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THE INFLUENCE OF THE WAVELENGTH OF LIGHT ON SEEDLINGS LETTUCE GROWING

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Abstract

The study was conducted at the Faculty of Horticulture in Bucharest, Romania Department of Hortiviticol Bioengineering Systems in 2012.
The seedlings production involves high costs for thermal energy. Using LED lighting leads to a shorter growing season and finally to an overall reduction in production costs.
The experiments were performed in growth chamber under controlled conditions regarding temperature, humidity and light. As biological material we used lettuce (*Lactuca sativa* L).
We found that there were differences in the growth of young plants of lettuce. Depending on the combination of colours (proportion between red and blue light) the reaction of plants was differently. All data obtained were processed with National Instruments Vision Assistant software 2009.
The aim of the experience was lettuce growers recommend using LED lighting particularly effective in producing seedlings.

Key words: lettuce, LED, growing

Introduction

Researchers have sought to address expansion space for growing different vegetable in restricted spaces using artificial lighting with LEDs (*Light-emitting diodes).*
At present, farmers are faced with price increases to provide additional lighting in greenhouses, at certain times when the light is low. Using incandescent lamps but causes high power consumption compared to LED lighting. Advantages of using LEDs provide: low-power, high productions, shortening the lettuce crop cycle, uniform plant development, good quality, low water consumption, reducing greenhouse emissions.
LEDs have started to be used in space by NASA since 1960, currently being widely used due to very low energy costs. By the 1980s, the Japanese have applied technology to increase planting, flowers and herbs.
LEDs not only a trend but has become an essential tool for survival in today's competitive market as its application is more diverse. (PARUS www.parus.co.kr, Plants grow with led lighting).
Light is a form of solar radiation energy that directly or indirectly triggers all living systems. The radiant energy must understand the full range of wavelengths that make solar photosphere radiation reaching the earth's surface. The main source of caloric energy is the radiant energy emitted by the sun. The effect of sun light on vegetable plants grown in protected areas is known. Light is a contributory factor in the growth of vegetable species representing photosynthesis energy support, the biomass structure and training. Light can condition the morphogenesis and organogenesis processes of plant thru intensity, duration and spectral composition.

Light quality directly influences physiological and chemical processes in plants the light spectrum radiation is selectively absorbed by chlorophyll pigments in a wider range than the human eye. Electromagnetic radiation differs in wavelength, colour and energy content. Sunlight spectrum ranges from red, orange, yellow, green, blue to violet, being visible spectrum of sunlight, plus at both ends of the spectrum, invisible to our eye colour, so that at one end is are infrared and ultraviolet to the other. Visible light radiation components are absorbed selectively. Chlorophyll absorbs light energy between 250-750 millimicrons, receptive maximum being between 280-500 and 650-680 millimicrons (Morrow, R.C., 2008).
It is known that leaves exposed to light predominates chlorophyll. A that better capitalizing red, orange and yellow radiation, but the leaves plants exposed at shade prevailing chlorophyll B and yellow pigments which capitalize blue-violet radiation, which leads to differences in the synthesis of carbohydrates and proteins (Niculita Petru, 2009).
Blue light is important for phototropism (Blaauw and Blaauw-Jansen, 1970 citated by Matioc, 2012), for stomata opening (Schwartz and Zeiger, 1984, citated by Matioc, 2012), and for inhibiting seedling growth on emergence of seedlings from a growth medium.
In addition it seems that LED's light improve the pollination and bumblebees activity and has an insecticide effect on aphidiae.
Knowledge the response to light quality vegetable plant allows growers to influence one or the other side of growth and development processes.
By using the proper combination of illumination light, it is possible to increase plant yield by more than 20 percent, while also improving product quality and extend the season of production. (Stalions Drake, 2011).

Materials and methods

The researches were conducted into Department of Hortiviticol Systems Bioengineering, Faculty of Horticulture, Bucharest, during 2011-2012.
As biologic material were used two lettuce varieties, Attraction and Murai Rijk Zwaan.
The seeding was carried out in the perlite substrate. The experiments were performed in growth chamber under environmental controlled conditions. It had been provided constant temperature of 22^{o}C during the day for 16 hours and 18^{o}C during 8 hours for night. It was used for each variety 50 seeds in three repetitions. Thus for every variety were sown 150 seeds how many.
The illumination was achieved using white light of neon as a witness and LED light consists of 70% red, 20% blue and 10% green light.
Bioleafez in concentration of 0.5% as fertilizer was used at intervals of 2 days.
In this study the behaviour of lettuce in different light was followed by assessing the percentage of germinated seeds, seedlings height growth dynamics, the dynamics of leaf mass and seedling root system development.

Results and discussions

By counting every day it was determined the percentage of seed germination. Based on observations made we found that the percentage of germination of lettuce seeds was between 97% and 100% for Murai Rijk Zwaan variety and 82% respectively 95% for the variety Attraction. The data presented in Table 1 show that for both varieties germination was higher when using the LED light.

Table 1. The influence of the nature of light on lettuce seed germination

Light	Date of sowing,	Date of sprouting	Percentage of germination, %	
			Murai Rijk Zwaan	Attraction
Neon	10.10.2012	13.10.2012	97	82
LED	10.10.2012	11.10.2012	100	95

The results are amazing because as we can see in the LED light the seeds germinated almost all for both varieties after one single day. In neon light seeds needed 3 days to germinate.
Observations on the dynamics of formation of lettuce leaves Attraction and Murai Rijk Zwaan varieties showed that in both varieties formed a greater number of leaves when seedlings growth under LED lighting (Figures 1 and 2).
As we can see from these figures, in both cases the number of leaves formed is higher in case of use LED light. Additionally variety Murai Rijk Zwaan is more productive than the variety Attraction. Thus at every period of 15, 20 and 30 days the number of leaves is higher for Murai Rijk Zwaan compared to variety Attraction.

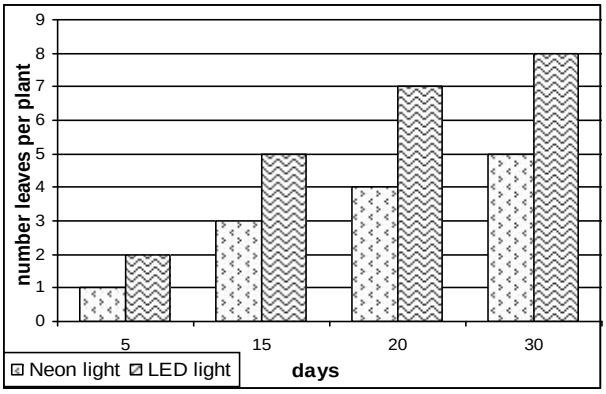


Fig.1 The dynamics of leaves formation at variety Attraction

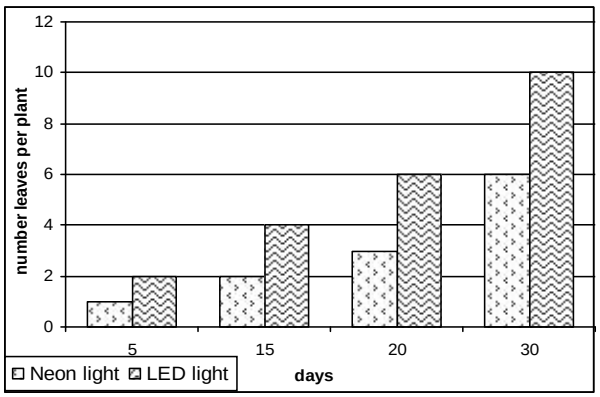


Fig.2 The dynamics of leaves formation at variety Murai Rijk Zwaan

There was a highly significant correlation of the number of leaf formation (fig. 3 and 4).

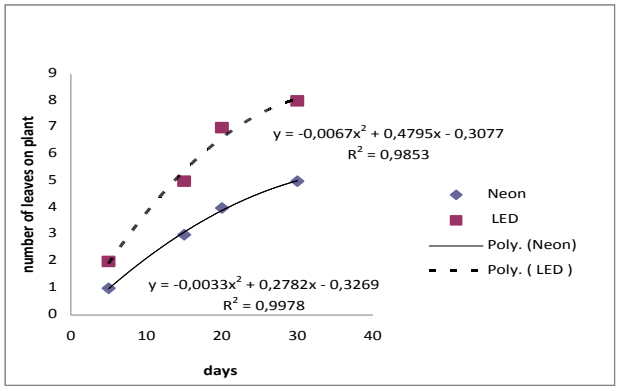


Fig. 3. Dynamics of training leaf at Attraction variety

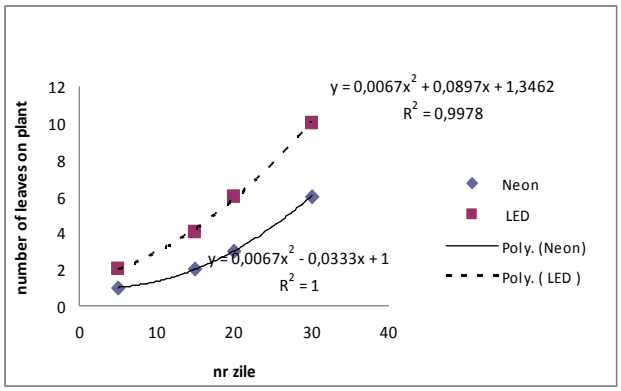
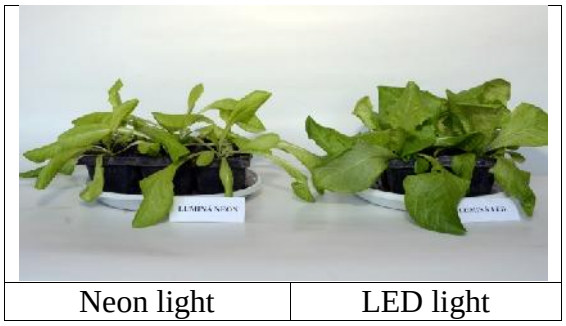
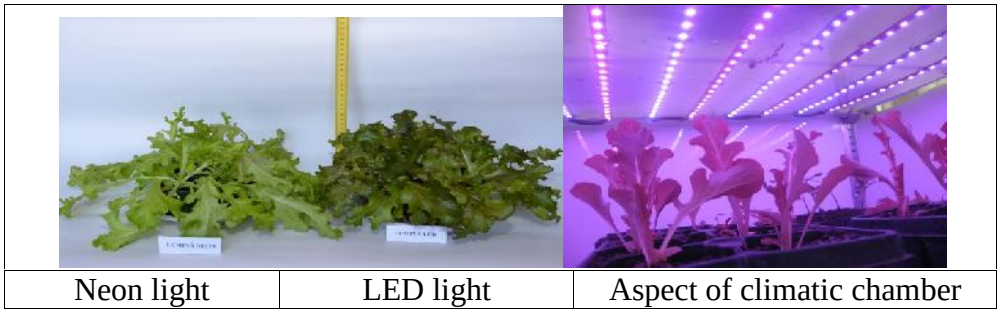


Fig. 4. Dynamics of training leaf at Murai Rijk Zwaan variety



Neon light	LED light

Fig. 5 The appearance in the two light sources after 30 days of variety Attraction.



Neon light	LED light	Aspect of climatic chamber

Fig. 6 The appearance in the two light sources after 30 days of variety Murai Rijk Zwaan

After a period of 30 days, the plants (transplants) of lettuce were weighed and dry mater analysed.

Mean mass per plant for both cultivars were higher for LED lighting.

Therefore the variety Attraction had a mean weight with 35.8% higher and the variety *Murai* Rijk Zwaan with 31.8% higher compared to plants exposed to neon light (table 2).

Table 2. The average weight of lettuce plants

Light	Attraction		Murai Rijk Zwaan	
	Mass g/plants	Percent to neon %	Mass g	Percent to neon %
Neon	12.91	100	13.75	100
LED	17.53	135.8	18.12	131.8

Therefore the conditions of cultivation by using LED lighting appear as favouring the development of plants (transplants).

Table 3. The dry matter content of lettuce plants

Variety	Variant	Dry matter %	The percentage of dry matter to V1 %
Murai	V1 - neon	780	100
	V2 -Led	977	125,26
Attraction	V1	741	100
	V2 Led	1069	144,26

Conclusions

These preliminary experiments show a favourable effect of LED light compared with the use of neon light, light commonly used in control cultures.
For all determinations the results were higher for both varieties in LED light culture conditions.

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