

CATEGORY: HORTICULTURAL PRACTICES IMPACTING HEALTH

Technology Tools

“Advances in horticulture technology and digital tools support higher yields, better monitoring of food production and processing systems, and lesser environmental footprint, each with its own impact on health in addition to impacts on human labor typically used in the horticulture industry (Sulecki, 2016)” (Fleming, 2021). Interest in biotechnology continues to expand with many of these technology tools used primarily in agriculture with applications for smaller scale operations including horticulture. They indicate future directions for use across sectors. Emerging issues include contributions of genome editing technologies for improved nutrition (Smyth, 2022), mucilage polysaccharide as a plant secretion and potential trends in food and biomedical applications (Goksen et al., 2023), and spray dried insect protein-polyphenol particles delivering health-relevant value-added food ingredients (Silva, et al., 2024).

Key Organizations

[Agritecture](#)

[American Society for Horticultural Science](#)

[Institute of Food Technologist](#)

[International Society for Horticultural Science](#)

[National Center for Appropriate Technology \(NCAT\)](#)

United States Food and Drug Administration, Agricultural Biotechnology

Books, journals & epublications on technology tools

[ActaHorticulturae](#)

[AFN news site for foodtech & agtech industry](#)

AgrAbility (2020). [The Toolbox Assistive Technology Database](#).

[Agritecture epub](#)

[Agronomy journal](#)

Alsanius, B.W., Jirström, M., Naznin, M.T. et al. (2020). Optimizing horticulture for urban agriculture.

In *Achieving sustainable urban agriculture* (pp. 223-280). Burleigh Dodds Science Publishing.

Avgoustaki, D.D., & Xydis, G. (2020). How energy innovation in indoor vertical farming can improve food security, sustainability, and food safety? In *Advances in food security and sustainability*, 5, 1-51. Elsevier.

[Computers and Electronics in Agriculture journal](#)

[Food Technology magazine](#)

[Greenhouse Grower magazine](#)

[Greenhouse Product News magazine](#)

[Green Plants for Green Buildings](#)

Halleck, L.F. (2018). *Gardening under lights: The complete guide for indoor growers*. Timber Press, Portland, OR.

[HortTechnology](#)

International Society for Horticultural Science. (2022). *IX International scientific and practical conference on biotechnology as an instrument for plant biodiversity conservation*

(physiological, biochemical, embryological, genetic and legal aspects).

International Society for Horticultural Science. (2022). [XXXI International horticultural congress \(IH2022\): International Symposium on Agroecology and System Approach for Sustainable and Resilient Horticultural Production.](#)

[People Plant Planet journal](#)

Solankey, S.S., Akhtar, S., Maldonado, A.I.L. et al. (Eds.). (2020). *Urban horticulture: Necessity of the future*. BoD–Books on Demand.

Research & articles on technology tools

Recently published selected research & articles:

Ariesen-Verschuur, N., Verdouw, C., & Tekinerdogan, B. (2022). [Digital twins in greenhouse horticulture: A review](#). *Computers and Electronics in Agriculture*, 199, 107183.

Askew, K. (2021). [‘It is the next logical step of the food transition’: How fermentation can help solve the ‘protein crisis’](#). *Food Navigator.com*.

Aziz, M.A., Brini, F., Rouached, H. et al. (2022). [Genetically engineered crops for sustainably enhanced food production systems](#). *Frontiers in Plant Science*, 13, 1027828.

Bandehali, S., Miri, T., Onyeaka, H., & Kumar, P. (2021). [Current state of indoor air phytoremediation using potted plants and green walls](#). *Atmosphere*, 12(4), 473.

Bashir, T., Ul Haq, S.A., Masoom, S. et al. (2023). [Quality trait improvement in horticultural crops: OMICS and modern biotechnological approaches](#). *Mol Biol Rep.*, 50(10), 8729-8742.

Cato, S., McWhirt, A., & Herrera, L. (2022). [Combating horticultural misinformation through integrated online campaigns using social media, graphic interchange format, and blogs](#). *HortTechnology*, 32(4), 342-347.

De, S. (2020). Strategies of plant biotechnology to meet the increasing demand of food and nutrition in India. *International Annals of Science*, 10(1).

Carolan, M. (2020). “Urban farming Is going high tech” digital urban agriculture's links to gentrification and land use. *Journal of the American Planning Association*, 86(1), 47-59.

Fanelli, V., Mascio, I., Miazzi, M.M. et al. (2021). [Molecular approaches to agri-food traceability and authentication: An updated review](#). *Foods*, 10(7), 1644.

Fleming, L. (2021). Horticulture for health framework. [ISHS Acta Horticulturae 1330: XV International People Plant Symposium and II International Symposium on Horticultural Therapies: the Role of Horticulture in Human Well-being and Social Development](#).

Gibney, M.J. (2021). Food technology and plant-based diets. *The Journal of Nutrition*, 151(1), 1-2.

Goksen, G., Demir, D., Dhama, K. et al. (2023). Mucilage polysaccharide as a plant secretion: Potential trends in food and biomedical applications. *International Journal of Biological Macromolecules*, 230, 123146.

Hadidi, M., Aghababaei, F., Gonzalez-Serrano, D.J. et al. (2024). Plant-based proteins from agro-industrial waste and by-products: Towards a more circular economy. *Int J Biol Macromol.*, 261(1), 129576.

Hassoun, A., Boukid, F., Pasqualone, A. et al. (2022). Emerging trends in the agri-food sector: Digitalisation and shift to plant-based diets. *Current Research in Food Science*, 5, 2261-2269.

Hollands, J., & Korjenic, A. (2021). [Indirect economic effects of vertical indoor green in the context of reduced sick leave in offices](#). *Sustainability*, 13(4), 2256.

Jackson, B. (2021). Current and future growing media supply and demand challenges. *Greenhouse Product News*.

- Karacor, G. (2021). [The collective power of greenhouse data and plant science](#). *Greenhouse Grower*.
- Khan, M.M., Akram, M.T., Janke, R. et al. (2020). [Urban horticulture for food secure cities through and beyond COVID-19](#). *Sustainability*, 12(22), 9592.
- Koukounaras, A. (2020). [Advanced greenhouse horticulture: New technologies and cultivation practices](#). *Horticulturae*, 7(1), 1.
- Kim, C.T., Maeng, J.S., Shin, W.S. et al. (2017). Food 3D-printing technology and its application in the food industry. *Food Eng Prog.*, 21, 12–21.
- Kraakman, N.J.R., González-Martín, J., Pérez, C. et al. (2021). Recent advances in biological systems for improving indoor air quality. *Reviews in Environmental Science and Bio/Technology*, 20(2), 363-387.
- Kumar, K., Gambhir, G., Dass, A. et al. (2020). Genetically modified crops: current status and future prospects. *Planta.*, 251(4), 91.
- Lee, S., & Park, S. (2024). [Psychophysiological and psychological responses of teenage students conducting computer programming activities combined with horticultural activities](#). *HortTechnology*, 34(3), 353-360.
- Lin, T., Chen, S., & Zhang, X., eds. (2024). [Artificial intelligence in agriculture \(special issue\)](#). *Computers and Electronics in Agriculture*.
- Lugones Perez, D., Campbell, C.G., & Gomez, C. (2023). [Using citizen science to evaluate home gardeners' experience with compact tomato plants](#). *HortTechnology*, 33(6), 578-586.
- Ma, X., Gallardo, R.K., Canales, E. et al. (2024). [Would consumers accept CRISPR fruit crops if the benefit has health implications? An application to cranberry products](#). *Agricultural and Resource Economics Review*, 1-23.
- Malochleb, M. (2021). [Boosting the benefits of apples; 3D-bioprinting stimulates Wagyu beef](#). *Food Technology Magazine*.
- Menta, R., Rosso, G., & Canzoneri, F. (2022). Plant-based: A perspective on nutritional and technological issues. Are we ready for “precision processing”? *Frontiers in Nutrition*, 9, 878926.
- Moussa, R.R., Mahmoud, A.H., & Hatem, T.M. (2020). A digital tool for integrating renewable energy devices within landscape elements: Energy-scape online application. *Journal of Cleaner Production*, 254, 119932.
- Mustapa, M., Batcha, M., Amin, L. et al. (2021). Farmers' attitudes towards GM crops and their predictors. *J. Sci. Food Agric.*, 101 (13), 5457–5468.
- Nansen, C., Purington, R., & Murdock, M. (2021). [Using advanced optical sensing to quantify phytotoxicity in ornamental plants](#). *Hort Technology*, 31(4), 532-534.
- Pichlhöfer, A., Sesto, E., Hollands, J. et al. (2021). [Health-related benefits of different indoor plant species in a school setting](#). *Sustainability*, 13(17), 9566.
- Raman, R. (2017). The impact of genetically modified (GM) crops in modern agriculture: A review. *GM Crops Food*, 8(4), 195–208.
- Reddy, R.V.S.K., Omprasad, J., & Janakiram, T. (2022). Technological innovations in commercial high tech horticulture, vertical farming and landscaping. *International Journal of Innovative Horticulture*, 11(1), 78-91.
- Robson, T.M., Pieriste, M., Durand, M. et al. (2022). The benefits of informed management of sunlight in production greenhouses and polytunnels. *Plants People Planet*, 4(3).
- Shubha, K., Mukherjee, A., Tamata, M. et al. (2019). [Vertical farming of high value horticultural crops](#). *ICAR Research Complex for Eastern Region*, 35.

Silva, E., Xiong, J., Medeiros, F. et al. (2024). [Spray dried insect protein-polyphenol particles deliver health-relevant value-added food ingredients](#). *Future Food*, 9, 100315.

Smyth, S. J. (2022). Contributions of genome editing technologies towards improved nutrition, environmental sustainability and poverty reduction. *Frontiers in Genome Editing*, 4, 863193.

Southey, F. (2021). [‘Welding’ tech eliminates sugar binders in snacks category: ‘We’re the game changer of the snacking industry’](#). *Food Navigator.com*.

Sulecki, J. (2016). Five trends in horticulture technology. *AgFunder News*.
<https://agfundernews.com/five-trends-horticulture-technology.html>

Yee, K. (2023). [Upcycling for hydroponics in Singapore](#). *Food Tank*.

Van Gerrewey, T., Boon, N., & Geelen, D. (2022). [Vertical farming: The only way is up?](#) *Agronomy*, 12(1), 2.

Walters, K.J., Behe, B K., Currey, C.J. et al. (2020). [Historical, current, and future perspectives for controlled environment hydroponic food crop production in the United States](#). *HortScience*, 55(6), 758-767.

Zahid, A., He, L., Lu, Y. et al (2024). [Sensing, automation, and robotics for sustainability of specialty crops \(special issue\)](#). *Computers and Electronics in Agriculture*.

Zhang, L., Ferguson, L., Ying, L. et al. (2024). [Developing a web-based pistachio nut growth prediction system for orchard management](#). *HortTechnology*, 34(1), 1-7.

(2021). [How greenhouses are enabling hurricane-resilient farming in Puerto Rico](#). *Agritecture*.

(2021). [7 ways urban agriculture can transform unused spaces](#). *Agritecture*.

(2021). [4 trends in high-tech horticulture](#). *Panasonic*.

(2021). [Food tech startup Planted Foods causes a stir in Berlin with giant chicken made of plants](#). *Vegconomist.com*.

(2021). [Atoll nation of Tuvalu adopts ‘cubes’ to step up nutritious food production](#). *Agritecture.com*.

(2022). [Feeding students on the go with 21st century technology](#). *TrayTalk*.

(2022). [Specialty equipment helps CA district serve 24,000 school meals a day](#). *TrayTalk*.

Examples of technology tools

[8 commercial urban farms in NYC](#), article featuring urban farms in New York City. From Hunter College New York City Food Policy Center.

[Eden-ISS is an indoor farm](#) bringing fresh produce to Antarctica at the German Aerospace Center.

[Growing Underground](#) in London, England is the latest hydroponic technology growing pesticide-free produce 33 meters below city streets.

[Harvest Croo Robotics](#), a Florida-based company is developing berry picking bots.

[15 Modern farming technologies](#) that are next level focus on farming with fish farming, pests, self-driving tractors, food waste b2b marketplace, with applications for horticulture.

[80 Acres Farms in Cincinnati, OH](#). Is building a large fully automated indoor farm for commercial production.

Videos, webinars & websites on technology tools

[Aerofarms](#) video demonstrates cutting-edge technology in a tour of indoor vertical farms.

[Exploring Plant-based Food Innovation Using High Pressure Processing \(HPP\) Technology](#) webinar.

[Farmers in the Netherlands are Growing More Food Using Less Resources](#)

[Learn about Food Science video](#) provides history of discipline, technology components and more.

[U.S. Botanic Gardens and the National Center for Appropriate Technology](#) offer training in urban farming for veterans.

[United States Food and Drug Administration, Agricultural Biotechnology, “Spread the Word About Feed Your Mind: Stakeholder Toolkit”](#)

[TrayTalk website](#)

Related organizations

[National Greenhouse Manufacturers Association](#)

[United Farm Workers](#)

Written & compiled by Lesley Fleming & Susan Morgan Dec 2021; revised by Lesley Fleming & Susan Morgan Jan 2023; revised by Susan Morgan, Joanna Brown July 2024.