



NDSU Research and Creative Activity
Presentation to ND Interim Higher Education Committee

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Overview of Breadth of NDSU Research and Creative Activity

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Dr. Wei Jin – Computer Science

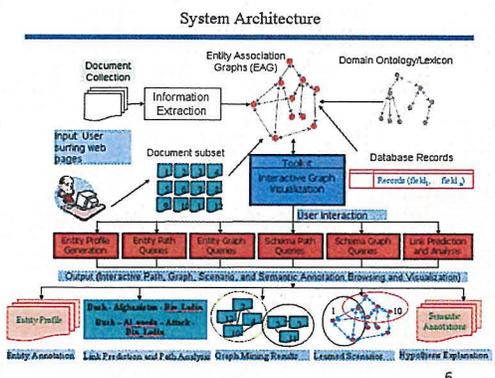
Big Data



Data mining, knowledge discovery, big data analysis, information retrieval and extraction and natural language processing

```

graph LR
    ben_laden --- attack
    al_qaeda --- al_qaeda_bin_laden
    al_qaeda --- bin_laden
    bin_laden --- attack
  
```



NSF CAREER Award winner (2015) - to develop better methods to find hidden connections from large document collections in multiple domains.

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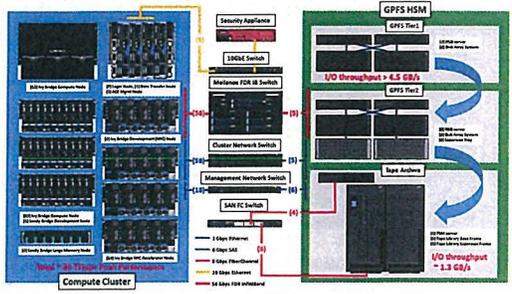
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Center for Computationally Assisted Science and Technology (CCAST)



Next-generation Data-intensive Cyberinfrastructure for Research and Education (BigThunder)



Blue – compute subsystem

Green – I/O and storage subsystem

↑
interconnect

Thunder Architecture

- Emphasis on data flow and Input/Output (I/O) capabilities
- “Oversized” tiered parallel file systems (up to ~750 Terabytes) and active-archive tape storage (~4 Petabytes uncompressed)
- Modular design for easy expansion
- ~1,500 compute cores
- ~36 Teraflops and ~18 million schedulable CPU hours/year

FY15 Data [from all 4 clusters]

- 176 user accounts (60 active users)
- Provided ~50 Teraflop performance and ~30 million schedulable CPU hours/year
- Enabled 45 publications, 35 talks/presentations, 32 proposals (4 funded), 4 MS and 2 PhD theses



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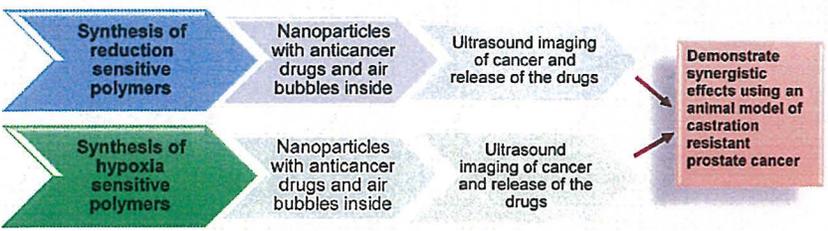
Drs. Sanku Mallik and Bin Guo – Pharmaceutical Sciences

New Drug Delivery Systems for Pancreatic Cancer



National Institutes of Health R01 Grant:

- 4-year, \$1.2 million
- Anticancer drugs kill cancer and normal cells indiscriminately, leading to severe side effects
- This research: package FDA-approved drugs with air bubbles and polymer-based nanoparticles
- Will use a mouse model





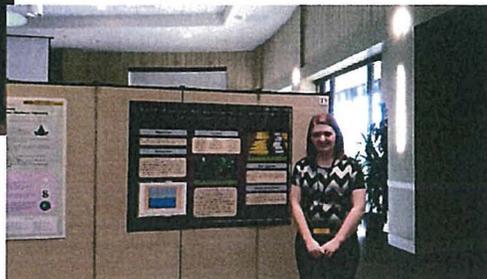
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NDSU EXPLORE

[campus-wide undergraduate research initiative]

Enhancing Student Success Through Research:

- Initiated in 2014
- 2014: 42 projects and 68 student registrants
- 2015: 60 projects and 96 student registrants
- 2015 1st place winners: 4 projects and 7 students
- 2015 1st place winners will be financially supported to present at the National Council on Undergraduate Research Conference in April 2016



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NDSU Student Entrepreneurs

- NDSU grad student named to Forbes 30 Under 30 List for Manufacturing and Industry Article: Fargo Forum, 01/13/2016
- Co-founded a team to design a "3-D printed, inexpensive, high-value prosthetic device for amputees or those who were born without arms due to a congenital defect"



Andrew Dalman (NDSU BS '15; current NDSU master's student)

- 2016: Forbes - 30 Under 30 in manufacturing and engineering
- 2015: U.S. Society of Manufacturing Engineers – 30 under 30 brightest manufacturing engineers

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Scientific Quest to Achieve Wheat Rust Resistance

Modified from: USDA-ARS Cereal Disease Laboratory
<http://www.ars.usda.gov/main/docs.htm?docid=8854>



wheat leaf rust

wheat stem rust

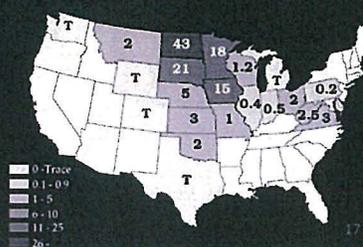
wheat stripe rust

Estimated Crop Losses due to Plant Diseases by Crop (1988-1990)

| Crop | US in billion | % of potential production |
|----------|---------------|---------------------------|
| Rice | 33.0 | 15.1 |
| Wheat | 14.0 | 13.6 |
| Potatoes | 9.8 | 16.4 |
| Maize | 7.8 | 10.9 |

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 02/02/2016 Source: Oerke et al., 1994.

1954 % Loss to Wheat Stem Rust



Global Research View

Kenya

Ethiopia

Morocco

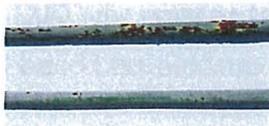
I cannot live comfortably in the midst of abject hunger and poverty and human misery.

No puedo vivir a gusto sabiendo que me rodea el hambre, la pobreza y la miseria humana.

Mexico

CIMMYT

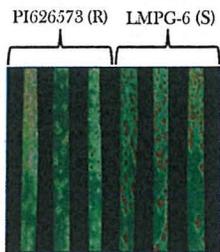
Scientific Quest to Achieve Wheat Rust Resistance



M.J. Burdick
DSR 1239761191246149114

High-density mapping of a resistance gene to Ug99 from the Iranian landrace PI 626573

Jaem D. Zure • Maria Nwumb • Matthew N. Hume • Yue Jin • Shilouan Chen • Jialu Sibapi • Deven R. Ser • Ruth Wanyera • Peter Njau • J. Michael Bonman • Robert Bruggeman • Markelis Nwendo



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UG99 – stem rust resistance

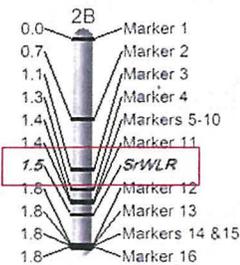
- 3,000 landraces screened from the USDA-ARS NSGC¹
- PI626573 – Resistant in seedling and adult-plant screenings¹
- *SrWLR* was delimited to an 1.9 cM region²
- This same region is known to contain *Sr9h* (*SrWeb*) and *Sr9³*

¹ Acevedo et al., 2011 ² Zure et al., 2014 ³ Rouse et al., 2014

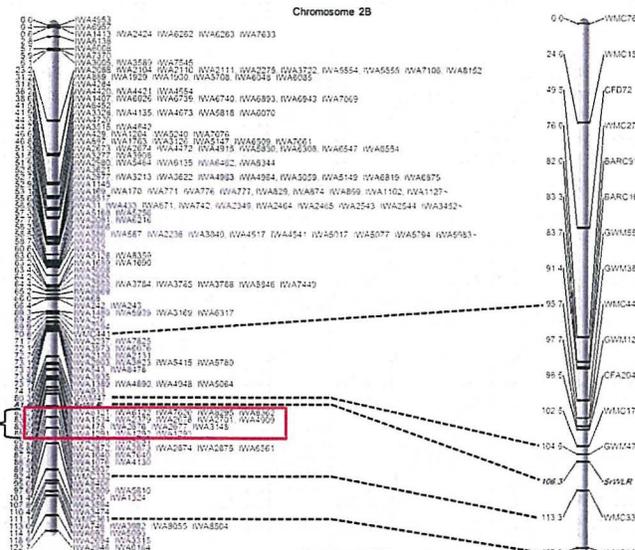
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Scientific Quest to Achieve Wheat Rust Resistance

New genetic markers



1.9 cM



Zure et al., 2014

As of 2015

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From Agriculture to Plastics

[Developing a spin-off business and licensing]

Dr. Ulven obtained funding from the ND Corn Council to demonstrate the scalability of the technology at NDSU





c2renew licensed the right to use the technology for commercial purposes from the NDSU Research Foundation



2010

Graduated four MS students from NDSU who contributed to the technology and helped published several journal articles related to the technology



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2011

Co-founded c2renew with outside business partner Corey Kratcha utilizing Agricultural Products Utilization Commission (APUC) Seed Funds



2012

c2renew raised \$550,000 from local/regional investors and angel funds to start up operations



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From Agriculture to Plastics

[First Few Years of Commercial Operation]

Hired c2renew's first employee, a former MS student of Dr. Ulven's and continued to bring on additional employees and interns from NDSU

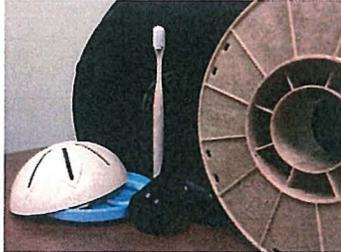
c2renew obtained additional grant funds from the Agricultural Products Utilization Commission (APUC) to partner with five other ND companies to develop three new agricultural biomass based products

2013

c2renew attracted private sector funding for engineering service projects along with ND Industrial Commission grant funds for expansion of the technology for commercial products

2014

2015





renewable ENERGY PROGRAM
NORTH DAKOTA INDUSTRIAL COMMISSION

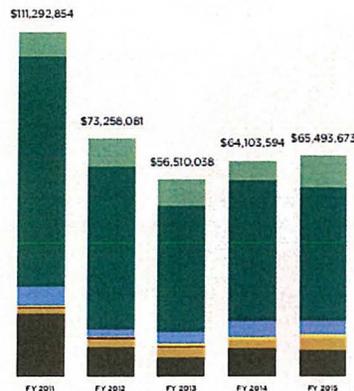


North Dakota
DEPARTMENT OF COMMERCE

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NDSU's Research Growth/Expansion Continues

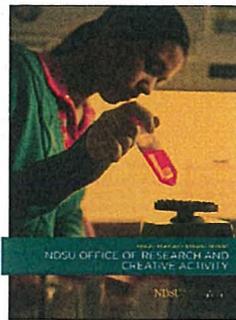
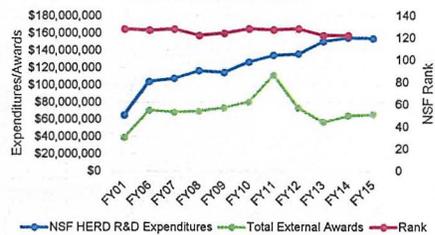
EXTERNAL AWARDS BY SOURCE



| Source | FY 2011 | FY 2012 | FY 2013 | FY 2014 | FY 2015 |
|--------------------------|--------------|--------------|--------------|--------------|--------------|
| Commodity | \$5,692,514 | \$774,908 | \$759,644 | \$6,213,329 | \$8,026,993 |
| Federal | \$82,271,268 | \$53,329,093 | \$73,578,782 | \$47,545,478 | \$43,826,333 |
| Industry/Non Profit | \$4,316,481 | \$7,975,710 | \$3,984,947 | \$4,785,654 | \$3,243,807 |
| Other | \$209,769 | \$64,772 | \$390,671 | \$338,014 | \$400,479 |
| Other Government Offices | \$134,487 | \$477,201 | \$231,850 | \$167,452 | \$272,013 |
| Private | \$1,442,904 | \$1,822,066 | \$2,307,909 | \$1,853,835 | \$2,876,040 |
| State | \$17,355,425 | \$7,873,328 | \$3,225,779 | \$7,636,770 | \$4,097,945 |

*An adjustment was made to the previously published FY 2011, 2012 and 2014 External Awards data. The adjusted award total is included here.

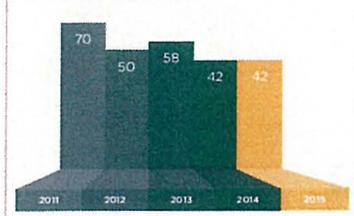
Total External Awards* and NSF HERD R&D Expenditures



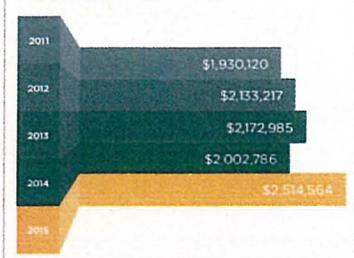
NDSU OFFICE OF RESEARCH AND CREATIVE ACTIVITY

NDSU's Research Growth/Expansion Continues

INVENTION DISCLOSURES



LICENSING INCOME



Invention Disclosures, Patents Filed and Licensing Income

