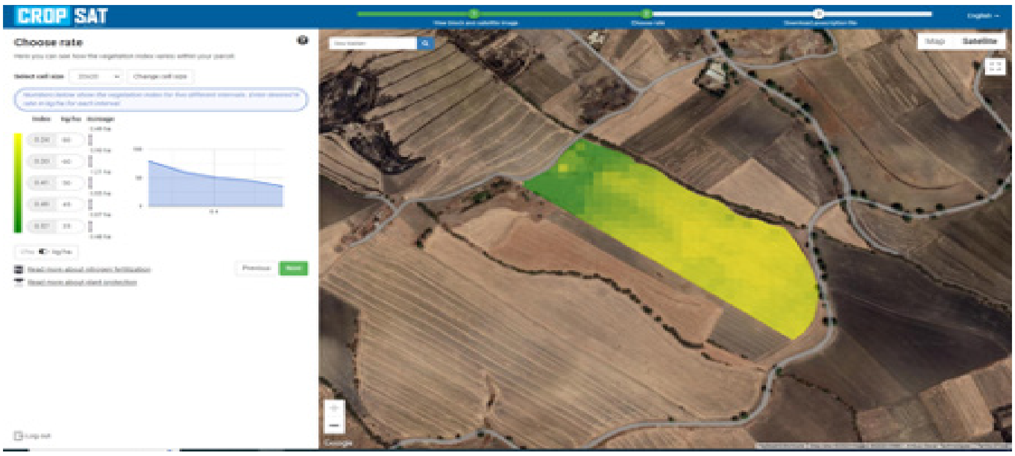
AAPA
AFRICAN ASSOCIATION for PRECISION AGRICULTURE

No. 3 - May, 2023

CROPSAT – Opportunities for Applications in Precision Agriculture in Africa



Increasing crop yield and improving quality are main targets of nitrogen (N) application. Well-adjusted N rates mean improving nitrogen use efficiency and in turn, better profit and minimized negative environmental impact associated with non-optimal nutrient application.

One of the main concepts in precision agriculture (PA) is taking into account the within field variations in the agricultural practices. The CropSAT system (cropsat.com; Dataväxt AB, Grästorp Sweden), is a Sentinel-2-based interactive decision support system (DSS) that provides vegetation index (VI) maps free-of charge all across the globe for different applications in PA.

These maps could be either be downloaded in different formats compatible with a wide range of spreaders/sprayers available in the machinery market, be printed to be used manually, or be used in smartphone or tablets to support discussion in advisory situations. The DSS was initially developed in a research project at the Swedish University of Agricultural Sciences (SLU), and since its launch in 2015 has been continuously developed in a private-public-partnership between SLU, private companies and the Swedish Board of Agriculture. One of the main applications of CropSAT is variable rate application (VRA) of any input in agriculture (fertilizers, pesticides or growth regulators). In arid and semi-arid areas, water deficiency in the soil is a limiting factor to achieve high nitrogen use efficiency and optimal crop growth. A research project is now running in Tunisia in collaboration between SLU, the National Institute of Field Crops (INGC) and the National Agronomic Institute of Tunisia (INAT) to assess the feasibility of using systems such as CropSAT for application under arid and semi-arid climate for both fertilizer and irrigation water management. Wider collaboration is planned to develop and disseminate DSS to empower the agricultural sector in Africa and the Middle East region with PA techniques for improved food production. AAPA

Contributed by Drs. O. Alshihabi, I. Nouiri, M. Mechri, H. Angar, K. Persson, J. Martinsson, and M. Söderström, Swedish University of Agricultural Sciences (SLU), Skara, Sweden; National Agronomic Institute of Tunisia (INAT), Tunis, Tunisia; National Institute of Field Crops (INGC), Bou Salem, Tunisia; Dataväxt AB, Grästorp, Sweden, omran.alshihabi@slu.se

For more information about this research conducted by Drs. O. Alshihabi, I. Nouiri, M. Mechri, H. Angar, K. Persson, J. Martinsson, and M. Söderström, please see the AfCPA 2022 Proceedings at https://paafrica.org/Proceedings.

Contact Us: info@AAPA.org

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

AAPA membership is free to all registrants.

Register with AAPA

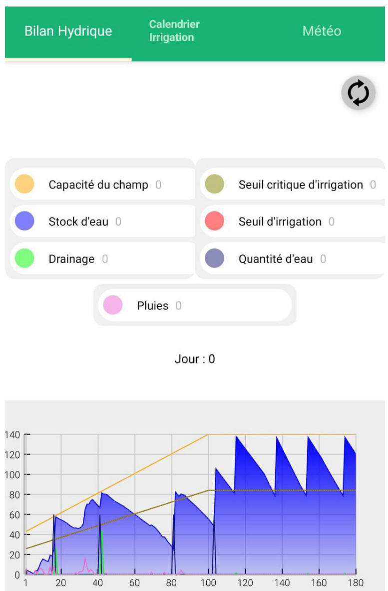
Developing Decision Support Tools for Smart Farming in Tunisia

The management of soil and water resources in Tunisia is becoming an urgent concern under the context of climate change and water scarcity. The adoption of new technologies and good farming practices is needed to improve agricultural production, farmer income, and strengthen the pillars of economic, social, and environmental growth. To address this, the National Institute of Field Crops (INGC) in Tunisia developed a smart irrigation app called "IREY" that provides real-time irrigation schedules for selected crops. The app calculates the water balance per plot and suggests a tailor-made irrigation schedule to farmers, which can help them optimize their productivity, reduce costs, and improve their income. The app has already been used by 100 farmers and technicians, and the INGC aims to reach 8,000 irrigated grain farmers with the new version of the app, which will incorporate data from remote sensing and other sources to improve precision and reliability.

Another development in Tunisian agriculture is the use of IoT technology. The INGC has partnered with the private operator Telnet to develop IoT applications in agriculture, connecting weather stations and soil moisture sensors to the Tunisian Satellite Challenge One, the first domestically-made satellite from Tunisia. This connection allows for more precise and real-time data on weather and soil conditions, which can help farmers make better decisions and improve their yields.

Overall, these developments in Tunisian agriculture show a commitment to using technology to address the challenges posed by climate change and the scarcity of resources. By leveraging modern technology and good farming practices, Tunisia can strengthen the pillars of economic, social, and environmental growth.

Weather station connected to IoT Satellite



IREY real-time and predicted Soil Water Chart

Contributed by Drs. A. Bouselmi, R. Nciri, R. Kalboussi and, T. Jarrahi from the National Institute of Field Crops.

For more information about this research conducted by Drs. A. Bouselmi, R. Nciri, R. Kalboussi and, T. Jarrahi, please see the AfCPA 2022 Proceedings at https://paafrica.org/Proceedings.

Digital Map of Soil Organic Carbon Stocks in Tunisian Topsoils

The knowledge of distributed soil organic carbon (SOC) stocks at a national level is a key element for environmental research relating to atmospheric carbon sequestration in soil. It is also a key element for agricultural planning and decision-making as SOC maps provide users with very useful information to monitor the soil conditions, identify degraded areas, set restoration targets, and explore SOC sequestration potentials. Therefore, there is a real need for methods that enable reliable and updated soil stock evaluations at the national scale. Digital Soil Mapping (DSM) is an interesting method for mapping soil properties. This method is widely used at global, continental and national scales. Nevertheless, despite the extensive application of various DSM techniques for SOC prediction around the world, few works are available in Tunisia. In order to fill this knowledge gap, the present study proposes a DSM initiative based on the Quantile Regression Forest (QRF) machine-learning algorithm to map SOC stocks in Tunisian topsoils (0 to 30 cm) at 100-m resolution.

A learning dataset of 1540 soil profiles were gathered. These profiles were collected across the country between 2000 and 2014, with higher spatial density in the north, where soil and vegetation are more spatially variable than in the south, where soils and land use are more homogeneous. The average density of soil profiles is about one per 100 km^2. The main environmental covariates considered in this study as potential predictors of SOC stocks relate to bioclimatic variables, morphometric variables, soil/parent material, land use and other environmental factors such as vegetation through remote sensing indices.

Application of the QRF predictive model resulted in a national map of SOC stocks and associated uncertainties. It provided a new assessment of the SOC stock in topsoil (0 to 30 cm) on the Tunisian territory at 391Tg C (i.e., an average of 2.53 kg m^{-2}). The performance of the SOC stocks prediction (R^2 of 0.44, RMSE of 1.94 kg m^{-2}) was in the same range as most SOC map studies conducted at regional or national scales. The present national initiative highly improved the predictions provided by the global SoilGrids2.0 DSM initiative (R^2 of 0.15, RMSE of 2.52 kg m^{-2}), which confirms the added value of locally produced maps and models compared to global estimation. The importance of the environmental covariates tested indicates the major role of bioclimatic parameters and, to a lesser extent, remote sensing images and topography-related variables.

The SOC stock map (Figure 1) shows a significant decreasing gradient from north to south of the country. The highest SOC stocks in Tunisia were observed in the northern region, with an average SOC stock of about 4.6 kg m^{-2}. In central Tunisia, the average SOC stock is about 2.9 kg m^{-2}. The average SOC stock in the southern part of Tunisia, which is characterized by an arid to desert climate (100 to 200 mm yr^{-1}) is about 1.8 kg m^{-2}. Finally, our results showed that increasing the quality and quantity of soil profile observations is most likely the best way to improve the future SOC map, starting with the northern region of Tunisia, which has the highest SOC stock predictions and uncertainties in the country.

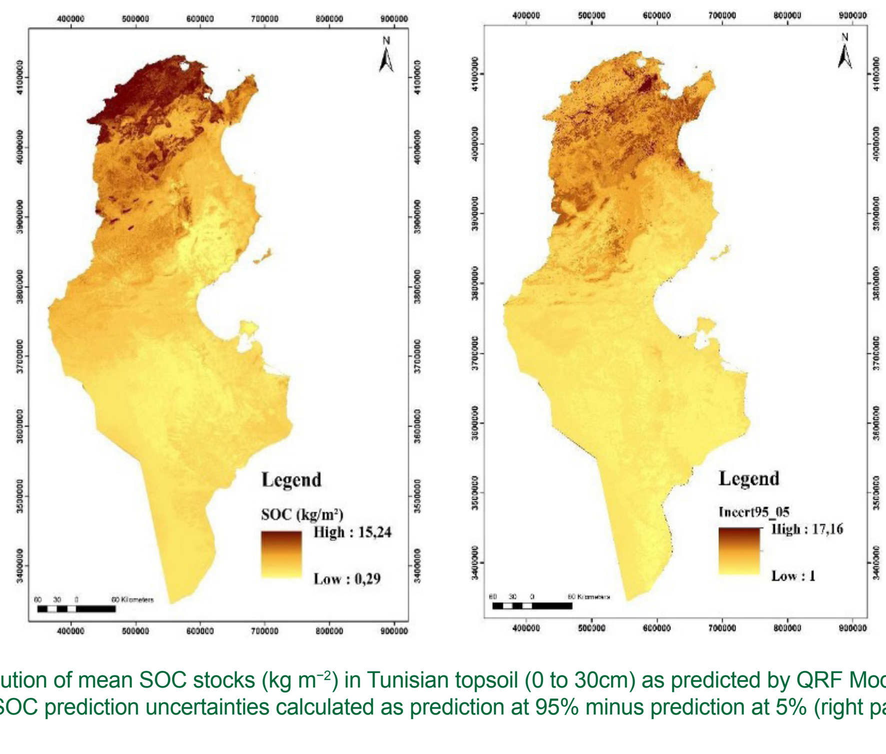


Figure 1. Map at 100-m resolution of mean SOC stocks (kg m^{-2}) in Tunisian topsoil (0 to 30cm) as predicted by QRF Model (left panel) and map of related SOC prediction uncertainties calculated as prediction at 95% minus prediction at 5% (right panel)

References

Bahri H., Raclot D., Barbouchi M., Lagacherie P., Annabi M. (2022). Mapping soil organic carbon stocks in Tunisian topsoils. Geoderma Regional 30, e00561. https://doi.org/10.1016/j.geodrs.2022.e00561

Contributed by Drs. Haithem Bahri[a], Damien Raclot[b], Meriem Barbouchi[c], Philippe Lagacherie[b], Mohamed Annabi[c]

[a] Agronomic Sciences and Techniques Laboratory, National Research Institute of Rural Engineering, Water and Forests (INRGREF), Carthage University, Rue Hedi Karray, CP1004, Menzah 1, Tunisia

[b] UMR LISAH, Univ. montpellier, INRAE, IRD, Institut Agro, 2 place Pierre Viala, F-340760 Montpellier, France

[c] Agronomic Sciences and Techniques Laboratory, National Institute of Agricultural Research of Tunisia (INRAT), Carthage University, Rue Hedi Karray, CP1004, Menzah 1, Tunisia

For more information about this research conducted by Drs.Haithem Bahri, Damien Raclot, Meriem Barbouchi, Philippe Lagacherie, and Mohamed Annabi please see the AfCPA 2022 Proceedings at https://paafrica.org/Proceedings.

Field-Specific Fertilization Approches for Wheat in Smallholder Farming Systems

Reducing excessive nutrient application and the balanced use of fertilizers are key mitigation options for climate change in agriculture. To meet the growing demand for food over the next 20 to 30 years, grain-growing systems must be enhanced, and current yields increased to 70 to 80% of the genetic yield potential. Dynamic and robust approaches to fertilizer management, such as site-specific nutrient management (SSNM), will be essential to increase yields and maximize profits while maintaining the productivity of these intensive cropping systems. The Nutrient Expert (NE) site-specific nutrient management tool was evaluated in the cultivation of wheat by installing two comparative trials with the fertilization practices of farmers and recommendations according to soil analyses in two bioclimatic areas of Tunisia. Management of NE-based fertilizers has been found to reduce fertilizer use relative to farmer practices. The NE increased the yield in the Manouba region (semiarid) area compared to the farmer's practices and soil analyses by an average of 20% and 10% respectively; however, in Beja region (subhumid), we did not observe a significant difference among fertilization approach. The Nutrient Expert (NE) tool is designed to provide crop advisors with a simpler and faster way to apply SSNM using existing information on the site.

More research is needed to improve the output of NE recommendations especially to optimize nitrogen fertilization rates.

		Farmer Practices	Soil Analyses	Nutrient Expert
Beja Region (Subhumid)	Farmer 1	6.6	6.9	6.7
	Farmer 2	4.3	3.6	3.5
	Farmer 3	4.8	5.3	5.5
	Farmer 4	5.1	5.4	4.8
	Average	**5.2**	**5.3**	**5.1**
Menouba Region (Semiarid)	Farmer 1	4.8	5.3	5.7
	Farmer 2	4.9	4.7	6
	Farmer 3	2.9	4.4	4
	Farmer 4	2.3	2.9	3.5
	Farmer 5	2.3	2.2	2.7
	Average	**3.44**	**3.9**	**4.3**

Table 1. Wheat yield in T/ha as affected by fertilization approach in bioclimatic region in Tunisia

Contributed by Drs. Mouna Mechri[1], Mohamed Boutfirass[2], Hayet Maaroufi[1], Tarek Jarrahi[1]

[1] National Institute of Field Crops (INGC)
[2] African Plant Nutrition Institute

For more information about this research conducted by Drs.Mouna Mechri, Mohamed Boutfirass, Hayet Maaroufi, and Tarek Jarrahi, please see the AfCPA 2022 Proceedings at https://paafrica.org/Proceedings.

Greetings AAPA members!

I am Vincent Aduramigba-Modupe, President of the African Association for Precision Agriculture (AAPA). I am very excited to serve this term on the board of the AAPA as I have focused throughout my career on mentoring and building the capacity of young academics and scientists in West Africa. I am currently a Senior Research Fellow at the Institute of Agricultural Research and Training, Obafemi Awolowo University, Moor Plantation, Ibadan, Nigeria and have more than 24 years of experience in agricultural research and development, and resource mobilization (particularly in the fields of digital soil mapping, precision agriculture, and natural resources management) in Africa and Europe.

Here are a few bullet points about the association:

African Association for Precision Agriculture (AAPA) - AAPA is run through an elected board comprising the President, President-Elect, Executive Secretary, Past-President, Representatives from Central, East, North, Southern and West Africa regions and the AAPA Founder.

Motivation - Sub-Saharan Africa is faced with bio-physical constraints which impinge on agricultural development. AAPA focuses on agricultural research for development through technologies and evidence-based Precision Agriculture (PA) recommendations that are technically appropriate and economically viable within Africa.

AAPA Mission - Contribute to the development of PA in Africa and engage the global PA community through scientific, informative, extension and training activities.

Vision: bring science-led management innovations to scale through PA value chain development approach.

Special Interests:

- identifying synergies between partners and developing strategic research concepts;
- interfacing with national research and extension partners to develop a common vision and joint ownership of PA project outputs;
- applying for external funding to finance joint research projects between partners and key stakeholders;
- promoting PA innovation platforms as the best way of making knowledge gained useful to key stakeholders in Africa and beyond.

Please feel free to contact me or any other AAPA board member with questions or comments about the association. AAPA

UPCOMING EVENTS

16th International Conference on Precision Agriculture (#ICPA2024)

Manhattan, Kansas, USA – 21-24 July 2024

Deadeline to submit abstracts: 31 October 2023

https://www.ispag.org/icpa/

OFE2023 Conference

Call for abstracts is OPEN until July 1st 2023

https://gofen.org/ofe2023/

14th European Conference on Precision Agriculture (ECPA)

Bologna, Italy – 2-6 July 2023

https://www.ecpa2023.it/

3rd Scientific Conference on Agricultural Science

Misurata, Libya – 7-8 October 2023

https://www.misuratau.edu.ly/conference/2023/tscas2023