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A Study on Water Conservation in Rhizosphere of Banana Plant Using Sensory Network

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Abstract:

The continued increase in world's population requires more food and water. Therefore development in agriculture practices to meet future food and water needs is required. It is important to know the humidity levels in the soil to increase productivity and avoid water excess use. Excess water use not only wastes water but also it harms the plant. But most farmers cannot afford the most expensive equipment to measure soil moisture. This paper focuses on an inexpensive method of measuring soil moisture content by using sensory network, by providing information on the availability of water present in rhizosphere. Sensory network may comprises of different controlling units with different types of sensors are available according to the price, precision value, size, technology etc. Analyzing the water content available in rhizosphere is an effective way to determine the condition of the soil and plant. Some plants such as banana plant get harmed by over watering. So measuring water content available in rhizosphere continuously or at regular time interval helps to know the level of moisture in rhizosphere of banana plant, with which root spoilage of banana plant may be avoided also it makes a plant more productive.

Index Terms **- Agriculture, Rhizosphere, Banana plant, Water Conservation, Sensory Network**

I. INTRODUCTION

Agriculture provides employment to more than 50% of the population of India but is still suffering from malnutrition. India is touching the sky in new fields and development, still a necessity for our livelihoods and survival, agriculture is done in the old ways. Though appreciable agricultural techniques have adopted which have showed tremendous growth in case of production and other factors. But still continuous study, awareness and research is necessary. There is a reason for this slow development of the agricultural sector. Farmers do not usually have full faith in today's automated techniques or at some parts of world they are not aware about the technology. Most farmers do aware that using controller and sensor's technology is little bit expensive but it may help the farmer to know the exact level of water supplied and nitrogen (N), phosphorus (P) and potassium (K) applied in the rhizosphere. Most automated bots tend to ignore experienced farmers and understand their land and agricultural practices thus yielding unsatisfactory results. One such application in the agricultural sector is irrigation, which can be monitored by a sensory network and automatic operation using a water supply system controller.

In addition to continuous development, irrigation in many parts of India is a manual process driven by conventional methods due to the high cost or complex operating systems for advanced irrigation. In the General System, Water is supplied equally to farm fields. Also, the user must have to manually turn on/off the pump. This often leads to excessive or insufficient water supply. Irrigation plays an important role in agriculture so accuracy play important role depending on the fields and the sensitivity of the crop. Also, this leads to a significant loss of electricity and water if not carefully considered. Therefore, clean and renewable energy sources are also distributed in the agricultural sector [1].

II. WATER CONSERVATION

The importance of water conservation in agriculture has been recognized for centuries. Agricultural water is available from rain or stream, pond, or aquifer where irrigation is done. Rainfall in humid regions is usually sufficient to meet the needs of the crop, but even in those regions, the amount of rainfall and distribution varies greatly from the middle of any given year. Water conservation, therefore, is important under such circumstances. Conversely, excess water is a problem in some cases, and water is needed to make a plant more productive.

Even with irrigation, water conservation is most important in many cases because supplies are limited or depleted. Water conservation is also important because freshwater competition is becoming increasingly important for nations, regions, and

sectors of society, including agricultural, urban, industrial, and recreational users (Unger and Howell, 1999). This is a major problem in some regions where supply is naturally limited and where the growing needs of other users are already in conflict with agriculture over available resources (Kuhn et al., 2007; Levy, 2003; Rothfeder, 2001). Water conservation is also more important than ever because of the growing amount needed to produce ever-increasing food, fibre, and gasoline [2].
Fresh water is not only a valuable source for agriculture practices but also it is most important for survival of Human race. As it is known that only 3 percent of total water on earth is fresh water. Out of this percentage also most of the percentage is locked up in polar ice caps, glaciers etc. So, conservation of fresh water is the main concern. As discussed, it is not only the duty of farmers to look after the optimum use of water, but also it is the duty of engineers also to contribute their knowledge in every possible field to avoid wastage of fresh water as much as possible.

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III. THE MOISTURE CONTENT OF WATER

The majority of water is contained in the content, such as soil (called soil moisture), rock, pottery, fruit, or wood. Water content is used in a variety of scientific and technological fields and is presented as a ratio, which can range from zero (completely dry) to the porosity value of the material used to fill the earth. It can be given in volume or by weight. Soil moisture is an important variant in regulating the exchange of water and thermal energy between the earth's surface and the atmosphere by the evaporation and respiration of plants. Soil moisture sensors measure water content in the soil. The most common method of measuring soil moisture content is a thermo gravimetric method, which requires drying in a well-known soil temperature oven at 105 ^{o}C and determining weight loss. This method is time-consuming and destructive to sample soil, which means that it cannot be used for repeated measurements in the same area [3].

IV. SENSORY NETWORK USE:

The digital integration of the virtual world is an industry that changes by integrating sensory networks. Therefore, Sensor-based decision support and automatic infrastructure control can help reduce manual intervention [4]. Also it increases the accuracy and time of operation for getting the result. In irrigation, decisions driven by digital data can allow for sustainable water use and reduce user burden [5]. Irrigation systems that include sensor network data with automatic controls can lead to powerful environmental adaptations as new data is introduced into the system via the sensor network, therefore, making system-based irrigation techniques more helpful [6]. Microcontrollers take on the responsibility of analyzing situations by the user. These microcontrollers/microprocessors collect complex real-time data from sensors and convert it into readable byte code and use this data for process operations, Raspberry pi, Atmega328P are such microcontrollers that has changed the course of technology due to its compact size and amazing processing power and performance [7, 8].

High-quality irrigation water is becoming increasingly scarce and it is becoming increasingly important to use available water. Another effective irrigation method is the use of soil moisture sensors to analyze level of moisture in rhizosphere so that adequate water can be used. Soil moisture sensors can detect when the groundwater content falls below the point defined by the farmers and this can be informed on display screen to turn the water supply on/off manually as per requirement. Excessive watering in the control areas also led to additional nutrient rewards. Therefore, soil moisture sensors are a very effective tool in analyzing both water use and nutrient leakage [9].

Continued population growth and urbanization threaten access to water for agriculture, including nursery and daycare centers. Therefore, the efficient use of water is becoming increasingly important. An effective irrigation system not only reduces water consumption but also save energy and makes a plant more productive. Most water resources used for agricultural irrigation purpose uses electric motor, so if adequate amount of water is supplied run time of motor will also reduce which save energy either electrical or mechanical. Also, better water management can reduce the incidence of root disease and can be used to control plant growth [10]. Another way to improve irrigation practices is the use of soil moisture boards to know the level of moisture in rhizosphere of plant based on the amount of water described. The purpose of this work is to measure water conservation that can be achieved using soil moisture systems.

V. RESEARCH METHEDOLOGY:

This paper focuses on low cost and is a simple method similar to most of the above methods for widespread use. One of the most widely used technologies for measuring water content is usig soil moisture sensors along with control systems [11]. One way is using capacitance based soil moisture sensors. This setting serves as a soil moisture measurement. Soil performance changes by changing the amount of water in it. Measuring water content in rhizosphere is important for agriculture which helps farmers to know the water content in rhizosphere. Farmers can not only use less water to conserve water, but they can also increase yields and plant quality by better managing soil moisture during critical periods of crop growth.

VI. RESULTS AND DISCUSSION

A 4-layer approach can be used to determine the moisture content of root system of banana plant. The roots of banana plant ranges from 1ft to 3ft underground. Each layer locates at an interval of 6 inches. Every layer of the banana plant consists of fibrous roots. Due to environmental factors, the water content in uppermost layer (called rhizome) can decrease drastically. The water moisture in at the lower level is still balanced by the ground water. The absorption of water takes place at the root tip so its important to maintain water moisture at the lowest level. Method in which array of moisture sensors may be used to monitor the

moisture level at 4 different levels as shown in figure 1,2. Figure 1 depicts the co-relation between the banana roots and the experiment. Table 1 shows the observations obtained from the experiment.

Table 1.0: Water moisture content at different level of rhizoshpere

Level (depth) (in ft)	**Water moisture content (in %)**
Level 1 --- (0.5 ft)	3 %
Level 2 --- (1 ft)	20 %
Level 3 --- (1.5 ft)	54 %
Level 4 --- (2 ft)	78 %

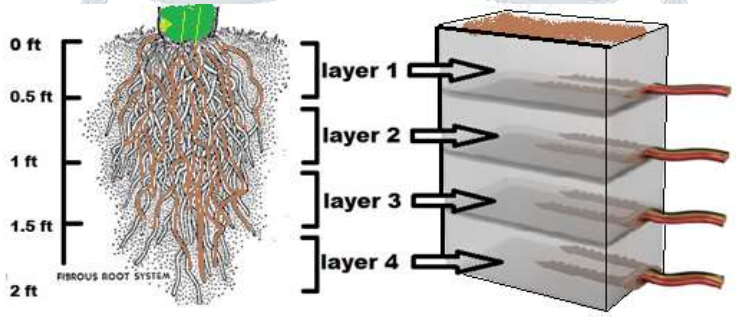

Fig: 1: Different sensors used in Rhizosphere of Banana plant

Fig. 2: Actual image of implementation of different sensor in Rhizosphere

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