UTIA Priorities Proposal:

**A genomic systems approach to agricultural productivity**

Systems biology is a new paradigm in biological research that emphasizes understanding the complex and dynamic interactions inherent in any biological system. This holistic view can provide new insights into emergent properties previously difficult to explain by a traditional reductionist approach. Systems biology emphasizes massive databases, omics technologies and mathematical modeling, allowing processes from the molecular and cellular level to be understood at the organismal and ecological scale.

State of the art biological and medical research relies on and emphasizes the importance of systems biology, particularly from the perspective of genomics and bioinformatics. Despite being some of the most promising tools for generating biological research discoveries, they are still significantly under-applied within agriculture when compared to medicine. UTIA already has a base of faculty utilizing genomics and proteomic approaches and many more interested in developing new expertise or collaborations to incorporate systems biology approaches. UTIA is poised to flourish in the area of translation of genomic technologies to production systems by leveraging our existing integrated Extension/research approach and proven track record in translating basic research to field applications. To seize the opportunity to become a leading research institution in this area, UTIA must strengthen its basic genomic research foundation, translational pipeline from discovery to production and student training in computational and molecular biology.

Many departments have expressed strong interested in the strengthening of systems biology and omics approaches through the addition of faculty. The combination of new and existing faculty will build collaboration across departments, allowing ambitious, holistic research aims encompassing all aspects of complex agricultural systems. The state of the art research approaches and technologies will be leveraged for advanced student training, which will ultimately attract the most promising talent to UT at all levels (student, staff, faculty). The overlapping of technologies will also enable purchase of shared equipment, with costs defrayed across many faculty members and leveraged into increased grant revenues.

**Granting Agencies and Grant Opportunities**
The National Science Foundation is very interested in the use of genomics and bioinformatics for a broad array of research programs, and as a part of larger, collaborative efforts. This is evidenced by the number of currently active RFPs that specifically mention or require a genomic or bioinformatic approach:

- Advances in Biological Informatics
- Advancing Theory in Biology
- Algorithms for Threat Detection
- Antarctic Organisms and Ecosystems
- Basic Research to Enable Agricultural Development (BREAD)
- Collections in Support of Biological Research
- Developing Country Collaborations in Plant Genome Research
- Dimensions of Biodiversity
- Division of Integrative Organismal Systems Core Program
● Division of Molecular and Cellular Biosciences: Investigator-initiated research projects (MCB)
● Ecology and Evolution of Infectious Diseases
● Genealogy of Life
● Geobiology and Low-Temperature Geochemistry
● Innovations in Biological Imaging and Visualization
● International Collaborations in Organismal Biology Between US and Israeli Investigators
● Metabolomics for a Low Carbon Society
● NSF Graduate Research Fellowship Program
● Partnerships for Enhanced Engagement in Research (PEER)
● Planetary Biodiversity Inventories
● Plant Genome Research Program
● Postdoctoral Research Fellowships in Biology
● Smart and Connected Health
● Surpassing Evolution: Transformative Approaches to Enhance the Efficiency of Photosynthesis

The USDA is also supportive of genomic and bioinformatic approaches. These are specifically supported across both plant and animal priority areas of the NIFA AFRI foundational program. Genomics is also mentioned in the RFPs for:

● Plant Feedstock Genomics for Bioenergy: A Joint Research Solicitation - USDA, DOE
● Small Business Innovation Research Program
● Specialty Crop Research Initiative

**Departments Contributing this Proposal:**
Animal Science (AS)
Biosystems Engineering & Soil Science (BESS)
Entomology and Plant Pathology (EPP)
Food Science and Technology (FST)
Forestry, Wildlife and Fisheries (FWF)
Plant Sciences (PS)
Biomedical & Diagnostic Sciences/College of Veterinary Medicine (BDS/CVM)

UTIA Faculty that have expressed interest in this area and would like to collaborate with the proposed new faculty:
● Chen, Feng (PS)
● Cheng, Max (PS)
● Critzer, Faith (FST)
● DeBruyn, Jen (BESS)
● Gwinn, Kimberly (EPP)
● Hadziabic Guerry, Denita (EPP)
● Hajimorad, Reza (EPP)
● Hewezi, Tarek (PS)
● Jurat-Fuentes, Juan (EPP)
● Lamour, Kurt (EPP)
● Molecular Food Microbiologist (Currently open position in FST)
● Moulton, Kevin (EPP)
● Myer, Phil (AS)
● Okafor, Chika (BDS/CVM)
* Interest is also present from faculty in the departments of Microbiology, Biochemistry & Molecular Biology, Genome Science and Technology, and Ecology & Evolutionary Biology. The faculty proposed here would significantly strengthen opportunities for research collaboration, development of new interdisciplinary educational efforts and shared equipment purchases with many departments the College of Arts and Sciences.

Priorities:
Food and Environmental Security
Translation of Genomic Technology to Agriculture

**New Positions Needed to Support the Priorities**

**Appointment splits are recommendations only; they should be altered to reflect stakeholder needs and available funding.**

**Assistant Professor in Biological Systems Modeling (Applicable to many departments)**
**Brief Description:** Research will focus on combining systems and mathematical biology to produce computational models of complex biological systems.
**Expected Outcomes/Goals:** Development of mathematical models to understand and predict agricultural systems and their outcomes; systems may be addressed from molecular to cellular to ecosystem scale. The models will provide new insights into the complex interactions and diverse data inputs inherent in agricultural and ecological environments, and their predictive power will be translated to improved management strategies for stakeholders. The NSF in particular has many competitions that require or encourage the integration of new experimental data into mathematical models for enhanced understanding of complex systems interactions.
**Potential Collaboration:** All departments could work with a modeler. All faculty listed as contributors on this proposal could be potential collaborators.
**Approximate Appointment:** 100R or 90R/10T

**Assistant Professor in Production-Based Genomics (AS)**
**Brief Description:** Education and production implementation of genomic discoveries in agricultural systems for breeders and producers
**Expected Outcomes/Goals:** To increase public and private stakeholder knowledge about genetic and genomic technologies available for supporting agricultural
production and to advise basic research faculty on translation of discoveries to field application. This position would also meet the demands for our beef cattle extension specialist in beef cattle genomics.

**Potential Collaboration:** Pohler, Myer, Rhinehart

**Approximate Appointment:** 100E

**Assistant Professor in Molecular Epidemiology (BDS)**

**Brief Description:** Utilizing omics approaches to evaluate and reduce potential diseases to human/animal/environmental system health.

**Expected Outcomes/Goals:** To increase public and private stakeholder knowledge about genetic and genomic technologies available for reducing risks (undesired outcomes) in agricultural production and improving public health.

**Potential Collaboration:** Okafor, Pohler, Myer, Rhinehart, Trout Fryxell, Staton

**Approximate Appointment:** 80R/20T

**Assistant Professor in the Microbiomes of Agricultural Systems**

**Brief Description:** Studying microbiomes associated with agriculturally relevant biological systems using Genomics, Bioinformatics and Molecular Biological Experimental approaches. Plants, animals, pests and microbes are potential organism sources in such studies. The research areas of interest include, but not limited to, mapping the microbiome associated with the focused organism source, interactions of microbiome with host of interest as well as interactions of microbiome to each other.

**Expected Outcomes/Goals:** Insights into multitrophic interactions, their influence in agricultural system health, and implementations of microbiome knowledge to improved agricultural practices.

**Potential Collaborators:**
- Meg Staton (EPP), Kurth Lamour (EPP), Reza Hajimorad (EPP), Rebecca Trout Fryxell (EPP), Phil Myer (AS), Jennifer DeBruyn (BESS), Tessa Burch-Smith (BCMB), Bonnie Ownley (EPP), Kim Gwinn (EPP), Tarek Hewezi (PS), Feng Chen (PS), Neal Stewart (PS), Denita Hadziabdic Guerry (EPP), Mark Radosevich (BESS), Sara Lebies (MICRO), Juan Jurat-Fuentes (EPP), Bob Trigiano (EPP), Max Cheng (PS)

**Approximate Appointment:** 80R/20T

**Assistant Professor in Landscape Genomics (FWF)**

**Brief Description:** Genomic and genetic approaches to understanding how landscapes and environments shape adaptive evolution and biodiversity.

**Expected Outcomes/Goals:** Understanding the complexity of genetic/environmental interaction, including spatial genetic variation and local adaptation. Applications include endangered species conservation and management as well as understanding and predicting adaptation to climate change.

**Potential Collaboration:** Staton, Lamour, Hewezi, Schlarbaum

**Approximate Appointment:** 80R/20T

**Assistant Professor in Arthropod Genomics (EPP)**

**Brief Description:** Omic and transgenic approaches in arthropod biology, with applications across human, animal and/or plant health

**Expected Outcomes/Goals:** Use of genomic and transgenic technologies to address fundamental and applied questions in arthropod biology, such as physiology and development, migration and population size, reproduction, plant-insect interactions, insect metagenomics, or related fields
Assistant Professor in Molecular Endocrinology (AS)

Brief Description: Genetic and molecular approaches to endocrinology and pathology

Expected Outcomes/Goals: Understanding molecular endocrinology by using omics based approaches also including tradition molecular biology. This position would provide an interface to utilizing cutting edge omics technology while understanding molecular endocrinology and systems biology to approach mechanisms of action of hormones and related molecules. This position would provide a vital collaborator to help understand animal and plant production on a systems approach.

Potential Collaboration: Pohler, Myer, Voy

Approximate Appointment: 80R/20T

Equipment and Technical Support Positions Needed to Support Priorities

The success of this genomic systems approach will also depend on the availability of infrastructure (laboratories) and equipment. Qualified technical support personnel would also greatly impact the efficacy of the program and provide much needed omics services to the UTIA research community. Specific equipment and personnel needed for maintenance and operation would need to be identified by the new hires.