EFFECT OF MOBILE AGRIVOLTAIC SHADING ON THE GROWTH AND YIELD OF CORIANDER (*CORIANDRUM SATIVUM* L.) UNDER FIELD CONDITIONS IN POLAND

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Research Areas

- Crop production, agronomy, sustainable agriculture
- Data analysis, statistics, research methodology
- Agro-photovoltaics and innovative agrotechnologies

Academic Profile

- Professor since 2019 in Agricultural and Horticultural Sciences
- Experienced lecturer: Research Methodology, Data Analysis, Contemporary Trends in Science
- Supervisor of multiple PhD theses (incl. distinguished works) and industrial doctorates
- Reviewer of doctoral, habilitation, and professorial applications in Poland

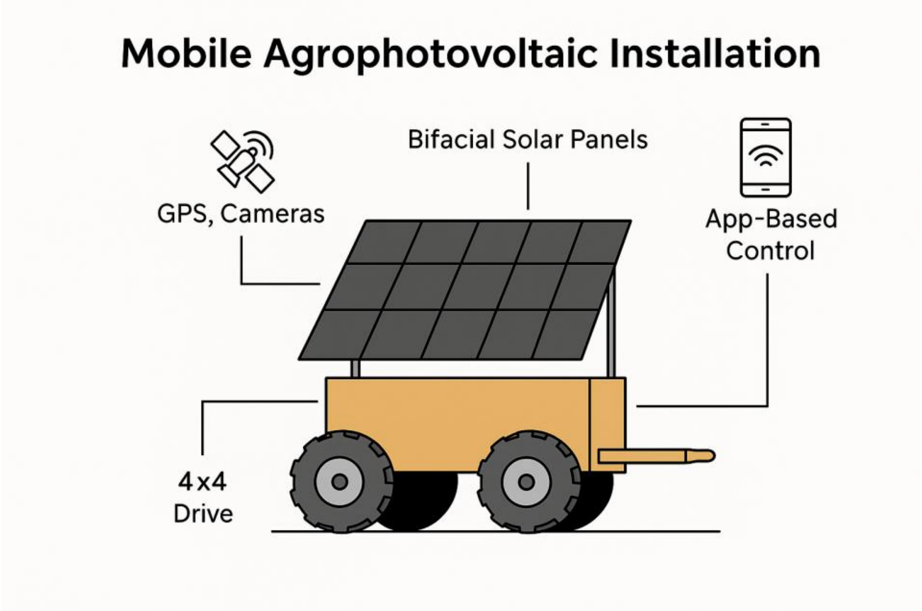
Research Projects (Selected)
BioHerOd (2017–2021, NCBiR BIOSTRATEG) – Herbicide-resistant weeds management
Moja Soja (2018–2020, ARiMR) – Innovative soybean cultivation
SOSS Stone Off Save Soil (2023–2024, ARiMR) – Low-carbon crop production practices
AgroPV (2022–2024, MNiSW) – Agro-photovoltaic innovations
Mobile AgroPV Installation (2024–2028, MNiSW)

International Experience

- Montana State University, USA (2002–2003)
- Instituto Politécnico de Coimbra, Portugal (2017)
- Tarleton State University, Texas, USA (2018)

Scientific Metrics

- Publications: IF total 96.746 | MNiSW pts: 2846
- Citations: ~1500 | h-index: 22



Agro PV

- Agrophotovoltaics (AgroPV) integrates crop production with solar energy harvesting.

- A promising approach to optimizing land-use efficiency by combining agricultural production with renewable energy generation.

- This study evaluates the impact of APV installations on crop growth, microclimate, and energy co-production.

System Overview

• Mobile Agrophotovoltaic Installation (MIA): prototype developed since 2022 at the University of Science and Technology in Bydgoszcz.

• Combines 48 bifacial PV panels,

autonomous movement,

and precision controls.

• Fully automated with GPS,

• Cameras,

• Remote operation *via* app.

Agro PV

- 415 Wp PV modules up to 23.9 kWh/day.
- 2 hybrid inverters + 25 kWh battery storage.
- 4 x 4 drive, autonomous movement, track sensors.
- Enables shading, irrigation, fertigation, and data collection.

https://www.facebook.com/watch/?v=876009937905471

Effect of Mobile Agrivoltaic Shading on the Growth and Yield of Coriander (*Coriandrum sativum* L.) Under Field Conditions in Poland

Experimental Site and Conditions

The field experiment was conducted in 2024 at the Minikowo Experimental Station (53°06′N, 17°53′E) in north-central Poland, on soil classified as Haplic Luvisol with moderate fertility. The region experiences a temperate climate with mean annual precipitation of approximately 525 mm and average annual temperature of 8.2°C.

Experimental Design and Treatments

The study utilized a randomized complete block design (RCBD) with two treatments:

- Mobile agrivoltaic installation (MIA) — shading created by bifacial photovoltaic panels mounted on a mobile 4 × 4 m platform.
- Control — full-sun, open-field reference plot without shading.

Each treatment consisted of four replications, with each plot measuring 16 m² (4 × 4 m).




- **Plant Material and Cultivation**
- *Coriandrum sativum* L. (cv. ‘Ursynowska’) was selected for its uniform growth and established cultivation history in Poland. Seeds were sown manually at a rate of 14 kg·ha^{-1} at 15 cm row spacing in early April each year. No pre-sowing fertilization was applied. Weed control was performed mechanically, and no pesticides or growth regulators were used. The crop was harvested in early July, at physiological maturity (brown seed stage), to assess seed yield and plant biomass.

Growth and Yield Measurements

Ten representative plants per replicate (n = 40 per treatment) were selected at harvest to evaluate:

- Plant height (cm) — from soil surface to the tip of the main stem,
- Number of lateral branches — counted manually,
- Number of seeds per plant — hand-threshed,
- Thousand seed weight (TSW, g) — using a precision seed counter and electronic scale,
- Seed yield ($g \cdot m^{-2}$) — estimated from total harvested seed mass and converted to yield per hectare.

All yield parameters were corrected to 13% seed moisture.

Leaf Physiology and Photosynthesis Indicators

To assess physiological responses to shading, the following parameters were measured:

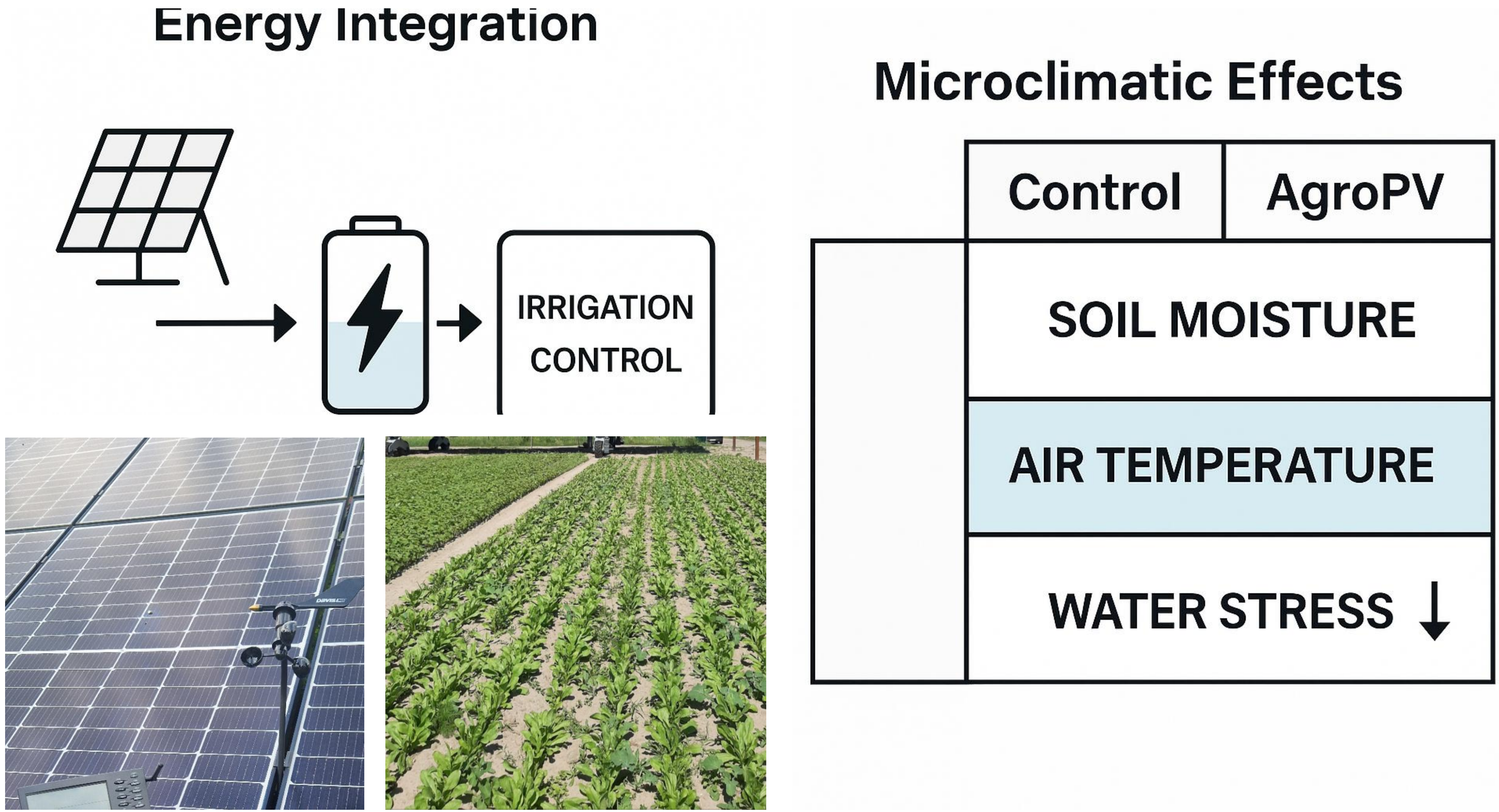
- Chlorophyll Content Index (CCI) — non-destructive readings using a CCM-300 device (Opti-Sciences Inc.) on five upper canopy leaves per plant.
- Chlorophyll fluorescence (PSII efficiency, Fv/Fm) — measured on dark-adapted leaves using a FluorPen FP 110-D (Photon Systems Instruments).
- Leaf Area Index (LAI) — estimated with LAI-2200C (LI-COR Inc.), averaged over 3 locations per plot.
- Soil moisture — measured bi-weekly using a TDR probe at 0–20 cm depth.
- Light intensity and spectral quality — PAR measured under and outside the panels using Apogee MQ-500 sensors.

Table 1 Growth and yield traits of coriander under control and mobile agrivoltaic (MIA) conditions.

Trait	Treatment	
	Control	MIA
Plant height (cm)	39.1 ± 0.5 a	37.2 ± 0.4 b
Lateral branches (no.)	4.9 ± 0.3 b	6.9 ± 0.4 a
Plant density (plants/m^2)	125 ± 2.1 a	120 ± 2.0 a
Seeds per plant (no.)	271 ± 5.7 a	256 ± 6.0 a
Seed yield (g/m^2)	338 ± 8.4 a	322 ± 9.2 a
Thousand seed weight (g)	7.65 ± 0.22 b	9.82 ± 0.25 a
Harvest index	0.38 ± 0.01 a	0.38 ± 0.01 a

TABLE 2 PHYSIOLOGICAL AND BIOCHEMICAL INDICATORS OF CORIANDER UNDER CONTROL AND MIA CONDITIONS.

Trait	Treatment	
	Control	MIA
PSII efficiency (Fv/Fm)	0.801 ± 0.013 b	0.826 ± 0.011 a
CCI (index units)	29.1 ± 1.1 b	34.6 ± 1.3 a
Leaf Area Index (LAI)	3.12 ± 0.15 a	2.78 ± 0.14 a
Soil moisture (%)	17.9 ± 1.2 b	21.2 ± 1.0 a


Energy Integration
IRRIGATION
CONTROL
Microclimatic Effects
Control
AgroPV
SOIL MOISTURE
AIR TEMPERATURE
WATER STRESS ↓

Key Findings

- Daily power production supports on-farm energy use.
- Possible integration with smart irrigation and fertigation systems.
- Toward energy self-sufficiency in small to mid-scale farms.


HYUNDAI

Future Perspectives

- • Diversification into horticulture and specialty crops.
- • Autonomous climate and irrigation control systems.
- • Custom AgroPV setups for different farm types and sizes.

Conclusions

Integrating coriander in mobile PV systems appears promising for dual-use agriculture in temperate climates.

Coriander demonstrated good adaptability to intermittent MIA shading.

Future work will assess essential oil composition and economic feasibility under extended agrivoltaic deployment.

Thanks for your attention

Agro PV