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Plant structure and early growth in coriander: Effect of light and temperature indoors

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Abstract

The optimization of environmental conditions is essential for improving crop growth and productivity in controlled environment agriculture. This study investigated the influence of different light spectra, photoperiods, and temperature regimes on the early growth and plant structure of coriander (*Coriandrum sativum* L.) cultivated under indoor farming conditions. A single coriander variety was exposed to seven treatments comprising a control, red light (2R:1B) under 16-hour and 18-hour photoperiods, blue light (2B:1R) under 16-hour and 18-hour photoperiods, and two temperature regimes (24–26°C and 18–20°C). Growth responses were evaluated by recording plant height, number of leaves, leaf length, and root length during the early stages of crop development. The results demonstrated that both light quality and temperature significantly influenced coriander growth, with distinct differences observed among the treatments. Balanced spectral combinations with appropriate photoperiods promoted improved vegetative development by enhancing plant height, leaf production, and leaf expansion, while suitable temperature conditions supported vigorous root growth and overall plant establishment. In contrast, less favourable environmental conditions resulted in comparatively reduced growth performance. The findings highlight the importance of optimizing light spectrum, photoperiod, and temperature to achieve healthy seedling establishment and improved structural development of coriander in indoor production systems. This study provides valuable information for designing efficient environmental management strategies for commercial indoor cultivation and vertical farming of coriander.

Keywords: *Coriandrum sativum* L., controlled environment agriculture, indoor farming, light spectrum, photoperiod, temperature regime, red and blue LEDs, plant height, leaf development, root growth, vegetative growth, vertical farming.

1. Introduction

Coriander (*Coriandrum sativum* L.) is one of the commonly used annual herbaceous plants in global cuisines, valued for its aromatic flavor (Mandal and Mandal, 2015) [2]. It belongs to the family Apiaceae. Remarkably, the entire coriander plant is edible. Coriander is extensively grown in India as compared to other countries. India is the largest producer, importer and exporter of coriander in the world. In India, it is widely grown in Rajasthan, Karnataka, Telangana, Andhra Pradesh, Gujarat, Madhya Pradesh, Tamil Nadu, Uttar Pradesh and Bihar. Rajasthan (58%) leads in the production of coriander seed, followed by Madhya Pradesh (15%). It was estimated that the area under the cultivation of coriander was found to be 6.2 million hectares with approximately 8.29 million metric tons of production.

Coriander is used as a traditional remedy for treating various disorders in the medicine systems of many civilizations (Sahib *et al.*, 2013) [3]. Coriander is rich in vitamins (vitamin A, vitamin B2 and vitamin C) and minerals (Shahwar *et al.*, 2012) [4]. It was reported that coriander extract contains anti-inflammatory, anti-diabetic, anti-lipidemic, anticarcinogenic, cytoprotective, vasoprotective, cardioprotective and neuroprotective activities (Laribi *et al.*, 2015) [6]. Coriander is also known for its antioxidant properties viz., flavonoids, terpenoids, phenolic compounds (rutin and chlorogenic acid), β -carotene and linolenic acid (Hwang *et al.*, 2014) [5]. These secondary metabolic compounds concentration is an important index for the assessment of quality. Overall, coriander is regarded as a functional food ingredient having medicinal and

economic importance.

The demand for fresh and high-quality vegetables, including coriander is growing widely in large cities. A plant factory with artificial growing conditions enables the production of vegetables inside cities with higher productivity, which can satisfy specific quality demands in plant growth and accumulation of secondary metabolites (Kozai and Niu, 2016) [7]. The growth and development of plants, and accumulation of secondary metabolites are mostly affected by environmental factors like air temperature, light, carbon dioxide concentration, etc. Under controlled environmental conditions, the cost for electrical energy essential for providing artificial lighting accounts about 28% of the total operational costs (Kozai and Niu, 2016) [7].

Hence, augmenting PPFD (photosynthetic photon flux density) is an important thing to improve the plant production. Additionally, plant growth and development are affected by temperature, which significantly affects the growth and various physiological processes viz., water uptake, mineral uptake, photosynthesis, metabolic absorption, and accumulation of bioactive compounds (Yan *et al.*, 2012).

Light is the most important resource that affects the morphology, development and bioactive chemical composition of plants. Several researchers have indicated that photoperiods improve photosynthesis, growth and secondary metabolites viz., sugars, proteins and phenols (16-19). Providing insufficient light checks photosynthesis process in mesophyll of leaf, while excessive light may alter the photosynthesis process by weakening photosynthetic tissues and cell membranes. The quality, intensity, and distribution of light, regulate highly complex effects on plant physiology. The quality of light affects the expression of genes that are associated with growth and development by stimulating signal cascades of photoreceptors, such as phytochromes, cryptochromes and phytochromes. Red and blue lights are the most efficient and dominant wavelengths because the absorption spectrum of chlorophyll in plants is most considerable in the red part of the spectrum (660 nm) and blue part of the spectrum (450 nm). Phytochromes mainly absorb R light, which has the highest quantum yield of CO₂ fixation plays a significant role in developing photosynthesis. Hence, it is required to balance photoperiod and light intensity to augment crop yields.

With customizable spectral qualities, intensities and eco-friendliness, LEDs (light emitting diodes) in plant factories have resulted in revolutionary changes under controlled environmental conditions for improving growth and development of plants by influencing their morphology, physiology, and photosynthetic characteristics (Gomez and Izzo, 2018) [9]. Also, LED lights reduce pests and precludes the necessity to apply pesticides and ensures the crop safety. Hence, growing coriander in plant factories can improve the productivity and enhance its food safety. Therefore, incorporating coriander into plant factories can enhance its yield and food safety and increase its industrial disease output. The application of LEDs ranges from the advanced replacement of incandescent lights used in the management of photoperiod (Craig and Runkle, 2013) [11], up to the replacement of high-pressure sodium (HPS) lamps and fluorescent lamps for providing supplemental lighting in controlled environmental conditions (Olle and Virsile, 2013) [10].

Additionally, temperature is another important factor which significantly affects the growth and development of plants. It also affects various physiological processes viz., water uptake, mineral uptake, photosynthesis, metabolic absorption, and

accumulation of bioactive compounds (Al- Rawahy *et al.*, 2019). Hence, keeping in view the above facts, the present study has been conducted with the objectives to know the effect of light on flowering in coriander, and to study the effect of temperature on growth and yield in coriander.

2. Materials and Methods

The study entitled “*Plant Structure and Early Growth in Coriander: Effect of Light and Temperature Indoors*” was carried out during the academic year 2025–2026 at the Urban Kisaan Research and Development Unit, Hyderabad, in academic coordination with the Department of Horticulture, School of Agricultural Sciences, Malla Reddy University.

2.1 Treatment details

T ₁	Control
T ₂	2R:1B+18 Hr duration
T ₃	2R:1B+16 Hr duration
T ₄	2B:1R +18 Hr duration
T ₅	2B:1R+16 Hr duration
T ₆	24-260 C Temperature
T ₇	18-200C Temperature

2.2 Experimental Details

The experiment was carried out in completely randomized design (CRD) comprising seven treatments with three replications. Each treatment consisted of 21 plants arranged on NFT (Nutrient Film Technique) stand. Plants were established in an alternate pattern to maintain uniform plant density. Planting was undertaken during the second week of November, and all recommended cultural practices were uniformly followed across treatments. In each replication, five plants per treatment were randomly selected and tagged for recording observations. The recorded data were used to compute mean values based on the observations obtained from the tagged plants.

3. Results and Discussion

3.1 Plant height 10, 20 and 30 days

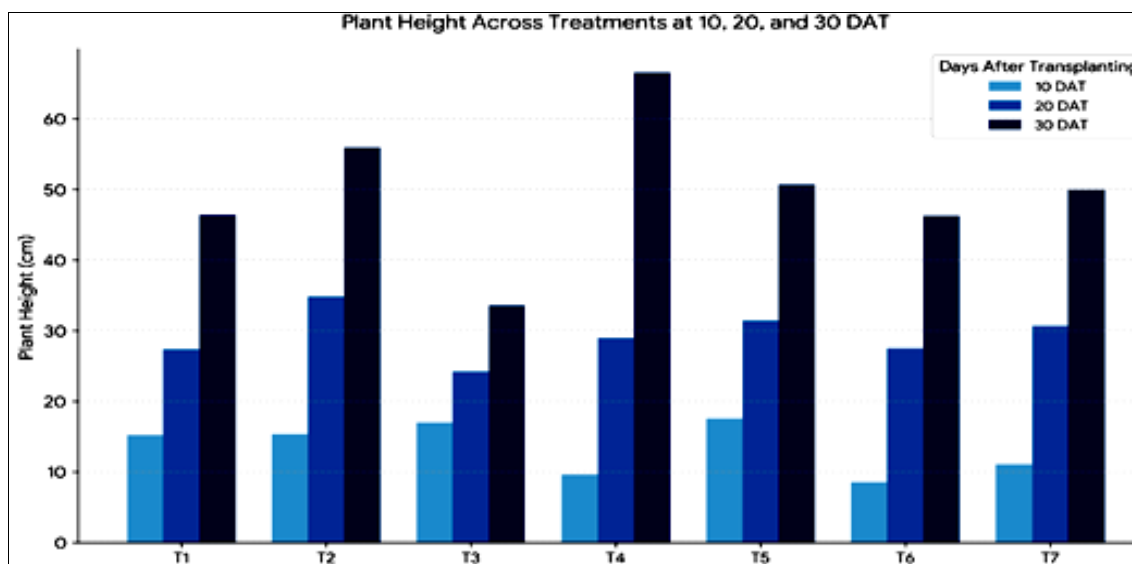
Table 1: Effect of light and temperature on plant height (cm) at 10,20 and 30 in Coriander

Treatment Details		Plant height (cm)		
		10 DAT	20 DAT	30 DAT
T ₁	Control	11.03	15.49	21.10
T ₂	2R:1B+18 Hr duration	13.74	19.26	24.65
T ₃	2R:1B+16 Hr duration	12.24	17.52	22.51
T ₄	2B:1R +18 Hr duration	14.41	20.43	25.72
T ₅	2B:1R+16 Hr duration	12.22	17.42	22.02
T ₆	24-260 C Temperature	12.32	17.98	22.71
T ₇	18-200C Temperature	12.55	18.34	23.63
SEm (+)		0.601	0.613	0.492
CD (p=0.05)		1.822	1.859	1.491

Plant height is an important indicator of vegetative growth and reflects the plant's response to environmental conditions, particularly light quality and temperature in controlled cultivation systems. Significant differences in plant height were observed among the treatments throughout the experimental period, indicating the influence of the tested environmental factors. At 10 DAT, plants grown under T₄ (2 Blue:1 Red LED with an 18-hour photoperiod) attained the greatest height (14.41 cm), followed by T₂ (2 Red:1 Blue LED with an 18-hour photoperiod) at 13.74 cm, whereas the control (T₁) recorded the

lowest value (11.03 cm). The same pattern was maintained at 20 DAT, with T₄ producing the tallest plants (20.43 cm), followed by T₂ (19.26 cm), while the control measured only 15.49 cm. By 30 DAT, T₄ continued to outperform all other treatments, reaching a maximum height of 25.72 cm, followed by T₂ (24.65 cm) and the temperature treatment T₇ (18–20°C), which recorded 23.63 cm. The control treatment consistently exhibited the lowest plant height (21.10 cm). The improved growth observed under T₄ may be associated with the synergistic effect of a blue- enriched light spectrum and an extended photoperiod,

which likely enhanced photosynthetic efficiency and stimulated vegetative development. In addition, both temperature treatments (T₆ and T₇) produced taller plants than the control, suggesting that optimized thermal conditions also contributed positively to plant growth. Overall, the findings indicate that the combination of 2 Blue:1 Red LED light with an 18-hour photoperiod was the most effective treatment for promoting plant height, demonstrating the importance of integrating appropriate light spectra and temperature management to maximize coriander growth under indoor cultivation systems.



Graphical representation of plant height at 10, 20 and 30 DAS

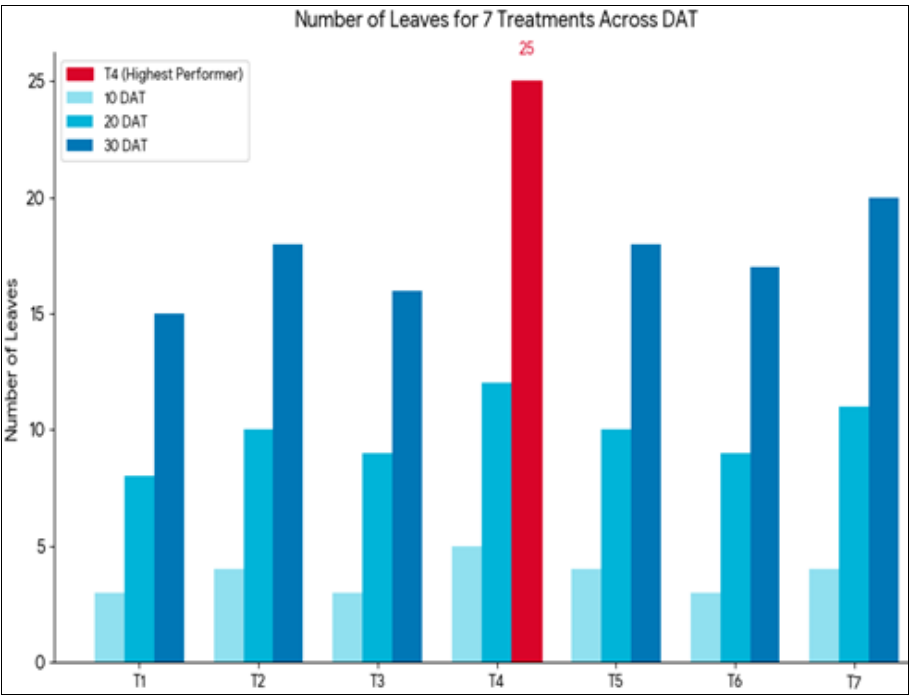
3.2 Number of leaves at 10, 20 and 30 DAS

Table 2: Effect of light and temperature on number of leaves (cm) at 10, 20 and 30 in Coriander

Treatment Details		Number of leaves (cm)		
		10 DAT	20 DAT	30 DAT
T ₁	Control	15.26	27.40	46.33
T ₂	2R:1B+18 Hr duration	15.40	34.86	55.93
T ₃	2R:1B+16 Hr duration	16.93	24.26	33.53
T ₄	2B:1R +18 Hr duration	9.66	29.00	66.60
T ₅	2B:1R+16 Hr duration	17.60	31.40	50.66
T ₆	24-26°C Temperature	8.53	27.533	46.20
T ₇	18-20°C Temperature	11.06	30.66	49.93
SEm (+)		0.513	1.078	1.80
CD (p=0.05)		1.780	3.271	5.453

The number of leaves in coriander was significantly influenced by different light spectra and temperature treatments throughout the crop growth period. At 10 DAT, the highest leaf number was recorded in T₅ (2B:1R + 16 h photoperiod) with 17.60 leaves, followed by T₃ (2R:1B + 16 h photoperiod) with 16.93 leaves, indicating that a 16-hour photoperiod promoted rapid early vegetative development. In contrast, the lowest leaf count was observed in T₆ (24–26°C temperature) with 8.53 leaves, while T₄ (2B:1R + 18 h photoperiod) also produced relatively fewer leaves (9.66) during the initial stage. At 20 DAT, T₂ (2R:1B + 18 h photoperiod) recorded the highest number of leaves (34.86), followed by T₅ (31.40 leaves) and T₇ (18–20°C temperature; 30.66 leaves), demonstrating improved canopy

development under extended photoperiods. By 30 DAT, T₄ (2B:1R + 18 h photoperiod) exhibited the maximum leaf number (66.60), followed by T₂ (55.93 leaves) and T₅ (50.66 leaves). The control treatment (T₁) and both temperature treatments (T₆ and T₇) produced intermediate leaf numbers at the final observation. Overall, the results indicate that the interaction of blue and red LED light with an extended 18-hour photoperiod substantially enhanced leaf production during later growth stages, whereas the 16-hour photoperiod was more effective in promoting early vegetative establishment. These findings suggest that optimizing light quality and photoperiod can effectively improve canopy development and photosynthetic potential under controlled environment cultivation.



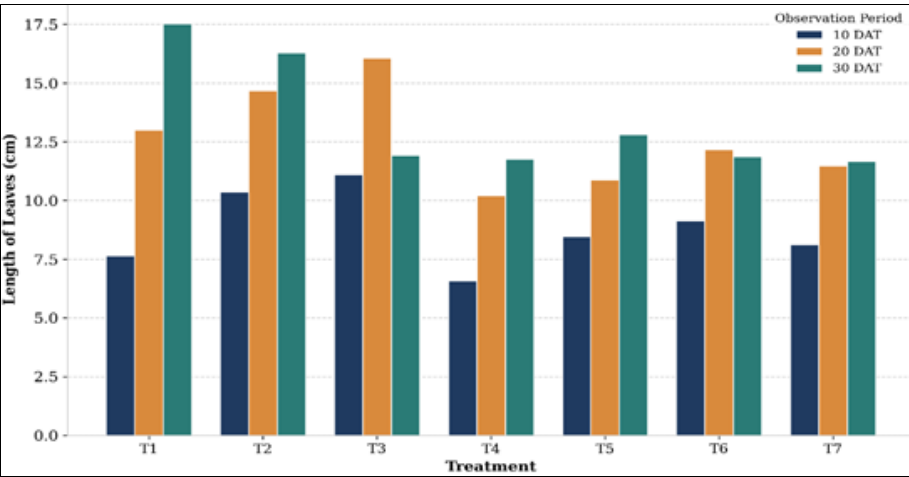
Graphical representation of Number of leaves at 10, 20 and 30 DAS iii Length of leaves (cm)

Table 3: Effect of light and temperature on length of the leaves 10,20 and 30 in Coriander (cm)

Treatment details		Length of leaves (cm)		
		10 DAT	20 DAT	30 DAT
T ₁	Control	7.64	13.00	17.53
T ₂	2R:1B+18 Hr duration	10.35	14.68	16.28
T ₃	2R:1B+16 Hr duration	11.10	16.06	11.93
T ₄	2B:1R +18 Hr duration	6.58	10.20	11.76
T ₅	2B:1R+16 Hr duration	8.46	10.88	12.80
T ₆	24-260 C Temperature	9.14	12.16	11.87
T ₇	18-200C Temperature	8.12	11.47	11.67
SEm (±)		0.520	0.553	0.870
CD (p=0.05)		1.578	1.677	2.639

Leaf length of coriander varied considerably among the different light spectra and temperature treatments across the observation period. At 10 DAT, the maximum leaf length was recorded in T₃ (2R:1B + 16 h photoperiod) with 11.10 cm, closely followed by T₂ (2R:1B + 18 h photoperiod) with 10.35 cm, indicating that red-dominant light promoted rapid leaf elongation during the early growth stage. The minimum leaf

length was observed in T₄ (2B:1R + 18 h photoperiod) with 6.58 cm. At 20 DAT, T₃ continued to produce the longest leaves (16.06 cm), followed by T₂ (14.68 cm) and the control (13.00 cm), whereas the shortest leaves were again recorded under T₄ (10.20 cm). However, by 30 DAT, the control treatment (T₁) exhibited the greatest leaf length (17.53 cm), followed by T₂ (16.28 cm), while all other treatments recorded comparatively shorter leaves ranging from 11.67 to 12.80 cm. The reduction in leaf length under several LED treatments during the later growth stage may indicate a shift in assimilate partitioning from leaf elongation to increased leaf production and biomass accumulation. Overall, the results suggest that red-enriched light spectra, particularly under a 16-hour photoperiod, favoured leaf expansion during the initial and intermediate growth stages, whereas plants under the control condition maintained greater leaf elongation at maturity. These findings demonstrate that leaf length responses are influenced by both light quality and growth stage, emphasizing the importance of optimizing spectral composition according to crop developmental requirements in controlled environment cultivation.



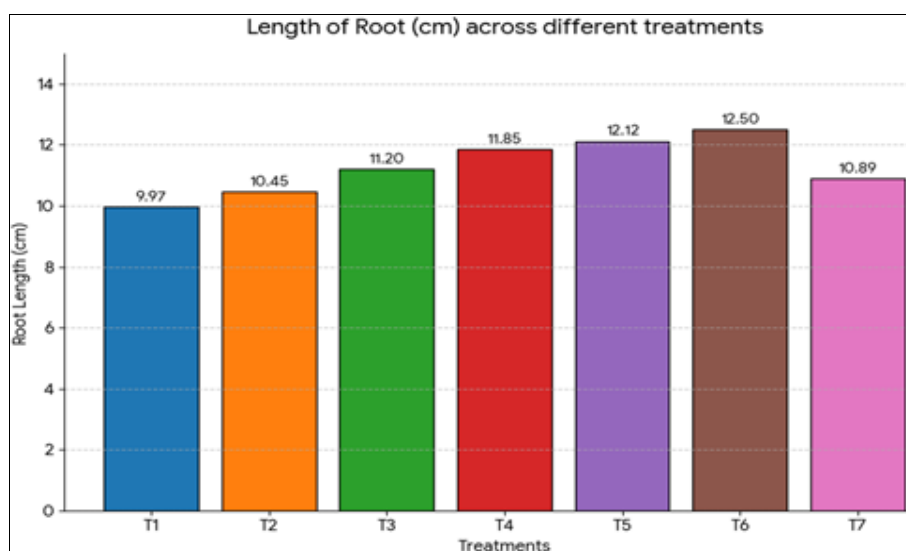
Graphical representation of leaf length at 10, 12 and 30 (cm) DAS iv length of the root (cm)

Table 4: Effect of light and temperature on length of the root after harvest in Coriander

Treatment Details		Length of the Root (cm)
T ₁	Control	9.97
T ₂	2R:1B+18 Hr duration	10.66
T ₃	2R:1B+16 Hr duration	10.26
T ₄	2B:1R +18 Hr duration	10.80
T ₅	2B:1R+16 Hr duration	10.20
T ₆	24-260 C Temperature	12.50
T ₇	18-200C Temperature	11.86
SEm (+)		0.510
CD (p=0.05)		1.546

Root length was markedly influenced by the different light spectrum and temperature treatments, indicating that environmental conditions played an important role in underground growth and root development. Among all treatments, T₆ (24–26°C temperature) produced the longest roots (12.50 cm), followed by T₇ (18–20°C temperature) with 11.86 cm, suggesting that temperature regimes had a stronger

influence on root elongation than light quality alone. Among the LED treatments, T₄ (2B:1R + 18 h photoperiod) recorded the greatest root length (10.80 cm), followed by T₂ (2R:1B + 18 h photoperiod) with 10.66 cm. Moderate root lengths were observed in T₃ (2R:1B + 16 h photoperiod) and T₅ (2B:1R + 16 h photoperiod), measuring 10.26 cm and 10.20 cm, respectively. The shortest roots were recorded under the control treatment (T₁) with 9.97 cm. The superior performance of the temperature treatments indicates that maintaining an appropriate thermal environment enhanced cell division and elongation in root tissues, resulting in improved root growth. Furthermore, the slightly better performance of the 18-hour photoperiod over the 16-hour photoperiod among LED treatments suggests that prolonged light exposure may indirectly support root development through increased photosynthate production. Overall, the findings demonstrate that both temperature management and optimized light conditions contribute to improved root growth, with temperature exerting a greater influence on root elongation under controlled environment cultivation.



Graphical representation of root length (cm) of coriander

References

- Al-Rawahy MS, Al-Rawahy SA, Al-Mulla YA, Nadaf SK. Effect of cooling root-zone temperature on growth, yield and nutrient uptake in cucumber grown in hydroponic system during summer season in cooled greenhouse. *Journal of Agricultural Science*. 2019;11(1):47-60.
- Mandal S, Mandal M. Coriander (*Coriandrum sativum* L.) essential oil: Chemistry and biological activity. *Asian Pacific Journal of Tropical Biomedicine*. 2015;5(6):421-428.
- Sahib NG, Anwar F, Gilani AH, Hamid AA, Saari N, Alkharfy KM. Coriander (*Coriandrum sativum* L.): A potential source of high-value components for functional foods and nutraceuticals—A review. *Phytotherapy Research*. 2013;27(10):1439-1456.
- Shahwar MK, El-Ghorab AH, Anjum FM, Butt MS, Hussain S, Nadeem M. Characterization of coriander (*Coriandrum sativum* L.) seeds and leaves: Volatile and nonvolatile extracts. *International Journal of Food Properties*. 2012;15:736-747.
- Hwang E, Lee DG, Park SH, Oh MS, Kim SY. Coriander leaf extract exerts antioxidant activity and protects against UVB-induced photoaging of skin by regulation of procollagen type I and MMP-1 expression. *Journal of Medicinal Food*. 2014;17(9):985-995.
- Laribi B, Kouki K, M'Hamdi M, Bettaieb T. Coriander (*Coriandrum sativum* L.) and its bioactive constituents. *Fitoterapia*. 2015;103:9-26.
- Kozai T, Niu G. Plant factory as a resource-efficient closed plant production system. In: Kozai T, Niu G, Takagaki M, editors. *Plant factory: An indoor vertical farming system for efficient quality food production*. San Diego (CA): Academic Press; 2016. p. 69-90.
- Lin YS, Medlyn BE, Ellsworth DS. Temperature responses of leaf net photosynthesis: The role of component processes. *Tree Physiology*. 2012;32(2):219-231.
- Gomez C, Izzo LG. Increasing efficiency of crop production with LEDs. *AIMS Agriculture and Food*. 2018;3(2):135-153.
- Olle M, Virsile A. The effects of light-emitting diode lighting on greenhouse plant growth and quality. *Agricultural and Food Science*. 2013;22(2):223-234.
- Craig DS, Runkle ES. A moderate to high red to far-red light ratio from light-emitting diodes controls flowering of short-day plants. *Journal of the American Society for Horticultural Science*. 2013;138(3):167-172.