Using LED lamps in cultivation of mulberry nurseries

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Abstract. The analysis of results carried out on revealing the efficiency of using in night LED lamps three, namely red, blue and white colors for increasing growth and development of mulberry nurseries in the greenhouse conditions has been presented. It has been shown that using LED strips improves growth and development of nurseries on in height, leaves quantity and width of nurseries. Moreover, the development degree of nurseries differs on the control variant weakly in case of red lighting one at the same time in the blue and white lighting variants it is essential. The maximal growth of nurseries on height in comparison of control variant in case of white lighting was to 25.0 %, and the minimal one corresponds to case of red lighting, 1.9 %. The average growths of nurseries for a season was 3.3, 13.2 and 15.5 % in cases of red, blue and white lightings, correspondingly. The relative growths of nurseries on the height for a season compared beginning of the experiences were 133.3, 140.0, 163.3 and 170.0 % in cases of control and also led, blue and white lighting variants, accordingly. The most quantity of leaves in case of white lighting variant was 44.4 % more than control one and the least quantity corresponds to the red lighting variant, 8.8 %. The average values of this quantity for a season were 5.7, 21.9 and 24.3 % for red, blue and white lighting variants, correspondingly.

1 Introduction

It is known that at present the Earth population is continuing increase and according to preliminary forecasts by the end of 2022 its value reached up to more 8 billion people [1-4]. This degree requires at least the increase correspondingly production the consumer goods too, in particularly, the ecological pure and natural materials. In limited allocated for agriculture area conditions and continuing area reduction because of construction the new residential and indusdtrial areas there is increasing possibility the production volume only through acceleration the growth of agricultural culteres [4-8].

For this aim in the last years the several investigations using plants growth stimulators had been carried out. For example, in paper [2-6] the dependence of economical efficiency of cultivation the different types of spring durum wheat for food aims on the used plants protection products and growth stimulators in Belarus Republic had been estimated. The profit with “Rozalia” type crops had been obtained when pickling seed material by “Inshur

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Perform" preparation, using "Ecosil" growth stimulator for seed treatment and two times treatments of plants invegetation period, two times treatment crops in vegetation period using "Exion" and "Kolosal" fungicides in which the production rentability equaled to 69.6, 67.0 and 70.3%, correspondingly [4-8].

In paper [3] growth biostumulator of plants, "Akpinol-alpha", with concentration 0.001% water solution had been used and had been shown that this preparation promotes to the best development and formation the greatest density of sugar beet yield and the additional treatment with 0.0001% of this preparation in vegetation stage increases the sugar content in the roots [9-11].

In paper [4] the investigations on using the growth regulators for epin-extra plants had been carried out where had been noted that using this preparation the green pear cuttings are being ability to root more than 50.0%. In paper [5] the investigation results on affecting no root treatment with the different plants polyfunctional growth regulators for formation parameters of photosynthetic activity and productivity of sugar beet had been presented. There had been revealed that the treatment with polyfunctional growth regulators allows increase the productivity up to 3.1-11.0% [5-8].

Of cource, as in mentioned above papers had been shown, using stimulators allows accelerate to some extent the development pace and using this way increase the productivity of the agricultural plants. However, all these growth stimulators contain a definite chemical active substances which will spoil the quality of the finished products, ground, water and environment. Therefore it is expedient to find other alternative plants growth controlling methods which are free from mentioned above shortcomings. One of these methods is lighting plants using lamps in night period [9-11].

In the last years the LED lamps are being used actively in agriculture too. There are results of field experiences [6], where the LED glue trap for monitoring corn borer *Ostrinia nubilalis* on corn crops in Krasnodar region had been used. It had been shown that, although beginning the generation flight using both LED and pheromone traps had been registered with same date, however, the peak of the butterflies catching was been displaced to beginning the generation flight to week before catching first eggs by damage females, whereas the peak of the males catching by pheromone traps after week after reaching eggs catching activity of females of maximum had been registered [5-11].

In climatic conditions of North-West of Russian Federation (Sankt-Petersburg) had been tested LNS-K3 type LED trap [7]. This trap for hunting insects in night period was intended. For attracting insects the super bright LED of ultraviolet range with 365-405 nm wave length had been used. It had been revealed that in the traps Lepidoptera is dominated [1-4].

It is known that for full growth of plants is required total solar spectrum. Chlorophyll in leaves absorbs the solar rays covering energy for all plants needs, photosynthesis uses wave length 400-700 nanometer for transforming the solar energy to plants one. However, the most plants not require the continuous spectrum in all visible region. For example, although flowering plants use all visible light spectrum, here some wave lengths are more important than other ones [4-7]. The red ray has crucial value for activation of hormones influencing to flowering and fruiting processes as the same time blue ray promotes to compact, dense and healthy looking plant. Because of the agrarian branch's workers use the artificial lighting of plants such as LED lighting with accent to the blue and red parts of the spectrum. Of course, in night period we deal with the pause in the plants growth [1-5]. There the question naturally arises: can we realize, let is even artificially, the plants growth in night period too?

The agronomist scientists went forward in solving this question – they accelerate the plants growth rate both in night period and in north regions where in daily period the intensity of the solar radiation in the natural conditions is not enough for the plants growth. For example, in recent paper [8] had been noted, that LED with quant points could be used as plants growth regulators. Without Cd quant points the long wave red light of LED can be used for stimulation of optimal absorption by chlorophyll both A and B types, which is important for such agrarian cultures as basilica and salad. Thereby interaction with the nature and also possibility of exact wavelength settings according to climatic conditions and plants features this technology allows us control better healthy and energetic growth of plants then growth plants in the natural conditions [10, 11]. For example, it creates more crispier or softer texture of salad than cultivated one in the natural conditions.

It should be noted that in other paper [9] had been investigated the efficiency of using the growth stimulators in sweet pepper plantings where had been shown that this procedure allows us increase productivity and stability of sweet pepper plants to diseases, improve the qualitative degrees and growth the efficiency of water using.

In the present paper the analysis of carried out experiences on revealing the efficiency using LED lamps in the night period for improving growth and development of mulberry tree (*Morus Alba*) nurseries in the greenhouse conditions has been presented [1-7]. The actuality of this task is conditioned by still in Uzbekistan is not providing in the enough quantity the fresh and qualitative (healthy) feed base (mulberry tree leaves) for silkworm (*Bombyx Mori*) in the relatively short period of feeding silkworms (May-June) although Uzbekistan ranks first in world on producing silkworms cocoons per capita [4-6].

2 Materials and methods

The experiences have been carried out in Andijan region in greenhouse conditions in 2020-2021 season period. For this purposes 4 greenhouses with 10×30 meters sizes situated in one area, obviously in 4 variants, have been selected. In order to obtain the more real credible comparative results on all variants in the all selected greenhouses the same natural (the environment pressure, temperature, air humidity) and agrarian technical (watering, cultivation and at el) conditions have been provided and the same biological fight method against pests has been used [1-5].

Before experiences (October 2020) we have prepared nurseries from mulberry tree branches with average length 30-32 centimeters which one have planted by 100 pieces (totally 400 pieces) to usual ground in the polyethylene potted in the each greenhouse. Wherein first variant was in control in period of experiences that is a LED lamp inside of this greenhouse has not been used. In all other three variants during period of experiences beginning from October 2020 up to October 2021 in night the greenhouses by tape LED lamps have been illuminated: in second variant the blue color, in third variant the red color and in fourth variant the white color lamps have been used. It should be noted that the lengths and types of used LED lamps in all variants were the identical, which has provided the equal room lighting of greenhouses [4-6].

Objects of the carried out experiences were the quantity of arising leaves, height and width (together with leaves) of mulberry nurseries in the each month during the season that is from October 2020 up to October 2021 on dependence of used lighting color inside of greenhouses in the night time. Results obtained in experiences on Figures 1-3 have been presented [1-5].

3 Results and discussion

As seen from the figures that in all variants the growth in height, and in leaves quantity, and in width of the nurseries is observed practically. It should be noted that as expected, in lighting variants is sensible acceleration of nurseries development in comparison of control variant on all mentioned above investigation parameters. Here if the development degree of nurseries in the red lighting variant differs from control one slightly, and at the same time in blue and white colors lightning variants it differs noticeable even to the eye.

The maximal growth on height of nurseries relatively the control variant corresponds to June, which equals to 5.0, 20.0 and 25.0 % for red, blue and white colors lighting variants, correspondingly. The minimal growth for the red lighting variant corresponds to August (1.9 %), for blue color – to April (11.1 %) and for white color – to the winter months (12.5 %). The averaging value during the season for this degree was 3.3, 13.2 and 15.5 %, correspondingly.

On the quantity of nurseries leaves relatively on the control variant the maximal value corresponds to the white lighting case in April, which equals 44.4 %, and the minimal value to the red color in August, 8.8 %. This degree in average for the season equals to 5.7, 21.9 and 24.3 % for red, blue and white lighting variants, correspondingly.

The maximal development of the nurseries on the width relatively control variant corresponds to March which equals 33.3, 66.7 and 66.7 % for red, blue and white lighting variants, correspondingly. The minimal extension of width corresponds to July, 7.7, 15.4 and 19.2 % for the same variants. The averaging value of this degree for a season equals to 9.5, 29.9 and 33.0 %, correspondingly. For the total season the relative extension of nurseries in comparison of beginning experiences, when we take into account the leaves too, was 35, 38, 41 and 42 times on all four variants, correspondingly (Fig. 1-3).

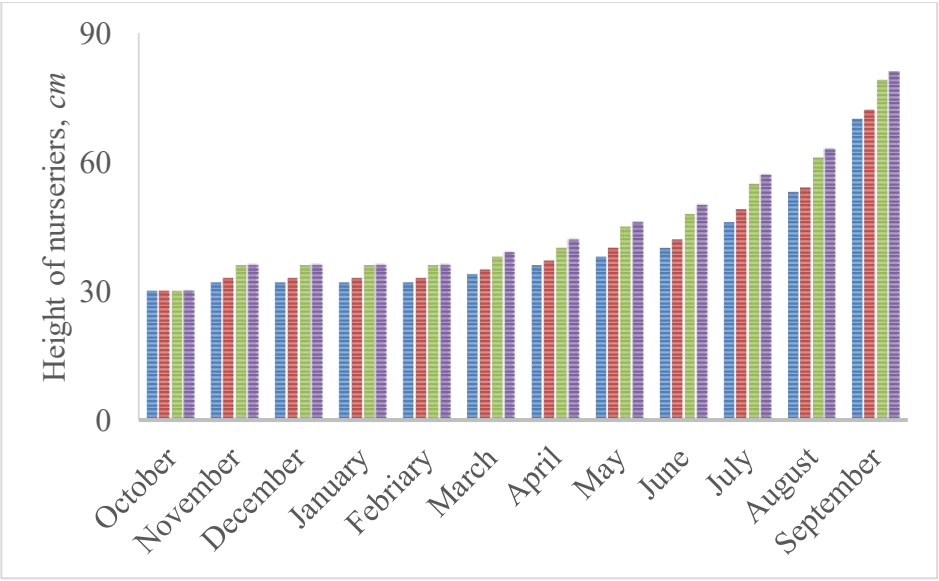

Fig. 1. Dynamics of growing mulberry tree nurseries height on months of 2020-2021 season. Here the blue color corresponds to control variant, brown color to red lighting variant, cyan - to blue and yellow - to white lighting variants.

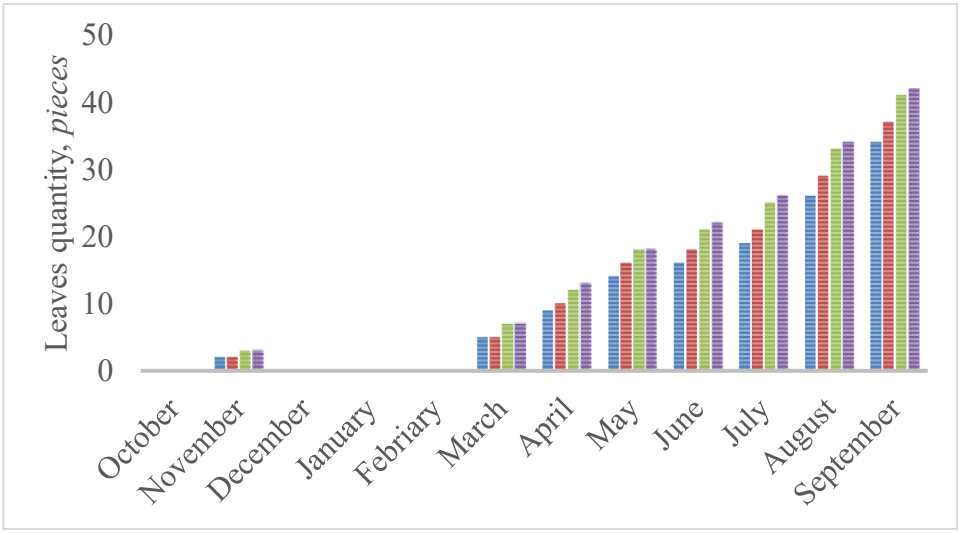

Fig. 2. Dynamics of growing mulberry tree nurseries leaves on months of 2020-2021 season. Here the blue color corresponds to control variant, brown color to red lighting variant, cyan - to blue and yellow - to white lighting variants.

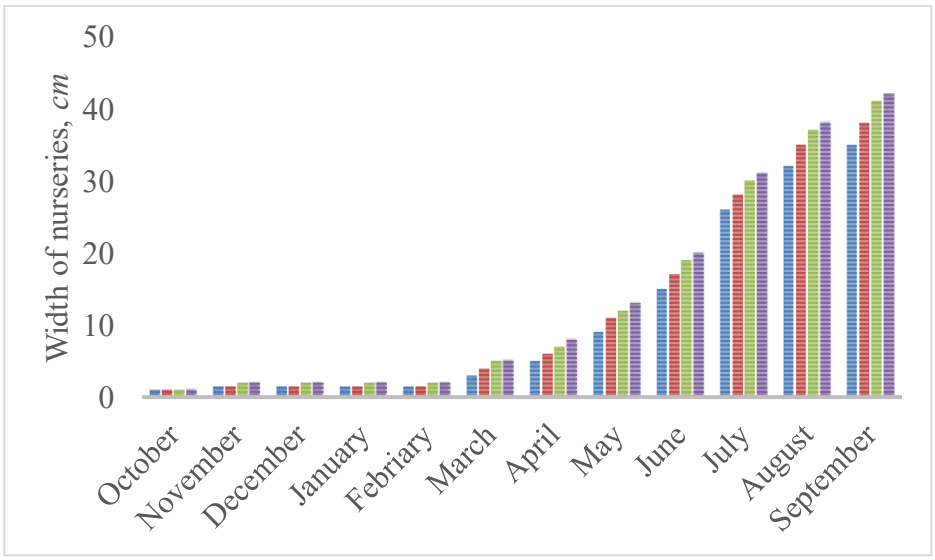

Fig. 3. Dynamics of growing mulberry tree nurseries width on months of 2020-2021 season. Here the blue color corresponds to control variant, brown color to red lighting variant, cyan - to blue and yellow - to white lighting variants.

4 Conclusion

Thus, based on the analysis of results of experiences carried out on revealing efficiency using in night period of LED lamps for growing height and developing the mulberry tree nurseries in greenhouse conditions we can conclude the followings. Firstly, using the LED

lamps accelerates the growth and development of nurseries both in height, and in leaves quantity, and in width of nurseries. At that the nurseries development degree differs from control variant in red lighting one is weakly and at the same time in the blue and white lighting variant it differs essentially.

Secondly, the maximal growth on height of nurseries relatively control variant in case of white lighting one in June was 25.0 % and the minimal growth in case of red lighting in August, 1.9 %. The average growth of the nurseries for the season was 3.3, 13.2 and 15.5 % in red, blue and white lighting variants, correspondingly. For the total season the relative growth on the height in comparison of beginning of experiences was 133.3, 140.0, 163.3 and 170.0 % in cases control variant, and red, blue and white lighting ones, correspondingly.

Thirdly, the most quantity of the nurseries leaves relatively on the control variant in case of white lighting one we observed in April, which equals to 44.4 %, and the least quantity in case of red lighting variant in August, 8.8. %. The average value for this degree for the season was 5.7, 21.9 and 24.3 % for red, blue and white lighting variants, correspondingly.

Fourthly, the development degree on the width relatively on the control variant we observed on March which equals 33.3, 66.7 and 66.7 % for red, blue and white lighting variants, correspondingly. The least extension corresponds to July, 7.7, 15.4 and 19.2 % for the same variants. The averaging value for this degree for the season was 9.5, 29.9 and 33.0 %, correspondingly. For the season the relative extension of nurseries in comparison of beginning experiences when we take into account the leaves too was 35, 38, 41 and 42 times on all four variants, correspondingly.

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