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DETERMINATION OF TECHNOLOGICAL LEVEL OF GREENHOUSE MECHANIZATION IN SOUTHEASTERN ANATOLIA OF TURKEY

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Abstract –

In this study, research on the determination of the technological level in the greenhouse mechanization in Southeastern Anatolia Region of Turkey has been carried out. The technological equipment and operating parameters that should be in a modern greenhouse have been measured and the situation has been tried to be determined in the region. The results have been tried to be determined in which aspect of Southeastern Anatolia Region in terms of greenhouse mechanization. For this study, 40 greenhouse enterprises in the provinces of Şanlıurfa, Diyarbakır, Mardin, Gaziantep and Kilis which located in the Southeastern Anatolia Region of Turkey were selected. A questionnaire form was prepared considering the technological characteristics that should be in a modern greenhouse. The questionnaire was applied to the greenhouse enterprises and the data were collected. The questionnaire includes the following items: greenhouse area, grown product type, greenhouse construction material, greenhouse material, indoor agriculture application, ventilation system, heating method, irrigation method, vehicles, fogging system, spraying machine, generator, packaging unit, administration building and lodgings. Survey results were analyzed and tried to be determined by scoring the technological level out of 5.

KEY WORDS: Greenhouse, mechanization, automation, southeastern.

I. INTRODUCTION

The first examples of greenhouses in the world was seen in Italy, during the Romans period. The Romans cultivated vegetables by closing transparent materials on the pits they opened to the secluded slopes facing south. Plant cultivation under cover continued to evolve by covering the south facing directions of houses in Europe with glass (Yüksel, 2000).

The undercover farming commenced commercially in northern European countries in the early of 19th century. But after World War II, it has improved. With the introduction of plastics in agriculture in the 1960s, it has shifted to the regions where temperate (Mediterranean) climate prevails. Over the past few years, undercover farming has also been widespread in Asian countries. In 2002, the total undercovered area in China is reported as 1,963,000 ha (Jiang and Yu, 2004).

15% of the world's total greenhouse areas constitute glass greenhouses and 85% of them constitute plastic greenhouses. In the EU countries, the most important countries in the sericulture are Spain, Italy, Germany, England, France and the Netherlands. The Netherlands has the greenhouse technology, while Spain and Italy have an important place with the greenhouse areas (Sevgican et al., 2000).

The undercover cultivation in Turkey started with glass greenhouses established in 1940s in Antalya. Between 1940 and 1960, the development of greenhouse was very slow and spread especially around Antalya and Izmir (Tüzel et al., 2005).

The great stage of greenhouse in Turkey was observed after 1970 (Önes, 1986). This development is due to the use of polyethylene (PE) as a cover material, which is lighter, cheaper and easier to use than glass. In addition, it was a positive effect of providing credit support to the greenhouse by the public banks.The growth rate of greenhouse areas reached 15% per annum after 1980 (Çolak, 2002).

It is possible to divide the greenhouse enterprises in our country according to technological level and size. In small-scale family businesses, the use of technology is limited and production is carried out under simple structures where measures are taken to protect only frost damage. In these greenhouses where ventilation is inadequate, chemicals that constitute a danger to human health and the environment are used unconsciously and then the same products are repeatedly cultivated. In addition to the traditional greenhouses, modern enterprises with large indoor areas, climatic control, landless cultivation techniques, and the necessary technical personnel have been spreading in recent years (Tüzel et al., 2005).

Since undergrowth cultivation has developed dependent on ecological conditions, it has been concentrated especially in our southern coasts (Anonymous,1997). The greenhouses in our country are composed of low and high tunnels and the total area is around 53603 hectares as of 2002 year. 43% of this area is composed of low plastic tunnel and 57% of the area is composed of greenhouse areas (Tüzel et al., 2005).

Vegetables in 95% of greenhouse areas, 4% of ornamental plants and 1% of fruit species are grown (Tüzel ve Eltez, 1997).

It is known that chemicals, fertilizers and plant growth regulators which are used intensively in greenhouse farming

threaten human and environmental health. In the long term, sustainability should be established as a primary goal by using agricultural technologies that do not damage the environment as well as protecting natural resources.
In our country, investments in this area have seen a rapid increase in recent years, with a growth of about 1,500 da per year. There are 2.667 in the province of Antalya and 73 in the field, and landless farming is being carried out (Antalya Food, Agriculture and Livestock Provincial Directorate, 2012). The share of our modern greenhouses in the covered production is 1%. According to the 2012 figures, the contribution of the country's modern greenhouses to the gross national product is about 450 million TL (Anonymous, 2012).
There are a number of scientific studies on greenhouse technologies, some of which are related to greenhouse automation and software.
Funt et al. Developed a hardware and decision method called the "Market Model" to enable the farmer to learn more about his own farm. With this program, the grower can determine the price of 50 different products. He is able to make comparisons with the fiftieth years and can plan production by considering the data of different years. There are many other data can be used, such as product prices, fertilizer, and buckets paid to storage (Funt, 1989).
In a study, a software was developed to help determine seedling selection, diagnosis of diseases and fertilizer program and plant nutrient requirement and fertilization program in the most common problems in greenhouse vegetable (Tuncay, 1990).
In the automation system, microprocessors have also been used. Microprocessor based temperature control was performed in a mechanical ventilation project suitable for the glass covered greenhouses (Okursoy, 1993).

Numerous studies have been carried out on energy balance, plant energy balance, computer aided analysis of greenhouse ventilation, optimization of greenhouse design, determination of the development of greenhouse plants using image processing technique, automatic data retrieval using computer in greenhouses and control of measuring devices (Kaçıra, 1997).

A program has been developed for climate control in the greenhouse. Visual Basic programming language has been used in the preparation of the program and for the climate control in the developed program, Environmental factors such as temperature, relative humidity, CO2, solar radiation and air velocity are measured. The measured values in the greenhouse are compared with the values of the environmental factors in the program in order to develop the plant in the most suitable conditions and the processes such as heating, ventilation, humidification and illumination are performed (Yelken, 2003).

In another study, an automation system was developed for use in rootstocks in order to grow fruit nurseries. Internet and internet communication techniques are used in automation. It is aimed that the automation system working on it is applicable and its cost is low. Environmental factors such as temperature and relative humidity of the seedling greenhouse were computer controlled (İnan, 2002).

Kürklü A. and Çağlayan N. published a study on the development of sera automation systems. In this study, the automation systems used in the greenhouse were examined in general terms as climate and irrigation-fertilization systems, and the results of a lab-based climate control study that could contribute to raising the technological levels of the greenhouses in the country and the comfort level of the producer were given. The greenhouse control can be provided automatically according to the previously set values or can be monitored by a computer (Kürklü and Çağlayan, 2005).

The chlorophyll fluorescence robotic imaging technique was used to improve the quality of the products grown in the greenhouse environment and to improve the greenhouse management techniques before the harvest (Tarumi, 2014).
In an effort to save energy in the suburbs, traditional greenhouse materials and insulated "double thermal screen" greenhouse have been compared on the basis of various energy sources such as solar, geothermal, fossil and wind. The energy used in heating, cooling, ventilation, shading and humidity control calculates the savings and repayment times derived from different energy sources. It is stated that some energy sources provide energy savings of up to 60% (Vadiee and Martin, 2013).

A study has been conducted using an ARM9-based S3C2440 microprocessor SPU (system processing unit) to send and collect data to a web address. (Junxiang and Haiqing, 2011). It has been demonstrated that the operation of the system is highly stable and real-time data collection for remote control takes place.

In another study, it was aimed to diagnose diseases causing loss in greenhouse products by using camera-monitor method. For this, attempts were made to identify diseases by referring to color changes by processing images taken with cameras set to positions that can see greenhouse products (Juncheng Ma et al. 2015).

II. MATERIALS AND METHOD

The research was conducted in Şanlıurfa, Mardin, Diyarbakır, Gaziantep and Kilis in the Southeast Anatolia region. The surveys were carried out in Sanlıurfa (10 greenhouses 330 da), Mardin (13 greenhouses 110,5 da), Diyarbakir (13 greenhouses 316 da), Gaziantep (2 greenhouses 44 da) and Kilis (2 greenhouses 10 da). The research was conducted mainly on technological greenhouses located in the region. In the scope of the research; the questionnaire applied to the enterprises shows whether the greenhouse area, the greenhouse grown product, the greenhouse contsruction material, the greenhouse covering material, landless cultivation techniques, the used ventilation method, the heating method, irrigation method, the automation existence, the existence of climate control system, vehicles, fogging system, spraying machine, generator,

packaging unit, administration building, lodging property and number of qualified staff were determined.

Fertilization, irrigation systems and air conditioning methods used in the suburbs have been examined in general terms. Studies were carried out to raise the technological level of our zoneless greenhouses and the level in developed countries was tried to be determined. The study was conducted over a period of 2 years by evaluating the results of research on medium and large scale greenhouses operating in the Southeastern Anatolia Region.

Within the scope of the research, a total of 40 greenhouses in Şanlıurfa, Mardin, Diyarbakır, Gaziantep and Kilis were examined. The data were obtained as a result of the survey applications.

In the Southeastern Anatolia Region, the technological level of the greenhouses surveyed was evaluated by scoring over 5 as given in Table 4.4. Scoring was done by giving a full score of 5 to a greenhouse with fully automated and has competent technical staff. According to the level of the technological equipment that the greenhouse has, 5, 4, 3, 2 and 1 points were given out of 5.

III. RESULTS

In the study, usage ratios of the automation systems in the total technological greenhouses in the Southeastern Anatolian region have been determined. In addition to the automation systems in the greenhouses, the technological equipment levels such as climate control systems, fertilizing unit, spraying machine and circulation fan have been determined.

The automation system is the key to the research. A modern greenhouse automation system is the most important parameter in determining the technological level.

While the greenhouse is selected for the study, greenhouses equipped for mechanization are preferred. Table 4.1 shows the the number of greenhouses which equipped for mechanization.

IV. DISCUSSION

Table 4.1. The technological situation in greenhouse enterprises

	Greenhouses		***Construction Material(%)***		***Covering Material(%)***	
Provinces	*Number(pc)*	*Area(de)*	*Aluminum*	*Steel*	*Plastics*	*Glass*
Sanlıurfa	10	329	10	90	90	10
Diyarbakır	13	316	0	100	100	0
Mardin	13	110,5	0	100	100	0
Gaziantep	2	44	0	100	100	0
Kilis	2	10	100	0	100	0

While the use of automation system in Kilis is at zero level, 80% in Şanlıurfa, 92% in Diyarbakır, 62% in Mardin and 100% in Gaziantep (Table 4.2).

Table 4.2. Technology usage level -1 (%)

Provinces	*Automatic Control*	*Climate control*	*Fertilizer Unit*	*Circulation Fan*	*Pesticide Machine*
Sanlıurfa	80	80	100	100	100
Diyarbakır	92	92	92	100	100
Mardin	62	62	100	100	100
Gaziantep	100	100	100	100	100
Kilis	0	0	100	100	100

The production design of a total of 40 greenhouses was examined within the scope of the research. According to these results, tomatoes, cucumbers, ornamental plants and aubergines are mostly cultivated. The proportion of tomatoes produced the in Şanlıurfa is around 80%. Cucumber is grown in Diyarbakir with 61,54% and Mardin with 53,85%. The rate of cultivation of ornamental plants is 10% in Şanlıurfa.

In the study, the usage level of technological equipment such that, harvesting vehicle, fogging system, generator and packing unit in the greenhouses in Southeast Anatolia region was determined (Table 4.3).

Table 4.3. Technology usage level -2 (%)

Provinces	*Harvesting vehicle*	*Fogging system*	*Generator*	*Packing unit*	*Insect screen*
Sanlıurfa	100	80	100	90	100
Diyarbakır	92	92	100	0	92
Mardin	23	46	85	15	100
Gaziantep	100	100	100	100	100
Kilis	0	100	100	0	100

V. CONCLUSION

On average, about 30 people work as employee in the greenhouse examined in the study. The vast majority of these 30 people are workers. These workers were mostly women and children workers. For example, there are 1 engineer and 1 technician in 9 of the 10 greenhouses studied in Sanlıurfa. There was only one engineer in the remaining one. There were only 2 engineers and technicians in the 13 seranities surveyed in Diyarbakir, only one engineer in the 1 greenhouse.

The result of technological level of the greenhouses surveyed in the Southeastern Anatolia Region was evaluated by scoring over 5 as given in Table 4.4. Scoring was done by giving a full score of 5 to a greenhouse with fully automated and has qualified employee. According to the level of the technological equipment that the greenhouse has, 4, 3, 2 points were given.

Advanced: 5
Good: 4
Intermediate: 3
Weak: 2
Very weak: 1

Table 4.4. Technological level of greenhouses in Southeastern Anatolia Region

Technology	***Şanlıurfa***	***Diyarbakır***	***Mardin***	***Gaziantep***	***Kilis***
Automatic Control	4	5	3	5	1
Fertilizer Unit	5	5	5	5	5
Circulation Fan	5	5	5	5	5
Fogging System	4	5	2	5	5
Insect screen	5	5	5	5	5
Pesticide Machine	5	5	5	5	5
Generator	5	5	4	5	5
Qualified employee	3	4	3	2	5

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