جامعة الملك سعود
King Saud University

كرسي أبحاث الزراعة الدقيقة

Precision Agriculture Research Chair (PARC)

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Overview

The Precision Agriculture Research Chair (PARC), established in 2009, is an academic-government cooperative chair of excellence for research and education. The focus of its research efforts is mainly on the precision agriculture technologies, which include management information systems, mechatronics, smart machines and robotics and machine instrumentation, and transferring these technologies into the Kingdom of Saudi Arabia. In addition, investigating the expected positive impact of precision agriculture on the environment and the agro-economic, along with exploring the potential commercial applications of precision agriculture in Saudi Arabia, are also be within the scope of PARC research efforts.

General Objectives

Since its establishment, PARC has devoted academic and research efforts to achieve a set of general objectives, including the following:

- To create a specific scope of research that conforms with the requirements of the government agriculture strategy, local agriculture industry and environment agencies, and explore the aspects that can be addressed by employing the proposed precision agriculture technology.
- To collaborate with universities, centers and scientists either national, regional and/or international in performing joint research projects to enhance the realization of PARC main objectives.
- To effectively participate in a good quality graduate education on the precision agriculture topic and encourage the participation of graduate students and related scientists from KSU and other organizations in or outside the Kingdom in professional training and scientific research efforts.
- To raise the stakeholders awareness of the economic and environmental problems associated with agricultural input applications and educate and train them on the principles of precision agriculture, the related new technologies and the new research trends in this field.

Vision

To be a pioneer, through an effective contribution on the international level, in the field of precision agriculture to achieve economic and environment-friendly agriculture.

Mission

To raise the awareness of the undesired economic and environmental consequences resulting from applications of agricultural chemicals, transfer and introduce the precision farming technology to ease these consequences through extensive research projects, collaboration with related scientific centers and specialists, and to educate concerned people on this technology and its application methods.

Specific Objectives

- To increase the accuracy and efficiency of agricultural input applications.
- To conduct lab and field experiments and researches on the economic and environmental negative impacts of agricultural chemical misapplications.
- To conduct researches on the economic and environmental feasibility of the precision agriculture technology that would promote this technology to be accepted and adopted by farmers and environmentalists in Saudi Arabia.
- To localize this technology through collaborative research efforts.
- To deliver this technology to a wide segment of local researchers, environmentalists, farmers and agro-economists.

PARC Principal Duties

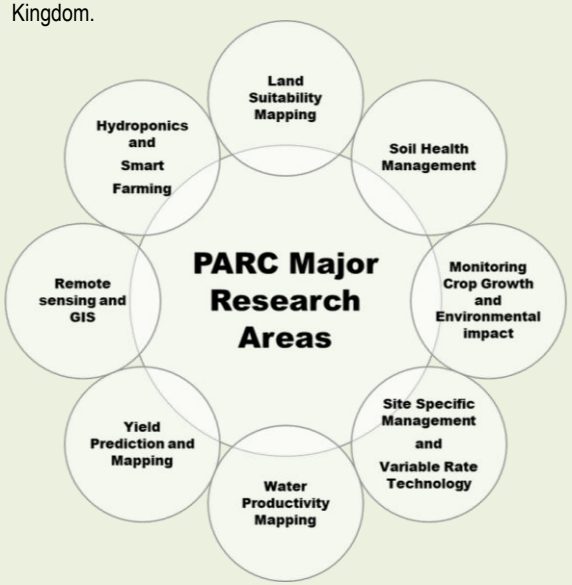
- Forming and raising, through specialized workshops and training, the level of understanding and awareness of the society in general, and farming community in particular, of the precision agriculture (PA) technology and its economic and environmental importance.
- Conducting laboratory researches and field studies in the different applications of the PA technology in the Saudi agricultural fields.
- Active participation, nationally and internationally, in the scientific efforts and researches related to the field of PA.
- Scientific collaboration with scientists, specialists and scientific institutions in the Kingdom, as well as with international scientists and recognized centers, in scientific activities related to PA techniques.
- Conducting joint research and mutual scientific visits to benefit from global expertise to enhance local scientific research in the field of PA, and transferring this technology to the Kingdom of Saudi Arabia.

PARC Key Partners

Local	1. National Agricultural Development Company (NADEC). 2. Saudi Agricultural Development Company (INMA). 3. Agro-Supplies & Development Company (ASDCO). 4. Tawdeehiya Farms.
International	1. Agricultural University of Athens – Greece. 2. The International Center for Agricultural Research in the Dry Areas (ICARDA). 3. University of California – USA. 4. University of Minnesota – USA. 5. Colorado State University – USA. 6. Harper Adams University. 7. University of Prince Edward Island – Canada.

PARC Research Interests

The Chair has carried out a number of scientific researches, on the farmer-partnership system basis, in order to transfer precision agriculture technologies and their applications to the Kingdom.



Major Implemented Research Projects

1. "**Precision fertigation for sustainable agriculture in the Kingdom of Saudi Arabia**", funded by the National Science, Technology and Innovation Plan (NSTIP), King Abdul-Aziz City for Science and Technology (SR 1,864,950), in the period between 2011 and 2013.
2. "**Water productivity mapping and assessment of irrigation performance for irrigation water conservation: a study in Al-Kharj region of Saudi Arabia**", funded by the NSTIP (SR 1,858,000), in the period between 2012 and 2014.
3. "**Use of saline water for tomato production in hydroponic greenhouses**", funded by the NSTIP (SR 1,868,975), in the period between 2019 and 2021.
4. "**Productivity and Water Footprint Analysis of Vegetables Cultivated in Riyadh Region of Saudi Arabia: A Remote Sensing and GIS Approach**", funded by the NSTIP (SR 593,918), in the period between 2020 and 2022.

Services Offered by PARC

Through the technologies of precision agriculture, PARC provides all the information needed to make effective, informative and successful decisions regarding agricultural production and sustainability. Services provided by PARC are aimed to enhance more accurate, efficient and effective spatial and/or temporal management of crop production inputs, including soil, water and agrochemicals.

(i) Soil Sampling and Analysis

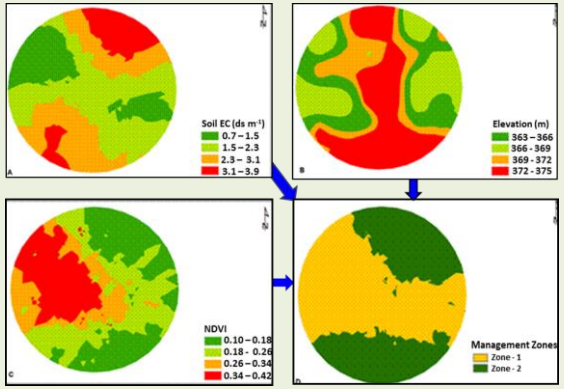
- **RTK GPS-assisted soil sampling can be provided.**
- **Soil analysis for physicochemical properties, such as texture, soil organic carbon, EC, soil nutrients (N, P, K, Ca, Cu, Fe, Mg, Na, Zn, etc.). Topography and soil compaction analysis are also offered.**

(ii) Crop Sampling and Performance Assessment

- **Plant sampling and analysis for nutrient concentration (N, P, K, Ca, Cu, Fe, Mg, Na, Zn, etc.) can be provided.**
- **Crop monitoring services, including measuring bio-physical parameters (leaf area index – LAI and VIs), chlorophyll concentration, crop health and productivity parameters (yield sampling, data interpretation and yield mapping) are also available.**

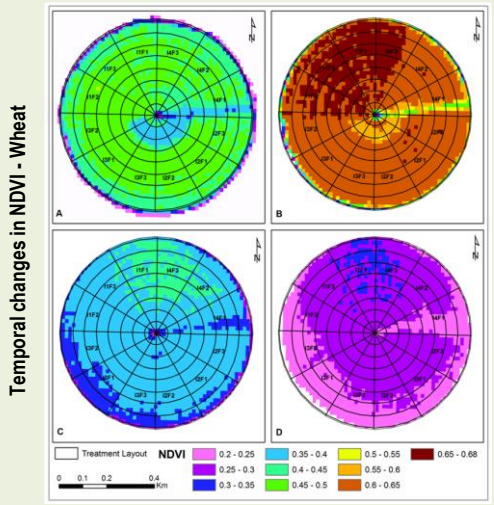
(iii) Delineation of Management Zones

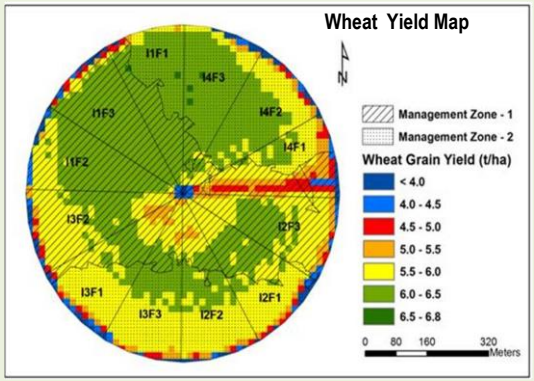
In order to optimize crop productivity, PARC provides services of delineating the fields into management zones based on the assessment of time series satellite images, along with agro-meteorological, soil, crop performance and yield data.



(iv) Mapping and Impact Assessment

- Base map of agricultural area (farm).
- Soil compaction, soil deterioration, salinity and other negative impacts can be mapped out for informative decision making.
- Maps of soil physicochemical properties (soil texture, EC, compaction, soil nutrients, etc.).
- Maps of time series crop health and biophysical parameters (LAI, NDVI, SAVI, WUE, etc.).
- Prescription maps for different agricultural inputs, early yield prediction maps, yield maps and water productivity maps.





PARC Laboratory

The Chair has established a fully-equipped Precision Agriculture (PA) laboratory featuring the latest devices used in PA technologies. The laboratory is used for the implementation of scientific research carried out by the Chair and for the educational purposes for Bachelor and Graduate students. It is considered to be one of the region's leading specialized analytical laboratories, capable of providing accurate services that meet the needs of clients working in agriculture, horticulture, and related industries.

1. **GPS Devices:** Used to locate sampling points for accurate geo-referenced/GIS data collection.

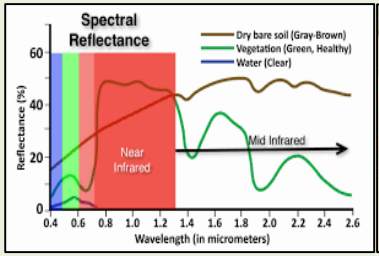
OmniSTAR: 9200- G2

Trimble (GeoXH 6000)

2. **Soil Compaction Meter: To measure soil compaction in terms of soil resistance to penetration.**

3. **Soil Electrical Conductivity Meter – EM38, with compatible GPS: Used for applications in agriculture, archaeology and general soil sciences.**

4. **Spectroradiometer (ASD FieldSpec-3): Used for applications of hyperspectral reflectance in remote sensing for soils and agricultural studies.**



5. **Plant Canopy Analyzer (LAI-2200): Used for non-destructive measurements of Leaf Area Index (LAI).**

6. **Portable Photosynthesis System (LI-6400XT):** Used to measure CO_2, H_2O, stomatal conductance, light control, etc.

7. **Nitrogen Analysis Unit (Kjeltech 8460) & Digestion System (Tecator™ 2540):** Used to analyze total nitrogen/protein for various samples, such soil, plant, vegetables, etc.

8. **Atomic Absorption Spectrometer (PinAcle 900F):** Provides analysis of major elements (Ca, Cu, Fe, Mg, Mn, K, Na and Zn) in plant, soil, water, etc..

9. **Crop Circle Handheld System (ACS-470):** Provides classic vegetation index data (NDVI, SR and others) and basic reflectance information from plant canopies and soil.

10. **Agricultural Digital Camera (Tetracam-ADC):** Used to capture images for agricultural crops/vegetation, which enables the extraction of standard vegetation indices.

11. **UV/VIS Spectrophotometer (LAMBDA 35):** Provides analysis of major elements in plant, soil, water and related samples which reflects in UV-VIS range.

12. **Portable Leaf Area Meter (LI-3100C): Designed to quickly digitize the area, length, and width of leaves.**

13. **Leaf Porometer (SC-1): Measures the stomatal conductance of a plant leaves.**

14. **IR Thermal Camera (FLIR T650Sc): Produces a visible image of a target's thermal profile**

Hydroponic Research Unit

Overview

The increasing demand for food have created an urgent need to adopt sustainable food production strategies. The production of crops in hydroponic greenhouses has greatly contributed to increasing food production, improving food quality, conserving resources and protecting the environment.

Advantages of soilless agriculture

- Increasing the efficiency of irrigation water use, thus reducing the significant waste of water.
- Applicable anywhere regardless of the availability of arable land.
- Increasing the amount of production per unit area (vertical farming).
- Significantly reducing the loss of fertilizers that are lost to or fixed in the soil.
- Reducing damage to soil, environment and groundwater resulting from heavy fertilizer application and repeated cultivation.
- Reducing traditional farming, pest control, fertilization, and soil sterilization.
- Improving the agroeconomic efficiency and producing high-quality crops.

The hydroponic system and the growing medium

The hydroponic glasshouse is equipped with MACQU systems (Geosmart, Athens, Greece) to control the indoor climate and the fertigation system. The environmental system included an automatic shade screen, circulatory fans, and evaporative cooling systems. The glasshouse is also equipped with a hydroponic system consisting of 12 plant lines established with stainless steel troughs of 1.0 m height, automatic electric motors, and self-compensating drippers for irrigation purposes.

Importance of the Hydroponic Research Unit

The Hydroponic Research Unit of the Precision Agriculture Research Chair provides a valuable resource and infrastructure for teaching hydroponics, as well as for scientific research and practical training for students and workers in this field.

Training courses organized in the research unit cover the main concept of hydroponics.

- Basics and Concepts of Hydroponics.
- Nutrient solution preparation.
- Instrumentation - hydroponic growing systems.
- Supervision and management of hydroponic farming.
- Plant biophysical data measurement and analysis.
- Hands-on training on hydroponics equipment.

Achievements (2009-2025)

Publications	
1. Papers Published in Scientific Journals	131
2. Papers Published in Scientific Conferences	9
3. Published Books/Book Chapters	5
Research Projects	
1. PARC-Implemented Research Projects	9
2. Joint-Implemented Research Projects	2