

NDSU's Dry Edible Bean Program — A Proven Winner

Executive Summary by Dale Zetocha



The NDSU Research Foundation's licensing revenue reached over \$2 million in FY-14 for the third consecutive year. The 'Prosper', 'Faller', 'Glenn' and 'Barlow' wheat varieties, 'Souris' oat and 'Eclipse' black bean varieties were the leading licensing revenue contributors. Forty-one licenses were executed of which seven were exclusive and thirty-four non-exclusive. Technologies were licensed or optioned to three new start-up companies in FY-14. New licenses included the seed sensor and heparin contamination detection technologies and the Gold ND flax and ND1406HP soybean varieties. NDSURF also optioned two bio-based resin and polymer technologies and ten corn inbreds. NDSURF has distributed over \$14.6 million in license and research fees to NDSU Agricultural Department/Units and breeders/inventors since FY-94. NDSURF maintains two endowments that support the spring wheat and durum wheat breeding programs. A total of \$170,512 was added to the spring wheat endowment in FY-14. Progress is also being made by previous licensees who are developing their products and planning to introduce these products into the marketplace within the next year or so.

Dale Zetocha

With North Dakota being the leading producer of dry edible beans in the United States, it's no wonder that NDSU has contributed to the research and development of beans that grow well in the Northern Great Plains. In the US, the greatest acreage of pinto beans planted is in North Dakota as well as many acres of black, navy, and other dry beans. The Dry Edible Bean Program at NDSU develops high yielding and high cooking quality bean varieties with improved disease resistance and harvestability. These characteristics involve many research disciplines at NDSU such as genetics, pathology, physiology, and nutrition.

The NDSU Research Foundation directly licenses edible bean varieties to seed companies/growers in the US. Some varieties are licensed exclusively in the US and/or Canada. Edible beans rank high - this year only behind wheat and potatoes - in licensing revenue to the NDSU Research Foundation.

The dry edible bean breeding program began in 1980 with Dr. Ken Grafton at the helm. The program has grown considerably since then. Long term financial support from the Northharvest Bean Growers Association has been crucial for the ongoing success of this program. Several popular varieties have been developed by Dr. Grafton, who is now the NDSU Vice President for Agricultural Affairs. This very successful program has been carried on since 2007 by the current NDSU breeder, Dr. Juan Osorno. Dr. Osorno states, "We were able to keep the good momentum of a mature breeding program left by Dr. Grafton so we could keep releasing new varieties as well as incorporating molecular tools to facilitate and in some cases, speed up the breeding process. It is quite challenging to handle a program working with 7 market classes simultaneously, but at the same time it is fun to be able to work and take advantage of all that genetic diversity, which is something you don't see in other crops."



Dr. Juan Osorno, NDSU edible bean breeder

The 'Maverick' pinto bean variety was the most widely grown pinto bean variety in ND and MN as well as other parts of the US for many years. The 'Eclipse' black bean variety is the most widely grown black bean in ND and Canada. Other newer varieties include the 'Lariat', 'Stampede', and 'ND-307' pinto beans, 'Avalanche' and 'Norstar' navy beans, 'Rio Rojo' small red bean, 'Rosie' light red kidney bean, and 'Talon' dark red kidney bean. A new slow darkening pinto bean adapted to North Dakota is close to being released as well. NDSU breeding program varieties account for approximately 40% of the pinto bean acreage and 87% of the black bean acreage in North Dakota. This demonstrates the importance of the dry edible bean breeding program to multiple market classes within the industry for North Dakota and the US.

FACT: The NDSU Research Foundation's intellectual property licensing revenue continues to rank high nationally, relative to other universities and/or associated research foundations without medical schools, other land grant universities with and without medical schools, and those peer institutions as defined by the North Dakota University System.

HQC Biosciences and Renuvix off to a Good “Start - Ups”



When Erin Nyren-Erickson was close to earning her PhD in Pharmaceutical Science in 2013, she was all set to take a job in pharmaceutical research at Sanford in Sioux Falls, SD. In the mean-

time, she had entered NDSU's 2013 Innovation Week challenge with a discovery she had made during her PhD program. This discovery was a surprising and unique way to detect chondroitin sulfate in heparin. Back in 2008, a large amount of heparin imported from China was found to have high levels of this contaminant that caused difficulty breathing, nausea, vomiting and led to the death of at least 149 people. Because Erin's discovery was cheaper and quicker than other methods of detecting impurities in heparin on the market, it was evaluated and later patented by the NDSU Research Foundation in 2012. After finding out that she had won

the \$5,000 “Tangible Innovations” and the \$5,000 “Best in Show” prizes, she began to consider using her winnings to start her own company where she could further develop this innovation by making test kits for pharma companies to use. Her company, HQC Biosciences, Inc. is a start-up company located in the Research and Technology Park Incubator north of NDSU's main campus. “HQC is committed to the development and production of simple, easy-to-use tools for the reliable identification of biological target and/or threats, such as drug contaminants, pathogenic microbes, etc.” quotes Erin. She is also working with a local company, Aldevron, to develop detection of production by-products in plasmid DNA. Additional products utilizing this technology for educational purposes are being considered as well. Erin signed a license and equity agreement with the NDSU Research Foundation in FY-14.

For more information on HQC Biosciences, visit their website:

www.hqcbio.com



In our 2011 Annual Report, NDSURF did a short feature on a bio-based technology developed at NDSU's Department of Coatings and Polymeric Materials that was made from bio-based materials such as sugar beets, and oils from soybeans, flax and sunflowers. These materials were an improvement over other bio-based materials and processes. Additionally, the mechanical and performance properties were comparable to petroleum based materials. This was an important discovery by Dr. Webster's research group for companies who are looking to decrease their dependence on non-renewable resources such as petroleum.

In FY-14 a new start-up company, Renuvix, LLC optioned two bio-based platform technologies from the NDSU Research Foundation. Renuvix, LLC was founded in 2013 to further develop, manufacture, and market bio-based resins and polymers to the coatings, composites, elastomer, adhesives, cosmetics, and personal care markets. Dean Webster and Bret Chisholm (Chief Technology Officers), both NDSU researchers and lead inventors of these technologies founded Renuvix, LLC along with Larry Goldstein, President.

Near-term efforts are focused on marketing and commercialization of epoxidized sucrose ester resins and derivatives. The company is also in the process of scaling-up the precursor to these sucrose ester resins, which have an already existing market. Samples of pilot scale quantities of resins have been provided to prospective customers for their evaluation. Commercial scale production of sucrose ester resins is expected in the first quarter of 2015 with commercial quantities of epoxidized resins and acrylated resins available soon thereafter. R&D work is ongoing on the second vegetable oil based polymer technology developed by Dr. Chisholm's research group.

Renuvix, LLC has been successful in obtaining an STTR grant to further develop this technology.

For more information visit their website: www.renuvix.com

FY14 Distribution for Agricultural Research Fees

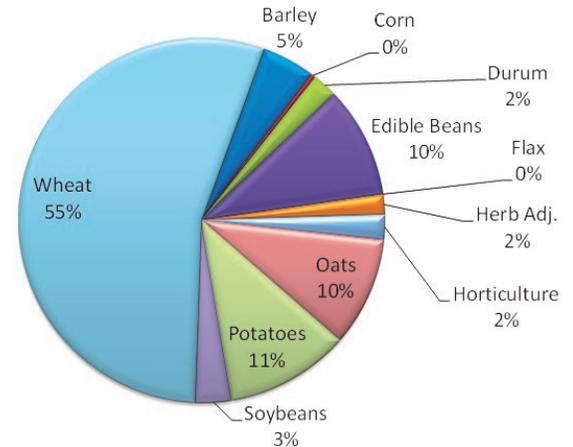
FY14 Agricultural License Revenues were distributed to the following entities:

Distribution Activity	Barley	Corn	Durum	Edible Bean	Flax	Herbical Adj	Horticulture	Oats	Potatoes	Soybeans	Wheat	Grand Total
BASF											612	612
Breeder/Inventor	9,130	1,626	17,641	42,287	142	8,095	4,660	38,903	27,068		246,471	396,022
Langdon REC									724			724
ND AES	1,442		1,705	5,243	14			2,436		417	21,149	32,407
ND Barley Council	51											51
ND Soybean Council										1,995		1,995
NDCISA											120	120
NDSU College of Ag									234			234
NDSU Entomology											204	204
NDSU FSS	882		1,705	1,342	14			2,412		899	21,084	28,339
NDSU Plant Pathology	3,700		1,705	8,087					55,128	1,823	49,151	119,593
NDSU Plant Sci Endow											170,512	170,512
NDSU Plant Sciences	36,355	2,710	23,301	51,532	208	12,142	16,293	45,173	61,278	28,422	86,710	364,126
NDSU Soil Science										900		900
NDSURF Endow	6,175	325	10,272	15,043	28	2,024	1,892	12,268	11,153	4,256	65,540	128,977
U MN Foundation											3,751	3,751
Grand Total	57,736	4,662	56,329	123,534	406	22,260	22,845	101,191	155,585	38,711	665,305	1,248,565

Royalties & License Fees

Barley	84,765	Horticulture	40,145
Corn	6,840	Oats	174,401
Durum	40,476	Potatoes	196,806
Edible Beans	177,159	Soybeans	57,992
Flax	556	Wheat	991,078
Herb Adj.	31,744	Total	1,801,962

NDSU Research Foundation FY14 Ag Royalty/Fee Income



Two New Horticultural Varieties Disclosed in FY14



Northern Empress™
Japanese Elm

Cinnamon Curls™ has an outstanding creamy white exfoliating bark, curling to expose a cinnamon underside which provides an interest in all seasons, and was also the inspiration for its name. These cultivars are not yet available for the nursery trade, as it takes years to propagate the materials, but are an exciting development coming from NDSU Plant Sciences. NDSURF has applied for registered trademarks for both of these trees. For more information on all our horticultural varieties, visit our website:

<http://www.ndsuresearchfoundation.org/horticulture>



Cinnamon Curls™
Dwarf Korean Birch

NDSU Agricultural Varieties
Contributing to Revenue
in FY14

Barley

Conlon
N. Dayman
Pinnacle
Rawson
Stellar-ND

Durum

Alkabo
Divide
Grenora
Tioga

Corn

NDL NDSAB
ND Early 521c
ND Early 521a

Edible Beans

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

Flax

Carter

Oats

Beach
Comet
Drover
Hi-Fi
Maida
Newburg
Nugene
Rockford
Souris
Taipan

Potatoes

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

Soybeans

Blue Horizon
ProSoy
Sheyenne
Traill
ND1005T
ND1100S

Wheat

Barlow
Elgin ND
Faller
Glenn
Howard
Mott
ND901CL Plus
Steele
Prosper
Velva

New Agricultural Varieties Licensed in FY-14



North Dakota Crop Improvement and Seed Association (NDCISA) signed exclusive license agreements with the NDSU Research Foundation for two new varieties in FY-14.

'GoldND' flax is a yellow seeded variety, as compared to the more common brown seeded flax and was found to have the greatest average yield of all varieties evaluated from 2009 to 2012. 'Gold ND' has good oil content and oil drying quality and can be used for health foods as well as industrial uses. North Dakota grows over 90% of the flax in the US. Gold ND was

developed by Dr. James Hammond, flax breeder at NDSU since 1969. 'Gold ND' will be protected under the Plant Variety Protection Act (PVP).

'ND1406HP' soybean is a non-GMO, high protein, high yielding, conventional food grade soybean variety. It will be targeted to the tofu or soy milk market, as it has the potential to create a superior quality product. Foreign as well as domestic market opportunities exist for this variety. Dr. Ted Helms, soybean breeder at NDSU, developed the ND1406HP variety. ND1406HP will also be protected under the Plant Variety Protection Act (PVP).

'Dakota Ruby' potato was also licensed non-exclusively to six companies in FY-14. "Dakota Ruby" is a beautiful, smooth, round, bright red skinned potato suitable for fresh consumption. It has a brighter skin and whiter flesh than other red skinned potatoes. A PVP application is currently pending for this potato. Dr. Asunta (Susie) Thompson is the potato breeder at NDSU.

NDSU Research Foundation Statement of Revenues and Expenses July 1, 2013 - June 30, 2014

Income	
Research Fees and Royalties	\$1,754,791
License Fees	153,382
Patent Cost and Other Reimbursements	97,613
Litigation Settlements	19,687
Interest	7,796
Dividends	100,383
Contributions	0
Investment Return	937,086
Total Income	\$3,070,738
Expenses	
Total Legal and Related	669,905
Patent	\$625,227
Licensing	11,015
Plant Variety Protection and Related	16,418
Research Fee Collection & Other	9,695
Trademark	7,550
Total Salaries and Operating	267,910
Total Research Fees and Royalties Disbursed	1,065,249
NDSU Dept/College/NDAES	659,856
Breeder/Inventor	398,865
Non-NDSU Royalty Disbursed	6,528
Total Expenses	\$2,003,064
Increase in Net Assets	1,067,674
Net Assets at Beginning of Year	\$4,969,133
Net Assets at End of Year	\$6,036,807

**NDSU Research Foundation
Statement of Assets and Net Assets**

June 30, 2014

Assets (Foundation)		Market Value
Current Assets (Foundation)		
Operating Checking and Savings	\$9,041	
Fund 81294	33	
Other Savings	165,318	
Prepaid Expenses	8,106	
Investments	150	
Total Current Assets		\$182,648
Property & Equipment		
Office Equipment	19,340	
Less: Accumulated Depreciation	(12,669)	
Net Property & Equipment		0
Other Assets		
Plant Sciences Endowment Assets:		
Durum Wheat Endowment		
Money Market	12,025	
Mutual Funds	1,977,184	
Spring Wheat Endowment		
Money Market	11,840	
Mutual Funds	2,468,564	
Total Plant Sciences Endowments		\$4,469,613
Sociology Endowment		\$356
Anthropology Endowment		\$38
University Studies Endowment		\$31,074
Math Endowment		\$7,373
Science & Math Endowment		\$1,916
ADHM Endowment		\$3,061
Assets (NDSU/RF Endowment)		
Cash Accounts (Endowment)		
Money Market State Bank and Trust	24,504	
Money Market Dain Rauscher	88,313	
Total Cash Accounts (Endowment)		\$112,817
Investment at Dain Rauscher		-0-
Investment at State Bank and Trust	858,499	
Investment at Vanguard - S&P 500	414,680	
Total NDSU/RF Endowment Investments		\$1,273,179
Total Other Assets		\$5,899,427
Total Assets		\$6,088,746
Restricted Assets (Foundation)		
Restricted Assets - Anthropology		\$38
Restricted Assets – Math		7,373
Restricted Assets - Plant Sciences		4,469,613
Restricted Assets - Sociology		356
Restricted Assets - University Studies		31,074
Restricted Assets – Science & Math Endowment		1,916
Restricted Assets – ADHM		3,061
Restricted Assets – NDSU/RF Endowment		1,385,996
Unrestricted Assets		137,380
Total Restricted and Unrestricted Assets		\$6,036,807

Two Plant Variety Protection Certificates (PVP's) Issued in FY14



'Carpio' Durum PVP 201300089 issued September 30, 2013

Breeder: Elias Elias

'Carpio' has very good protein content for pasta. Pasta made from 'Carpio' has good color and has the highest cooking firmness among all the North Dakota varieties. 'Carpio' was distributed to North Dakota Crop Improvement Association in the spring of 2014

'Dakota Trailblazer' Potato Variety PVP 201100304 issued March 11, 2014

Breeder: Asunta (Susie) Thompson

'Dakota Trailblazer' is a dual purpose potato. It can be used as tablestock, but also has excellent French fry quality, with better color and lower percentage of sugar ends than other russet potatoes. It is licensed by McCain Produce in Canada, Simplot Australia in Australia, and is available under non-exclusive licensing in the US.

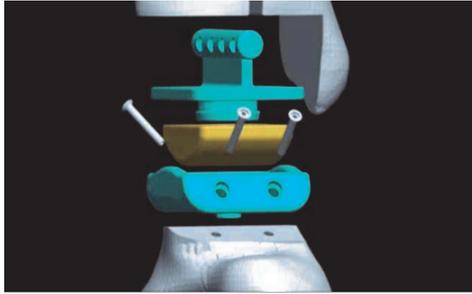


**Horticultural Varieties
Contributing to Income
in FY-14**

- Copper Delight™
- Juniper
- Prairie Mist™
- Juniper
- 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
- Snow Mantle®
- Gray Dogwood
- Snow Lace®
- Gray Dogwood
- Copper Curlys®
- 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
- Prairie Spirit®
- Juniper
- Royal Splendor®
- Norway Spruce
- Northern Flare®
- Sugar Maple



**Total Ankle Replacement (TAR) Technology Developed as a
Collaboration between Essentia Health and NDSU**



Inverted Design of NDSU's Total Ankle Replacement

Dr. Jared Aelony of Essentia Health, who specializes in Foot and Ankle Surgery, has done many Total Ankle Replacements (TAR's) in his career and found the current technology to be lacking. The surgery was difficult and often required having to remove more bone and needing to stretch or navigate around tendons. Additionally, the typical life time of the current TAR is only 10 years.

**Inventor
Team**



Dr. Chad Ulven



Dr. Fardad Azarmi



Dr. Jared Aelony

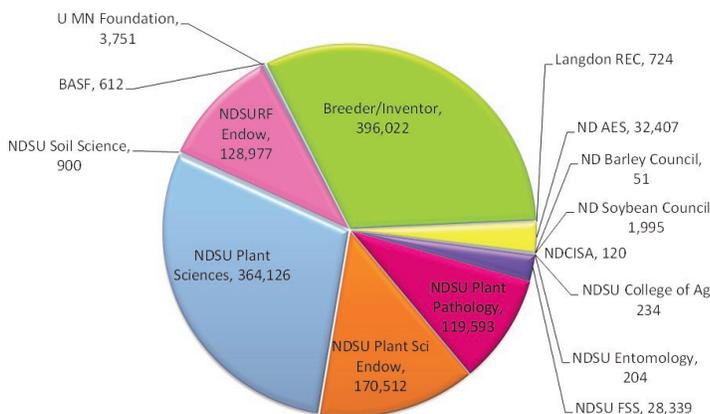
When Dr. Aelony first met a department machinist from NDSU's Department of Mechanical Engineering (ME) and saw what the department's capabilities were, he was intrigued. In the summer of 2009, he began meeting with Dr. Chad Ulven and Dr. Fardad Azarmi, both professors in the ME Department. This was the beginning of a successful collaboration. The plan was to have NDSU Dept. of ME Senior design students work on the project to help build a better TAR. The end product after two years of work features a TAR with an inverted design, in which the concave portion of the joint is on the bottom, and the convex portion on the top. This inverted design and the mode of assembly offers several benefits to surgeons and patients. These benefits include a reduction in wear and fracture of components, increased range of motion, greater stabilization, easier implantation that enables solid anchoring of the implant with minimal bone removal, a much lower failure rate in the first 10 years, and a projected life of approximately 20 years.

This technology is patent pending through the NDSU Research Foundation and is being marketed to companies for licensing/partnering opportunities.

FACT: NDSU is recognized as one of the nation's top 108 public and private universities by the Carnegie Commission on Higher Education's elite category of "Research Universities Very High Research Activity". NDSU has averaged well over \$100 million in research expenditures for the last several years.

ND Agricultural Research License Income

**NDSU Research Foundation
FY14 Distribution Activity**



NDSURF Mission:

The mission of the NDSU Research Foundation is to provide support for NDSU by protecting, adding value to and commercializing intellectual property that is developed through research activities at NDSU.

Origin of NDSURF:

The NDSU Research Foundation was established May 30, 1989, and incorporated in North Dakota as a scientific and educational not-for-profit organization under Section 501 (c) (3) of the Internal Revenue Code to interact with business and industry and to expand NDSU's ability to commercialize its research discoveries.

Technology Licensing Updates

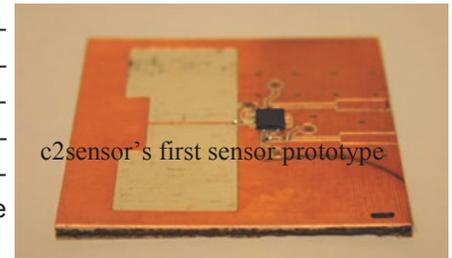


c2renew corporation is continuing to build on its current customer base in biocomposite development and expand into new markets, products, and through new engineering services projects. In 2014 c2renew saw the launch of the first consumer product in collaboration with Earth-Kind, in which c2renew provided the engineering services from initial production ideation to market launch.

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



In addition to the continued development of the biocomposites, c2renew expanded into a new technology and created a new spin-off company, c2sensor corporation. The SEED Sensor was a collaborative research and development effort among researchers at NDSU, in which a bio-degradable sensor was created that will be focused in the agricultural market as a soil sensor. The SEED Sensor was licensed in FY-14 to c2sensor corporation. The company will continue to develop the SEED Sensor technology in collaboration with NDSU throughout the coming years.



Fluorescence Innovations (FI) transferred its operations from Bozeman, MT to Minneapolis, MN in the second half of 2012 and is now located in space leased from the University of Minnesota in the heart of the Academic Health Center. Its R&D activities are funded through an STTR grant

from the NIH, a development contract from a top-ten pharmaceutical company, services provided to UMN researchers, and a license agreement that pays royalties to FI. Two new employees have been hired. Technical highlights of the past year include completion of a 50,000 compound screen, which serves to validate the Fluorescence Innovations screening platform. A new spectral recording mode has been added and the platform has been completely redesigned to incorporate numerous improvements as a result of lessons learned from the compound screen.

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



Elinor Specialty Coatings, LLC licensed a removable coating for bronze from the NDSU Research Foundation in 2011. Co-founders Holly and Dante Battocchi have since that time introduced the BronzeShield™ coating for the maintenance and preservation of bronze art and monuments to conservators across the US.



Holly and Dante Battocchi of Elinor

In FY-14, Elinor licensed the chromium-free, magnesium rich primer technology from the NDSU Research Foundation. Elinor showcased this primer, named Aluma45, in Washington, DC after which it was selected as a 2014 TechConnect National Innovation Awardee at the world's largest showcase and accelerator for industry-vetted emerging technologies ready for commercialization. This coating can be used directly on bare metal, eliminating toxic chromium-based pre-treatments, which reduces weight, manufacturing time and costs, and eliminates toxic chromium coating procedures and disposal. It is now ready for sale.

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



AkzoNobel Aerospace Coatings is the global leader in the manufacture, development, and supply of coatings for the OEM and MRO sectors of the Commercial Airline and General Aviation markets, as well as the Military Aerospace new build and refurbishing markets. In 2006, Akzo Nobel Aerospace Coatings, Inc. entered into a license agreement for exclusive use of an anticorrosion magnesium primer coating for aluminum substrates to be used in the aerospace industry.

This corrosion inhibition technology, developed at NDSU's Department of Coatings and Polymeric Materials, uses magnesium rather than the current chromium materials which are known to be toxic and carcinogenic. Akzo Nobel has made modest sales of this coating in the past three years. There have been multiple years of Department of Defense (DOD) testing on trial aircraft and further product and process refinement. In 2014, the first major US defense and commercial airline approvals have been achieved, which should lead to significant market expansion in the coming years.

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

Technology Licensing Updates, Continued



Treeminer continues to progress in meeting the “Big Data” data mining challenge with the patented data mining software licensed from the NDSU Research Foundation in 2011. This technology, developed by Dr. William Perrizo at NDSU, organizes data vertically and then compresses it into a patented data structure called a pTree (predicate tree) resulting in dramatic reductions in analysis times over existing methods and with increased accuracy and reduced hardware needs and costs.

As the world continues to collect more and more potentially beneficial data, the challenges on organizations to leverage this data to extract useful information only multiplies. Treeminer has adapted the NDSU technology to operate efficiently in these environments. Uniquely, they have leveraged the speed and accuracy of Dr. Perrizo’s work to operate on either very large “static” data stores, or on streaming, real time data – these broad capabilities are unique in the industry today (and all enabled by the innovation of the pTree).

“We continue to see tremendous possibilities for this technology” stated Mark Silverman, CEO of Treeminer. “There is an emerging recognition that these technologies will allow organizations to respond much more nimbly to opportunities, customers, and missions, and they’d like to see those benefits quickly.”

Treeminer is continuing to develop and market its vMiner product, which is based on the pTree technology. The applicability of Treeminer’s vMiner product using the pTree technology is almost unlimited - they are currently working with Government customers, as well as running trials in Oil and Gas, Manufacturing, Medical Information, and other market segments.

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



Dakota Technologies Inc., located in Fargo, ND was founded in 1993 to develop fluorescence-based instrumentation to map subsurface petroleum contamination. Dakota manufactures and sells petroleum contaminant detection identification and screening products in several countries. Dakota also provides site characterization services in 35 states, Canada and Europe. Dakota continues to develop new equipment and systems that target remediation at chlorinated sites. The NDSU Research Foundation holds an equity position in Dakota Technologies, Inc.

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



We’d like to welcome **Neeraj Visen**, who joined NDSU TTO and NDSU Research Foundation as the Licensing Associate/Technology Manager on July 21, 2014. He comes to us from the University of Manitoba where he had 8 years of experience working in Technology Transfer. He joined the University of Manitoba’s Technology Transfer Office in 2006 and led the office in generating new streams of royalty revenues. He was instrumental in several start-ups and license transactions with Fortune 500 companies for both physical and life science technologies. Dr. Visen is a registered Professional Engineer and a member of the Licensing Executive Society and the Association of University Technology Managers.

Staff FY14

Dale Zetocha, Executive Director, MS, RTTP
Tracy Larson, Administrative Assistant
Denise Roehl, Licensing Administrative Assistant
Laura Slicer, Accountant MBA

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