintenance. It can be disassembled and cleaned.

- Disconnect the inlet sample filter by pressing down on the black ring and pulling the sample tube.
- Rinse the filter with deionised water.
- Cut the cable ties around the filter.
- Unwrap the mesh.
- Rinse with deionised, use a soft brush to remove any particles attached.
- Rinse the filter with deionised water too.
- Fill a 20 mL syringe with DI water. Connect a short piece of blue tubing (sample outlet) and black tubing (sample inlet) together.
- Attach the filter to the black tubing and the syringe to the blue tubing.
- Press down the plunger, deionised water will flush through the filter. Repeat three to four times.
- Disconnect filter from tubing with syringe. Rinse the filter with deionised water once more time to remove any leftover particles.
- Wrap the mesh around the filter, covering all sides and bottom. It does not need to be extremely tight as it could cause obstruction.
- Hold the mesh around with two cable ties and cut excess plastic.
- Replace filter on sample inlet tubing.

STORAGE & MAINTENANCE

The analyser will require maintenance after 600 analytical cycles, which will vary in time based on sample frequency.



AGRORADAR – AI APP (1/2)

DESCRIPTION

AgroRadar is a powerful software for agricultural monitoring (e.g., nutrients, pests). This software uses satellite imagery from the European Space Agency's (ESA) Copernicus program that can be visualized through the SmartAG app. The information generated allows farmers to monitor and inspect their crops for more precise and efficient management through the mobile web app.

INSTRUCTIONS

Regional scale

Information can be accessed about plant productivity and water stress, vegetation structure and regional land surface temperature.



Steps:

- Type <https://smartag.agroinsider.com/> in a web browser and login with username and password.
- Select "Daily Reports".
- Select the Campaign (e.g., Tomato and select the parcel).
- Select a report unseen or seen.
- Check the anomalies in space, i.e., the images.
- Check the anomalies in time, i.e., the crop evolution.
- Check the thermal gradient, i.e., the regional minimum and maximum temperature.

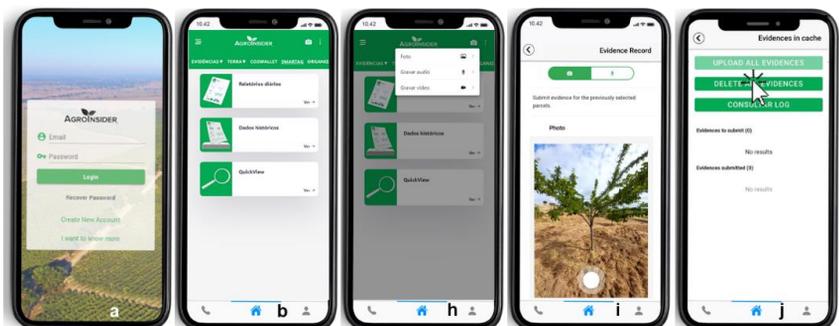


Local scale

After installing the SmartAG app in the smartphone, geolocated data (photos, videos & audios) can be added/recorded, enriching the monitoring and certification process with this information, protected by blockchain technologies.



After completing the steps on the regional scale, follow the next additional steps:



- Select what you want to see in the SmartAG – Evidences/ Land/ SmartAG.
- Register georeferenced field evidence –Photos/Audios/Videos.
- Upload all evidence.



AGRORADAR – AI APP (2/2)

MAIN ADVANTAGES

- ✓ Satellite data, combined with the georeferenced evidence collected in the field, can be used for the transparency process of traceability of the on-farm food production system.
- ✓ This tool supports the reduction of the environmental footprint of each food produced and align with European objectives and targeting the Sustainable Development Goals marketplaces.
- ✓ PestNu foresees additional protection of the evidence registered through AgoroRadar by blockchain technologies (deployed by CERTH).



OTHER NECESSARY INFORMATION

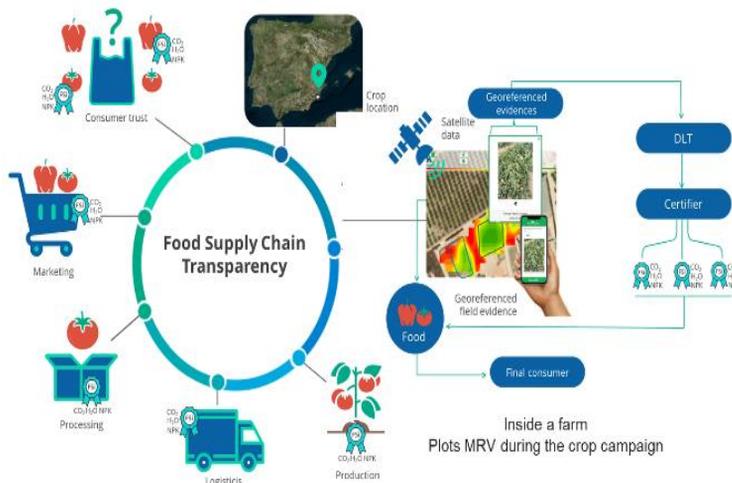
Required data requested from users to calculate the FSi (CO₂, NPK and water footprint):

- Crop type
- Campaign
- Plot area
- Crop productivity
- Soil pH
- Crop residues
- Fuel quantity
- Type of fertilizers
- Fertilizer application method (to the soil)
- Nitrogen fraction of fertilizers
- Fertilizer distribution
- Total quantity of applied fertilizer
- Total amount of water used per plot



Food Sustainability Index (FSi) tool

- ✓ calculates the carbon, water and nutrient (NPK) footprint associated with crops.
- ✓ allows to evaluate the efficiency of your products in terms of natural resources.
- ✓ allows comparison of different practices within your plots, over time, or in relation to the regional average.



DATA HANDLING

All the data is stored and maintained in the AgoroRadar infrastructure and sent to the PestNu project's Decision Support System (DSS).

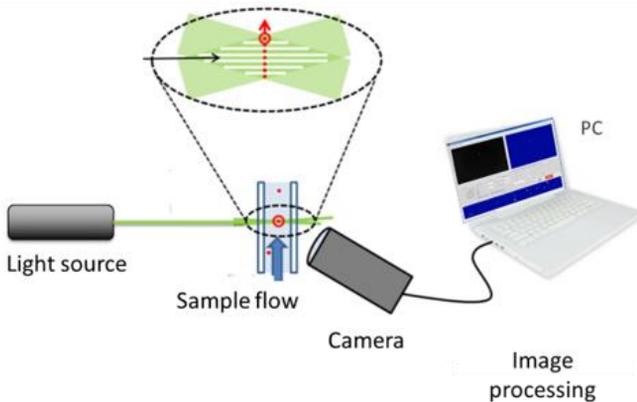
TECNICAL CHARACTERISTICS

The system is based on satellite data from ESA's Copernicus program-Sentinel-1 and Sentinel-2 – and data from Meteosat 2nd Generation - Land Surface Temperature (LST) - processed by AgoroRadar using artificial intelligence algorithms that provide information and deep learning capabilities on agricultural data. With this specific data, several processes and models are used to produce agronomic outcomes (intelligence), which will help the farmer in their decision making. At the same time the infrastructure integrates, stores and secures all the user data.

FLOW CYTOMETER (1/3)

DESCRIPTION

The camera-based Flow Cytometer is a portable, easy-to-use, instrument for detecting and analysing microalgae/cyanobacteria in liquid samples. The system is based on the optical detection of autofluorescence from chlorophyll and by using image processing and AI/Machine Learning, information on the growth rate (counts over time) and health status (cluster types, size, intensity) of the microalgae culture can be determined.



TECHNICAL CHARACTERISTICS

DIMENSIONS	400x300x170mm (DxWxH)
WEIGHT	~ 10 kg
ORIENTATION	The unit must always be kept vertical
POWER SUPPLY	Mains
IP RATING	None
SAMPLE VOLUME	~ 2 mL
MEAS. TIME	~ 10 min

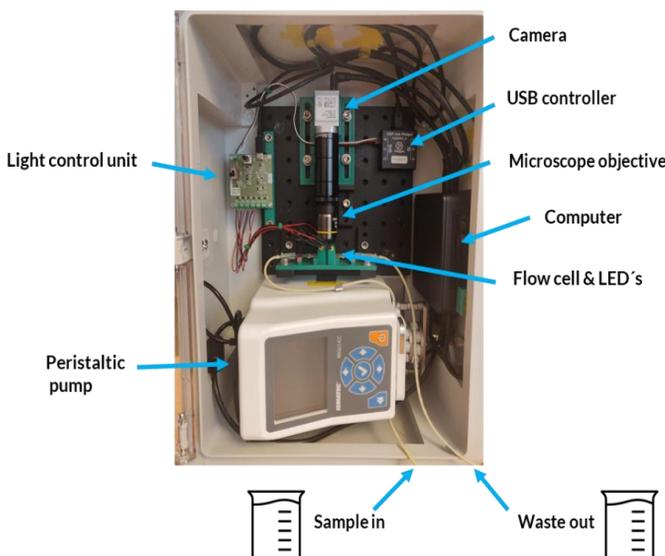
MAIN COMPONENTS

The Flow Cytometer instrument consists of:

- a single unit with all necessary parts integrated; LEDs, optical flow cell, peristaltic pump, camera with a microscope objective and a built-in computer.
- an external screen, keyboard, and mouse are used to control and visualize the measurements.

STORAGE & MAINTENANCE

- ✓ Indoor, vibration- free environment.
- ✓ Avoid moving the system, as new optical calibration might be needed.
- ✓ Flush with clean water after each measurement.
- ✓ Regular cleaning of tubing and flow cell by flushing the system with detergent (once every month or after 100 measurements).



- The instrument is based on optical detection to count microalgae cells in a liquid flow.
- A camera is used to capture images when the microalgae are emitted by a light source.
- Images are stored in the built-in computer for further image processing.

FLOW CYTOMETER (2/3)

INSTRUCTIONS FOR USE IN STEPS

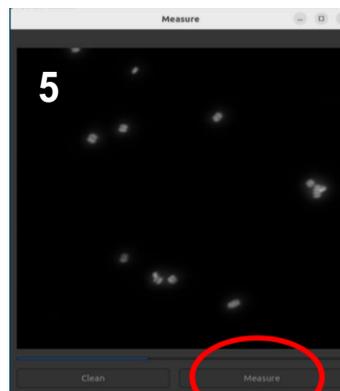
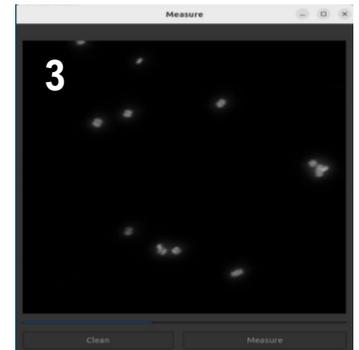
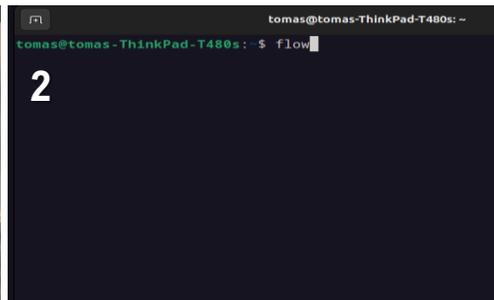
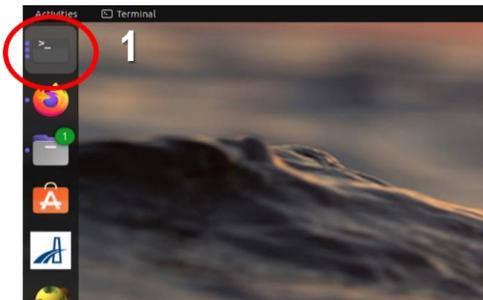
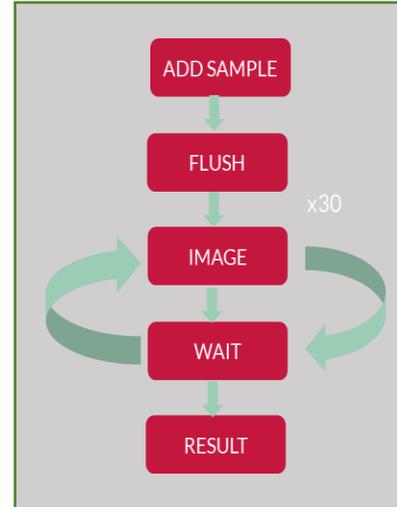
PRE-RUN CHECKLIST:

- Connect the power cable(s) to the external power supply.
- Add the sample container to the “Sample In” tube.
- Empty the waste container and place it in the “Sample/Waste Out” tube.
- Connect the power cable to the external power supply.



HOW TO START THE SYSTEM:

1. Power up the system and open a terminal window.
2. Type "flow" in the terminal.
3. Press "Enter" and wait a few seconds until the GUI starts.
4. Cleaning (optional): Add cleaning liquid to the "sample in" tube and click on the "clean" button.
5. Start measurement: Add the sample to the "sample in" tube and click on the "Measure" button on the GUI.



BENEFITS

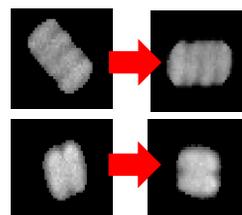
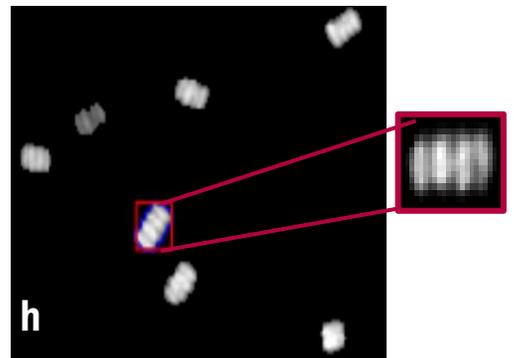
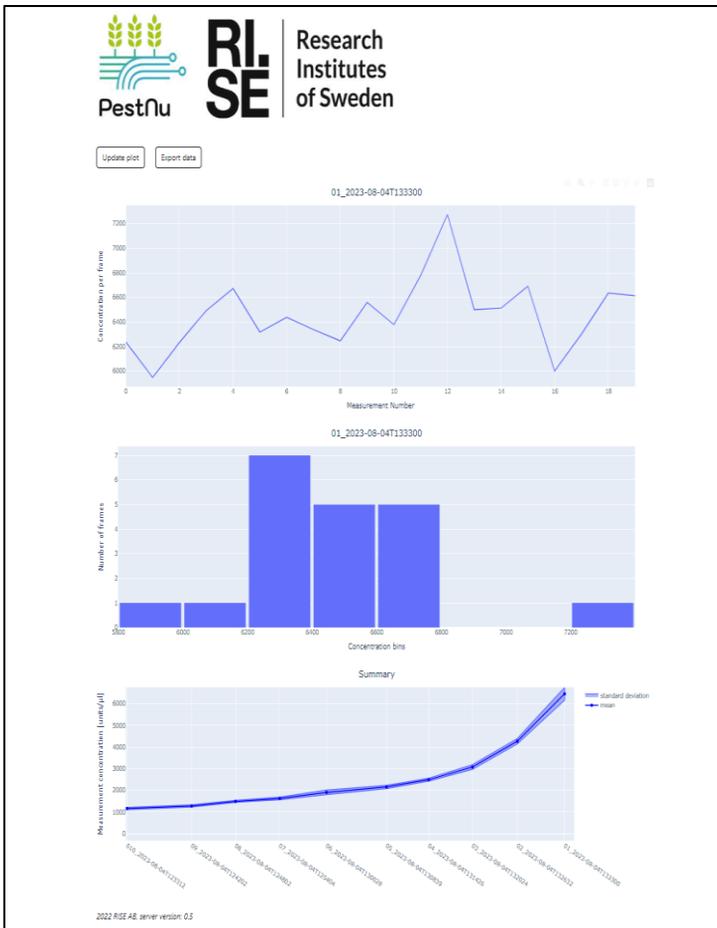
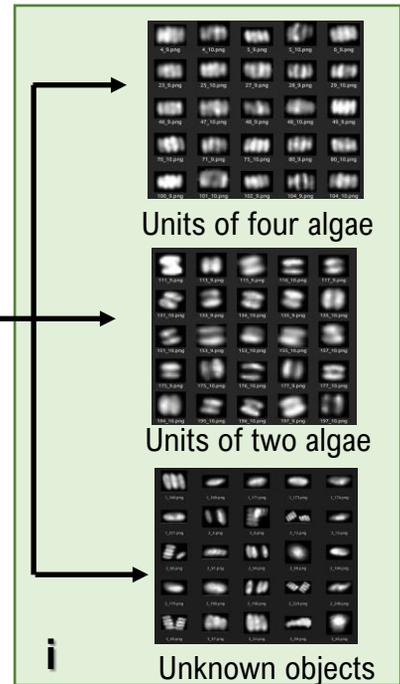


- ✓ Camera-based systems can give additional information about the health status of microalgae culture.
- ✓ Artificial intelligence and machine learning are used to enable new analytics.
- ✓ With this tool, we aim for a cheaper and simpler system compared to available systems in the market.
- ✓ Designed to be “good enough” and affordable!

FLOW CYTOMETER (3/3)

THE RESULTS:

- ✓ The system is fully automatic and captures a sequence of images during a measurement.
- ✓ An image processing and machine learning algorithm is used to count the algae and to classify them into groups (2-by-2 and 4-by-4).
- ✓ The total number of algae and the ratio between the groups are shown in the GUI and optionally uploaded to a cloud server.



PESTNU AGROBOT (1/2)

DESCRIPTION

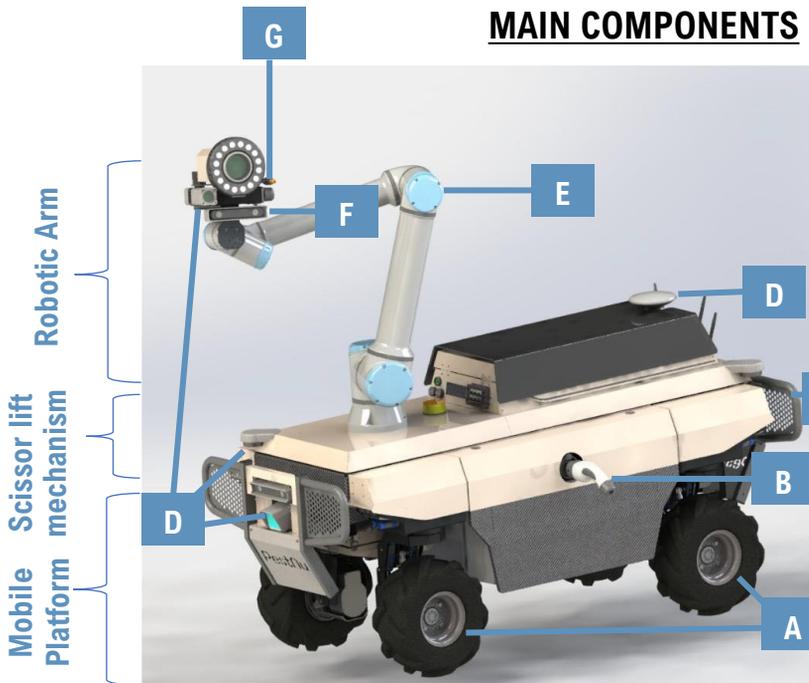
The PestNu Agrobot is an Autonomous Ground Vehicle, able to move and navigate **both between the tight rows of a Greenhouse and outdoors** on the rough terrains of the open field and a lifting mechanism carrying a 6 degrees of freedom robotic arm. The end-effector is equipped with a set of sensors and a custom spraying nozzle for the detection of the pests and consequently its precision spraying.

The PestNu Agrobot carries a high accuracy localization system and can employ mapping techniques in order to sense, map and interpret the surrounding surface. It can move in a safe and structured way, with dynamic human and obstacle avoidance. The detection method can currently detect Tuta Absoluta with 65% accuracy.

TECHNICAL CHARACTERISTICS

DIMENSIONS	W770mm x L1810mm
WEIGHT	~ 400 kg
LIQUID TANK CAPACITY	40lt
MOTOR FOR MOTION (X4)	800Watt
MOTOR FOR ROTATION (X4)	170Watt
SCISSOR LIFT	~ 2m
BATTERY TYPE	LiFePO4

MAIN COMPONENTS



Mobile Platform:

- A. 4 Wheels – Multiple kinematic modes
- B. Charging connector
- C. Battery Pack
- D. A variety of localization and perception sensors (3D lidar & two RGBD cameras)
 - Tank for liquid
 - 1st Onboard computer

Scissor lift mechanism

- D. Localization and perception sensors (IMU & two 2D lidars)
- E. Robotic Arm electronics
 - 2nd Onboard computer
 - Hydraulic mechanism

Robotic Arm (E)

- F. Disease detection sensors (multi spectral camera, RGBD camera)
- G. Spraying nozzle and mechanism

CONNECTIVITY

- ✓ Physical ports: HDMI/ USB/ Ethernet
- ✓ Wifi: Access point to connect with the robot pc
- ✓ 4G: Enables internet access
- ✓ 4G, Wifi and GNSS antennas
- ✓ Bluetooth control pad
- ✓ Graphical User Interface (Web Based)

SENSORS



RGBD Camera



Livox 3D Lidar

IMU and GPS sensor



2D Lidar

PESTNU AGROBOT (2/2)

PRE-USE ASSESSMENT



- 1) Ensure that the robot is in open area before powering it on.
- 2) Test that emergency stop buttons stop the robot and engage brakes.
- 3) Test that you are able to teleoperate the robot using the control pad.
- 4) Examine the robot status (sensors, position, error logs) on the GUI screen.
- 5) Ensure that the robot electronics cases are properly closed.
- 6) Test the battery level of the robot.
- 7) Ensure that there are no surrounding obstacles.

ROBOT START-UP SEQUENCE

- a. On/Off Switch must be activated for giving electricity to the robot components.
- b. Then press the PC buttons to power up the robot's onboard computers.
- c. The emergency buttons should be released (not pressed).

SAFETY MEASURES IN PRACTICE

- Loading and unloading procedure to be executed by certified or familiar with robot users.
- Make sure the scissor lift is folded and the robotic arm in proper configuration.
- Make sure that the ramps are properly set to the vehicle.
- User should move to a safe position to observe the robot movements and behavior.



EMERGENCY STOP



✓ 2 emergency stop buttons can be found on the rear-right and the front-left of the robot.

This button should be used only in exceptional cases, when an immediate stop of the robot's motors is required.

SHUTTING DOWN THE ROBOT PROPERLY



Press computer power-up buttons



Shutdown via Bluetooth controller

BENEFITS



- ✓ Different set of wheels for outdoors and indoors.
- ✓ Detects White flies, Aphids & Botrytis Reduction.
- ✓ Precised 3D spot spraying at the infected areas.
- ✓ The detection method with accuracy of up to 90%.
- ✓ Reaches tall vegetable crops thanks to the scissor lift.

DECISION SUPPORT SYSTEM USER INTERFACE (1/2)

DESCRIPTION

DSS UI (Decision Support System User Interface) is a user-friendly web-based dashboard of PestNu visualizes the data gathered by each of the DSTs in a separate dashlet, aiming to enable farmers to get a comprehensive view on the condition of their cultivation

MAIN COMPONENTS

The whole dashboard:

A Bell icon for notifications/alerts

B Weather conditions panel

C Autonomous Guided Vehicle (AGV) data panel

D Battery level and Glue Paper Life indicators

E Nutrient analysis (Nitrite, Nitrate, Phosphate, Ammonium) panel

F Campaigns and plant health (Greenness, Water in Plant) panel

Notifications/Alerts

Show 5 entries

Title	Action
UVC PO4 Waste Level	Please empty the PO4 device waste container
UVC PO4 Eluent Level	Please fill the PO4 device eluent container
UVC PO4 Guard	Please close the PO4 device guard
UVC Phosphate Aquaponics	The Phosphate concentration is '125' and the Aquaponics threshold values are low: '40' and high: '60'
UVC NH4 Leak	Please check the NH4 device for leaks

Showing 1 to 5 of 13 entries

Weather Conditions

Temperature 33 °C	Humidity 20 %
Barometric Pressure 1010.99 Pa	Last Update 05/02/2024 12:00:33

A. Bell icon: shows the notifications created for each tool. By clicking, expands and presents a table that contains all the notifications.

B. Weather conditions: provides information for the weather (temperature, humidity, barometric pressure and date and time of the last update), collected by the sensors of AI-based robotic trap.

Autonomous Guided Vehicle

State inspection

Battery Level discharging 80%

Pesticides Tank Level 75%

Serial Number: RR-9435-6058
Compartment: Volos_Greenhouse
Farm Type: greenhouse

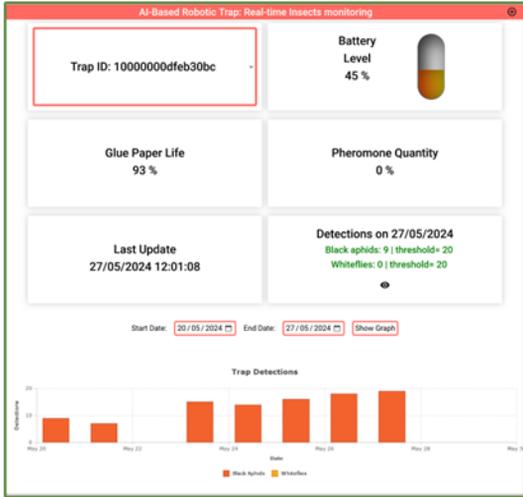
Last Update: 09/02/2024 12:40:00

Class	Datetime	Height	Rail Length	Rail Number	Rail Side	Total Length	Image	Spots To Spray
white fly	09/02/2024 12:12:50	3.60	2.69	0	0	29.25		
botrytis	09/02/2024 12:12:58	4.57	3.66	0	1	29.25		
black aphid	09/02/2024 12:13:25	2.86	8.58	0	1	29.25		
white fly	09/02/2024 12:13:03	2.38	4.69	0	1	29.25		
botrytis	09/02/2024 12:13:09	3.49	5.62	0	0	29.25		

C. Autonomous Guide Vehicle: presents the data for the Autonomous Guided Vehicle (state, position, battery level, tank level, serial number, compartment, farm type, and date and time of the last update). A table holds information regarding the detections it made in order to enable farmers to view the images it took and decide whether to send it or not for spraying each specific spot.

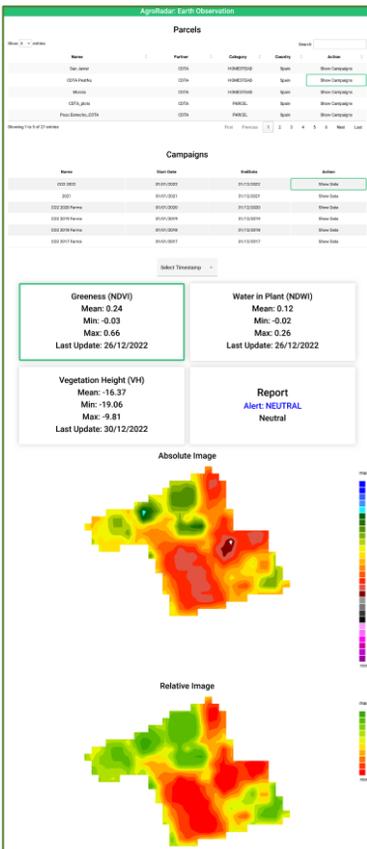
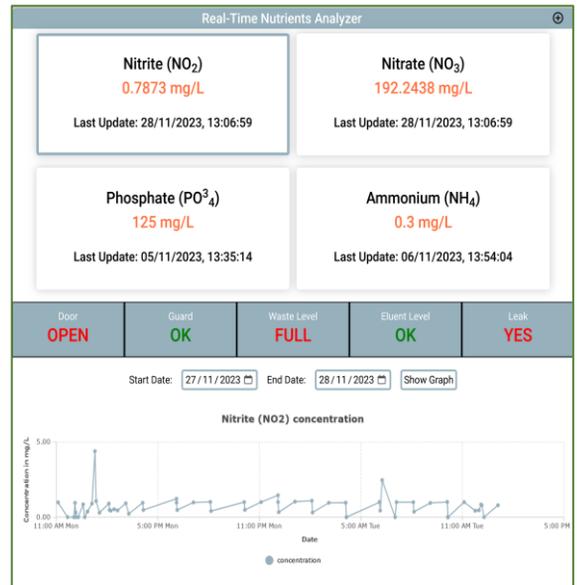
DECISION SUPPORT SYSTEM USER INTERFACE (2/2)

MAIN COMPONENTS



D. AI-based Robotic Trap – Real time insects monitoring: provides information on the serial number of the Robotic trap, its battery level, the glue paper life, the quantity of pheromone, the date and time of the last update and the amount of detections made at the current day and the threshold for each kind of insects. Moreover, on the bottom of the dashlet, a table visualizes the kind and amount of insects detected each day, for a range of dates. By clicking on the dropdown menu, a specific trap can choose between a list of traps to get its information.

E. Real time Nutrients Analyser: presents the data related to the Real-time Nutrients Analyzer. It has the value for each of the nutrients (Nitrite, Nitrate, Phosphate and Ammonium) and information regarding the condition of the device (door, guard, waste level, eluent level and leak). A graph presents the values of the selected nutrient in a range of dates.



F. Agroradar – Earth Observation: provides the data for the Agroradar. Users select a parcel and a specific campaign of it to get the relative data on the vegetation indices (VIs). For each of the VIs the UI presents its min, mean and max value, the date of the data and the corresponding-colored maps by clicking on the corresponding VI. In addition, it provides the alert level of the report for notifying the user in case of specific areas of the cultivation need further examination.

CONTACTS AND OTHER INFORMATION RESOURCES



PestNu



Europe - Headquarters Rua Circular Norte, Edifício NERE Sala 12.10 7005-841 Évora - Portugal



+351 266 709 115



www.agroinsider.com



Via Giovanni Lanza 51, Fondi (LT), Italy



www.agrorobotica.it



info@agrorobotica.it



Centro empresarial Galileo. c/ Los Enebros, 74. 44002 Teruel, Spain



+34 978 623 077



www.fertinagrobiotech.com



info@fertinagro.es



340 Kifisias Avenue, 15451, Athens, Greece



+30 210 6041425



www.iknowhow.com



Calle Carmen Leal Mata, 191, 33211 Gijón, Asturias, Spain



+34 984 041 266



www.neoalgae.es



info@neoalgae.es



Research Institutes of Sweden



RISE Research Institutes of Sweden AB, Box 857, 501 15 Borås



010 516 50 00



www.ri.se



invoice.rise@ri.se



Leoforos Kyriakou Matsi 23, 4th
Floor, Office 401, CY-1082
Nicosia, Cyprus



+357 22450777



www.sidroco.com



info@sidroco.com



Via Pareto 8 rosso A
16129 Genova, Italy



+39 010 0999288



www.stamtech.com



stam@stamtech.com



T.E Laboratories, Loughmartin
Business Park, Tullow, Co.
Carlow. R93 N529



+059 91 52881



www.tellab.ie



info@tellab.ie



340, Kifissias Avenue, 154 51,
Neo Psychiko, Greece



+30 210 6711080



www.sevt.gr



sevt@sevt.gr



CERTH

CENTRE FOR RESEARCH & TECHNOLOGY HELLAS



6th km Charilaou-Thermi Rd, P.O. Box 60361, GR 57001
Thermi, Thessaloniki, Greece



+30 2310 498100



www.certh.gr



certh@certh.gr



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