

METEOAGRO1 – METEOROLOGICAL STATION FOR AGRICULTURE AND MONITORING OF CROPS

WATER STRESS (Rev.3 180121)



Weather-climatic conditions have always been the factor that most influences the onset of diseases; thanks to new technologies, meteorological parameters can be acquired automatically, providing with a valid tool for the farmers and industry professionals to prevent crop diseases and water stress.

For this target, Geoves, thanks to its many years of experience in monitoring and construction of professional meteorological sensors, has developed the agro-meteorological stations of the **MeteoAGRO** series with **Butterfly** cpu that allow to detect the hazardous climatic conditions and transmit any alarms that may be managed by an external forecasting model on the web.

The technology implemented in the Cpu Butterfly allows to optimize the intervention timing and, at the same time, to manage possible treatments (irrigation, phytosanitary, etc ...) to guarantee the growth, the quality of the final product and the management costs

MeteoAGRO1 station: How is it made and what it includes

Butterfly: it's the data acquisition unit and the most important part of

meteorological station that displays, acquires, stores and transmits the data by remote **via GPRS** on a protected internet area (FTP); this feature combined with the very low power consumption allows to power the station just with a small photovoltaic **panel** without any needs of connection to the electrical network. Butterfly is programmable by remote and allows to send alarms via **SMS** to the on call staff when particular weather conditions for the growth of the crop occur (eg. water stress). For this reason Butterfly is able to calculate automatically the **evapotranspiration data** answering the **Fao-WMO Penman Monteith's** method.

Meteorological Sensors: The meteorological sensors provided with MeteoAGRO1 station are: thermo-hygrometer, rain-gauge, pyranometer, anemometer (sensors used to calculate the evapotranspiration) beyond the leaves wetness sensor, the temperature and humidity of the soil. All sensors are built with rugged and non corrodible materials, in compliance with **WMO** guidelines (World Meteorological Organization – Annex 8) and are tested in primary laboratories of calibration (such as Accredia and WMO); this aspect is an essential point to get an accurate and reliable mathematical model to prevent diseases.

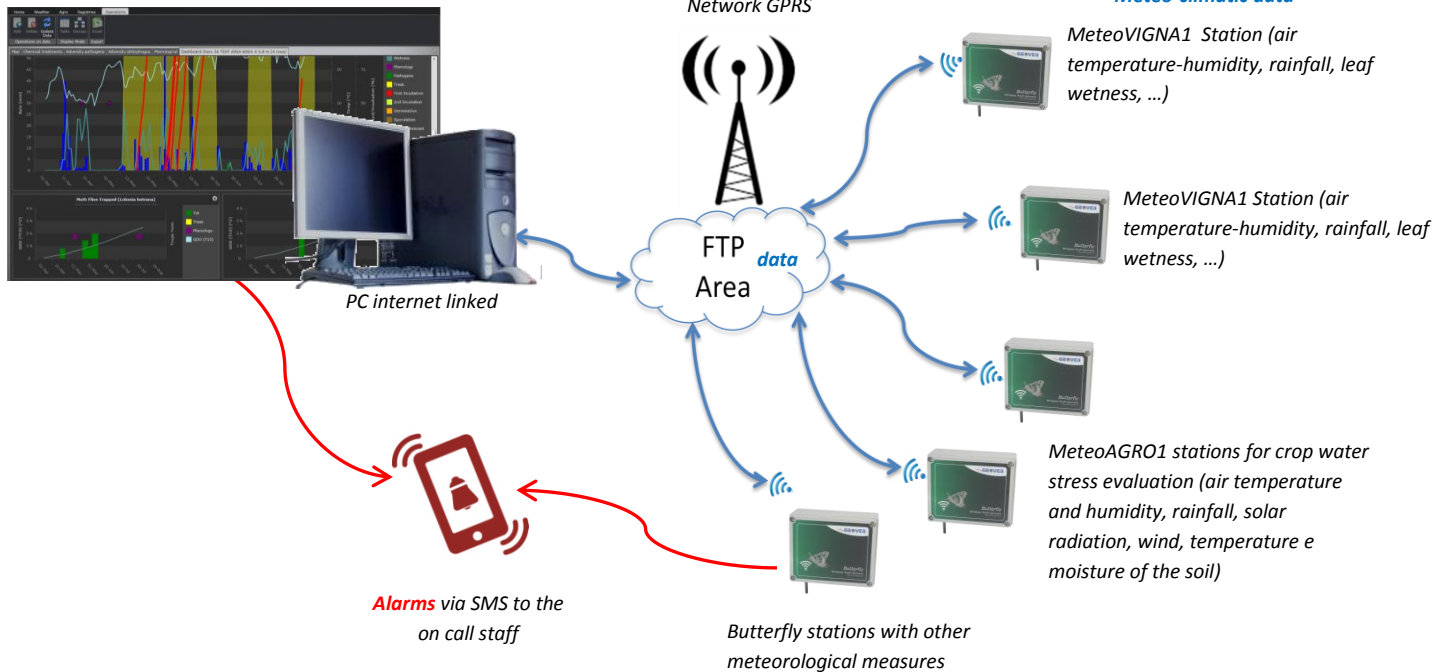
Pole and brackets: The supporting pole of the station is extremely simple to install because it's sufficient tighten the base to the soil and insert the pole in the base (without any civil works). Next all instruments are fitted to the pole using clamps and U-bolts (included).

Geodesk Software: MeteoAGRO1 is equipped of Geodesk free software that allows to access to the data in text format to get Excel chart and graph reports. Besides Geodesk allows to join the data in a desired period (eg. monthly) and permits to set by remote the alarm thresholds of every acquired weather measures. Optionally it can be supplied a yearly web service which allows to manage the meteorological and field data (observations of agronomist) to prevent crop diseases and proceed with any phytosanitary treatments.



Logic of data and alarms transmission

OPTION: Model for data display and alarms management



Advantages

- ✓ Meteorological sensors in compliance to **WMO** and **Accredia** certificable
- ✓ **Very high accuracy** and **resolution of measuring**
- ✓ Very low power consumption
- ✓ Compact and low environmental impact
- ✓ Easy to install (**it doesn't require civil works**)
- ✓ No telephonic or electrical connection is required
- ✓ Longtime reliability and minimum maintenance
- ✓ More than 70 types of sensor connectable
- ✓ Versatility of data communication without frequency concessions
- ✓ Italian design and technology
- ✓ **Extreme working conditions** (salinity, ice, sand, corrosive agents, high thermic excursion, etc...)
- ✓ **Data format: Ascii Text standard** with every field separated by comma (CSV format), compatible with Excel and all databases and software available in the market.

Technical features of meteorological station

Datalogger	Butterfly – Wireless multi-parametric logger
I/O Channels	8 analog inputs for meteorological sensors such as pyranometers, hygrometers, thermometers, barometers or chemical sensors; 2 insulated digital inputs (pulse counter) for sensors with "high" frequency up to 50KHz (anemometers, flow gauges, ecc...) and with "low" frequency output (rain gauges), sensors that requires the time counting (sunshine duration, leaf wetness,...), on/off signal (free-contacts) 1 diagnostic input for battery monitor
Power supply	10...14.4Vdc (typical 12Vdc); On-board battery charger, input from photovoltaic panel, with battery monitoring (deactivation of the load <10,5Vdc, restart >12Vdc) or mains power supplier 220Vac/12Vdc



Butterfly

Average autonomy of a weather station with 7 measures	>15days: with 12Vdc/7Ah battery, 20W photov. panel, storage: 5' transmission: 60' >30days: with 12Vdc/18Ah battery, 30W photov. panel, storage: 5' transmission: 60'
Data communication	via GPRS on FTP area
Alarms transmission	via SMS (or via e-mail using MeteoGraph web software) with change of data transmission rate
Programming	On site: setting of text file in the SD Card memory By remote: by sending of setting file on FTP area
Settable parameters	- Alarm threshold for every measure (settable as rising or falling overflows) - Storage rate (5, 10, 15, 30 or 60') - Transmission rate (5, 10, 15, 30 or 60') - Date and time with NTP synchronization (network time protocol)
Elaborations	Min, max (gust), arithmetic average, standard deviation, turbulence; trigonometric average; sum; diagnostic measure for battery voltage. Calculable measurements (if the weather sensors that allow the calculation are present): Evapotranspiration Et0, TD Dew point temperature, TWB wet bulb temperature
Data storage	Backup of 500 days data with circular storage
Conformity	Annex 8 – WMO (World Meteorological Organization)
Working temperature	-30...+70°C
IP65 Enclosure	Plastic material Dim.(LxHxP): 250x350x160mm, key closure and universal brackets for mounting on the pole.



Mounting IP65 outdoor container

METEOROLOGICAL SENSORS

	mSTAU – Outdoor air temperature-humidity sensor
TEMPERATURE - Range	-40...+60 °C
Transducer	Pt100 with anti-radiation shields
Accuracy	±0.2°C
REL. HUMIDITY - Range	0...100 %
Transducer	Capacitive with anti-radiation shields
Accuracy	±2%
Conformity	Accredia

	STBB – Electronic Psychrometer
Temperature range of both thermistors (bulbs)	-40...+60 °C
Transducer	Pt100 wet and dry bulbs with aspiration fan
Accuracy	±0.2°C
Outputs	4...20mA
Conformity/test	Accredia

	RG200 – Rain gauge (available with anti-icing heater)
Range	infinite
Orifice area	200cm ² (option: 400 cm ²)
Transducer	Double contact (n.o.) tilting bucket
Accuracy	Class B UNI 11452:2012 (class A connected to the Geoves' datalogger)
Resolution	0.2 mm/commutation (or 0.1mm 400cm ² version)
Conformity	WMO



Model	mWS1 – Wind speed sensor
Typical Range	0...75m/s
Transducer	Magnetic with sinusoidal AC signal not powered
Rotation	High performance bearings
Accuracy	<±0.1m/s



Model	PIRSC – Silicon cell pyranometer
Measuring range	0...2000 W/m ²
Spectral Range	0.4...1.1µm
Transducer	Silicon cell
Accuracy (typ.)	±4%



Model	RHTT – Soil moisture (temperature and water content)
Range	RH: 0...60% VWC (Soil volumetric water content) T: -40...+60°C
Transducer	Capacitive (RH) and thermo-resistance NTC (T)
Outputs	n.2 0...5Vdc outputs (other on request)
Accuracy	RH: ± 3% VWC between 0 and 50VWC (standard mineral soil, EC <5 mS/cm) T: ±0.5°C (long-term stability: 0.1°C/year)



Model	WLS – Leaf wetness sensor
Measuring range	0...100% of leaf wetness and wetness duration (s)
Transducer	Capacitive
Operative Temperature	-30...+60°C



Model	mPA – Micro Barometer
Range (typical)	800...1100 hPa (on request 600...1100 hPa for sites over 1000m above s.l.)
Transducer	Piezoresistive
Accuracy	<±0.6hPa @ 25°C
Long-term stability	±0.01hPa / year



*Other meteorological sensors are available on request

POLES				
Models	PF2-40	PF3-55	PL3-TREP	PRBF10-110
Heights (m)	2m	2,7 max 2 min	3.9 max 1.9 min	10 max
Typical application	Fix or rilocatable	Fix	Fix or portable	Fix
Mounting	On the soil without civil works or plinth or wall	On the plinth or wall	On the soil without civil works or plinth	On the plinth in reinforced concrete
Rising up	No	Telescopic, manual		Balanced tiltable
Wind resistance	100km/h with gusts up to 130km/h@0...1000masl and without ice load			
Diameters (mm)	Base: 40 Top: 40	Base: 55 Top: 50	Base: 40 Top: 30	Base: 170 Top: 70
Weight (kg) accessories excluded	4kg	11kg	10kg	170kg
Material	Galvanized steel			
N. of elements	1	2	3	2
N. guy wires	/			/
Required workers x installation	1			2 (it requires truck with crane)

Other kind of poles on request

APPLICATION EXAMPLES WITH MeteoAGRO1 STATIONS



PF2-40 – Light pole h=2m with screw tip mounting (without civil works)

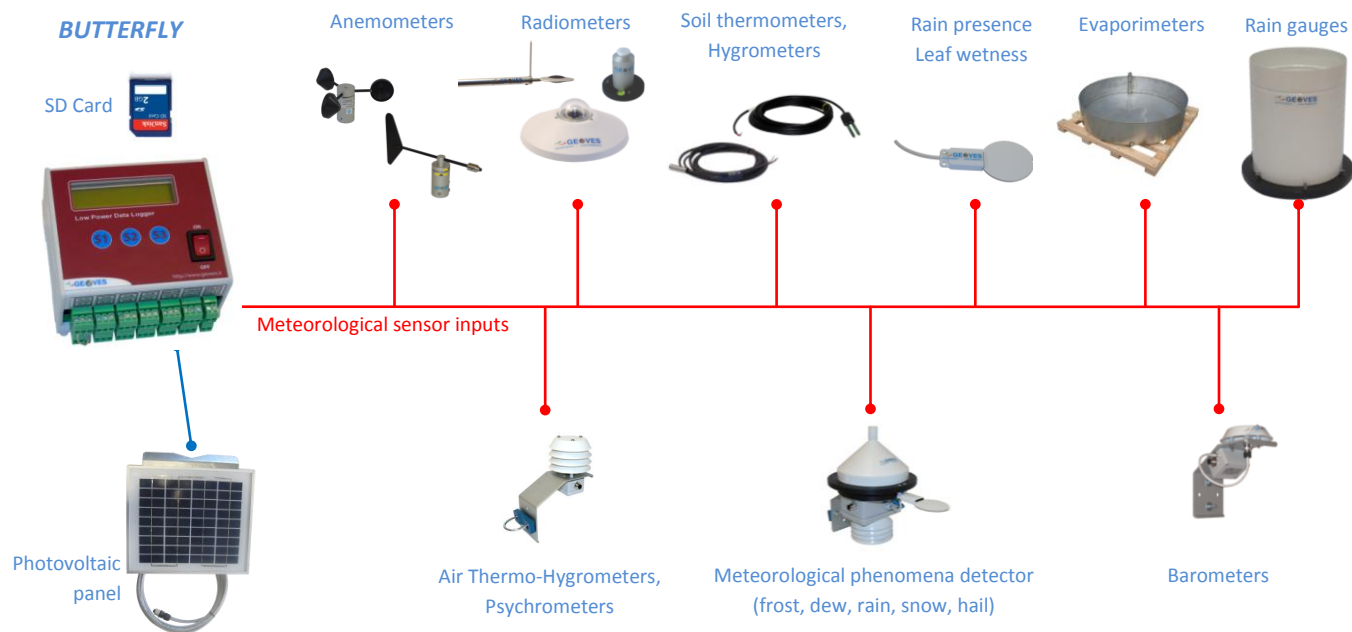


PL3-TREP – Light telescopic pole hmax=4m with tripod, screw tip base and ground stakes mounting



PRBF10-110 – Tilttable balanced pole h=10m with mounting on plinth

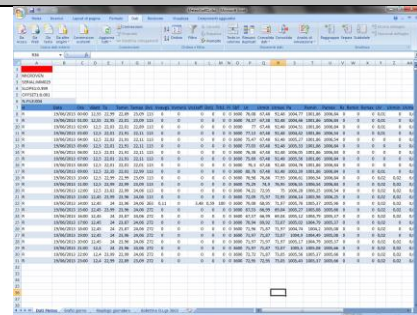
Layout of connectable sensors



Geodesk&Meteograph – Setup software for Geoves datalogger and web service for data management

SOFTWARE

Model



Geodesk & MeteoGraph

Geodesk is a basic service software, free supplied with all Geoves datalogger, that can import data recorded (on SD card or sent via GPRS or transmitted by cable from the datalogger) and generate a single data file in Excel format. In this way it's possible to create data aggregation of desired period (eg. Monthly) and then derive the tabular and graphical reports.

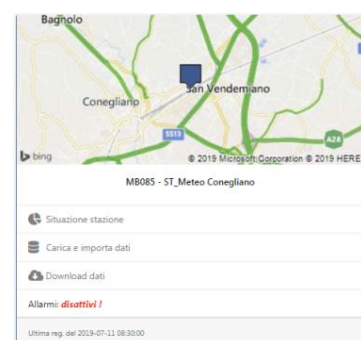
Besides Geodesk creates the setup configuration for the functioning of Butterfly, Micro3 and LPDL Geoves dataloggers



MeteoGraph is a web application for the numerical and graphic display of data transmitted via GPRS on FTP area from environmental monitoring stations with Geoves datalogger.

The software relies on an FTP Geoves area where data is sent autonomously by the control units at fixed times and are available in **standard text format** with fields separated by commas (**CSV format**). The data is therefore **always usable without the need to use proprietary communication protocols or specific programs for data decoding**; furthermore, the software **does not require any installation** as Internet access is sufficient and a username and password must be entered to enter the dedicated web page and display the measurements from a PC, tablet or smartphone.

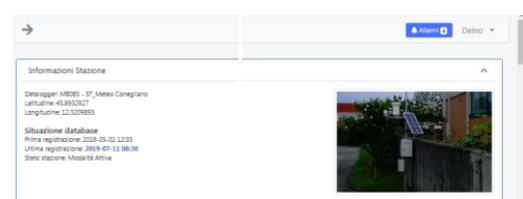
The data in text format are processed by MeteoGraph to obtain on the web page both the measurement in numeric format (eg average minimum maximum trend, etc.) and in graphic format that can be downloaded in jpg bitmap format.



Station dashboard

The available functions are:

- **Station situation:** access to the graphic processing page and to the station's synoptic
- **Load and import data:** the data saved on the datalogger SD card are imported, or on a PC folder (or other support)
- **Data download:** data are downloaded in text format with fields separated by commas for simple backups or subsequent processing with other applications (eg Excel, Access, external databases or other commercially available software)
- **Alarms:** access to the station alarm management menu (optional on request)



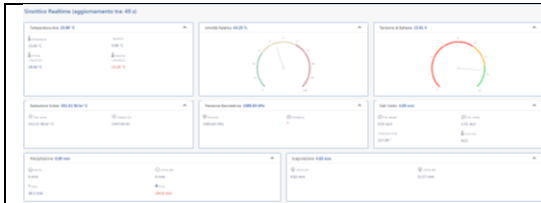
Station situation - Station information

The parameters displayed are:

- Station unique identifier (ID)
- Name of the station
- Geographic coordinates (Latitude and Longitude)
- Data base status:
 - Date and time of Start data storage
 - Date and time Last data storage
 - Operation status of the station
- Photos of the station

Real-time synoptic of the station

The synoptic is a very useful tool for assessing the situation of the latest measurements taken by the monitoring station and assessing the



meteorological or environmental situation of the site. For each measurement it is possible to associate one or more dedicated processes. For example, for the temperature it is possible to indicate the minimum and maximum value and the time in which it occurred in addition to other calculated measures such as the dew point.

The synoptic also shows:

- calculated measures
- Diagnostic data (eg battery voltage)
- Significant data for the interpretation of the measure (eg barometric tendency, wind chill, monthly precipitation, etc.)

Selezionare il periodo di osservazione

Intervallo dati

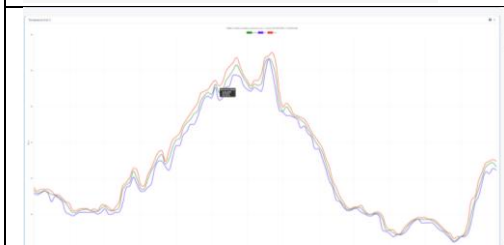
Da 10/07/2019 00:00

A 11/07/2019 23:59

Aggiorna

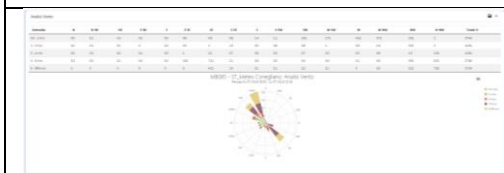
Observation period

It is possible to select the observation period in which to carry out all the elaborations that are displayed by MeteoGraph



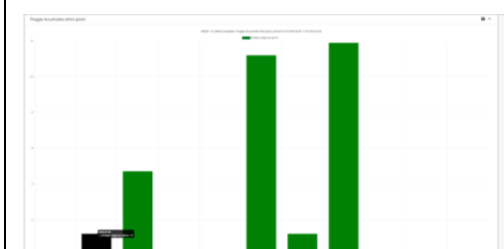
Graphic elaborations

- **Linear multi-line** for measurements where the arithmetic average is applied (eg temperature, humidity, pressure, etc.) with representation of the minimum and maximum value



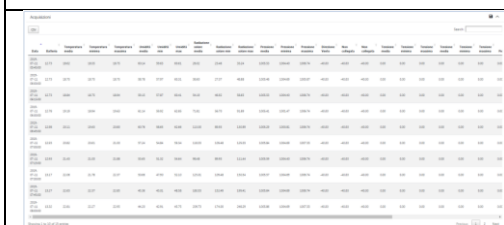
Graphic elaborations

- **Wind-rose** for the anemometer measurements



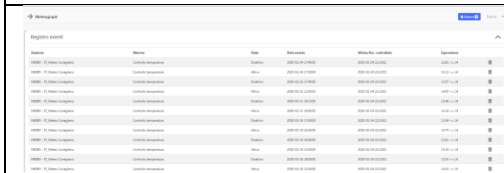
Graphic elaborations for precipitation

- Graph with hourly summation
- Monthly or annual precipitation histogram
- Other graphs are available on request or can be customized with simple filters



Tabular elaborations

Daily data table can be downloaded both in text and in .png image format



Alarm management

To manage alarms, the software allows you to set upward (> value) or downward (<value) intervention thresholds, after which alert emails are sent to the personnel in charge.

The alarms are then represented on the screen with adequate effects and colors to attract the attention of the operator

O-Guard – DSS (Decisional Support System) Web service with models for crop monitoring

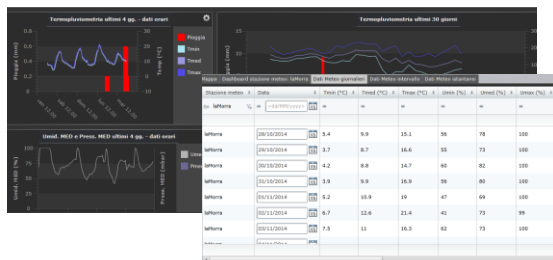
Modello



Web application: geographic map with meteorological stations network



Forecasting model for fungal diseases and catch of phytophagous insects



Meteo-climatic data elaboration



O-Guard – Agro-meteorological platform for crops management

O-Guard is an advanced digital ecosystem, in which technologies and people are connected to each other, through a technological platform that guarantees the processing and distribution of data. The system is accessed from a personal computer, or through mobile devices such as smartphones and tablets. In both cases, Internet connectivity is required to access the system. The web service for PC has a GIS (Geographic Information System) module that allows you to use cartographic sources and view data directly from the map.

It allows to use in an organized way, the measurements of sensors coming from electronic stations installed in the field, the monitoring data of agricultural crops and phytosanitary treatments; it also guarantees real-time updating through a notification system of dispatches and alerts distributed automatically by the system.

The system is particularly suitable for bodies and organizations that provide technical assistance services in the agricultural sector and that need an ICT solution for managing information in conditions of mobility. Typically, organizations that have their own technical staff in the area that need to receive an updated descriptive framework, from an agronomic and agro-meteorological point of view, can benefit from this type of solution during their activity in the field at farms.

Two different applications can be used to ensure the accessibility and usability of agronomic information:

1. **DESKTOP APPLICATION** (In this web platform large amounts of data are accessed from a PC).
2. **MOBILE APPLICATION** (summary data is organized for quick access from a mobile device, eg tablet or smartphone).

Main functions of the APPLICATION

Field technicians can use the APPs installed on tablets and smartphones to carry out various activities:

- Annotation and consultation of information relating to the general state of the points monitored from an agrometeorological point of view
- Continuous updating while traveling by car thanks to the "navigation" mode,
- Input from the field of agronomic and cultural data (phenological measurements, climatic damage on the plant, pathogenic organisms, calendar of phytosanitary treatments and irrigation).
- Evaluation of bioclimatic indices and outputs of phytopathological models.

The information provided by the meteorological monitoring system can be used for any crop, herbaceous and arboreal, annual and multi-year, because it provides bioclimatic indices and raw data essential for understanding the seasonal trend and the relationship between plant and environment.

As regards forecasting models, the computerization of phyto-pathological modeling is underway on the basis of the scientific publications available.

The models already made or under development are indicated below:

	INSECTS	PERONOSPORA	OIDIUM	DIABROTICA	BRUSONE	SCAB	BACTERIAL FIRE	FUSARIUM
CORN	x			x				x
RICE					x	x	x	x
WHEAT AND BARLEY	x							x
BEAN	x							
POTATO	x	x						
TOMATO	x	x						
LIVES	x	x	x					
MELON	x	x	x					
WATERMELON	x	x	x					
ZUCCHINI	x	x	x					
OLIVE	x							
HAZELNUT	x							
HOWEVER	x					x	x	
APPLE TREE			x			x	x	
APRICOT						x	x	
PRUNO						x	x	
KIWI	x							
PEACH	x		x					

Summary of the main strengths

- Accessibility to multi-channel information
- Accessibility in conditions of mobility
- Absence of investments charged to the customer
- System scalability
- Possibility of integrating phyto-pathological mathematical models
- Upload data directly from the field
- Possibility of using GIS tools
- Automatic alert when pre-set thresholds are exceeded