Degradation of Photovoltaic Cells in Agrivoltaics: Environmental Stressors, Reliability, and Degradation Pathways

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Agrivoltaics, also referred to as agrophotovoltaics (APV), is a technology that enables land to be used for both agriculture and electricity generation at the same time [1]. Extensive field studies have confirmed the agronomic advantages of the APV systems [2], yet the impact of agricultural environments on solar cell aging and output remains unexplored. Beyond conventional stressors such as irradiance, precipitation and wind, APV cells are exposed to agrochemicals, bioaerosols, and sharp microclimatic shifts that can accelerate corrosion and other degradation pathways. This work reviews the knowledge about this specific environment and degradation modes of the principal architectures now used in APV: standard, PERC (passivated emitter rear cell), bifacial, TOPCon (tunnel oxide passivated contact), and HJT (heterojunction) crystalline silicon solar cells, thin-film copper indium gallium selenide (CIGS), organic photovoltaics, halide-perovskite, and perovskite–silicon tandem devices. Performance trends and suggested interpretations are analyzed in relation to specific crops and contaminant profiles. By synthesizing current research and identifying knowledge gaps, this review aims to guide the selection of the most critical combinations of materials and environment for future studies.

[1] M. Trommsdorff, S. Gruber, T. Keinath, et al., "Agrivoltaics: Opportunities for Agriculture and the Energy Transition," Fraunhofer Institute for Solar Energy Systems ISE, https://www.ise.fraunhofer.de/content/dam/ise/en/documents/publications/studies/APV-Guideline.pdf

[2] Barron-Gafford, G. A., Kimaro, A. A., Lamanna, C., Macharia, C., Maro, J., Mbele, A., & Hartley, S. E. (2025). Harvesting the sun twice : Energy, food and water benefits from agrivoltaics in East Africa. Renewable and Sustainable Energy Reviews, 208, 115066. https://doi.org/10.1016/j.rser.2024.115066