Available online at www.elixirpublishers.com (Elixir International Journal)

Agriculture

Elixir Agriculture 146 (2020) 54746-54748

ISSN: 2229-712X

Analysis of the Challenges Faced in Regulation of Soil Moisture Content in Greenhouse in Wareng Sub County Uasin Gishu County.

Joseph Kipkemoi Sang
Jomo Kenyatta University of Agriculture Technology

ARTICLE INFO

Article history:
Received: 3 February 2020;
Received in revised form:
8 August 2020;
Accepted: 8 September 2020;

Keywords
Green House,
Soil Moisture.

ABSTRACT

Greenhouse farming in Kenya is becoming a lucrative investment as well as a means of improving food production in marginal environments. The Greenhouse is intended to regulate external conditions including soil moisture content suitable to different types of crops. Many farmers use timers to control irrigation, but timers do not account to day to day changes in plant use. The aim of this study was to analyze the challenges faced in regulation of soil moisture content in greenhouses; The study was guided by Mamdani Fuzzy Logic Theory that uses Nested "IF THEN RULES". Preliminary data was collected through Observation and Interview schedules. The population of the study comprises five greenhouse farmers and four field officers. Experimental Research Methodology was applied. The study found out that most small scale farmers had a lot of difficulties in determining and controlling soil moisture content. Apart from having a person on site at the right time to control the turning on and off of the water taps, they also mention the following as being the prevalent challenges: Lack of appropriate equipment to measure, monitor and regulate the soil moisture content, inability to determine the correct or the optimum moisture level for a particular crop, inability to determine water holding capacity of a specific type of soil in the greenhouse for a particular crop, inability to measure the nutrient concentration at a given soil moisture content and its uptake by the crop, Source of power to the Greenhouse and Lack of enough funds to buy the equipment.

Introduction

Food has become a major issue which needs to be addressed for a nation to be stable economically, socially and politically. The most cost effective means to the achievement of optimum productivity in this sector has been over time considered to be achievable through the construction and management of Greenhouse. The difficulties in controlling the natural climatic conditions in which crops are grown is inevitable and there is need to invest in the creation of artificial micro climatic conditions that favor the cultivation of horticultural crops which are vulnerable to the extreme climatic and weather conditions. The present day microcomputers or personal computers are fairly versatile and can be interfaced to an experimental set up, using numerous sensors for high speed and large data storage (Chaudhry *et al.*, 2004).

The year 2011 was a particularly difficult period for Kenyans (Oparanya, 2012). After steady economic recovery in 2010 which saw the GDP growth reach 5.6%, the year 2011 began with a severe drought that affected most Kenyans whose livelihoods are dependent on agriculture and livestock. The greatest adversity that faced the country in 2011 was food shortage and famine that affected 2.4 million Kenyans, a problem that can be traced to global climate change (Oparanya, 2012).

During the last couple of centuries, the implementation of fertilizers and farming tools has increased the crop yield and thereby resulted in today's mechanized farming culture. To realize the optimum crop yield, water is a major carrier component of various nutrients in the plant growth. In recent years, additional steps towards production optimization have drawn the attention to electronics. The goal is to have computerized farms where all the environmental conditions as well as production details are monitored and evaluated (Soren, 2006).

The realization of Kenya's Vision 2030 will be achieved if the country is self-reliant in terms of feeding her people. Agriculture plays a major role and Kenya aims to promote an innovative, commercially-oriented, and modern agricultural sector (Ministry of Agriculture, 2012). This will be accomplished through; transforming key institutions in agriculture and livestock to promote agricultural growth, increasing productivity of crops and livestock, developing more irrigable areas in arid and semi-arid lands for both crops and livestock (Ministry of Agriculture, 2012).

Greenhouse is one of the tools that have been of major importance for the agriculture where the conditions for agricultural practices such as growing of food are unfavorable. The greenhouse introduces a controlled environment that can protect the crops in all seasons i.e. during the winter and the dry seasons in the tropics. It can also increase the growth rate of the crops, because the atmosphere and the fertilizers are easily adjustable in modern Greenhouse and growth boxes.

By controlling the environment and atmosphere in the greenhouse, the plant growth can be optimized. The watering

Tele:
E-mail address:jksangbarchok3@gmail.com

and air humidity can influence the overall health of the plants and increase their lifetime and survival rates (Mortensen, 2000).

Water moisture, temperature, light, humidity and carbon (iv) oxide (co_2) are the basic conditions that are monitored and controlled in a greenhouse system. An increase in the CO_2 concentration in the air can enhance the growth rate of the vegetation, and this rate is also closely related to the temperature. The cornerstone in plant growth is the photosynthesis, and since light is the only source of energy for this process, it obviously has a strong impact on the vegetation growth (Kirdmance, 2004).

The Challenges in the Greenhouses

The closed environment of a greenhouse has its own unique challenges, compared with outdoor production. Pests and diseases, extremes of heat and humidity, have to be controlled, and irrigation is necessary to provide water.

According to the study done by Soren (2006) on MEMS Multi Sensor for use in Greenhouses, he developed a four-point thermistor which was used for temperature measurements. A polymer capacitor with finger electrodes is used as a humidity sensor. Finally, three photo diodes with different optical filters are used to measure the light intensity from different parts of the optical spectrum. The multi sensor chips failed to address soil moisture content.

Most studies done on the non-tropical countries concentrated on development of system which can be used to regulate temperature, humidity and carbon dioxide. Wang et al (2014), developed Multi-span Greenhouse Measure and Control System which monitor environment parameters such as temperature, humidity, carbon dioxide concentrations and soil moisture content. The system uses modular design of the master-slave structure and dual serial single chip microcomputer STC12C5A60S2 as core.

The system concentrated with controlling temperature which in turn has influence on soil moisture content in the greenhouse. The system was complicated and developed mainly to be used in non-tropical countries. Therefore, there is need to develop an intelligent system to be used in tropical countries like Kenya where extreme low temperature is not an issue.

According to Eshenaur and Anderson, (2004) the numerous plant disease problems can arise in greenhouse situations. These diseases can cause extensive damage if allowed to develop unchecked. Since plant diseases are strongly affected by temperature and humidity, the best way to combat disease is to manipulate the greenhouse environment. The risk of plant diseases is reduced when the foliage and flowers are kept dry. They further stated that most disease organisms need water on the plant surface for normal growth. Excess water in the growing medium weakens plants and makes them more susceptible to damping off and root rotting diseases. Therefore good drainage and aeration are important medium to prevent root rot problems.

Methodology

Research design is the plan and structure of investigation used to obtain evidence and answer research objectives (Mugenda, 1999). The study was conducted using experimental research design. According to (Oso et al, 2005), experimental method entails systematic manipulation of some characteristics and examination of the outcome. The study was carried out in selected Greenhouses in Wareng Sub-County, Uasin Gishu County. The three small scale Greenhouses and one large scale greenhouse are located a long Eldoret-Iten road. The other large scale greenhouse is located a long Eldoret-Kaptagat road. The population of the study will comprise of all the Greenhouse farmers and field officers in Wareng Sub-County, Uasin Gishu County who are in access to professional constructed Greenhouse. The total study population for this study was nine as shown in Table 1.

Table 1. Population and Sample Population of the Study

Respondent Categories	Study Population	Population to be sampled
Small scale Greenhouse farmers	3	3
Large scale Greenhouse farmers	2	2
Field officers	4	4
Total	9	9

Since the population was small, all the respondents were included in the study. The sample focused on informants who have experiences on Greenhouse management. Therefore, three small scale Greenhouse farmers, two large scale Greenhouse farmers and four field officers were sampled. This sampling was guided by sampling fact emphasized by (Krejcie and Morgan 1970), who state that if a population is less than ten then all should be sampled.

The instruments used for data collection were Interview schedule and observation were used to get information from Greenhouse farmers and field officers. Experiment was performed to determine the maximum and minimum thresholds of soil moisture content in greenhouse. Piloting was done by administering an Interview schedule to four respondents in Kesses Sub County to test reliability.

Findings and Discussions

The preliminary data was collected in Wareng Sub-County, Uasin Gishu County from selected farmers with Greenhouse and field officers. The study area comprises of farmers with small and large scale greenhouse constructed professionally.

Small Scale Greenhouse

The three small scales Greenhouse under study are located along Eldoret-Iten road. The researcher labeled them the Greenhouse A, Greenhouse B and Greenhouse C as per the request of the farmers so that the identity is withheld. The table below shows the description of each greenhouse.

The three Greenhouses are adequately large and they were professionally constructed. All of them are covered with plastic paper as covers and used drip irrigation. The type of soil in the three Greenhouses was loam soil and mixed forest soil. All the three farmers had tomatoes, onions and cucumbers on their Greenhouse. None of them had electricity in the greenhouse though it is within the range. Most of the workers had experiences of over five years.

The three farmers also stated that the porosity or soil texture surface matters a lot when it comes to water filtration to the soil. Compacted soils are likely to over flood while fine soil cannot flood easily. The farmers said that if soil in the greenhouse is compacted the frequency of irrigation should be more but within short duration.

Large Scale Greenhouse

The two large scales Greenhouse were located within Wareng Division, Uasin Gishu County. One located along Eldoret-Iten road and the other was located along Eldoret-Kaptagat road. The two Greenhouses specialized on the growing of flowers.

Table 2: Description of Small Scale Greenhouse

DESCRIPTION	REMARKS		
	GREENHOUSE A	GREENHOUSE B	GREENHOUSE C
Size of Greenhouse	8m width by 15m long.	16m width by 30m long.	16m width by 30m long.
Cover of Greenhouse	Plastic cover	Plastic cover	Plastic cover
Shape of Greenhouse	Oval	Triangular	Triangular
Type of crop grown	Tomatoes and Cabbages	Onions and Cucumber	Tomatoes and Pepper
Source of water	Borehole	Piped	Piped
Type of irrigation	Drip	Drip	Drip
Type of soil in the greenhouse	Loam	Mixed Forest soil	Loam
Method of monitoring Soil moisture content	Manual	Manual	Manual
Availability of electricity	Not available	Not available	Not available
Application of ICT infrastructure	None	None	None
Nature of work force	Semi-skilled	Skilled	Semi-skilled

Table 3. Description of Large Scale Greenhouse

DESCRIPTION	REMARKS	
	GREENHOUSE D	GREENHOUSE E
Size of Greenhouse	64m width by 90m long.(several of them)	32m width by 90m long.(several of them)
Cover of Greenhouse	Plastic cover	Plastic cover
Shape of Greenhouse	Oval	Triangular
Type of crop grown	Flowers	Flowers
Source of water	Piped	Piped
Type of irrigation	Drip	Drip
Type of soil in the greenhouse	Loam	Mixed Forest soil
Method of monitoring Soil moisture content	Manual	Manual
Availability of electricity	Available	Not available
Application of ICT infrastructure	Yes	None
Nature of work force	Semi-skilled and skilled	Semi-skilled and Skilled

The Greenhouses were fairly large in size. They covered an area of about six acres of land with a good number of employees. In both farms (Greenhouse), the workers were skilled with few who are semi-skilled. The two large scale Greenhouse uses drip irrigation. It has electricity for warming the greenhouses during the cold seasons and majorly for lighting at night.

Most small scale farmers had a lot of difficulties in determining and controlling soil moisture content. Apart from having a person on site at the right time to control the turning on and off of the water taps, they also mention the following as being the prevalent challenges: Lack of appropriate equipment to measure, monitor and regulate the soil moisture content, inability to determine the correct or the optimum moisture level for a particular crop, inability to determine water holding capacity of a specific type of soil in the greenhouse for a particular crop, inability to measure the nutrient concentration at a given soil moisture content and its uptake by the crop, Source of power to the Greenhouse and Lack of enough funds to buy the equipment.

References

Chaudhry, K.K. and Nakra, B.C. (2004). *Instrumentation, Measurement and Analysis.* . New Delh: Tata McGraw-Hill.

Kirdmance,C. (2004). Enhanced Growth and Photosynthesis of Rain Tree Plantlets in Vitro Under a CO2-Enriched Condition with Decreased Sucrose Concentrations in the Medium. *Scientia Horticulturae*, 51-63.

Ministry of Agriculture . (2012, November 3). *Kilimo Docs*. Retrieved November 3, 2012, from Ministry of Agriculture: www.kilimo.go.ke

Mortensen, L. M. (1998). *Effects of air humidity on growth, flowering, keeping quality*.

Mortensen, L. M. (2000). *Scientia Horticulturae Effects of air humidity on growth, flowering, keeping quality*, 299-310.

Mugenda, O. & Mugenda,A.G.(1999). *Research methods, quantitiattive and qualitative Approaches.African Centre of Technology Studies(acts) Press.*Nairobi: Kenya Literature Bureau.

Mugenda,A.G.(2008). *Social Science Research: Theory and practice.Nairobi.Applied Research and Training Service.* Nairobi: Africa Centre for Technology Studies.

Oparanya, (2012).*UNDP Supports Government on Vision 2030 and MDG attainment*.

Soren,P.(2006). *MEMS Multi Sensor for used in Greenhouses.* Denmark.

Wang, Q. M.S, Feng R. , Cui L. &Luan Y. (2014). Development of Multi-span Greenhouse Measure and Control System. *Hebei normal university of science &technology*, pp 14-36.