TEOSYNTE

Project Descriptions

TEXAS A&M AGRILIFE RESEARCH – College Station, TX

Developing Field-deployable Low Nitrous Oxide Emission Sorghum Hybrids Using Biological Nitrification Inhibition and Nitrogen Fixation - $3,820,000

Technology Description

Texas A&M AgriLife Research will leverage advanced breeding and phenotyping to strengthen traits in sorghum that will enable cost-competitive crop yields using lower nitrogen fertilizer amounts. Genomic prediction models, marker association analyses, and marker-assisted trait integration will be used for the project in conjunction with genetic diversity found in wild and modified varieties. Advantageous traits will be improved to deliver agronomically competitive sorghum hybrids.

Market Impact Potential

Approximately one third of U.S. sorghum grains are used to produce fuel ethanol, and the technologies developed in the project will target the ethanol sorghum market. The sorghum hybrids developed through this project will offer unique opportunities for both growers and sorghum grain buyers to reduce costs by lowering fertilizer application levels.

UNIVERSITY OF ILLINOIS, URBANA-CHAMPAIGN – Urbana, IL

Redomesticating Maize for More Sustainable Nitrogen Cycling - $5,000,000

Technology Description

University of Illinois, Urbana-Champaign (UIUC), in collaboration with partners at North Carolina State University, University of Arizona, and Oak Ridge National Lab, is developing a novel variety of corn called NSave that will reduce nitrogen fertilizer use and greenhouse gas emissions while maintaining crop yield. To do so, the project will integrate traits from teosinte, a wild relative of corn. NSave corn will help reduce our country's reliance on foreign fertilizer imports and lower costs for farmers.

Market Impact Potential

Implementing NSave in commercial maize will require no new infrastructure, and will lower fertilizer costs and nitrate runoff, lowering risks for growers, improving the environmental impact of agriculture, and facilitating adoption in new markets, such as sustainable aviation fuels.

UNIVERSITY OF WISCONSIN-MADISON – Madison, WI

N_2Cereals: Delivering Nitrogen to Cereal Crops through Biological Nitrogen Fixation for Sustainable Bioenergy Production - $5,500,000

Technology Description

The University of Wisconsin-Madison (UW-Madison) will focus on strengthening symbiotic relationships between the bioenergy crops and nitrogen-fixing bacteria through coordinated plant and microbial bio-design. The project uses traditional breeding to introduce nitrogen fixing aerial root mucilage traits into corn and sorghum cultivars. Also, it will engineer bacteria to enhance their ability to fix and deliver nitrogen both above and below ground. These advancements will allow for substantial reductions in the use of synthetic nitrogen fertilizer, reducing operational costs for farmers.

Market Impact Potential

Since the Green Revolution in the 1950s, commercial sorghum and maize have been bred for agriculture

with abundant nitrogen fertilizers, which are produced using natural gas as a feedstock and heat source. By enabling farmers to reduce nitrogen inputs up to 50% for bioenergy crops, UW-Madison's project will provide substantial economic benefits for farmers and maize production, considering that annual maize nitrogen fertilizer use amounts to 8.2 million metric tons and costs of fertilizer fluctuate with the price of natural gas.

SWITCH BIOWORKS – San Carlos, CA

Engineering Tunable Ammonia Release In Biofertilizers - $2,000,000

Technology Description

Switch Bioworks is developing sustainable and cost-effective alternatives to synthetic nitrogen fertilizers by using engineered microbes with "switches" that control ammonia release. The project focuses on maximizing root colonization of ammonia-releasing strains, ensuring compatibility and synergy for consortia building, and engineering controlled ammonia release. The project involves rigorous discovery, engineering, and testing phases.

Market Impact Potential

Switch Bioworks's approach allows for optimal timing of nitrogen delivery, maximizing plant growth under reduced synthetic nitrogen application regimes. The technology holds the promise of transforming agriculture, reducing reliance on synthetic fertilizers, improving performance and unit economics of biofertilizer products.

DANFORTH PLANT SCIENCE CENTRE – St. Louis, MO

N-SYNC: Engineering Synchronized Nitrogen Efficiency Traits in Corn Agriculture - $5,600,000

Technology Description

Danforth Plant Science Center is developing corn varieties with improved root systems that enhance soil food web interactions. The project will focus on the interaction of corn roots with soil fungi that mediate nutrient transfer to plants. The technology will reduce the nitrogen used in agriculture.

Market Impact Potential

Danforth's approach will add new technologies that save U.S. farmers money and time as well as reduce imports of synthetic fertilizer. Danforth's proposed technology will compete in the global market for nitrogen use efficiency solutions. The market was estimated at a value of $10 billion in 2021 and is projected to reach $17 billion to $20 billion by 2027.

LAWERENCE BERKELEY NATIONAL LABORATORY – Berkeley, CA

Developing Biological Nitrification Inhibitors to Reduce N_2O Emissions in Sorghum - $3,000,000

Technology Description

Lawrence Berkeley National Laboratory (LBNL), in collaboration with the University of California, Berkeley, and the University of Colorado Boulder, is harnessing plant-microbe interactions to reduce nitrogen fertilizer use in sorghum. By engineering biofuel sorghum and its associated bacteria to produce biological nitrification inhibitors, the project aims to lower U.S. farmers' reliance on imported fertilizers while maintaining crop yields. The project will leverage database of plant exudates, EcoPOD lab ecosystems, and crop engineering expertise to advance novel solutions. The team will also conduct tests in both laboratory and field conditions, monitored by state-of-the-art sensors.

Market Impact Potential

The U.S. is the leading grower of sorghum with a production of approximately 8 million metric tons. Since the 1960s, 95% of all U.S. sorghum fields are hybrid sorghum. LBNL will target a variety of grain sorghum that is commercially available today. While the primary focus of the research is on sorghum, the approach could be extended to other crops that are sensitive to nitrogen, such as corn.

NEW YORK UNIVERSITY – New York City, NY

TF Regulon Engineering: Reducing N_2O Emissions by Increasing NUE in Bioenergy

Crops - $5,600,000

Technology Description

New York University (NYU) is collaborating with the University of Illinois and U.S. Department of Agriculture to develop a novel machine learning approaches to enhance plant nitrogen use efficiency. The project focuses on discovering the regulatory networks that link transcription factors to the expression of genes that control nitrogen use efficiency. By engineering maize to have an equal or greater yield despite lower nitrogen fertilizer application, this project will help farmers cut fertilizer costs and reduce nitrous oxide emissions.

Market Impact Potential

Most molecular breeding approaches today rely on existing genetic variation in landraces or modern germplasm. By contrast, NYU's project is designing novel gene combinations that will create new varieties. The project aims to disrupt the agricultural market that depends on costly synthetic fertilizer imports.

COLORADO STATE UNIVERSITY (CSU) – Fort Collins, CO

Breeding and Mechanisms to Maximize Yield at 45% Current Nitrogen Level - $5,400,000

Technology Description

Colorado State University (CSU) will partner with U.S. plant breeding company, Corteva, to improve nitrogen absorption by maize. The team will identify the environmental, genetic and microbiome impacts on plant nitrogen use with the goal of maximizing nitrogen uptake from the soil.

Market Impact Potential

CSU's approach is centered on field testing using commercial hybrids. The team's project will generate a technology that is scalable and easily adoptable in the $6 billion market for hybrid corn seed.

THE UNIVERSITY OF TENNESSEE – Knoxville, TN

SyN-Fix: Synthetic Biology to Improve Nitrogen Cycling in the Maize Rhizosphere - $2,500,000

Technology Description

The University of Tennessee will bio-design maize to improve nitrogen use by plants. The project will incorporate heterologous pathways for biological nitrification inhibition and use genetic circuits to control the root architecture of maize. The proposed changes will produce maize cultivars that will both lower the nitrous oxide released from soil and have increased nitrogen uptake, without suffering any yield penalties.

Market Impact Potential

The U.S. is the largest producer of maize with approximately 350 million metric tons produced annually. Enhancements to the plant's roots and nitrogen pathways can be implemented into current commercial seed varieties that support U.S. farmers.