

PlantControl CX



The self-learning, intelligent
irrigation controller for all
applications



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PlantControl CX: The ultimate solution for intelligent agricultural irrigation

Demand-oriented irrigation is not only an essential prerequisite for secure yields in agriculture but also ensures economical use of the increasingly valuable resource of water. In addition, less water use also avoids the leaching of nutrients and pesticides, saves energy and makes the crops more robust to drought stress and disease.

Intelligent irrigation by measuring soil moisture

However, intelligent, needs-based irrigation can only be achieved if one knows the current soil moisture in the root area. Since this is not known in most cases, is - as experience shows - often according to the principle "more is better" and "sooner than too late" - acted. Basically, it is possible to measure soil moisture by means of sensors, but the use of conventional soil moisture sensors, such as tensiometers or sensors based on the measurement of electrical conductivity or use capacitive measuring methods, has not been proven in agriculture due to measurement problems or difficult handling and therefore not enforced.

In 2004, PlantCare AG invented a completely new soil moisture sensor based on a microthermal measurement. A small hermetically encapsulated tip - similar to an electronic clinical thermometer - heats a few degrees for a few seconds. Thereafter, the cooling curve is measured electronically. If the tip is stuck in a wet or moist soil, it will cool much faster than in a dry soil. The cooling time is a measure of the soil moisture.



Fig. 1: Tip of the microthermal soil Moisture sensors with and without felt cuff

The tip is surrounded by a plastic-felted cuff, which ensures the connection to the surrounding earth. With two AA batteries, the sensor can be operated for one season.

This robust and maintenance-free sensor, which is not affected by fertilizer content or soil temperature, has become a new standard in soil moisture measurement in recent years and a large number of university and industrial agricultural research institutes today use this sensor to measure soil moisture. Meanwhile over 300,000 sensors have been sold worldwide.



Scientifically confirmed results

Knowledge of soil moisture is essential, but processing this information in a smart, automatic irrigation control is also very important for a viable agricultural application. Therefore, PlantCare has developed a self-learning irrigation control system optimized for agricultural applications in close collaboration with farmers. Under the leadership of Zurich University for Applied Science ZHAW Wädenswil and supported by specialists from Agroscope and Inforama Ins, the system underwent a multi-year test in practice in a project funded by the Federal Office for the Environment and the Federal Office for Agriculture. The insights gained were unexpected and spectacular even for specialists.

As part of this funding project, the irrigation controller PlantControl CX was tested on various crops. This research project was preceded by an examination of the ZHAW on the occasion of a bachelor thesis. Egg plants were watered with the PlantControl CX system, with different moisture regimes during one season.

Tab.1	PlantControl Moist Regime (35-85% Band)	PlantControl Dry Regime (35-45% Band)
Water Consumption: m ³ / ha	1956	1760
Yield: t/ha	32	49
Water Efficiency: m ³ /t	62	36



Fig. 2: Eggplant culture (Fischer, Brütten)

As Table 1 shows, limiting the soil moisture to a tight band of 10% (35-45%) has significantly improved water efficiency.

In addition, it was found that the dry culture was virtually resistant to pests (aphids), i. While the wet culture had up to 1,600 aphids per 3 leaves, practically no aphids could be detected in the approximately 5 meters away, dry culture kept.

As part of the above-mentioned funding project, a field crop of Brussel sprouts (6 ha) was also subjected to a comparison test between manually made irrigation and irrigation controlled by the PlantControl CX. The evaluation of the measured data was carried out by the Institute of Soil Ecology of the ZHAW, the evaluation by the Inforama in Ins.

Irrigation Method	1. Harvest	2. Harvest	Rejects	Total	Rejects: % to total harvest	Water-consump.	Water-efficiency
	kg/Are	kg/Are	kg/Are	kg		m3/Are	l/kg
Experience based Manually	177	29	60	266	22	19	70
Sensor controlled quite moist	163	28	66	257	26	15	58
Sensor controlled medium moist	147	31	58	236	25	11	48
Sensor controlled rather dry	162	32	49	242	20	6	24

Tab.2



Fig. 3: Shows soil moisture sensors in a Brussels sprout field where the electronics and the radio antenna are mounted on slalom poles. So the farmer can work with spray cars unhindered.

Again, the result was amazing. As can be seen from Table 2, with a slightly reduced yield, the water efficiency could be improved practically by a factor of 3. This is even more surprising because water consumption using drip irrigation is already much lower compared to conventional irrigation methods.

Extrapolated to the total cultivated area, the use of the intelligent irrigation control system in 2013 would have resulted in a water saving of more than 8,000 m³.

An intelligent, self-learning system.

The PlantControl CX system offers a very special advantage for the user: the self-learning system automatically adjusts the irrigation volume according to the current needs of the plants, i.e. a manual readjustment at high temperatures or as a result of the size growth of the plants is no longer necessary: If the plant needs more, then it gets more, it needs less water, it gets less. This is done by a worldwide patented control algorithm.



Fig. 4: The plants always get the right amount of water according to their needs.



This fully automatic readjustment, which also takes into account factors such as high or low humidity, wind, etc., relieves the operator of the stress associated with daily, even sometimes hourly monitoring of crops.

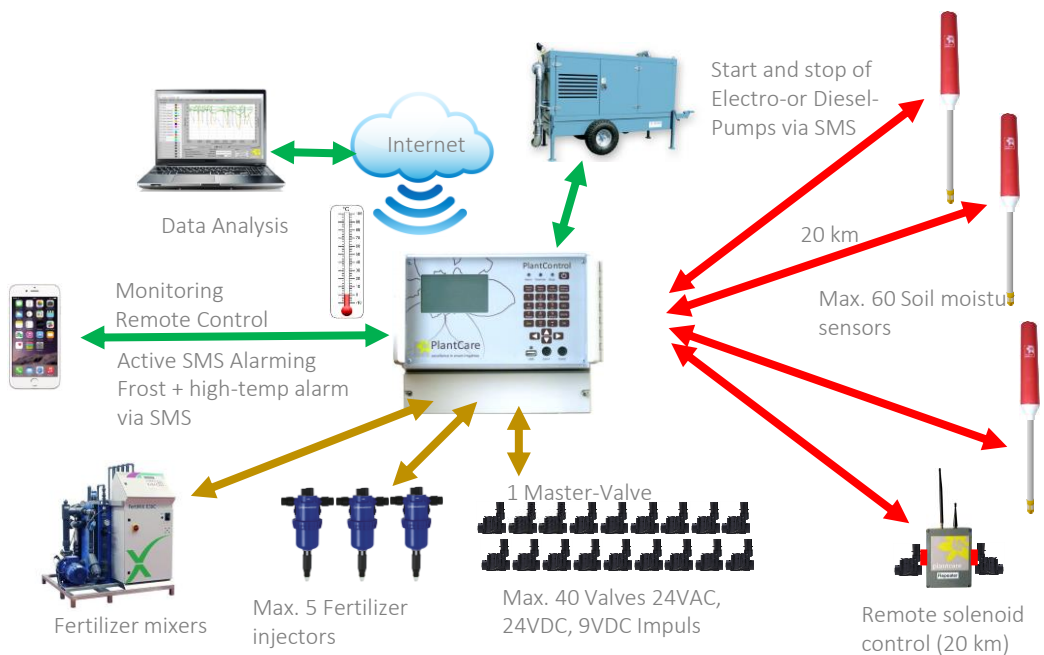


Fig.5: Overview of the PlantControl CX system

The basis of the PlantControl CX system is the soil moisture and soil temperature sensor, which transmits the measured data to the control center via radio. This sensor has in the optimal case a radio range of 20km. If larger areas have to be covered, then there are repeaters (amplifiers) available that can expand the range up to 100km.



The PlantControl CX system includes a whole range of other very valuable functions:

- Each solenoid valve can be controlled either fully automatically, semi-automatically or as a normal timer.
- Each valve can be assigned up to five fertilizer injectors, which are also miscible.
- Valves can also be controlled by radio, which avoids the laying of long control lines.
- The system can be operated either with 230/115 V mains power or solar cell, which allows outdoor use
- It is capable of switching on and off remote pumps - electric or diesel - via SMS.
- The system can also be combined with existing fertilizer mixers.
- For organic farms - which may only use organic liquid fertilizers - a final rinse time can be set per valve.
- If a main valve is used, it can be closed a few seconds before the watering valve, thus avoiding a pressure shock in the pipes.
- The system can also be used as a frost alarm.
- In addition to soil moisture, the soil temperature is also measured, which can be beneficial for certain crops.

Always fully informed

Very valuable is also the so-called active monitoring function. For crops which do not have permanently installed irrigation equipment and e.g. irrigated with pivots, sensors can also be used. In case of falling below an adjustable threshold, an SMS message will be sent to up to 4 recipients. This shows the current measured value of the soil moisture, the deviation from the dry threshold, the name of the zone and also the sensors that monitor this zone.

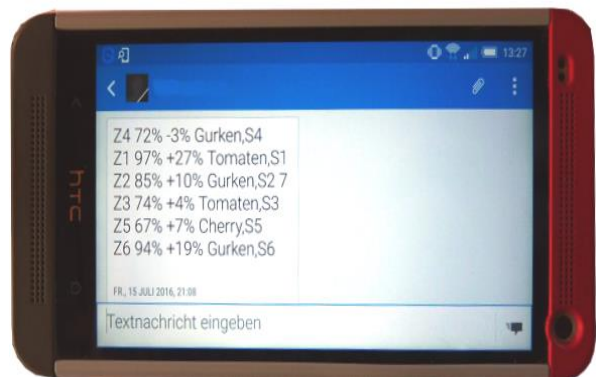


Fig.6: Example of an SMS containing the status of 6 monitored zones. Zone 4 shows a negative deviation from the threshold and should be watered.

It is up to the farmer to decide if and when he will do the irrigation effectively. With this message, the humidity values of all other monitored fields are also transmitted so that the operator always receives a current status of his fields. This information can also be retrieved at any time by SMS from the system. The owner is therefore able to monitor the water status of his fields during his holidays.

Complete monitoring

All essential functions are monitored electronically and in the event of a problem, up to 4 persons can be informed via SMS. If a valve does not open or is a filter clogged and there is no water delivered, then the system notices this because the sensor could not measure any increase in humidity and informs the responsible personnel. Even if a sensor was unintentionally pulled out of the ground, this is communicated to the owner by SMS. In addition, there are about 15 other alarm messages, such as, if the batteries should be replaced. The operator of the system must therefore intervene only if the system sends him a corresponding SMS message.

On the other hand, the system allows new external settings to be made at any time via SMS commands. It is also possible to remotely activate valves via SMS.

A Swiss invention conquers the world

All in all, it can be said with justification that the PlantControl CX is the ultimate in irrigation control and unique in the world. Facilities in all continents have proven their reliability under extreme climatic conditions. If one considers that the investment volume for a medium-sized plant with 10 sensors is under US\$ 10,000.- then it is understandable why many customers have already decided in favor of PlantCare.

