



Non-traditional Honors Student Completes Nitrogen Fertilizer Dynamics Project with NMSP

By Lisa Fields

Jeff Williard never thought he could earn a degree from Cornell University. He said, "The support of my wife and five children all along made this accomplishment possible." They were all there to cheer when he received his B.S diploma in Agricultural Sciences with honors in research.

Williard transferred to Cornell after earning 60 credits with Empire State College (ESC). At ESC classes are completed via distance learning or seminars. The laboratory component of agricultural science classes required cross-registration with another college. Williard explained, "When I couldn't find a good cross-registration fit to continue with ESC, I applied to Cornell with little hope of being accepted. I was really surprised and excited when Cornell Admissions said I was a great fit. My grades had been excellent, and all my previous credits transferred." The Williards relocated to Candor from Western NY so that Jeff could attend Cornell in the fall of 2009.

Williard received continual encouragement from his major advisor Associate Professor Dr. Quirine Ketterings, director of the Nutrient Management Spear Program (NMSP). He approached her about getting involved in the NMSP program. "When I asked Quirine about work with NMSP I thought I would be washing test tubes. She just laughed and said, 'oh no, not with the Spear program!'" Instead of washing test tubes, Williard worked part-time for NMSP for two and a half years, successfully completing an honors thesis, project, "Nitrogen Dynamics Following Surface-Application of Enhanced Efficiency Fertilizers."

The project was his greatest challenge and satisfaction. He also faced logistical challenges not experienced by most college students. Williard explained, "Getting to campus involved a commute on the Tioga County bus. This presented a scheduling challenge at times and I missed out on being in study groups, but it all worked out.

Initially, Williard didn't think he could tackle an honors level project. "Quirine had a

way of getting me to take on things I didn't think I could do without pushing me. She set tasks and guided me through the process. I found myself achieving far more than I envisioned."

Ketterings commented, "Jeff's application to Cornell showed his interest in working in agriculture and environmental management. His farm and life experience and interest made him an excellent candidate for our program. I invited him to take on a project that was meaningful for our farming community and would expose him to all aspects of doing agricultural research, from proposal writing and designing of the experiment to data collection, analyses, and interpretation of the results and presentation of his finding. Jeff took on the challenge and produced a terrific project."



Jeff Williard (right) celebrated the completion of his college degree in agricultural sciences with family at the College of Agriculture and Life Sciences graduation breakfast on December 17, 2011.

Williard discussed his honors thesis project. "The objective was to compare the dynamic behavior of forms of nitrogen from several materials over a 13-week period. I studied urea and enhanced efficiency N fertilizers (EEFs). In theory, the EEFs slow down microbial processes that convert urea to ammonium (NH₄) or ammonium to nitrate

(NO₃). This reduces volatilization and leaching so the N stays available for the crop when most needed. The fertilizer materials were surface applied to reflect the increase in no-till corn production. I also examined the impact of NH₄ release on the Illinois Soil Nitrogen Test's (ISNT) ability to accurately predict soil N supply for the growing season."

The EEFS studied were "Agrotain" (urease inhibitor), "SuperU" (urease and nitrification inhibitor), "NutriSphere", and "ESN" (urea controlled release polymer). The project was done in growth chambers in Guterman Laboratory at Cornell University. The 216 soil samples had a nutrient analysis and organic matter content typical of the region, with no recent manure applications. To imitate a field season, the temperature inside the chambers was altered on a weekly basis to mimic warming of the soil. Soil moisture was maintained at 75% of field capacity.

Ketterings explained, "This was a very ambitious project. We had done incubation studies before but this project required some thinking to ensure the results would be translatable to a field situation. Jeff came up with questions as well as answers that ensured that in the end we had a scientifically sound design for the project that could test if the various EEFs were actually working. He was the lead researcher for the project. The design reflected both his attention to detail and ability to connect what we can do in the laboratory with what matters to farmers."

Williard added, "The NMSP lab staff, Dr. Sanjay Gami and Eun Hong (former intern and assistant), were a great help guiding me through the weekly sample analysis."

He concluded that Agrotain, SuperU, and ESN were all effective in reducing volatilization loss to the environment, with ESN showing elevated NH₄-N levels only after 56 days. Surface application of urea and NutriSphere resulted in high volatilization losses in the week after application. Williard explained the effects on ISNT. "Agrotain, SuperU, and ESN effectively slowed the conversion process of

NH₄-N to nitrate, so ISNT sampling should be done prior to application. With ESN, the ISNTs may be done up to 8 weeks post-application. Soil nitrate levels were higher following Agrotain and SuperU than when urea or NutriSphere-N were applied, while ESN produced NO₃ levels higher than the control only after 28 days, when daytime temperatures reached 69°F." He added, "It was exciting to see the N dynamics of the materials over time, and satisfying to get concrete results that were consistent with other universities' studies."

Williard presented his findings at the Northeastern Branch meeting of the American Society of Crop, Agronomy, Soil Sciences that was hosted by Cornell University in the summer of 2010. He noted what he gained beyond technical knowledge and skills. "I was interested in being part of research that benefits the ag community. I felt that the data would be applied to more efficient use of N fertilizers. That means better crop growth and reduced losses to the environment, both important for sustainable agriculture."

Williard's future hopes include work with farmers to achieve profitable and environmentally sustainable practices. "My goal is to work for NRCS as a Conservationist. I learned about their work as an Earth Team volunteer while home schooling my kids. Both the engineering and agronomic aspects are fascinating to me."

Williard reflected on his recent experience. "Graduating from Cornell with honors gave me a tremendous sense of accomplishment. At times I worried about the challenges, but Quirine never doubted my abilities and that was a great help. It was inspiring to be part of the Extension process. It's valid and necessary work: identifying problems farmers face and finding solutions."

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The **Nutrient Management Spear Program** (NMSP) is an applied research, teaching and extension program for field crop fertilizer and manure management on dairy and livestock farms. It is a collaboration among faculty, staff and students in the Department of Animal Science, Cornell Cooperative Extension, and PRO-DAIRY. Our vision is to assess current knowledge, identify research and educational needs, facilitate new research, technology and knowledge transfer, and aid in the on-farm implementation of strategies for field crop nutrient management including timely application of organic and inorganic nutrient sources to improve farm profitability while protecting the environment. An integrated network approach is used to address research, extension and teaching priorities in nutrient management in New York State. For more information on NMSP projects and extension/teaching activities, visit the program website (<http://nmssp.cals.cornell.edu>) or contact Quirine Ketterings at qmk2@cornell.edu or (607) 255-3061.