P-ISSN: 2305-6622; E-ISSN: 2306-3599
International Journal of Agriculture and Biosciences
www.ijagbio.com; editor@ijagbio.com

Research Article

Evaluate of the Consequence of Different Colors Effects on the Leaf Surface of Coleus

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Article History: Received: January 12, 2016 Revised: April 18, 2016 Accepted: June 12, 2016

ABSTRACT

Coleus is one of the most interesting plants in Iran, for its attractive leaf color and easy propagation. The Leaf color variation in Coleus is strongly depended to light duration, quality and intensity. The changes occurring in the leaf color is related to conversion of plants pigments. To evaluate the consequence of different colors effects on the leaf surface of coleus (blumei), a study was done using different light including: yellow, red, blue, green and white in three replications, for two months. The results indicated that the minimum level of carotenoids, chlorophyll a and b was recorded in blue treated plants. The red color treated plants showed the highest amount of carotenoids, chlorophyll a. samples lighted by green, white and yellow Lamps indicates intermediate amount of pigments among blue and red light treated plants. The results related to the leaf beauty index indicated that lights between 500 to 600 nanometer will increase green color which is because of chlorophyll a increase and under 500 nanometer will directed to less green and amethyst purple color in the leaf surface. By increasing the light influence from 500 to 700 nanometer, using red and yellow lamps, the color range on the leaf exterior part changed to dark green corner, amethyst purple surface and dark pink in the center, which can increase the Marketable efficiency of the produced plants.

Key words: Carotenoids, Chlorophyll a, Light

INTRODUCTION

Light is a visible form of electromagnetic wave. It makes it possible for plants to grow and produce the food we eat. Plants derive this energy from sunlight by means of photosynthesis. The characteristics of light such as intensity, quality (color) and duration determine to some extent the level of its interaction with matter. The sun emits the most of its radiation in the visible range, it covers the range of wavelength from 400-700nm (Kolawole *et al*., 2010). The integration, quality, duration and intensity of red, far-red, blue, UV-A (320–500 nm) and UV-B (280–320 nm) light have a profound influence on plants by triggering physiological reactions to control their growth and development (Briggs *et al*., 2001; Briggs and Olney, 2001; Clouse, 2001). LEDs are solid-state, long-lasting and durable sources of narrow-band light that can be used in a variety of horticultural and photo-biological applications (Stutte, 2009), including controlled research environments (Avercheva *et al*., 2009), lighting for tissue culture (Li *et al*., 2010) and supplemental and photoperiod lighting for greenhouses (Morrow, 2008). Because of their potential to be implemented in dynamic lighting strategies to control plant growth, development, physiological responses and production, it is important to learn more about the influence of light quality on these processes (Folta and Childers, 2008; Lefsrud *et al*., 2008; Massa *et al*., 2008). Receiving sunlight by the plants and using that in plant biomass indicates the fundamental processes which control the crop yield (Purcell *et al*., 2002). Intensity of incoming radiation from the sun is altered by both atmospheric and terrestrial obstructions. A host of researchers (Holmes and Smith, 1977a; Ballare *et al.,* 1991; Baraldi *et al*., 1994; Gratani, 1997) have shown that change in spectral energy distribution affect plant growth and development. Photoreceptors in plants are divided into two: phytochrome principally sensitive to light in the red and far-red regions of the visible spectrum (Batschaver *et al*., 1998; Ballare, 1999; Smith, 2000) and crytochrome and phototropin sensitive to blue light (Briggs and Huala, 1999). Most plants use the photoreceptors to regulate the time of flowering, germination of seeds, elongation of seedlings, size and shape of leaves, number of leaves, the synthesis of chlorophyll, straightening of the epicotyls hook of dicot seedlings and stomata opening (Gay and Hurd, 1980;

Cite This Article as: Molashahi M, Mood AAM and Keykavoosi K, 2016. Evaluate of the consequence of different colors effects on the leaf surface of coleus. Inter J Agri Biosci, 5(4): 158-161. www.ijagbio.com (©2016 IJAB. All rights reserved)

Wild and Wolf, 1980; Furukawa, 1997; James and Bell, 2000; Hennig, 2001; Answer, 2006). Photosynthesis is the process by which green plants and certain other organisms (seaweeds, algae and certain bacteria) use the energy of light to convert carbon dioxide and water into simple sugar (Leal, 2007). Light energy causes the electrons in chlorophyll and light-trapping pigments to boost up the electrons out of their orbits; the electrons instantly fall back into place, releasing vibration energy as they go, all in millionths of a second. Chlorophyll and the other pigments absorb the energy released by the electrons which is used during photosynthesis. Plants from different environments have different responses to colors of light. For example, species that have adapted to shade do not usually show a marked shade avoidance response. Branching, internodes length, and flowering initiation can all be affected, to varying degrees, by the ratio of red light to far-red. Hence, one of old methods in assessing plants yield is to measure the received light by the plant and calculate the yield in its transformation into dry matter (Cadersa and Govinden, 1999). Photosynthetically active radiation (PAR) reception method by the plant ghosting is among the main determining factors in ghosting photosynthesis and crop yield (Stewart *et al*., 2003). on the other hand, studying the growth and various crops biomass density has shown that biomass production is dependent on leaf area index (LAI) and received light during the growth (Wolf *et al*., 2002; Yano *et al*., 2007; Asseng *et al*., 2004). In other studies, the received light is calculated by measuring leaf area index (Bonhomme, 2000) and obtaining light receipt yield index or light depreciation coefficient or radiation extinction (Lindquist *et al*., 2005). Decrease in crop growth speed is attributed to the decrease in leave area index. Generally, leaf area index and dry weight are the main crop characteristics (Van Acker *et al*., 1993). There is a correlation between light absorption rate and soybean yield. Light penetration into soybean canopy leads into later lower canopy leaves fall and increase the seed yield (Shafiq *et al*., 2006). Reporting specific wavelength ratios for the quantification of the wavelengths of light important to phytochrome is consistent with McCree's (1979) recommendations on spectral measuring and reporting. He suggested that certain parts of the radiation spectrum were identified with specific physiological plant responses, and that simplified measures of the quantity of radiation available to plants in those spectral regions should be reported. As an alternative to adding more Red light, a similar effect can be obtained by removal of Far-red light, as a means to modify the R:FR ratio from the natural solar radiation. Using liquid copper sulfate ($CuSO_4$) filters, reduced plant height in Rosa x hybrid 'Meirutral' (McMahon and Kelly, 1990) and chrysanthemum (Dendranthema x grandiflorum (Ramat.) (Rajapakse and Kelly, 1992). There are a series of well-documented plant responses that have been attributed to radiation in the blue portion (400 to 500 nm) of the electromagnetic spectrum. Unfortunately, our knowledge on the action or even the location of this hypothesized plant pigment ("cryptochrome") is not known. In addition some of the plant's responsiveness to blue light may be attributed to perception and activation of phytochrome in these wavelengths (Mohr et al., 1984). The second most discussed effect of radiation, after photosynthesis and its subsequent effect on plant growth rates, is photomorphogenesis and its specific effects on plant development. The wavelengths specific for phytochrome responses are Red and Far-red light. The plant light environment must be characterized according to the absorption spectra or action spectra of phytochrome, since phytochrome is the pigment involved in the regulation of plant development. The action or response spectrum is indicated by the wavelengths that will cause a plant response. The action spectra for various plant physiological processes are presented in Figure 2 (Salisbury and Ross, 1992). Coleus, is a bedding plant valued primarily for its vibrant colorful foliage and not for its floral characteristics (Lebowitz, 1985). In plants, coloration of different organs such as flower, fruit and leaf is due to the accumulation of betalains, carotenoids or flavonoids (anthocyanins) (Mol, 1998). Anthocyanins are the major pigments that impart the wide range of red and purple colors observed in coleus leaves (Lebowitz, 1985). The synthesis of anthocyanins and color change in vegetative tissues due to light have been investigated at the physiological and molecular level for many plant species such as maize (Singh, 1999), *Perilla frutescens* (Gong, 1997), and in bilberry (Jaakola, 2004) but limited work has been done in coleus. The types of pigments involved in the coloration of coleus foliage have been investigated (Lebowitz, 1995) but little is known about their genetic control. The bright red and purple colors observed in the leaves are produced primarily by anthocyanin pigments, with most of the pigments composed of a complex of cyanidin and glucose components (Lebowitz, 1985). Green coloration is mainly due to chlorophyll pigments (Rife, 1948). As mottled coleus cultivars age, the content of carotene and xanthophyll in leaves increases (Lebowitz, 1985).

MATERIALS AND METHODS

Location of experiment

The experiment was conducted at the Tissue Culture Laboratory of Islamic Azad University of Zahedan Branch.

Soil sampling

For better growth from mixture of perlite and leaf soil and Cocopeat a ratio of 1: 1: 1 were filled. Before of the fill pots with soil the use of gas injection and the use of anti-infective autoclave device, and then were transferred to the flower pots.

Field experiment

The field experiment was laid out completely randomized design with four replications.

Specifications of pots used

Pots that were used in the experiment, with 25 cm diameter and 30 cm in height from the ground to the tip of the pot.

Physical characteristics and environmental experiment

The treatments were designed and constructed light-Flower special chambers. The chamber dimensions of 100 cm long and 90 cm wide and 90 cm in height and intended uses 8-cm-thick sheets were made. The chamber holes in

Table 1: Analysis of variance related to the amount of carotenoids in leaves grown under different light treatments

S.O.V	SS	df	Ms	F	Sig.
light	1.335	4	.3340	4.980	.0060
Error	1.340	20	.0670		
C.V	2.674	24			

Table 2: Compare mean values of carotenoids in leaves grown under different light treatments

Carotenoids			
Treatment	Number of observations	Statistics groups	
		Group 1	Group 2
blue	5	.40040	
green	5		.88840
white	5		.92900
yellow	5		.95860
red	5		1.0628
Levels of significant		1.000	.3410

All differences mean that in a column are not significant at the 5% level

Table 3: Analysis of variance related to the amount of chlorophyll a in leaves grown under different light treatments

S.O.V	SS	df	Ms	F	Sig.
light	1.228	4	.3070	6.652	.0010
Error	.9230	20	.0460		
C.V	1.228	4	.3070	6.652	.0010

Table 4: Compare mean values of chlorophyll a in leaves grown under different light treatments

chlorophyll a			
Treatment	Number of observations	Statistics groups	
		Group 1	Group 2
Blue	5	.4892	
Green	5		.8722
White	5		1.0102
Yellow	5		1.0126
Red	5		1.1264
Levels of significant		1.000	.100

All differences mean that in a column are not significant at the 5% level

the roof and the installation of four colored mercury lamp (anthers on the type of treatment), conditions of light on plant height were provided.

Treatment performed during the test

After preparing the same pots and place of experiments cuttings from plants are fully developed over 10 cm were prepared and were planted in the pots. Then pots were placed in each chamber 4, so that daily during the growth period for 16 hours exposure to radiation in the spectrum of light and 8 hours of darkness. Irrigation pots on a regular basis and daily and a rate of 50 ml half concentrated and Hoagland nutrient solution was added to each pot.

RESULTS AND DISCUSSION

The concentration of carotenoids

Analysis of variance showed that the effect of quality of incident light to the amount of carotenoids in the leaves Coleus is significant (Table 1). Comparison of the mean of light treatments in terms of the effect on the amount of carotenoids showed that blue light exposure in the least amount of carotenoid is produced. Whereas the in other of light treatments between 0.9 to 1.06 mg carotenoids per gram of fresh weight. Difference was not significant.

The concentration of chlorophyll a

Analysis of variance showed that the effect of light treatments on chlorophyll a significant at the 1% level and causing differences are significant. So that Table 4 shows that of light treatments can be divided into two groups, significant difference. In group A the blue light treatment with the least amount of 0.48 and the average value in the second group were other treatments.

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