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EFFECTS OF DIFFERENT LEDS LIGHT SPECTRUM ON THE GROWTH, LEAF ANATOMY, AND CHLOROPLAST ULTRASTRUCTURE OF POTATO PLANTLETS IN VITRO AND MINITUBER PRODUCTION AFTER TRANSPLANTING IN THE GREENHOUSE

(ВПЛИВ СВІТЛОДІОДНОГО СПЕКТРУ РІЗНИХ СВІТЛОДІОДІВ НА РІСТ, АНАТОМІЮ ЛИСТЯ ТА УЛЬТРАСТРУКТУРУ ХЛОРОПЛАСТІВ КАРТОПЛЯНИХ ПРОРОСТКІВ У ВИРОБНИЦТВІ ПІСЛЯ ПЕРЕСАДКИ В ТЕПЛИЦІ)

Севлісян В. С. *– здобувач вищої освіти групи Ен маг. 1/1*

Науковий керівник – Марковська А.В., кандидат філолоічних наук, доцент кафедри іноземних мов МНАУ

У цій статті аналізується реакція рослин картоплі на спектр різних світло діодів та розглядається анатомія листя та ультраструктура хлоропластів розсади картоплі після висадки в теплиці.

Ключові слова: *розсада картоплі, світлодіодні спектри світлодіодів, анатомія листя, ультраструктура хлоропласту, виробництво міні-бульб.*

This article analyzes the reaction of potato plants to the spectrum of different LEDs an considers the anatomy of leaves and ultrastructure of chloroplasts of potato seedlings after planting in a greenhouse.

Key words: *potato seedlings, LED spectra of LEDs, leaf anatomy, chloroplast ultrastructure, production of minitubers*

Introduction. Potatoes are one of the most important crops in the world, with a yield of 400 million tons annually. However, this culture is likely to be infected with the virus, which leads to reduced production and degradation of embryonic plasma. Light plays a crucial role in regulating the growth and development of potato seedlings.

The aim of the work is: to analyze the reaction of potato plants to the spectrum of different LEDs, to consider the anatomy of leaves and ultrastructure of chloroplasts of potato seedlings after planting in a greenhouse.

Basic research materials. The test seedlings were treated at different light photoperiods (06: 00–22: 00) and (70 ± 5)% relative humidity (RH) at (23 ± 1) ° C for 4 weeks. The light procedures were 100% red (660 nm) LED lights (RR), 100% blue (450 nm) LED lights (BB), 65% red (660 nm) + 35% blue (450 nm) LED lights (RB), 45% red (660 nm) + 35% blue (450 nm) + 20% green (520 nm) LED

lights (RBG) and 100% white fluorescent lamps (CK) with 100 µmol m. The installation for light irradiation includes LED red, blue and green lamps. Each LED lamp was connected to a common controller capable of independently adjusting the light output of the same type of LED lamps. The range of lamps is shown in fig. 1.

Determination of growth parameters. After 4 weeks of exposure to different light spectra, stem length, stem diameter, fresh plant weight and dry plant weight were measured. Leaf area, root length and root diameter were measured by scanning. The content of free amino acids was measured by the method of ninhydrin To determine the activity of development of potato seedlings used fresh roots weighing 0.5 grams. The results of the influence of different LED spectra of lamps on the anatomical structure of potato seedling leaves are presented in Fig. 2 and table.1. The leaves of potato seedlings showed a smaller intercellular space during LED treatments (RR, BB, RB and RBG) (Fig. 2). In addition, the maximum leaf thickness of potato seedlings was found in BB and RBG, all of which were significantly larger than in LEDs (RR and RB). The thickness of the leaves in the explosive and RGB lamps was increased by 0.17 and 0.23 times, respectively. While the thickness of the leaves in RR decreased by 0.13 times. Although the lowest leaf thickness was found in RR (Table 1), the RR spectrum caused a regular and dense arrangement of spongy cells in the leaves of potato seedlings. And the thickness of UE and LE in RR was the largest, which was 1.62 and 1.27 times greater than in CK, respectively (Table 1).

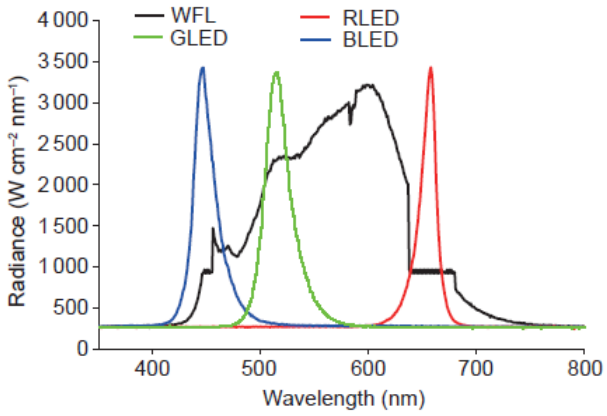

Fig.1 - Distribution of the spectrum of LEDs (bulbs) and fluorescent lamps used in this experiment. WFL - white fluorescent lamp; RLED - red LED; BLED- blue LEDs; GLED - green LED.

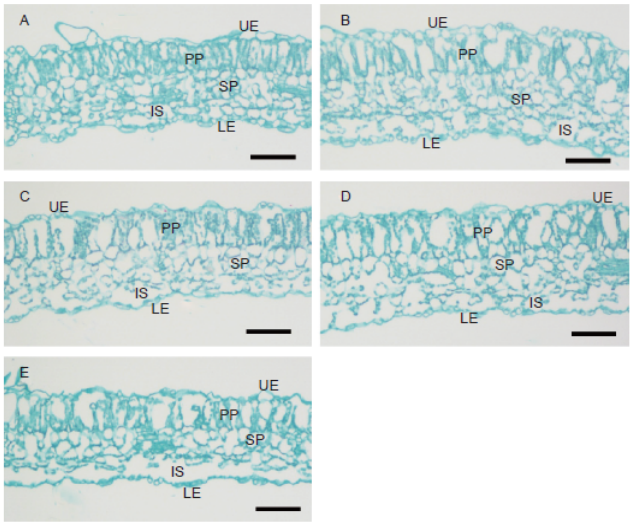

Fig. - 2. Leaf anatomical structure of potato seedlings grown under different light emitting diodes (LEDs), light spectrum.

A) and B) 100% red and 100% blue LEDs respectively.

C) 65% red + 35% blue LED spectrum.

D) 45% red + 35% blue + 20% green LED spectrum.

E) the range of fluorescent lamps. UE - upper epidermis; PP- palisade parenchyma; SP- spongy parenchyma; LE- lower epidermis; IP - intercellular spaces.

Table 1

Parameter	Light treatment				
	RR	BB	RB	RGB	CK
Upper epidermis	18.52±1.32 a	15.28±1.59 b	11.57±1.82 c	11.37±1.43 c	11.43±1.96 c
Palisade parenchyma	56.14±3.85 c	83.94±3.96 a	70.74±2.96 b	87.25±4.06 a	67.74±3.59 b
Spongy parenchyma	87.52±3.92 c	128.43±4.01 a	103.38±3.43 b	132.39±5.01 a	93.38±3.43 b
Lower epidermis	14.62±0.79 a	12.46±1.26 b	11.49±1.13 c	11.76±2.14 c	11.55±0.68 c
Leaf thickness	170.98±5.69 c	229.65±5.01 a	197.18±3.76 b	242.77±3.95 a	196.69±6.01 b

Conclusion. This study showed that the monochromatic blue LED spectrum (BB) and the combined red, blue or green LED spectrum (RB and RBG) promoted growth, inducing good chloroplast development in early-maturing varieties of Zhongshu 5 potatoes, as well as tuber productivity after transplanting. months. Potato seedlings with an explosive spectrum reduced the number of tubers per seedling, but improved the weight of the largest tuber after transplanting into a greenhouse. Potato seedlings under R G B increased the number of tubers per seedling, as well as the weight and percentage of large tubers. In summary, RBG is suitable for use in micropropagation of early-maturing varieties of potato varieties, and BB and RB can be used as alternatives.

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DIGITAL MARKETING AS AN EFFECTIVE SALES TOOL IN THE XXI CENTURY

Сизоненко Ю. С. *– здобувач вищої освіти групи Ф 3/1*

Науковий керівник - Тішечкіна К.В., кандидат філологічних наук, доцент кафедри іноземних мов МНАУ

Основною метою статті є пояснення частого використання цифрового маркетингу в сучасному світі, а саме ефективності та важливості цього напряму маркетингу в порівнянні з іншими в контексті комп'ютеризації та цифровізації всіх секторів сучасного суспільства.

Ключові слова: *цифровий маркетинг; оцифрування; інструменти цифрового маркетингу.*

The main purpose of the article is to explain the frequent use of digital marketing in the modern world, namely, the effectiveness and importance of this direction of marketing in comparison with others in the context of computerization and digitalization of all sectors of modern society.

Keywords: *digital marketing; digitalization; digital marketing tools.*

The relevance of this work lies in the fact that in the conditions of computerization and digitalization of various sectors of society, it is quite difficult for large corporations, manufacturers and even small organizations to draw the attention of buyers and interest them in their new products or services using classic advertising. Advertising and traditional means of promoting products are becoming less and less effective against the backdrop of the digital transformation of society.