

### Executive Summary by Jolynne Tschetter, Interim Executive Director



The NDSU Research Foundation's (NDSURF) licensing revenue for FY17 was just over \$1.95M. The 'Prosper', 'Faller', 'Glenn', and 'Elgin ND' wheat varieties along with the 'Dakota Pearl' potato cultivar continue to be leading revenue generators, while another year of record patent and IP cost reimbursements added to NDSURF's revenues.

Sixty-one licenses were executed, of which 12 were exclusive and 49 were non-exclusive. License agreements this year included both exclusive and non-exclusive agreements for released crop varieties and cultivars, an exclusive license for a temperature controlling device utilizing carbon dioxide, and a non-exclusive license to distribute an award winning documentary developed jointly by NDSU, United Tribes Technical College, KAT Communications, Cankdeska Cikana Community College and RAIN UND .

Highlights about the NDSU Potato Breeding program and "The Essence of Healing: Journey of American Indian Nurses" can be found on pages one and four respectively.

June 30, 2017, not only marked the end of the NDSURF fiscal year, but also the end of an era as our long time Executive Director, Dale Zetocha, retired after 22 years. FY18 will be a year of transition at NDSURF as the Board of Directors takes this opportunity to review the past performance of the foundation and map a path into the future.

*Jolynne R. Tschetter*

## NDSU Potato Breeding Program

According to the USDA's Economic Research Service, Americans consumed just over 48.3 pounds of potatoes per person in 2015, making potatoes the most eaten vegetable. North Dakota ranks fourth in annual potato production in the U.S. with a harvest of 21,600,000 cwt and a value of just under \$222.5M in 2016.

The NDSU Potato Breeding Project is focused on breeding and evaluation of cultivars for important traits to the commercial potato industry which includes cold process development and disease resistance.

The potato improvement team is an interdisciplinary group including:

- Dr. Susie Thompson, Potato Breeder
- Drs. Gudmestad and Secor Plant Pathology
- Drs. Hatterman-Valenti and Robinson, Plant Sciences
- Dr. Prischman-Voldseth, Entomology



The Potato Breeding team: Dr. Asunta (Susie) Thompson, Dr. Gary Secor, and Dr. Neil Gudmestad

They also work very closely with Drs. Ian MacRae and Carl Rosen

with the University of Minnesota on insect and soil related aspects, respectively. NDSU's Potato Breeder, Dr. Asunta (Susie) Thompson states "I count our producers and industry folks as part of the team. They are so generous in sharing ideas, hosting research trials, helping us with equipment needs, supporting our programs and providing funding. They come out and walk through fields with us, dig samples, ride on the harvester, or walk the single hills while I make selections. It is just incredible how involved they are."

The North Dakota Agricultural Experiment Station (NDAES) released its first potato cultivar, 'Manota', collaboratively with the University of Manitoba in 1952. Since then, NDAES has released an additional 26 cultivars independently and collaborated with USDA or other Agricultural Experiment Stations on the release of eight additional potato cultivars. The latest cultivar, 'Dakota Ruby', released in 2014, is a bright red skin potato with shallow eyes for the fresh market.

'Dakota Trailblazer', exclusively licensed in the U.S. to McCain Produce, Inc., and 'Dakota Russet', exclusively licensed by Hoverson Farms/R.D. Offutt were the first two russet cultivar releases from the program that meet commercial specifications for French fry manufacturing. Both were entered in the National French Fry Processing Trial and were quickly identified as having suitable characteristics.

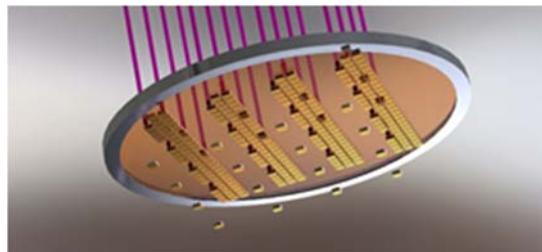
'Dakota Russet' is currently being evaluated on a large scale basis by several processors with the hope that it will be approved for production of French fries for McDonalds. Only six cultivars are currently approved by McDonalds.



## Technology Licensing Updates

We live in a world of ubiquitous electronics. This increasingly requires thinner and more densely populated integrated circuit (IC) assemblies. Existing assembly methods are too slow and are limited to ICs that are thick and rigid. Uniqarta is commercializing breakthrough manufacturing processes that are up to ten thousand times faster than existing solutions and can accommodate ICs that are up to ten times thinner or smaller.

Uniqarta's Laser Enabled Advanced Placement (LEAP™) solution, using technology licensed from the NDSU Research Foundation, replaces conventional pick-and-place assembly methods with an ultra-fast, massively parallel laser technique. Applicable to both ultra-thin and conventional-thickness ICs, this solution can achieve placement rates in excess of 100 million units per hour in high density applications.



LEAP™ massively parallel laser transfer.

Uniqarta is applying this approach to emerging Light Emitting Diode (LED) applications involving large quantities of densely spaced chips. In applications such as micro-LED displays, developers are struggling with the problem of accurately placing millions of dies onto a circuit board area in an economical fashion. The defining characteristic in such applications is that huge quantities (hundreds of thousands to millions) of LEDs need to be placed in a fine-pitch array. Today's die placement technology is too slow to do this at a reasonable cost. For example, with today's pick-and-place approach, placing the 6.3 million LEDs required for a 1080p television display would take over 600 hours! Uniqarta's LEAP™ technology can address this problem with an ultra-high speed die placement method that can accomplish this in under three minutes.

Uniqarta is currently exploring partnerships with multiple LED manufacturers and will enter into a collaborative development agreement in 2018 with one of them.

For more information go to: <http://www.uniqarta.com>



Elinor Specialty Coatings is currently a semi-finalist in the 2017 Cleantech Open Midwest accelerator. Twenty teams were selected from a pool of over 120 candidates and hail from 10 states including Illinois, Michigan, Minnesota, Missouri, Nebraska, Ohio, North Dakota, Iowa, Kentucky and Wisconsin. Cleantech Open's mission is to find, fund and foster the most promising clean tech startups on the planet. Elinor's long-lasting primer for aluminum surfaces, Aluma45, offers twice the lifetime protection and better adhesion under any topcoat than competitors and old industry solutions still using harmful Chromium 6. The chrome-free technology used in Aluma45 was developed in the Department of Coatings and Polymeric Materials at NDSU and licensed from NDSURF. [www.cleantechopen.org](http://www.cleantechopen.org)

For more information go to: <http://www.elinorcorp.com>



Fluorescence Innovations (FI) is a spinoff of a company which licensed technology from NDSURF. FI has entered into an exclusive license agreement with Photonic Pharma (PP), a start-up based on expertise in the University of Minnesota (UMN) Biochemistry, Molecular Biology and Biophysics departments. The license grants PP access to FI's cutting edge microplate reader technology. The most significant use of the microplate readers is for high-throughput drug discovery. The preferred screening format in industry involves small plastic plates, approximately 3" x 5", which hold up to 1536 samples, each about the size of one-tenth of a drop of water. All 1536 samples must be measured in about three minutes. Through a contract with PP and FI, an east coast pharmaceutical company tested a total of 2.4 million compounds looking for candidates to address heart failure. The work will continue in 2018, and negotiations to expand the contract to additional targets are underway.

For more information go to: <http://www.fluorescenceinnovations.com>

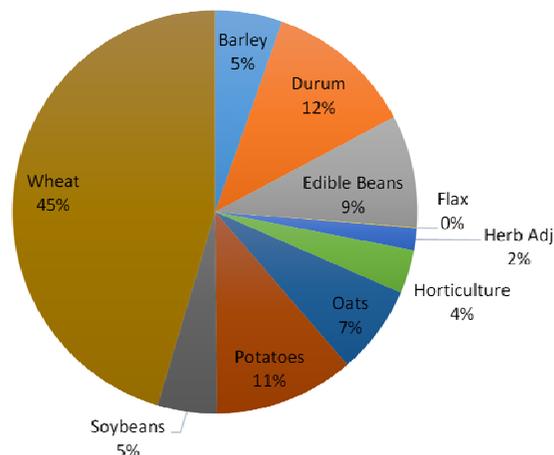
## FY17 Distribution for Agricultural Research Fees

FY17 Agricultural License Revenues were distributed to the following entities:

Distribution Activity	Barley	Durum	Edible Beans	Flax	Herb Adj	Horticulture	Oats	Potatoes	Soybeans	Wheat	Grand Total
Breeder/Inventor	13,929	52,550	37,297	33	7,833	8,850	32,072	22,513		199,348	<b>374,426</b>
NDSU AES	1,553	5,133	3,982	3			1,774		309	15,976	<b>28,730</b>
NDSU Carrington REC			20								<b>20</b>
NDSU Entomology										11	<b>11</b>
NDSU FSS	1,133	5,133	1,913	3			1,774		1,210	15,969	<b>27,135</b>
NDSU Langdon REC								349			<b>349</b>
NDSU Plant Path	4,345	5,133	8,467					50,930	2,440	37,267	<b>108,581</b>
NDSU Plant Sci	30,229	70,148	40,901	44	11,750	29,306	37,925	55,608	37,429	65,269	<b>378,609</b>
NDSU Plant Sci Endow										130,557	<b>130,557</b>
NDSU RF Endow	5,414	11,121	12,028	8	1,958	3,508	10,199	10,205	4,419	59,672	<b>118,532</b>
NDSU Soil Sci									1,210		<b>1,210</b>
U of MN										1,239	<b>1,239</b>
ND Barley Council	1,190										<b>1,190</b>
ND Soybean Council									2,327		<b>2,327</b>
<b>Grand Total</b>	<b>57,793</b>	<b>149,218</b>	<b>104,608</b>	<b>91</b>	<b>21,541</b>	<b>41,664</b>	<b>83,743</b>	<b>139,605</b>	<b>49,343</b>	<b>525,309</b>	<b>1,172,915</b>

### NDSU Research Foundation FY17 Ag Royalty/Fee Income

Royalties & License Fees			
<b>Barley</b>	87,476	<b>Horticulture</b>	57,316
<b>Durum</b>	193,675	<b>Oats</b>	116,563
<b>Edible Beans</b>	147,416	<b>Potatoes</b>	182,416
<b>Flax</b>	922	<b>Soybeans</b>	77,226
<b>Herb Adj.</b>	29,012	<b>Wheat</b>	742,242
		<b>Total</b>	<b>1,634,264</b>



### New Agricultural Varieties Released in FY17



In FY17, the North Dakota Experiment Station released 'ND VitPro', a new hard red spring wheat variety which is widely adapted to the North Dakota spring wheat region. Some of its characteristics include: improved straw strength over recent NDSU varieties, high grain protein, outstanding kernel and milling traits. It is moderately resistant to all prevailing races of stem rust and has moderate scab resistance, as well as adult plant resistance to leaf rust and stripe rust.



'ND17009GT' glyphosate resistant soybean variety, 'ND Benson' conventional soybean variety, and 'ND Stutsman' conventional soybean variety are all new soybeans released in FY17. All three soybeans have high yield potential and resistance to various diseases. Development of these new soybean varieties was made possible through funds provided by the North Dakota Soybean Council.



Two new durum varieties were also released in FY17, namely 'ND Grano' and 'ND Riveland'. Both varieties have high yield potential, good quality, and low Cadmium uptake.

## Revenue Generating Varieties

### Barley

Conlon  
ND Genesis  
Pinnacle  
Rawson

### Durum

Alkabo  
Carpio  
Divide  
Grenora  
Tioga  
Joppa

### Edible Beans

Avalanche Navy Bean  
Eclipse Black Bean  
Lariat Pinto Bean  
Maverick Pinto Bean  
ND307 Pinto Bean  
Stampede Pinto Bean

### Flax

Carter  
Gold ND

### Oats

Beach  
Comet  
Drover  
Jury  
Newburg  
Nugene  
Rockford  
Souris  
Taipan

### Potatoes

AC Peregrine Red  
Dakota Crisp  
Dakota Jewel  
Dakota Pearl  
Dakota Rose  
Dakota Ruby  
Dakota Russet  
Dakota Trailblazer  
NorDonna  
NorValley

### Soybeans

Blue Horizon  
Cavalier  
ProSoy  
Sheyenne  
Traill  
ND1005T  
ND1100S  
ND1406HP  
ND Henson  
ND Bison

### Wheat

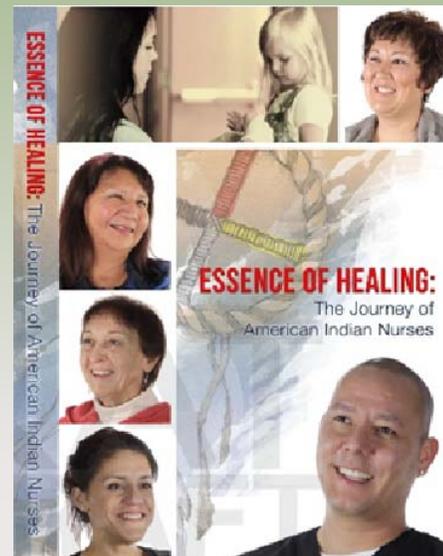
Barlow  
Elgin ND  
Faller  
Glenn  
Howard  
Mott  
Steele  
Prosper  
Velva

## Creative Activities Increase and Diversify in FY17

The documentary entitled "The Essence of Healing: Journey of American Indian Nurses" and produced by Dr. Loretta Heuer of the NDSU School of Nursing earned its first revenues in FY17. This documentary was made possible with cooperation of the following partners: United Tribes Technical College, KAT Communications, Cankdeska Cikana Community College and RAIN UND.

The documentary was accepted at a number of film festivals and is a semi-finalist at one, a finalist at another and has also won two awards. In addition, it is scheduled to be shown on Prairie Public TV in the near future.

A trailer of the documentary may be viewed at:  
<http://bit.ly/1SxxcYz>.



Dr. Ganapathy Mahalingam of the NDSU School of Architecture led a team that has developed a software module called SpecMaster™ to assist architects in developing building-code-compliant specifications that correlate to three dimensional designs. The software is available in three different formats and will be marketed to over 20,000 architecture firms in the U.S.

NDSURF is evaluating three other apps that are being developed at NDSU. One measures road roughness using a smart phone or tablet. Another provides a fitness score for a person using various body and health parameters. A third translates spectral images of crop fields to determine stand size (number and height of crop plants) and herbicide effectiveness against weeds.

### NDSU Research Foundation Statement of Revenues and Expenses

July 1, 2016 - June 30, 2017

Income		
Research Fees and Royalties		\$1,706,526
License Fees		43,700
Patent, PVP and Other Cost Reimbursements		203,278
Litigation Settlements		0
Interest		17,597
Dividends		121,284
Net Realized and Change in Unrealized Gains on Investments		900,977
<b>Total Revenues and Support</b>		<b>\$2,993,362</b>
Expenses		
<b>Total Legal and Related</b>		<b>415,133</b>
Patent	\$386,563	
Licensing	5,867	
Plant Variety Protection and Related	21,285	
Litigation Legal Fees & Other	126	
Trademark	1,292	
<b>Total Salaries and Operating</b>		<b>322,160</b>
<b>Total Research Fees and Royalties Disbursed</b>		<b>1,597,643</b>
NDSU Dept/College/NDAES	1,194,146	
Breeder/Inventor	398,741	
Non-NDSU Royalty Disbursed	4,756	
<b>Total Expenses</b>		<b>\$2,334,936</b>
<b>Increase in Net Assets</b>		<b>658,426</b>
<b>Net Assets at Beginning of Year</b>		<b>\$7,307,364</b>
<b>Net Assets at End of Year</b>		<b>\$7,965,790</b>

**NDSU Research Foundation**  
**Statement of Assets and Net Assets**  
**June 30, 2017**

Assets (Foundation)	Market Value
<b>Current Assets (Foundation)</b>	
Operating Checking and Savings	\$118,095
Fund 81294	(1,815)
Other Savings	450,724
Prepaid Expenses	9,635
Receivables	0
<b>Total Current Assets</b>	<b>\$576,639</b>
<b>Property &amp; Equipment</b>	
Office Equipment	19,340
Less: Accumulated Depreciation	(17,200)
<b>Net Property &amp; Equipment</b>	<b>2,140</b>
<b>Other Assets</b>	
<b>Plant Sciences Endowment Assets:</b>	
<b>Durum Wheat Endowment</b>	
Mutual Funds	2,141,588
<b>Spring Wheat Endowment</b>	
Mutual Funds	3,198,217
<b>Total Plant Sciences Endowments</b>	<b>\$5,339,805</b>
Sociology Endowment	\$0
Anthropology Endowment	\$0
University Studies Endowment	\$0
Math Endowment	\$3,916
Science & Math Endowment	\$1,917
ADHM Endowment	\$2,642
<b>Assets (NDSU/RF Endowment)</b>	
<b>Cash Accounts (Endowment)</b>	
Money Market State Bank and Trust	13,306
Money Market RBC Wealth Management	250,586
<b>Total Cash Accounts (Endowment)</b>	<b>\$263,892</b>
Investment at RBC Wealth Management	-0-
Investment at State Bank and Trust	1,263,249
Investment at Vanguard - S&P 500	545,636
<b>Total NDSU/RF Endowment</b>	<b>\$2,072,777</b>
<b>Total Other Assets</b>	<b>\$7,421,057</b>
<b>Total Assets</b>	<b>\$7,999,836</b>
<b>Restricted Assets (Foundation)</b>	
Restricted Assets - Anthropology	\$0
Restricted Assets - Math	3,916
Restricted Assets - Plant Sciences	5,339,805
Restricted Assets - Sociology	0
Restricted Assets - University Studies	0
Restricted Assets - Science & Math Endowment	1,917
Restricted Assets - ADHM	2,642
Restricted Assets - NDSU/RF Endowment	2,072,777
<b>Unrestricted Assets</b>	<b>544,733</b>
<b>Total Restricted and Unrestricted Assets</b>	<b>\$7,965,790</b>

## ‘ND Genesis’ Barley Plant Variety Protection Certificate (PVP) Issued in FY17

'ND Genesis' barley seems adapted to all areas of North Dakota and adjacent parts of Minnesota, Montana and South Dakota where barley is grown. Its large kernel and low grain protein traits may be helpful when growing malting barley in environments where moisture stress occurs after heading. Besides the Upper Midwest production area, 'ND Genesis' also has some promise in the spring barley production areas of the eastern U.S. where growers are producing barley for the craft brewing market.

To help ensure genetic purity, 'ND Genesis' is protected under Plant Variety Protection (PVP) Title V Certificate No. PV201600264 and must be sold as a class of certified seed.



**Horticultural Varieties  
Contributing to Income  
in FY17**

Copper Delight™  
Juniper

Dakota Goldcharm®  
Spirea

Dakota Goldrush®  
Potentilla

Dakota Sunspot®  
Potentilla

Prairie Dome®  
Ash

Prairie Gem®  
Flowering Pear

Prairie Spire®  
Green Ash

Dakota Pinnacle®  
Asian White Birch

Blueberry Delight®  
Juniper

Copper Curls®  
Pekin Lilac

Northern Acclaim®  
Thornless Honey-locust

Prairie Dream®  
Paper Birch

Prairie Horizon®  
Manchurian Alder

Prairie Torch®  
Hybrid Buckeye

Prairie Statesman®  
Swiss Stone Pine

Prairie Expedition®  
American Elm

Prairie Stature®  
Hybrid Oak

Prairie Reflection®  
Laurel Willow

Spring Welcome®  
Magnolia

Royal Splendor®  
Norway Spruce

Northern Flare®  
Sugar Maple

Prairie Pioneer®  
Dwarf Chinkapin Oak

Northern Spotlight®  
Korean Maple

**NDSU Researcher Works to Improve the Availability of  
an FDA Approved Cancer Treatment**



Dr. Dharmakeerthi Nawarathna with students  
in his lab at NDSU

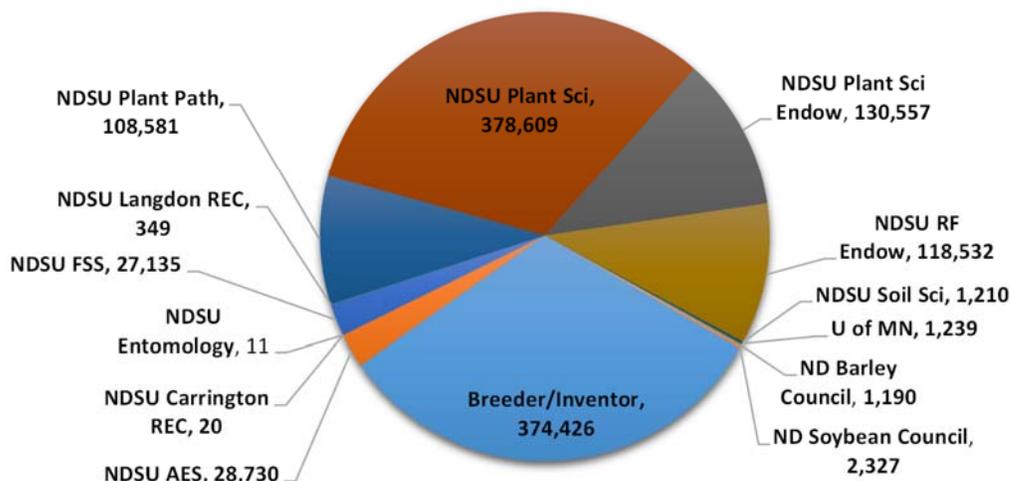
Dr. Dharmakeerthi (Keerthi) Nawarathna of the NDSU Department of Electrical and Computer Engineering is studying how biological cells and molecules interact with electric fields. His findings have helped to develop configurations of electric fields to separate, manipulate and detect different populations of biologically relevant molecules and cells. One device he is working on is a new production method for CAR T-cell therapy.

CAR T-cell therapy, also known as “living drug”, uses a cancer patient’s own immune cells that are isolated and modified

to specifically target cancer cells without causing side effects to non-cancer cells. CAR T-cell therapy has been approved in the U.S. for treating lymphoblastic leukemia in patients under 25. The treatment costs approximately \$475,000 for each course, and multiple courses are usually needed. Currently when the immune cells are taken from the patient, it takes four to six weeks to prepare the cells for reinfusion into the patient. Keerthi’s device could cut the cost and time for preparing the immune cells by as much as 90 percent.

Much more work needs to be conducted for this device to be widely available, and the NDSU Research Foundation is in discussion with commercial partners to conduct that development work. Several of Keerthi’s technologies are the subject of multiple patent applications.

**NDSU Research Foundation  
FY17 Ag Distribution Activity**



## Technology Licensing Updates, continued



AkzoNobel Aerospace Coatings is the global leader in the manufacture, development and supply of coatings for the original equipment manufacturers (OEM) and maintenance, repair, and operations (MRO) sectors of the commercial airline, general aviation, and military aerospace markets. In 2006, AkzoNobel Aerospace Coatings entered into a license agreement with the NDSU Research Foundation for exclusive use of an anticorrosion magnesium primer coating for aluminum substrates to be used in the aerospace industry that was developed at NDSU. The licensed coating was approved in 2015 to the MIL-PRF-32239 specification, the first “full system” specification of the 2100MgRP coating, where the distribution has now been expanded to include Europe. In addition, the military is testing the use of 2100MgRP in a plural component application system to support automation, and the initial testing shows positive results. Expanded military applications are taking place in both the U.S. and Europe, including the use of the 2100MgRP coating on aluminum trailers and testing on 7000 series alloys for armored vehicles.

In the general aviation market, the product was recently approved at a leading general aviation jet manufacturer as part of their move to a non-chromated exterior paint system. To date, they have painted 75 general aviation jets using 2100MgRP and expect to continue at a pace of 70-90 aircraft per year. Second generation coatings have also been developed for structural aircraft components which are currently being tested and are expected to replace chromated materials for structural parts.

For more information go to: <http://www.akzonobel.com>



Coretec Industries, LLC continues the commercialization process for the Si6 related technologies they have licensed from the NDSU Research Foundation. The company is also in the process of scaling the lab chemistry developed by Dr. Philip Boudjouk of NDSU into a production scalable chemistry.

For more information go to: <http://www.thecoretecgrou.com>



c2renew has licensed a technology from the NDSU Research Foundation that allows lignocellulose fibers from agricultural waste to be used as reinforcing and strengthening agents in thermoplastics. This past year, they have continued to develop new materials and products that impact a vast number of industries ranging from agriculture, health and entertainment. They are also expanding their efforts in the additive manufacturing space with the launch of two new lines of 3D printer filament, in addition to developing and manufacturing exclusive materials for companies.

For more information go to: <http://www.c2renew.com>



c2sensor has been focused on building out their core hardware for the Sensing Earth Environment Directly (SEED) sensor which was originally developed at NDSU and licensed from the NDSU Research Foundation. The company continues to refine the technology and iterate design advancements to improve the functionality. To assist this process, they initiated field trials in a number of locations with varying crops, soil types and inputs. They are continuing to assess the data received from these trial sensors to determine how to best develop and build off the current technology. The team at c2sensor is excited about the new innovations they are creating and look forward to showing those improvements to partners over the coming year.

For more information go to: <http://www.c2renew.com/c2sensor/>

## Three US Trademarks for Horticultural Varieties Issued in FY17



**Northern Spotlight®**  
Korean maple



**Lavaburst®**  
Ohio Buckeye



**September Flare®**  
Sugar Maple

In FY17 three beautiful trees, shown above in their fall splendor, received a US trademark. For more information on these and all our horticultural varieties, visit the NDSU Research Foundation website: [www.ndsuresearchfoundation.org/horticulture](http://www.ndsuresearchfoundation.org/horticulture).

## Eleven Patents Issued in FY17

Although invention disclosures and patent application filings were down in FY17 compared to the previous year, issued patents were up. The NDSU Research Foundation received eleven issued patents in FY17, which included nine U.S. patents, one European patent, and one Chinese patent. Several of the patents are licensed to companies, and the others were either licensed previously or received strong interest from the marketplace.

In the last ten years, NDSU Research Foundation has ranked third out of the top five entities that receive patents in North Dakota. The ranking is as follows: 1) Bobcat, 2) Clark Equipment Co—a legal entity for Bobcat, 3) NDSU Research Foundation, 4) Energy and Environmental Research Center (EERC) at the University of North Dakota, and 5) Appareo.



### NDSURF Board of Directors FY17

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**Henry Nowak, Technology Manager, J.D., M.B.A, M.S.**  
**Denise Roehl, Administrative Assistant**  
**Laura Slicer, Accountant, MBA**