International Journal of Horticultural Science and Technology (2026) Vol. 13, No. 1, pp. 193-196 doi.org/10.22059/ijhst.2025.399260.1158

International Journal of Horticultural Science and Technology
Journal homepage: https://ijhst.ut.ac.ir

In Memory and Scientific Contributions of Dr. Sasan Aliniaeifard: A Trailblazer in Controlled Environment Agriculture

Kourosh Vahdati*

Department of Horticulture, College of Aburaihan, University of Tehran, Tehran, Iran

*Corresponding author's email: kvahdati@ut.ac.ir

ARTICLE INFO

Article history:

Received: 9 July 2025,
Received in revised form: 15 July 2025,
Accepted: 16 July 2025,

Article type:

Review paper

Keywords:

Controlled Environment Agriculture (CEA),
Horticulture,
LED Lighting,
Photosynthesis,
Plant Physiology,
Stomatal Response

ABSTRACT

Dr. Sasan Aliniaeifard (1981–2025) was a pioneering horticultural scientist whose innovative work in controlled environment agriculture (CEA), particularly in greenhouse and vertical farming systems, significantly advanced plant physiology research and education in Iran and beyond. This review is a tribute to highlight his major scientific achievements, academic leadership, and educational impact, while also incorporating personal reflections to honor his enduring influence on future generations of researchers.

Introduction

The untimely passing of Dr. Sasan Aliniaeifard in a tragic car accident in March 2025, together with his wife Dr. Maryam Seifikalhor and their son, Avash, represents an irreplaceable loss for the national and international scientific community. Born in 1981 in Khorramabad, Iran, Dr. Aliniaeifard demonstrated a passion for scientific inquiry from an early age. He earned his B.Sc. in Plant Production Engineering Horticulture at Kurdistan University, his M.Sc. in Horticulture from the University of Tabriz in 2007, and later completed his Ph.D. in Greenhouse Horticulture in 2014 at Wageningen University, the Netherlands, within the Horticulture and Product Physiology Group. His doctoral work laid the foundation for a prolific career dedicated to advancing the understanding of plant–environment interactions, particularly photosynthesis and plant responses to light and vapor pressure deficit (VPD).

Dr. Aliniaeifard was widely recognized as a pioneer in CEA, directing his efforts toward improving productivity and quality in modern systems such as greenhouses, vertical farms, plant factories, and growth chambers, the core themes of GreenSys Symposia. During his career, he authored 117 scientific publications, which have collectively received more than 3,200 citations, underscoring his broad international influence.

At the University of Tehran, he became Associate Professor in a short time and established the Center for Controlled Environment Agricultural

Technology (CEA) at the College of Aburaihan. Under his leadership, the center became one of Iran's most advanced facilities for greenhouse horticulture, equipped with production and nursery halls, photosynthesis laboratories, photorhizomaster systems, robotic UV light systems, multi-tiered production platforms, and educational hydroponic units. His scientific contributions were widely disseminated through international and national journals, lectures at prestigious congresses in the United States, Russia, China, and several other countries, as well as a book chapter published by Taylor & Francis.

Scientific Achievements

Stomatal physiology under low Vapor Pressure Deficit (VPD)

Dr. Aliniaeifard's pioneering research revealed that prolonged exposure to low VPD reduces stomatal sensitivity to abscisic acid (ABA), thereby impairing transpiration regulation and postharvest quality. His foundational studies yielded significant findings in the plant physiology of *Arabidopsis* (Aliniaeifard and van Meeteren, 2014), chrysanthemum (Aliniaeifard and van Meeteren, 2016), *Tradescantia* (Aliniaeifard et al., 2014), and walnut (Maleki Asayesh et al., 2017; Aliniaeifard et al., 2020; Asayesh et al., 2021; Saeedi et al., 2023). He also introduced novel applications of chlorophyll fluorescence for non-invasive assessments of stomatal responses, thereby offering significant advances in plant physiological phenotyping, as presented at the 2016 International Plant Phenotyping Symposium. In addition, he contributed to elucidating the role of stomata in plant–pathogen interactions. His work on wheat demonstrated that the Stb6 resistance gene regulates stomatal immunity by triggering transient closure to restrict pathogen entry. This function is now known to preserve photosynthetic performance through non-photochemical quenching, while coordinating antioxidant enzyme activity to alleviate oxidative stress. The study provided novel insights into the physiological and biochemical mechanisms underpinning gene-for-gene resistance in cereals (Ghiasi Noei et al., 2022).

Light spectrum and postharvest physiology

His work demonstrated that low-dose UVA radiation improved the shelf life of *Lactuca sativa* by modulating physiological traits during growth (Chen et al., 2020). Supplemental red and white LED lighting increased resilience and flower development in roses under high irradiance, enhancing cut flower production (Davarzani et al., 2023). Collaborative studies further showed that optimizing daily light integral (DLI) with LED lighting enhanced phytochemical content, hormonal regulation, and photosynthetic activity in basil, leading to superior growth and quality (Eghbal et al., 2024).

Innovations in greenhouse technology and environmental control

Dr. Aliniaeifard explored the role of biostimulants such as gamma-aminobutyric acid (GABA) and silicon in improving tolerance to salinity and heavy metals (Seifi Kalhor et al., 2018). He also developed integrated solar-powered evaporative cooling systems to improve water-use efficiency and regulate salinity in greenhouse environments (Ahmadinik et al., 2020). His studies on lettuce demonstrated the synergistic benefits of elevated CO_2 and tailored light intensities on yield and water-use efficiency (Esmaili et al., 2020).

Enhancing photosynthetic efficiency in Phalaenopsis

A study on enhancing photosynthetic efficiency in Phalaenopsis amabilis shows that SM2 medium with temporary immersion systems (TIS-FA-Bio and TIS-RITA®) enables economical, high-growth, high-photosynthesis mass propagation of Phalaenopsis orchids with more plantlets per liter and substantially lower costs than traditional semi-solid media or MMS (Mohammadpour Barough et al., 2024).

Collaborative research on Persian walnut physiology and biotechnology

In collaboration with the author, Dr. Aliniaeifard made substantial contributions to the physiology and biotechnology of *Juglans regia* (Persian walnut). Their work encompassed improving *in vitro* propagation, stress tolerance, and genetic characterization. Joint studies investigated stomatal morphology, desiccation responses, and acclimatization challenges in walnut plantlets, while exploring solutions such as CO_2 enrichment and light spectrum manipulation (Asayesh et al., 2017; Maleki Asayesh et al., 2017; Vahdati et al., 2017; Aliniaeifard et al., 2020; Asayesh et al., 2021).

Further studies examined gelling agents, culture media, and light spectra for their effects on morpho-physiological traits and photosynthetic performance in walnut explants (Saeedi et al., 2023; Saeedi et al., 2024). At the molecular level, Dr. Aliniaeifard contributed to cloning and characterization of the *GAI* gene, which is linked to dwarfism and precocity (Mohseniazar et al., 2021). They conducted genome-wide association studies to elucidate genetic determinants of photosynthesis and water-use traits under drought stress (Arab et al., 2022; Arab et al., 2023). More recently, he co-led research on Persian walnut responses to combined drought and heat stress, yielding valuable insights into complex abiotic interactions (Habibi et al., 2024).

Scientific Collaboration and Influence

Dr. Aliniaeifard was a strong advocate of interdisciplinary collaboration. He delivered keynote lectures at international conferences in St. Petersburg, Russia, and Iran, and played a pivotal role in national congresses on ornamental plants, hydroponics, and greenhouse cultivation. His commitment to collaboration and knowledge exchange earned him multiple awards for both scientific excellence and mentorship.

Awards and Academic Recognition

Dr. Aliniaeifard received numerous honors throughout his career:

- Recognition as Outstanding M.Sc. Graduate, University of Tabriz (2007)
- Doctoral Scholarship for Studies Abroad
- €1,000 ALIB Institute grant to attend the Plant Dynamic Signaling Symposium (U.S.)
- Kazemi Ashtiani Award for Young Academicians, National Elites Foundation
- Recognition as "Educational Elite" of the University of Tehran (2017)
- International Academic Elite, University of Tehran (2018)
- Top Educator Award, Fourth Educational Festival of the University of Tehran
- Top Researcher, 63rd Research and Technology Festival, University of Tehran
- Best Laboratory Award, University of Tehran (2020)
- Co-translator of the book "Smart Plant Factory" (Toyoki Kozai; Springer), which was selected as the Book of the Year at the 7th National Week of Agricultural and Natural Resources Books (2025)

His impact is evidenced by an h-index of 32 (Web of Science), 36 (Scopus), and 42 (Google Scholar). In 2024, he was listed among the top 1% of plant scientists globally by Essential Science Indicators (ESI). Additionally, the Elsevier Data Repository (2025 update) ranked him among the world's top 2% most-cited scientists in his field for single-year performance, underscoring his international stature.

Academic Leadership roles and infrastructure development

- Founder and Director of the CEA Center (2022): A cutting-edge hub with advanced facilities for hydroponics, robotic lighting, and plant physiology research.
- Editorial Service: Managing Editor and Editorial Board Member, *International Journal of Horticultural Science and Technology* (IJHST).
- Editorial Advisory Board: *Scientia Horticulturae*
- Guest Editor: Special issue of *Horticulturae* (MDPI) dedicated in his honor.
- Policy Engagement: Led expert panels on CEA at the National Elites Foundation of Iran.

International recognition and community tributes

Dr. Aliniaeifard participated actively in multiple GreenSys Symposia organized by the International Society for Horticultural Science (ISHS). For GreenSys 2025, he had agreed to serve on the Scientific Committee. Following his passing, the organizers and ISHS Board named him an Honorary Member. In recognition of his mentorship, the "Dr. Sasan Aliniaeifard Award" was established for the best oral presentation by a young researcher at GreenSys 2025. Additionally, the Acta Horticulturae volume of GreenSys 2025 has been dedicated to his memory. The global community will remember him not only for his outstanding scientific contributions but also for his integrity, generosity, and commitment to nurturing young scientists. His personal and scientific legacy will endure for generations.

Conclusion

Dr. Sasan Aliniaeifard's vision and dedication profoundly advanced sustainable horticulture through innovations in stress physiology, LED lighting applications, and environmental control technologies. His legacy lives on in the innovations he pioneered, the scholars he mentored, and the thriving research infrastructure he established. He leaves behind not only a remarkable body of work but also a community deeply inspired by his life and contributions.

Acknowledgements

The author gratefully acknowledges the contributions of Tao Li, Saeid Karimi, Mansoor Karimi Jashni, Arman Beyraghdar Kashkoli, Amir Mirzadi Gohari, Naser Askari, Sheida Moradifard, Mohsen Hamedpour Darabi and Aylar Mohammadpour Barough for their help in preparing and reviewing this manuscript.

Author Contributions

The author was solely responsible for the conception, design, and writing of this manuscript.

Funding

This research received no external funding.

Conflict of Interest

The authors indicate no conflict of interest in this work.

References

Ahmadinik A, Rahimikhoob A, Aliniaeifard S. 2020. Water use efficiency in novel integrated system of

greenhouse and saltwater evaporative pond. Desalination 496, 114698. https://doi.org/10.1016/j.desal.2020.114698

Aliniaeifard S, Maleki Asayesh Z, Driver J, Vahdati K. 2020. Stomatal features and desiccation responses of Persian walnut leaf as caused by *in vitro* stimuli aimed at stomatal closure. Trees 34, 1219-1232. https://doi.org/10.1007/s00468-020-01992-x

Aliniaeifard S, Malcolm Matamoros P, Van Meeteren U. 2014. Stomatal malfunctioning under low VPD conditions: induced by alterations in stomatal morphology and leaf anatomy or in the ABA signaling? Physiologia Plantarum 152(4), 688-699. https://doi.org/10.1111/ppl.12216

Aliniaeifard S, Van Meeteren U. 2014. Natural variation in stomatal response to closing stimulus among *Arabidopsis thaliana* accessions after exposure to low VPD as a tool to recognize the mechanism of disturbed stomatal functioning. Journal of Experimental Botany 65(22), 6529-6542. https://doi.org/10.1093/jxb/eru370

Aliniaeifard S, Van Meeteren U. 2016. Stomatal characteristics and desiccation response of leaves of cut chrysanthemum (*Chrysanthemum morifolium*) flowers grown at high air humidity. Scientia Horticulturae 205, 84-89. https://doi.org/10.1016/j.scienta.2016.04.025

Arab MM, Askari H, Aliniaeifard S, Mokhtassi-Bidgoli A, Estaji A, Sadat-Hosseini M, Sohrabi SS, Mesgaran MB, Leslie CA, Brown PJ, Vahdati K. 2023. Natural variation in photosynthesis and water use efficiency of locally adapted Persian walnut populations under drought stress and recovery. Plant Physiology and Biochemistry 201, 107859. https://doi.org/10.1016/j.plaphy.2023.107859

Arab MM, Brown PJ, Abdollahi-Arpanahi R, Sohrabi SS, Askari H, Aliniaeifard S, Mokhtassi-Bidgoli A, Mesgaran MB, Leslie CA, Marrano A, Neale DB, Vahdati K. 2022. Genome-wide association analysis and pathway enrichment provide insights into the genetic basis of photosynthetic responses to drought stress in Persian walnut. Horticulture Research 9, uhac042. https://doi.org/10.1093/hr/uhac124

Asayesh ZM, Aliniaeifard S, Vahdati K. 2021. Stomatal morphology and desiccation response of Persian walnut tissue culture plantlets influenced by the gelling agent of *in vitro* culture medium. Journal of Nuts 12(1), 41-52. https://doi.org/10.22034/jon.2021.1922749.1105

Asayesh ZM, Vahdati K, Aliniaeifard S. 2017. Investigation of physiological components involved in low water conservation capacity of *in vitro* walnut plants. Scientia Horticulturae 224, 1–7. https://doi.org/10.1016/j.scienta.2017.04.023

Chen Y, Fanourakis D, Tsaniklidis G, Aliniaeifard S, Yang Q, Li T. 2020. Low UVA intensity during cultivation improves the lettuce shelf-life, an effect that is not sustained at higher intensity. Postharvest Biology and Technology 172, 111376. https://doi.org/10.1016/j.postharvbio.2020.111376

Davarzani M, Aliniaeifard S, Zare Mehrjerdi M, Roozban M, Saeedi A, Gruda N. 2023. Optimizing supplemental light spectrum improves growth and yield of cut roses. Scientific Reports 13, 21381. https://doi.org/10.1038/s41598-023-48266-3

Eghbal E, Aliniaeifard S, Zare Mehrjerdi M, Abdi S, Hassani B, Rassaie T, Gruda N. 2024. Growth, phytochemical, and phytohormonal responses of basil to different light durations and intensities under constant daily light integral. BMC Plant Biology 24, 935. https://doi.org/10.1186/s12870-024-05637-w

Esmaili M, Aliniaeifard S, Mashal M, Ghorbanzaseh P, Seif M, Gavilan M, Carrillo F, Lastochkina O, Li T. 2020. CO_2 enrichment and increasing light intensity till a threshold level, enhance growth and water use efficiency of lettuce plants in controlled environment. Notulae Botanicae Horti Agrobotanici Cluj-Napoca 48(4), 2244-2262. https://doi.org/10.15835/nbha48411835

Habibi A, Sarikhani S, Arab MM, Soltani M, Aliniaeifard S, Roozban MR, Vahdati K. 2024. Drought and heat stress interactions: Unveiling the molecular and physiological responses of Persian walnut. Plant Physiology and Biochemistry 217, 109237. https://doi.org/10.1016/j.plaphy.2024.109237

Maleki Asayesh Z, Vahdati K, Aliniaeifard S, Askari N. 2017. Enhancement of *ex vitro* acclimation of walnut plantlets through modification of stomatal characteristics *in vitro*. Scientia Horticulturae 220, 114-121. https://doi.org/10.1016/j.scienta.2017.03.045

Mohammadpour Barough A, Dianati Daylami S, Fadavi A, Vahdati K. 2024. Enhancing photosynthetic efficiency in Phalaenopsis amabilis through bioreactor innovations. BMC Plant Biology 24, 1166. https://doi.org/10.1186/s12870-024-05767-1

Mohseniazar M, Vahdati K, Aliniaeifard S, Wang Y. 2021. Cloning and in silico characterization of GAI gene and its promoter region from dwarf/precocious and vigorous/non-precocious Persian walnut genotypes. Acta Horticulturae 1315, 313-318. https://doi.org/10.17660/ActaHortic.2021.1315.47

Saeedi SA, Vahdati K, Aliniaeifard S, Sarikhani S, Dianati S, Davarzani M, Fakhari S. 2024. Enhancing growth and morpho-physiological traits of tissue-cultured explants of Persian walnut through manipulation of *in vitro* lighting spectra. Journal of Nuts 15(1), 71-80. https://doi.org/10.22034/jon.2024.2004910.1259

Saeedi SA, Vahdati K, Sarikhani S, Daylami SD, Davarzani M, Gruda NS, Aliniaeifard S. 2023. Growth, photosynthetic function, and stomatal characteristics of Persian walnut explants *in vitro* under different light spectra. Frontiers in Plant Science 14, 1292045. https://doi.org/10.3389/fpls.2023.1292045

Seifi Kalhor M, Aliniaeifard S, Seif M, Javadi Asayesh E, Bernard F, Hassani B, Li T. 2018. Enhanced salt tolerance and photosynthetic performance: Implication of ɤ-amino butyric acid application in salt-exposed lettuce (*Lactuca sativa* L.) plants. Plant Physiology and Biochemistry 130, 157-172. https://doi.org/10.1016/j.plaphy.2018.07.003

Vahdati K, Maleki Asayesh Z, Aliniaeifard S, Leslie C. 2017. Improvement of *ex vitro* desiccation through elevation of CO_2 concentration in the atmosphere of culture vessels during *in vitro* growth. HortScience 52(7), 1006-1012. https://www.doi.org/10.21273/HORTSCI11922-17