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The Effect of Green Light on Physiological Characteristics of Tomato Plants

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Abstract:- The influence of green light on the germination of tomato seeds, the amount of green pigments in the leaves, the activity of photosystem 2, and the parameters of the leaves were studied. Tomato plants were grown in an experimental plot on the plots with an area of 1 m^2. The pilot plants were coated with atransparent film transmitting light at wavelength of 420-480nm, 490-580nm and 620-680 nm during the growing season. It was found that green light (GL), like blue (BL) and red (RL) light, regulates metabolic processes in plants through its receptors.

***Keywords**:- Tomato, Seed Germination, Chlorophyll, Carotenoids, Photosystem 2.*

I. INTRODUCTION

The effect of white, red and blue light on the growth and development of various plants in the spectrum of sunlight falling on plants has been extensively studied, but little is known about the effect of green light with a wavelength (490-580 nm). According to the results of many studies in this field, green light has no physiological or photochemical activity in plants. These assumptions are based on the absorption spectra of chlorophyll a and b. These pigments, which play a key role in the process of photosynthesis, absorb blue light with a wavelength of 300-400 nm and red light with a wavelength of 600-700 nm, become excited and transfer their electrons to the receptors. Therefore, in experiments, green light is taken as a control option. According to the authors, green light plays a major role in very dense and overly shaded phytocenoses [Wang, Folta, 2013]. In such cenoses, plants growing in the lower tier or the leaves of the same plant absorb energy rich in green rays. It is logical to conclude that green light itself can play a role in photosynthesis. It is believed that high-intensity green light does not weaken the process of photosynthesis, but regulates growth. An increase in the share of green light in the light spectrum does not slow down and weakens the growth intensity of wheat, which indicates that it has a regulatory effect [Folta, Maruhnich 2007]. However, it is also known that green light can fully support the vital activity of plants. Thus, according to the literature, green light plays a major role in regulating the morphogenesis of plants. In our experiments, we studied the effect of green light on the growth and development of different varieties of tomato plants using transparent curtains that emit light at 500-600 nm.

II. MATERIALS AND METHODS

Five tomato varieties (Lycopersiconesculentum Mill.) wereused in the work: early ripening variety Volgograd, highlyproductive variety Tolstoy, mid-ripening varieties Falkon,22-24, and Rally. Plants were grown onthe experimental plots with an area of 1m^2. The pilot plants were coated with atransparent film transmitting light at wavelength of 420-480nm, 490-580nm and 620-680 nm during the growing season (June - July).For physiological and biochemical studies, samples of fullyformed leaves were taken every week at 11 o'clock.Photosynthetic pigments were determined by homogenizingleaves in 96% ethanol, further centrifuging at 200 g. Thecontent of chlorophyll a and b was determined ona spectrophotometer at wavelengths of 665 and 649 nm.

Theactivity of photosystem 2 (PS 2) was determined using a Fv / Fmcoefficient, where $Fv=Fm - F_0$; F_0 – fluorescence of "dark"leaves, Fm - fluorescence of "light" leaves. The means of values were compared by Duncan'smultiple range test (p=0.05).

III. RESULTS

When studying the effect of red, blue and green light on the germination energy and germination rate of tomato seeds, it was found that the highest germination intensity was observed in red light, then in green light, and the weakest in blue light (Table 1).

Table1.Influence of light spectrum on germination of tomato seeds.

Varities	**Germination energy, %**			**Germination, %**		
	420-480 nm	490-580 nm	620-680 nm	420-480 nm	490-580 nm	620-680 nm
Falkon	35	45	50	60	70	80
22-74	37	48	52	62	75	85
Krasnodar	39	50	56	64	76	88
Volgograd	40	52	58	66	78	90
Tolstoy	42	55	59	68	80	92
Ralli	41	54	58	67	79	90

As seen from the table, the highest germination energy and germination percentage were observed in red at all varieties. In the green light, these quantities were higher than in the sky. At the same time, there are differences between the varieties. High germination intensity was observed in Krasnodar, Volgograd and Tolstoy varieties in all spectra. The seedlings of higher plants adjust their height according to the direction of the incident light so that the process of photosynthesis can proceed normally. As a rule, phototropism is regulated by blue and ultraviolet-A light, but is also effective in green light. Red light by phytochrome also stimulates phototropism. Experiments with chlorella have shown that green light also regulates carbohydrate metabolism, increases the amount of disaccharides, reduces the amount of polysaccharides. In long-term green light, on the other hand, the amount of starch increases and the amount of disaccharides decreases. Despite the research, the mechanism of the effect of green light on plant life has not yet been fully elucidated, which is necessary to establish the ratio of spectra under artificial illumination of plants. In our experience, some differences were observed in the morphometric parameters of tomato plants grown in long-term green, blue and red light(Table 2).

Table 2. The area and dry weight of leaves of 45-day-old tomato varieties grown in different spectrum of light*

Varities	**Light spectrum**			
	Blue	**Green**	**Red**	**White**
Leaf area, sm ^{2}				
Falkon	170±11	168±11	221±12	225±15
22-74	165±13	160±15	219±15	220±11
Krasnodar	175±12	171±12	225±16	227±13
Volgograd	150±9	148±10	215±14	218±12
Tolstoy	180±15	175±14	230±12	229±13
Ralli	168±14	164±13	195±11	194±14
Dry mass, g				
Falkon	0.68±0.02	0.56±0.07	0.78±0.02	0.88±0.05
22-74	0.64±0.04	0.53±0.08	0.75±0.01	0.82±0.06
Krasnodar	0.69±0.03	0.62±0.06	0.67±0.02	0.79±0.04
Volgograd	0.55±0.02	0.52±0.05	0.56±0.03	0.66±0.02
Tolstoy	0.72±0.01	0.68±0.04	0.65±0.04	0.89±0.03

*Each value represents the mean±SD (standard deviation) for the mean n=3 independent experiments p=0.05.

As seen from the table, in plants growing in green light, the leaf area is the same as in blue light. Due to their dry mass, plants that grow in green light are slightly different from plants that grow in blue light.

It has been found that during the intensive growth of the baby leaf, the area of the leaf is mainly due to the active division of cells. Green light has a slowing effect on cell division [Sun et al.,1998]. This effect was more pronounced in dicotyledonous plants. The mechanism of action of green light on cell division and stress is poorly understood. It was found that the number of chloroplasts per unit area of a leaf is less in green light than in red and blue light. This is due to the low intensity of photosynthesis in green light. However, in green light, the area of chloroplasts was larger than in red and blue light[Terashima et al. 2009].During the long-term exposure to green light, the assimilation of carbon dioxide was close to that of red and blue light.

In our experiments, the amount of chlorophyll pigments in the leaves and the photochemical activity of chloroplasts were close to those in green light and blue and red light (Table 3).

Table 3. The amount of chlorophyll and photochemical activity of chloroplasts in plants grown in different spectrum oflight*

Varities	**Light spectrum**							
	Blue		Green		Red		White	
	Chl a+b mg/g	PS 2	Chl a+b mg/g	PS 2	Chl a+b mg/g	PS 2	Chl a+b mg/g	PS 2
Falkon	3.4±0.05	67±0.02	2.4±0.02	56±0.05	3.6±0.02	68±0.01	3.2±0.07	67±0.1
22-74	2.5±0.01	66±0.06	2.1±0.04	54±0.01	2.8±0.03	67±0.02	3.4±0.07	65±0.8
Krasnodar	4.5±0.02	72±0.02	3.2±0.01	62±0.02	4.4±0.08	74±0.06	3.6±0.02	69±0.9
Volqoqrad	4.8±0.04	75±0.04	3.5±0.02	65±0.04	4.8±0.01	78±0.04	4.5±0.01	71±0.2
Tolstoy	4.7±0.02	78±0.01	3.8±0.03	68±0.03	4.9±0.02	80±0.02	4.8±0.04	78±0.3
Ralli	3.6±0.04	65±0.03	3.5±0.05	58±0.03	3.7±0.02	88±0.02	4.9±0.02	39±0.5

*Each value represents the mean±SD (standard deviation) for the mean n=3 independent experiments p=0.05.

As seen from the table, both the amount of pigments and the photochemical activity of chloroplasts were slightly higher in blue and red light than in green light. As for the differences between varieties, these quantities were greater in Krasnodar, Volgograd and Tolstoy varieties.

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IV. DISCUSSION

Similar results have been obtained in experiments with other plants by other authors [Wang, Folta, 2013]. Green light causes changes in leaf mesostructure, reduces the amount of green pigments, which affects the intensity of photosynthesis, and as a result slows down the transition of plants from vegetative to generative development.

The usefulness of green light in plant growth applications has been demonstrated by many researchers from various universities and research institutes. For example, in an experiment conducted at Michigan State University, partially replacing green light with red light (resulting in 25 to 50 percent green light) reduced seedling growth, making the leaves slightly smaller and the stems shorter. However, the fresh weight of the plants was similar. Some experiments show that at higher proportions of green light can actually promote extended growth, which is somewhat similar to the effects of far red radiation. The flowering of plants with a photoperiodic flowering reaction is primarily regulated by two pigments: phytochrome and cryptochrome. Phytochrome primarily absorbs red and far-red radiation, while cryptochrome mainly absorbs blue and ultraviolet radiation. These pigments also absorb green light, although to a much lesser extent. Because of this, one would expect that green light delivered at night (to create a long day) would be relatively ineffective in regulating flowering. However, our recent research has shown that for many plants, green light is as effective in regulating long day flowering as the same intensity of red and far red light. For all three colors, direct light penetrates more deeply than diffuse light, and for both direct and scattered light, GL penetrates much deeper than RL and BL. Accordingly, both the upper part of individual leaves and the upper dome as a whole are saturated with RL and BL; additional GL is most likely more useful for increasing photosynthesis of the whole plant than RL or BL. This Effect was experimentally confirmed by Terashima et al. (2009), who reported that at high PPF, GL stimulates leaf photosynthesis more efficiently than RL and BL. Thus, the entire plant photosynthesis can be increased GL in two ways: first, by increasing total photosynthesis in individual leaves and two, by transferring to the lower layers of the leaf. Whole plant studies show that GL supplementation can improve plant growth.

V. CONCLUSION

Thus, the analysis of the obtained results suggests that in plants, as in red and blue light, green light has receptors, and green light regulates metabolic processes through these receptors.

REFERENCES

[1]. Folta K.M., Maruhnich S.A. Green Light: a signal to slow down or stop. J. Exp. Bot. 2007;58:3099-111.
[2]. Sun J, Nishio J.N., Vogelmann T.C. Green light drives CO_2 fixation deep within leaves. Plant Cell Physiol. 1998;39:1020-26.
[3]. Terashima I, Fujita T, Inoue T, Chow W.S., Oguchi R. Green light drives leafe photosynthesis more efficiently than red light and strong white light: revisiting the enigmatic question of why leaves are geen. Plant Cell Physiol. 2009;50:684-89.
[4]. Wang Y, FoltaK.M..Contribution of green light to plant growth and development.Am. J. Bot. 2013; 100:70-78.