The Effects of Light-Eemitting Diodes (LED) and Light Intensity in the Growth and Quality of Tomato Seedling *In Vitro*

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Abstract

The forthcoming of LED technology to produce high-quality white light with unprecedented energy productivity is the impetus for the intense level of study and improvement now. In this presentation, the effect of the red, blue light emitting diodes (LED) and white fluorescent lampson in the morphogenesis of tomato seedling grown *in vitro* have been studied by using four groups of light-emitting diode under four levels of the light intensity to determine the combined influence of the light in tomato. Six morphological factors record under treatments are taken *in vitro*. Maximum rate of the plant length, number of nodes , number of branch and number of leaves, have been obtained in (6:2:1) spectral (LED) mixture, with decreaseing of light intensity at 500 and 1000 lux. In conclusion, the contribution of red and blue light to significant affected the morphology and quality of tomato seedling in micropropagation .

1. Introduction

In vitro, culture techniques are used wide-reaching to yield pre-basic, virus-free seed tomato; have tremendous advantages in terms of storage, transportation and mechanization. They can be directly sown into the soil and can be produced in bulk in any season. They have the similar morphological and chemical physiognomies to ground produced seedling [1]. In other words, according to the mainstream of readings have been done, *in vitro*, plant renewal depends on many factors, such as explant kind, genotype, rudimentary medium components, growth regulators, crystallizing agent, light intensity and value, photoperiod, and temperature [2]. It is important to test a wide collection of cultivars to improve a global applicable protocol for stem regeneration in tomato [3].

The tomato (*Lycopersicon esculentum* Mill.) is a commercially important crop during the world [4]. It was very clear that, newly the world has shown an growing interest in the planting tomato as the high portability for tissue culture techniques, the conservation and germplasm exchange. However, morphogenesis in cultivated tomato has been achieved less frequently compared to other members of the family Solanaceae, such as Nicotiana spp., Petunia spp., and Solanum spp., known for their amenability to *in vitro* culture techniques. The record often used way of renewal in tomato is through stem organogenesis from callus from leave or cotyledon explants or directly from thin cell layers of the inflorescence [5].

Unfortunately, there is little information on the light-emitting diodes (LEDs) were tested for vegetable growth and currently more and other often are rummage-sale for plant lighting [6]. Consequently, the LEDs have a variety of remunerations ended traditional forms of horticultural lighting. Their small size, toughness, extended lifetime, cool producing temperature, and the selection to first-rate unambiguous wavelengths for targeted vegetable reply make LEDs new appropriate for plant-based uses than many other light sources [7]. Conventional lighting systems for lab utilize broad-spectrum light sources, such as high weight sodium (HPS) or fluorescent lamps. The lamps are outstanding glowing foundations for the human sense, but the are not the well-organized light sources for vegetable production, due to their little levels of blue light and new photosynthesis subtle wavelengths. Light-emitting diodes (LEDs) are a fifty year old knowledge which is presented possible in the greenhouse and glasshouse production. In general, with LEDs, specific wavelengths container be shaped, making a custom light spectrum targeted for maximum vegetable production. Furthermore, the studies have shown that the maximum significant wavelengths for photosynthesis are in the blue and red wavelengths; advancements in photosynthetic efficacy are found at 440 (blue), 620 (red) and 670 (red) nm (+/- 10 nm) (McCree 1972a). In the matter, an enhanced dependable tissue culture method is a sensible another for efficient production of mixture seedlings with high quality and free from pathogens[7]. Hence, the study presented here aims to explore the undertaken to discovery out the preferable construction of Light-emitting diodes (LED) with the best of light intensity (combined), for through renewal of tomato in tissue culture.

2. Materials and Methods

This study was conducted during seasons of 2017 in Institute of Vegetables and Flowers (IVF) of chaina, Free disease tissue culture plantlets are used in this study. The stock explants are multiplied by using Hypocotyl (1 cm), cotyledon (0.5 ± 0.5 cm^2) and leaf (0.5 ± 0.5 cm2) explants excised from four leaves [8]. *In vitro* grown from seeds of genotypes T-3-, T-20 and T -7 during summer 2017. The media is prepared properly when the required number of explants is obtained. In addition, the following ingredients are taken based on [9]. 4.43 g /L of MS powder, medium contained 30 g /L sucrose, and 5.89g /L, agar. The pH of the media was adjusted to 5.8 ± 0.01 with 0.1 N either NaOH or 0.1 N HCl before agar use. In a culture, jar prepared under the laminar air flower with filtration method. All these are placed inside a growth chamber for four weeks. In this experiment, the device is placed above the table for observation and established in the following conditions: the shelf without normal light, the combination of LED light provided with (6:2:1), (5:2:0), (4:1:1), (3:1:1) for (red: blue: white, respectively) and different levels of the light intensity (500, 1000, 1500 and 2000 lux) are taken in (Fig.1). The experiment was organized in a Completely Randomized Design (CRD), for each treatment, three replicates are subjected to distinctive combinations of the light spectra and intensities. During the 30 days after planting. firstly, the samples are chosen and then the measurements are recorded for several traits individually such as the plant height (cm), node number node, branch number, leave number, root length (cm) and the fresh weight of seedling (mg) in all the emerge for seedling.

Fig 1. Growth of seedling under combinations of LED light (6:2:1), ((5:2:0), (4:1:1) and (3:1:1) with light intensity (500, 1000, 1500 and 2000 lux)

2.1. Statistical Analysis

Data are analyzed by using the Statistical Analysis System program package [10]. for three samples in each test. The data are expressed by mean ±SEM, Variance (ANOVA), and test significance of differences at $p < 0.05$.

3. Results

3. 1. Plant Height (cm)

The data related to the effect of light-emitting diodes (LED) with light intensities and varieties plant height is presented in (Table-1). The highest rate is up to 9.53 cm with T- 20. In contrast, this highest is achieved in the 500 lux light intensity and the high rate to plant height is 10.22 cm, so it surpassed to other dealings. Seedling developed under LED light is significantly practical with combination (6:2:1) give the plant height 10.14 cm. The joint intersection (X × Y) shown the recorded 11.53 cm with (6:2:1) and 500 lux. Including, the combination (4:1:1) is the recorded lowest rate 7.91 cm in 2000 lux light intensity. However, with (X × Z) affects the plant height in the (6:2:1) through variety T-20 which recorded the all-out rate 10.99 cm, so it exceeded all other treatments. There is a significant effect of between (Y × Z) on the length on 500 lux through variety T- 3 which gives the highest rate 10.40 cm. It was very clear that three-way (X × Y × Z) for the variety T- 20 through (6:2:1) of LED light and 500 lux light intensity is recorded the developed rate 12.01 cm, the grouping (4:1:1) and 2000 lux light intensity for variety T-3 is recorded the lower rate 6.97 cm.

Table 1: Effect of LED light and light intensity in plant height (cm) of the laboratory condition.

Treatments		Genotypes *Z			*X*Y
Red: Blue: White *X	Intensity(lux) *Y	T- 3	T- 20	T-7	
6:2:1	500	11.43	12.01	11.17	11.53
	1000	10.32	11.65	9.55	10.50
	1500	9.18	10.32	8.14	9.21
	2000	9.33	9.98	8.67	9.32
5:2:0	500	10.44	9.76	10.61	10.27
	1000	9.19	10.31	9.19	9.56
	1500	9.11	10.18	9.44	9.59
	2000	7.39	8.17	9.88	8.48
4:1:1	500	8.98	10.09	9.71	9.61
	1000	8.11	9.41	9.70	9.09
	1500	9.66	8.10	8.81	8.85
	2000	6.97	7.68	9.09	7.91
3:1:1	500	10.76	8.44	9.30	9.50
	1000	8.99	9.14	9.50	9.21
	1500	7.65	8.77	7.78	8.08
	2000	8.40	8.64	7.45	8.16
*X*Z					*X
	6:2:1	10.06	10.99	9.38	10.14

	5:2:0	9.03	9.60	9.78	9.47
	4:1:1	8.43	8.82	9.32	8.85
	3:1:1	8.95	8.74	8.54	8.74
					***Y**
***Y*Z**	500	10.40	10.07	10.19	10.22
	1000	9.15	10.12	9.48	9.58
	1500	8.90	9.34	8.54	8.95
	2000	8.02	8.61	8.77	8.46
***Z**		9.11	9.53	9.24	
Note: LSD *X=0.10, LSD *Y =0.13 , LSD *Z=0.11 , LSD *XY=0.37 , LSD *XZ=0.33 , LSD *YZ=0.35 and LSD *XYZ=0.50.					

3.2. Nodes of Number

The data presented in (Table-2).Show that the average nodes of number was significantly (P<0.05) to LED light and with light intensities in both varieties (Table-2) the variety T- 3, which achieved better when compared to other varieties, which presented the highest rate 7.81, whereas T-7 variety recorded lowest level 6.83. Analyses of difference exposed important changes among levels of light intensity, representative that 500 lux intensity recorded rate 8.08. However, the node number better recorded rate 7.88 with (6:2:1) of LED. The interaction (X × Y) had a drastic effect on the node, where the high rate was recorded at composition (6:2:1) and 1500 lux was 8.77. Conversely, with (3:1:1) of LED and 1500 lux, the lesser rate was 5.42. In the same way, the (X ×Z) at combination (6:2:1) and variety T- 20 recorded the highest rate 8.85. Thereafter, the effects of (Y × Z) for the average of node obtained the highest rate at 500 lux and variety T-3 recorded 8.89. Furthermore, the interaction (X ×Y × Z) for node number was significant (p<0.05) at (6:2:1) of LED, 2000 lux and variety T-20, recorded 9.71. Whereas, the recorded rate 5.06 for (3:1:1), 2000 lux and variety T-7.

Table 2. Effect of LED light and light intensity in node number of the laboratory condition.

Treatments		**Genotypes *Z**			***X*Y**
Red: Blue: White *X	**Intensity(lux) *Y**	**T- 3**	**T- 20**	**T-7**	
6:2:1	500	9.08	8.96	7.76	8.60
	1000	8.43	9.71	8.17	8.77
	1500	6.54	9.22	6.19	7.31
	2000	5.98	7.54	7.09	6.87
5:2:0	500	8.78	8.05	7.14	7.99
	1000	6.98	8.09	7.14	7.39
	1500	7.13	9.02	6.12	7.42
	2000	6.89	7.43	6.16	6.82
4:1:1	500	9.54	7.71	8.11	8.45
	1000	7.32	7.00	8.13	7.49
	1500	7.01	6.98	6.15	6.71
	2000	6.88	7.21	5.96	6.67
3:1:1	500	8.18	6.59	6.89	7.22
	1000	7.42	8.09	6.10	7.20
	1500	5.99	6.51	7.13	6.54
	2000	6.03	5.18	5.06	5.42
***X*Z**					***X**

	6:2:1	7.50	8.85	7.30	7.88
	5:2:0	7.44	8.14	6.64	7.40
	4:1:1	7.68	7.22	7.08	7.32
	3:1:1	6.90	6.59	6.29	6.60
					***Y**
***Y*Z**	500	8.89	7.82	7.47	8.08
	1000	7.53	8.22	7.38	7.71
	1500	6.66	7.93	6.41	7.00
	2000	8.17	6.84	6.06	7.02
***Z**		7.81	7.70	6.83	
Note: LSD *X=0.16, LSD*Y =0.18 , LSD *Z=0.12 , LSD *XY=0.31 ,LSD *XZ=0.35 ,LSD* YZ=0.38 and LSD *XYZ=0.98.					

3.3. Branch Number

The results pertaining to the branch number influenced by LED and light intensity application rates are given in (Table-3). It is evident from the data that the effect of different photoperiod potential application rates on varieties, the T-20 was an increaseing in average values of branches traits when associated to corresponding varieties. At the same time, when associated to the other heights' intensity at 500 lux which showed the very high response to a number of branches recorded 2.88. Whereas, 2000 lux of intensity had a bad effect on the number of branches recorded 1.65. In the matter, the extreme just increased was 2.42 for 3:1:1 of LED light. Furthermore, in the (X × Z) it was found on (6:2:1) and T-20 the highest recorded rate 2.62 of branch number. Likewise, the (Y × Z) at 500 lux with variety T-7 was recorded 3.09. At the same time, the highest decreaseing in 2000 lux and variety T-3 was recorded 1.31. In the matter, the results showed that interaction (X × Y) had an effect on the branch number recorded was 3.11 at (6:2:1) and 500 lux. As expected, the (X × Y × Z) gave improvement with combination (6:2:1) and 500 lux light intensity for variety T-20, which was recorded higher rate up to 3.87.

Table 3. Effect of LED light and light intensity in branch number of the laboratory condition.

Treatments		**Genotypes *Z**			***X*Y**
Red: Blue: White *X	**Intensity(lux) *Y**	**T- 3**	**T- 20**	**T-7**	
6:2:1	500	3.33	3.87	2.15	3.11
	1000	2.08	1.98	2.14	2.06
	1500	0.98	2.87	0.18	1.34
	2000	0.96	1.74	1.91	1.54
5:2:0	500	2.98	1.56	2.87	2.47
	1000	2.09	1.76	2.11	1.98
	1500	1.23	1.55	2.07	1.61
	2000	0.98	2.04	0.87	0.97
4:1:1	500	3.14	2.76	2.88	2.92
	1000	2.18	2.09	0.99	1.75
	1500	1.87	2.21	1.98	2.02
	2000	2.21	2.23	1.19	1.87
3:1:1	500	2.88	2.78	2.90	2.85
	1000	2.87	2.22	2.10	2.39
	1500	3.11	2.19	2.34	2.54

	2000	1.11	1.90	2.76	1.90
***X*Z**					***X**
	6:2:1	1.83	2.62	1.59	2.01
	5:2:0	1.82	1.72	1.98	1.84
	4:1:1	2.35	2.32	1.76	2.14
	3:1:1	2.49	2.27	2.52	2.42
***Y*Z**					***Y**
	500	2.82	2.74	3.09	2.88
	1000	2.30	2.01	1.83	2.04
	1500	1.79	2.23	1.64	1.88
	2000	1.31	1.97	1.68	1.65
***Z**		2.06	2.23	2.08	

Note: LSD *X=0.13, LSD*Y =0.11 , LSD *Z=0.11, LSD *XY=0.24, LSD *XZ=0.28 ,LSD *YZ=0.21 and LSD *XYZ=0.85.

3.4. Number of Leaves

It is evident from the data related to leaf number in (Table-5) and (Table 4) that the variety T-4 surpassed others which registered 12.75. The manifold significant of light intensity effect in a number of leafs, which registered 13.36 with 1500 lux light intensity, At the same time, the highest with the combination (3:1:1) was registered 13.19. Among the different (X × Y) had a significant effect in the leaves number the maximum rate in (3:1:1) of LED for 1500 lux intensity registered 15.30. The intersection among (X × Z) had a significant effect in the leaves number level (4:1:1) with variety T-20 was registered 14.51. On the other hand, the (Y × Z) a important effect for the leave number with1500 lux for variety T-20 which registered 14.79. On the other hand, the interaction (X ×Y × Z) effect due to the combined application of LED light x light intensity x varieties was significantly ($p<0.05$) of leave number which registered 17.75 for T-20 and (6:2:1) LED light with 1500 light intensity.

Table 4. Effect of LED light and light intensity in number of leaves of the laboratory condition.

Treatments		**Genotypes *Z**			***X*Y**
Red: Blue: White *X	**Intensity(lux) *Y**	**T- 3**	**T- 20**	**T-7**	
6:2:1	500	15.13	13.71	11.95	13.60
	1000	11.87	13.87	11.52	12.42
	1500	11.44	17.75	10.11	13.10
	2000	10.13	12.40	11.76	11.43
5:2:0	500	13.43	12.87	10.32	12.20
	1000	11.65	13.78	12.21	12.55
	1500	14.23	11.66	10.73	12.21
	2000	9.69	12.14	13.29	11.70
4:1:1	500	15.13	13.68	12.18	13.66
	1000	13.61	15.19	10.99	13.26
	1500	13.53	13.87	11.09	12.83
	2000	10.67	15.33	11.89	12.61
3:1:1	500	13.66	12.65	10.18	13.16
	1000	13.51	12.98	13.49	13.32
	1500	14.86	15.89	15.17	15.30
	2000	11.54	11.04	13.44	11.97

*X*Z					*X
	6:2:1	12.14	14.43	11.83	12.81
	5:2:0	12.25	12.61	11.63	12.16
	4:1:1	13.23	14.51	11.53	13.09
	3:1:1	13.39	13.14	13.06	13.19
*Y*Z					*Y
	500	14.33	13.22	11.15	12.90
	1000	12.66	13.95	12.05	12.88
	1500	13.53	14.79	11.77	13.36
	2000	10.50	12.72	12.59	11.93
*Z		12.75	11.28	11.89	
Note: LSD* X=0.13, LSD *Y=0.19, LSD *Z=0.21, LSD *XY=1.63, LSD *XZ=1.45, LSD * YZ=1.33 and LSD *XYZ=2.09.					

3. 5. Root Length (cm)

Data presented in (Table-1) showed the response of used LED light and light with three varieties their interaction treatments on the root length. For the T-20 variety the length was registered 9.34 cm. In addition, with 1500 lux on the root length recorded 9.47 cm. In contrast, the effect of 2000 lux intensity on the root length recorded 8.80 cm, .Furthermore, at (6:2:1) of LED recorded the maximum recorded the root length 9.57 cm. Hence, The interaction effect (X × Y) for root length with the combination (5:2:0) and 1500 lux recorded highest root length was 10.30 cm. Additionally, the intersection (X × Z) with (5:2:0) and variety T-20 which was 9.81 cm. Likewise, the intersection (Y × Z) on the root length at 1500 lux and varietyT-20 registered 10.00 cm. The result indicated a significant interaction between (X × Y × Z) effect on the root length recorded 10.97 with (5:2:0) of LED light, 1000 lux and variety T- 7.

Table 5. Effect of LED light and light intensity in root length (cm) of the laboratory condition.

Treatments		Genotypes *Z			*X*Y
Red: Blue: White *X	Intensity(lux) *Y	T- 3	T- 20	T-7	
6:2:1	500	9.27	9.53	10.45	9.75
	1000	10.24	9.77	8.17	9.39
	1500	9.54	9.98	10.08	9.86
	2000	9.76	8.14	9.43	9.11
5:2:0	500	8.18	9.88	9.75	9.27
	1000	10.18	9.76	10.97	10.30
	1500	9.14	10.33	8.98	9.48
	2000	7.72	9.44	9.32	8.82
4:1:1	500	9.65	9.87	8.99	9.50
	1000	9.16	8.79	9.98	9.31
	1500	8.99	10.12	8.97	9.36
	2000	8.64	9.80	8.95	9.13
3:1:1	500	8.09	8.76	9.64	8.83
	1000	8.98	7.81	8.72	8.50
	1500	9.54	9.58	8.41	9.17
	2000	8.13	7.98	8.32	7.81
*X*Z					*X
	6:2:1	9.70	9.35	9.53	9.57
	5:2:0	8.80	9.81	9.75	9.46

	4:1:1	9.11	9.64	9.22	9.32
	3:1:1	8.68	8.53	8.77	8.66
					***Y**
***Y *Z**	500	8.79	9.51	9.70	9.33
	1000	9.64	9.03	9.46	9.36
	1500	9.30	10.00	9.11	9.47
	2000	8.56	8.84	9.00	8.80
***Z**		9.07	9.34	9.31	
Note: LSD *X=0.31, LSD *Y =0.33, LSD *Z=0.20, LSD *XY=0.42, LSD *XZ=0.41, LSD *YZ=0.45 and LSD *XYZ=0.89.					

3.6. Fresh Weight of Seedling (mg)

Perusal data indicated that light-eemitting-diodes and light intensity have significantly influenced on the fresh weight (Table 6). As a result, the T-20 variety is recorded was 132.21 mg. Furthermore, at 1000 lux, efficient in increasing which was 137.89 mg. additionally, at combination (4:1:1) of LED recorded 138.71 mg, while the combination (6:2:1) recorded 118.63 mg. The interactions among (Y× Z) on the fresh weight recorded 159.30 mg in 1000 lux and T- 20. Furthermore, the (X × Y) combination (6:2:1) of LED and 1000 lux are light intensity. It was very clear that, at (6:2:1) of light-eemitting-diodes and 2000 lux light intensity recorded the highest value 96.80 mg. In the same way , the intersection (X × Z) in (4:1:1) LED light and variety T-20 recorded the maximum 148.58 mg The interaction effect (X× Y × Z), on The Fresh weight which registered 214.46 mg at (4:1:1) ,500 lux and variety T-3. Whereas, the (6:2:1), 2000 lux of light intensity and variety T-7 is recorded 97.39 mg.

Table 6. Effect of LED light and light intensity in fresh weight (mg) of the laboratory condition.

Treatments		**Genotypes *Z**			***X*Y**
Red: Blue: White *X	**Intensity(lux) *Y**	**T- 3**	**T- 20**	**T-7**	
6:2:1	500	132.66	98.99	107.33	112.99
	1000	219.54	138.95	118.12	`158.87
	1500	100.43	101.61	115.56	105.89
	2000	89.91	103.10	97.39	96.80
5:2:0	500	117.66	123.31	110.11	117.02
	1000	102.14	123.71	118.99	114.96
	1500	98.91	198.76	121.18	139.64
	2000	118.76	110.98	118.14	115.96
4:1:1	500	171.18	156.09	132.88	153.38
	1000	134.87	182.03	159.90	158.94
	1500	141.68	149.07	127.57	139.44
	2000	98.89	107.11	103.29	103.09
	500	154.63	133.77	148.08	145.49

3:1:1	1000	147.22	99.85	109.43	118.83
	1500	116.55	188.30	111.20	138.68
	2000	98.92	100.45	98.81	99.39
					***X**
***X*Z**	6:2:1	135.63	110.66	109.60	118.63
	5:2:0	109.38	139.20	117.10	121.89
	4:1:1	136.65	148.58	130.91	138.71
	3:1:1	129.33	130.59	116.88	125.60
					***Y**
***Y*Z**	500	144.03	128.04	124.60	132.22
	1000	150.94	136.13	126.61	137.89
	1500	114.39	159.30	118.87	130.85
	2000	101.62	105.41	104.40	103.81
***Z**		127.74	132.21	118.61	
Note: LSD *X= 10.23 ,LSD *Y = 9.90 , LSD *Z= 8.65 , LSD *XY= 13.21 ,LSD *XZ= 16.11 ,LSD *YZ= 13.78 and LSD*XYZ=25.18					

4. Discussion

Wavelength 400–700 nm is called “Photosynthetically Active Radiation", wherever much of the light that plants essential at UV light (280-400 nm) and/or far-red LED light (700-800 nm) strength be imperative for best development, and some parts are other important than others as established in [11]. Apparently,, the photoreceptors are the best active in the blue and red part of the spectrum. Green plants reflect a significant participation of light in the green zone of the light spectrum, however absorbing a higher percentage of blue and red of LED. The blue of LED is foremost accountable for vegetative growth [12]. Nevertheless,, the whole spectrum for on 350-750 nm at a appropriate light intensity is interesting in plant cultivation. Moreover, the key to make a light which is optimally appropriate for its task by balancing the different areas, thus that the seedling get right ability and signals to fulfil the target [11]. In our study, exposure to a combination (6:2:1) light-emitting diodes (LED) in 1000 lux has a many effect on the growth plant height, node number, branch number and leafs. Simultaneously, it has been shown that combination (5:2:0) of LED with 1000 lux make the most increment in length root for plants as long as likely and lowering with different combinations of LED and light intensity. In present study, results give a evident indication in red and blue of LED with 500 and 1000 lux are more effective for biomass product in seedling and indispensable for normal growth and development [5],[6], [13]. Tikhomirov [15], reported that this wavelength encourages the chlorophyll production. LED of light systems have several unique advantages, including the capability to control the spectral composition. Most importantly , LED of light is a perfect for use in plant lighting designs, and it permits wavelengths to be matched to plantlets photoreceptors to provide an optimal production and influence on the plant morphology [12], [16]. Results of the present study showed that these wavelengths promote vegetative development through strong plantlets growth and powerful photosynthesis. Generally, plants are not sensitive to all wavelengths within the growth region, due to the specific absorption characteristics of the pigment. [17]. In particular, the average wet weight demonstrate a significant increaseing in plantlets and it peaks in (4:1:1) of LED and 500 lux, the relatively higher vegetative growth of plants obtained from the plant responses are dependent on light quality or cultivar. The relatively high growth rate that characterized these plants and probably coupled with high photosynthetic ability of these plants [18].

5. Conclusion

The results revealed that the seedling grown under combination (6:2:1) of LED 500 and 1000 lux of light intensity were significantly affected in plant length, number of nodes , number of branch and number of leaves, that mean the LED conditions along with different light intensities can be used for controlling plantlets morphology in micropropagation.

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آثار الثنائيات الباعثة للضوء (LED) وشدة الاضاءة في نمو وجودة شتلات الطماطه خارج الجسم الحي

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الخلاصة:

إن التطورات الحديثة في استخدام تكنولوجيا الثنائيات الباعثة للضوء(LED) للتكون بديلا عن الضوء الابيض عالي الجودة في استخدامة للانتاج الطاقة . بدأت الدراسات الحديثة الان للتطوير هذه التكنلوجيا والذي يجري دعمه حاليا وقد تكون واحدة من أكبر التطورات في الإضاءة للنمو النباتات من خلال تقنية زراعة الانسجة . في هذا العرض تم دراسة تأثير الثنائيات الباعثة للضوء الاحمر والأزرق مع مصابيح البيضاء الفلورسنت في نباتات الطماطه المزروعة في المختبر باستعمال أربع مجموعات من الصمام الثنائي الباعث للضوء(LED) مع أربعة مستويات من شدة الضوء وذلك للتحديد التأثير المشترك في النباتات. أخذت ستة صفات مورفولوجية تحت العلاجات في المختبر وتم الحصول على اعلى معدل لطول النبات، عدد العقد، عدد الفروع وعدد الأوراق، تحت التركيب (1:2:6) من (LED) ، مع المستويات المنخفضة من شدة الاضاءة عند (500 و 1000 لوكس وفي الختام، يمكن اظهار دور الضوء الأحمر والأزرق الكبير على تطور وجودة نباتات الطماطه في الاكثار الدقيق خارج الجسم الحي.

الكلمات الدالة :الطماطة, الثنائيات الباعثة للضوء, شدة الاضاءة و خارج الجسم الحي.