

IOWA STATE UNIVERSITY

Office of the Vice President for Research

## Bioscience Platforms Update

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- Associate Vice President for Research, ISU

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## Bioscience Platforms

- 2017 TEconomy Study of Bioscience-Based Economic Development Opportunities
- State of Iowa should focus on four bioscience platforms:
  - Biobased products
  - Digital and precision agriculture
  - Vaccines and immunotherapeutics
  - Medical devices

## Bioscience Platforms

- Iowa State University is working in close partnership with the Iowa Innovation Corporation to fuel the state's economic growth in Iowa-advantaged bioscience platforms
- We are establishing an efficient innovation ecosystem by leveraging existing assets and strengths to capitalize on this critical opportunity for Iowa's economic growth and development
- We are grateful for initial FY20 funding of \$825K from the Iowa Legislature
- We immediately began leveraging this investment in July 2019 by focusing on the Biobased Products platform, with smaller support for other two platforms to ensure positive momentum



IOWA INNOVATION CORPORATION

## Leveraging of State Funding

- ISU and the State of Iowa's platform investments significantly leverage over **\$123M** in past research and tech transfer funding received by faculty pursuing discoveries in these three platforms ... This trend continues – in the last six months:

### Biobased Products

- Seed grants matching from industry: Cash - \$25,000, In-kind - \$35,000
- External funding from sponsors (past six months): \$763,000; Proposals pending: \$26.18M

### Digital and Precision Agriculture

- Recent federal SBIR grants for ISU technology-based start-ups in this space: \$325,000

### Vaccines and Immunotherapeutics

- Seed grants matching from industry: In-kind - \$30,000
- External funding from sponsors: \$8.77M; Proposals pending: Over \$35M

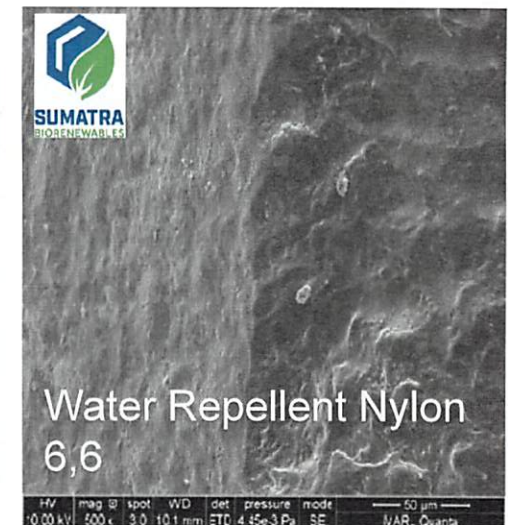
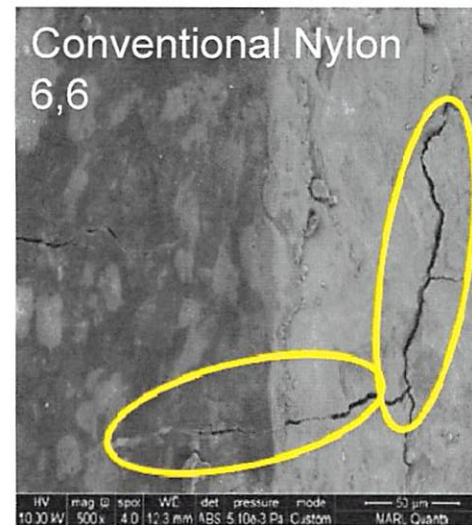
## Biobased Products Ecosystem Status

- Hired a **Chief Technology Officer** – Dr. Sundeep Vani – to identify, develop and prioritize technology transfer opportunities with industry, start-ups and the State
  - 22 years industrial experience with product development and tech transfer (ADM, Kelco)
- Four **seed grants** awarded to ISU researchers to collaborate with industry in accelerating technologies of interest to industrial partners
  - ADM, Cargill, Dickinson Industries, Kemin Industries, Kent Corporation, Pella Corporation, Puretein Bioscience and Siegwirk USA
- **Industrial workforce development** activities
  - Feed Energy Company employee pursuing ISU Ph.D.
  - 2 ISU graduate students interning with ADM
  - Spring 2020: Fermentation workshop including partnering with VC portfolio firms
- **Industry and technology outreach** for Biobased Products ecosystem in Iowa
  - July 2020: Des Moines hosted 2019 BIO World Congress on Industrial Biotech
  - Sep 2020: Ames hosted Department of Energy “Leveraging First Generation Bioethanol Production” workshop

# ISU Startup - Bioadvantaged Nylon 6,6



- **Significant market opportunity**
  - Nylon is used for textiles, packaging, automotive and other applications
  - 10 million tons of Nylon 6,6 by 2022
  - \$40 billion annual market
  - Compound annual growth rate 5.6%
- Sumatra Biorenewables, LLC received the 2019 Corn Challenge Award from the National Corn Growers Association (BIO World Congress)
- Other product opportunities:
  - Flame retardancy
  - 3-D printing
  - Enhanced strength



# ISU Research - Developing a new biobased asphalt modifier

- New polymers known as PAEHOSO (Polyacrylated Epoxidized High Oleic Soybean Oil), developed at ISU from High Oleic Soybean Oil,
- PAEHOSO is a polymer additive that can transform the asphalt industry through use of biorenewable feedstocks, and provide better functionality
  - 300,000,000 tons of asphalt placed in 2017
  - 60,000,000 tons of polymer-modified pavements
  - 350,000,000 pounds of polymer used for this purpose

ISU Faculty Leads: Eric Cochran (CBE); Chris Williams (CCEE)

## How does PAEHOSO disrupt the status quo?

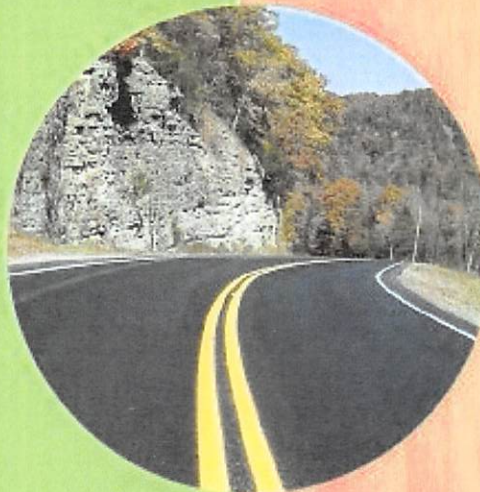
Recycled Asphalt Pavement (RAPs)



Vacuum Tower Bottoms (VTBs)



BIOMAG



High  
Performance  
Pavement

Paving-grade base binder



Status Quo

Specialty grade SBS polymer





## Biopolymer Processing Facility

- In FY18 project 1000 gallons of high-oleic soybean oil polymer were produced and blended with an asphalt binder.
- This polymer modified binder was then transported to the National Center for Asphalt Technology.





National Center for  
Asphalt Technology

**NCAT**

at AUBURN UNIVERSITY

A 2-mile track that undergoes continuous loading by heavily burdened semi-trailers to generate 24 years of simulated aging over 3 years.



# Stakeholders for developing a new biobased asphalt modifier



# Emerging Biobased Product Opportunities

Spring 2020 decision on National Science Foundation proposal – “Growing the Biobased Chemical Innovation Ecosystem”

- \$20M over 5 years
- Partners ISU, UI, UNI, Dordt (research and education)



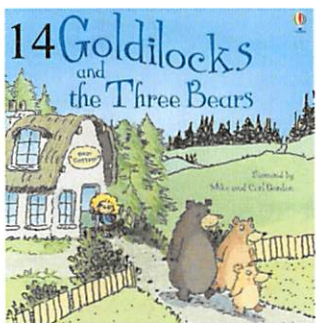
Biomanufacturing Innovation Institute (Department of Defense funding)

- Past Manufacturing Innovation Institutes have been \$75M over 5 years with at least 1:1 match from non-federal sources
- Request for Proposals expected in Spring 2020
- Iowa would be Midwest hub for the national institute



## Digital and Precision Agriculture (DP&A): A strategy to identify potential commercialization partners

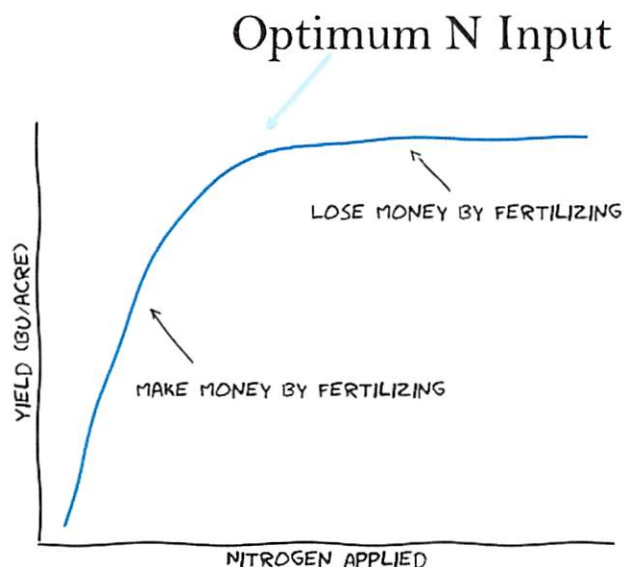
- To effectively partner with private-sector, we need to understand their research needs
- The D&PA platform has contracted a survey of relevant companies in the D&PA space to ascertain their needs
- This information will be cross-referenced with ISU's research expertise and interests to identify potential private-sector partners



## N Application is a Goldilocks Problem

**Under** application -> yield losses

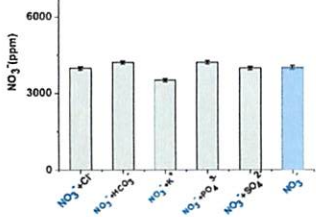
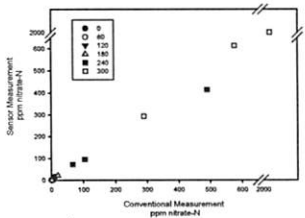
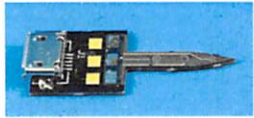
**Over** application -> wasted input costs & environmental impact



- Nitrogen is 2<sup>nd</sup> most expensive input for rain-fed corn (after seed)
- Selecting appropriate N application rates is complicated by substantial year-to-year variation in N production from soil organic matter and N field losses
- *Predicting the optimal level of Nitrogen is currently difficult to impossible*
- *35% of fields exhibit NO response to N*
- *\$1.67B of wasted N fertilizer per year*

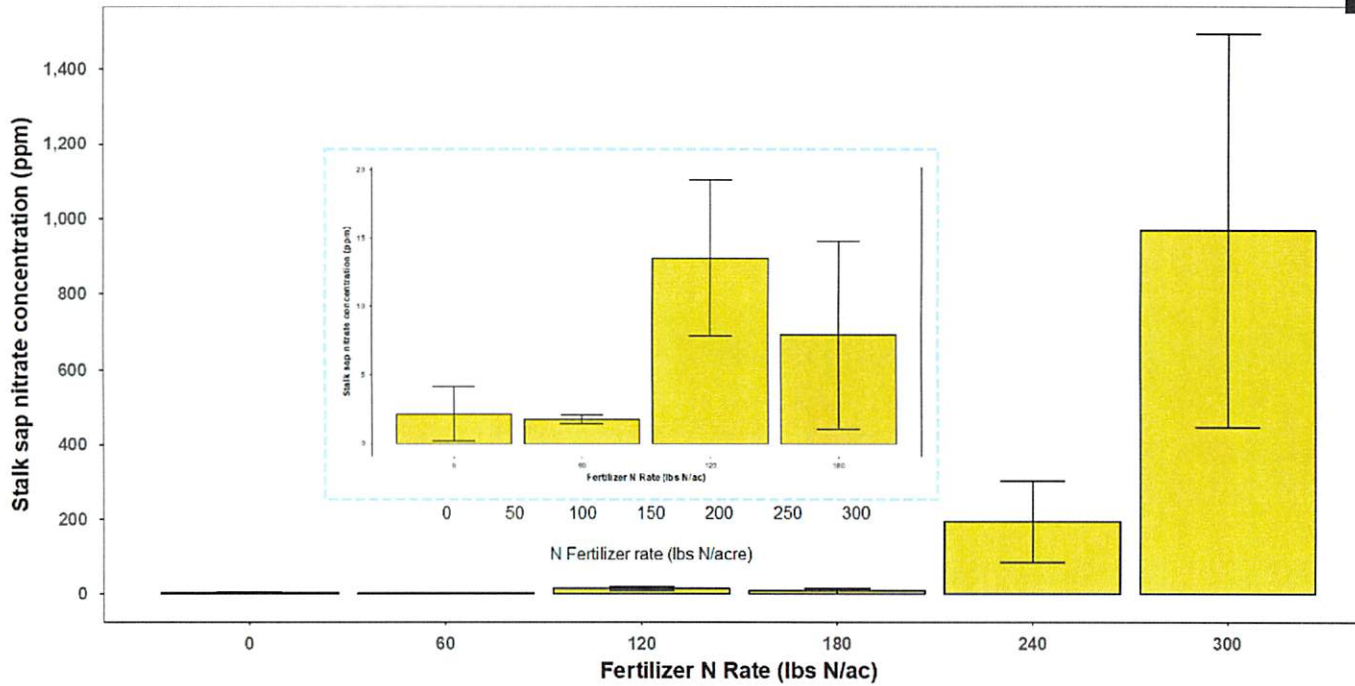


Liang Dong  
(ISU)



# Potentially Actionable Data

## Plant Sensor Fertilizer N Rate



James Schnable  
(UNL)

Mike Castellano  
(ISU)



# Digital and Precision Agriculture: Progress Towards Commercialization

EnGeniousAg LLC, an ISU spin-out licensed the nitrate sensor technology from ISURF and has secured two competitive SBIR grants this year:

- NSF (\$225,000; award number: 1914251)
- USDA (\$100,000; award number: 2019-33610-29771)

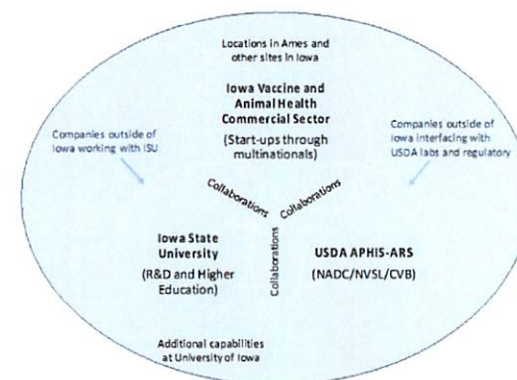
This technology has the potential to both increase farmer profitability and sustainability





# Vaccines and Immunotherapeutics Platform

- Global vaccine market revenue is \$33B with 6% growth through 2021
  - Animal vaccine segment is \$6B with 5% growth through 2021
- Iowa is well-positioned to be a leader in R&D-driven innovation and economic growth in this area
  - Unique confluence of leading vaccine companies, USDA research and regulatory facilities, and ISU and UI's research expertise
- ISU's Nanovaccine Institute is coordinating triangulation of these assets and expanding partnerships for economic development
- Impact: Reduced use of antibiotics; more efficient production agriculture; and efficacious and easy-to-administer vaccines for livestock



Ecosystem for Animal Health and Vaccines in Iowa

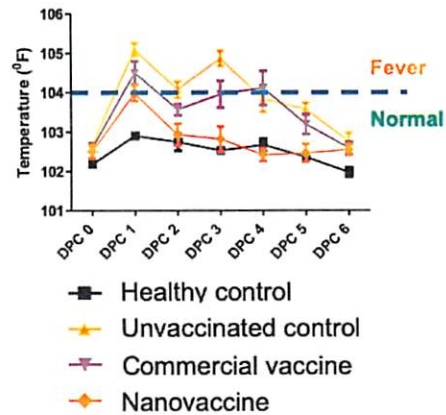
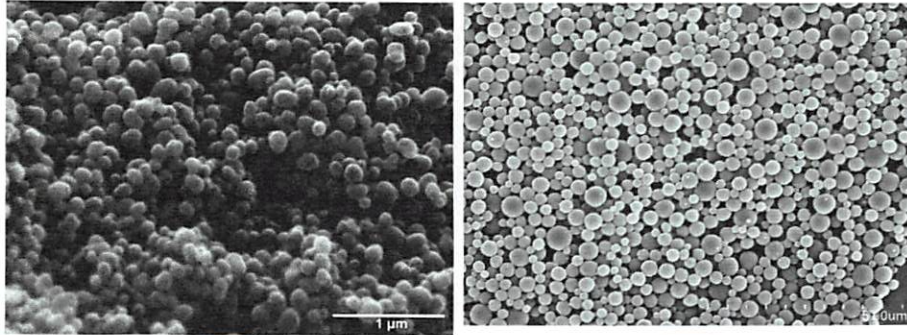


# ISU's Innovation Ecosystem for this Platform

- Research: Nanovaccine Institute, Center for Food Security and Public Health, Institute for International Cooperation in Animal Biologics, Antimicrobial Research Initiative
  - Examples: Vaccines against swine and avian influenza, bovine RSV
- Tech transfer: ISURF-licensed technologies have led to vaccine-related start-ups at the ISU Research Park
- Industry partnerships: Collaborations with multiple companies on vaccines and therapeutics
- Workforce development: Interdepartmental Microbiology, Immunobiology; Veterinary Biologics training program



# Next Gen Vaccines for Animal Agriculture



*Universal influenza nanovaccine clinically protects pigs*

- Diseases impacted
  - Swine
    - PRRSV
    - Influenza virus
  - Cattle
    - BRD
    - Johne's disease
  - Poultry
    - Avian influenza virus
    - Infectious bronchitis virus
- Potential targets
  - ASFV, RVFV

## Progress and Updates

- Created an initial steering group composed of Iowa-based industry leaders, USDA-NADC leadership, and ISU Nanovaccine Institute and Center for Food Security and Public Health members
- Discussions led to multiple recommendations to enhance industry-ISU-USDA interactions and accelerate economic development
- New seed grant opportunity launched to accelerate technology transfer and new product development
  - Funded projects: PRRS nanovaccine and vaccine implant (ISU-Boehringer Ingelheim)
- New \$5.6M award from the National Institutes of Health to move ISU tech towards commercialization and launch of new startup, ImmunoNanoMed Inc.

## ISU Bioscience Platforms – Legislative Request

The BOR is requesting \$3M to grow partnerships with the Iowa Innovation Corporation and Iowa industry in accelerating technology transfer and growing the innovation ecosystem for *all three platforms*. We would plan to:

- Build on and continue significant initial progress in the Biobased Products platform
- Create similar momentum in the Vaccines and Immunotherapeutics and the Digital and Precision Agriculture platforms

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## Thank you! Questions?

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