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Potential of agrivoltaic system for lettuce plantation in a non-irrigated small scale areas: case study in northern Thailand

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Abstract

Solar energy, in terms of solar PV, has gained more interest these days as a substitute for fossil fuels in generating electricity. A solar farm requires a significant quantity of land for PV installation, and it is expected to compete for land with agriculture. The idea of growing crops below the PV has recently become popular. Therefore, this study aims to investigate the possibility of crop production under solar PV on lettuce growth and yields. The study area was located in Hang Dong district, Chiang Mai Province, Thailand. Two growing systems were compared: lettuce plantation i) in a greenhouse as a control (GH) and ii) below the solar PV (SL). Lettuce varieties (*Lactuca sativa*) of ‘Butter Head’ (BH) and ‘Green Oak’ (GO) were selected for comparative measurement. The lettuce was planted in both GH and SL systems. Light intensities were recorded as Photosynthetically Photon Flux Density (PPFD, $\mu\text{mol}/\text{m}^2/\text{s}$) every 30 mins and the values were then converted to daily light integral (DLI, $\text{mol}/\text{m}^2/\text{d}$). SPAD values (using the Chlorophyll Meter SPAD-502), growth (height and width) and fresh yields were measured every 7 days. The results showed that PPFD values in GH ($538 \mu\text{mol}/\text{m}^2/\text{s}$) were higher than in SL ($404 \mu\text{mol}/\text{m}^2/\text{s}$), with a ratio of 28 %. At maturity, the highest values of SPAD were observed under BH_GH of 36.2 in comparison to the others during the measurement date. GO_SL had the highest values of plant height (14.8 cm) and width (21.0 cm) while the lowest values were observed in BH_SL (height = 10.4 cm and width = 11.9 cm). Fresh yield showed the highest and lowest values in GO_SL and BH_SL, with average values of 41.8 g/plant and 25.4 g/plant, respectively. In conclusion, sunlight availability under the PV was adequate for growing lettuce but further investigation is needed for the other crops.

Keywords: Agrivoltaic system, lettuce plantation, solar energy