

## THE IMPORTANCE OF METROLOGY AND STANDARDIZATION IN GREENHOUSE CLIMATE CONTROL

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**Abstract.** *Metrology and standardization provides protection for the environment and for the health of the public by the establishment of measurement methods and units of certain parameters in the agriculture. As a result, measurements are kept within an acceptable range. It promotes standardization in agriculture, design and construction of greenhouse. Different countries are able to calibrate units of universal measurement. This eliminates technical barriers that could be a hindrance to scientific research and technological advancements for greenhouse construction.*

**Keywords:** *metrology, standard, standardization, measurement, equipment, greenhouse system, temperature, humidity, sensors, heating system.*

### INTRODUCTION

The temperature is one of the most important factors in the production of horticultural crops. Often Predictive control of the temperature in a greenhouse is the key to producing high-quality crops. The ability to heat a greenhouse is important on cold, cloudy days and at night. Solar energy on sunny days is often enough to keep a greenhouse warm, even in cold weather. Several different methods are used to heat greenhouses. Several greenhouse automation devices like computer software and sensors are connected and used to collect data in the smart greenhouse environment to increase efficiency of crop yields in different condition. This new innovative technology makes use of sensors linked to climate control computer. The greenhouse sensor system has elements that monitor and control temperature, humidity, shading and read external weather conditions via a weather station. Metrology is an essential to successfully measure data and control detected temperature in real-life time. Measurement is always obtained with some inaccuracy due to fact that some influence on the system. As a result, it strongly effects to the quality of cultivated product. Metrology can solve this issue by applying the scientific method based on standard introduced by Governmental organization.

Metrology provides quality assurance behind modern-day controlling processes. It is the science that enables production lines to produce thousands of identical pieces of sophisticated climate control equipment. Without the standardized parts that metrology enables the creation of we would not have the newly-based approach and the world would be a very different place.

All parts produced on modern crop-yield production lines will have an allowable tolerance of error preset. The degree of tolerance will depend on the part measured by sensors linked to the central controlling machine. The machines will diagnose if the components it is producing are within the allowable tolerances. If they are not, then they will alert the machine operators and quality control team to the issue. Metrology allows farmers to cultivate products more accurately, more quickly, and to a higher standard. These benefits are passed onto consumers as products become cheaper to purchase and are made to a higher quality. The distinctive feature of greenhouse cultivation, as compared to outdoor cultivation, is the presence of a barrier between the crop and the external environment. This barrier creates a distinct micro-climate within the greenhouse, protects the crop against wind, precipitation, weeds, pests, diseases and animals, and enables the grower to control the crop environment to an extent unknown in outdoor cultivation. The protection from the outside world makes it feasible to heat, to add carbon dioxide, and to effectively apply chemical and biological control for crop protection. The high value produced per unit area enables the grower to invest in equipment as well as to improve and facilitate production, by such means as substrate culture, supplementary lighting, control of day length, screening, cooling, benches, soil cooling/heating, etc. Today's greenhouse cultivation may be considered as the most intensive and sophisticated form of crop production, often referred to as the greenhouse industry, thus the role of technology in the whole process [1].

#### **JAPAN GREENHOUSE HORTICULTURE ASSOCIATION**

Greenhouse cultivation is recently developed horticulture in the world. The climate is drastically changing, which can cause to take actively research to develop the newly-based greenhouse to supply food chain for human consumption. To promote the modernization of greenhouse industries to extend the superior greenhouse materials through survey, research, training, seminar etc. in Japan, JGHA was established in 1972. JGHA Japan Greenhouse Horticulture Association main activities. Proposals to promote greenhouse horticulture Ideal support and safety management that suit the Japanese climate conditions for large facilities Formulate and review safety structure standards for horticulture Considering the review of standards so they are easier to use for farmers and suit the regions Disseminate the new technical information Organizing Greenhouse Horticulture Plant Factory Exhibition/Conference(GPEC) at Tokyo Big Site once every two years and holding comprehensive seminars and regional seminars annually Improve member technical standards Issue the publication "Greenhouse Horticulture", hold greenhouse horticulture technical lectures (elementary and intermediate levels), certify greenhouse horticulture technical instructions, training overseas and in Japan Promote measures for plastic used for agriculture Advise and support to strengthen the system for optical treatment created by the committee that consists of academic experts and concerned parties for optimal treatment of agricultural plastics. As an initiative to promote the expansion of the scale of family businesses using employment, the Association has recently examined standard specifications for the installation of large-scale (1 hectare) houses that can be expected to be highly productive and profitable while suppressing excessive facility and capital investment. In order to select rational application specifications for the house itself, internal equipment, and cultivation system, we presented it as a model house specification. From this fiscal year, we will proceed with the verification of the effectiveness of the specifications and promote the reduction of installation costs throughout the industry through initiatives aimed at standardizing basic specifications [2].

#### **NEN 3859:1996 NL: DESIGN AND CONSTRUCTION OF GREENHOUSES**

### **FOR COMERCIAL CROP PRODUCTION (THE NETHERLANDS)**

This standard provides requirements for the strength, stiffness, stability and durability of greenhouses. This standard applies to: a. greenhouses on a horticultural farm; b. greenhouses on display for promoting the sale of the greenhouse type; c. greenhouses prototypes; d. greenhouses on the premises of research institutes, garden centers, experiment and educational institutions, as far as these are exclusively or mainly entered by personnel in charge of the cultivation of the crops. This standard does not apply to glasshouses that are used for purposes other than for growing crops [3].

### **THE GREENHOUSE INDUSTRY IN THE NETHERLANDS**

The cultivation of horticultural crops under cover is in nearly every country in the world. The total area of greenhouses at the end of the 1980's was 45,500 hectares, and of plastic tunnels 135,000 hectare. Most plastic tunnels are located in the Mediterranean countries and China and Japan. Cultivation in greenhouses covered with glass is mainly practiced in countries with a moderate climate. About 60Chapter One: Introduction Greenhouse Climate Control 7 Netherlands leads with 10,000 hectares, of which 4,700 hectares are devoted to vegetable production, 4,200 hectares to cut-flowers and 1,100 hectares to pot plants (Data 1993). Most North-European countries are big importers of cut-flowers, pot plants and vegetables such as tomato, sweet pepper and cucumber. More than 80. The main exporters are The Netherlands (vegetables, cut-flowers and pot plants), Belgium (vegetables) and Denmark (pot plants). 80and to the members of the European Free Trade Association (Norway, Sweden, Finland, Iceland, Switzerland and Austria). Exports to other countries are negligible. The leading exporters to North-West Europe from outside the area are Morocco and the Canary Islands for vegetables and Israel and Columbia in the cut-flower sector. In general, the destination of a country's exports is limited to its neighbor countries. This is so for imports in North-West Europe [4].

#### **a. Effects of temperature on product quality**

Most processes of growth and development are influenced by temperature so there is a clear influence on different aspects of quality. When temperature is low in relation to the light conditions during the growing period the texture of the plants will be strong and the firmness of the stems high. This may be positive for the external quality of many pot plants and cut-flowers (Cyclamen, carnation). In many crops both the internode length and the stem length increase at lower temperatures. It is an important quality aspect for many pot and bedding plants. It has been shown for different crops that plant height can be reduced by high night and low temperatures. The difference between day and night temperature (DIF) can be used to control plant height as far as this difference can be realized, dependent on time of the year. The reversed day/night temperature is partly as an alternative to growth retardants which are also commonly used for the height control of many pot and bedding plants [4].

#### **b. Effects of humidity on product quality**

Transpiration of plants, which is important for cooling and the transport of nutrient elements, is highly affected by air humidity. When the pressure deficit is low, transpiration will be low, and plant cells can easily maintain a high turgor and reach their maximum size. Plants grown at high air humidity tend to make larger leaves, while under extreme situations some plants show uncontrolled cell growth at the main nerves. To maximize the growth large cells are desirable but in many cases restricted growth and stimulated transpiration result in a better quality [4].

### **MODERN GREENHOUSE INDUSTRY IN UZBEKISTAN**

A special feature of the greenhouse is a galvanized frame. Galvanization of the supporting structures allows to resist corrosion and temperature differences and guarantees the long life and strength of the frame. Our engineers approach the design of each greenhouse, taking into account the individual characteristics of the landscape and climate, as well as the wishes of the client. Parameters such as wind strength, annual precipitation, location at cardinal points, etc. are taken into account. This allows you to achieve optimal results when working in a greenhouse complex. The process for sealing our greenhouses has a three-layer structure. Each layer has its own technical load. Thus, the first layer cuts off the harmful spectrum of sunlight and ultraviolet rays. The second layer provides reliable thermal insulation. The third inner layer is covered with a special composition with antibacterial and anti-drop properties. A film with a thickness of 180 microns is optimal for sufficient penetration of sun- light and thermal insulation. Polycarbonate greenhouses have become increasingly popular in recent years and are beginning to overtake glass as the primary material used to make greenhouse glass. The most important aspect of polycarbonate is that it provides the greenhouse with good insulating properties. Polycarbonate greenhouses have a low coefficient of heat loss, which leads to savings in fuel consumption. This quality is the guarantee of overall efficiency and effective- ness in the greenhouse. The special properties of polycarbonate have the ability to overcome over time. Since plastic is thicker than glass, it provides easier diffusion, which means that the light spreads evenly in the greenhouse. The climate control system in new-generation greenhouses is an indispensable attribute for the successful operation of the entire greenhouse complex. Climate control system internal and external features measures and sends all the data for processing, after which the system makes a decision on the following actions: opening or closing the ventilation hatches, using the horizontal shut-off system of the greenhouse, using the mist cleaning system, etc. This, in turn, allows to achieve an optimal microclimate inside the greenhouse. Special roofing design provides timely natural ventilation or complete sealing. A two-way automatic system is regulated by the control panel to raise the roof areas by 1.5 meters. An automatic ma- chine for ventilation of the greenhouse is an indispensable device that allows creating favorable conditions for growth of plants. Its presence allows not only to improve the design of the greenhouse, but also to prevent harmful air stagnation for many vegetable crops. In addition, the automation of greenhouses is easily maintained and independently maintains the optimal internal microclimate with- out human intervention.

### **CONCLUSIONS**

The importance of greenhouse in metrology and standardization is essential for human development. So, Various greenhouse is being invented and put into practice in the world. Construction and design of greenhouse is well-developing, as a result, metrology need to introduce more modern method- ology.

### **ACKNOWLEDGMENT**

This paper indicates the future plan of greenhouse climate control. In the future planning to create actual greenhouse system to control using optimal approach such as predictive control or artificial intellect climate.

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