NRRI Now

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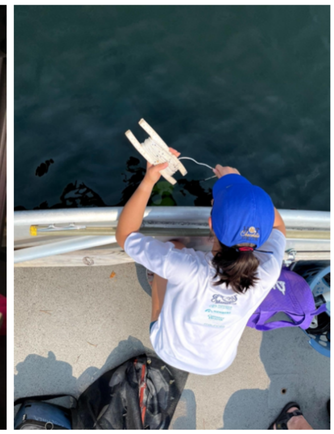

Summarizing NRRI's fiscal year in an annual report challenges me every year. It's never comprehensive.There's just too much going on and something is always unfolding.

What's the best way to organize 365 days of activity? How can we showcase the hard work that leads to success... or sometimes not. What is meaningful to document? Does this report convey the energy?

In the end, it's not a complete picture. But like a photograph, it frames and captures a moment to archive and reflect on. I hope you find it as inspiring as I do.

Click here to read through the highlights of our fiscal year July 1, 2020 to June 1, 2021, including a letter from our Executive Director, Rolf Weberg.

And please share with colleagues and friends.

June

June Breneman
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NRRI's hybrid poplar wins praises for phytoremediation potential

November 3, 2021
June Breneman
Fast-growing, disease-resistant trees hold potential for environmental clean-up.

Humans have a long history of making a big mess. Our legacy manufacturing activities, landfills, and leaky gasoline storage tanks have, in one place or another, leached harmful chemicals into the environment – and to us.

But an old friend is standing by to help clean up our mess.

Trees. Super awesome trees.

That's how Ron Zalesny describes NRRI's fast-growing hybrid poplar trees. Deployed as a phytoremediation tool, these trees can take up harmful organic chemicals (compounds with a carbon-hydrogen bond) like PAHs, VOCs and PCBs, and inorganic pollutants like heavy metals, through their roots. The chemicals are stored or break down in the tree roots, wood and leaves.

Jeff Jackson, NRRI/UMN Extension stands with Ron Zelsney by a 3-year old NRRI InnovaTree.

"NRRI's poplars establish roots really quickly, grow extremely fast and have awesome disease resistance," said Zalesny, a research plant geneticist for the USDA Forest Service, Northern Research Station. "That's the trifecta for why we love them so much."

NRRI is ready to begin commercial licensing of its top variety of hybrid poplar – trademarked as InnovaTree™ – which has performed well in Zalesny's phytotechnologies research trials.

Decades of Research

NRRI geneticist Bernie McMahon, now retired, spent his 25-year career breeding and cloning a cross between native eastern cottonwood and European black poplar. He nurtured many generations of this cross, taking from the best of the best, for trees that can grow 10 times faster than native aspen and 50 percent faster than current unimproved hybrid poplars. They are also "geo-robust" meaning they can grow well across many climate zones.

The faster and bigger a tree grows, the greater potential it has to take up pollutants from soil and nearby water sources such as streams, freshwater lakes, and groundwater. After harvest, hybrid poplar can be used for bioenergy, landscaping mulch, paper, lumber or engineered wood products.

he USDA Forest Service has partnered with NRRI throughout the decades to develop fast-growing poplar for a variety of specific purposes. Zalesny and his crew are now monitoring 16 agroforestry phytoremediation buffer systems with some 20,000 trees for phytoremediation potential.

"They're now in the middle of their life cycle," said Zalesny. "So they're getting to where we can see the growth and disease advantages of the NRRI varieties."

Joining Forces

He and other stakeholders have pulled together as a group called Great Lakes Phyto, a consortium focused on incorporating trees into community or industry clean-up efforts to protect regional water systems. Their overarching goal is to develop a protocol that matches different tree genotypes to different contaminants for the most effective remediation.

NRRI's early focus for the hybrid poplar program was to breed trees for biomass for the pulp and paper industry and other biomass-based products.

"But in the last few years we've taken a greater interest in the environmental services our fast-growing trees can provide," explained Neil Nelson, NRRI research program manager. "Stream bank riparian zones, water treatment and the carbon credit markets that are opening up. We're looking at all of these other applications, as well as the biomass market."

Nelson pointed out that NRRI's InnovaTree™ is a prime candidate to fill the need of large corporations seeking ways to reduce their carbon footprint by purchasing carbon credits.

Cottonwoods – one of the hybrid's breeding species -- are large trees with large root systems. NRRI's InnovaTree™ can help achieve these environmental goals more quickly, more efficiently and in higher volumes than any other species.

Close Collaboration

NRRI and the USDA Forest Service's Northern Research Station have a long history of working together. But there's even more on the horizon.

"With NRRI's expertise and the variety of real-world demonstrations the USDA Forest Service offers, I think we'll be collaborating for decades to come," said Zalesny.

Next level Safety Program keeps research safely on track

NRRI Safety Program Manager, Jean Cranston, has a large responsibility to monitor all safety details at NRRI's Duluth and Coleraine facilities.

October 28, 2021
June Breneman
Minerals safety spurs development of a screening process to better understand rocks being processed.

Rocks from all over the world are shipped to NRRI's Coleraine facility for processing and testing. But that shot up a red flag for researchers and NRRI's Safety Program Manager, Jean Cranston, a certified industrial hygienist.

“There was no way to know what might be in those rocks,” she said. “Rocks from here in Minnesota, we know what we’re dealing with. But who knows what’s coming in from goldmines and mines outside the United States?”

Silica, lead and arsenic are all hazardous components that can be naturally found in mineral deposits. When the rocks are crushed for processing, the materials could become airborne and controlling that presents a huge safety challenge.

“After you know what is in the material you need to know what safety controls are required to prevent exposure to employees,” Cranston added.

NRRI Taconite Chair, Rod Johnson, asked Cranston to find guidelines that would convert rock analysis results into estimates of airborne concentrations.

Cranston leaned into her 20-some years of experience in Environmental Health and Safety -- including environmental remediation, construction, mining and industrial hygiene -- in search of a process that didn’t exist.

“We couldn’t find anything,” said Cranston. “So we decided that the NRRI Safety Program would develop their own.”

Cranston’s goal is to produce a portfolio of control plans for different minerals and scenarios.

“I’m envisioning a manual that, if the safety screening indicates arsenic, for example, on the XRF [X-Ray Florescence analyzer] I can flip to that section and follow that safety control plan for arsenic mineral processing,” she said. “It’s remarkable that something like that isn’t already available.”

This next level of minerals safety might be of interest to mining companies or other industries that have airborne particulates issues. Cranston recently went onsite when taconite tailings were being applied as a road surface material to test dust levels.

NRRI’s Safety Program is closely tied to its Quality Program, managed by Lisa Estepp. In addition to developing quality protocols, the team has developed extensive protocols for reporting hazards and accident “near misses” and incidents. They also developed a guide for the many contractors who come to NRRI’s Duluth and Coleraine sites.

A protocol for managing changes in equipment, materials and procedures ensures adequate controls are in place so that information is current, no unintended hazards are introduced and risks are properly evaluated and mitigated – all while delivering top quality work. Her efforts have led to new exhaust systems, monitoring equipment and upgraded personal protective equipment.

“What I love about my role here is that I get to conduct research of my own, follow through, implement controls, and actually see the results,” said Cranston. “To be able to put science and safety together is really exciting.”

Four recent doctoral graduates bring a world of talent to NRRI projects

October 28, 2021
June Breneman
Four recent doctoral graduates bring fresh talent to NRRI to deliver solutions for Minnesota's environmental challenges.

Postdoc. It’s a common term in academia, and growing more common in industry, as well. But what exactly is a Postdoc?

It's a person who finished their doctoral degree, a Ph.D, who is hired on to a new organization to gain skills and research experience on specific topics. NRRI currently has four Postdocs working on projects with real impact for Minnesota and beyond.

"Our NRRI Postdocs are a valuable part of our team," said Rolf Weberg, NRRI executive director. "They bring fresh talent, perspective and enthusiasm that motivates the whole organization.

Meet Tadele

From Austria, to Duluth, Minnesota, Tadele Haile brings expertise in filter media for stormwater clean-up. Polluted stormwater runoff is an especially vexing challenge as climate change delivers more severe rain events.

During his Ph.D. studies at the University of Natural Resources and Life Science in Vienna, Haile was lead investigator and author of the Austrian Standard for the certification of commercially produced filter media. This experience is now being applied to NRRI's biochar research and other materials applied to biofiltration systems for polluted stormwater. He is part of the team developing demonstration projects at the Mississippi Watershed Management Organization in the Twin Cities.

Tadele Haile

"We are developing a mobile stormwater testing laboratory that will collect data to inform watershed management and will also contribute to community education and outreach," Haile explained.

Haile works across NRRI's Water and Materials platforms to develop novel filtration media from waste natural resources, like beetle-killed trees and taconite industry byproducts.

He credits working at NRRI for broadening his expertise in evaluating biochar performance at lab-scale and its subsequent application for water treatment at the field scale.

“We produced 14 biochars from different feedstocks at varying pyrolysis temperatures, some exceeding 1,000 degrees Fahrenheit,” he said. “Having that capability at NRRI was really amazing and gave me a lot of opportunities to learn about biochar production and characterization.”

Meet Matthew

With a range of expertise, Matthew Berens is a valuable contributor to the new Great Lakes Sediment Surveillance Program. His skills in biogeochemistry, environmental engineering, soil chemistry and analytical chemistry all play well in the effort to identify legacy and emerging chemical contaminants in our valuable freshwater Great Lakes.

Berens received his Ph.D. in Civil Engineering from the University of Minnesota. His two-part thesis looked at the degradation of military munitions in soils and the risks associated with nicotine-like insecticides in Minnesota waterbodies.

Matthew Berens

“In just a few short months, our team of researchers worked quickly to adapt analytical methods that can measure over 200 contaminants in lake sediments,” said Berens. “Recording contaminant levels across the entire Great Lakes system will not only inform policy decisions and increase public awareness but also helps us understand the long-term impacts of pollutants in our shared water resources.”

Berens is also investigating the complicated relationship of mercury and sulfur in lakes and wetlands. Sulfate pollution (a form of sulfur) can lead to the formation of methylmercury, a dangerous neurotoxin that bioaccumulates in fish and is toxic to humans who eat the fish.

Berens enjoys his role in developing sustainable technologies for water treatment to ensure equitable access to clean water, both as sustenance and for recreation.

"Our goal is to develop a treatment system that can be deployed in the field to remove sulfate both before and after it enters a watershed," he said. "In addition to the toxic effects of methylmercury, sulfate contamination is a concern for native manoomin (wild rice) populations, which is a sacred cultural and spiritual resource for the Anishinaabe nations of Minnesota."

Meet Susma

While Duluth's Spirit Mountain can't compare to the soaring peaks of the Himalayan Mountains, the rocky natural beauty of the area still reminds Susma Bhattarai Gautam of her childhood home in Nepal.

Susma Bhattarai Gautam

But before she came to Duluth, Bhattarai Gautam tapped expertise across Europe to attain her doctoral degree from the IHE Delft Institute for Water Education in the Netherlands. Her Ph.D. work involved studying the unique microbial process of anaerobic oxidation of methane coupled with sulfate reduction in different bioreactor configurations. Her expertise in environmental engineering, microbiology and environmental chemistry are especially valuable to NRRI's projects.

Bhattarai Gautam is involved in two NRRI projects to develop sustainable sulfate and nutrient removal from water and wastewater. For both systems, she is involved in the design, installation, operation and maintenance of the lab scale treatment system and pilot-scale biological sulfate treatment system for sulfate removal from the wastewater.

"The mobile pilot-scale treatment system applies our lab-based knowledge to a real field application, so I can see the practical implications of the system we developed," said Bhattarai Gautam. "That's a very exciting step for a researcher."

Natural Resources Research Institute
UNIVERSITY OF MINNESOTA DULUTH
Driven to Discover

Meet Saleh

In a unique shared position, Saleh Mamun is tackling a big question: What are the connections and interdependence between human economies and natural ecosystems?

Saleh Mamun

Mamun is a natural resource economist specializing in ecosystem services. He came to Duluth in 2019 to fill a 50/50 position at NRRI and the University of Minnesota's College of Food, Agricultural and Natural Resources Sciences, in the Applied Economics Department. He received his Ph.D. from the University of New Mexico while studying the interdependence of environmental and economic policy.

At NRRI, Mamun is working with a multidisciplinary team to develop a Forest Optimization Tool. Mamun's role is to evaluate biophysical ecosystem services and convert them into monetary value, considering the trade-off among ecosystem services. He's also analyzing the life cycle of forest harvest production.

"This will be a valuable tool for Minnesota forestry sector policymakers to decide best forest management practices," said Mamun.

And on a much larger scale, Mamun is working on a global analysis that will provide national-scale indicators on the efficiency of natural and capital management to inform policy and strategic decisions. This Natural Capital Index is a collaboration between the University of Minnesota and Stanford University, funded by the World Bank Group.

"Natural Capital" is all the world's natural resources -- geology, soil, air and all the flora and fauna -- and the ecosystem services they provide that humans depend upon. The Natural Capital Index is a measure of the efficiency of sustainable use and management of natural capital in a country.

Pandemic Positions

Mamun was hired at NRRI in 2019 just before the Covid pandemic started, and Haile, Bhattarai Gautam and Berens were all hired during the pandemic lock-down. While the remote working and limited in-person contacts had its challenges, all four Postdocs can point to some highlights.

Many neighborhood walks and hikes in Duluth's urban forests was a soothing tonic for them and Saleh used his extra time at home to learn to play guitar.

"I was really amazed by Duluth's landscape and gorgeous view of the lake," said Haile. "And the people here are friendly beyond my expectation."

Tiff's Tips for Ecoliving #4: The clean, green laundry room

October 28, 2021
Tiffany Sprague
People coming home for the holidays, college kids bringing home bags of dirty clothes, germy face masks and handkerchiefs... it all adds up to a busy laundry room.

Editor's Note: Tiffany Sprague is NRRI's Sustainability Coordinator, helping us all live out our best sustainable lives, both at work and at home. This is her monthly blog series.

With cozy autumn and holiday season upon us, many of us may find we are spending more time in our laundry room (or creepy, drafty basements, wearing knee-length winter coats and gloves, fingers freezing as towels are fluffed…[Tiff, circa 2012, grad school duplex rental]). College students visiting home over breaks, family members spending evenings...weeks...too much time really, inhabiting guest bedrooms and basement couches -- all that clothing and bedding sure does add up.

And, because I expect many folks are using handkerchiefs, reusable napkins, and cleaning cloths instead of paper towels and other throwaways (ehm I right?) -- laundry baskets may be bursting at the seams. So this month we are going to discuss various ways to create an eco-friendly laundry experience.

Energy Star Products

I think the first thing that comes to mind is owning an Energy Star certified washer and/or dryer. Each year, Energy Star puts out a list of the most efficient appliances for the year, and the 2021 washer list and dryer list have a lot of snazzy options. But, not all of us can afford to upgrade our washer and dryers every few years (which leads to an entirely different issue of material waste and end of life recycling, so for now, let's assume everyone has a crusty old washer and dryer like I do).

Tiffany Sprague

Wonder how a product becomes Energy Star Certified, and if it is a real thing? Well, the Environmental Protection Agency makes the call on what gets Energy Star Certified, and the EPA is a group of real scientists, so, yes, it is very real. You can also read more on the specifications required for certification, or watch a cute little video about it.

Things You Can do to Improve Efficiency

Not everything needs to be fancy, newly purchased or complicated. Some classic rules to live by:

- Wash and dry full loads.

- Use cold water (reduces additional energy consumption to heat up your hot water tank).
- Don't over dry. Better yet, use a clothesline. (My favorite. Makes me feel European and sophisticated. Other days, very Laura Ingalls and rugged homesteader. Either way, smug. Definitely smug. And is there any better way to do laundry than smugly hanging clothes on a line? Correct. There is not.)
- Regularly clean lint screens -- fire safety and efficiency -- a double-win!
- Dry in consecutive loads while the dryer is still warm to reduce the energy needed to raise dryer temperature. (That is, when you aren't smugly hanging your clothes.)

Microfiber Pollution

Microfibers. Microplastics. All the rage right now in the media and scientific research. And, truthfully, the outlook isn't too good. Essentially, the fibers from that PolarTec fleece jacket shed off in your washer. These fibers are not natural, and are made, in essence, from plastic. From your washer, they pass through wastewater treatment plants, and end up in our lakes and streams. Little animals eat them, big animals eat the little animals, then bam, bald eagles are extinct.

While you can act like Steve Jobs and freeze your clothing rather than wash them (Smithsonian Magazine has an article on freezing jeans [essentially, meh]). They also make products which can capture these microfibers from your wash load.

Wool Dryer Balls

Tiff's dryer balls

Are you still using dryer sheets? Well, that is so 1990s. The new rage is wool dryer balls. They don't contain chemicals (I mean, have you ever asked yourself what is on a dryer sheet?), they help to floof up your clothing, and you can place essential oils on them if you'd like to lightly scent your clothing.

There are a bunch of different brands out there, and small crafters who sell them at local shops and on Etsy. They last forever; I owned a set for about 10 years before I had to replace them (they unraveled; the surviving ones are cat toys). I like 6 balls in use at once to really give those towels a nice floofing.

Dryer Safety & Efficiency

Have you ever really cleaned out your dryer? I mean, like really gotten in there? Well, you should. It can maintain the efficiency of your dryer and minimize safety concerns like lint fires.

Ace Hardware has a fantastic video (3 minutes) on how to clean out your dryer and replace your vent line.

While laundry may not be the most exciting adulting activity, I appreciate the technological advancements and ingenuity that allows for a laundry day experience with minimized impact on the environment. I hope you will take a moment next time you are scrubbing chocolate stains out of your favorite sweater to reflect on your gratitudes for this awesome planet and the many wonders Mother Nature offers.

Until next month - with gratitude and in reflection,

Tiff

Around the State:

NRRI supports entrepreneurial efforts in Innovate 218

NRRI Business Development and Intellectual Property Manager, Tim White, weighs in on Minnesota's natural resources-based economy as part of Innovate 218.

“Northeast Minnesota has amazing natural resources available. We are charged with considering responsible use of those resources,” White said.

Read the Tech.mn article:
Outstate MN: Innovation in Northeast Minnesota