ENGINEERING AND TECHNOLOGY IN INDIA
Volume 4 | Issue 2 | Oct., 2013 | 24-29

RESEARCH ARTICLE

RF radiation effects on green house vegetation and protection methodologies using integrated EM protectors

A. BENO, K. EMINA DEVI, N. NAZEERA BANU, K. SASI AND R.O. NISHANTHI

ABSTRACT : This paper presents the design of an intelligent embedded system to analyze the natural growth and yield from agricultural plantations. The system is used to analyze the effect of R.F radiation on plantations with and without radiation. The microwave radiation sources on plantations using R.F Microwave sources in C-Band (4-6GHz) and X-Band (8-12GHz) is applied to study the effects. The system displays the adverse effects of radiation on growth of plantations and products, using the intelligent embedded monitoring system. The paper also presents a novel concept to construct a model plantation with R.F radiation blocking structures to minimize the radiation effects into the artificially made Green House Plantations. The design helps to produce agricultural products without the influence of radiation effects.

KEY WORDS : Green house vegetation, Microwave antenna, Embedded, Radiations

Article Chronicle : Received : 19.03.2013**; Revised :** 02.07.2013**; Accepted :** 06.09.2013

How to cite this Article : Beno, A., Devi, K. Emina, Banu, N. Nazeera, Sasi, K. and Nishanthi, R.O. (2013). RF radiation effects on green house vegetation and protection methodologies using integrated EM protectors. *Engg. & Tech. in India,* **4** (2) : 24-29.

INTRODUCTION

The abrupt development in the field of communication has occupied almost all bands of RF frequency bands (IEEE, 1999). The entire atmosphere is filled with electromagnetic fields radiated from the antennas used for different applications. The influence of the electromagnetic field pollution has created many effects on the human community directly and indirectly with the radiated EM power into our surroundings. The effects of the wireless communication on the agriculture productivity and the presence of active EM fields on the products consumed by humans are considered (Guy, 1987). The global warming and missing periodical rainfall have caused big damage to the members associated with agriculture society. The productivity of the agricultural lands has reduced considerably due to unwanted exposure to radiation. The increasing number of cell phone towers and other communication support transportations have much effect on the productivity.

MEMBERS OF RESEARCH FORUM

Address for correspondence :
A. BENO, Department of Electrical and Computer Engineering, Dr. Sivanthi Aditanar College of Engineering, TIRUCHENDUR (T.N.) INDIA
Email: beno_csi@yahoo.com

Coopted Authors :
K. EMINA DEVI, N. NAZEERA BANU, K. SASI AND R.O. NISHANTHI,
Department of Electrical and Computer Engineering, Dr. Sivanthi Aditanar College of Engineering, TIRUCHENDUR (T.N.) INDIA
Email: sasiece45@gmail.com

System architecture :

The system comprises of a RF unit consisting of microwave generator and an embedded system. Agriculture plays a key role in the life cycle completion. The productivity decides the stability of a country and food reserve ensures the safety limit. Along with the productivity, the quality of the products rate the country in the world market with its export capability. The development in technology has paved way for modern cultivation systems with fertilizers improving the productivity. In the present situation the seasonal changes has affected the rainfall and directly reduced the production cycle. The effect of global warming also has a greater impact on the agriculture production. Apart from these natural variations and human made changes, the implementation of wireless technology has also created a worldwide impact on the production. The radiation emitted from a system has adverse effects on the human beings and cultivation. The human era is looking forward for improving the cultivation with advanced technologies. Due to improved construction sites and industries the agricultural lands are considerably reduced in area. This is compensated with roof top gardening and green house vegetation systems.

This paper presents a novel work demonstrating the radiation effect reduction on modern cultivation and green house vegetations by implementing integrated structures that protect it from intensified radiation effects. A low level radiation effect is applied on vegetations to study the changes. The system is designed to monitor the R.F frequency effect on the agricultural products. The R.F source (Klystron) is used to generate frequency in X-Band (8-12GHz) and VCO for generating C-Band frequency (4- 6GHz). The R.F signal is allowed to radiate through a pyramidal horn antenna for X-Band and Microstrip Antenna for C-Band. The R.F signal radiated from the source is allowed to fall in the test area where the vegetation is kept for observation.

The system develops a central module with monitoring units for temperature, humidity, and time to monitor the hours of exposed radiation using an embedded controller (Stipanicev and Marasovic, 2003). The system design implements a new methodology using an integrated special unit to increase the natural productivity of the green house vegetation preventing it from radiation effects and artificial pesticides. This system helps to protect our nature and the natural vegetation for the decades to come. The standard condition before the R.F exposure is observed and data from the test site is stored for comparative study.

Test sample characteristics :

Sprouts are used as a test sample. Sprouts grow in heat ranges of 7–24^{0}C (45–75^{0}F), with highest yields at 15–18^{0}C (59–64^{0}F). Fields are ready for harvest 90 to 180 days after planting. The edible sprouts grow like buds in helical patterns along the side of long, thick stalks of about 60 to 120 cm (24 to 47 in) in height, maturing over several weeks from the lower to the upper part of the stalk. The harvested, sprouts last three to five weeks under ideal near-freezing conditions before wilting and discolouring, and about half as long at refrigerator temperature.

Test area charactersitics :

Red soils (Fig. A) are used to cultivate the sprout plant, because red soil has more minerals compare to other types of soils. Water holding and supplying capacities are important soil physical properties and also the basis of water saving techniques in agriculture. Red soil is red because of the presence of a particular chemical compound present in them. Red soils generally formed due to decomposition of granites and gneisses and rocks rich in iron and magnesium bearing minerals. The principal crops are rice, maize, groundnut, barley, oats, etc (Simms and Yanful, 2001).

Fig. A: Red soil

The test area is categorized into three different categories for the analysis.

- Open area test.
- Under radiation test.
- Radiation protection test.

EXPERIMENTAL PROCEDURE

System functionality :

Transmission section :

The transmission section comprised of two types of sources Klystron and VCO. The reflex klystron was used as the microwave source operated by the principles of velocity and current modulation. This source was used to generate a frequency band of 8-12GHz with a center frequency of operation 9.8GHz. The system can be used to operate in between the available bands of frequencies. The voltage controlled oscillator based microwave source for C-Band can generate frequencies between 4GHz – 6GHz tunable over the entire band of operation. The transmission unit is terminated with an antenna to radiate the microwave signals generated on to the fields with a maximum generated power of 20mW. The preferred antennas used for radiating the signals are Pyramidal Horn antenna, Parabolic Dish Antenna and Microstrip Patch Antenna.

Embedded system :

The embedded system comprised of a PIC controller, used to monitor the cultivation area's information with environmental temperature, soil wet condition and humidity level of the plant. The environmental status around the test site was monitored using this unit. The system comprises of a controller board connected with the sensors for monitoring the temperature and humidity. The internal clock of the controller unit was used to programme the system to monitor critical changes in the environment and to store the information for analysis. The observation of the system in the test site with environmental temperature is shown in Fig. B.

Fig. B : Plant environmental temperature by using embedded controller unit

Green house vegetation :

A greenhouse (also called a glasshouse) is a building in which plants are grown. These structures range in size from small sheds to industrial-sized buildings. A greenhouse is a structural building with different types of covering materials, such as a glass or plastic roof and frequently glass or plastic walls; it gets heated up because oincoming visible solar radiation (for which the glass is transparent) from the sun is absorbed by plants, soil, and other things inside the building. Air warmed by the heat from hot interior surfaces is retained in the building by the roof and wall (Tik *et al.*,2000). Greenhouses are often used for growing flowers, vegetables, fruits, and transplants. Special greenhouse varieties of certain crops, such as tomatoes, are generally used for commercial production.

System block diagram :

The system block diagram used for the testing in the considered environments of open area space, exposure to radiation and with integral radiation protection system is given in Fig. C, D and E.

A constant low power RF microwave source was used to radiate the EM Signals on the test site. The sensor signals are sent to an embedded unit (PIC Controller) which stores the data received. The received data from the sensors are transmitted to a central server through a Transceiver GSM Communication module. The transmitted data were received using a Transceiver GSM module in the central server and

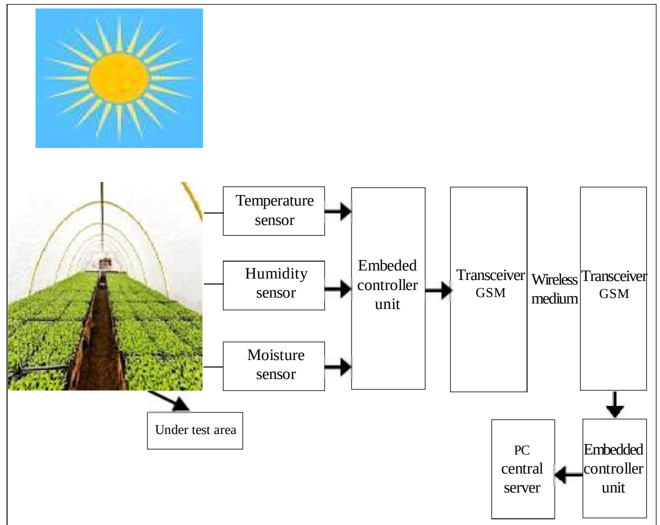

Fig. C : Area under test1- Effect of free space RF (EM) radiation on agriculture land

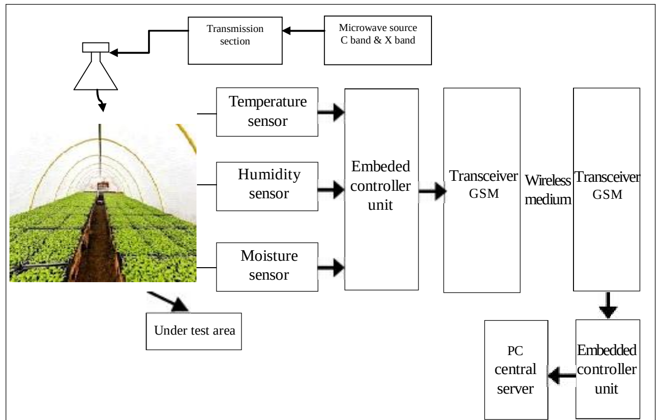

Fig. D : Test area 2- Effect of RF (EM) radiation on influenced agriculture land

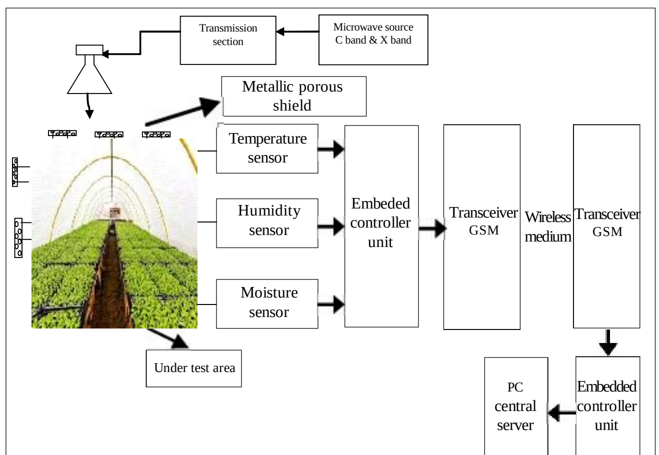

Fig. E : Test area 3- Effect of intelligent protection shield from RF (EM) radiation on influenced agriculture land

given through an embedded unit to the P.C for storage and analysis. The embedded unit was programmed to monitor the number of hours radiation applied, the temperature during operation of the test site, the moisture contents, humidity value in a continuous manner.

The embedded unit acts as an intelligent eye to monitor the characteristics and parameter change that occur in the surrounding environment. Data collected in the intelligent circuit were compared with that in the database and the software program loaded in the system will take appropriate decision. This system will energize the source in a periodical manner and collect data, transmit/receive it, store and process to understand, limit and introduce a new concept of Radiation Protected Agriculture farms to keep our younger generation free from harmful diseases like Cancer .The yield from the plantation is also subjected to chemical testing to understand the effect of radiation on it and also know the radiation activity on the consumer end.

Experimental analysis :

The basic microwave test bench was used to generate the microwave signals in the range of 8GHz to 12GHz of the X-Band with klystron source and 4GHz to 6GHz of C –Band with a Voltage Controlled Oscillator source. The microwave signals were allowed to radiate into the free space using the horn antenna, parabolic dish antenna and microstrip antenna.

The experimental arrangement consisting of the sources and antenna units is shown in the Fig. The samples were evenly planted on the test bed filled with red soil in a plastic baggage with holes. Three identical bags were filled with same samples of red soil and seeded with sample seeds from same group in the same time. The samples were kept in the test sites considered for the growth analysis. The samples were monitored for the initial growth time for one week period. The daily monitoring on the growth of the sample was observed critically with the embedded units.

The radiation of signals on the test area arrangement is shown in Fig. F where the antenna is facing the test area. The protection module is a specified unit created with a metallic wire mesh placed in front of the radiating antenna structure as given in Fig. G. The perfect conductor of the metallic porous shield was used in Radiation Protection Test as shown in the Fig. H. The basic principle of the Electromagnetic signal is that when it is allowed to fall on a perfect conductor the field gets reflected back. The structure is made porous in nature close spacing between them. This will enable the plant to get the air flow as well as water sprays to enter into the plantation area. The behavior of the EM radiation on metal sheet was used to design an intelligent structure arranged in a periodic form around the test area to reduce and block EM radiation on the plantation. The power from the klystron power amplifiers is adjustable from 2mW to 20 kW.

Fig. F: Open area test

Fig. G: Under radiation test

Fig. H: Radiation prodection test using porous shield

The effect of EM radiation was observed and compared for analyzing the effects on the growth of the plant and productivity of it. The observation of the system is tabulated in Table 1.

EXPERIMENTAL FINDINGS AND ANALYSIS

The test sample of sprout was chosen because sprout was faster in growth compared to the other type of plants. The test was carried out for a period of one week, with the open area test, exposed radiation test and radiation protection test. The radiated power of 20mW was applied in the under radiation test and radiation protection test. The detailed observation on the growth of the plant was tabulated as in Table 1. The first day had no growth in open area test, under radiation test and radiation protection test. 2nd day morning open area test and radiation protection test had the same growth level of .2cm but, under radiation test there was no growth. The 3rd day evening open area test and radiation test had the same level of growth that is 6.5cm as shown in Fig. 1 and 2 . But, under radiation test its growth level was 1.5cm as represented in Fig. 3. Seventy six per cent (76%) of the growth was affected by applying a very small amount of radiation in it.

The comparative growth in the end of the week resulted with a maximum height of 18.24cm for open area test, 2.4cm

Fig. 2: Under radiation test growth measurement

Fig. 1: Open area test growth measurement

Fig. 3: Radiation protection test growth measurement

Table 1: Growth monitoring of plantation

Sr. No.	Parameters	Open area free EM radiation environment	Exposed to EM radiation from C-Band	Under intelligent RF protector system design
1.	Seeded plant	Sprout	Sprout	Sprout
2.	Seeded date	21/1/2013	21/1/2013	21/1/2013
3.	Radiated power	Null	20mW	20mW
4.	1st day growth	Null	Null	Null
5.	2nd day morning growth	.2 cm	Null	.2 cm
6.	2nd day evening growth	.6 cm	Null	.6cm
7.	3nd day morning growth	4 cm	1.2 cm	4 cm
8.	3nd day evening growth	6.5 cm	1.5cm	6.5 cm

in exposed radiation environment and 18.24cm in the protected environment.The growth of the open area and protected environment nearly had the same growth of 18.24cm. This clearly shows that the exposed radiation suffers from growth rate that proves that radiation has affected the plant.The remaining day of growth is tabulated as represented in Table 1.

$$\text{Percentage of the growth in under radiation test} = \frac{\text{Open area test growth}}{\text{under radiation test growth}} \times 100$$

The test sample was maintained in the lab environmental temperature. The test sample environmental temperature was monitored by using embedded system. As shown in Fig. 2. the test sample environmental temperature was accessed by using GSM Transceiver module. The embedded controller was programmed to be set for the specific environmental temperature (20^0C-30^0C). If abrupt change in temperature occurred it will be recorded and transmitted through GSM Transceiver module.

Conclusion :

The sprout plant has been analyzed in one week. During analysis the plant experiences a very small amount of radiation affects in the growth of the plant. In a very minimum level of radiation itself the growth has affected 76 per cent. This also shows that will the production time gets delayed and quantity and quality of the product too has the possibility to get affected by the radiation. The integrated protection module here proved that it can prevent the vegetation from the harmful radiation and manage to have a improved quantity and quality of the production. This system implementation was used to get the products in pure form and the system will be used to avoid diseases possibly been caused by the radiation effects. This system entirely used to have a radiation free environment for green house vegetation.

Acknowledgement :

We thank our Institution and Management of Dr.Sivanthi Aditanar College of Engineering for the facilities and support rendered to us in all aspects to complete this project.

REFERENCES

Gonda, L. and Cugnasca, C.E. (2006). A proposal of greenhouse control using wireless sensor networks," in Proc. 4th World Congr. Conf. Comput. Agric. Nat. Resour., Orlando, FL, Jul. 24–26.

Guy, A.W. (1987). Dosimetry assessment with exposure to non-ionising radiation VLF to Microwave. *Health Physics,***53** (6): 569-584.

IEEE (1999). Standard for safety levels with respect to human exposure to radiofrequency electromagnetic fields; IEEE C95.1–1999; IEEE New York,USA. (IEEE Std C95.1–1999 Copyright ©1999 IEEE All rights reserved).

Leong Boon Tik, Chan Toong Khuan and Palaniappan, Sellappan (2009). Monitoring of an Aeroponic Greenhouse with a Sensor Network. *Internat. J. Computer Sci.& Network Security,* **9** (3) : 240-246.

Simms, P.H. and Yanful, E.K. (2001). Measurement and estimation of pore shrinkage and pore distribution in a clayey till during soil-water characteristic curve tests. *Can Geot. J.,***38**(4): 741-754.

Stipanicev, D. and Marasovic, J. (2003). Network embedded greenhouse monitoring and control?, Proceedings of 2003 IEEE Conference on Control Applications, Vol.**2**, June, pp. 1350-1355.

4th Year
★★★★★ of Excellence ★★★★★