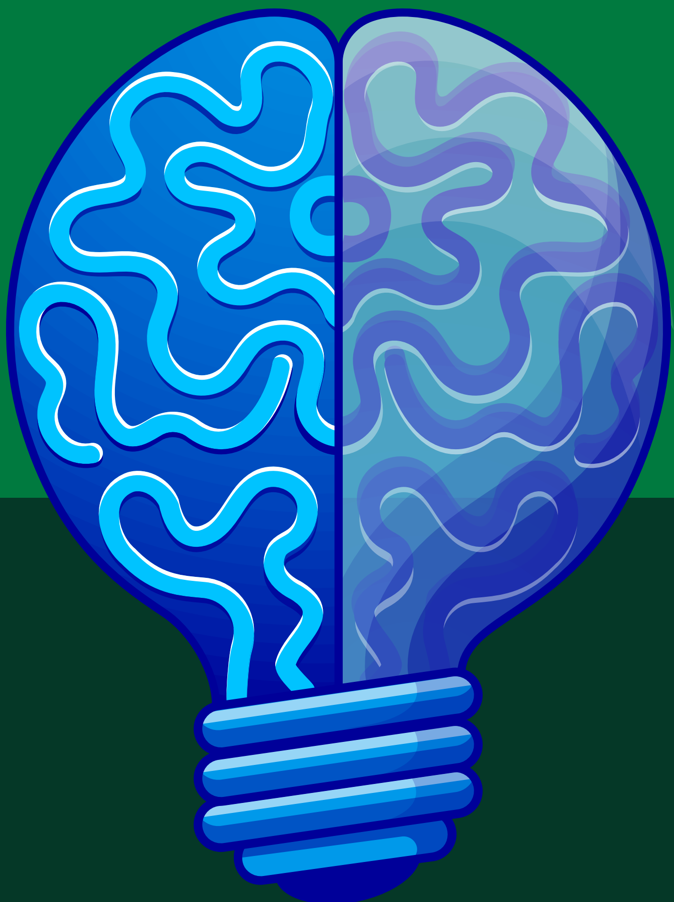
FACULTY OF APPLIED SCIENCES

UNIVERSITI TEKNOLOGI MARA PERAK BRANCH

SCIENTIFIC PROJECT COLLOQUIUM 2025



BIOLOGY ~ CHEMISTRY ~ PHYSICS

Final Year Project Colloquium 2025
Faculty of Applied Sciences,
Universiti Teknologi MARA,
Perak Branch Tapah Campus,
35400 Tapah Road, Perak, Malaysia.

Colloquium date 12th July 2025
Publication date 31st October 2025

Proceedings of Extended Abstracts

EDITORS
Pn. Rosliza Ali
Pn. Nunshaimah Salleh
Pn. Norsakina Zurina Zulkifli
Pn. Adibatul Husna Fadzil
Pn. Yanti Yaacob
Pn. Lili Widarti Zainuddin

e-1.S.B.N: 978-629-97630-6-2

Published by Faculty of Applied Sciences, Universiti Teknologi MARA, Perak Branch Tapah Campus

Faculty of Applied Sciences,
Universiti Teknologi MARA,
Perak Branch Tapah Campus,
35400 Tapah Road,
Perak, Malaysia.

Preface

The Scientific Project Colloquium offers a platform for publishing Diploma Science final year projects (FYP). The objective is to effectively distribute research findings throughout all scientific disciplines. The primary objective of including final year projects into the course curriculum is to encourage students to put their theoretical knowledge into practical applications.

We would like to express our gratitude to our primary establishment, the Faculty of Applied Sciences and Universiti Teknologi MARA, Perak Branch, for their invaluable assistance.

Lastly, we would like to express our gratitude to all of the authors for the tremendous help in preparing the articles, without which this undertaking would not have been completed.

Editors

Rosliza Ali
Nunshaimah Salleh
Norsakina Zurina Zulkifli
Adibatul Husna Fadzil
Yanti Yaacob
Lili Widarti Zainuddin

Universiti Teknologi MARA
Perak Branch Tapah Campus
October 2025

EFFECTS OF DIFFERENT LIGHT WAVELENGTHS ON THE GROWTH OF WATER SPINACH (*IPOMOEA AQUATICA*)

Lili Widarti Zainuddin*, Nuraina Batrisyia Azhar, Nurshuhadah Mohd Radzuan

Faculty of Applied Sciences, Universiti Teknologi MARA, Perak Branch Tapah Campus,
35400 Tapah Road, Perak, Malaysia

*E-mail: liliwidarti@uitm.edu.my

Abstract: This study explores the effect of different LED light wavelengths on the growth of water spinach (Ipomoea aquatica). Over an eight-day period, plants were exposed to red, blue, white, and green LEDs, and their height and leaf development were monitored. Red light produced the greatest height increase (4.7 cm), while blue and white lights supported balanced leaf growth, with three leaves each by Day 8. Green light resulted in the least growth. These results highlight the importance of light spectrum in shaping plant growth and suggest practical applications for optimizing sustainable indoor agriculture.

Keywords: *Water spinach, LED light wavelengths, Plant growth, Sustainable indoor agriculture*

INTRODUCTION

Light is one of the most critical environmental factors influencing plant growth and development. Beyond its role as the primary energy source for photosynthesis, light also regulates several physiological processes such as photomorphogenesis, stomatal activity, circadian rhythm, and hormonal regulation (Hogewoning et al., 2010). The spectrum, intensity, and duration of light exposure determine how efficiently plants capture energy and how they shape their morphology. Understanding these interactions is especially relevant in controlled-environment agriculture (CEA), where artificial lighting systems are increasingly used to enhance crop productivity and sustainability (Bantis et al., 2018).

Plants respond differently to specific regions of the light spectrum due to the presence of specialized photoreceptors. Blue light with a wavelength of 400–500 nm plays an essential role in regulating leaf expansion, chlorophyll synthesis, and stomatal opening. It promotes compact growth, higher chlorophyll content, and efficient photosynthesis in leafy vegetables such as spinach and lettuce (Hasan et al., 2017; Johkan et al., 2012). However, excessive blue light may reduce stem elongation and leaf size, suggesting that optimal levels are required for balanced development. Meanwhile red light with a wavelength of 600–700 nm is vital for photosynthesis, seed germination, stem elongation, and flowering (Lin et al., 2020). When combined with blue light, red light enhances leaf size, biomass accumulation, and balanced morphology (Johkan et al., 2012). Green light with a wavelength in between 495–570 nm, recently shows evidence that suggests it can penetrate deeper into the leaf canopy, supporting photosynthesis in lower tissues where red and blue light cannot reach effectively (Kim et al., 2004). Although green light alone does not maximize growth, its integration into a full-spectrum regime may improve overall plant performance, particularly in dense plantings. Lastly, white light, which combines red, blue, green, and sometimes far-red wavelengths, closely mimics natural sunlight and provides a balanced spectrum for plant development. While it may not maximize any single growth parameter, white LED light supports moderate photosynthesis, stem elongation, and leaf expansion, making it a practical choice in small-scale and educational settings (Bourget, 2008).

The rise of light-emitting diode (LED) technology has revolutionized plant growth studies by offering spectrum-specific control, energy efficiency, and longer operational lifespans compared to traditional light sources (Massa et al., 2008). This advancement has allowed researchers to design and optimize traits such as plant height, leaf morphology, and biomass accumulation (Hasan et al., 2017). Despite this progress, many studies have focused on model crops such as lettuce and kale, while less attention has been given to leafy vegetables of regional importance, such as water spinach. Water spinach is widely cultivated in Asia and valued for its nutritional content, but its responses to specific light spectra remain underexplored.

Therefore, this study examines the effects of different LED light wavelength (red, blue, green, and white) on the growth performance of water spinach. By linking plant growth responses with physical concepts such as photon energy and light absorption, this research not only contributes to the understanding of plant–light interactions but also provides insights into the optimization of artificial lighting strategies for sustainable indoor agriculture.

METHODOLOGY

Water Spinach was chosen for its rapid growth and sensitivity to environmental changes, making it suitable for short-term light experiments. Seeds were obtained from a certified agricultural supplier and soaked in water for 12 hours to promote uniform germination. Then, about 20 seed were planted in each container. The elongation and the growth of water spinach was an average data obtained from each container. The soil used is made up from a 1:1 mixture of coconut coir and organic compost, providing good aeration, water retention, and nutrients. Each container was placed inside a light-isolation box to prevent contamination between treatments as shown in Figure 1. Four compartments were equipped with red, blue, green, or white LEDs. The environment was maintained at ~26°C, and each plant was watered with 10 mL of distilled water twice daily. No fertilisers were applied to ensure that light was the only variable affecting growth. Four LED types were tested: red (660 nm), blue (450 nm), green (520 nm), and white (full spectrum). Lamps were positioned 25 cm above the plants with equal power output to maintain uniform intensity. Plants were exposed to a 16 h light/8 h dark cycle daily, controlled by a digital timer. Each compartment was lined with reflective material to maximise light distribution and eliminate interference from external light sources.

(a) (b)

Figure 1 (a) and (b) is the experimental set up for measuring the plant growth for different light

FINDINGS

The growth of water spinach under different LED light treatments revealed significant variations in plant height across the eight-day period as shown in Table 1. From the data, it is observed that red and blue light treatments produced the greatest increases in height compared to white and green light. At day 8, plants grown under red light reached 4.7 cm, slightly exceeding those under blue light at 4.5 cm. meanwhile, plants under white (3.0 cm) and green light (3.8 cm) showed comparatively slower growth. The growth observed under red light is consistent with the role of red wavelengths in stimulating phytochromes, which regulate stem elongation and biomass accumulation (Lin et al., 2020). From the data, blue light also contributed substantially to height gain, specifically after day 4, reflecting its role in chlorophyll production, stomatal regulation, and efficient photosynthesis (Johkan et al., 2012). The data for green light treatment shows the lowest growth performance which is aligning with reports that plants reflect much of the green spectrum, reducing its effectiveness for photosynthesis (Kim et al., 2004 while white light, as a full-spectrum treatment, provided intermediate results, confirming its ability to support general development but not maximise any single growth parameter (Bourget, 2008).

Table 1 Plant height of water spinach (*Ipomoea aquatica)* under different LED light treatments

Day	White (cm)	Red (cm)	Blue (cm)	Green (cm)
1	0.2	0.3	0.4	0.2
2	0.3	0.5	0.4	0.3
3	0.3	0.6	0.4	0.3
4	0.7	1.1	1.2	0.9
5	1.3	1.8	2.0	1.6
6	1.9	2.7	3.0	2.3
7	2.4	3.7	3.7	3.0
8	3.0	4.7	4.5	3.8

The growth trends of water spinach under different LED light treatments are shown in Figure 2. Across the 8-day period, plant height increased steadily under all light conditions, but the rate of elongation varied significantly depending on the wavelength provided. From this figure, after 8 days of observation, red and blue LED lights promoted the highest growth rates, with final plant heights of 4.7 cm and 4.5 cm, respectively. This indicates that both wavelengths are highly effective in stimulating vegetative growth, though red light showed a slight advantage in overall elongation. The pronounced effect of red light supports its role in activating phytochromes, which regulate stem elongation and photosynthetic efficiency (Lin et al., 2020). Green light produced moderate growth, with plants reaching 3.8 cm by Day 8. Although green wavelengths are largely reflected by plant tissues, their ability to penetrate deeper into the canopy may provide supplementary photosynthesis in lower leaves (Kim et al., 2004). However, compared to red and blue light, the growth-promoting effect of green was weaker.

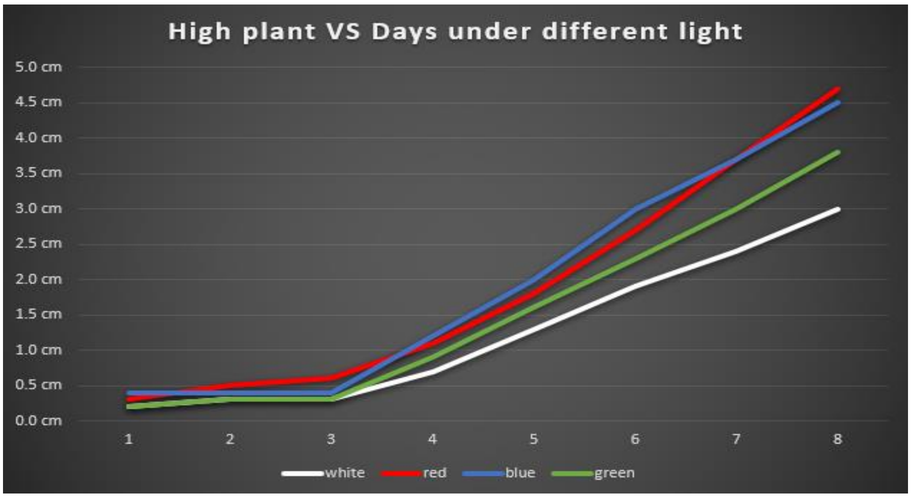


Figure 2 The plant height versus different light used

CONCLUSIONS

This study demonstrates that the growth of *water spinach* is strongly influenced by the wavelength of LED light. Among the treatments, red light produced the greatest stem elongation (4.7 cm), followed closely by blue light (4.5 cm), while green light supported moderate growth (3.8 cm) and white light resulted in the lowest growth (3.0 cm). These findings highlight the role of red and blue wavelengths in promoting rapid vegetative development through the activation of specific photoreceptors, whereas green and white lights were less effective. Based on the results, it can be suggested that combining red and blue wavelengths, can optimize plant growth and offer practical benefits for sustainable indoor agriculture.

COMPLIANCE OF ETHICAL STANDARDS

Not applicable.

REFERENCES

Bantis, F., Smirnakou, S., Ouzounis, T., Koukounaras, A., Ntagkas, N., & Radoglou, K. (2018). Current status and recent achievements in the field of horticulture with the use of light-emitting diodes (LEDs). *Scientia Horticulturae, 235,* 437–451. https://doi.org/10.1016/j.scienta.2018.02.058

Bourget, C. M. (2008). An introduction to light-emitting diodes. *HortScience, 43*(7), 1944–1946. https://doi.org/10.21273/HORTSCI.43.7.1944

Hasan, M. M., Bashir, T., Ghosh, R., Lee, S. K., & Bae, H. (2017). An overview of LEDs' effects on the production of bioactive compounds and crop quality. *Molecules, 22*(9), 1420. https://doi.org/10.3390/molecules22091420

Hogewoning, S. W., Trouwborst, G., Maljaars, H., Poorter, H., van Ieperen, W., & Harbinson, J. (2010). Blue light dose–responses of leaf photosynthesis, morphology, and chemical composition of Cucumis sativus grown under different combinations of red and blue light. *Journal of Experimental Botany, 61*(11), 3107–3117. https://doi.org/10.1093/jxb/erq132

Johkan, M., Shoji, K., Goto, F., Hashida, S. N., & Yoshihara, T. (2012). Blue light-emitting diode light irradiation of seedlings improves seedling quality and growth after transplanting in red leaf lettuce. *HortScience, 47*(2), 149–155. https://doi.org/10.21273/HORTSCI.47.2.149

Kim, H. H., Goins, G. D., Wheeler, R. M., & Sager, J. C. (2004). Green-light supplementation for enhanced lettuce growth under red- and blue-light-emitting diodes. *HortScience, 39*(7), 1617–1622. https://doi.org/10.21273/HORTSCI.39.7.1617

Lin, K. H., Huang, M. Y., Huang, W. D., Hsu, M. H., Yang, Z. W., & Yang, C. M. (2020). The effects of red, blue, and white light-emitting diodes on the growth, development, and edible quality of hydroponically grown lettuce (Lactuca sativa L. var. capitata). *Scientific Reports, 10,* 1–8. https://doi.org/10.1038/s41598-020-67274-0

Massa, G. D., Kim, H. H., Wheeler, R. M., & Mitchell, C. A. (2008). Plant productivity in response to LED lighting. *HortScience, 43*(7), 1951–1956. https://doi.org/10.21273/HORTSCI.43.7.1951

Pejabat Perpustakaan
Librarian Office

Universiti Teknologi MARA
Cawangan Perak
Kampus Seri Iskandar
32610 Bandar Baru Seri Iskandar,
Perak Darul Ridzuan, MALAYSIA
Tel: (+605) 374 2093/2453 Faks: (+605) 374 2299

UNIVERSITI TEKNOLOGI MARA

Surat kami : 700-KPK (PRP.UP.1/20/1)
Tarikh : 20 Januari 2023

Prof. Madya Dr. Nur Hisham Ibrahim
Rektor
Universiti Teknologi MARA
Cawangan Perak

Tuan,

PERMOHONAN KELULUSAN MEMUAT NAIK PENERBITAN UiTM CAWANGAN PERAK MELALUI REPOSITORI INSTITUSI UiTM (IR)

Perkara di atas adalah dirujuk.

2. Adalah dimaklumkan bahawa pihak kami ingin memohon kelulusan tuan untuk mengimbas (*digitize*) dan memuat naik semua jenis penerbitan di bawah UiTM Cawangan Perak melalui Repositori Institusi UiTM, PTAR.

3. Tujuan permohonan ini adalah bagi membolehkan akses yang lebih meluas oleh pengguna perpustakaan terhadap semua maklumat yang terkandung di dalam penerbitan melalui laman Web PTAR UiTM Cawangan Perak.

Kelulusan daripada pihak tuan dalam perkara ini amat dihargai.

Sekian, terima kasih.

"BERKHIDMAT UNTUK NEGARA"

Saya yang menjalankan amanah,

SITI BASRIYAH SHAIK BAHARUDIN
Timbalan Ketua Pustakawan

nar

Setuju.

27.1.2023

PROF. MADYA DR. NUR HISHAM IBRAHIM
REKTOR
UNIVERSITI TEKNOLOGI MARA
CAWANGAN PERAK
KAMPUS SERI ISKANDAR