

MP-508E

SOIL MOISTURE/CONDUCTIVITY/TEMPERATURE SENSOR MANUAL



INTRODUCTION & KNOWLEDGE

1.1 KNOWLEDGE

1.1.1 Effects of soil conductance (salinity) on plants

The effects of excessive soil salt on plant growth are various, and the main hazards are as follows:

(1) Physiological drought. There are too many soluble salts in the soil, and the water potential of the soil decreases due to the increase of the seepage potential

The principle of flow from high water potential to low water potential is that the water potential of root cells must be lower than that of surrounding medium to absorb water, so soil

The more salt, the more difficult it is to absorb water, and even the water in the body may leak out.

Therefore, the common manifestation of salt damage is actually a drought

Especially in the case of low relative humidity of atmosphere, with the increase of transpiration, salt damage is more serious, plant growth is abnormal, plant is short, leaves are small and dark green, like drought and water shortage.

(2) The toxic effect of ions. Plants reject the absorption of other nutrients because they absorb too much salt.

(3) Destroy normal metabolism. Too much salt can inhibit the synthesis of chlorophyll and the occurrence of various enzymes in photosynthetic apparatus, especially the shade

The formation of ring leaf green protein, the crops growing in the soil with too much salt, generally the net photosynthetic rate is lower than that of the plants in the light soil, the net photosynthetic production rate is low, which is not conducive to growth. Chloroplast is the main place for photosynthesis. Chlorophyll content is a physiological index reflecting the photosynthesis intensity of plants. Therefore, the effect of salt stress on photosynthesis is mainly on chloroplast. Under salt stress, plants can not absorb enough water and mineral nutrition, resulting in malnutrition, resulting in low chlorophyll content, affecting photosynthesis. In addition, too much salt reduced the activity of fusinase and fusinase, chloroplast tended to decompose and chlorophyll was destroyed. The biosynthesis of chlorophyll and carotenoid is blocked, stomata are closed, photosynthetic rate is decreased, and crop yield is affected.

(4) Effect on the structure of plant cell membrane. Salt stress directly affects membrane lipids and membrane proteins, and increases membrane permeability

And membrane lipid peroxidation, thus affecting the normal physiological function of the membrane. Under normal conditions, the cell wall and the plasma membrane contact each other, and the plasma membrane shrinks when the cell loses water. Due to the different elasticity between the plasma membrane and the cell wall, the plasma wall "tears" each other and deforms, resulting in mechanical stress, which increases the concentration of free calcium ion in the cell, and induces the burst of plant active oxygen. Salt stress forced the cells to lose water, resulting in the changes of cell swelling pressure and osmotic pressure.

(5) It hinders the protein synthesis of crops. Too much salt has obvious effect on protein metabolism, inhibiting synthesis and promoting decomposition,

The direct reason for the inhibition of protein synthesis may be that it destroys the synthesis of amino acids, for example, the half skin ammonia in the leaves of *Vicia faba* under salt stress

The synthesis of acid and methionine is reduced, thus reducing the protein content. Produce toxic

substances to crops. Salt stress forces the accumulation of toxic metabolites in plants, such as free amino acids, amines and ammonia, which are the products of protein decomposition. These substances have toxic effects on plants, resulting in poor growth of plant leaves, inhibition of root growth, black necrosis of tissues, etc.

1.1.2 The significance of measuring soil conductance (salinity)

The total salt content in the soil is the total salt content in the soil. Because all kinds of salts in the soil leaching solution generally exist in the form of ions, the total salt amount can also be expressed as the sum of the amount of various cations and anions in the soil leaching solution. In recent years, the total salt content of soil increases year by year, resulting in soil acidification and secondary salinization, which is mainly due to the soil

Annual or seasonal coverage changes the water and heat balance (high temperature, lack of rain, strong evaporation) in the natural state,

The soil can not be fully washed by rainwater, which leads to the accumulation of salt on the surface of the soil; it is also the result of unreasonable fertilization. In soil analysis

The content of salt is an important comprehensive index, and the conductivity of soil can directly reflect the content of mixed salt.

Therefore, it is necessary to monitor the conductivity of soil to master its pollution status. Soil electrical conductivity is an indispensable parameter for the study of fine agriculture, which contains rich information reflecting the soil quality and physical properties. For example, the salinity, water content, temperature, organic matter content and texture structure of soil all affect the soil conductivity to varying degrees. It is of great significance to obtain the soil conductivity value effectively for determining the spatial and temporal distribution differences of various field parameters, thus laying a foundation for the popularization of modern precision agriculture based on information and knowledge.

(1) To understand the dynamic of water and salt and its harm to crops, so as to provide reference for the prediction and prediction of soil salt, so as to

Measures should be taken to ensure the normal growth of crops.

(2) To understand the effect of comprehensive treatment of saline soil.

(3) According to the salt content and composition of the soil, the saline soil shall be classified and reasonably planned to achieve reasonable planting

The purpose of reasonable irrigation and drainage.

(4) To identify the quality of irrigation water and determine the salt content of irrigation water so as to make rational use of water resources and reclamation

Wasteland to prevent soil salinization.

1.1.3 Judgment of plants under Salt Stress

The higher the EC Value of the soil matrix, the higher the concentration of soluble salt ions in the soil, which may form

Reverse osmosis can replace the water in the plant root system, damage the root tip, and then lose the ability to absorb water and nutrition

This is also the reason that excessive fertilization will cause seedling burning.

(1) The symptoms of the above ground plants were wilting, yellowing, tissue necrosis or plant short.

(2) The symptoms of roots are: the root tip turns brown, the lateral roots are dry, there is no root hair, and the whole root rots in severe cases

Necrosis. Too high EC Value of soil will also increase the incidence of root rot (caused by cotton rot fungus). When it is found that crop plants grow slowly or stop growing, it is forbidden to apply fertilizer blindly to supplement nutrition. First of all, we should observe the condition of plant roots, combine the characteristics of matrix and the management of water and fertilizer to make a judgment, and use the soil conductivity (salt) tester to detect the EC Value of soil. When the absorption capacity of plant roots decreases, unreasonable fertilization will cause the soil salt to accumulate again and accelerate the plant death; secondly, use the water with low EC value to irrigate and wash the soil to reduce the soil salt concentration; thirdly, use the rooting agent properly to promote the plant root growth and accelerate the plant to return to normal.

1.1.4 Measurement of conductance and salinity

Generally, electrical conductivity (EC) is an indicator used to measure the concentration of soluble salt in solution, with the unit of

Siemens s / m per meter ($1\text{ s} / \text{M} = 10\text{ms} / \text{cm} = 10000\text{us} / \text{cm} = 10\text{ds} / \text{M}$). According to the conductivity of soil matrix or nutrient solution depends on its temperature and salinity (i.e. salt), the salinity can be obtained by measuring its conductivity and temperature. The measurement temperature of EC value is usually 25 °C. In the same solution, the lower the measurement temperature, the lower the EC value. Under normal air temperature, the change value of conductivity per 1 °C difference is about 2%. The electrical conductivity has a linear relationship with the salt content. Based on the temperature of 25 °C, the ratio is: $1\ \mu\text{s} / \text{cm} = 0.55\text{-}0.75\text{mg/l}$ salt content. In other temperatures, it needs to be corrected, that is, the salt content changes about 1.5-2% for every 1 °C temperature change. The negative value is used when the temperature is higher than 25 °C, and the positive value is used when the temperature is lower than 25 °C. So salt can be estimated according to conductivity.

1.1.5 Effect of soil moisture content on plants

Moderate water content is an important condition for plant growth. If there is too much or lack of water, the growth will be affected by the following aspects
Influence.

(1) Effects on plant morphology

Plant photosynthesis and dry matter accumulation are carried out by water supply, and the amount of accumulation is directly reflected in plant height, stem diameter, stem diameter, stem diameter and stem diameter

The dynamic changes of leaf area and yield formation. Under water stress, the height of the plant was low and the area of photosynthetic leaf was decreased,

The output decreased.

(2) Effect on blade change

Leaf is the main place of photosynthesis and transpiration. Mesophyll cell expansion and leaf growth are very sensitive to water conditions. Plant leaves

In order to maintain the standing state, it is necessary to rely on not only the support of cellulose, but also the support of higher swelling pressure in the tissue, which occurs when the plant is short of water

The wilting phenomenon is the decrease of turgor pressure.

(3) Impact on Yield Formation

Crop yield is the accumulation of solar energy into chemical energy on crops. Influence of soil moisture on water absorption of plant roots and leaves

Leaf transpiration, then affect dry matter accumulation, and ultimately affect crop yield.

(4) Effect of water on root and crown development

Plant root system is the main organ of water absorption, its development is affected by many aspects, but the main role is the soil water condition

And ventilation. The vertical distribution of root system is affected by soil moisture. When the soil moisture content is high, the root diffusion is affected by the soil

The lower the resistance, the better the new roots and the more developed the roots. The soil usually contains some useful water, so the root system itself

Not prone to water deficit. When the soil is dry or the water supply is insufficient, the root system absorbs limited water and first meets its own needs,

There is very little transport for the above ground part. Therefore, when the soil water is insufficient, the effect on the upper part is greater than that on the lower part. Root cap

Ratio increases. On the contrary, if the soil moisture is too much and the soil aeration condition is poor, the influence on the underground part is more than that on the ground part

The ratio of root to shoot decreased. Moderate and slow water deficit can increase the absolute root weight, inhibit the growth of the aboveground part and reduce the aboveground part

Part of the dry matter accumulation, yield per unit decreased, but conducive to close planting, so as to improve the total yield. The results show that: water content in a certain period

Deficit is good for improving yield and quality. Drought in early stage can enhance drought resistance in later stage, and light drought resistance in seedling stage can promote "compensatory growth" of root system and improve drought resistance of plant.

(5) Effect on Photosynthesis

Photosynthesis is the main source of energy for green plants. The photosynthetic rate is closely related to the water status of plants.

The results showed that when the water content of plant tissue was close to saturation, the photosynthesis was the strongest; when the water content was too much, when the water content of plant tissue reached saturation, the stomatal cover was

When the action is closed, photosynthesis is inhibited. The photosynthetic rate decreased with water deficiency, and decreased sharply with leaf wilting

To stop. Soil moisture also affects photosynthesis of plants. The decrease of soil water content results in the decrease of leaf water potential and stomatal resistance

With the increase of force, the diffusion resistance of leaves increased, the diffusion of CO₂ was blocked and the photosynthetic rate decreased.

(6) Impact on organic matter transport

With the decrease of water supply, the water potential of leaves decreased, and the assimilates transported from source leaves to phloem decreased. For one thing

It is the decrease of leaf water potential and photosynthetic rate that makes the concentration of sucrose transported from mesophyll cells lower. On the other hand, it is due to the sieve tube

The velocity of longitudinal motion of the internal flow is reduced. Water is the medium of substance transformation and transportation, and it also directly participates in some biochemical reactions.

In general, the water content in the fruit expanding or filling stage of crops is insufficient, and the fruits and seeds cannot accumulate due to the blocked photosynthesis and transportation. Tired of enough organic matter and become small and shriveled. Therefore, in the case of drought, irrigation can accelerate the transport of organic matter. However, Too much water is not conducive to the transport of organic matter, which is mainly due to the poor ventilation of soil caused by too much water, which affects the respiration and other metabolic processes.

(7) Influence on absorption and transportation of mineral elements

Mineral elements must be dissolved in water to be absorbed by plants. But the amount of water and salt that plants absorb is not

In proportion, the two kinds of absorption are greatly different due to the change of environment.

The absorption of water and mineral by plants is related to both,

It has nothing to do with it. It shows that salt must be dissolved in water before it can be absorbed by plant roots, and it will enter plant roots with water flow

The absorption mechanism of the two is different. Water absorption is mainly passive water absorption caused by transpiration, while mineral

Absorption is mainly the active absorption of metabolic energy.

(8) Effect on Seed Germination

Water absorption is the main condition of seed germination. Only after the seeds have absorbed enough water, can they grow all kinds of physiological plants related to germination

Only by this way can we start. This is because the moisture can make the testa expand and soften, and the oxygen can be easily penetrated to enhance the respiration of the embryo,

At the same time, the embryo is easy to break through the seed coat. Water can change the protoplasm from the gel state to the sol state, and increase the metabolism.

Under the action of a series of enzymes, the storage substance of endosperm is gradually transformed into soluble substance for embryo growth and differentiation

It can promote the transport of soluble substances to the growing buds and roots, and supply for respiratory needs and the formation of new cell structures.

1.2 INTRODUCTION

RY-508E soil moisture / conductivity / temperature sensor has high stability and sensitivity, which is used to observe and study the occurrence of saline soil

An important tool for evolution, improvement, and water and salt dynamics. By measuring the dielectric constant of soil, it can reflect all kinds of soil directly and stably

The true moisture content of the soil. The soil moisture sensor can measure the volume percentage of soil moisture, which is in line with the current international standard

Standard soil moisture measurement method. Suitable for soil moisture monitoring, scientific experiment, water-saving irrigation, greenhouse, flowers and vegetables

Vegetable, grassland and pasture, soil quick test, plant culture, sewage treatment, fine agriculture and other occasions. The sensor has the following features:

(1) The three parameters of soil moisture content, conductivity and temperature are combined.

(2) It can also be used for the conductivity of water fertilizer integrated solution and other nutrient solution and matrix.

(3) The electrode is made of specially treated alloy material, which can bear strong impact of external force and is not easy to be damaged.

(4) Completely sealed, acid and alkali resistant, it can be buried in soil or directly put into water for long-term dynamic detection.

(5) High precision, fast response, good interchangeability, probe insertion design ensures accurate measurement and reliable performance.

(6) Perfect protection circuit and various signal output interfaces are optional.

TECHNICAL SPECIFICATION	
Output	RS4845
Supply voltage	DC5-24V
Soil moisture range	Optional range: 0-50%, 0-100% Resolution: 0-50% :0.03%, 50-100% :1% Accuracy: 0-50%:2%, 50-100%:3%
Conductivity range	Optional range: 0-5000us/cm, 10000us/cm, 20000us/cm Resolution: 0-10000us/cm :10us/cm, 10000-20000us/cm: 50us/cm Accuracy 0-10000us/cm :±3%; 10000-20000us/cm :±5%
Conductivity temperature compensation	Built in temperature compensation sensor, compensation range 0-50 °C
Temperature measurement range	Range: -40~80°C, Resolution: 0.1°C, Accuracy: ±0.5°C
Measurement principle and method	FDR method of soil moisture, alternating current bridge method of soil conductivity Direct test of soil in-situ insertion or immersion in culture medium, water and fertilizer integrated nutrient solution
Ingress Protection	IP68
Work environment	-40~85°C
Fixed form	All embedded or probe inserted into the measured medium

2 SENSOR WIRING

Red(V+): Positive pole

Black(G): Negative pole

Yellow(T+): RS485+/A/T+

White(T-): RS485-/B/T-

Green(SET): Connect V+(Positive pole),The electric starting module enters the "setting mode". When not connected or connected to G (power ground), power on and start to enter "operation mode".

The configuration parameters of the module, such as MODBUS address, baud rate, check bit and communication protocol, are stored in the EEPROM (power down storage device) memory inside the module. Sometimes the specific configuration of these parameters will be forgotten, resulting

in the failure to communicate with the module. To prevent this problem, the module has a special mode called "setup mode". When the module is powered on in "setup mode", the module communicates with the following parameters:

1. Modbus address is 0
2. Communication configuration as: 9600,N,8,1 (9600bps, no check bit, 8 data bits, one stop bit)
3. The communication protocol is: Modbus-RTU

The configuration parameters in EEPROM will not be changed when the module enters "setting mode". When the module is in "operation mode", it will still communicate according to these configuration parameters in EEPROM.

3、 Installation and measurement

Because the conductivity of soluble salt ions in soil is measured directly by the electrode, it is necessary for the soluble ions in soil to reflect the conductivity of soil correctly when the soil volume moisture content is higher than about 20%. In the long-term observation, the measured value after irrigation or rainfall is closer to the real level. If the rapid measurement is carried out, the tested soil can be watered first, and the measurement can be carried out after the water is fully penetrated.

(1) Rapid measurement method: select a suitable measurement location, avoid stones, ensure that the electrode will not touch hard objects such as stones, and plane the topsoil according to the required measurement depth, maintain the original tightness of the soil below, hold the sensor body and insert it vertically into the soil, and when inserting, do not move forward or backward, left or right, to ensure close contact with the soil. It is recommended to average several times in a small range of a measuring point.

(2) Buried measurement method: according to the required depth, dig a pit with a diameter of more than 20cm vertically, and then insert the sensor steel needle horizontally into the pit wall at a given depth, fill the pit and compact it, so as to ensure that the electrode is in close contact with the soil. After stabilization for a period of time, the measurement and recording can be carried out continuously for days, months or even longer.

If the measurement is conducted on a hard surface, the hole shall be drilled first (the hole diameter shall be smaller than the probe diameter), then it shall be inserted into the soil and compacted before measurement; the sensor shall prevent severe vibration and impact, not to mention knocking with hard objects. Due to the black package of the sensor, the sensor will be heated sharply under the strong sunlight (up to 50 °C). In order to prevent the excessive temperature from affecting the temperature measurement of the sensor, please pay attention to sunshade and protection when using in the field or in the field.

