Vegetable seedlings and transplants and their impacts on product quality

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Keywords: eustress; fresh food; metabolic reprogramming; moderate salinity; plant salt stress.

Using high-quality planting material during early vegetable production is crucial for enhancing crop performance, reducing time to harvest, and improving profitability. Here, we analyzed the f research trends in vegetable seedling and transplant production, emphasizing innovations that could elevate the nutritional value of vegetables and address sustainability in agriculture. Using statistical, mathematical, and clustering tools to identify key topics and trends, we comprehensively reviewed 762 articles and 5,248 keywords from Scopus (1971–2022). Visualization maps were created to trace the evolution of keyword usage, resulting in five primary research clusters. Key findings indicate that seed tray design, mechanical seeders, and greenhouse technology influence transplant quality. Practices such as grafting, LED lighting, biofortification, biostimulant applications, and plant growth-promoting microorganisms are highlighted as practical approaches to enhance seedling vigor and nutritional quality, aligning with the need for sustainable agricultural practices. We revealed significant gaps in understanding the interactions between seedling treatments and final nutritional outcomes, suggesting a need for further studies on operational mechanisms to improve transplant efficacy and vegetable quality. Practical recommendations and research directions include optimizing seed tray architecture, selecting environmentally sustainable substrates, and refining grafting techniques to enhance vegetable transplant quality. Additionally, integrating lighting and biostimulants appears promising for stimulating the accumulation of bioactive compounds and improving the nutritional profile of vegetables. This research highlights the value of sustainable vegetable transplant production systems, which enhance crops' nutritional quality and resilience. Future research should focus on elucidating the molecular pathways and physiological responses associated with enhanced nutritional outcomes and developing early markers for seedling quality. Particular attention should be given to breeding programs to produce cultivars with improved levels of essential vitamins, minerals, and antioxidants. The study also identifies the role of beneficial microorganisms, including bacteria, mycorrhizal fungi, and algae, as a promising area for investigation. These microorganisms can potentially improve seedling health, nutrient absorption, and, ultimately, the nutritional content of mature plants. By advancing transplant production methods and refining screening techniques, this research paves the way for achieving high-quality, nutrient-dense vegetable crops that address the growing demand for sustainable, nutritious food sources. Our study analysis offers valuable insights into the technical, statistical, and scientific aspects of seedling and transplant production, shaping future research in horticulture, highlighting the potential for applied innovations to transform vegetable production, and emphasizing the need for further research to achieve sustainable and nutritionally optimized agricultural practices.

For the complete paper, please see:

Gallegos-Cedillo, VM, C Nájera, A Signore, J Ochoa, J Gallegos, C Egea-Gilabert, NS Gruda, JA Fernández 2024. Analysis of global research on vegetable seedlings and transplants and their impacts on product quality. Journal of the Science of Food and Agriculture. DOI: 10.1002/jsfa.13309.