

Research News

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Understanding the impact of saline soil

BY SEAN MOORE
Research Promotion

Given the breadth of the boreal forest, it is hard to believe aspects of its plant life have been overlooked in the past, but they have been.

Plant Physiologist Sylvie Renault, however, has turned a keen eye towards this northern forest. She's investigating salt toxicity and salt tolerance in the woody plants of the boreal forest, a previously ignored area of study.

To be sure, Canada does not have swathes of saline rich soils like Australia and India, but the Prairie Provinces alone have around one million hectares of land affected by salinity that limits plant growth. This salinity problem has been aggravated by mining activities in places like Alberta's oil sands, which produce saline tailings.

How, and if, global warming will change salinity levels is unknown. Drought periods could increase the problem by concentrating salts in the soil while increased precipitation could lead to a dilution of salts. Renault's work will shed light on how certain plants adapt and grow in these conditions and what plants can be used to reclaim land lost to mining.

In a greenhouse, Renault examined how white and black spruce, tamarack, aspen and red-osier dogwood responded to sodium chloride and sodium sulfate, the salts found in mine tailings. Red-osier dogwood (*Cornus*

stolonifera syn. Cornus sericea), she found, was the most tolerant and has since become a focal point of her research.

"Red-osier dogwood is interesting because it's one of the most cold tolerant species. By being able to tolerate one type of stress, a plant is more likely to tolerate other stresses," Renault said. "We want to see if cold hardening (cold acclimation) of seedlings will improve salinity tolerance."

The relationship between freezing and salinity stresses stems from the fact that in both scenarios water is hard to get, creating a water stress. Renault is investigating whether such tolerant plants can modify cell wall and membrane structures, enabling them to absorb enough water to grow. She found that changes in shoot cell wall composition occurred in response to salt treatment. Further work will be undertaken to determine if these changes have a role in stress tolerance.

Red-osier dogwood was not, prior to Renault's work, known to grow in salty soils but when she grew seeds from different locations – British Columbia, near Alberta mine sites, and New Brunswick – in a salty soil, the Alberta seeds showed the highest level of tolerance.

"The wide distribution of red-osier dogwood across North America has led to the development of geographic races



Photo by Sean Moore

Biological sciences' Sylvie Renault is studying how certain plants adapt and grow in salty conditions and what plants can be used to reclaim land lost to mining.

that develop differently in response to the environment," Renault said, noting that she will soon investigate the adaptations the Alberta plants have undergone.

She is also studying the effects of adding calcium to a salty soil. Past literature suggests it's beneficial and Renault's lab found that calcium can reduce some effects of salt but it depends on the plant, the salt, the soil, and the environment.

The basic story of calcium's effects is this. Transport proteins in

the root determine what elements get absorbed. Salts are readily taken in, leaving beneficial elements like potassium and magnesium in the soil. Calcium could alter the functioning of transport proteins, making them more discerning and thereby reducing the nutrient deficiency salty soils usually cause.

"There is still a lot to learn. But we are getting closer to understanding some of the fundamentals of salt tolerance and toxicity," Renault said.

Twinkle, twinkle, exploding star

BY SEAN MOORE
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People pay to see things explode on movie screens, but these pyrotechnic pops offer anemic entertainment when compared to the best bang-for-your-buck explosions: supernovae.

Granted, movie theatres are closer to home than violently dying stars, but on January 29 Samar Safi-Harb, Canada Research Chair in Supernova Astrophysics, will bring the excitement of supernova to you in a free public lecture (details below).

Safi-Harb is an expert in supernova remnants (SNR) – the glowing gaseous remains supernova explosions leave behind. She studies them because they contain all the heavy elements life on Earth was built from; and because supernova explosions leave behind different types of neutron stars – the most exotic stars in the Universe.

"I am basically studying our origins," she said.

So, how did we get here?

Nuclear reactions taking place in a star's core maintain enough thermal pressure to resist the incessant crush of gravity. But when the fuel cascade

stops, the star is suddenly left with an inactive iron core, which produces no thermal pressure.

Instantly, gravity forces the core's electrons to combine with protons, forming neutrons, hence "neutron star". Within seconds, this gravitational collapse releases more energy than the Sun will radiate over its lifetime.

The star, which was once bigger than Earth, is now 20 kilometers across. It is so dense a paper clip made from its material would outweigh Mount Everest. It can rotate hundreds of times per second and, if it becomes a subspecies of neutron star known as a magnetar, its magnetic field can be a thousand trillion times stronger than Earth's.

As for the SNR, its blast wave travels outward at 10,000 km/sec. It can be light years across, and millions of degrees Kelvin. It expands until it joins other interstellar gas, thus distributing its heavy elements across the universe.

"The main, fundamental question is what happens to massive stars when they explode? The answer is in the SNR. You can use x-ray information to peer into SNR and understand what the star



Photo by Sean Moore

Astrophysicist Samar Safi-Harb studies aspects of supernova. She will share her findings at a free public lecture on January 29.

was like before it exploded and how it will look like after its death," Safi-Harb said.

Astronomers believe that one supernova should happen in our Galaxy every 50 to 100 years. But no supernova has been seen in it since

1680.

Our galaxy has over 300 SNR, a few dozen of which surround neutron stars or pulsars, called so because they pulsate light with admirable regularity. That pulsars are found within SNR provides proof that supernovae produce them.

As for what SNR produce, well, they may be involved in the creation of mysterious high-energy particles called cosmic rays. But more work is needed.

"There are so many surprises in this field. It seems like most discoveries come as a surprise. But with each one, we get a better understanding of the fate of stars, and at the same time we think of new questions that drive more observations and theoretical work."

If you want to be surprised, attend "Supernova Explosions: The Hunt for the Extreme in the Invisible Sky" at the next *Get to Know Research at Your University* speaker series on Jan. 29. It starts at 7 p.m. in the Smartpark boardroom, located at 135 Innovation Drive. Admission is free and all are welcome. For more information please call 474-9020.

Bringing Research To Life

Research News is Published
by the Office of the Vice-President (Research)
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