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SOIL ELECTRICAL CONDUCTIVITY METER FOR AUTOMATED GREENHOUSE

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ABSRTACT

Greenhouses are specially designed agricultural environments that offer a human creation of better way to growth of friendlier conditions for plants. The automation of green house is new trend of greenhouse elevation. The specific sensors are needed when the automating and well managing greenhouse efficiency. Soil is used as the main growing media in the greenhouse. Good soil health is strongly effect for better harvesting. There are many indicators for measuring soil health. Among these properties soil electrical conductivity (EC) is better than others. Different types of soil EC meters are available. But they are not configured as suitable for automated greenhouse. This study has been introduced low cost soil EC meter. The soil EC meter is tested with different types of soil samples. In these test; the soil EC sensor is obtained linear change when increasing soil EC level.

Keywords: Greenhouse automation, EC, Soil conditioning

1. INTRODUCTION

1.1. Automated greenhouse

Automated greenhouses are automatically controlled environment. It can be created favorable micro – climate which crop production could be made possible though out the year or part of the year. In this closed environment maintained greater control of parameters; temperature, light intensity, relative humidity, CO_2 concentration, soil EC, soil PH, soil moisture, shade, irrigation and fertilizer application as major functions. Greenhouses may be used to overcome shortcomings in the growing qualities of a piece of land, such as a short growing season or poor light levels, and they can thereby improve

food production in marginal environments. When automating the greenhouse control systems have a number of sensors, both inside and outside the greenhouse, that monitor all of the important environmental factors which affect crop growth.

Soil is used as main growing media in the greenhouse. Because the soil health is strongly affect plant growth and harvest. Soils have physical, chemical and biological properties. Among these properties the chemical component relates to the nutritional aspect of the soil. Chemical issues address the sufficiency of both the macro- and micronutrients in the soil. There are 15 major elements needed by crops to grow successfully: carbon, hydrogen, oxygen, nitrogen, potassium, phosphorus, calcium, magnesium, sulfur, iron, manganese, boron, zinc, molybdenum, and copper. Other important chemical factors affecting crop growth and yield include soil pH, salinity, and sodicity[1]. All the nutrients are have electrical conductivity (EC). Because EC is a good indication of soil health.

1.2. Soil Electrical Conductivity

Soil Electrical Conductivity means ability of a soil to conduct electricity. Soil EC level is a good indication of the amount of nutrients of the soil. Electrical resistivity uses the unit of Siemens per meter. Electrical conductivity is the reciprocal of electrical resistivity. Rather than use the units mho per meter. Siemens defined this unit as the resistance of a column of mercury 100 cm high and with 1 mm^2 cross-section and at temperature of 0° C. EC is a universal standard for measuring electrical conductivity. Parts per million (ppm) is also used that measuring. Soil electrical conductivity is an indirect measurement that correlates very well with several soil physical and chemical properties. It is a measure of the amount of salts in soil .It is an important indicator of soil health[2, 3].

1.3. Soil Electrical Conductivity Meter

An EC meter measured the potential for an electrical current to be transported through the material.

In this study, after considering theoretical concept a soil EC meter is produced. The system have three parts; probe, amplify circuit and programming part. First voltage difference between two probes is obtained and amplified. After the voltage is converted to the EC measured unit; Siemens(S) using universal standard.

2. METHODOLOGY

In the proposed system voltage difference between two probes were measured and amplified it using an op amp. Here soil EC measured by applying an alternating electrical current (I) to two electrodes immersed in a solution and measuring the resulting voltage (V). During this process, the cations migrate to the negative electrode, the anions to the positive electrode and the solution acts as an electrical conductor. The system have been designed as follows.

2.1. Probes

In the system soil EC is measured between two probes 1cm apart, each probe length 30cm. 1/3 length of the probes were inserted in to the soil and remained are insulated.

2.2. Oscillator

Oscillator circuit is used to produce a periodic, oscillating electronic signal. It converts direct current (DC) from a power supply to an alternating current (AC) signal. Here oscillator designed to generate sine wave.

2.3. Gain (amplify circuit)

Here amplify circuit used to controlled the output to match the input signal shape but with a larger amplitude. In this sense, an amplifier modulates the output of the power supply to make the output signal stronger than the input signal. It does this by taking energy from a power supply.

2.4. AC to DC converter

Here op-amp is configured to convert the AC signal level into a DC voltage with adjustable gain for scale.

After getting amplified voltage difference it is converted Siemens. Here used universal standard for measuring electrical conductivity conversion; 1 ms/cm (EC 1.0 or CF 10) = 500 ppm (USA)[4].

3. RESULTS AND DISCUSSION

The device was tested with dry soil samples and mixed them with and distill water and 0.001M Sodium Chloride (NaCl) solution separately. Then prepared ten soil samples in different moisture levels. Also tested gold plated probes and brass probes with this soil

samples separately. The amplified voltage difference between to probes were measured. The experimental results as follows.

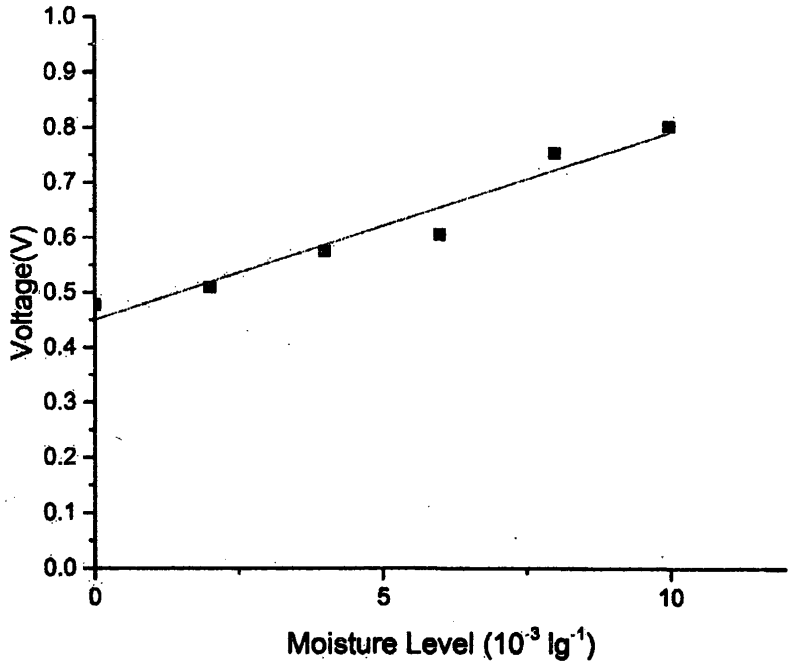

Figure 1: Voltage variation of soil with distill water with gold probes

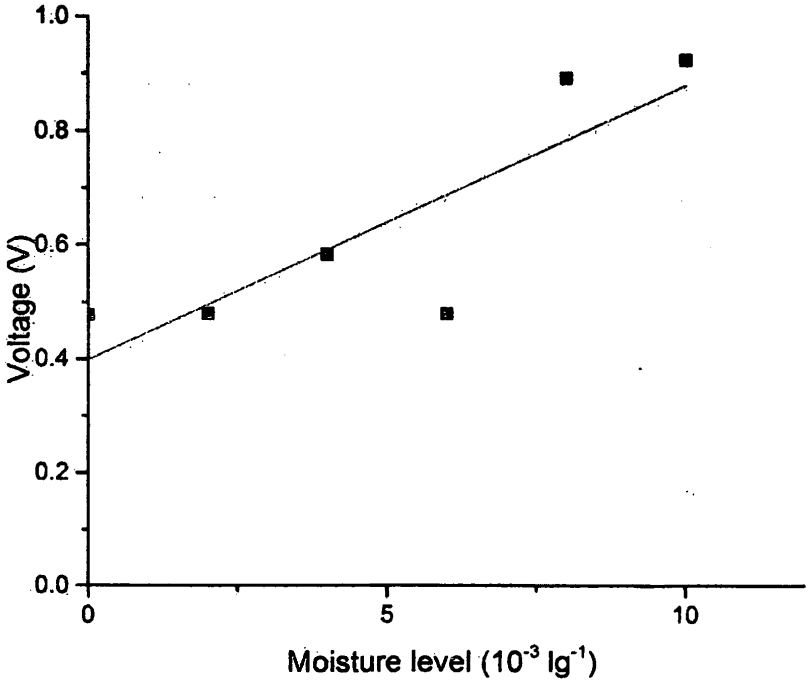

Figure 2: Voltage variation of soil with 0.001M NaCl with gold probes

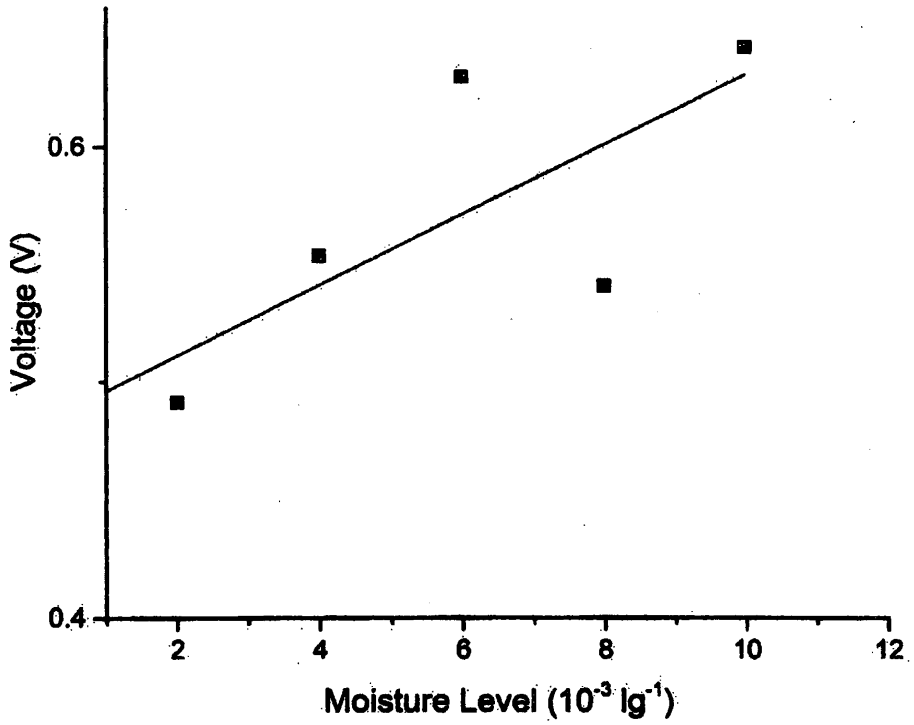

Figure 3: Voltage variation of soil with 0.001M NaCl with brass probes

According to the above graphs voltage is varied linearly with soil moisture and soil salinity. Also that this linear variation is remained two types of probes gold and brass. The gold probes voltage variation is better than the brass probes. When consider those results the EC meter can be used to measure soil electrical conductivity.

4. CONCLUTION

The automated greenhouses are specially designed environment for agriculture. When automating the greenhouse, it can be created favorable micro – climate and it can be maintained as required environmental condition manually or automatically. To achieve this task number of sensors should be used. Here Soil is used as the main growing media in the greenhouse. Because more attention should be focused about Soil properties. Soil EC is a good measurement to knowing about the soil health. Automated greenhouse is needed specially configured soil electrical conductivity meter. The device is linearity, repeatable

results, calibratable and low cost. The system can be developed further and customized according to the need of the automated greenhouse.

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