Agrivoltaics (AVs) for combined renewable energy and food production

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Agrivoltaic (AV) systems are described as multi-output systems with trade-offs between crop production and electricity output, which together can quantify Land Equivalent Ratio (LER) for comparison against conventional cropping or stand-alone photovoltaics (PV). This concept consists of the association, on a land area basis, of agricultural and electrical production within the same field with similarities to polyculture systems. Agrivoltaics has the potential to increase land use efficiency, water use efficiency, and PV panel efficiency, and make agriculture climate smart by reducing exposure to extreme heat and precipitation. Light reduction is considered as the main ecophysiological constraint for plant productivity under PV panels and it is not well understood if all existing crops are compatible with AV systems due to the significant decrease in the amount of transmitted light. The behavior of annual crops such as corn, sorghum, soybean, etc. is uncertain. The potential benefits in the reduction of air temperature and increase in air humidity must be evaluated in balance of the reduction in light. Therefore, systematic eco-physiological research is needed to understand crop yield responses to shading under AV production systems. Our research will focus on: (1) Assessing the tolerance to AV shade of multiple crop species, (2) Defining the physiological response of photosynthetically contrasting crops to various light environments, (3) Quantifying the potential benefits of AV systems on crop yield, (4) Exploring the potential of AVs to reduce competition for land and enhance land use efficiency across a wide range of environments (climate/soils) and crop types, (5) Deciphering the effects of AV on local microclimate, and (6) Optimizing AV design to maximize the potential advantages of integrating PV panels and agriculture. This research is essential to better estimate the potential of AV systems as a potential solution for renewable energies and food production.

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