**Department of Soil and Crop Science Strategic Plan**

The Department of Soil and Crop Science is a world leader in Agronomy, Plant Breeding, and Soil and Water Science teaching, research, and extension faculty who work to solve some of the greatest challenges facing humanity including sustainable food production, climate change, and soil security.

Our mission is to promote the wise use, management, and stewardship of soil, plant, and water resources by preparing students for careers in soil, plant, and environmentally related disciplines; discovering new scientific knowledge and developing associated technologies to sustain environmentally sound and economically profitable production systems; and ensuring the efficient extension of technological developments and best management practices to user clientele and society in general.

Our vision is to provide the world with sustainable food, feed, fiber, greenspace, and fuel in a safe and aesthetically pleasing environment through discovery, education, and application.

Land Grant Universities, such as Texas A&M University, are charged with the tripart mission of the Land Grant System of teaching, research, and extension.

# Teaching

Educating and training the next generation of professional agronomists, soil scientists, and plant breeders is a mission of the Department of Soil and Crop Sciences. This mission is enhanced and accomplished by the scientists who conduct cutting-edge research in their fields and bring their experience and expertise to the classroom.

Students interested in a rewarding career in applied biological, chemical, and physical sciences will find numerous opportunities in Soil and Crop Sciences. The department provides undergraduate (UG) students with the option of two applied science majors, “Plant and Environmental Soil Science” and “Turfgrass Science.” Within the Plant and Environmental Soil Science major, students can choose either a “Soil and Water” emphasis or a "Crop" emphasis. We also offer UG minors in “Agronomy,” “Environmental Soil Science,” and “Plant Breeding.”

Our UG students can help mitigate the effects of global climate change. They will also participate in biofuel agronomics, manage high quality green spaces (e.g., golf courses, sports fields and parks), and advance environmental and sustainable development. We equip students with the knowledge and skills to sustainably manage soil, water, and plant systems that are essential for mankind that provide food, clothing, housing, greenspace, and fuel for more than nine billion people by 2050. Our students are part of the next generation that is preparing to meet these immense challenges and opportunities.

In addition to classroom and academic lab experiences, students have opportunities to 1) participate in practical hands-on training with our on- and off-campus researchers; 2) study abroad; 3) conduct undergraduate research; 4) interact with fellow students and develop professional skills via student organizations; 5) participate in internships both nationally and internationally; and 6) become a member of the department’s judging teams.

Graduates with a B.S. in Plant and Environmental Soil Science and Turfgrass Science from Texas A&M University are highly qualified and sought for post graduate degrees or careers in such fields as:

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| Agricultural Research | Education | Sales |
| Environmental Soils Research | Crop Variety Development | Industry |
| Environmental Consulting | Soil/Water Conservation  | Turfgrass Management  |
| Crop Consulting | Extension | Food Security/Quality  |
| Government | Land Management | Water Quality  |

Additionally, the Plant Breeding degrees are also offered at distance, which is the only research-based distance M.S. and Ph.D. degree program in the U.S. Our M.S. and Ph.D. programs in Soil and Crop Sciences are designed to prepare students for careers in research, teaching, extension, industry, and management of agronomic and environmental enterprises. Members of the faculty have expertise in biotechnology, crop breeding, crop genetics, crop physiology, molecular biology, agroecosystem management, environmental physics, environmental soil science, environmental toxicology, invasive species, soil chemistry, soil fertility, soil genesis and classification, soil hydrological sciences, soil microbiology, soil mineralogy, turfgrass science, turfgrass management, urban ecosystem management, water quality, watershed management, and weed science.

Our graduate students gain research experience in agronomy, plant breeding, and/or soil science that prepares them for professional careers in resource conservation, extension, education, variety development, research and development, environmental assessment, and related disciplines. In addition, graduate students gain experience in teaching and oral communication by directing undergraduate or graduate lab sections and by presenting research data at professional meetings.

Our teaching strategy revolves around maintaining a critical mass of professors across the multiple facets of agronomy, plant breeding, soil, and water sciences. Areas of science that support the state and U.S. agricultural landscape continue to evolve with scientific discoveries and emerging technologies that were unknown a decade ago, such as drone technology, high-throughput genomic and phenotyping, robotics, biophotonics, and gene editing. The department is committed to maintaining faculty in emerging areas while maintaining faculty in the traditional areas to serve our graduate and undergraduate students. The department collaborates with other departments who utilize these technologies to provide educational opportunities.

# Research

Research missions of Soil and Crop Sciences faculty, located on campus and 13 research and extension centers across Texas, are broadly categorized as the disciplines of Agronomy, Plant Breeding, and Soil and Water Science. However, these missions span across diverse disciplines ranging from ecology to the environment to resource conservation, basic sciences to production of agricultural products and conventional plant breeding to genetic investigations. The Department has a large and diverse population of scientists with dissimilar expertise, yet complementary skills and background knowledge. Strong collaboration and interaction among campus-based and center-based faculty also provides strength for graduate student training and hands-on experience, which has contributed to a national reputation for training high-quality undergraduate and graduate students. Diverse faculty expertise results in competitive grants and contracts; enhances scholarship; and garners local, state, regional, national, and international recognition. Faculty expertise generates new information and technology that enhances the lives of Texans; develops and maintains innovative technologies at reduced costs; increases the economic viability of crop, forage, and turfgrass producers; and provides comparative experimental information to conserve and protect natural resources.

Research strategies in Agronomy, Plant Breeding, Soil and Water Science, and Turfgrass Science are designed to educate students and producers about the application of new discoveries regarding scientific-based knowledge to sustainably improve agricultural production strategies . We couple these aspects with helping our production systems remain competitive and capable of feeding the world’s growing population. Because of our faculty diversity, we have unique opportunities to 1) maintain and improve soil productivity, 2) provide greenspace for humanity’s enjoyment, physical health, and emotional health, 3) enhance water cleanliness and availability, 4) improve air quality, and 5) boost the quality and quantity of agronomic farming products.

## Agronomy Research

Research in Agronomy is roughly divided into crop science and management, weed science, and turfgrass science. Programs range from fundamental processes to applied research in production systems that contribute to more productive and sustainable crop and turf systems. Our Agronomy faculty have cultivated strong relationships with commodity groups; this maintains relevancy with these groups as their goals and focus change over time. Collaboration among faculty in Research and Extension bridges the gap between basic and applied research, leading to adoption of new information and technology to enhance the lives of our clientele in Texas and beyond.

Examples of research areas where our Agronomy faculty excel:

* Climate-smart agriculture
* Organic production systems and technologies
* Crop management to address climate change and weather extremes
* Digital agriculture/precision farming
* Sensor technologies
* Crop and ecosystem modeling
* Soil health/security-promoting cropping practices
* Water, carbon, and GHG footprints of crops, turfgrasses, and forages
* Yield physiology
* Ideotype of plant roots for a given plant/soil/function
* Bioenergy feedstocks
* Novel or emerging crops such as native forages and hemp
* Ecosystem services associated with agroecosystems (natural capital)
* Novel methods for addressing herbicide-resistant weeds.
* Integrated weed management for addressing multiple herbicide-resistant weeds in cropping systems, turf, and forages
* Turfgrass management

## Plant Breeding Research

The Plant Breeding Program within the Department of Soil and Crop Sciences is one of the largest among the US Land-Grant institutions in the nation, with 31 faculty. The program faculty pursue breeding and genetic research in 20 plus species used for food, feed, forage, fiber, turfgrass and biofuel, including but not limited to cotton, maize, wheat, sorghum, turfgrasses, clover, rice, peanut, soybean, sugarcane, energy cane, oat, barley, and cowpea. Although field-based breeding predominates these programs, extensive efforts are also made in research of crop genomics, genetics, molecular biology, systems biology, physiology and, recently, phenomics to develop advanced knowledge, innovative technologies, and desirable toolkits for continued and enhanced plant genetic improvement. Furthermore, the plant breeding program and its graduate education and training benefit from the expertise of 26 adjunct faculty members from USDA/ARS (11) and other national or international institutions or private companies.

Examples of plant breeding research areas where our faculty excel:

* Developing new or improved crop varieties that address adaptation to climate change and climate mitigation, sustainability, and multiple desirable agronomic traits, such as yield, quality and tolerance to biotic/abiotic stresses, and disease resistance
* Developing and utilizing advanced breeding technology to expedite variety release through DNA-dependent technologies to enhance plant breeding, such as marker-assisted selection (MAS), doubled haploid (DH) development, genome-wide association analyses or genomic selection (GS), genetic transformation and recently, genome editing, gene-based breeding, and systems biology
* Use of lasers to study biological systems, both those that occur naturally and in bioengineered materials.
* High-throughput phenotyping (HTP), especially field-based high-throughput phenotyping (FHTP), that uses modern imaging systems, such as unmanned aerial vehicles (UAVs)

## Soil and Water Science Research

The Soil and Water Science faculty envisions a program recognized globally for its leadership and innovation in advancing the application of Soil and Water Science as a discipline critical to solving the multiple crises and challenges facing the world food security, water security, energy security, climate change mitigation, climate adaptation, natural resource conservation, and preservation of biodiversity. Research expertise includes soil and water microbiology, soil and water chemistry, plant nutrition and fertility, mineralogy, physics, hydrology, pedology, and soil salinity applied to current issues to improve the understanding of soil and water processes that influence soil function to substantively improve management and ecosystem services provision to benefit humanity.

Examples of Soil and Water Science research areas where our faculty excel:

* Improving sustainable agricultural production, particularly in water and nutrient use efficiency and resilience to climate change.
* Mitigating climate change through soil carbon sequestration and greenhouse gas emissions mitigation in environmental, agricultural, and urban sectors.
* Providing insight into soil processes and promoting adaptive technological solutions that address climate-related stressors, such as wildfires and drought.
* Advancing fundamental knowledge of carbon transformations and storage processes in soils
* Restoring impaired lands, particularly for flood mitigation in urban and coastal environment, saline/sodic soil recovery in coastal, desert, and semi-arid ecosystems, and bioremediation of contaminated urban, natural, agricultural, and industrial environments.
* Elucidating plant-soil microbiome mechanisms that control plant responses to abiotic and biotic stressors and carbon storage mechanisms.
* Enhancing our fundamental understanding of soil biogeochemical cycling
* Contributing valid scientific data for soil health management and soil conservation
* Modeling landscape processes
* Advancing fundamental research-driven solution to remediation of soil and water contaminants
* Applying new technology (e.g., artificial intelligence, remote sensing) in soil science

# Extension

Since the passage of the Smith-Lever Act in 1914 that created the Cooperative Extension Service as part of the land-grant system, Extension faculty have been charged with educating growers about best management practices for crop growth and production. Soil and Crop Science Extension faculty, in conjunction with other faculty and county extension agents, conduct educational events throughout the year and across Texas. These educational programs, combined with written and video resources, help rural and urban clientele understand best management practices for their production system, whether it be homeowner lawns, forage for grazing livestock, major row crops grown in Texas, or how best manage our soil and water resources. Additionally, our Extension faculty engage in training the next generation of agronomists and soil and water scientists by serving as graduate student advisors. Strategically, the Soil and Crop Science Extension Unit constantly evaluates and examines new technologies to aid in educational program delivery to our clientele.

## Extension Agronomy

Extension agronomistswithin the Department of Soil and Crop Sciences conduct variety and agronomic management trials across most of Texas on all major crops representing diverse soil types, precipitation zones, and cropping systems. Data from variety trials provides growers with the latest production data on germplasm releases that may offer a better economic return due to enhanced yield characteristics, improved drought tolerance, better pest resistance, or better regional adaptability. Agronomic management trials focus more on management practices of specific crops to provide recommendations on crop management including irrigation scheduling, nutrient management (synthetic fertilizers and manures) sustainability, and weed management. Additionally, our Extension faculty are responsible for evaluating new herbicide chemistries across a wide range of crops and environments.

## Extension Plant Breeding

While Extension Specialists are not typically involved with genetics and genomics, our Extension Specialists constantly evaluate new plant varieties as part of their ongoing efforts to determine the best selection for various environmental regions in the state of Texas. Extension faculty test new TAMU varieties and those from other breeding programs to ensure growers are using the most appropriate variety for their soils, climate, and markets. Testing involves responses to fertilizers, herbicides, pesticides, and other agronomic inputs.

## Extension Soil and Water Science

Soil and Crop Science Extension Soil and Water faculty are well-versed in soils, soil fertility, and water science. They routinely conduct fertility trials to fine-tune fertilizer application rates and timing for a multitude of crops in diverse regions and management practices to improve efficiency and protect water resources. Additionally, our Extension faculty conduct experiments to determine the efficacy of new fertilizer and growth enhancing products and evaluate management practices that improve soil health and sustainability. One Extension faculty member also serves as the director of the TAMU Soil, Water, and Forage Testing Laboratory. This lab provides analytical services for thousands of homeowners, growers, industry, and other faculty across the state. Finally, several of our SCSC Extension faculty have dedicated water programs ranging from row crop irrigation scheduling to urban turf to rangeland and pastures educating producers on how to conserve our most precious of natural resources and helping enhance water quality through nutrient management and protection from bacterial infestation of Texas waterways and waterbodies.

# Overall Strategic Plan

Our goal is to serve as a global leader in practices of student and stakeholder engagement in the agronomic, crop, turf, soil, and water sciences and extension of new knowledge to our producers and consumers.