

plantcare

PlantCare Mini-Logger

Soil moisture and soil temperature sensor

Operating Instructions



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1. Introduction

Please read through these instructions carefully before commissioning your PlantCare Mini-Logger

Basic aspects

The PlantCare Mini-Logger is a maintenance-free sensor which records soil moisture and soil temperature. Fields of application include scientific research and agriculture. Configuring a Mini Logger as well as reading the data recorded is simple and easy to do using the data upload/download cable and a USB stick. The data thus acquired can be analyzed on a PC using PlantCare DataViewer software.

How the sensor measures soil moisture

PlantCare's worldwide patented sensor technology is based on the microthermic measurement of soil moisture. Specially developed felt material in moisture balance with the soil acts as the interface between the surrounding soil and the sensor. To measure the moisture level, the sensor is briefly heated and the cooling-down time, which varies depending on soil moisture, is determined. The sensor's cooling-down time thus provides a reliable statement of the soil's moisture content.

Features

- The sensor measures soil moisture levels and soil temperature at freely selectable intervals.
- The sensor reacts speedily to changes in moisture levels.
- Reliable results even at minimum depths (from 5 cm).
- Value measured is unaffected by salt or fertilizer content.
- The mini-logger's internal clock enables measurements to be precisely recorded with date and time.
- Acquisition of up to 12.000 records.
- A USB-interface allows programming the logger as well as readout the measured data.
- PlantCare DataViewer software allows the optimal display and analysis of the data.

Quick guide

1. Check the scope and contents of delivery for completion according to your order.
2. Switch the unit(s) on and off to check whether batteries have been inserted. (Units are generally supplied ex works with batteries installed). Install batteries if required (2 AA mono cell batteries).
3. If you wish to adjust the Mini-Logger's factory settings, you must prepare the Mini-Logger's configuration file. To do so, open the "PlantCare Mini-Logger Configurator" software from your CONFIG Stick and make the requested adjustments. Alternatively, the mentioned Configurator Software can be downloaded from:
www.plantcare.ch/en → Support.
4. Configure your Mini-Logger.
5. Immerse the sensor felt in water for about 1 minute and then insert the sensor with the protection cap into the soil.
6. Thoroughly irrigate the soil around the sensor.
7. Read off the collected soil moisture and temperature data at intervals.
8. Use your PlantCare DataViewer software to view and analyze the data acquired.
PlantCare DataViewer software can be downloaded from:
www.plantcare.ch/en → Support.
9. Maintenance: we recommend replacing the felt once a year or when reinserting the sensor into the soil.

Scope of delivery

- PlantCare Mini-Logger Sensor (version according to your order)
- Software:
 - **PlantCare DataViewer Software** download from www.plantcare.ch/en → Support.
 - **PlantCare Mini-Logger Configurator Software** on white CONFIG Stick or download from www.plantcare.ch/en → Support.
- Manuals:
 - **PlantCare Mini-Logger Sensor Manual** on white CONFIG Stick or download from www.plantcare.ch/en → Support.
 - **PlantCare Mini-Logger Configurator Manual** on white CONFIG Stick or download from www.plantcare.ch/en → Support.



- Mini-Logger ST → Insertion depth max. 18 cm
- Mini-Logger M → Insertion depth max. 35 cm
- Mini-Logger XL → Insertion depth max. 60 cm
- Mini-Logger XXL → Insertion depth max. 100 cm
- Mini-Logger XL cable → Insertion depth max. 60 cm
- Mini-Logger XXL cable → Insertion depth max. 250 cm



Sensor with protection cap
(Shipments from September 2012 on)

Optional accessoires



Data upload /download cable with
USB interface incl. 2 USB Sticks



Replacement tip with felt

2. Commissioning

Mini-Loggers are generally supplied with batteries fitted.

Inserting/replacing the batteries

Switch the unit off if it has been switched on.

1. Only release the fastening screw on the Mini-Logger cover as far as is necessary to open the cover.
2. Carefully withdraw the battery holder from the casing. Dispose of old batteries appropriately if new ones are to be fitted. Empty batteries will not cause your Mini-Logger to lose its settings.
3. Insert 2 AA mono cells. Ensure that the polarity is correct as you will otherwise damage your Mini-Logger.
4. Reinsert the battery holder into the casing with care.
5. Replace the cover so that it fits over the white inner casing. Ensure that the cover seal is located in the groove provided in the cover and that no dirt is present. Re-attach the cover by tightening the fastening screw. (Warning: do not overtighten!).
6. Switch on your Mini-Logger.

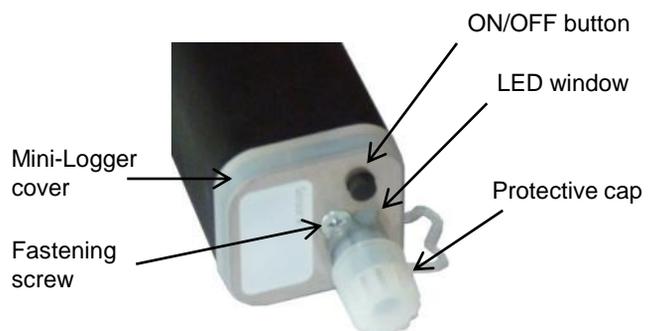
IMPORTANT: After a battery change, please download the data and ensure that the date and the time are still correct. If they are not, proceed in accordance with the details given in the sections “Preparing the configuration file” and “Configuring your Mini-Logger”.



Switching on/switching off

- **Switching on:** Press the ON/OFF button briefly. The LED will flash briefly.
- **Switching off:** Hold the ON/OFF button down until the LED lights up and then goes out.

IMPORTANT: A Mini-Logger cannot be switched off when it is taking a measurement. Wait for 3-4 minutes if this happens.



LED display

- Switch on: LED flashes briefly
- Switch off: LED will light up and then go out
- Uploading the configuration file or downloading data: the LED will light up until downloading or uploading is complete.
- LED flashes continuously: the batteries need replacing.
- The LED will not light up when the Mini-Logger is making a measurement. In a case like this, wait for about 3-4 minutes.

Preparing the configuration file with the PlantCare Mini-Logger Configurator

The PlantCare Mini-Logger Configurator automatically generates a file (MLConfig.txt) that you save on the white CONFIG Stick and then read in into the Mini-Logger.

- If you would like to keep the factory settings, you must not configure the Mini-Logger.
- If you would like to configure the Mini-Logger according to your needs, proceed as follows:
 - Open the "PlantCareMLConfigurator.exe" software. This software is either delivered on the white "CONFIG Stick" from PlantCare or can be downloaded from: www.plantcare.ch/en → Support. The software does not need any installation. Just copy the exe.file either on your desktop or preferably save it directly on an empty USB Stick (e.g. PlantCare white CONFIG Stick).
 - A help file is integrated in the PlantCare Mini-Logger Configurator software.
 - Initial configuration: If you leave a field empty, the factory setting will be retained.
 - Re-configuring: Adjust the required parameters and ignore (leave empty) those fields that are not to be adjusted. The box for date and time should not be clicked, if you do not wish to update them.
 - Save your configuration by clicking "Save to stick". This will generate automatically a configuration file in the corresponding CONFIG Stick.



Configuration field	Factory setting	Description
Device Name	PlantCare Mini-Logger (From version 1.20 on, a 4-digit serial number)	Mini-Loggers can be given any name and/or number (at least 4-digits. No ü / ö / é, etc. or special characters or space) . The first 4 digits will appear on readout file name. The full device name will appear on readout data.
Measuring Cycle Start	60min	The factory setting entered is 60min and a Mini-Logger carries out the first measurement 60 minutes after being switched on. Enter the time here (0...23) if you would like to have the first measurement taken at a certain time.
Measuring Cycle Time	60	With the factory setting, a Mini-Logger takes a moisture measurement every 60 minutes. This measurement cycle can be adjusted.
* Moisture Output	rel%	The factory setting is rel% . This means that the output of measured moisture values are in relative moisture percentage. From Mini-Logger Version 1.15 (apparent on housing), the moisture values can be read out also in hPa suction pressure. If you select hPa, you can choose out of 6 different soil types the one, which matches best with your soil. Alternatively, if your specific soil has been calibrated by PlantCare, the corresponding parameters for converting the measurement data into hPa can be entered here. See also Chapter "Moisture output in hPa suction pressure".
Set Date-Time	Central European Time (can be up to 15 minutes plus to the actual time)	
Erase Data Memory		If you wish to delete the previous measurement data, click this box. This does not delete your settings.

* The measurements stored in the Mini-Logger, for example in rel%, can be (after reconfiguration) read at any time for the same measurement period in hPa and vice versa.

Configuring your Mini-Logger

You will require the following components to configure your Mini-Logger:



USB stick with PlantCare Mini-Logger Configurator software and an automatically generated configuration file



Data upload /download cable

Uploading the configuration file:

1. Carefully remove the protective cap over the Mini-Logger socket.
2. Connect the round plug on the data upload/download cable to the Mini-Logger.
3. Upload the configuration file: Attach the CONFIG Stick to the data upload/download cable.
4. If the Mini-Logger has not yet been switched on, switch it on (press the ON/OFF button briefly).
5. Press the ON/OFF button briefly. The LED on the Mini-Logger will light up and then go out when the configuration process has been completed.
6. Now disconnect the cable from the Mini-Logger and firmly replace the protective cap.
7. Check the configuration → q.v. “Downloading data”. The downloaded file displays all the parameters that you entered in PlantCare Mini-Logger Configurator.



3. Installation

Inserting a Mini-Logger Sensor into the soil - quick guide (see also next pages)

1. Dip the tip of the sensor with the felt in water for approx. 30 seconds.
2. Put on the protection cap, in order to protect the sensor electronics.
3. Place the sensor tip at a position at which the sensor must measure the moisture level. This is usually in the area of the roots. It is a good idea to make a suitable hole in advance into which the sensor can be inserted. The sensor tip should be in contact with the soil on all sides.
4. Avoid forming a preferential water path along the sensor channel.
5. Irrigate the immediate surrounding area of the soil moisture sensor with a sufficient amount of water. Dependent on the soil and the depth at which the sensor is located, it can take up to a few hours before the soil moisture sensor records the actual soil moisture level.

Sensor with protection cap



Caution!

- The tip of the sensor will only measure the soil moisture correctly if the sensor tip is in full contact with the ground on all sides! Entrapped air in the surrounding of the sensor may cause false measuring results.
- Never rotate the sensor when inserting or pulling out as this may unscrew the yellow sensor tip.

Guide for the correct placement of the soil moisture sensors

Placing at the right depth

The sensors should measure the moisture there, where the plants absorb the water, namely in the root zone (Fig. 1). As the size of the root ball change significantly during the growth phase, it is recommended to re-place the sensors deeper after the initial growth phase.

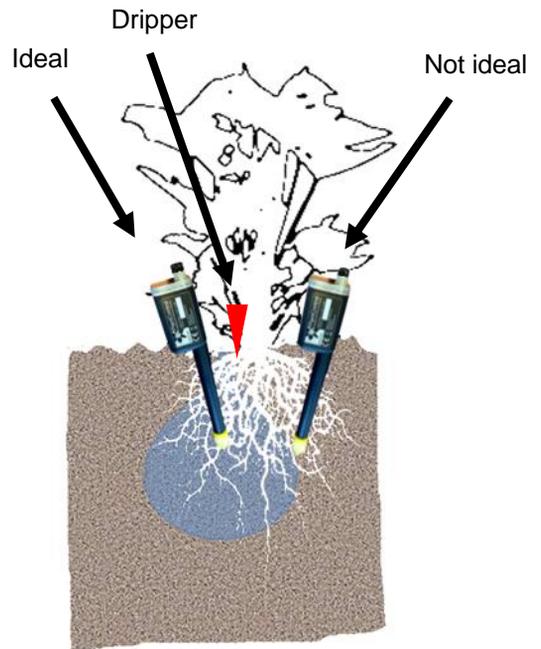


Fig. 1

Sensors in stick version

1. For longer sensors in stick version, drilling of a hole is reasonable. Use an auger or a drilling machine with a bore diameter of 16 mm.
2. If the soil is dry, moisten.
3. Immerse entire sensor tip (yellow part) in water (felt must be wet).
4. Insert the sensor cautiously. Never rotate the sensor when inserting or pulling out as this may unscrew the yellow sensor tip.
5. Water the area around the sensor with sufficient water.

Sensors in cable version

Depending on the placement depth, the installation of sensors in cable version requires a different approach.

If the sensor is placed in turf, it is virtually impossible to accommodate the electronics within the lawn, as this would disrupt the use of the lawn. In this case, sensors with extension cable are available. This allows to embed just the sensor tip in the lawn. The electronics on the other hand is placed on the edge of the lawn (Fig. 2).

If the sensor has to be buried deeper in the soil, it is inevitable to excavate soil first.



Fig. 2

Installing cable version

Use any plastic or metal rod or tube of the required length and a diameter of approx. 16 mm.



Plastic clamp for the Mini-Logger, cable version



Placing the sensor in drip irrigation applications

The following recommendations are particularly important when the Mini-Logger is used within an irrigation system. However, this section also contains important information when the Mini-Logger is used for general moisture investigations.

The sensors must be placed in a way that it can register the water. This is more or less critical, depending on the type of irrigation. If sprinklers are used, the distribution uniformity is usually homogeneous enough, unless the root zone and thus the sensor is not shielded by leaves.

If a drip irrigation is used, the water is supplied very locally and it will diffuse more or less evenly and quickly within the soil over a certain volume range. Therefore, especially in drip irrigation it is important to pay attention to the following points:

Depending on the permeability of the soil or substrate, differently shaped moisture zones are formed (Fig. 3).

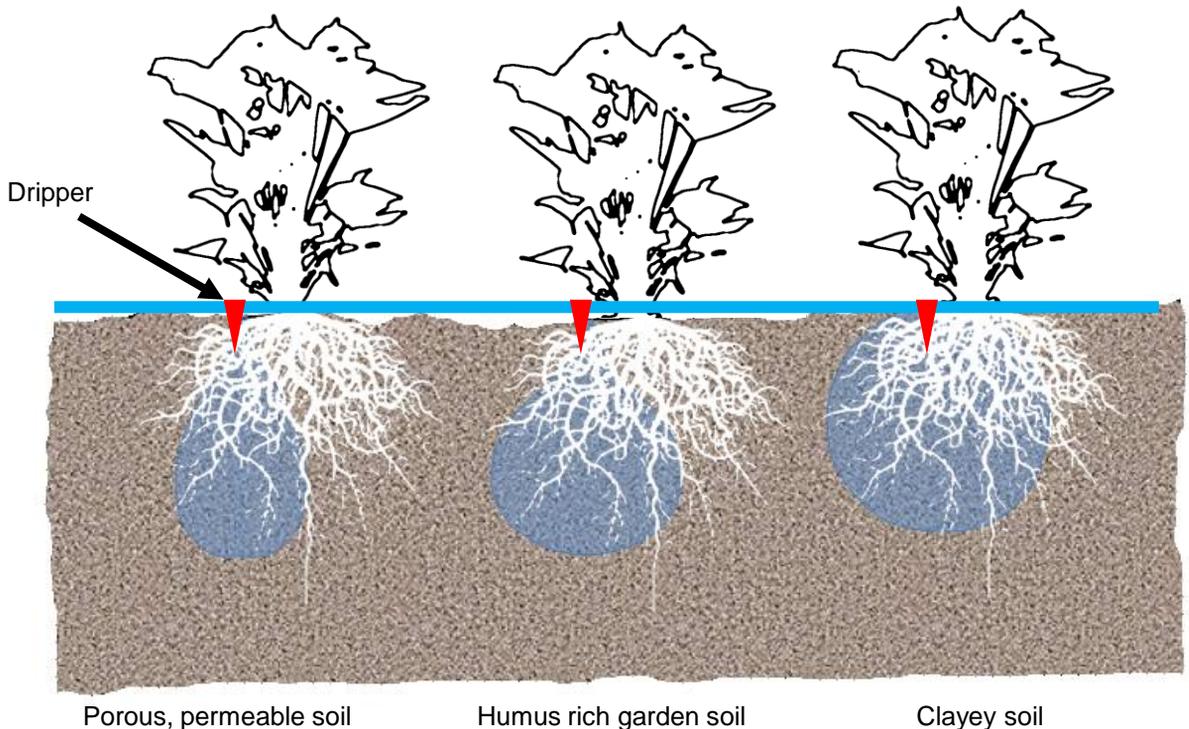


Fig. 3

If the soil is porous and permeable, it is advisable to use several dripper with a correspondingly lower water outlet per plant, in order to achieve a better distribution of water. Plants are very adaptive and the roots will grow into those areas, where water is available. However, the yield respectively the health of a plant is improving, the bigger a water saturated soil volume is available for the roots. Using this type of soil - especially in pot cultures - may result in the formation of so-called preferential water paths. This will always occur, whenever a dripper with a high water output is used. Since the water in the substrate runs off quite rapidly downward, fine particles are washed out, resulting in a preferred water path. In such a case, the water barely has time to spread horizontally, and this inevitably leads to an insufficient water supply to the plants. Once such a water path is formed, an initially correct placed sensor may not be able to register the applied water.

To avoid this problem, you can use drippers with a lower water output rate. However, such drippers may clog faster or calcify. The best remedy against the formation of preferred water paths is to use a piece of felt which is laid onto the substrate, so that the water drops first onto the felt and is distributed horizontally.

4. Downloading and analyzing your data

The following components are required to download the data from your Mini-Logger:



USB stick on which to download the data files



Data upload/download cable

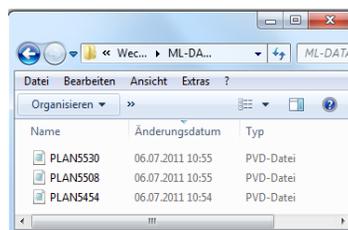
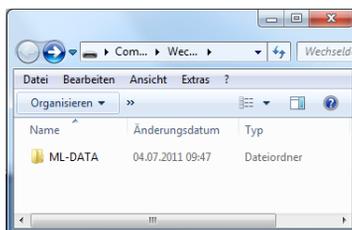
Downloading your data:

Note: Downloading data leads to high battery consumption. Only download data, when necessary. When LED flashes continuously during download, the batteries need replacing.

1. Carefully remove the protective cap over the Mini-Logger socket.
2. Connect the round plug on the data upload/download cable to the Mini-Logger.
3. Download the data: Attach the DATA Stick for downloading the data to the data upload/download cable.

IMPORTANT: The data cannot be downloaded if the USB stick contains a configuration file ("MLConfig.txt").

4. If the Mini-Logger has not yet been switched on, switch it on (press the ON/OFF button briefly).
5. Press the ON/OFF button briefly. The LED on the Mini-Logger will light up and then go out when the process has been completed.
6. Now disconnect the cable from the Mini-Logger and firmly replace the protective cap.
7. Downloaded data: Connect the DATA Stick with the downloaded data to your computer and open it. An automatically generated file structure will be displayed. This contains the folder "ML-DATA", which contains the downloaded data file. The filename consists of the first four letters of the name of the Mini-Logger as well as the download time (minutes/seconds). You can now open this file either in an editing program or with PlantCare DataViewer software. Alongside the soil moisture data and the soil temperature data, the file also displays all the parameters that you entered in the configuration file. Each new download creates a new data file. The old files remain unaffected by this.



Data analyses with PlantCare DataViewer

PlantCare DataViewer software enables the optimal display and analysis of your data. After a short registration process, this software can be downloaded free of charge and used to obtain a graphic view of the moisture and temperature levels on one or several Mini-Loggers as well as data averages.

PlantCare DataViewer analysis software can be downloaded using the following link: www.plantcare.ch/en → Support



5. Moisture output in hPa suction pressure

Note: Only applicable for sensors with a hard felt or part-number endings "H" and from Mini-Logger Version 1.15 on (apparent on housing).

The PlantCare moisture sensor technology is based on a micro-thermal measuring principle. A cooling time is measured, which allows a statement about the water content of the soil.

To permit a conversion to a suction pressure (hPa), a calibration must therefore be made. This can be achieved by parallel measurements with a tensiometer. Here, a soil sample at different moisture levels is measured with both sensors, the PlantCare sensor as well as with a tensiometer and the measured values are set into a relation according to the accepted van Genuchten equation. However, such a calibration is valid for the used soil type only.

As there can also occur quite large variations in moisture measurements between two tensiometers, a tensiometer-independent calibration was performed by the Zurich University of Applied Sciences (ZHAW) in Wädenswil. For the calibration, a pF-pressure chamber was used.

To cover the most important soil types, 6 standard soils were obtained from the "Agricultural Research Institute (LUFA) Speyer" in Germany. The data from these standard soils can be seen on the table below.

The results are primarily two parameters, alpha and n, which have to be inserted into the van Genuchten equation, in order to convert from the measured time to hPa. Moreover, a scaling factor K can be entered.

van Genuchten equation:

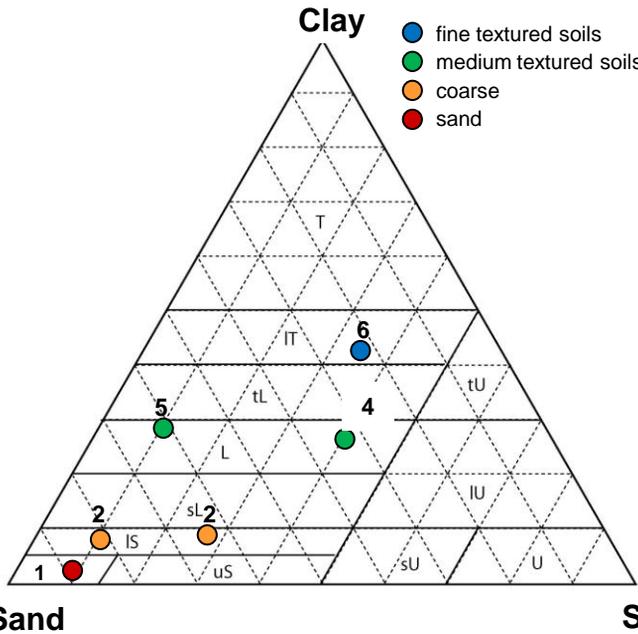
$$\psi_m = K \frac{1}{\alpha} \left[(1 - t_n)^{-1/m} - 1 \right]^{1/n} \quad m = 1 - 1/n$$

Standard soils from the „Agricultural Research Institute (LUFA) Speyer“:

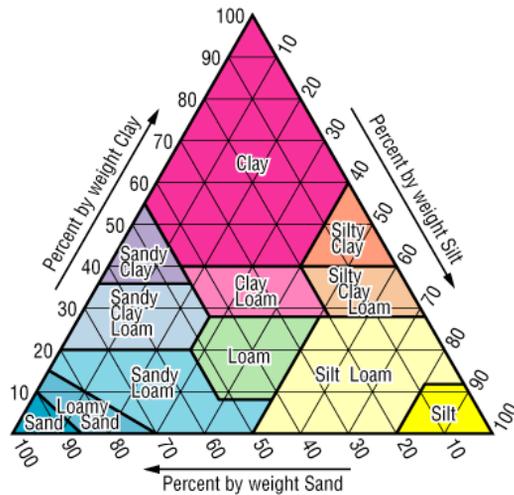
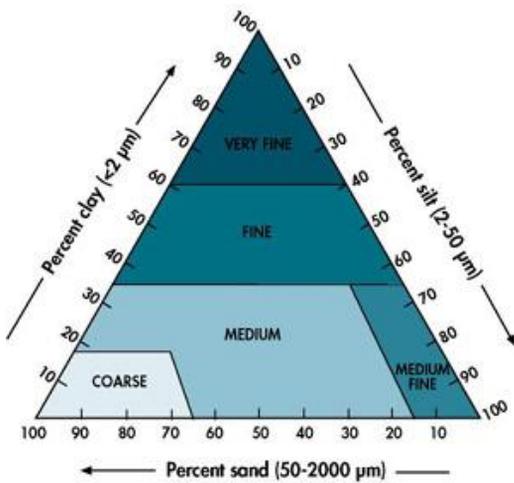
Standard Soils - Analyses Data Sheet (9/11)						
Mean values of different batch analyses +- standard deviation. All values refer to dry matter						
Standard soil type no.	1	2	3	4	5	6
organic carbon in % C	0,62+- 0,07	1,87 +- 0,20	0,94+- 0,10	2,42 +- 0,5	1,05 +- 0,20	1,64 +- 0,12
Nitrogen in % N	0,05 +- 0,01	0,17 +- 0,02	0,08 +- 0,02	0,20 +- 0,04	0,12 +- 0,03	0,20 +- 0,02
pH-value (0.01 M CaCl ₂)	5,1+- 0,4	5,5 +- 0,2	6,8+- 0,2	7,1 +- 0,2	7,3 +- 0,1	7,1 +- 0,1
cation exchange capacity (meq / 100g)	4,0 +- 0,7	10,1 +- 0,5	10,3 +- 1,3	30,8 +- 6,2	15,3 +- 2,9	24,5 +- 7,0
Particle size (mm) distribution according to German DIN (%):						
<0.002	2,4 +- 0,4	6,5 +- 0,8	8,7 +- 1,6	27,0 +- 1,9	10,4 +- 1,1	42,1 +- 1,2
0.002 - 0.006	2,0 +- 0,9	3,3 +- 0,7	4,2 +- 0,9	8,7 +- 0,7	5,1 +- 0,5	10,4 +- 1,0
0.006 - 0.02	3,1 +- 0,8	4,1 +- 0,7	8,8 +- 0,8	14,7 +- 1,3	9,1 +- 1,0	12,3 +- 1,4
0.02 - 0.063	6,9 +- 0,5	6,9 +- 0,9	17,6 +- 2,8	23,0 +- 1,3	21,2 +- 1,0	14,3 +- 2,0
0.063 - 0.2	27,4 +- 2,2	34,5 +- 1,9	30,1 +- 4,0	19,1 +- 0,3	38,1 +- 1,2	8,6 +- 0,4
0.2 - 0.63	55,8 +- 3,1	43,9 +- 1,6	27,9 +- 2,1	5,8 +- 0,3	14,7 +- 1,5	8,9 +- 0,5
0.63 - 2.0	2,4 +- 0,6	0,8 +- 0,3	2,7 +- 0,7	1,7 +- 0,3	1,4 +- 0,2	3,4 +- 0,7
soil type	silty sand (uS)	loamy sand (IS)	silty sand (uS)	clayey loam (tL)	loamy sand (IS)	clayey loam (tL)
Particle size (mm) distribution according to USDA (%)						
<0.002	2,7 +- 1,1	6,8 +- 1,3	8,7 +- 1,7	26,9 +- 0,3	11,2 +- 1,0	41,0 +- 1,9
0.002 - 0.05	10,0 +- 1,6	12,6 +- 1,7	27,6 +- 3,8	40,3 +- 1,1	28,5 +- 3,3	36,8 +- 2,0
0.05 - 2.0	87,3 +- 1,2	80,6 +- 2,6	63,7 +- 4,4	32,8 +- 1,1	60,3 +- 4,1	22,2 +- 1,6
soil type	sand	loamy sand	sandy loam	loam	sandy loam	clay
water holding capacity (g/100g)	31,2 +- 2,0	44,4 +- 6,0	35,6 +- 3,0	44,1 +- 1,5	40,4 +- 2,7	38,9 +- 4,6
weight per volume (g/1000ml)	1462 +- 39	1257 +- 43	1295 +- 30	1305 +- 12	1280 +- 89	1372 +- 60

5. Moisture output in hPa suction pressure

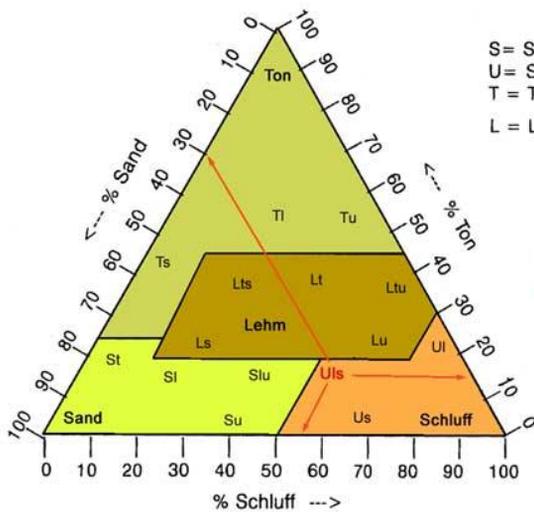
Swiss soil texture pyramid classification with positioning of the LUFA Speyer standard soils



European Union soil texture pyramid classification



German soil texture pyramid classification

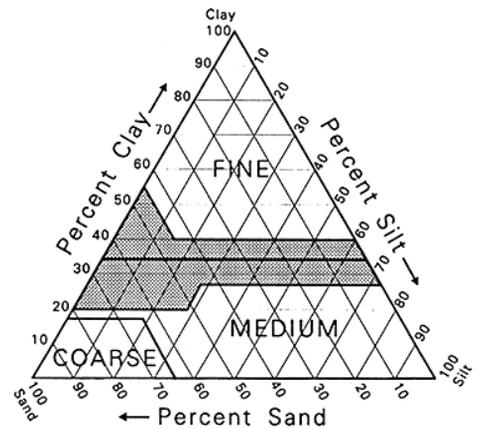


S = Sand, s = sandig,
 U = Schluff, u = schluffig,
 T = Ton, t = tonig,
 L = Lehm, l = lehmig

Beispiel:
 Uls = lehmiger, sandiger Schluff
 mit folgender Zusammensetzung:
 30 % Sand
 55 % Schluff
 15 % Ton

FAO soil texture pyramid classification

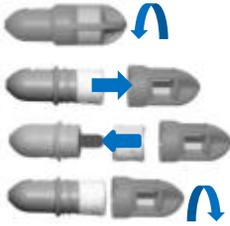
(Food and Agriculture Organization of the United Nations)



gray area has no significance

6. Maintenance

Replacing the sensor felt



7. Technical specifications

PlantCare Mini-Logger	Description
Measuring principle	MHP: Micro-Heat-Pulse measurement of soil moisture and soil temperature
Operating temperature	-20° C to +50° C
Measuring range	<ul style="list-style-type: none"> ▪ Moisture: 0 -100% at 0° - 37°C soil temperature ▪ Temperature: -20 - +50°C
Reading accuracy	<ul style="list-style-type: none"> ▪ Moisture: Relative %: 1% / hPa: 1hPa ▪ Temperature: 0.1 °C
Measuring accuracy	<ul style="list-style-type: none"> ▪ Moisture: +/- 3% ▪ Temperature: +/- 0.3°C
Frost resistant	Yes
Type of soil	All
Weight	130 gr.
Power supply	2 AA 1.5V mono-cells
Battery life	Approx. 1 year depending on measuring cycle and frequency of data readout
Logging capacity	approx. 12.000 records
Data-Export	Export cable and USB stick
Programming	Via configuration file on USB stick
Possible settings	<ul style="list-style-type: none"> ▪ Device name ▪ Start-time for first measurement ▪ Measuring cycle time: 10 – 360 min ▪ Moisture output in relative % or hPa ▪ Date and time ▪ Data erase
Data analysing	PlantCare DataViewer software (included)
Sealing electronics and sensor	IP67
Maintenance	None
Accessories	Sensor tip with felt / Data upload/download cable with 2 USB Sticks

8. Warranty

Your dealer will issue a two-year warranty for this product (from date of purchase). This warranty covers all substantial defects of the unit that are demonstrably attributable to faulty material(s) or manufacturing faults. It will be implemented either by replacement with a unit in perfect condition or by repair (free of charge) of the returned unit at our discretion if the following conditions are met:

- The unit was treated properly and in accordance with the recommendations in the operating instructions.
- Neither the buyer nor any third party has attempted to repair the unit themselves.

9. Disclaimer

No liability can be assumed for any consequential damage resulting from the incorrect operation of or any malfunctioning by this product.

10. Support

If you have any questions, please contact us by e-mail: support@plant-care.ch

Felt Selection

