Alfalfa benefits dairy crop rotations

Hay & Forage Grower is featuring results of research projects funded through the Alfalfa Checkoff, officially named the U.S. Alfalfa Farmer Research Initiative, administered by National Alfalfa & Forage Alliance (NAFA). The checkoff program facilitates farmer-funded research.

RECENT research on alfalfa's impacts on dairy cropping systems found first- and second-year alfalfa stands accumulated more carbon than older stands. Younger alfalfa pulled carbon from the atmosphere and stored it in soil and roots while third- and fourth-year stands released carbon into the environment, said Alison Duff, dairy forage research ecologist with the U.S. Dairy Forage Research Center (USDFRC).

ALISON DUFF
HEATHCLIFFE RIDAY
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"That's probably because, as alfalfa stands age, they're producing less biomass," said Duff, adding that the research fields' intensive, four-cut harvest schedule likely contributed to stand deterioration. She suggested utilizing practices to improve stand longevity, whether through selecting varieties that allow for fewer cuttings but are still productive and/or highly digestible, or taking steps to reduce compaction and impacts to growing plants at harvest.

"The fewer times you cut will improve resilience of the stand; cutting more frequently will drive stand decline," added Heathcliffe Riday, USDFRC research leader.

The Alfalfa Checkoff-funded research compared cropland emissions, carbon sequestration, and soil health in alfalfa and corn silage, a common rotation on dairies. It was inspired by farmers' concerns over extreme weather and warming trends associated with climate change and their interest in carbon sequestration and mitigating greenhouse gas emissions, according to Duff and Riday.

Three alfalfa and three corn fields at the USDFRC farm in Prairie du Sac, Wis., were measured for in situ soil respiration and soils were sampled for chemical, physical, and biological analysis. Meteorological and carbon flux measurements were gathered through a 30-meter eddy covariance tower on the farm. The carbon balance assessment of corn silage showed it also stored some carbon, probably because it produced a high biomass during the growing season, was harvested only once, and rotated with alfalfa.

Minimize soil loss

The study showed few differences in soil condition between alfalfa and corn silage fields grown in rotation. "We may have found greater differences if we had compared continuous corn silage fields and alfalfa fields," Duff said. "We found instead that the landscape position of the sampling point was predictive of, for example, soil organic carbon or active carbon in the soil. If your sampling point is on a hilltop with more erosion, you probably have less soil organic matter because of its position. In contrast, if you're sampling at the bottom of a hill or where you've had soil deposition from erosion, there's probably a lot more soil organic matter in that soil," Duff asserted.

That illustrates the importance of using farming practices that help preserve soil. "Alfalfa is a part of that solution — finding continuous living cover crops that protect, particularly in fall and spring when more soil is exposed after harvest and before spring growth," she said.

"There were some key differences in the soil biological community," Duff added. "We don't have those data fully analyzed, but we found more diversity in the (fungal and bacterial)

Researchers recorded soil respiration on alfalfa and corn ground to measure carbon balance and impacts of alfalfa within a dairy crop rotation.

PROJECT RESULTS

One- and two-year alfalfa stands were a net carbon sink; alfalfa stands greater than two years old lost carbon. Corn silage fields in 2019 were a net carbon sink due to significant biomass accumulation, one harvest, and rotation with alfalfa.

Soil health metrics didn't differ between the crops, likely because they were grown in rotation with each other. Landscape position did show differences. As alfalfa stands advanced in age, bacterial and fungal diversity improved.

biological community in alfalfa fields, particularly in their second and third growing season."

That shows biological changes build over multiple years of alfalfa growth. Corn silage fields had a less diverse biological community with reduced functional diversity. A statistical analysis will be completed yet this year. This research contributes to ongoing modeling efforts like the Ruminant Farm Systems (RuFaS) Model.

"These types of studies, particularly about landscapes or rotations that we have less information on, help so we can then model whole farming systems to see which are the most sustainable rotations," Riday said.

The Alfalfa Checkoff funding, he stressed, is very much needed. "Checkoff money really does drive alfalfa-centric or alfalfa-based research. There's been a lot more focus on alfalfa and alfalfa research," Riday said.

Duff, whose work involves understanding carbon balance and ecosystem services dairy forage systems can provide, welcomes farmer comments or questions. Her email address is alison.duff@usda.gov. ●

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