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RESEARCH ARTICLE

WSN CONTROLLED INSECTS MONITORING: IDENTIFICATION OF LOCATION OF WHITE GRUB

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ABSTRACT

Soil-dwelling pest are often neglected for monitoring. In India, every year a large-scale of agricultural crops are destroyed by these soil-dwelling pests and White Grubs have most significant damage among them. White grubs are the larvae of scarab beetle that feeds on the rootlets of the plants. It is considered as the national importance pest of India. Several technologies are being adapted from the past few years in order to control White Grubs. Apparently, they serve as either slow methods or costly. A different framework is developed to sort out the problems faced by the earlier technologies. The use of Smart Greenhouse technology has aided in finding the location of grubs' larvae efficiently. The capability of EPNs nematode to locate White Grubs is taken as the fundamental methodology to develop a system for tracing the location of White Grubs.The proposed method is mainly invented to find the second instar and third instar of grubs as they are the most damaging stages in the grub lifecycle. MQ-135 is used in the developed hardware to detect the CO_2 bursts emerged from the grubs. In addition to this, the output of the hardware is simulated with a MATLAB program to read the exact variance in the parameters of the system.

INTRODUCTION

A large proportion of India's population is strictly dependent on agriculture. Therefore, agriculture is considered as the main occupation of our nation. Apparently, the mentioned occupation is being deteriorated by several factors. One of the most significant factors to harm the agriculture of our nation is the pests. Agricultural insects can be categorized into two types i.e.; beneficial insects and damaging insects. However, it is seen that the insects in agriculture field are collaboratively famous for their damaging nature rather the beneficiary nature. Such is the kind of damaging pest is White Grub. It resides in soil and cause a huge damage to the fields' plantations. It is considered as the pest of national importance. These are present in all the corners of our country. The tremendous destruction caused by the grubs are quite dreadful.

Figure 1.1 Ginger roots damaged by grubs
[Photo taken in R.A.R.I]

Every year many experiments are carried out to reduce the damage caused by scarab beetles. Seed treatment technologies, soil treatment technology as well as the standing crop treatment procedure re some of the manual methodology that have been take in use in order to dwindle the grubs' population. Indeed, it is noticed that the manual methods serve as a slow process. In addition to this, they also tends to destroy only the scarab beetles and first instar which are recognized to produce less damage. WSN technology can be used to control White Grubs efficiently. WSN technique is trending in all sectors; however it has already attained its popularity-peak in agriculture sector [1]. Its easy installation and low-cost has made it to utilize in agricultural fields. Some of the sectors of agronomy that are already using WSN technology are smart greenhouse monitoring, livestock monitoring, woods monitoring and field monitoring.[2] In the recent researches, WSN has also intervened in the field of insect monitoring. A lot of sensors were developed to identify the movements, sounds and many more features exhibited by the insects.

Figure1.2 Maize root destroyed by White Grubs
[Photo taken in R.A.R.I]

In this paper, an easy method of locating White Grubs is proffered by using Smart greenhouse technology. CO_2 Sensors, moisture sensor, pH sensor and other components

have constituted a system to locate the White Grubs Larvae in fields.

Background Study

Initially, acoustic technologies for monitoring of white grub were used [3]. The sensors have recorded the activity pattern of white grubs in different areas. Three clear and definite sounds were recorded which fall under different ranges of frequency, intensity and temporal patterns. The experiment conducted mentioned in this paper has wrapped up on the fact that the sound emanated by grubs are dependent on temperature. The second instar redounded to produce sound for about 3 min while the temperature of the soil was less than 13°C whereas it was 15 min for the temperature above than 13°C. Different acoustic technologies were taken in use with the help ofAccelerometer and microphone [4]. In spite of high rate of attenuation, few distinct spectral templates were seized for investigation. Many factors were noticed as the disadvantages of acoustic monitoring. Such as presence of eminent chunk of noise, digging and scraping sounds found in recorded audio etc. A pre-visible detection of grub was purported in order to lower the grubs' damage [5]. The injury caused to the plants due to White Grubs' damage has led to change of light intensity reflected through them. Thus, a multi-band/index combination and reflectance data were reported that aided in the detection process.

EPNs being the natural enemy of White Grub [6]. CO_2 is considered as an important cue to attract EPNs. The other chemical released from the plants were found to be less effective to pull EPNs in comparison with CO_2. EPNs gravitated towards synergic compound of CO_2 rather non-CO_2 compounds. This has consummated at the fact that CO_2 ameliorate to attract EPNs.

A system is developed with the help of soil moisture sensor, soil pH sensor, atmospheric and leaf wetness sensor [7]. In order to get a massive yield, the fields need to get proper irrigated and fertilize. The sensors used in this system help to attain these tasks. Micaz mote with MDA 300 was taken for the development of the whole system. Greenhouses are built for growing any type of plants anywhere irrespective of the climate. An automated system becomes quite difficult to operate when the parameters are inter-related like temperature and humidity [8]. As the temperature increases, humidity decreases. Wireless sensor network aids in sorting out this problem. With the help of several sensors, a framework is developed. The values recorded by the sensors are passed to the co-ordinator and thus the microcontroller drives the actuators accordingly.

PROPOSED METHODOLOGY

Several manual methods are taken in use to reduce the population of White Grubs. Yet they are unable to manage the grubs' population copiously. The hiding trait of grubs beneath the soil layers has persuaded a lot of technologies to failure. Pheromone technology has helped in trapping the White Grubs to a great extent. The chemical secretion of White Grubs has an alternative use i.e. making a trap for White Grubs and for killing same [8]. The pheromone technology has reduced the area boundary for insecticides. Nonetheless, this former technology is quite tiresome and needs lot of human hands.

A wholesome method to kill White Grubs by EPNs is being in practice in recent years [9]. The most attractive cue for them towards White Grubs is the tendency of releasing CO_2 [10]. During the egress from one tree to another with a view to fodder on them, White Grubs release carbon dioxide in form of burst instead releasing continuously. The concept of finding the White Grubs location by EPNs is the fundamental notion of our system.

In our system, we have used smart Greenhouse monitoring technology to locate White Grubs. Few beneficial features also provided by this system are specific monitoring of second instar and third instar Grubs, knowledge of soil pH and soil moisture throughout the year. The presented hardware system is capable of withstanding any kind of natural calamities. Moreover, it can be deployed in agricultural fields easily and at very cheap rate. An ATMega16 controller is used in the system for the main processing. It is programmed with simple basic hardware language i.e. BASCOM. The peripheral components of the system are CO_2 Sensor, Soil moisture sensor, Soil pH sensor, GPS, LCD, Serial to USB converter, and GSM. The block diagram of the system is given below:-

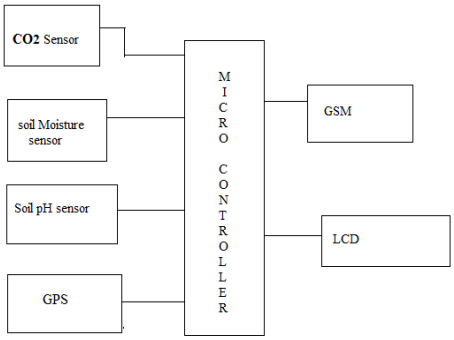

Figure 3.1 Block diagram of the system

The main components that are used in our system are MQ-135, SIM 800, L80 GPS, and soil moisture & pH sensor. The White Grubs are believed to appear in Monsoon season. Hence, it is automatically known that the soil pH and soil moisture will change eventually. After the controller is programmed, the system can be installed into the field. The figure below shows such situation:-

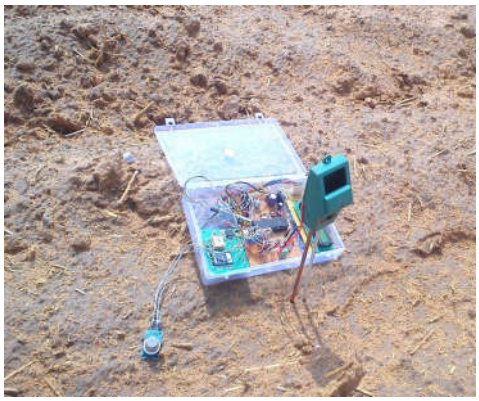

Figure 3.2 System installed in the field

This system will remain static as the power supply will be given at fixed place and the soil moisture/pH sensor will be buried into the soil. The MQ-135 sensor which has been used in our system needs calibration. As the sensor i.e. MQ-135

senses the CO_2 more than the actual concentration in the soil, the system is said to have detected the White Grub. A message indicating the detection of White Grub will be displayed in LCD.

Figure 3.3 Values retrieved by the sensors and Message indication about the detection of White Grub displayed in LCD

This system is made with a purpose to aid farmers in agriculture. Hence, there is an essential requirement that the insects' status should reach the farmers. In context with this concept, we have used L80 GPS and SIM 800 GSM module to deliver the information to farmers. Apparently, in our system, a mobile number is connected to the GSM module. As soon as the hardware detects the insects, the GPS will record its present location. The information about the detection of the soil-dwelling pest and its location is sent to the former mobile network. The figure below tell the exact position of the insect.

Figure 3.4 Location of pest sent to mobile

The message which is sent to the mobile number is in terms of latitude and longitude. The latitude and longitude are easily converted to the human readable position by using google maps.

RESULT

The presented system needs an analysis of the output. The values retrieved from the sensors varies a lot during the whole processing. The three parameters that have been measured in this system shows a variance in their output. The variance can be read with the help of graph. MATLAB is used to plot the graph.

The graph for the CO2 depicts the maximum value detected by the sensor i.e. the concentration of CO_2 burst. Similarly, the changes in value of moisture and pH can be seen.

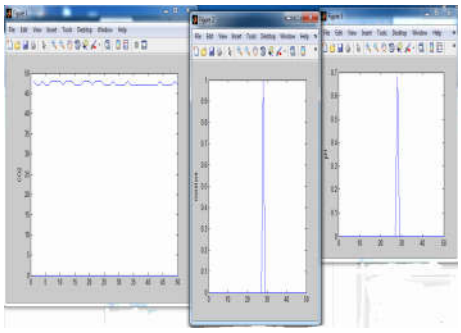

Figure 4.1 Graph of CO_2, moisture and pH values

CONCLUSION

A very cheap and efficient method is presented in this paper. Some of the main advantages proffered by this technology are:-

- ✓ Monitoring White Grubs using the greenhouse monitoring technology.
- ✓ Sensor that can detect White Grubs' pheromone can be fabricated too in these systems which can more accurate result.
- ✓ A network of this type of system in the field can also aid in detecting other harmful pest
- ✓ Fetching the soil status relentlessly.

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