



## Senior Research Connects Students with a Living Laboratory As Part of an Integrated Crop and Livestock System

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Soil, water, soil microbes, and solar energy are the main sources that sustain life on this planet. Without them working in concert, neither plants nor animals would survive. Considering the efficiency of animal production targets, soil must be protected and improved. Therefore, through our sustainable integrated crop and livestock research, we are studying animal and soil interactions from the soil to the plate.

Integrating beef cattle systems into a diverse cropping system is providing a living laboratory for education beyond the traditional classroom setting. To establish the living learning laboratory at the Dickinson Research Extension Center, a five-crop rotation was established that included adapted cool and warm season grasses and broadleaf crops. The crop rotation is: sunflower > hard red spring wheat > fall seeded winter triticale-hairy vetch (hay)/spring seeded 7-species cover crop > Corn (85-95 day varieties) > field pea-barley intercrop. Sunflower and spring wheat are harvested for cash crop income in the rotation. Livestock integration occurs when yearling steers that had previously grazed perennial pastures until mid-August graze field pea-barley and subsequently unharvested corn. Average grazing days for field pea-barley and unharvested corn is 30 and 70 days, respectively. At the end of the grazing period, the yearling steers average 499-544 kg and are moved to a feedlot and fed an additional 75 days until slaughter. Maximizing grazing days and extending the grazing season through integration with the cropping system reduces custom feeding costs and enhances animal profit. Beef cows do not require high quality feed after their calves have been weaned. Therefore, gestating beef cows are an ideal animal to graze cover crops and crop aftermath (residue) after yearling steer grazing and farming operations have been completed. Extending the grazing season for beef cows by grazing cover crops and residues reduces winter feed cost, which is one of the highest expenses in beef cattle production.

Senior research investigating the impact of livestock integration and multi-species cover crop grown within the crop rotation is studying changes in soil attributes resulting from the crop-animal integration by measuring bulk density and in-season soil fertility in the crop rotation. These responses are further contrasted with results from within the crop rotation and responses from perennial native range. Students that become engaged in the research represent a broad cross section of the consuming public and include high school junior and senior students, college undergraduate students that conduct research projects, postdoctoral research scientists engaged in senior level research, agricultural extension educators, and finally, farmer and rancher businessmen. The integrated nature of the research provides a wealth of learning opportunities for these various groups. For the high school students, visits to the living laboratory increase awareness and introduces students to a potential career path in agriculture, natural resource fields, and the many allied vocational fields that support agriculture. When college undergraduate students visit the living laboratory, they seek to address a researchable question or a problem in agriculture, while fulfilling requirements for graduation by conducting a research project. Because postdoctoral students want to be actively engaged in research and advanced learning, they are interested in conducting research in the living laboratory that can be published in peer reviewed journals. Agricultural extension educators, who advise farmers and ranchers, are looking for research results from the living laboratory that can be convey to their constituents. Farmers and ranchers participate in workshop events that give them face-to-face learning opportunities that they can use to effect change in their farm and ranch businesses.

Each of these demographic groups are unique in their interest in the interaction between agricultural production and soil science. The authors will describe and discuss how each of these very different research consumers have been assisted during their experience and involvement in the living laboratory.