AAPA

AFRICAN ASSOCIATION *for* PRECISION AGRICULTURE

May, 2025

Welcome Message from the President of the African Association for Precision Agriculture

Dear Reader,

The **African Association for Precision Agriculture (AAPA)** was founded in 2020 by the **African Plant Nutrition Institute (APNI)** with the mission of advancing precision agriculture across Africa. Our goal is to harness and expand precision agriculture tools for the benefit of all stakeholders involved in both crop and livestock production value chains.

We are proud to announce that our association now comprises **1,065 active members** from across Africa and beyond. We warmly invite you to **join AAPA** [here] and take advantage of our diverse resources, capacity-building programs, and professional opportunities for PhD and MSc students, researchers, and industry professionals. Additionally, members gain access to leading events such as the **African Conference on Precision Agriculture (AfCPA)**.

As we continue to grow, we remain committed to our vision: **African agriculture should be data-driven and technology-enabled to meet the continent's unique needs.**

We look forward to welcoming you to our community!

Sincerely,

Dr Ir. Fassinou Hotegni V. Nicodeme

President, African Association for Precision Agriculture (AAPA)

ABOUT AAPA

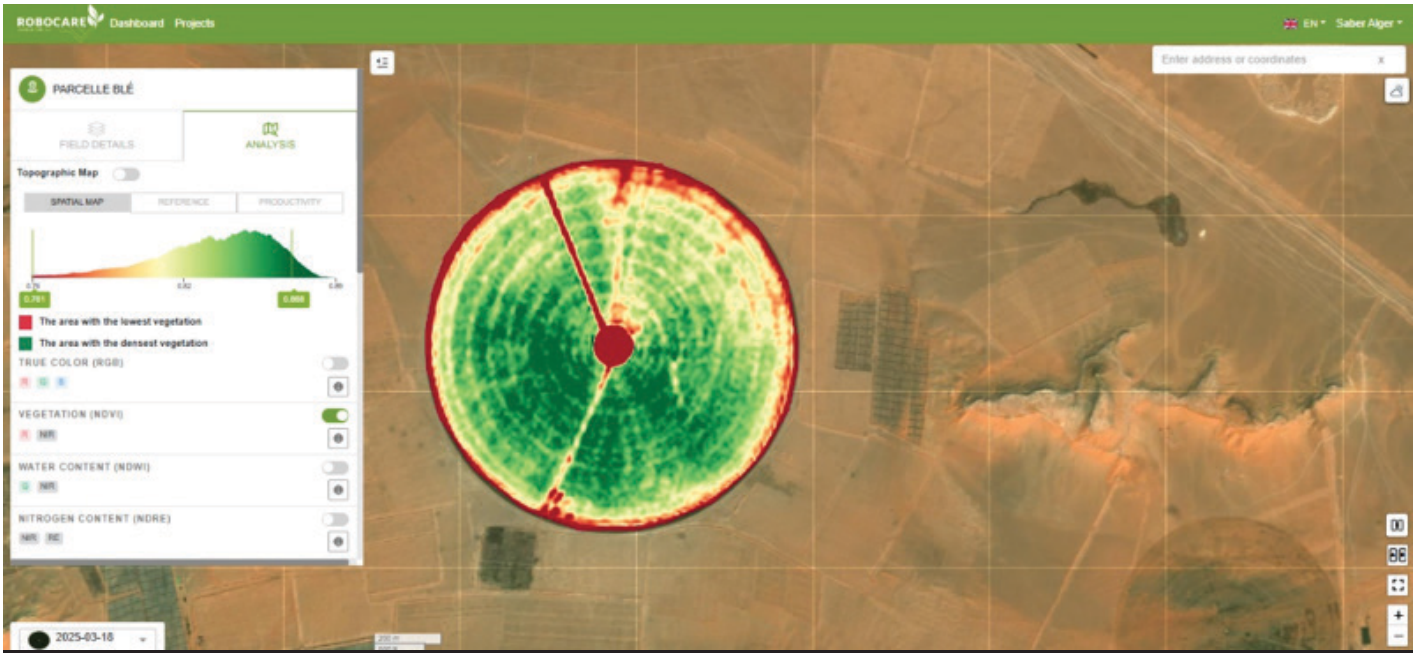
The mission of the African Association for Precision Agriculture (AAPA), is to organize and contribute to the development of precision agriculture in Africa, and engage the global precision agriculture community through scientific, informative, extension, and training activities.

JOIN THE AAPA

AAAP membership is free to all registrants.

Register with AAPA

Contact Us: info@AAPA.com



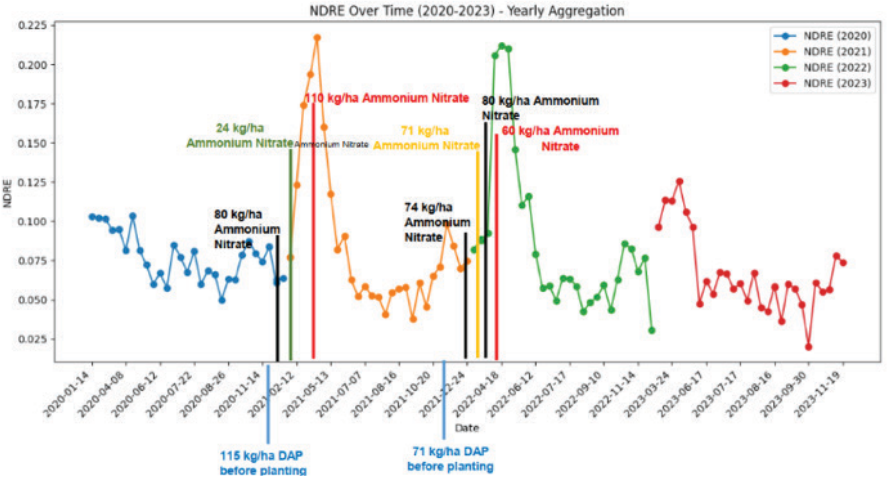
Transforming Agriculture with ROBOCARE: Bridging Research, Innovation, and Sustainability in Precision Farming for Real-World Use Case Impact

In the quest to address global agricultural challenges, particularly in Africa, ROBOCARE emerges as a pioneering force at the intersection of research and technology. This Tunisian-based AgriTech company focuses on developing cutting-edge solutions rooted in robotics, artificial intelligence (AI), and data analytics to enhance farming practices while ensuring environmental sustainability.

ROBOCARE's mission is to empower farmers with innovative tools that enhance productivity while ensuring environmental sustainability. The company leverages a combination of satellite imagery (such as Sentinel-2, Landsat, and Planet), autonomous drones, and IoT-based field sensors to provide precise crop monitoring. This multi-layered approach enables the early detection of stress, disease, or nutrient deficiencies, allowing farmers to take timely action to protect their crops.

These innovations are supported by rigorous research collaborations, merging agronomic expertise with advancements in remote sensing and machine learning. ROBOCARE's smart irrigation systems further optimize water usage by integrating IoT devices that analyze real-time soil moisture data and predictive weather models, addressing critical issues like water scarcity and resource inefficiency.

Beyond hardware, the company's cloud-based decision support platform aggregates field-level data to provide actionable insights, empowering farmers to make informed decisions about planting, fertilization, and harvesting.



By bridging the gap between academic research and practical applications, ROBOCARE drives sustainable agricultural transformation across Africa. For more information, visit www.robocare.tn or contact the team at contact@robocare.tn.

Contibuted by Imen Hbiri, Marwa Kadri, Nour El Houda Boughattas

Optimizing Nitrogen Management in Durum Wheat through Remote Sensing

Precision agriculture is revolutionizing farming by using advanced technologies to optimize resource use and boost crop productivity, addressing global challenges like food security and environmental sustainability. In Tunisia, where water scarcity and soil degradation limit agricultural performance, it offers innovative solutions to enhance efficiency and reduce environmental impacts. This study integrates Sentinel-2 satellite imagery into durum wheat nitrogen management, improving Nitrogen Nutrition Index (NNI) prediction through modified formulations and vegetation indices (VIs). The research provides farmers with a precise tool for monitoring crop nitrogen status, supporting sustainable practices in Tunisia and offering potential applications across Africa and beyond.

The study was conducted at two experimental sites in Tunisia during the 2023-2024 growing season. Data were collected at key growth stages (Z30 and Z60) using field measurements and satellite-derived indices (NDVI, GNDVI, NDRE, etc.) calculated by ROBOCARE. Laboratory analysis determined total nitrogen content using the Kjeldahl method and calculated NNI values.

Statistical analysis revealed that the Green Normalized Difference Vegetation Index (GNDVI) showed the strongest correlation with NNI (R^2=0.972), outperforming traditional indices like NDVI. The developed multiple linear regression model achieved an impressive R^2 value of 0.975, explaining 97.5% of NNI variation at the Z30 stage.

These findings highlight the potential of integrating modified NNI formulations with diverse vegetation indices (VIs) to enhance fertilizer management precision. The study underscores the dynamic correlations between VIs and nitrogen-related variables across growth stages, reflecting the complexity of crop-nutrient interactions over time.

The predictive model was successfully applied to high-resolution drone imagery (10 cm GSD) from a separate study site in Rostock, Germany. High-resolution drone images (10 cm GSD) were processed to extract VIs, which used to predict NNI across the field. The resulting NNI map (**Figure.1**) highlighted spatial variability in nitrogen status within the parcel, enabling precise identification of areas with nitrogen deficits or sufficiency.

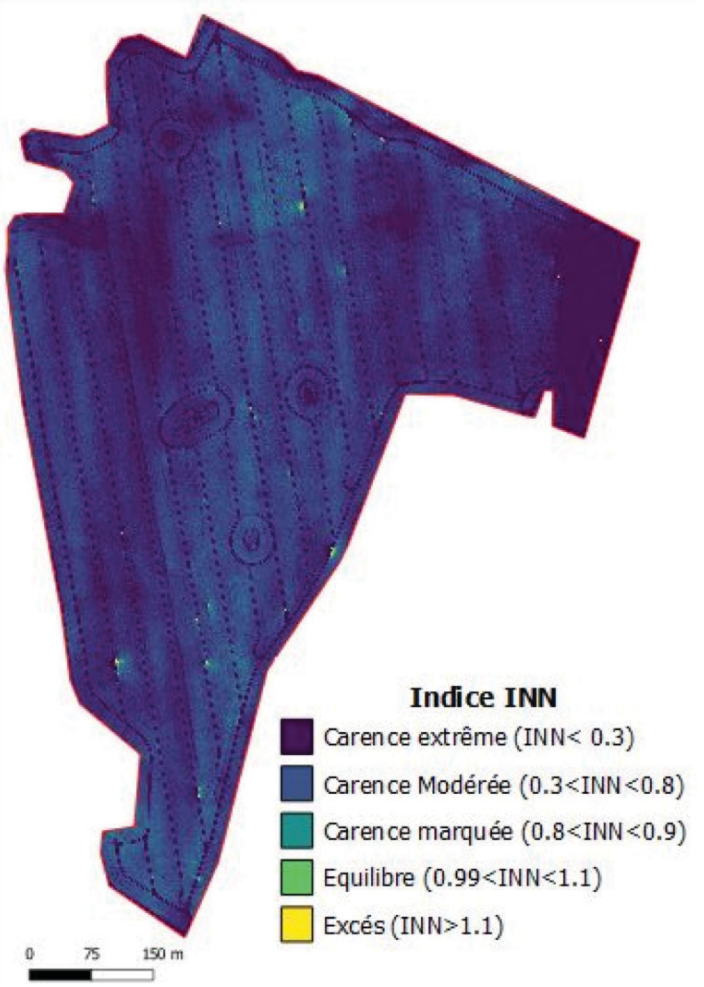


Figure 1: Map of spatial variation of Nitrogen Nutrition Index (NNI).

Future research should focus on refining model accuracy by incorporating additional data sources and conducting field validation trials. Developing new vegetation indices tailored for nitrogen management could further enhance precision agriculture strategies. ■

Contributed by, Nour El Houda Boughattas, Marwa Kadri, Mohamed Zekri, Sawssen Ayadi, Soumaya Arraouadi, Hafedh Hajlaoui, Youssef Trifa and Imen Hbiri. University of Sousse, Higher Institute of agronomy of chott-Meriem (ISA-CM), Startup ROBOCARE, National Agronomic Institute of Tunisia (INAT), Regional Center of Agriculture Research of Sidi Bouzid (CRRA) and Faculty of Sciences and Technology of Sidi Bouzid, Tunisia.

For more information about this research, please see the AfCPA 2024 Proceeding at https://paafrica.org/files/3rd_AfCPA_Proceedingsv2.pdf

Optimizing Nitrogen Use in Durum Wheat Cultivation: A Study on the N-Tester Tool

Context and Objectives

This study aimed to optimize nitrogen use in durum wheat crops by employing the N-Tester tool to measure the Nitrogen Nutrition Index (NNI). The goal was to evaluate nitrogen application efficiency across six durum wheat varieties under two cropping systems: supplemental irrigation at the Marja experimental station and rainfed conditions in a semi-humid region at the Metline station. Nine nitrogen rates were tested to assess their impact.

Methodology:

The N-Tester was used at key growth stages to measure chlorophyll levels, which were then correlated with final yields. The relationship between the chlorophyll index and yield was analyzed to determine the tool's effectiveness in predicting nitrogen needs.

Preliminary Results:

The results revealed a strong correlation between chlorophyll measurements and grain yields, with the following R^2 values at different growth stages:

- **Stage 2.6:** $R^2 = 0.73$
- **Stage 3.2:** $R^2 = 0.74$
- **Stage 3.8:** $R^2 = 0.78$
- **Stage 4.2:** $R^2 = 0.67$
- **Stage 5.2:** $R^2 = 0.72$

These findings confirm that the N-Tester is a reliable tool for estimating nitrogen requirements and improving fertilization strategies.

Conclusion and Future Directions

This study underscores the value of tools like the N-Tester for precise nitrogen management in durum wheat cultivation, enhancing input efficiency. Future research will focus on refining recommendations to help farmers optimize their fertilization practices. ■

Contributions: Dr. Mouna Mechri, Dr. Mesaad Khamassi, Ramdhan Nasraoui, Naziha Chihi and Nahla Saidani; National Institute of Field Crops (INGC)

The PATH Project: Youth Capacity building on Precision Agriculture (2024-2027)

The PATH "Capacity Building of African Young Scientists in Precision Agriculture Through Cross-Regional Academic Mobility for Enhanced Climate-Smart Agri-Food System'' project aims at increasing skills and qualifications across the African continent. Through the proposed project, the capacities of young African Scientists and entrepreneurs in precision agriculture to build climate-resilient and adaptable agrifood systems will be reinforced. Specifically, PATH aims at:

I. **Training** 32 MSc and 12 PhD African scholars in PAAC to upgrade the continent's capability.

II. **Building** the capacity of 10 young African trainees and 10 staff in precision agriculture and entrepreneurship.

III. **Improving** PAAC and ICT4Ag curricula and research at the participating African Higher Education Institutions (HEIs) to address more efficiently the current challenges of agriculture and climate change; and

IV. **Developing** a network of HEIs in Africa involved in PAAC research and training. Partners HEI are University of Abomey Calavi (Republic of Benin), University of Cape Coast (Ghana), University of Rwanda (Rwanda), University of Swaziland (Eswatini). Université Mohammed VI Polytechnique (UM6P) is involved as associated partner and the Institut National D'enseignement Supérieur Pour L'agriculture, L'alimentation Et L'environnement (France) as EU technical partner.

The project is funded by the Intra-Africa Program of the Education, Audiovisual and Culture Executive Agency (EACEA) of the European Commission. ■

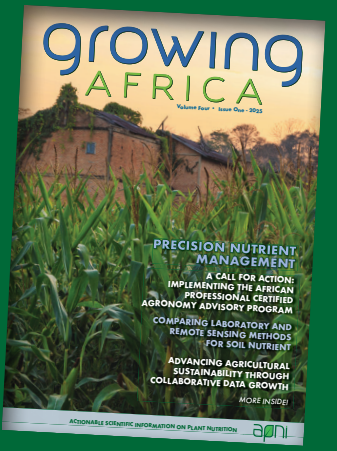
For more information click here

Invitation to Contribute to *Growing Africa* Magazine

Growing Africa is a new semi-annual, digital publication initiated by the African Plant Nutrition Institute to provide a forum serving stakeholders interested in Africa-centric plant nutrition science. The publication seeks to providing scientific information in an actionable manner that helps to enable Agricultural Research for Development (AR4D) in Africa.

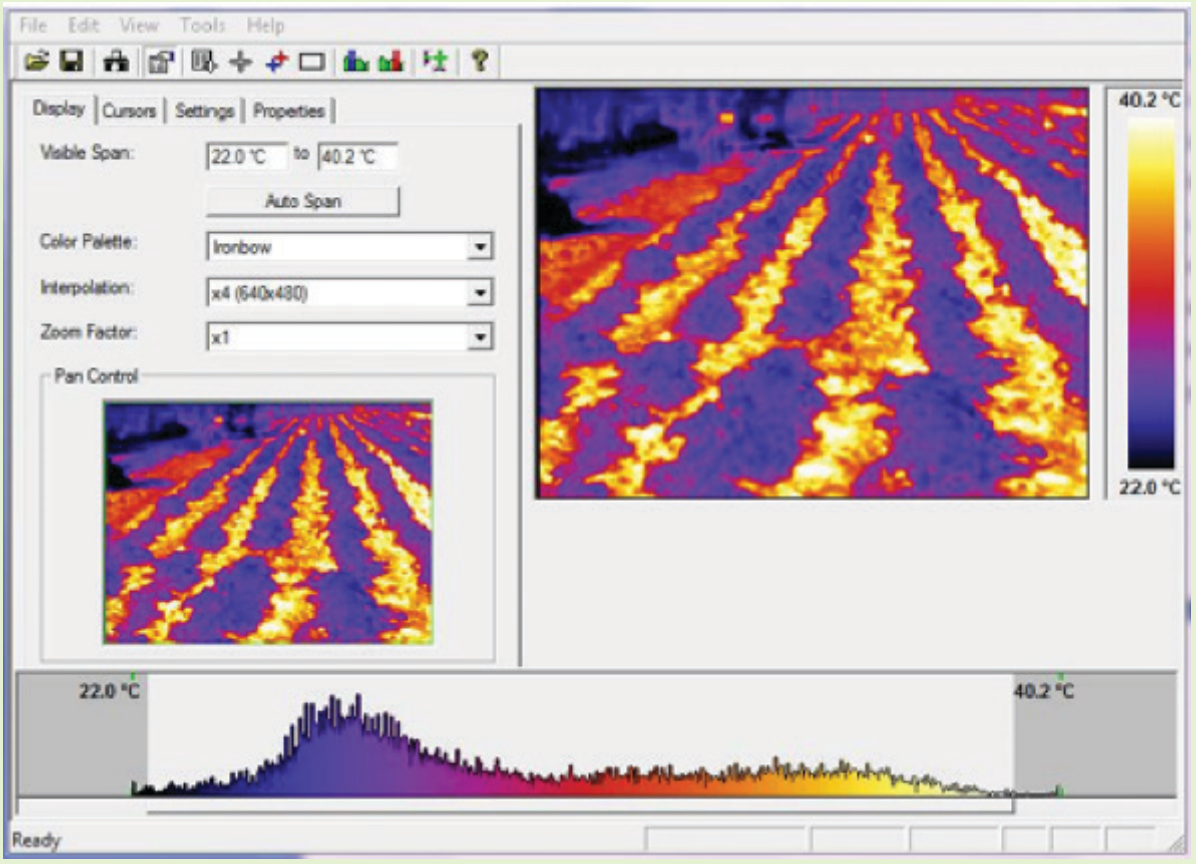
Topics of interest include:

- Site-specific nutrient management, Integrated soil fertility management, 4R Nutrient Stewardship
- Nutrient and yield gap assessment and reduction
- Best management practice development and implementation
- Best agronomic practices and their influence on nutrient use
- Nutrient-driven cropping system diversification
- Nutrients as a catalyst for value chains
- Nutrient catalyzed improvement in Soil-Plant-Animal-Human Health outcomes
- Economic, and Socioeconomic performance of nutrient management practices
- New analytics/tools for dissemination and scaling of nutrient best management practices (BMPs)
- Nutrient use efficiencies, nutrient balances, and nutrient cycling in agricultural systems



Interested in submitting an article? Learn more by downloading a copy of our guidelines at https://www.growingafrica.pub/about/ Specific enquiries about the article submission process may be sent to the editor at g.sulewski@apni.net.

Optimizing Irrigation in Tunisia: The Contribution of Thermal Imaging and Simulation Models



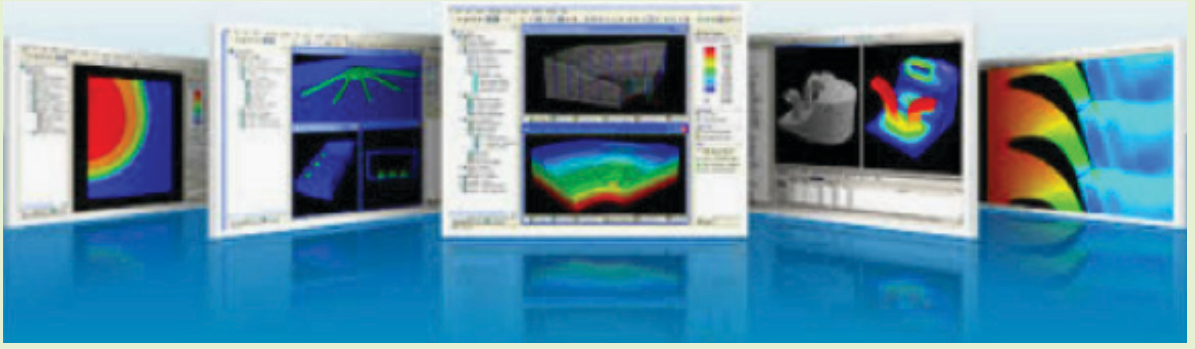


Figure 1: Screenshot of HSI 3000 software showing the view of a plot the having a fixed temperature and Hydrus 2D software.

With increasing water scarcity in semi-arid Mediterranean regions, optimizing water resource use is crucial. A recent study investigated the combined use of infrared thermography and Hydrus-2D simulation models to assess the impact of water and salt stress on potato crops in central Tunisia.

Study Objective

The research aimed to determine how the combined use of model simulations and infrared thermography can help improve irrigation management and water use efficiency in agriculture under different water qualities.

Methodology:

- Experimentation on potato crops under four different treatments (combinations of irrigation levels and water quality).
- Analysis of leaf temperatures using thermal cameras to calculate the Crop Water Stress Index (CWSI).
- Simulation of water and salt dynamics in the soil using the Hydrus-2D model.

Key Findings

- Increased irrigation water salinity led to a 10% reduction in tuber yield per unit of dS/m.

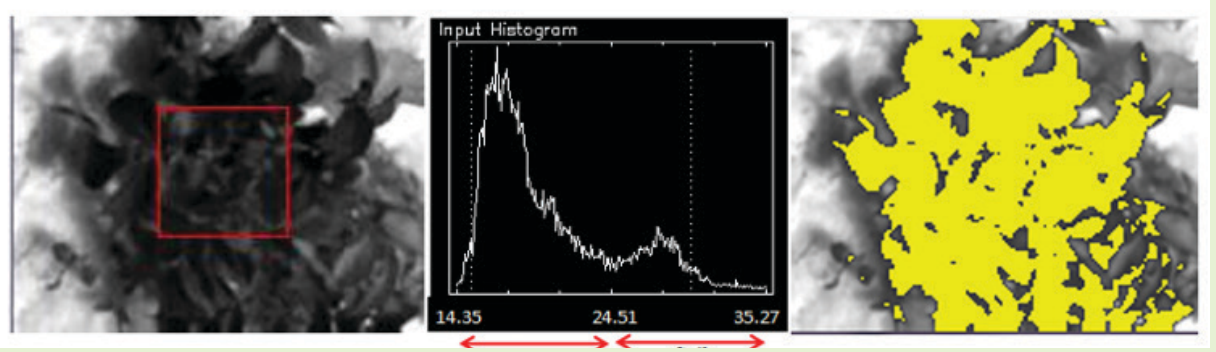


Figure 2: Steps to separate plant from soil in a thermal image in a thermal image

- A 100 mm reduction in irrigation decreased yield by 17 t/ha with good-quality water and by 12 t/ha with saline water.
- A strong correlation (R^2=0.91) between CWSI and tuber productivity was demonstrated.
- The Hydrus-2D model effectively simulated soil moisture variations and crop water stress.

Implications and Recommendations

- Using infrared thermography for real-time monitoring of water stress could improve irrigation scheduling.
- The Hydrus-2D model could serve as a decision-support tool for farmers, enabling better irrigation water management.
- Combining these technologies would optimize water supply and mitigate the negative effects of water and salt stress on crops.

Conclusion

This study highlights the potential of infrared thermography and simulation models to enhance irrigation management. Wider adoption of these technologies could contribute to more sustainable and climate-resilient agriculture.

Contribution de : Hiba Ghazouani[1], Fulvio Capodici[2], Giuseppe Ciraolo[2], Antonino Maltese[2], Giovanni Rallo[3], Giuseppe Provenzano[2].

[1]Centre Régional de recherche en grandes cultures à Béja (CRRGCB), [2]Université de Palerme, [3]Université de Pisa.

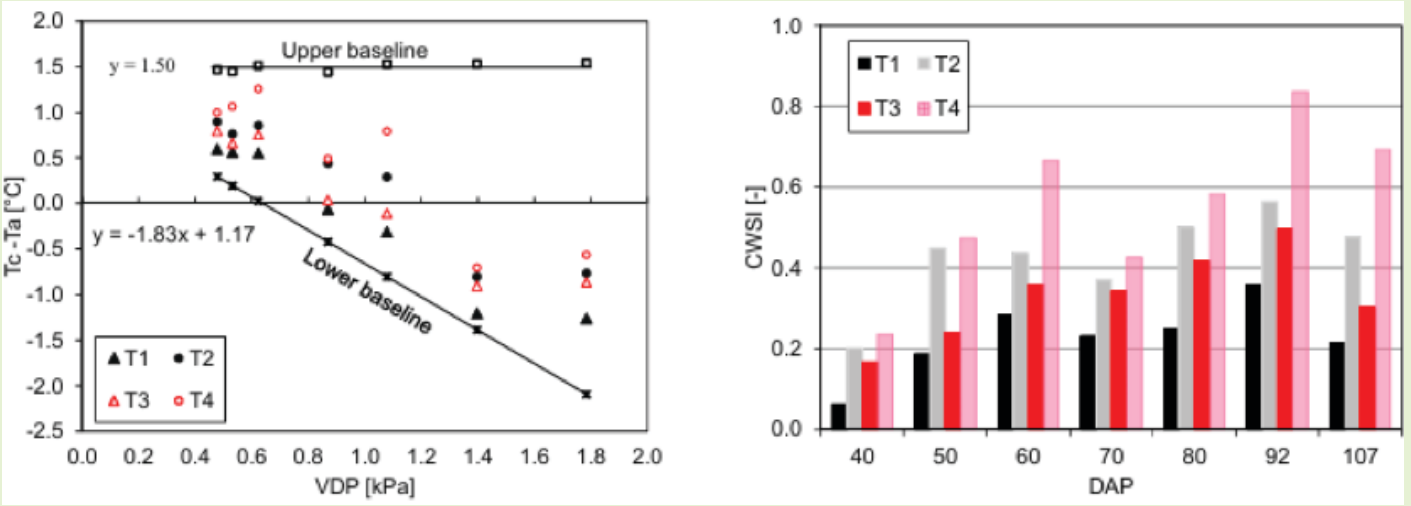


Figure 3: Difference between canopy and air temperature, (Ta-Tc), versus the vapour pressure deficit, VDP and b) values of CWSI estimated in treatments for different irrigation doses and water qualities at different days after planting.

Unlocking Precision Farming: How Drones Revolutionize the Mapping of Neglected and Underutilized Crops like Taro and Sweet Potatoes in Smallholder Croplands

In the face of climate change challenges, traditional crops like maize are struggling, intensifying food insecurity in Southern Africa. However, lesser-known crops like taro and sweet potatoes offer promising solutions. This article delves into the potential of these neglected and underutilized crop species (NUS) to combat food and nutrition insecurities. Despite their promise, NUS face obstacles like limited research and market interest, compounded by the difficulty of determining their spatial extent in smallholder croplands.

To tackle these challenges, researchers in South Africa are turning to cutting-edge technology: unmanned aerial vehicles (UAVs) and high-throughput phenotyping. The study, conducted in the Kwazulu-Natal Province, aims to systematically map the distribution of NUS crops using UAVs equipped with multispectral sensors. Through rigorous analysis, the researchers evaluated various classification methods to accurately identify and delineate the spatial distribution of these crops.

Their findings highlight the potential of machine learning algorithms, particularly tree-based classifiers like Random Forest (RF) and Gradient Tree Boosting (GTB), which outperformed traditional methods. By leveraging near-infrared and red-edge vegetation indices, these classifiers achieved over 90% accuracy in distinguishing NUS crops. Moreover, the study compared object-based image analysis (OBIA) and pixel-based analysis (PBIA) techniques, revealing that PBIA combined with GTB classification offered slightly better results.

Ultimately, the integration of UAV-acquired data and advanced classification techniques holds promise for efficient monitoring and management of NUS crops in small-scale agricultural areas. This not only enhances food production but also promotes biodiversity conservation, climate resilience, and sustainable agriculture practices. By shedding light on the spatial distribution of NUS crops, this research provides valuable insights for local communities and smallholder farmers, paving the way for sustainable development and improved food security in Southern Africa. ■

Contributed by: Mishkah Abrahams[1], Mbulisi sibanda[1], Luxon Nhamo[2], Sylvester Mpandeli[2], and Tafadzwanashe Mabhaudhi[3,4]

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UPCOMING CONFERENCES

2025

Africa Agri-Tech 2025: shaping the future of farming here

Precision Agriculture and Technology Training Course in Pretoria here

ICAACS 2025: 19. International Conference on Agriculture, Agronomy and Crop Sciences, April 10-11, 2025 in Cape Town, South Africa here

15th European Conference on Precision Agriculture in Barcelona (ECPA 2025) here

AAPA AFRICAN ASSOCIATION for PRECISION AGRICULTURE

APNI AFRICAN PLANT NUTRITION INSTITUTE

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