Student Profile

Thinking Sustainably: From Hobby Turtles to Honours Thesis

Zijing Guo has always had a love for exploring beneficial natural processes as solutions to complex problems. In his high school days, back in his home country of China, he gardened and kept turtles.

Because his turtles ate constantly and produced so much waste that he had to clean from their tanks every day, he came up with a system that incorporated natural processes involved in the nitrogen and carbon cycles. He added nitrifying bacteria, denitrifying bacteria, and active carbon to the water tank where he kept his turtles. The nitrifying bacteria converted the ammonia to nitrates that are used by algae growing in the tank. Some of the nitrates, and other inorganic wastes, were absorbed by the active carbon. The denitrifying bacteria converted the nitrogenous compounds in the turtle wastes into nitrogen gas and nitrogen dioxide.

This was a very delicate system, which Guo is still learning. He hopes to perfect the system someday, as it is hard to achieve the constant balance given the consistent care required.

"When done right, the water in the tank can stay clear for up to one month," he explained. "This gave me my first experience of working with natural systems."

Born in Beijing, Guo lived most of his childhood in metropolitan cities and transferred to the University of Manitoba in 2014. In the 2018 winter semester he completed his research project, entitled: *Study of Competitiveness Between Reed Canary Grass and Purple Loosestrife in a Replacement Series*. He graduated spring 2018 from the agroecology program of the Faculty of Agricultural and Food Sciences.

Guo plans to continue in research roles and hopes to work to broaden the understanding of our natural environment, and to help advance the incorporation of natural processes into our agricultural systems.

While volunteering on farms in China, Guo learned much about the agricultural system and realized that some things need improvement, including how the current agricultural system functions with regards to environmental sustainability.

He explained that we mostly think about the cost of inputs — fertilizers, herbicides, and other practices that increase agricultural yield. The cost of output — effects of our agricultural practices on the environment — is not equally regarded. We have NGOs and many different groups that try to save the environment by paying producers the cost of adopting environmentally-friendly agricultural practices.

Guo believes that this system is flawed. The endeavour to protect the environment should not be a cause that people "donate to", rather everyone should pay for the costs of our environmental impact. He thinks that part of the solution should be to distribute these costs throughout the supply chain from producer to consumer.

Guo took interest in his research project topic when he realized through literature searches that there have been very few studies into the interaction between purple loosestrife (*Lythrum salicari*) and reed canary grass (*Phalaris arundinacea*) — despite the fact they often grow in the same ecological niche. He also realized that when biocontrol agents are tested on crops, the efficacy of the bioagents is measured without properly taking into consideration the effect of interspecific and intraspecific plant competition.

Both purple loosestrife and reed canary grass are invasive species in Manitoba. They are both dominant in the wetlands they inhabit and can prevent other plant species from thriving.

Through his small-scale research, Guo hoped to see whether interspecific plant interaction played a role in the competitiveness of these two invasive plant species, and whether varying the population ratio of the two species affected their biomass.

In one germination trial, less than 10% of the reed canary grass seeds germinated. This germination rate was insufficient to start his project. After multiple failed germination tests, Guo was finally able to get his reed canary grass seeds to germinate. His purple loosestrife seed germination test continued to remain unsuccessful.

"I learned a lot from negative feedback," said Guo. "When I tried one thing and it did not work, I looked at the literature to find something else that might work."

Natural systems may not always respond as anticipated, but persevering through setbacks is one of the keys to a successful research project. Having overcome initial seed germination failures, Guo got his project on the road in November 2017. It had been approved in August.

The main result was that as the reed canary grass was replaced by increasingly more purple loosestrife, the biomass of the reed canary grass increased. This result suggested that the competitiveness of reed canary grass was affected more by intraspecific competition than by its competition with purple loosestrife.

"The ultimate practical value of understanding competitive mechanisms of invasive species is to find a management strategy," said Guo.

— David Zirangey

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