Cornell Honors Student Lindsay Chamberlain Evaluates Use of Drones for Yield Predictions of Corn and Forage Sorghum

By Lisa Fields

Cornell Plant Sciences 2017 Honors graduate Lindsay Chamberlain entered college with a clear focus and enriched her curriculum with experiential learning. "I was raised on an 800 cow Jersey dairy farm in Wyoming, NY and I loved growing up and working there." Chamberlain said. "My parents, who are both Cornell graduates, emphasized the importance of focusing on schoolwork. I developed an interest in plant science in high school and chose the Plant Physiology concentration when I entered Cornell as a Plant Sciences major."

Along with her classes, Chamberlain experienced hands-on application of plant science by working for the Western NY Crop Management Association (WNYCMA) as a field crop scout after her freshman year. The following summer she worked at the Beer Lab on campus with research on bacterial pathogens of onions. "That job gave me some solid laboratory experience," she noted. "It was great exposure and helped me realize that I'm truly motivated by work that combines the field and lab aspects of research."

In 2016, Chamberlain experienced that combination during a Cornell Cooperative Extension (CCE) internship with Professor Quirine Ketterings' Nutrient Management Spear Program (NMSP) in Animal Sciences, and Professor Elson Shields in Entomology.

"My project and Honor's Thesis was 'UAS (Drones) for Yield Predictions and Precision Nitrogen Management in NY,'" Chamberlain explained. "The objective was to determine the impact of the time of day on sensor tools' assessment of crop normalized differential vegetation index, NDVI in corn and forage sorghum. The NDVI is an indicator of crop biomass and greenness derived from a ratio of red and near-infrared light reflected from the leaf canopy. It's applied to determine end-of-season yield predictions and a nitrogen (N) response index to assess crop N needs to meet that yield. I examined and compared data from two sensor-based methods of determining

NDVI, the hand-held GreenSeeker device and a Quad-copter drone. The GreenSeeker has been used in NY in recent years to help determine N side-dress rates in corn around the V-6 leaf stage, but the drone is a new tool for this application. It was exciting to apply this technology to such a relevant topic for famers."

Ketterings commented, "When we interviewed Lindsay, she showed a keen interest in being involved in applied research with practical implications for farmers. She was also very interested in pursuing an honors thesis in her senior year and the drone project enabled that effort."

Lindsay Chamberlain, Cornell Plant Sciences honor student, evaluated unmanned aerial systems (drones) for yield prediction of corn and forage sorghum. She received the 2017 Outstanding Senior Award of the Northeast Regional Branch of the Crop, Soil and Agronomy Sciences of America (NEBCSA).

Chamberlain described her project and Honor's Thesis details. "Each week I walked three local plots with the GreenSeeker. The GreenSeeker is an active NDVI sensor, taking "on-the-go" readings, while the drone is a passive method, taking pictures every 3 seconds with 3 types of cameras. After the fieldwork, I translated the sensing tools' readings in the lab to arrive at yield predictions. The drone's camera images are processed in three steps using ArcGIS software, which was an exciting challenge to learn how to do."

Elaborating on her project's conclusions, Chamberlain said, "The ambient sunlight changes throughout a day had a greater effect on the drone camera than the GreenSeeker sensor, so the NDVI derived from it didn't correlate well with the GreenSeeker data. Droughty conditions also impacted the results. Curling corn leaves created bare soil that lowered the NDVI values derived from the camera readings so they couldn't provide accurate predictions of yield and N response. Although we are still analyzing data from the sorghum, for both crops further research is needed to get more time-of-day data with the drone, and during better growing conditions."

Chamberlain gained valuable experience beyond the technical aspects of the internship. "One message that stays with me about research is that you don't always find the answer to your question, but the data you obtain is still valuable. It may get applied to important research in the future," she commented. "I loved being part of the NMSP team. Everyone is so supportive of each other and we had truly stimulating conversations during work breaks. The group has diverse viewpoints and cultural backgrounds, so it was a very enriching experience for me." She added, "Quirine has created an environment for us to learn by doing and having responsibility. I felt important and trusted, and had a sense of ownership of the data generated by the GreenSeeker and UAS, so I was highly invested in seeing the project through. I'm very grateful for the opportunity and strongly recommend an NMSP internship."

Key experiences for Chamberlain were project presentations at the Aurora Research Farm Field Day, the Northeast Region Certified Crop Advisor annual conference, the Cornell Cooperative Extension Agricultural Inservice, the Honor's Seminar and an Entomology class. Ketterings added, "Lindsay took ownership of the project and did such a great job with the extension presentations that we nominated her for the 2017 Outstanding Senior Award of the Northeast Regional Branch of the Crop, Soil and Agronomy Sciences of America (NEBCSA). She was selected by NEBCSA for the award!"

Lindsay's internship included time with the Western NY Cornell Cooperative Extension Dairy, Livestock and Field Crops Team and helping with research on local farms. "I loved the chance to work directly with farmers," she noted. "I was involved with Tactical Ag (Tag) meetings with Dr. Mike Stanyard that focused on insects and diseases in field corn and soybeans, and worked with a large-scale on-farm tillage study at Table Rock Farm as well."

This summer Chamberlain enters a graduate program working on soybean agronomy and cover cropping at the University of Wisconsin at Madison. "I'm excited and a little nervous because I'll be diving right into fieldwork for my Master's project." she explained. "But the full spectrum of research work along with the Extension focus I experienced with NMSP has me well prepared for the challenges I'll face."

Chamberlain reflected on her future plans. "I'm open to learning what the opportunities are that fit my desire to be part of the direct connection between research and agricultural producers. In whatever form it may be, that link to practical solutions that improve farmers' lives is what really inspires me."

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