



5º Seminario del Foro Internacional para el intercambio de prácticas sostenibles

18 y 19 de junio de 2025 (Andalucía Agrotech DIH, Córdoba)

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Water management sensing and technology in citrus orchards

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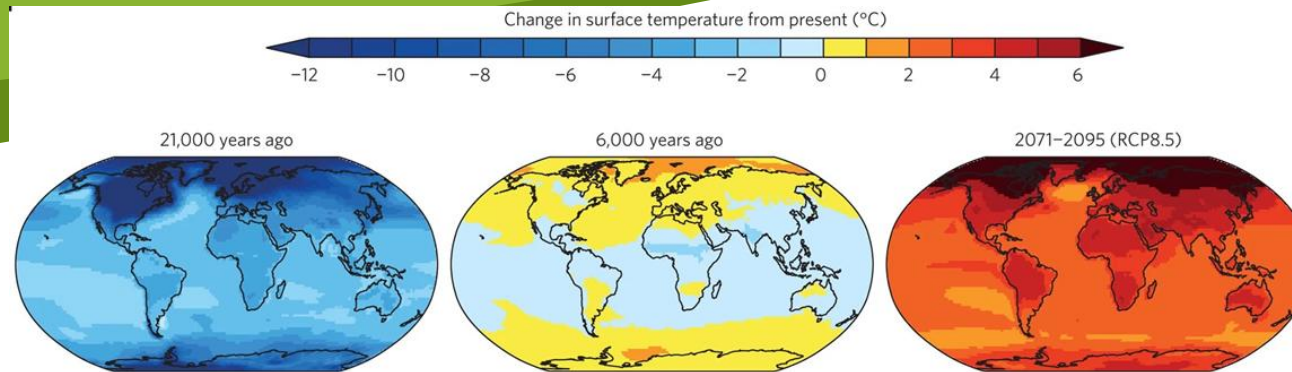
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Source: <https://climateknowledgeportal.worldbank.org/overview>

Italian organic citrus surfaces, in 2022, were just over 35 thousand hectares, 31.3% of the national citrus industry (<https://www.reterurale.it/Bioreport2023>)

Challenges

- Increase in food demand
- Increase of production & energy costs
- Increase in climate fluctuation and extreme *fenomena*
- How to pay back positive externalities?

Long-term solutions in the (citrus) food system (productivity + stability + resilience)

Multidisciplinary/multiactor approach to key issues

CREA started in 1995 a field trial on organic orange, to verify the feasibility of the organic method in the local conditions. In the two hectares plot multiple trials have been performed (fertility management, cover cropping, biostimulant use, etc.) to front oncoming contingencies in the sector and find out feasible solutions with a participatory approach.

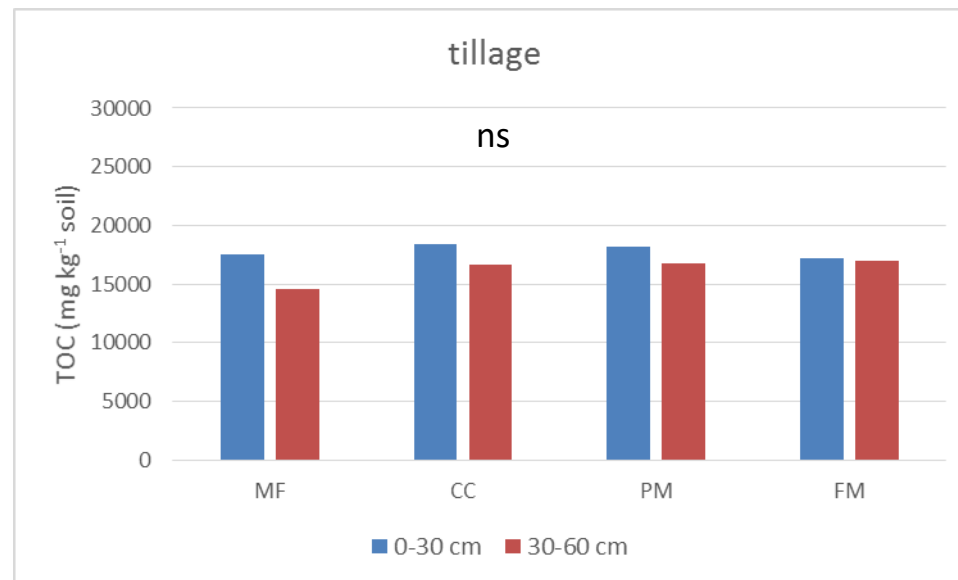
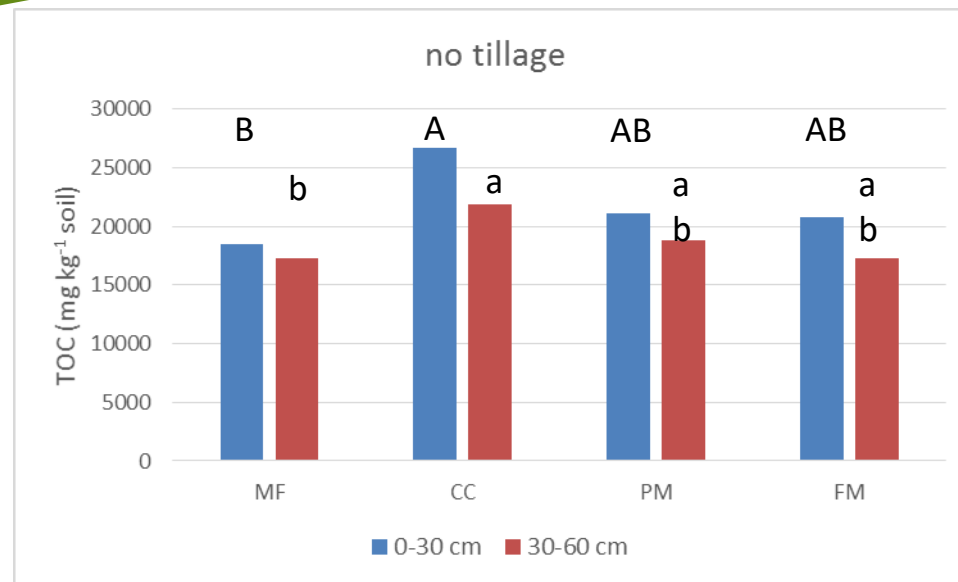


In recent years, due to climate instability, there has been a huge concern on water shortages, including its effects on citriculture in the Mediterranean region. The future of organic citriculture in the Mediterranean area is linked both to water scarcity and soil quality decay. Research questions are related to find out feasible solutions to cope with these priorities.

Starting point of the new orchard (Tarocco rosso orange/Carrizo citrange)

3-year cover-crop trial

- ✓ fava bean
- ✓ barley
- ✓ vetch + barley
- ✓ vetch
- ✓ natural cover



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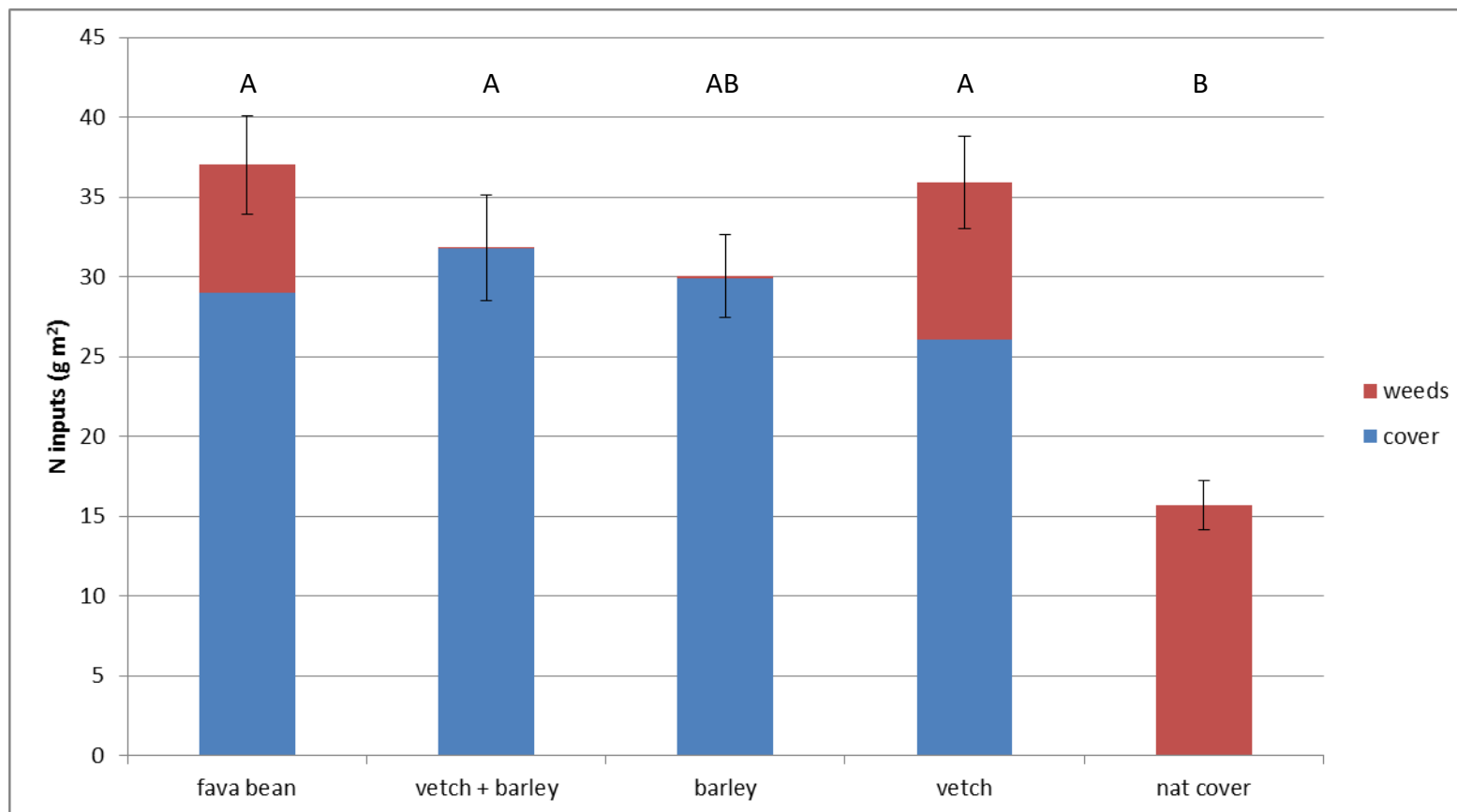


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N from cover crops (mean of 3 years)



The field experiment was conducted during the irrigation season (June-October 2022-24) in an orange orchard [*Citrus sinensis* (L.) Osbeck] cv 'Tarocco Rosso VCR' grafted on Carrizo citrange rootstock [*Poncirus trifoliata* (L.) Raf. × *C. sinensis* (L.) Osbeck], spaced at 6 × 4 m



Five irrigation treatments: a control with a dual drip line system to replace 100% of crop evapotranspiration (ET_c) and sub-surface drip irrigation (SDI) system to replace 80% (SSDI). In both methods partial rootzone drying was applied.

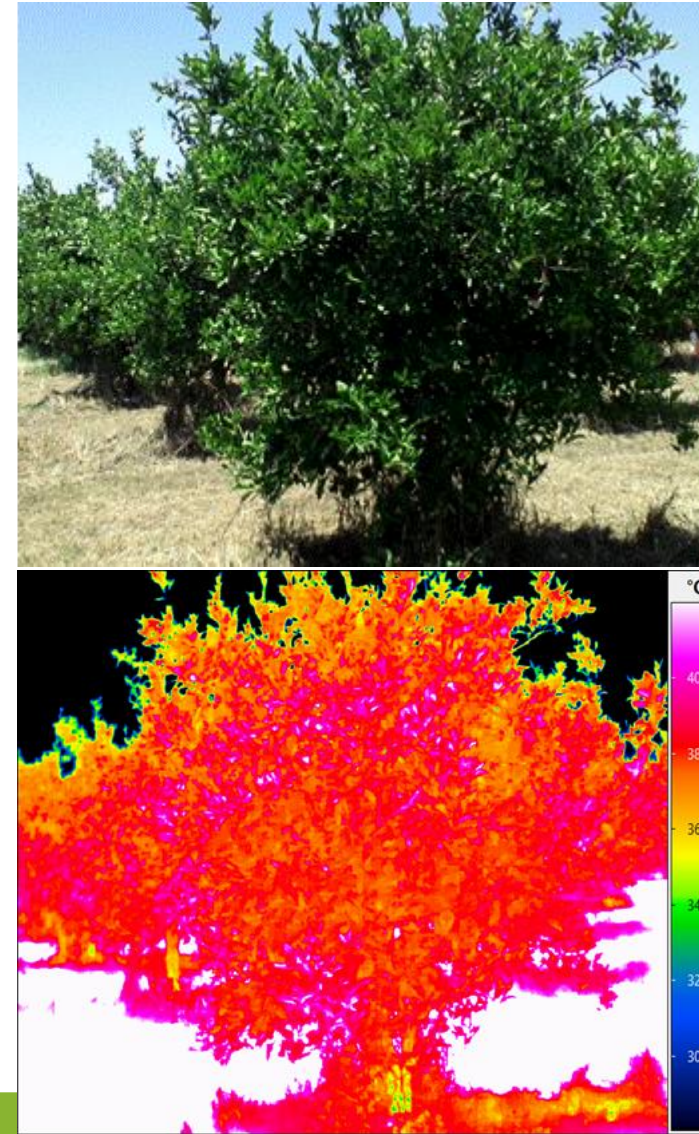
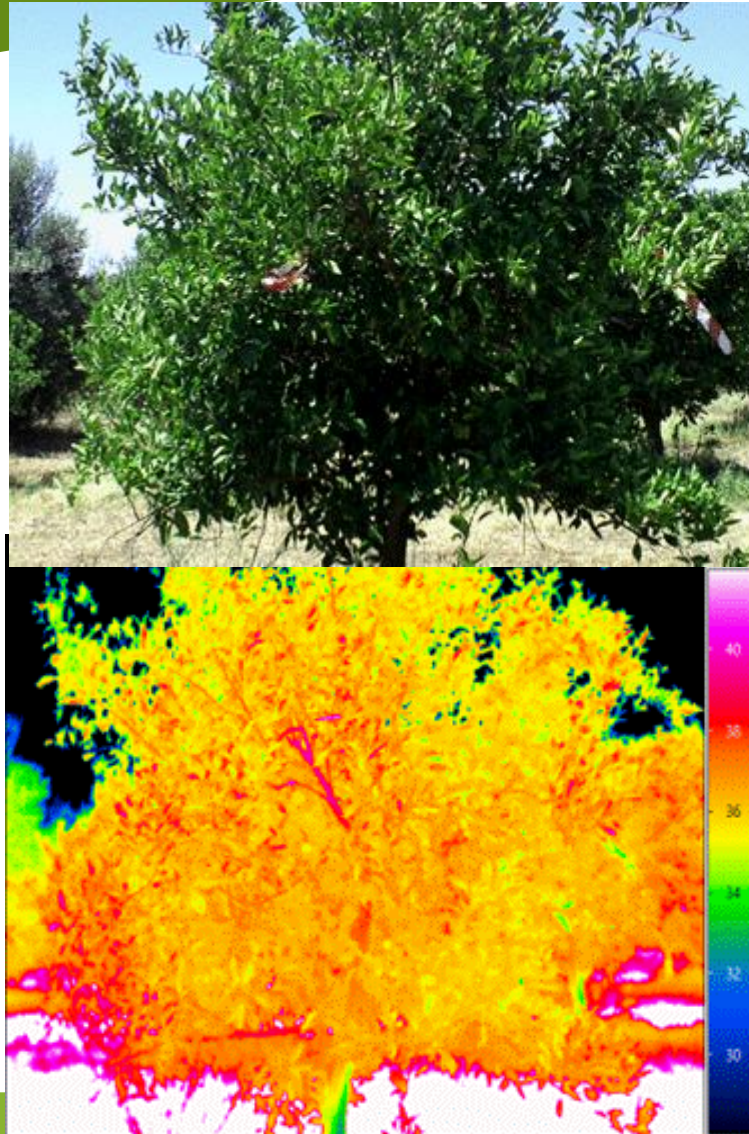
- Physiology
- Yield and fruit quality
- Proximal sensing



A dataset for each spectral index was obtained. The NDVI spectral index showed a similar trend between the two treatments. Moderate water stress did not reduce the photosynthetic efficiency of the crop

Year	Treatment	NDVI
2022	SSDI	0.336
	DI	0.330

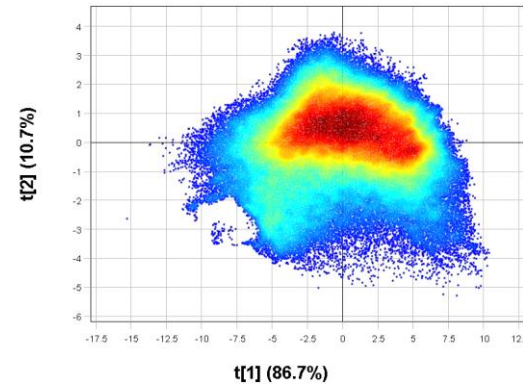
DI (VarioCAM HDx research) SSDI



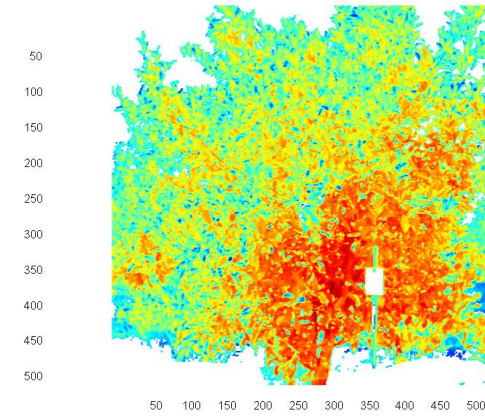
SPECIM IQ (HYP)



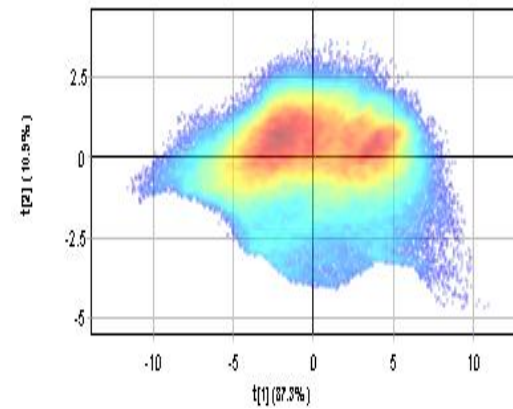
PCA Model - Scatter 2D (T)
DataSet (645)



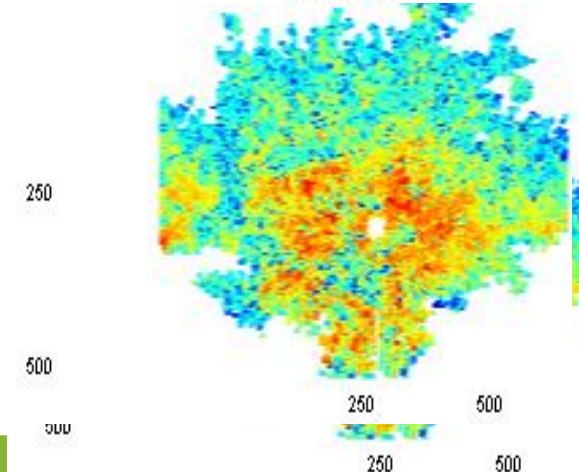
PCA Model - Contour 2D (T)
DataSet (645)

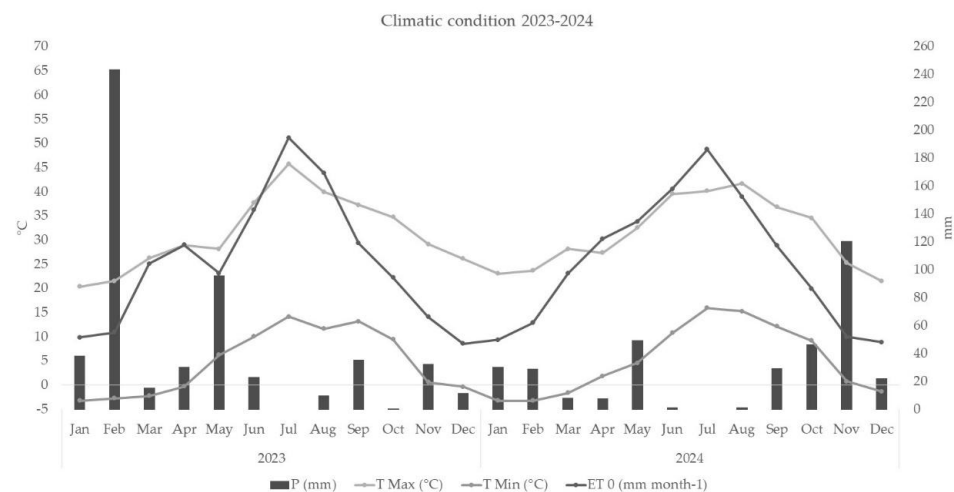


PCA Model - Scatter 2D (T)
DataSet (648)

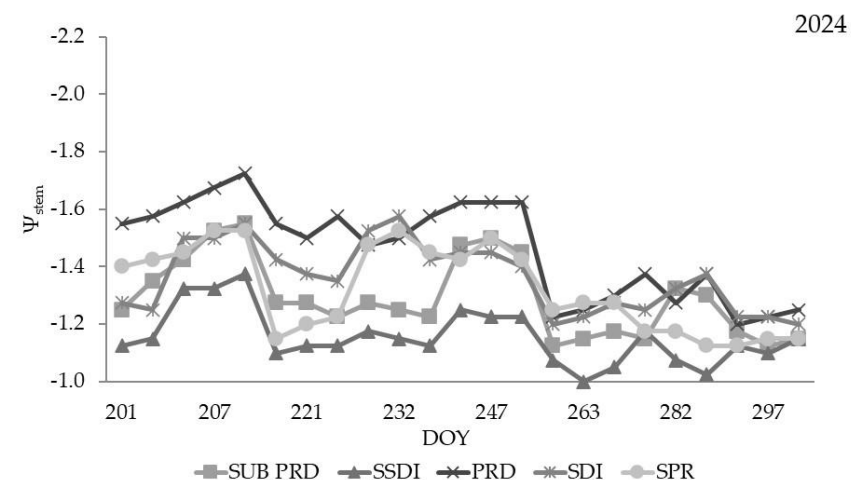
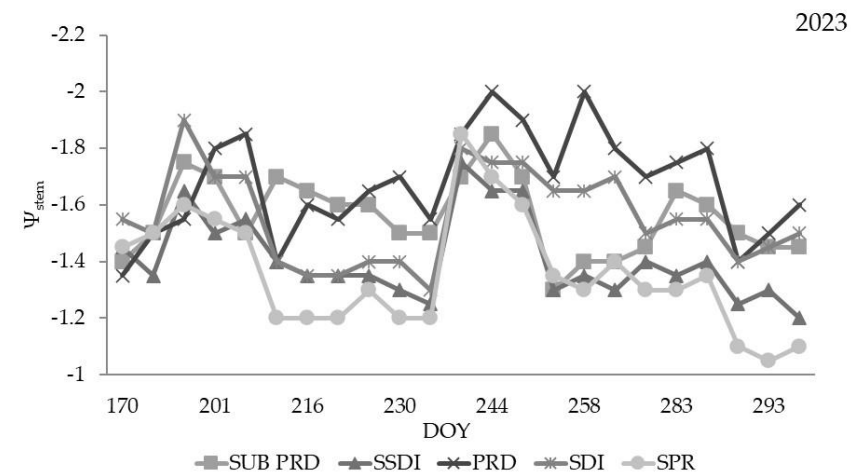


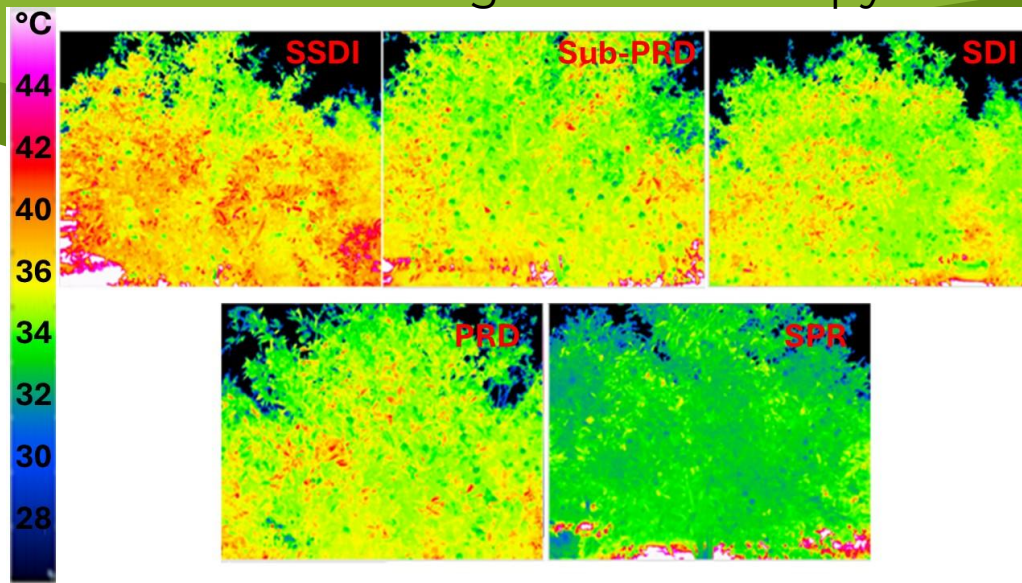
PCA Model - Contour 2D (T)
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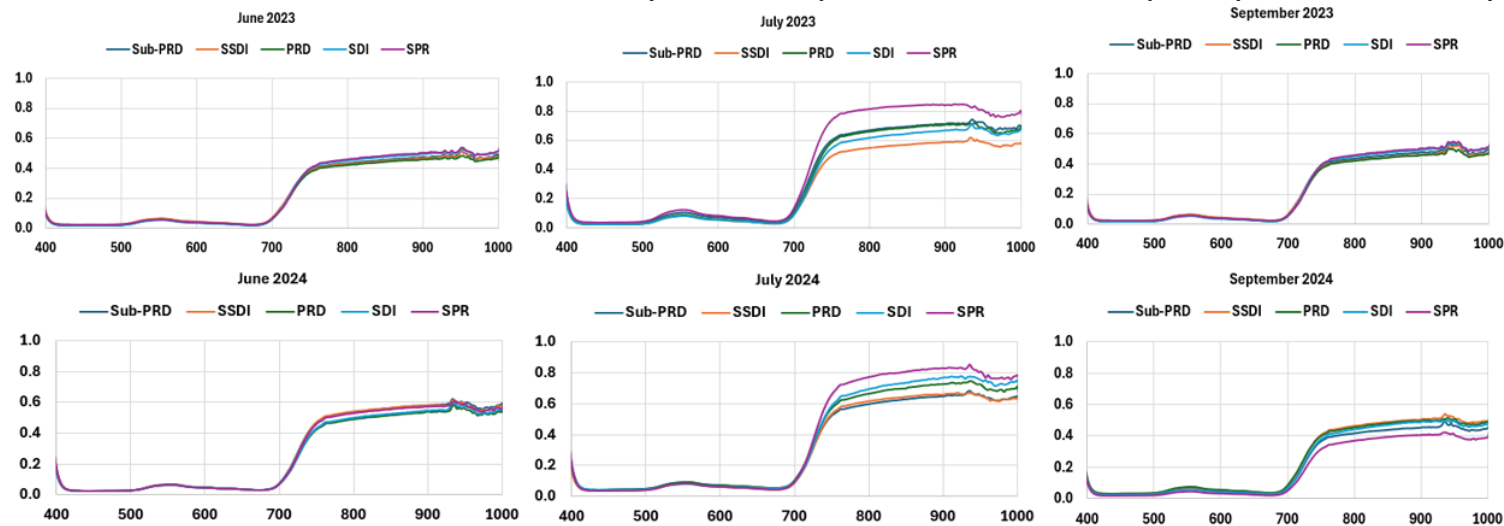
Treatments	IA (mm)	
year	2023	2024
SPR	250.0	215.2
SDI	244.7	260.9
SSDI	186.6	193.6
PRD	148.9	172.3
Sub-PRD	119.3	129.8





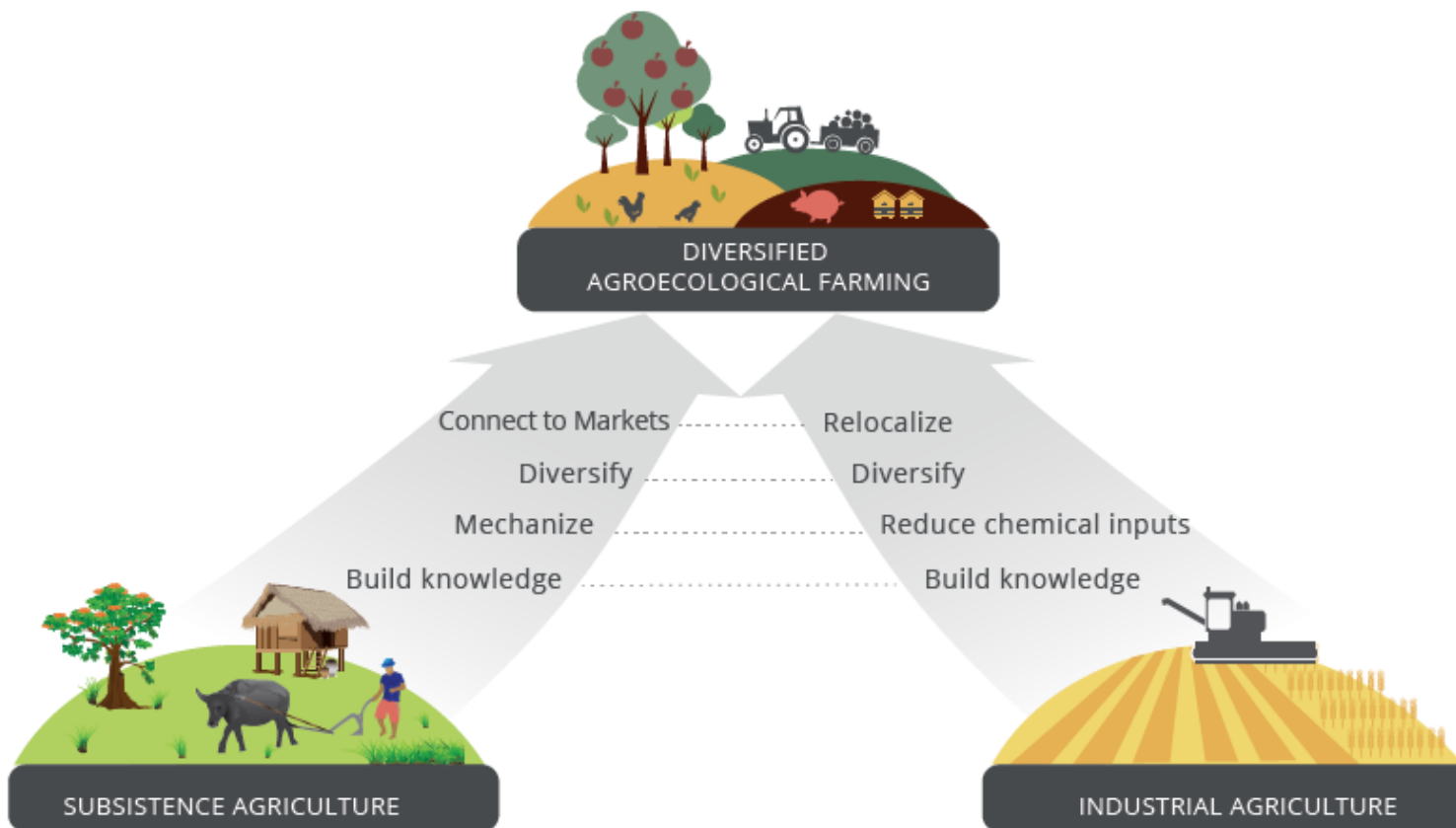
	Sub-PRD	SSDI	PRD	SDI	SPR
Season 2023					
WUE	4.2 ± 0.6 b	7.1 ± 0.6 a	7.2 ± 1.1 a	3.9 ± 1.0 b	3.5 ± 0.4 b
Weight (g)	224 ± 28 a	228 ± 12 a	222 ± 21 a	227 ± 8 a	225 ± 9 a
Yield (T ha ⁻¹)	5.0 ± 1.3 b	13.3 ± 1.8 a	10.8 ± 2.9 a	9.6 ± 4.3 ab	8.7 ± 1.5 a
Season 2024					
WUE	26.4 ± 2.4 a	24.7 ± 6.0 a	22.8 ± 5.9 a	12.4 ± 4.0 b	14.3 ± 2.1 b
Weight (g)	191 ± 18 ab	182 ± 8 b	184 ± 17 ab	228 ± 58 a	184 ± 10 ab
Yield (T ha ⁻¹)	26.0 ± 2.4 ab	36.9 ± 9.0 a	30.1 ± 8.2 ab	24.4 ± 7.9 b	23.5 ± 3.5 b

Mean Vis-NIR reflectance spectra (400–1000 nm) of plant canopy



- Deficit irrigation strategies offer different methods to optimize water use in agriculture, especially in regions with limited water resources.
- A moderate water stress is a sustainable strategy to save water, increase irrigation efficiency without altering yield and fruit properties
 - Conservative orchard management techniques enhance system resilience
- The combined use of proximal and remote monitoring of citrus groves seems to be the frontier of irrigation management





REPORT 02 FROM UNIFORMITY TO DIVERSITY



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