SOLAR BASED IRRIGATION SYSTEM AND GROWTH ENHANCED SURVEY

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Abstract — India is an agricultural country. Tons of new technologies are emerging in the field of agriculture to raise its productivity. A solar based irrigation system and itsfeasibility in growth enhancement of plants is discussed. The burden of the farmer gets reduced by providing an automated irrigation scheme. The time of water consumption and the effort taken by the farmer gets reduced. A photovoltaic system with a storage battery, back up for two days, is used to provide the electric power for the control and monitoring operations. The devices used for controlling and monitoring operations are controller, solenoid valve, timer circuit, water level detector, moisture level sensor and other electronic devices. Drip irrigation is used here because of its advantages over the conventional methods of irrigation. Using drip irrigation, the wastage of water is very less and also all the plants coming under the area of drip irrigation will get the correct and required amount of water very effectively. It is proved that red and blue lights from sun are responsible for the growth of plants. An artificial lighting system (red and blue lights) using LED strips is provided for the plants during night and this is will increase the photosynthesis of the plants during the night time. It has also been proved that the rate of growth of plants becomes faster by giving electricity to the stems of the plants. A DC supply of 4V and 5V having 5µA current is provided for a duration of 5 minutes. Polarity of supply also affects the growth of plants.

Keywords: Smart Drip Irrigation, Artificial Light Survey, Electricity Plants, Solar PV system

I. INTRODUCTION

In India more than half of the population is dependent on agriculture sector and also as the population is increasing the demand for food is also increasing. In agriculture irrigation is very time consuming and requires a great effort. By using advanced and smart technologies these difficulties can be reduced and also growth of crops can be enhanced. An approach to minimize the human interface for the agriculture sector, which provides comfort to the farmer in monitoring and performing automatic irrigation operation. A research is shown down on how to increase the productivity using electricity and lighting system.

In India about 50 per cent income is generated in the manufacturing sector and nearly 70 per cent of exports are from agricultural sector. But now the agricultural sector is falling backward due to the difficulties in monitoring and maintaining of crops. One of the main difficulty is providing water and fertilizer to the crop in a regular interval. By giving proper care to crops healthy food can be cultivated, which decreases the rise of diseases that arise from food.

II. SOLAR BASED SMART IRRIGATION

The power required for the field is given by the photovoltaic system, with a battery upto 2 days of backup. Power required for controlling and monitoring operations are taken from the same solar PV system. The devices used for controlling and monitoring are microcontroller, solenoid valve, timer circuit, water level detector, moisture level sensor and other electronic devices.

Drip irrigation is one of the common and efficient method of irrigation. The key speciality of this technique is that the water is poured directly to the root tips of the plant using drip irrigation system and only a single drop of water is poured at a time. Daily, the water is poured to each and every plant for 30 min after checking the moisture level of soil in the same manner. Automatic irrigation system is achieved by using arduino uno microcontroller. There are moisture level sensors for getting the moisture level of the soil. The microcontroller works on the basis of a 24 hour timer for the operation of irrigation, for eg, it will be activated only for 12 hours, and watering of plants will be done only on that period of time. At the operating time of microcontroller, if the value of moisture level goes very low beyond a certain set point then the signal from moisture sensor will be given to the microcontroller and then microcontroller will give the signal to open the solenoid valve for a period of time till the entire area gets watered. Similarly if the value of moisture content is very high beyond a certain set point then arduino will give the signal to solenoid valve to remain closed.

A tank is used to store the water for the irrigation purposes for a period of one week. For eg, if the water required for irrigation for a week is 200 litre, then there are tanks available for 100 litres, 200 litres etc and more. There is a water level indicator inserted in the tank, this will help in giving an indication signal to the user if the water level becomes very low, for this purpose the gsm module of the arduino plays an important role. There is unique IP address that will be there for the gsm module. In the arduino we can write program through IDE software for getting the status of moisture level and also to know the water level of the tank. The user can access these status using smartphone or laptop through the IP address[1][2].

III. EFFECT OF LIGHT ON PLANTS

The experiments with artificial lighting of vegetable seedling using different types of lamps were carried out. The results obtained indicate that varying lighting systems affected plants growth and quality of the vegetable seedlings. The use of LEDs allowed to obtain very good plant habit, especially in the first stage of cultivation.

The simplest LED fixtures contain primarily red diodes (620-700 nm) and blue ones (450-495 nm), the main waves bands of the light spectrum for enhancing process of photosynthesis, transport of assimilates and the formation of chlorophyll in leaves. Plants cultivated only with blue and red light requires some other wavelengths as green or far red to improve plant growth or positively influence metabolic effect. Study of lighting tomato transplants with LED lamps showed that supplemental lighting increased the intensity of leaf gas exchange, increased chlorophyll content and intense plant growth**.**

Red and blue light has been highly concerned about the influence on growth of crops. Most of the vegetables in the combination of red and blue light than under monochromatic red or blue light better growth, and more easier to control the spectral components compared with the traditional light source energy. LED light source has many advantages, such as high efficiency, no pollution, energy saving, environmental protection, long operating life, firm structure, adjustable spectrum, etc[6][7].

IV. EFFECT OF ELECTRICITY ON PLANTS

Results of conducted experiments:

1. Sideway reported, lettuce seeds sown on filter paper and subjected to a DC supply were affected by electrostatic fields. He obtained a result, that when a positive field was applied, plant development was inhibited. He also pointed that the nature of plant response is due to electrostatic field and not by the presence of electric field.

2. Oleshko and Lutkova found after treating the cherry seeds with a current density of 0.57 mA/cm^2. He observed an acceleration of germination.

3. Stanko treated the wheat seeds with a DC voltage for a period of 30 seconds. He reported that there was an acceleration in the movement of nitrogen containing substances into the roots and shoots.

4. Shatilov and Trifonova treated barley seeds with a DC field of currents $8*10^{-8}$, $15*10^{-9}$ A/cm^2 for 5 to 30 min. Germination rate was increased and nitrite absorption was increased. Nitrates were absorbed in a higher rate when the seeds are provided with a current density of $8*10^{-7}$ A/cm^2 for 5 minutes. It was further reported that the glucose content in the seeds were doubled with current densities of $8*10^{-8}$ and $15*10^{-7}$ A/cm^2 , applied for 5 min duration.

5. Lund passed currents through the roots of an onion. He made the root tip negative i.e current flows downwards and only a slight growth is observed. However, when the root tip is made positive i.e current flows upward, growth was completely inhibited. He used 1.57µA for the experiment. He also observed that for a current greater than 1.57µA (passed for a period of 50 to 90 min), injury or death occurred [8][9][10][11].

V. EXPERIMENTAL SETUP

1.LIGHTING SYSTEM

Light from the sun is an important factor for the growth of plants. By researches it had been proved that, from sun's light, red and blue light are the main lights that are responsible for the growth of plants. Providing artificial light increases the photosynthesis of the plants during the night time also. LEDs are used because of its advantages from other light sources. Other light sources like fluorescent lights, sodium vapor lamps are not used here because they produce more heat than what is required for the plants and also red and blue combinations are not available in all the other types of sources, also when compared efficiency is very less when we use other light sources than led strips.

LED strip of 5m length having wavelength 650-630 nm and 450-460 nm, 12V DC is used here. Also providing these lights at a distance of 50 cm to 100 cm above ground. The ratio of red and blue used is 1:1. During day time the energy from solar is used and at night artificial lighting system is used.

2.ELECTRIC SYSTEM

The plants are treated with a DC supply of 4V and 5V having 5µA current for a duration of 5 minutes. There are 4 beds for conducting the experiment.

BED 1: normal growth.

BED 2: light only.

BED 3: light and electric field.

BED 4: electric field only.

Half of the plants in BED 3 and BED 4 will be supplied with 4V and another half with 5V DC supply. The polarity of apex is also considered in our project. In the above mentioned beds, we made the apex positive for some plants and others with apex negative i.e, for a set of plants the current will flow upwards and for another set the will flow downwards. The supply will be provided to the specified plants, two hours before irrigation. With the help of timer, the supply will be provided automatically.

2.1 PRELIMINARY TEST CONDUCTED

A tomato plant was treated with a test supply of 5V before planting on the ground. From the test, it was concluded that the 5V supply will not damage the plants that have been selected for the cultivation Fig 2.1.1.

Fig 2.1.1 Preliminary Test.

VI. CONCLUSION

With the help of solar based smart irrigation system, the farmer can reduce his effort on the field and increase the productivity. The two feasibility study shows that it increases the growth of the plant than normal growth. If this is properly implemented on field, the farmer gets the yield or output in short span of time.

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