ANNUAL REPORT

FY2021

NDSU RESEARCH FOUNDATION

STAFF

Jolynne R. Tschetter, Executive Director, Ph.D.

Saurabhi Satam, Business Development and Licensing Associate, M.S.

Denise Roehl, Business Coordinator

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MISSION

To assist North Dakota State University in teaching, research, and public service projects.

EXECUTIVE SUMMARY

Highlights from this past year include:

- Assignment to the NDSU Research Foundation for protection and licensing the six varieties released by the North Dakota Agricultural Experiment Station;
- Issuance of ND Gardner's Plant Variety Protection certificate;
- Release of KoolKat® Katsura tree
- Issuance of the Northern Empress® trademark in Canada and Hyland Splendor® in the United States;
- Issuance of four US patents and three foreign patents
- Research Fee and Royalty Revenue for Fiscal Year 2021 was just over $1.6M
- Uniqarta, Inc., a startup company based on contactless Laser-Enabled Advanced Placement (LEAP) technology developed at NDSU and assigned to the NDSU Research Foundation, was acquired by Kulicke and Soffa Industries

Below is a summary of the crops, horticulture varieties and technologies with highest levels of revenue for Fiscal Year 2021.

Soybeans
- ND17009GT

Potatoes
- Dakota Russet
- Dakota Pearl

Edible Beans
- Eclipse
- ND Palomino

Horticulture
- Dakota Pinnacle® Asian White Birch
- Dakota Goldcharm® Spirea
- Northern Acclaim Thornless Honeylocust

Technology
- Mg+ Rich Coating Systems

Denise Roehl, a long time employee of NDSU and the NDSU Research Foundation retired at the beginning of May 2021. Denise began her career as an Administrative Assistant and ended it as the Business Coordinator. Her knowledge and expertise related to the Foundation's business operations will be missed but we wish her the best in her retirement.

Image courtesy of ND Crop Improvement & Seed Association

FY2021 HIGHLIGHTS

PLANT VARIETIES

Six new agricultural varieties were released from NDSU in FY2021:

'Brewski' two-rowed barley
'ND Stanley' Durum Wheat*
'ND21008GT20' glyphosate tolerant soybean*
'ND2108GT73' glyphosate tolerant soybean*
'ND Noreen' Hard Red Winter Wheat*
'ND Frohberg' Hard Red Spring Wheat*

Varieties marked with an asterisk are either under license or a license is being negotiated with ND Crop Improvement and Seed Association. 'Brewski' two-row barley was a specialty release and a license is being negotiated.

A Plant Variety Protection certificate was issued for 'ND Gardner' winter rye.

HORTICULTURE

The **KoolKat® Katsura Tree** is the newest addition to the NDSU Research Foundation's horticulture portfolio. This is a cold-hardy selection of Cercidiphyllum japonicum that has survived without damage in USDA climatic zone 3a at -37 degrees F. Foliage goes through an amazing seasonal color change from bronzy spring emergence, bluish-green in the summer to yellow/apricot in the fall. This selection is unique in that it has early fall dormancy as compared to the species, assisting with increasing the winter hardiness.

Ornamental attributes of the **KoolKat® Katsura Tree** include heart (cordate) shaped leaves emerging reddish-purple in the spring, changing to blue-green as they mature for summer. In autumn, fall color will be yellow to apricot in color depending on the year with delightful cinnamon odor when senescing.

The Northern Empress® Japanese Elm trademark was issued in Canada while the Hyland Splendor® Mugo Pine trademark was issued in the United States.

ISSUED PATENTS

Four patents were issued in the US while three others were issued outside the US.

- US Issued Patents:
  - Highly Functional Epoxidized Resins and Coatings
  - Eco-Friendly Materials and Methods for Renewable and Sustainable Applications in Material Chemistry
  - Acetoacetylated and (Meth)Acrylated Lignin and Thermosets Therefrom
  - Integrated Dielectrophoretic and Surface Plasmonic Apparatus and Methods for Improvement in the Detection of Biological Molecules
- Foreign Issued Patents:
  - Selective Laser-Assisted Transfer of Discrete Components
  - Novel Non-Isocyanate Siloxane-Modified Glycidyl Carbamate Resins and Coatings Containing Them
  - Bio-Based Thermosets

FY2021 HIGHLIGHTS

Additive Manufacturing Composites with Flow Induced Fiber Alignment

3D printing has been around for over three decades, but has recently gained widespread popularity. This can be attributed to advances in overall design and accessibility of 3D printers making them favorable for personal, commercial and industrial use. With developments certain drawbacks have come to light. While 3D printing makes it convenient to print complex novelty designs, this technology has been unable to provide strong functionality. Printed pieces tend to be brittle and have shorter shelf-life.

To address this issue, Dr. Chad Ulven and his team at NDSU's Department of Mechanical Engineering, have designed a new component to add to the framework of 3D printers. This piece is compact, cost effective and compatible with different types of printing materials. This piece can be used with different printer models to produce strong, quick drying, durable prints. Dr. Ulven's team has optimized this modification for benchtop models and there is potential to apply this technology to larger, industrial scale printers. The resulting prints can be used in small- and large-scale manufacturing of a myriad of products, ranging from household novelty items to automotive parts. A Utility patent application was filed in September to protect this invention.

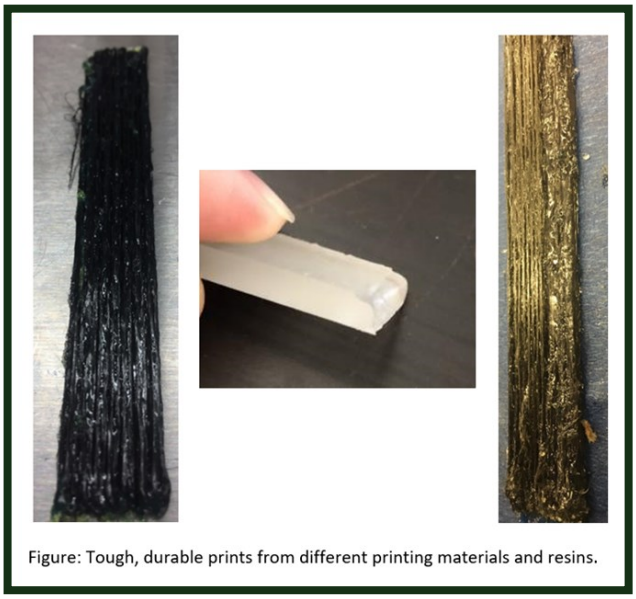


Figure: Tough, durable prints from different printing materials and resins.

Methods for Identifying Cancer

Recent advances in cancer research are focused on early detection techniques, allowing oncologists to get an early start on well-established, yet less severe lines of treatment and in turn improve chances of patient survival. Dr. Dali Sun of NDSU's Department of Electrical and Computer Engineering has developed a novel method of cancer screening and detection. It is a quick, non-invasive technique that detects biomarkers secreted by early-stage tumors.

This technique can be customized to detect different biomarkers from different cancers and can distinguish between malignant and non-malignant/benign tumors. This method can be easily used in hospitals, clinics, and pathology lab settings that routinely perform blood tests and other screening procedures. Hence, suspecting physicians can simply order a routine blood test to get an early diagnosis and quickly take appropriate preventative or treatment measures. On a lab scale, this method has provided promising results in the early detection of pancreatic cancer. Dr. Sun is currently exploring the use of this method to detect breast cancer and hopes to further apply this method to detect other cancers that form solid tumors. A Provisional patent application was filed in May to protect this invention.

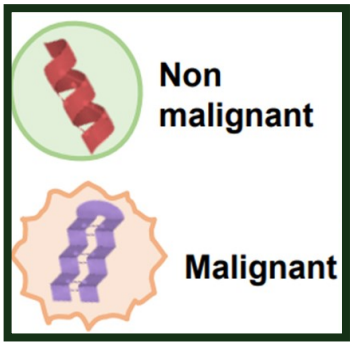


Figure: Illustration of detection biomarkers from non-malignant and malignant tumors

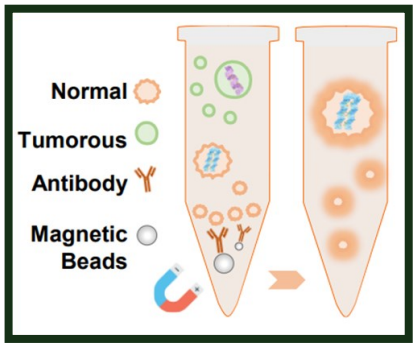


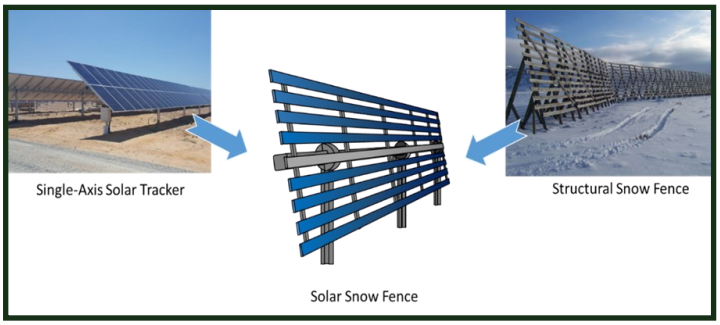
Figure: Illustration of detection setup

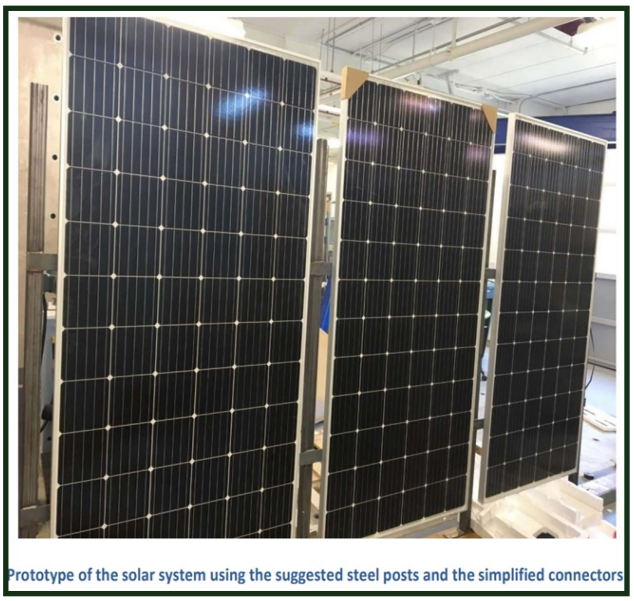
FY2021 HIGHLIGHTS

Solar Snow Fence System

North Dakotans are no strangers to snow, we spend months dealing with drifting snow, winter storms, and blizzards. Hence a snow fence along the roads is a common sight in winters. However, these structural snow fences provide very basic snowdrift control and have much room for improvement in terms of traffic safety. Drs. Mijia Yang and Yao Yu at NDSU's Department of Civil, Construction and Environmental Engineering have recently developed a modified snow-fence – A Solar Snow Fence.

This first-of-its-kind invention utilizes adjustable solar panels that not only assist with snowdrift control and protection, but also harness solar energy to produce electricity simultaneously. This system can produce electricity for self-use and maintenance or be readily integrated with an existing power grid. This modified structure has tremendous potential to improve traffic safety by a reduction in noise and glaring, and low voltage operations reduce human fatalities in case of vehicular mishaps or accidents. In its current design, the Solar Snow Fence can be applicable for its dual-use at private and commercial properties, highways, recreational spaces, and nature preserves; and is applicable as a solar energy harvesting system at utility companies and distributors. The research team is currently working to improve the noise barrier properties of this fence. A Provisional patent application was filed in June to protect this invention.




Prototype of the solar system using the suggested steel posts and the simplified connectors

NDSU Research Foundation Overview

370+
PLANT VARIETIES, HORTICULTURE VARIETIES AND TECHNOLOGIES UNDER ACTIVE MANAGEMENT

81
ISSUED ACTIVE PATENTS
40 PENDING PATENT APPLICATIONS

29+
AVERAGE NUMBER OF INVENTIONS/PLANT VARIETIES DISCLOSED ANNUALLY SINCE 2004

66
ACTIVE US PVP CERTIFICATES
24 FOREIGN PBR REGISTRATIONS

36
REGISTERED U.S. TRADEMARKS
21 FOREIGN REGISTERED TRADEMARKS
15 PENDING PVP APPLICATIONS

PLANT VARIETIES CONTRIBUTING TO INCOME

BARLEY
Pinnacle
ND-Genesis
Conlon

DURUM
Alkabo
Divide
Tioga
Carpio
Joppa
ND Grano
ND Riveland

EDIBLE BEANS
Eclipse
Lariat
Stampede
ND307
Talon
Rosie
ND Palomino
ND Falcon
Maverick

FLAX
ND Hammond

OATS
Drover
Beach
Souris
Rockford
Newburg
Comet
Empire
Bond
Boss
Lavish
Austin
Flinders
Bronco
Dynasty
Taipan

POTATOES
Dakota Crisp
Dakota Trailblazer
Dakota Russet
Dakota Ruby
NorValley
NorDonna
Dakota Pearl
AC Peregrine
Dakota Rose

RYE
ND Dylan

SOYBEANS
Sheyenne
Ashtabula
ND Henson
ND Stutsman
ND17009GT
ND18008GT
ND Rolette
Traill
Blue Horizon

WHEAT
Glenn
Faller
Mott
Barlow
Prosper
Velva
Elgin-ND

HORTICULTURAL VARIETIES CONTRIBUTING TO INCOME

Dakota Goldcharm® Spirea

Dakota Goldrush® Potentilla

Dakota Sunspot® Potentilla

Prairie Gem® Flowering Pear

Prairie Spire® Green Ash

Dakota Pinnacle® Asian White Birch

Blueberry Delight® Juniper

Copper Curls® Pekin Lilac

Northern Acclaim® Thornless Honeylocust

Prairie Dream® Paper Birch

Prairie Horizon® Manchurian Alder

Prairie Statesman® Swiss Stone Pine

Prairie Expedition® American Elm

Prairie Stature® Hybrid Oak

Prairie Reflection® Laurel Willow

Spring Welcome® Magnolia

Northern Tribute® River Birch

Royal Splendor® Norway Spruce

Northern Herald® Eastern Redbud

Cinnamon Curls® Dwarf Korean Birch

Northern Empress® Japanese Elm

Hyland Splendor® Mugo Pine

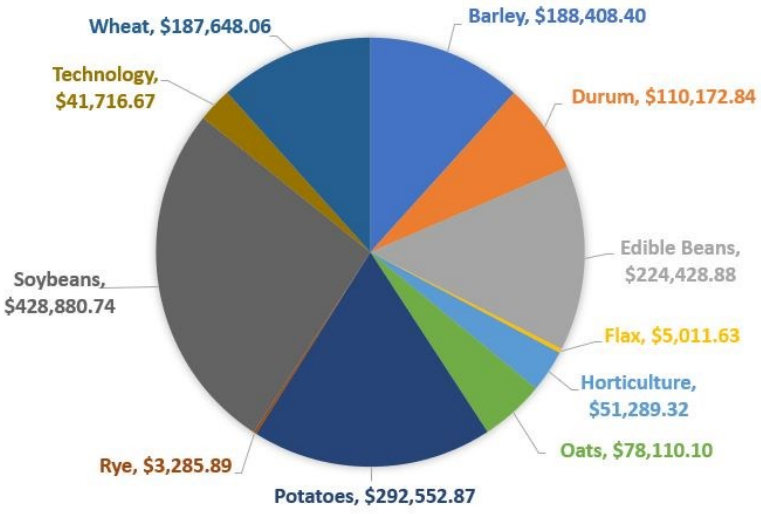
RESEARCH FEES AND ROYALTIES

Research Fees and Royalty Distributions*

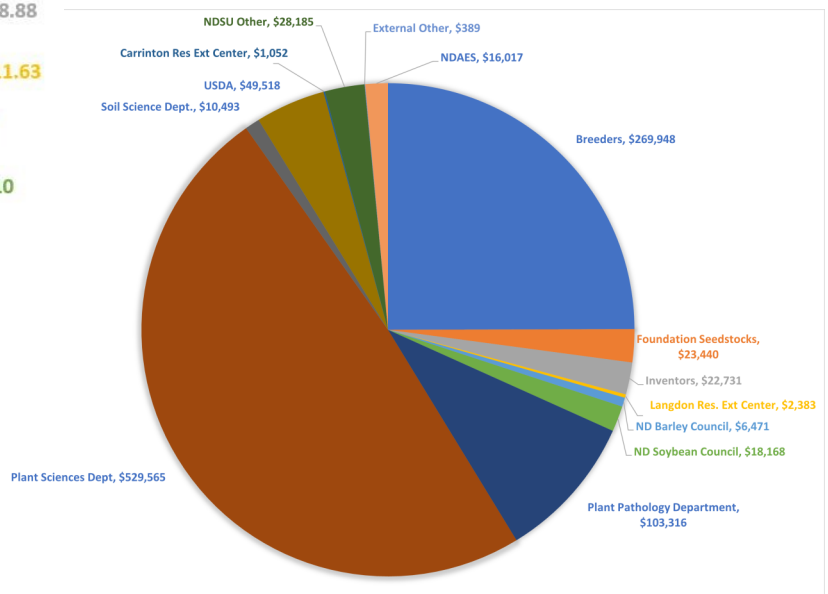
Distribution Activity	Barley	Durum	Edible Beans	Flax	Horticulture	Oats	Potatoes	RFC-01	Rye	Soybeans	Technology	Wheat	Grand Total
2D Endow Durum Disbursement		$100,000											$100,000
2W Endow Wheat Disbursement												$230,000	$230,000
Breeders	$42,402	$38,157	$51,039		$10,100	$21,532	$51,613		$1,284	$211		$53,610	$269,948
Carrington Research Ext. Ctr.			$57						$995				$1,052
Chemistry Department											$11,459		$11,459
Coatings/Polymers Department											$5,356		$5,356
College of Science & Mathematic											$11,033		$11,033
Foundation Seedstocks	$2,904	$2,791	$2,179	$137		$645			$64	$10,494		$4,226	$23,440
Inventors							$14,697				$8,034		$22,731
Langdon Res. Ext Center							$2,383						$2,383
ND Barley Council	$6,471												$6,471
ND Soybean Council										$18,168			$18,168
NDSU School of Nursing								$336					$336
Plant Pathology Department	$10,422	$2,791	$9,874				$49,385			$21,013		$9,831	$103,316
Plant Sciences Dept	$59,337	$39,874	$44,901	$3,610	$22,694	$23,730	$67,252			$251,172		$16,994	$529,565
Soil Science Dept.										$10,493			$10,493
U MN Foundation #3830												$2	$2
University of IL										$386			$386
USDA			$49,518										$49,518
NDAES	$3,245	$2,791	$4,732	$137	$42	$647			$155	$11		$4,256	$16,017
Grand Total	**$124,780**	**$186,405**	**$162,301**	**$3,884**	**$32,836**	**$46,554**	**$185,330**	**$336**	**$2,497**	**$311,949**	**$35,882**	**$318,919**	**$1,411,675**

*rounded to the nearest dollar

RESEARCH FEE AND ROYALTY INCOME



DISTRIBUTION OF NET RESEARCH FEES AND ROYALTY INCOME



NDSU RESEARCH FOUNDATION
STATEMENT OF FINANCIAL ACTIVITIES—AUDITED

Ordinary Income/Expense	
Income	
Foundation	
Research Fee/Royalty Payments	1,611,505.40
Total Other Operating Income	37,082.19
Total Foundation Interest Income	404.64
Total Foundation	1,648,992.23
Endowment	
ADHM Endow Inc.	0.53
Math Endow Inc.	0.36
CSM Endow Inc.	0.12
Total NDSU/RF Endow Income	53,980.38
Total Spring Wheat Endowment	72,671.35
Total Durum Endowment	39,505.50
Total Endowment	166,158.24
Total Income	1,815,150.47
Gross Profit	1,815,150.47
Expense	
Total Legal & Related Expenses	248,518.12
Distributions	
PS Endowment	
2W Endow Wheat Disbursement	230,000.00
2D Endow Durum Disbursement	100,000.00
Total PS Endowment	330,000.00
Other Distributions	
University of IL	386.33
USDA	49,518.15
U MN Foundation #3830	2.40
Total Other Distributions	49,906.88
Creator Distributions	
Inventors	22,730.69
Breeders	269,947.79
Total Creator Distributions	292,678.48
ND Commodity Group Distribution	
ND Soybean Council	18,168.19
ND Barley Council	6,470.84
Total ND Commodity Group Distribution	24,639.03

NDSU RESEARCH FOUNDATION
STATEMENT OF FINANCIAL ACTIVITIES—AUDITED
(continued)

NDAES/Ext Distributions	
Plant Sciences Dept	529,564.95
Soil Science Dept	10,493.11
Plant Pathology Dept	103,315.50
Langdon Res Ext Center	2,383.47
Foundation Seedstocks	23,440.24
Entomology Department	29.72
Carrington Research Ext. Ctr.	1,051.64
Ag. Experiment Station	15,986.97
Total NDAES/Ext Distributions	686,265.60
NDSU Distributions	
NDSU School of Nursing	336.41
College of Science & Mathematic	11,033.12
Coatings/Polymers Department	5,355.98
Chemistry Department	11,459.37
Total NDSU Distributions	28,184.88
Total Distributions	1,411,674.87
Total Administrative Expenses	332,340.41
Total Expense	1,992,533.40
Net Ordinary Income	-177,382.93
Other Income/Expense	
Other Income	
Net Gain/Loss on Investments	
Total BSBT	246,785.00
Total 2D Endow Gain/Loss	829,690.50
Total 2W Endow Gain/Loss	1,524,922.18
Vanguard Gain/Loss	287,915.95
Total Net Gain/Loss on Investments	2,889,313.63
Total Other Income	2,889,313.63
Net Other Income	2,889,313.63
Net Income	**2,711,930.70**

NDSU RESEARCH FOUNDATION
STATEMENT OF FINANCIAL POSITION—AUDITED

	Jun 30, 21
ASSETS	
Current Assets	
Total Checking/Savings	317,314.14
Other Current Assets	
Prepaid Expenses	
Prepaid Database Service	5,079.15
Prepaid Insurance	2,606.41
Total Prepaid Expenses	7,685.56
Total Other Current Assets	7,685.56
Total Current Assets	324,999.70
Other Assets	
(1) NDSU/RF Endowment	
Bell State Bank & Trust	
Total BSBT Bison Fund	725,515.10
Total BSBT STL SUB	331,424.17
Total BSBT RF Agency	1,409,544.32
Total Bell State Bank & Trust	2,466,483.59
Vanguard-S&P 500 Fund	1,041,771.56
Total (1) NDSU/RF Endowment	3,508,255.15
(3) Plant Sciences Endowment	
Total 2D Endow Durum	2,931,764.04
Total 2W Endow Spring Wheat	5,375,581.72
Total (3) Plant Sciences Endowment	8,307,345.76
Total (8) Math Endow	3,975.77
Total (9) College of Science and Math	1,933.21
Total (10) ADHM Endow	7,168.33
Total Other Assets	11,828,678.22
TOTAL ASSETS	**12,153,677.92**
LIABILITIES & EQUITY	
Liabilities	
Current Liabilities	
Total Accounts Payable	3,553.67
Other Current Liabilities	
Accrued Payroll Expense	367.65
Total Other Current Liabilities	367.65
Total Current Liabilities	3,921.32
Total Liabilities	3,921.32

NDSU RESEARCH FOUNDATION
STATEMENT OF FINANCIAL POSITION—AUDITED
(continued)

Equity	
Designated for Plant Science	
(2) PS Endowment 2W End	5,375,581.54
(3) PS Endowment 2DEnd	2,931,764.04
Total Designated for Plant Science	8,307,345.58
Designated for Endowment	
NDSU RF/Endowment	3,508,255.00
Total Designated for Endowment	3,508,255.00
Designated for ADHM	7,168.37
Designated for Math	3,975.77
Designated for Science & Math	1,933.21
Research Foundation	321,079.00
Retained Earnings	-2,711,931.03
Net Income	2,711,930.70
Total Equity	12,149,756.60
TOTAL LIABILITIES & EQUITY	**12,153,677.92**