International Journal of Management, Sciences, Innovation, and Technology

Vol.2, Issue.1, pp.31-34, Jan (2021) **ISSN:** 0000-0000

Research Casestudy

Experimenting Electrical Conductivity for Nourishing Soil: Highlighting The Process and Measurement of Soil Testing

Yuvika Mahaganapathy, Kailesh Saravanan, Kavisha Nagarajan, Dr. Mahaganapathy Dass

1 2 3 4 SJK(T) Taman Melawati, Kuala Lumpur Malaysia

Corresponding Authors:e-mail: *mahaganapathydass@gmail.com*

Available online at: https://ijmsit.com/volume-2-issue-1

Received: 18 Nov 2020 Revised: 23 Nov., 2020 Accepted: 25 Dec, 2020

Abstract— Studying about Soil is a vital process during the course of seeding, yielding and harvesting. While this can be done through several process, it is important to adhere prominent standard of measuring the soil. The standard method for soil assessment is by laboratory method which is cumbersome and gives rise to limitations for data-intensive works. This research paper is an extract of experiment from young scientists who executed a process of assessing apparently through Electrical Conductivity (EC) in soil which entails to set a new standard. These are presented along with the means and modes of measurement process. Procedures to measure and mathematical calculations are sourced for this experiment. The owners of experiment were awarded for coining this idea, and later the abridged version of the experiment is drafted as a research paper herewith.

Keywords— Electrical Conductivity, Soil, Soil Testing, Salt, Nutrients.

I. Introduction

The ability of plants are determined by the capability of soil. Roots of plants do not overgrow down-to-up, it is always up-to-down. Hence the soil which is underneath the plants has to be treated and studied as priority. Trees, plants need large quantity of air, sun water, and nutrients to-grow or at the least case to-survive. The both sun and water are available thru nature independently (Visconti & de Paz, 2016). However, how can we make sure our plants have enough nutrients? Measuring different aspects of soil can tell you exactly what you need and what your missing, and help you to foster strong and healthy plants. Testing the pH, moisture content, and temperature of your soil are a good start for healthy soil. Monitoring phosphates, nitrates, calcium, and potassium are all primary components to plant growth. Other minor nutrients are needed as well (Morgan, 2019).

II. New Measurement Method

One way to help keep track of all these nutrients is by testing the electrical conductivity of your soil. Electrical conductivity can tell you if you need more nutrients, or if you have too much. This will save you time and money when managing your plants. EC stands for electrical conductivity, which measures the potential for a material to conduct electricity (Rhoades & Corwin, 1990). Even though most growers are familiar with measuring the amount of feeding that they have to give in ounces per gallon, grams per liter, or any other measuring units used, EC goes a little further than this. When growing, it is important to have a good understanding of what EC is all about and its significance to the grower.

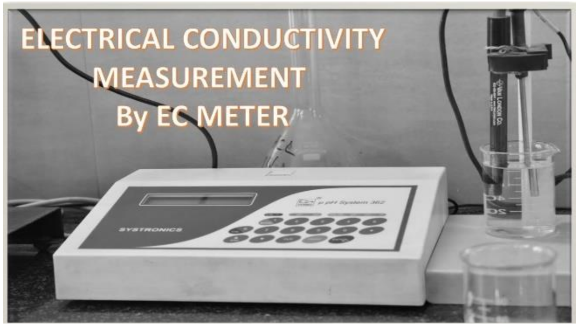


Figure 1 - EC Meter

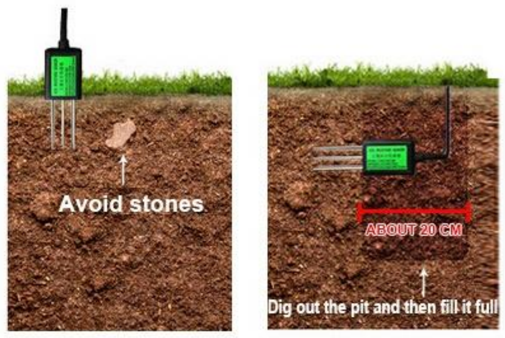
An EC meter measures the potential for an electrical current to be transported through water known as molar conductivity (electrolytic conductivity) and expressed as Siemens (S). Electrons flow from one set of electrodes to another in water across a space not because of the water molecules but because of the ions in the water. Ions transport the electrons and limit the amount of electrons that can travel the space by the number of ions available or able to transport; the higher the concentration the greater the flow (Bottraud & Rhoades, 1985). Pure water itself is a bad conductor, which is why an EC meter will read 0.0 in rainwater, reverse osmosis water or de-mineralized water. In contrast, salty seawater is a much better conductor.

III. Electrical Conductivity

Electrical conductivity is the measure of a material's ability to conduct an electrical charge, measured in Siemens per meter. An electrical current (measured in amperes) is the movement of electrons over time across a medium such as water. Put simply, EC gauges how a current moves in solution. Plants grown in a particular type of soil finding difficulties to grown again in the same soil (Visconti & de Paz, 2016). This is due to the soil texture, characteristics and its properties changes over time. Hence effecting its growth. However, these changes in the soil properties can be measured by reading its electro-conductivity, and we can determine what type of plants to plant.

2.1 Procedure for testing Electrical Conductivity

1. Prepare a 1:5 soil:water suspension by weighing 10 g air-dry soil (<2 mm) into a bottle. Add 50 mL deionised water. Mechanically shake at 15 rpm for 1 hour to dissolve soluble salts.
2. Calibrate the conductivity meter according to the manufacturer's instructions using the KCl reference solution to obtain the cell constant.
3. Rinse the cell thoroughly. Measure the electrical conductivity of the 0.01M KCl at the same temperature as the soil suspensions.
4. Rinse the conductivity cell with the soil suspension. Refill the conductivity cell without disturbing the settled soil. Record the value indicated on the conductivity meter. Rinse the cell with deionised water between samples



IV. Mathematica Calculation for Measurement

Following formulae are applied by agro-scientists to measure soil through Electrical Conductivty. If the meter is not equipped for automatic temperature compensation, then the following carry out the following calculations,

If the meter reads directly in conductivity values, then calculate EC_{25}

$$EC25\left(\frac{dS}{m}\right) = \frac{Sx1.413}{K}$$

Where:

S = Measured EC of suspension

K = Measured EC of KCl solution

If the meter reads resistance value, then calculate EC25

$$EC25\left(\frac{dS}{m}\right) = \frac{K}{Sx0.708}$$

Where:

S = Measured resistance of suspension

K = Measured resistance of KCl solution

V. Role of Salts in Irrigated Soil

Usually the irrigated land has 41.5% of our food supplies, and salts impact yields fair quauntum in those acres. It is well know that irrigation water contains salt. If those salts are potential to build up around the root zone of a crop, they injure and harm the plants, also reduces the yield, and even change soil structure causing long-term damage to the land itself (Rhoades & Corwin, 1990). Therefore, to preserve the productivity of irrigated land, it is important to understand how to manage salts.

Figure 1 - Manadator Soil Testing yeilds better result

VI. Steps on Managing Salts

Following steps are to be conducted to manage these salts not to affect the plant or soil,

- Step 1: Measure how much salt is currently in the soil
- Step 2: Determine how much salt is added through irrigation
- Step 3: Monitor continuously during irrigation to manage salts

Electrical conductivity (EC) is the key to making these measurements. Pure water does not conduct electricity, but most water, even tap water, has enough dissolved salts to be conductive. Because the concentration of salts in water directly affects its conductivity, the measurement of electrical conductivity is a very effective way of measuring salt concentrations in soil water.

5.1 Relationship between Soil, Plants and Salts

While irrigating land many tend to fertilize too heavily, perhaps unknowingly, and kill grass or other plants. While Agriculturists are not aware about this phenomenon as they are in dire need to raise the plant and soil, literateagriculturists claim that the fertilizer has "burned" the plants. But generally, it isn't the nutrients themselves that cause the damage. It's often their effect on water and the salt aligned in that water. Plants take up water, but they don't take up salts in any appreciable quantity (Morgan, 2019). When salt is added to the soil through fertilization and irrigation, it becomes concentrated there. Salt tend to cause a variety of problems for plants. For example, Na+ may reach concentrations that are toxic to plants, even though the plant isn't taking up any appreciable quantity. Salt also attracts water and makes it more difficult for plants to take up water from the soil. At the same time, there are some soils and plants which are highly sensitive compared to other to salt in the soil. Sprouts yield will be affected if soil saturation extract EC exceeds 2 dS/m, for instance, certain grains can be grown without yield reduction in soil saturation extract up to 16 dS/m. Whatsoever, high salt content will affect all plants. This has to be taken care while feeding the soil.

VII. Role of Electrical Conductivity Education

Education plays a significant role in alleviating poverty, especially in rural areas, in light of changing market demands. Education institutions should lead the way to initiate and lead in articulating a vision for the future. Education has a very powerful role to play on several levels The future of the agricultural sector is all about science, technology and education and there is no better place to propel that type of growth than through knowledge, which is created at the education institutions (García-Rodríguez et al., 2013). They have a role to educate and prepare the future entrepreneurs who are coming through the education system. Education institutions need to become even more productive in terms of generating research – around seed technologies, better planting methods, ways of analyzing soil, and understanding and mitigating the impacts of climate change because much of what is going to happen in the agricultural sector has to do with operating within a knowledge-based global economy.

6.1 Advantages of our innovation / product development / design / process towards education and community

There is a need to respond quickly enough to changing market needs in terms of skills. However, many are starting up incubators aimed at creating new technologies that can be commercialized and contribute towards industrial growth. There needs to be a greater level of investment, in terms of both technical and scientific training, as well as practical applied experiences for young people so that what they are learning can be put into a workplace environment (Hammer, 2016).

Technology is actually key to engaging youth more in agriculture. It centered on unemployment among youth and how to prepare them to create entrepreneurship opportunities in agriculture.

6.2 Advantages Commercial value in terms of marketability or profitability

As continues improvement effort, we have planned to add additional features, which is to:
Upgrade the power options to either

- Solar Power
- Rechargeable battery
- USB port charging using power bank
- Audio announcement to cater handicapped and elderly group

And if it goes well as part of commercialization, this innovation we plan to

- Sell this as product
- Sell as a service

VIII. Conclusion

This research paper is an extract of the experiment performed by young scientists Yuvika Mahaganapathy, Kailesh Saravana and Kavisha Nagarajan under the mentorship of Dr. Mahaganapathy Dass in the year 2020 (Facebook, 2020). The findings were praised by agro-stalwarts which encouraged them to draft a research paper. Therefore, this entire research has been experiemented in a fertile soil and it was proven that electrical conductivity can measure the soil's nutrients which in-turn shall make the soil more productive and healthy

IX. References

1. Bottraud, J.-C., & Rhoades, J. D. (1985). Referencing Water Content Effects on Soil Electrical Conductivity-Salinity Calibrations. Soil Science Society of America Journal, 49(6), 1579–1581. https://doi.org/10.2136/sssaj1985.03615995004900060049x
2. Facebook. (2020). Facebook. Webportal. https://www.facebook.com/TheStarOnline/photos/three-pupils-from-sjkt-taman-melawati-kualalumpur-bagged-yet-another-internation/10156875896532255/
3. García-Rodríguez, F. J., García-Rodríguez, J. L., Castilla-Gutiérrez, C., & Major, S. A. (2013). Corporate Social Responsibility of Oil Companies in Developing Countries: From Altruism to Business Strategy. Corporate Social Responsibility and Environmental Management, 20(6), 371–384. https://doi.org/10.1002/csr.1320
4. Hammer, M. (2016). What is Business Process Management ? Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-642-45100-3
5. Morgan, D. W. (2019). How to Measure Electrical Conductivity of the Soil Solution. International Journal of Agricultural Science. https://www.environmentalbiophysics.org/measure-electrical-conductivity-soil/
6. Rhoades, J. D., & Corwin, D. L. (1990). Soil Electrical Conductivity: Effects Of Soil Properties And Application To Soil Salinity Appraisal.

Communications in Soil Science and Plant Analysis, 21(11–12), 837–860. https://doi.org/10.1080/00103629009368274

7. Visconti, F., & de Paz, J. M. (2016). Electrical Conductivity Measurements in Agriculture: The Assessment of Soil Salinity. In New Trends and Developments in Metrology. InTech. https://doi.org/10.5772/62741.

Authors Profile

Yuvika Mahaganapathy
Kailesh Saravanan
Kavisha Nagarajan
Dr. Mahaganapathy Dass

1 2 3 4 SJK(T) Taman Melawati, Kuala Lumpur Malaysia

