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Regenerative Crop Rotation and Livestock Grazing Reduce Nitrogen Input and Greenhouse Gas Fluxes

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"Regenerative agriculture" focuses on alternative production methods. However, among agriculture producers viewing agriculture from a regenerative perspective, soil nutrient cycling is essential for nutrient availability, plant growth, and crop production. Diverse multi-crop rotations are shown to decrease GHG fluxes compared to growing continuous monoculture crops. The four essential components of regenerative agriculture are no-till farming, utilization of diverse specie cover crop mixes, diverse crop rotation that includes cool- and warm-season crops interspersed with winter crops that build soil organic matter and interfere with weed culture further augmented by livestock grazing and waste deposition. Long-term research comparing a spring wheat monoculture crop grown continuously to spring wheat grown in a five crop rotation (spring wheat, winter and summer cover crop, corn, pea-barley, and sunflower) began in 2011. Spring wheat and sunflower harvested mechanically are cash crops. Whereas harvesting of cover crop, corn, and pea-barley is with grazing by yearling beef steers. The integrated system defines a consistent improvement in soil nitrogen mineralization resulting in reduced fertilizer application. Regression analysis of soil organic matter and potential mineralized nitrogen suggests that 8.4 mg N/kg are mineralized for each 1% increase in SOM. Previous research has shown that grazing contributes to increased GHG emissions. Crop rotations are often limited to two to three crops that do not represent the full range of cool- and warm-season crops, but include leguminous crops. GHG fluxes are complex environmental systems sensitive to temperature and precipitation. Year-one, fluxes (CO_2, N2O, and CH4) monitored over a two-year period under grazing and non-grazing conditions received average precipitation and normal max-min temperature modulation. Year-two, characterized as exceptional drought, had severely reduced precipitation and above average max-min temperature modulation. Compared to rotation wheat, sunflower, and cover crop, cumulative CO_2 was higher for continuous wheat, pea-barley, and corn year-one, but not year-two. Cumulative CO_2 and N2O was higher in continuous wheat both years one and two. Compared to all other crops, N2O release from pea-barley was higher year-one, but not year-two. Both study years, grazing decreased cumulative CO_2. Nitrous oxide emission did not decrease due to grazing, when soil moisture was adequate year-one, but decreased during grazing when drought limited soil moisture. Compared to crops such as wheat grown as a monoculture, diverse multi-crop rotations can be beneficial for reducing GHG fluxes and compared to non-grazing, grazing can reduce CO_2 emissions.