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CREATING A LIGHTING ENVIRONMENT IN ARTIFICIAL LIGHTING TECHNOLOGIES

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ABSTRACT

In the context of resource shortages, the use of energy-saving methods in agriculture is one of the main goals of the greenhouse industry. In our study, we focused on how to maximize the effectiveness of light in the cultivation of tomato plants. As a result, in order to increase the productivity of tomato plants in artificial light using blue energy spectra close to 5.0, green 2.5, red 2.5 and using energy-saving LED lamps We found it expedient to increase the duration of the study.

KEYWORDS: *Artificial lighting technology, radiation spectra, tomato products.*

INTRODUCTION

Hosil miqdori, o'simlik va tashqi muhit sharoitlarining o'zaro bir-biriga bog'liqligidir. Muhit sharoitlarini hisobga olmay sabzavotlarni yetishtirish texnologiyasini to'g'ri olib borish va qoniqarli hosil olish mumkin emas. Tomato cultivation facilities have the potential to create an artificial microclimate and optimal soil environment, taking into account the characteristics of plants, age, variety and purpose of cultivation, as well as existing climatic conditions. Modern greenhouses, equipped with heating soil and air humidification, ventilation, gasification, electric lighting systems, can create an artificial climate in practice, taking into account the requirements of the plant. Productivity in greenhouses and unheated buildings is similar [1, 2, 21].

It is possible to artificially create optimal temperature, water and air conditions in the cultivation facilities. Lighting is currently efficient due to natural solar radiation, and only occasionally electric lights are used.

Solar radiation is the main process that creates the climate and is the main factor that determines the type and variety of protected land structures in the area, the selected crops and the timing of their cultivation.

Under the film coverings, a microclimate is created, where the temperature changes sharply during the day compared to under the glass, the humidity is higher, the light is better and the amount of ultraviolet light is higher. Because the films cannot protect plants from negative temperatures, they are often used after repeated frosts have passed [3, 4, 22].

Plants themselves have a significant impact on the microclimate. The air and soil environment in which the greenhouse is located creates an agro-phytoclimate, a microclimate in which plants can live. Changing this pattern has its own characteristics, the larger the area of the greenhouse and the mass of the plants, the more noticeable these features will be.

MATERIALS AND METHODS

The purpose of the study is to analyze the impact of artificial lighting on water consumption in the acceleration of photochemical processes in the territory of the Republic of Uzbekistan, where there are 3350 hectares of greenhouses. Based on the purpose, the following tasks were identified. Including: increasing the duration of the light period for the growth and development of plants. For the growth and development of plants, to determine the specific physiological nature of the spectral ranges of FFr in the range that ensures the occurrence of basic photosynthetic control processes, and others.

RESULTS AND DISCUSSION

In recent years, significant changes have taken place in the field of vegetable growing in greenhouses of the country. In total, about 3350 hectares of modern greenhouses have been commissioned in the Republic of Karakalpakstan and other regions.

The role of artificial light environment in accelerating the rapid photochemical processes of plants in industrial greenhouses is great [5, 6, 23]. Additional artificial light is needed, especially during the winter months (December, January and February). The reason is the short duration of natural daylight. In addition, for 3 months (December-February) we can observe that the plant has grown significantly under the influence of artificial light in the greenhouse.

The light fluxes of photosynthetic active radiation (FAR) can be modified to provide the radiation needed for plant productivity. Even chlorophyll absorption in plants is low, but high levels of radiation (510-610 nm) are suitable for high plant yields. The radiation mentioned above has been shown to have a high effect on crop processing in plants. From the above, it can be concluded that even when the radiation is low, it is incorrect to generalize the intensity of the test light to the same spectrum of the spectrum of different light sources.

Ensuring maximum light efficiency in tomato plant cultivation lies on the surface of FAR 100-160 W / m 2 . Tomato plants require 50 W / m 2 at a young age , FAR in the norms of intensive light conditions during the development of generative organs should not be less than radiation in the area of 80 W / m 2 [7, 8, 24].

The amount of radiation that can affect plants under greenhouse conditions was determined by V.L. Sudakov, L.M. Anikina, O.R. Udalova, P.V.Sharupich, A. A. Tixomirov, T. S. Sharupich, G. M. We meet in Lisovsky's research, and they interpret it as follows;

- radiation in the range of 270-330 nm has a topical effect on the growth and development of plants. However, the fact that this radiation is around ~ 0.5% determines its effective development. Radiation in the range of 330–400 nm is a regulator. It is preferable that this radiation be present in the total flux (1-3%);
- for the growth and development of plants, an FAR range (optical range) of 280–750 nm is considered important, which ensures that basic photosynthetic control processes occur. Some spectral ranges of FAR have special physiological consideration:
- the 400-500 nm range of the plant (blue) contains FAR, which controls the movement of processes not related to multiple photochemical reactions. This process serves to collect the biomass of the tomato plant throughout the growing season. It should be noted that the blue spectrum should not be higher than the light flux, otherwise the tomato plant will be low in height, low productivity. Therefore, in increasing the yield of tomato plant, it depends on the overall irradiance efficiency of FAR processes together with blue rays [25];
- the 500-600 nm range of the plants (green) is not considered very important for the FAR process, but the blue and red rays pass through them to the leaves below, where they cannot pass, ensuring their photosynthetic process. In the green most irradiated area of the spectrum range, 510–550 nm of plant cells and chloroplasts perform subsynthesis of a thin thin leaf area.
- The 600-700 nm range of the plant photosynthesis process (red) is the part that determines the FAR effect. Phytochrome R660 has the highest absorption of pigment, which is responsible for performing important non-photochemical reactions not only in tomatoes but also in other plants, and has the ability to control at 660 nm units. The red rays of the cenosis of the tomato plant provide high productivity;
- 700–750 nm of radiation (long red) also has a large control power - 730 nm phytochrome can absorb the highest at R730. In small quantities this light should be included in the general composition of the radiation.

A.I. Korovin and B.S. According to Moshkov, at an air temperature of 20-25 ° C and high lighting (about 50 thousand lux) the growth, development and ripening of tomato fruits is accelerated by 2-3 times. At this temperature, economic efficiency can be achieved by a complete reduction in the amount of energy per unit of production [8, 9, 10] .

Natural sunlight provides a spectrum of waves of different lengths. Then the plants, like other representatives of the flora, use certain waves at different stages of development. For example, in vegetative growth (for the formation of a green mass in the fruit of the plant) blue light itself gives good results. The wavelength should be 400-500nm. The role of red light in flowering and fruit ripening is great. The wavelength is 600-700 nm .

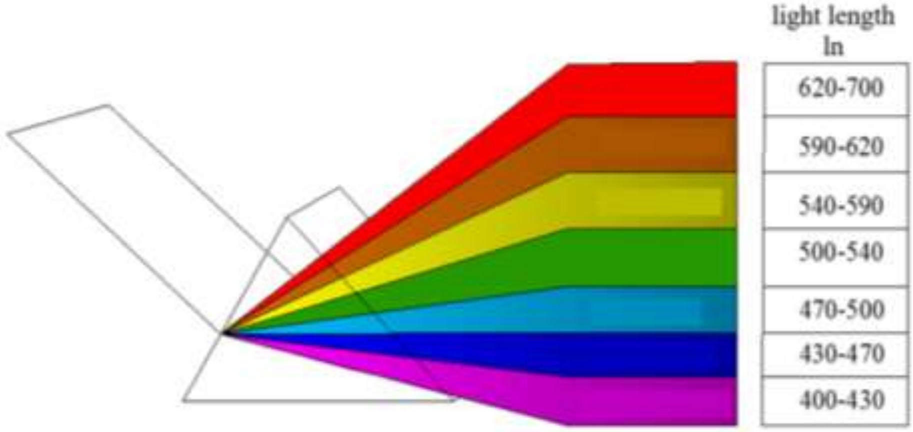

Figure 1. Wavelength depending on light spectra

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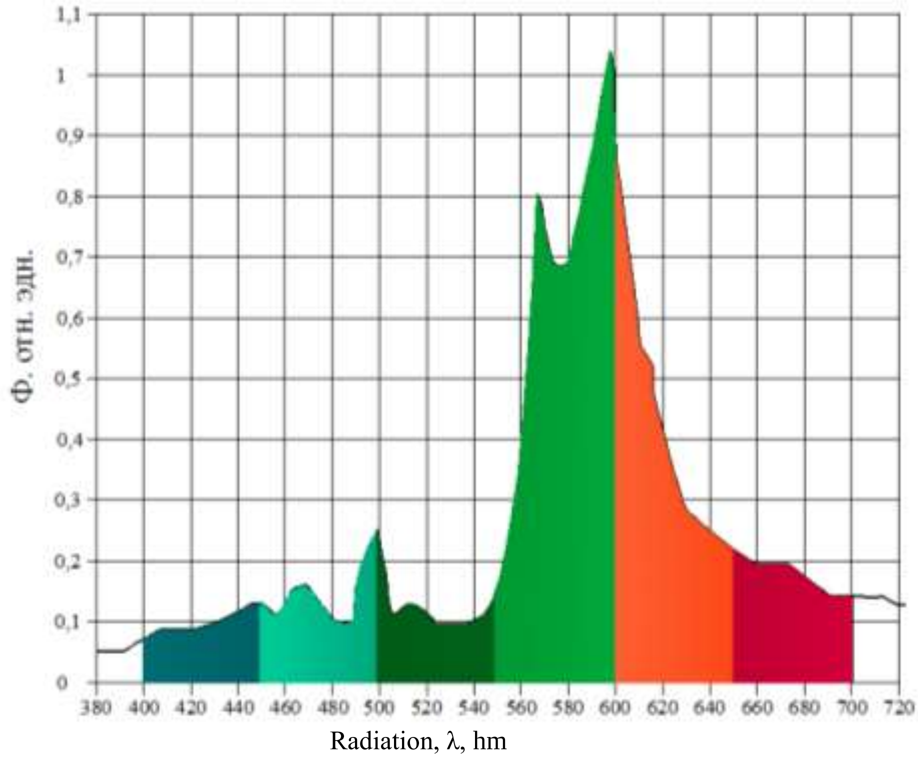

Figure 2. Total radiation spectrum under BAT conditions (November-February)

One of the greatest blessings of nature is the sun. Under the influence of sunlight, the process of photosynthesis takes place in plants, especially the tomato plant, where the need for sunlight is high. The following figure shows the spectrum of sunlight.

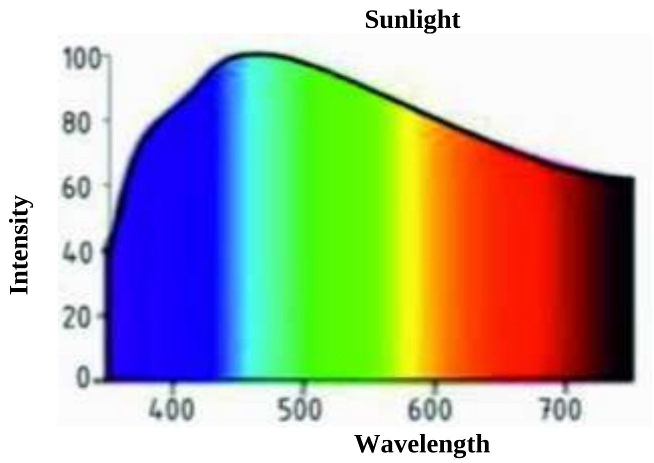

Figure 3. The spectrum of waves emitted under the influence of sunlight

1. Incandescent lamps contribute to the heating of the air due to their good heat output. These types of bulbs provide the dark red, red, and yellow colors needed for a plant. When such bulbs are placed close to plants, heat can damage delicate tissue, leading to deterioration of growth processes [10, 11, 12].

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Incandescent (incandescent) lamp

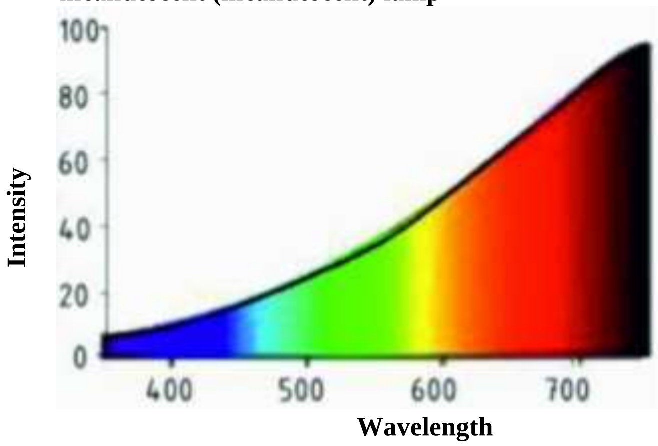

Figure 4. Wave spectrum of incandescent lamps

In the FFR field, normal Desert lamps (DL) has a Profitability ratio (PR) of 3-5% and halogen DL has a FIC of around 9%. The use of ChL for artificial lighting purposes has virtually ceased.

2. Ceramic metallogalagen, such lamps emit nups close to the rays of the sun and are very suitable for plants growing in greenhouses. In addition to their very short service life, they have not developed on an industrial scale due to their high cost.

Ceramic metal lamp

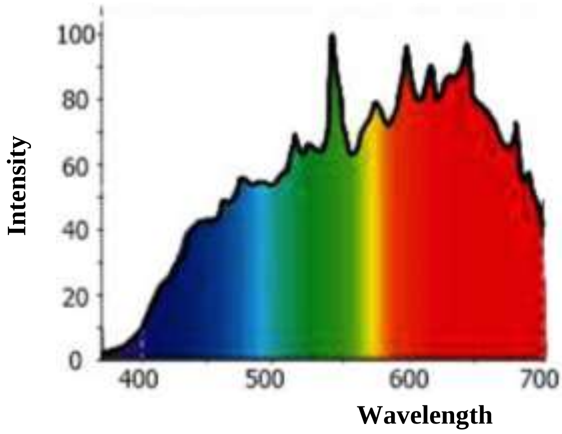

Figure 5. Wave spectrum of a ceramic metallogalagen lamp

In ceramic metal halides, light is generated as a result of an electric current passing through a special arc from a gaseous mixture of gaseous mercury and metal halogens. When the quartz tube reaches the operating temperature, sodium iodine is released, and when the metal is ionized, the spectrum adds orange and red, and high efficiency is achieved around 1 watt 75–100 lumens [13, 14, 15, 16].

3 . Light output of Arc mercury ion (AMI) series lamps is 70-90 lm / W, operating time is 8-11 thousand hours. AMI type lamps of different power of 200, 400, 600, 800, 1000 or 2000 watts have been created for growing tomatoes and cucumbers. AMI lamps help to provide the required light in the FAR spectral field to tomatoes and other plants that require light. However, in the light range of AMI series lamps, the proportion of infrared rays absorbed by the plant leaves and causing the leaves to heat up is large.

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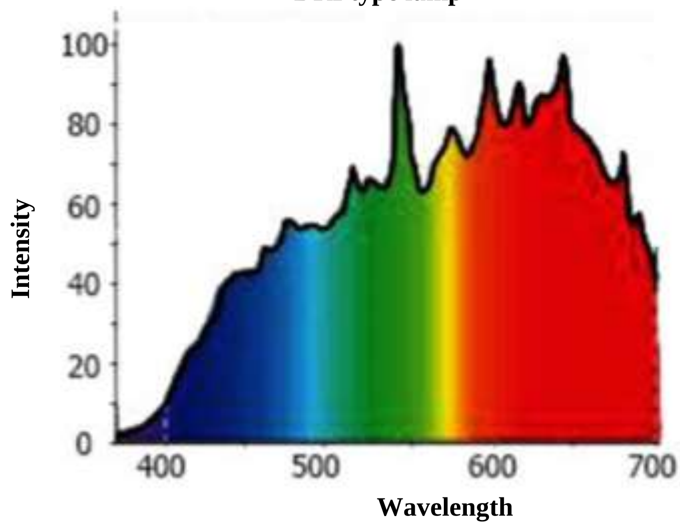

Figure 6. The wave spectrum of a AMI type lamp

4. Fluorescent lamps (FL) radiation spectrum corresponds to the needs of the plant, illumination ~ 60 - 80 lumens / W, operating time ~ 10 thousand hours, PR (9-12%). The overall radiation of plants in FLs is not of high quality. When growing a tomato plant, LL can be placed horizontally or vertically next to the top of the seedling. Nowadays, energy-saving, compact, high-light FL is used.

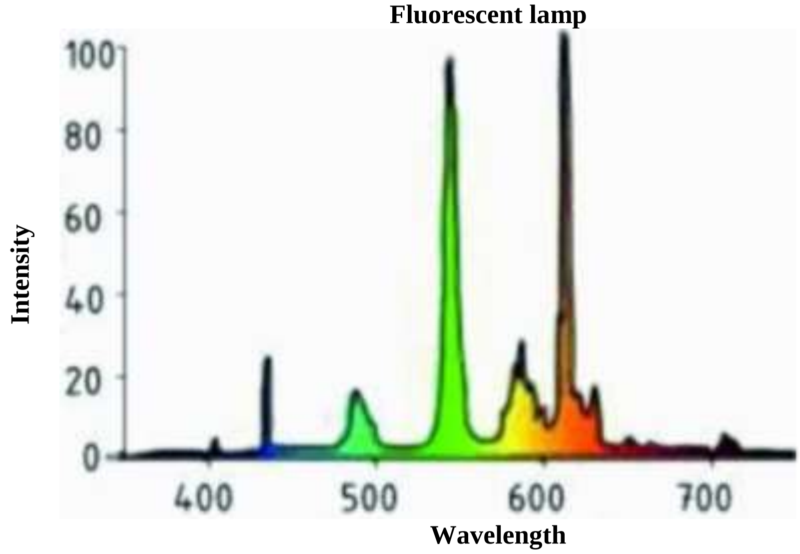

Figure 7. Fluorescent lamp wave spectrum

5. High pressure sodium lamps (HPSL) are widely used in vegetable and ornamental plants. The light scattering spectrum emitted by HPSL is considered successful for FAR of plants and has a working life of 10,000 hours and high luminous power. As the power of the HPSL increases, so does its brightness. When HPSL are 400, 600, 800W, the corresponding light power is 120, 140, 160 lm / W, which is quite economical in the cultivation of plants [15, 16, 17, 18].

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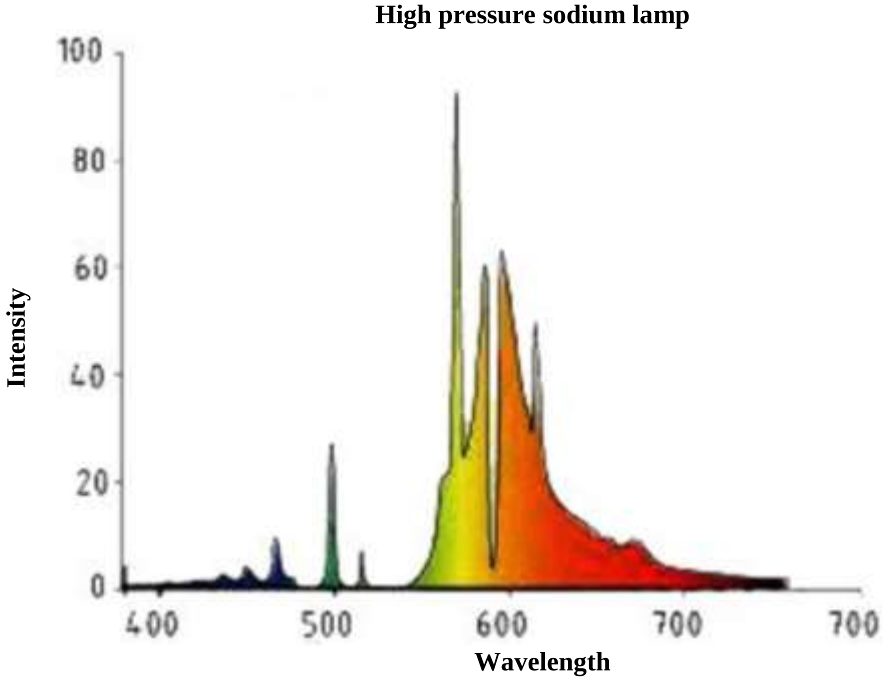

Figure 8. High-pressure sodium lamp light spectrum

6. Light emitting diodes are one of the lowest power consumers in the world, light sources with a service life of more than 36,000 hours. High yields can be obtained from plants through the combined use of light emitting diodes [19, 20].

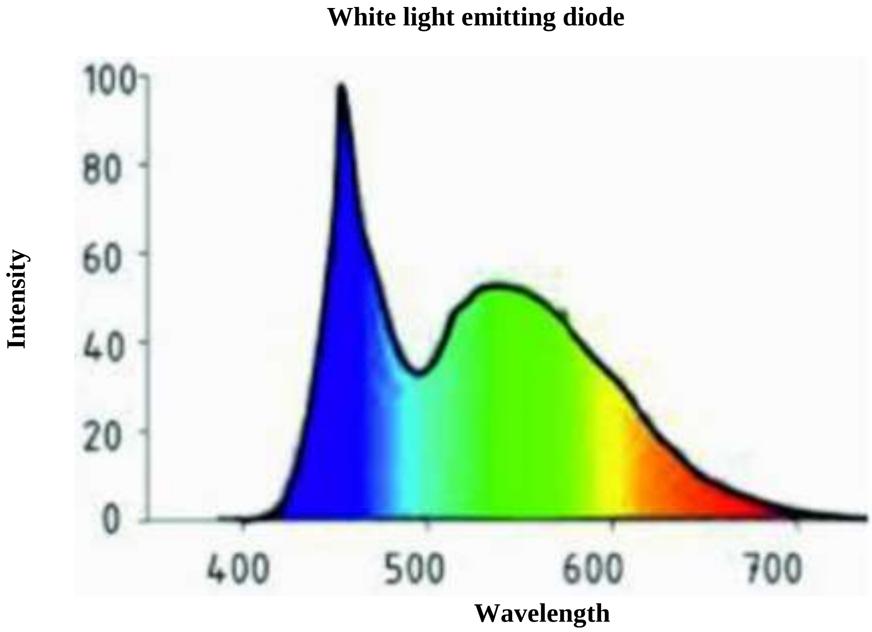

Figure 9. Light spectrum of white light emitting diodes

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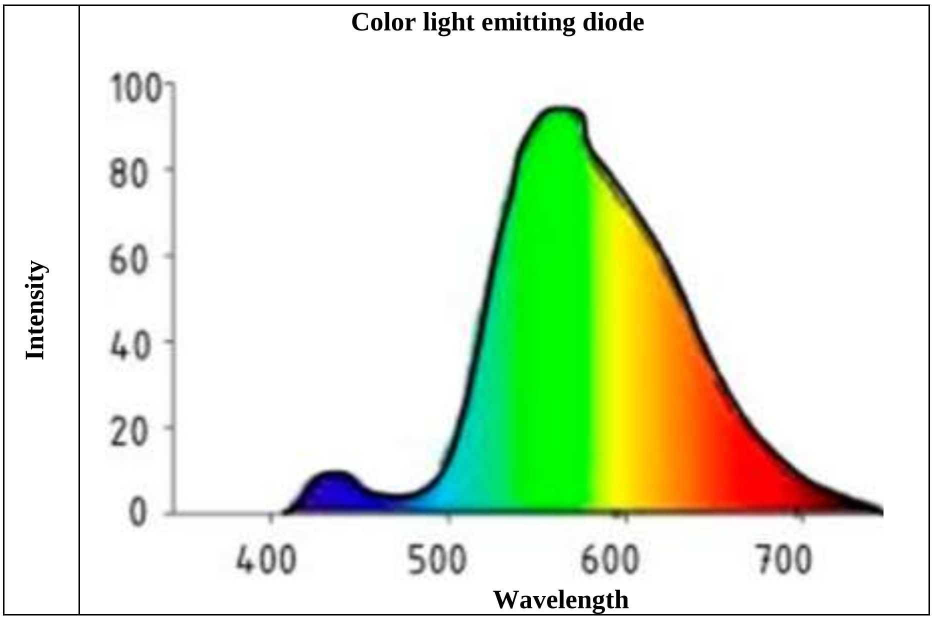

Figure 10. The light spectrum of diodes that emit colored light

By combining light emitting diodes, it is possible to control the radiation flux required by the plant while increasing the productivity of the tomato plant. The addition of light emitting diodes to the light distribution range ensures a quality light flux of around 450 - 475 nm and brings the light energy closer to the following optimal values: 30% - blue, 20% - green, 50% - red. The intensity of photosynthesis can be as high as 20% in artificial light sources used in combination for plants only when high-pressure lamps are used.

The use of gas-discharge lamps and the optimal amount of artificially transmitted light flux are effective in increasing the productivity of tomato plants. The spectrum of light that does not have a sufficient level of radiation does not sufficiently affect not only the yield of tomatoes but also other plant species such as cucumbers, strawberries, flowers and others. Conversely, electricity is wasted [11; 76-82, 12; 113-148, 42; 135-148, 54; 12-15, 58; 200-240].

CONCLUSION

In view of the above, it is advisable to use LED lamps in order to create the necessary radiation for the tomato plant in greenhouse conditions and for intensive cultivation of the tomato plant. In the future, we plan to achieve positive results in the cultivation of cucumbers, strawberries, flowers and other agricultural products, not only tomato yield, but also the optimal use of high-efficiency technologies in the conditions of greenhouse.

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