Application for faculty positions in the School of Plant Sciences FY2024

Introduction

The School of Plant Sciences (SPLS) five-year Strategic Plan was written in 2019 and published in 2020. We are now approximately halfway through that Plan. At the time of writing, the level of Lake Powell was, at its maximum, 3621.66 feet above sea level, full pool being 3,700 feet. The difference, about 2%, raised no alarms. Now, the surface of the lake is at 3536.17 feet. Again, the difference in absolute elevation (about 5%) appears insignificant, but when you consider content, Lake Powell is now only 22.73% of Full Pool (24,322,000 af). Dead pool is probably at a level of 3,490, since at that point no hydroelectric power can be generated.

Reading the SPLS 2019 Strategic Plan indicates no concerns of an impending water catastrophe. The plan did provide comprehensive strategies to address and ameliorate problems associated with drought and temperature stresses on agricultural crops, based on the technologies available at that time, but also assuming water would not itself become limiting.

This preamble serves to introduce the idea that we as a unit and college now have to address agricultural water use issues more aggressively and more holistically. This is emphasized by water use metrics indicating 70-80% of the Colorado flow is consumed by agriculture, this proportion of water use being remarkably consistent worldwide. We now must solve the conundrum of continuing agricultural production and profitability in the context of the drastic changes anticipated in irrigation water availability.

Our proposed hiring requests focus on this conundrum at multiple levels and at different scales of measurement, from molecular and cellular mechanisms via genomics discovery involving field-based discovery, to evaluation of species naturally adapted to the Arizona climate, and addressing deployment of new added-value crops that require less water. We propose to achieve this through integrating the strengths of the School and proposing new hires to complement our faculty with elements that we perceive as missing.

Overview of the current agricultural situation in Arizona

The existential problem of increasing water unavailability, compounded by that of increased environmental temperatures, is upon us, and will affect Arizona agriculture for the foreseeable future. To offset these problems, we must respond, individually and collectively, to a number of critical issues:

- Ameliorating/managing salinity due to increased surface evaporation, by adjusting farming practices and using more salt-tolerant crop varieties, and/or developing new approaches (e.g., plant enhancement via microbial symbioses).
- Adjusting agricultural practices to deal with unavailability and/or increased cost of water, handling “water-closed” systems (ex. Benson) as well as “water-open” systems (ex. Colorado watershed) and including mitigation of plant pathogens.
- Identifying high-value crops that can grow in different farming regions of Arizona and that can replace those of lower-value, thereby requiring less irrigation per unit profit.

- Bioengineering existing crops for improved water-use efficiency, possible focuses being on stomate function (aiming at reducing water loss), root morphologies and surface properties (aiming at improving water uptake and retention) and leveraging microbial symbioses to yield these desired outcomes.
- Identifying genes, traits, and symbionts common to and shared between plant species adapted to desert environments, to inform future crop improvement.
- Undertaking rapid neodomestication of native crop species, using gene editing and modern plant breeding techniques, to take advantage of their existing adaptations to our climate, and thereby provide additional sources of energy, nutrition, and valuable secondary products.

Based on this outline of the critical issues, we have identified six positions for which we request funding. These are divided between the categories of Research (three Tenure-Track positions), Cooperative Extension (two Continuing Track positions), and Teaching (one POP position).

Proposed Positions

RESEARCH

- **Assistant Professor - <u>Plant and Microbial Biotechnology & Translational Plant Biotechnology</u> (70% Research : 20% Teaching : 10% Service).** In response to the dramatic growth of the APBT major and of the local biotechnology industry, and recognizing the success of high-throughput phenotyping (HTP) platforms here in Arizona, there is a critical need for additional research expertise to address applied biotechnological questions. Examples encompass constructing gene edited or transgenic crops, the manipulation of plant-associated microbes, and the deployment of novel genes and gene sets relevant to agricultural questions of the desert southwest, particularly relating to water and temperature stress, and enhanced food, feed, fuel, fiber, or pharmaceutical production

- **Assistant Professor – <u>Microbiology</u> (70% Research : 20% Teaching : 10% Service).** Climate change associated with rising temperatures and water limitations increases plant stress. This increases vulnerability to pathogens, and perturbs beneficial plant-microbial communities. To support the agricultural industry in Arizona into the future, a climate change microbiologist will address this critical area of microbiology.

- **Assistant Professor- <u>Quantitative Genetics</u>/<u>Plant Breeding</u> (70% Research : 20% Teaching: 10% Service).** A quantitative geneticist would be tied to our activities in High Throughput Phenotyping (HTP), working either on individual crops or crop groups important to Arizona. An obvious focus would be on advancing the integration of big data science with HTP, for targeted improvement of specific crops in a hot, dry climate, and addressing the question of neodomestication of new crops utilizing native species that already exhibit drought and heat adaptation, including halophytes.

EXTENSION

- **Assistant Specialist/Professor- <u>Landscape and Turf Management</u> (70% Extension : 20% Research : 10% Service) @ MAC**. The turf industry has changed considerably in the last decades and requires

support from CALS in research and Extension. Green spaces with turf are essential for recreation and sports activities of Arizona residents. Water use/conservation, plant materials tolerant to the arid, hot climate, and sustainable management practices on sports turf, desert golf courses and urban landscapes are a big challenge in Arizona.

- **Assistant Specialist/Professor- <u>Specialty Crops</u> (70% Extension : 20% Research : 10% Service) @ YAC.** This position is critical to address the needs of the vegetable industry in Yuma which leads the nation's production in winter vegetable specialty crops including lettuce and other leafy greens. Adapting to climate change, pending water shortages, and existing labor shortages are some of the challenges facing producers. Identifying crops and cultivars that can be grown successfully and decreasing inputs in specialty crop production systems are key for maintaining sustainable and profitable crop production in the Yuma area and southern Arizona.

TEACHING

- **<u>Assistant POP- Horticulture</u> (90% Teaching : 10% Service).** There is a need to develop our teaching programs in SPLS horticulture related topics, to strengthen the curriculum in this area, thereby leading to significant increases in enrollment. This POP will be responsible for developing and teaching several subjects in general horticulture, including specialty crop production and management.

Position Justification

Assistant Professor, Tenure-track - <u>Plant and Microbial Biotechnology & Translational Plant Biotechnology</u> (70% Research : 20% Teaching : 10% Service). In response to the dramatic growth of the Plant Sciences APBT major and of the local biotechnology industry, and recognizing the success of high-throughput phenotyping (HTP) platforms here in Arizona, there is a critical need for additional research expertise to address applied biotechnological questions. Examples encompass constructing gene edited or transgenic crops, the manipulation of plant-associated microbes, and the deployment of novel genes and gene sets relevant to agricultural questions of the desert southwest. This position particularly relates to addressing problems of water and temperature stress on Arizona crops, to ensure continued and enhanced food, feed, fuel, fiber, or pharmaceutical production.

<u>Research Justification</u>

The School of Plant Sciences has notable faculty strengths in the area of crop phenotyping ranging from large scale, high throughput methods (cf. the Scanalyzer and drone technologies at the Maricopa Agricultural Center, Dr. Pauli; field trials at MAC and the Yuma Agricultural Center), to methods involving enclosed environments of various sizes (cf. greenhouses, the Campus Agricultural Center/CEAC), and Biosphere 2. The School's strengths also include world-class capabilities in DNA sequencing and analysis (cf. The Arizona Genomics Institute; Dr. Wing), and in Bioinformatics Infrastructure and associated capabilities (cf. Cyverse, Dr. Lyons). The School is also recognized for its strengths in field sampling both in agricultural and natural situations (Dr. Arnold). In all cases, the strengths are in identification and characterization of organisms displaying specific phenotypes of agricultural significance of which drought and heat-tolerance are emerging as the most critical, as discussed elsewhere.

Success in phenotyping is naturally followed by identification of the causative mechanisms, including the genes and pathways and, as discussed elsewhere, in the contributions of symbiotic and commensal organisms. Identification of genes associated with traits of biological significance is becoming largely routine, meaning that accumulation of large sets of potential candidates is no longer the rate-limiting step. This has changed to determining the critical question, namely which genes are causative. Central to addressing this question are technologies to deploy candidate genes transgenically, and through specific gene-editing. Although individual faculty are successfully employing transformation strategies in their research (cf. Dr. Schmidt, Dr. Galbraith), these are limited to the characterization of small numbers of genes. Combinatorial strategies are not currently being employed.

This position seeks to identify candidates that can lead research in these specific technologies, as well as pursuing their own specific research. Across the US, it is recognized that we lack plant transformation centers for the major crop species, which suggests that investment in this area would have the potential to attract considerable external service. Further, in considering transformation technologies, it should be mentioned that most efforts have focused on a very limited number of crop species (maize, soybean, wheat, rice, being notable examples). Transformation of other important crop species has not yet been successful (for example field beans), and transformation of new species, particularly those in Arizona naturally adapted to drought and heat-tolerance is not reported. IN emphasizing the importance of gene characterization following discovery, it should be emphasized that this position is not restricted to specific technologies, and the applicants would be encouraged to propose and pursue innovative alternatives that are likely to be successful.

Teaching Mission Justification

We expect this future faculty member to take over the teaching of PLS 424R/524R Plant Biotechnology (lecture; 3 credits), which is a course that was taught last in Spring 2021 by Dr. Eliot Herman with an enrollment of 17 students in PLS 424R and 2 students in PLS 524R. Dr. Herman has applied for Emeritus status and is not expected to teach this course again, but it is an important course for the BS in Applied Biotechnology program and as the program grows, we anticipate enrollment in this course to grow. We also anticipate offering this course as part of the Arizona International dual degree program at Kozybayev University in Kazakhstan and will need a Tucson-based instructor to develop the online materials and co-teach it with the on-the-ground instructor in Petropavl starting in late 2024 or in 2025. We will adjust this faculty member's instruction FTE, frequency of this course offering, or instructional support as needed to accommodate this responsibility.

Because we plan for this position to have a 20% instructional split, the faculty member would also be expected to teach PLS 424L/PLS 524L Plant Biotechnology (laboratory; 2 credits) in alternate years. This course has not yet been offered but is in the course catalog. This practical, hands-on course would train students in plant transformation and culturing methods, which are essential techniques for plant genetic engineering, using either transgenic or CRISPR-style gene editing tools. Plant genetic engineering will be a key tool for adapting crops for the effects of climate change and for enhancing their nutritional and shelf-life traits to help ensure an adequate food supply in the future.

These courses fit into the ALVSCE Career and Academic Services Strategic Plan by:

- Helping students learn the applied science of biotechnology and how it can be put to work in agriculture.
- Enhancing CALS recruitment through strengthening the Applied Biotechnology and Plant Sciences degree programs.
- Enhancing career development by teaching practical methods that increase the employability of our graduates.

Further, it would fit into the UA Strategic Plan pillars of Grand Challenges (tackling the major, coinciding challenges of climate change and human population growth), Arizona Advantage (advancing our land grant mission and our responsibility to Arizona agriculture by training students to modify crops), and Institutional Excellence (promoting an innovative mindset, which is of great importance in the biotechnology industry).

Integration and Synergy with Existing SPLS, CALS, and UA Faculty and Programs

From the discussion above, the research synergy of this proposed hire is very evident. The School will benefit from the hiring of a Tenure Track faculty member that can focus on biotechnology problems focusing on questions of heat and drought tolerance in Arizona crops, and that can also provide new approaches in plant biotechnology. Searching for a person to enhance instruction in this area has been a goal of the School of Plant Sciences over many years, and will be welcomed by students and faculty alike.

Relevance to Stakeholder Needs.

We view the stakeholder needs in this area as compelling. Beyond the immediate need to alleviate issues associated with drought, the ability to manipulate Arizona crops using biotechnology is key to ensuring future resilience in production and maintenance of income under non optimal environmental conditions.

Envisaged Fit Supporting to the Future Development of SPLS/CALS (institutes, enhancing funding, etc.).

A number of Institutes have appeared or are under development at the UA that address water use issues. Our interest in the School of Plant Sciences is to directly address, at all levels of research and extension endeavor, the problems of agricultural production associated with decreasing irrigation water and increasing environmental temperatures. We favor a practical approach, engineering the plants at the level of genes, pathways, and commensal organisms and pathways, identifying new species for deployment, and exploring optimal methods for field-scale based crop production. We believe that approving this position will enhance our ability to attract external funding, and enable recognition of the University of Arizona as the natural center for research and development of new crops that are resilient to abiotic stress.

Position Justification

Assistant Professor – <u>Microbiology/Plant Pathology</u> (70% Research : 20% Teaching : 10% Service). Climate change associated with rising temperatures and water limitations increases plant stress. This increases vulnerability to pathogens, and perturbs beneficial plant-microbial communities. To support the agricultural industry in Arizona into the future, a climate change microbiologist will address this critical area of microbiology.

<u>Research Justification</u>

The School of Plant Sciences has notable faculty strengths in Microbiology focused on pathogens critical to agriculture and human health in the desert Southwest and other regions as well as beneficial microbes and plant microbiomes. SPLS is recognized for groundbreaking studies on environmental analysis of plant-associated fungi in agricultural and natural settings (Dr. Arnold), as well as virology vector biology (Dr. Brown). SPLS also provides support for the Arizona agricultural industry through virus detection (Brown), detection and protection against lettuce pathogens (Pryor) and general support for detection and A growing strength is in the area of plant microbiomes (Dr. Baltrus) with the addition of two recent hires (Dr. Favela and Dr. Schomer) with expertise in the area of plant-microbiome-ecosystem interactions impacting nutrient utilization and assembly and recruitment of plant rhizosphere microbes.

Climate change, leading to water limitations imposed by reduced availability, and rising temperatures, are impacting Arizona agriculture now. Less visible, but equally critical for crop production is the impact of these changes on both beneficial microbes that aid plant growth as well as that on pathogens which decrease productivity. In order to continue crop production in the desert regions identification and modification of beneficial plant microbes to mitigate the impact of drought, heat and increased salinity associated with climate change is necessary.

This position seeks to identify candidates whose research will use a combination of the latest approaches in population biology and ecological methodology in combination with stress biology to define critical microbial communities for crop protection or to identify the impacts of climate change on biology of pathogens of agricultural crops. This position will complement our strengths in the biology of beneficial and pathogenic microbes and further our understanding of microbial-plant interactions in desert climates. It should be emphasized that this position is not restricted to specific technologies, and the applicants would be encouraged to propose and pursue innovative alternatives that are likely to be successful in improving plant adaptation to the impacts of climate change through controlling plant-microbe interactions.

This position supports the Pillar Grand Challenges of the University of Arizona Strategic Plan, tackling the major, coinciding challenges of climate change and human population growth, and the Pillar Arizona Advantage, advancing our land grant mission and our responsibility to Arizona agriculture.

<u>Teaching Mission Justification</u>

We expect this future faculty member to develop a new 3-credit course that would bridge the fields of plant biology, agriculture/agronomy, environmental science, climate change, plant pathology and microbiology. This would be an important addition to our current suite of courses for these reasons:

- It would help us expand the diversity of offerings for the undergraduate Microbiology program, which we co-direct with ACBS and ENVS, beyond its current focus on medical aspects of Microbiology, into an area that is very relevant to SPLS, ENVS, and CALS. This would support growth in enrollment in this degree and introduce students to new types of microbiology-related careers.
- It would be a useful addition to the BS in Applied Biotechnology degree, as it would allow students to learn about the environmental/agricultural application of microbes and potentially spur innovations in this area that would support the agricultural and biotechnology industries.
- Depending on its final level and form, this course might be used in a planned accelerated Masters program in Plant Pathology that is being developed by Dr. Judith Brown.

To bring this position to 20% FTE for the instructional split, we would also ask this faculty member to co-teach a plant pathogen detection/identification course, which would be a key course in the planned accelerated Masters program and for the existing MS and PhD in Plant Pathology programs.

For the reasons described above, these courses fit into the ALVSCE Career and Academic Services Strategic Plan by:

- Helping students learn how our understanding of plant-microbe interactions can be put to work in the agriculture and biotechnology applications.
- Enhancing CALS recruitment through strengthening the Applied Biotechnology and Plant Pathology programs and expanding the focus of the Microbiology program.

Further, it would fit into the UA Strategic Plan pillars of Grand Challenges (tackling the major, coinciding challenges of climate change and human population growth), Arizona Advantage (advancing our land grant mission and our responsibility to Arizona agriculture by introducing students to the idea of supporting crops using microbes and protecting crops from microbial pathogens), and Institutional Excellence (promoting an innovative mindset).

<u>Integration with existing SPLS, CALS, and UA Faculty and Programs</u>

As indicated above, the successful candidate will find an active core of microbiologists in SPLS, and will be able to participate in the further development of the CALS Inter-unit microbiology program.

Position Justification

Assistant Professor- Quantitative Genetics/Plant Breeding (70% Research : 20% Teaching: 10% Service). A quantitative geneticist would be tied to our activities in High Throughput Phenotyping (HTP), working either on individual crops or crop groups important to Arizona. An obvious focus would be on advancing the integration of big data science with HTP, for targeted improvement of specific crops in a hot, dry climate. A second focus would involve addressing the question of neodomestication of new crops utilizing native species that already exhibit drought and heat adaptation, including halophytes.

Research Justification

One of the advantages of living in Arizona is that the Sonoran Desert climate provides an almost ideal testbed for development of agricultural crops that are resilient to abiotic stresses accompanying climate change. Not only is our climate extreme, in the sense that peak summer temperatures are some of the highest in the US if not the world. But the amount of rainfall typically falling (about 12 inches per year in Tucson) is sufficient to allow native plants to have evolved mechanisms of resilience that may be unique, and that may be employed through gene identification transfer and manipulation, or through the alternative approach of neodomestication to lead to development of crops resilient to abiotic stress. In this respect, Arizona is superior to Saudi Arabia, in that the amount of annual rainfall over there is insufficient for adequate plant growth and reproduction, without which evolution of desirable resistance traits becomes impossible. This argues that the native plant and microbial biome of Arizona represents a unique resource for which we should construct a systematic and comprehensive inventory.

This inventory would include measurable phenotypic and developmental parameters at many levels. As indicated elsewhere, the School of Plant Sciences has notable faculty strengths in the area of plant phenotyping ranging from large scale, high throughput methods (cf. the Scanalyzer and drone technologies at the Maricopa Agricultural Center, Dr. Pauli; field trials at MAC and the Yuma Agricultural Center), to methods involving enclosed environments of various sizes (cf. greenhouses, the Campus Agricultural Center/CEAC), and Biosphere 2. The School's strengths also include world-class capabilities in DNA sequencing and analysis (cf. The Arizona Genomics Institute; Dr. Wing), and in Bioinformatics Infrastructure and associated capabilities (cf. Cyverse, Dr. Lyons). The School is also recognized for its strengths in field sampling both in agricultural and natural situations (Dr. Arnold). Finally, Dr. Galbraith originated flow cytometric methods of genome size measurement that are deployed around the world for many important applications in the analysis of natural and agricultural plant populations. Measurement of plant genome sizes and their spatial distributions across Arizona evidently allows educated selection of candidates for genome sequencing.

In all cases, SPLS strengths are in identification and characterization of organisms displaying specific phenotypes of agricultural significance of which drought and heat-tolerance are emerging as the most critical, as discussed elsewhere. Another of our position requests focuses on the direct identification of genes responsible for desirable traits and their deployment into agronomic crops. However, beyond a species level characterization of native species, there is the possibility of employing neodomestication to produce new agriculturally significant crops that are naturally tolerant of abiotic stress. Neodomestication starts with the identification of species that have the potential for agricultural productivity, in our case also having natural resilience to drought and heat stress, but also having agronomic potential. Arizona has notable resources based on the cultural history of its indigenous peoples, including local seed collections. Reaching out in a sensitive way to the local federally-recognized tribes (the O'odham and the Yaqui) coud be of mutual benefit.

This position therefore seeks to identify candidates that can lead research in two areas: (i) generating a species-level inventory of native plants in Arizona, and (ii) identifying and manipulating candidate native plants for neodomestication it should be emphasized that this position is not restricted to specific technologies, and the applicants would be encouraged to propose and pursue innovative alternatives that are likely to be successful.

Teaching Mission Justification

This faculty member would be tasked with developing and teaching one of these two courses, depending on their specialty area and expertise, benefiting both our undergraduate and graduate degree programs in Plant Sciences:

- Abiotic stress physiology of plants (3 credits; 400/500 level)
- Neodomestication and introduction of climate change resilience traits (3 credits; 400/500 level)

We plan for this position to have a 20% instructional split. The remaining 5%, after teaching one of the above-named courses, could be met by co-teaching a graduate level course related to high-throughput phenotyping, or we may adjust the position to have 15% in-class instruction and retain 5% to support outreach efforts between SPLS and native tribes.

These courses fit into the ALVSCE Career and Academic Services Strategic Plan by:

- Helping students put science to work in agriculture.
- Enhancing CALS recruitment through strengthening the Plant Sciences undergraduate and graduate degree programs.
- Providing graduate-level instruction, and in a future-facing topic.

Further, it would fit into the UA Strategic Plan pillars of Grand Challenges (tackling the major, coinciding challenges of climate change and human population growth) and Arizona Advantage (advancing our land grant mission and our responsibility to Arizona agriculture by training students to modify crops, especially in the context of climate change).

Integration and Synergy with Existing SPLS, CALS, and UA Faculty and Programs

The research synergy of this proposed hire is strong. The School will benefit from employing a Tenure Track faculty member that searches for new genotypes and species native to Arizona, and that leads the provision of an inventory of these plants. The concept of neodomestication interfaces classical plant breeding and selection with indigenous agriculture, an area that is particularly understudied at the molecular and genomic level. Searching for a person to enhance instruction in this area as well as providing outreach to traditionally underserved populations will be welcomed by students and faculty alike.

Relevance to Stakeholder Needs.

We view the stakeholder needs in this area as compelling. Beyond the immediate need to alleviate issues associated with drought, the ability to deploy native Arizona species as targets for neodomestication offers entirely new strategies to address our issues of crop resilience to drought and heat stresses.

Envisaged Fit Supporting to the Future Development of SPLS/CALS (institutes, enhancing funding, etc.).

A number of Institutes have appeared or are under development at the UA that address water use issues. This position would clearly interface with the proposed Agroecosystem Research in the Desert (ARID) Center proposed by CALS. We believe that approving this position will enhance our ability to attract external funding, particularly based on its focus on native plants. It could also enhance the level of communication between the native tribes and the University of Arizona based on the development of new domesticated crops that are resilient to abiotic stress.

Assistant Specialist/Professor- Specialty Crops (70% Extension : 20% Research : 10% Service) @ Yuma Agricultural Center.

This position is critical to address the needs of the vegetable industry in Yuma, which leads the nation's production in winter vegetable specialty crops including lettuces, other leafy greens, and melons. Adapting to climate change, pending water shortages, and existing labor shortages are some of the challenges facing producers. Identifying crops and cultivars that can be grown successfully in this changing environment will require research in crop and cultivar selection, development of crop production management practices, including the use of precision agriculture tools to optimize inputs of water, fertilizer, and labor. This position will support vegetable producers in Yuma and similar production areas in Arizona through the development or enhancement of crop production systems that are adapted to shorter cool season production, improved water use efficiency, and minimum input requirements for a sustainable and profitable crop production.

Justification:

Extension Specialists in the School of Plant Sciences support the Land Grant Mission at the University of Arizona. Arizona Agriculture produced crops at a value of $2.23 billion in 2021 with a $23.3 billion impact on the Arizona economy. Arizona is a leading state in commercial agriculture, producing fresh market vegetables and other crops for export across the US and to other countries. SPLS Extension specialists support this expansive industry by conducting applied research and taking the science of the University to the people of Arizona through programs, publications, classes, events and teaching.

The Assistant Specialist/Professor Specialty Crops faculty position will support the Pillar Grand Challenges of the University of Arizona Strategic Plan, tackling the major, coinciding challenges of climate change and human population growth, and the Pillar Arizona Advantage, advancing our land grant mission and our responsibility to Arizona agriculture.

Winter vegetable production in Yuma is the second largest in the US after California and an essential supplier of lettuces, leafy greens, and melons. Yuma growers rely on the Colorado River water to irrigate their crops. The ongoing drought in the western US and discussions about curtailing water allocations in the future threaten this important industry and require adaptations in irrigation technology and crop management. Climate change is expected to impact Arizona and can affect vegetable production and quality in the future. Species and cultivar selection will be vital to ensure successful crop production during a shorter and potentially warmer time period when cool season crops can be cultivated.

Although Yuma growers specialize in a small number of crop species, the combined environmental and labor challenges facing growers may require diversification of the current crop palette to maintain their current production. Potential areas of research required may include nutrient management, irrigation management, soil health, cultivar evaluation, cultural practices, diversified and novel cropping systems, and weed and pest control. Faculty in this position can include other CALS Specialists and research faculty with expertise in irrigation, soil health, water availability and quality, precision agriculture, weed science, entomology, plant pathology, climate science, and economics to address these complex issues as a team.

Assistant Specialist/Professor- Landscape and Turf Management (70% Extension : 20% Research: 10% Service) @ MAC

The turf industry has changed considerably in the last decades and requires support from CALS in research and Extension. Green spaces with turf are essential for recreation and sports activities of Arizona residents. Water use/conservation, plant materials tolerant to the arid, hot climate, and sustainable management practices on sports turf, desert golf courses and urban landscapes are a big challenge in Arizona. This position will support the golf and sports turf industry as well as residential and commercial properties managing turfgrass. New turfgrass species and cultivars require testing under Arizona conditions with more customers demanding turfgrass that will successfully perform with less maintenance, less input of fertilizer and water, and grow with poor quality water to accommodate the growing trend of irrigating with reclaimed water. Faculty in this position will develop integrated management strategies that address irrigation, fertility, species selection, pest and disease management, and renovation of facilities requiring updating.

Justification

Extension Specialists in the School of Plant Sciences support the Land Grant Mission at the University of Arizona. Arizona is a leading state in commercial agriculture, producing fresh market vegetables and other crops for export across the US and to other countries. The golf industry contributes $3.9 billion to Arizona's economy not including other turfgrass production. SPLS Extension specialists and other CALS personnel support the turfgrass industry by conducting applied research and taking the science of the University to the people of Arizona through programs, publications, classes, and events.

The ongoing drought in the western US and the possibility of curtailing water allocations in the future are likely to require adaptations in irrigation technology and turfgrass management. Although golf courses and other sports facilities have in many cases changed from potable to reclaimed water, further improvements in irrigation efficiency and possibly conversion of turfgrass to other groundcovers requiring less water may be necessary to curb future water use. Climate change is expected to impact Arizona and hotter temperatures and greater demand for the use of turfgrass areas for recreation will affect the management of these fields and golf courses in the future.

Water conservation, the ability to use water with greater salinity, resistance to excess heat, potential drought conditions and tolerance to foot traffic and light vehicle traffic need to be addressed. Maintaining healthy, sustainable sports fields and golf courses with minimal inputs of water, fertilizer, and labor will require a team approach of the turf management Extension Specialist with colleagues who have expertise in the area of turfgrass breeding, water supply and quality, soil health and fertility management, and pest and disease management. Programs to convert golf courses and turfgrass areas currently growing species or cultivars that are intolerant to the increasingly higher stress environments will be important for thriving turfgrass areas that serve Arizona residents.

- **<u>Assistant POP- Horticulture</u> (90% Teaching : 10% Service).** There is a need to develop our teaching programs in SPLS horticulture related topics, to strengthen the curriculum in this area, thereby leading to significant increases in enrollment. This POP will be responsible for developing and teaching several subjects in general horticulture, including specialty crop production and management.

Teaching Justification

In June 2022, Jennifer Yamnitz (ex-CALS Marketing) shared a market research report with SPLS that indicated a relatively high search volume for the terms "horticulture degree" and "botany degree" and suggested that we focus our advertising on our offerings in those areas. While our existing undergraduate degree in Sustainable Plant Systems includes an emphasis in Urban Horticulture, we would like to expand and strengthen our course offerings in areas of horticulture and botany to take advantage of these potential growth areas. The Urban Horticulture emphasis of our BS in Sustainable Plant Systems degree may also soon be used as an accepted 'feeder' degree into CAPLA's Masters in Landscape Architecture program, from which we anticipate a growth in enrollment in this undergraduate program.

As a result of the factors above, we would ask this faculty member to develop and teach courses that cover these specific topics at the intersection of Plant Sciences and ENVS:

- Urban horticulture in arid and semi-arid environments and in the context of climate change and water limitations
- Urban forestry
- Green infrastructure
- Restoration/reconciliation ecology and land reclamation

In addition, because a 2021 survey of SPLS students by our then academic advisor indicated that the students would like us to offer a course on plant identification/botany and because of our planned Certificate in Cannabis, we would task this faculty member with developing and teaching courses on:

- Botany and plant identification
- Industrial plant cultivation, potentially including cannabis, hemp, guayule, and other industrially-important crops [This could also potentially serve our Applied Biotechnology major as an elective]

These courses fit into the ALVSCE Career and Academic Services Strategic Plan by:

- Helping students learn how to apply our understanding of plants and their relationship to humans and the human environment.
- Enhancing CALS recruitment through strengthening the Sustainable Plant Systems program.

Further, it would fit into the UA Strategic Plan pillars of Grand Challenges (tackling the challenge of climate change and its effect on urban plants, and potentially mitigating heat island effects using plants) and Arizona Advantage (advancing our land grant mission and impacting our economy via the landscaping and nursery industries).