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Agronomic strategies in response to changes in agricultural and cropping systems

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Session: 1. Agronomic strategies and transformations

OPTIMIZING NITROGEN INPUT IN SILAGE MAIZE THROUGH COVER CROP MANAGEMENT

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Ecological intensification of cropping systems requires innovative strategies able to reduce synthetic fertilizers inputs, while maintaining crop productivity. This study evaluates the contribution of different cover crops to soil N dynamics and maize (*Zea mays* L.) performance, with the aim of evaluating their potential to reduce mineral N fertilization. A two-year field trial (2022/2023 and 2023/2024) was conducted in Ferrara to evaluate three cover crop treatments [hairy vetch (HV), black oat (BO), and their mixture (HV+BO)] compared to a conventional bare fallow system with full N fertilization. We measured cover crop biomass production, C:N ratio, N accumulation, and mineralization rates, along with silage maize yield and N uptake. Cover crop biomass at maize sowing (0 DAS) varied from 4.61 t ha^{-1} (BO) to 6.98 t ha^{-1} (HV+BO). HV showed the lowest C:N ratio (9.2), indicating high-quality residues with faster N release potential, while BO and HV+BO showed higher values (17.1 and 16.2, respectively). At maize harvest (120 DAS), the remaining cover crop biomass and associated N content reflected differing mineralization patterns. HV had the lowest residual biomass and the highest mineralization rate (78.2%), while BO retained more biomass (1.77 t ha^{-1}) and had lower mineralization (60.9%), suggesting a slower N release. Maize aboveground biomass was strongly affected by soil management and year. Conventional fertilization resulted in the highest yields (20.9 and 15.3 t ha^{-1} in 2023 and 2024, respectively), but HV and HV+BO treatments showed competitive productivity, especially in the first season (17.0 and 16.2 t ha^{-1}, respectively). Notably, BO resulted in significantly lower yields in both years, indicating limited N contribution.. Maize N content and uptake followed similar trends, with the conventional treatment achieving the highest values (up to 1.23% N and 217.9 kg N ha^{-1}), while HV and HV+BO provided substantial N uptake improvements, particularly in 2023 growing season. Results demonstrate that cover crop mixtures (HV+BO) or legume-based systems (HV) can substantially contribute to maize

N nutrition, particularly under favorable seasonal conditions. HV and HV+BO treatments provided up to 78% N mineralization and enabled N uptake levels comparable to the conventional approach, suggesting that strategic cover crop management can reduce reliance on synthetic N. However, seasonal variability in biomass production and mineralization highlights the need for site-specific management. Overall, integrating cover crops, especially hairy vetch, can enhance system sustainability through improved N cycling, though caution is warranted in extrapolating their effectiveness across diverse climatic scenarios. Further research is warranted to refine models predicting N release and to optimize fertilization strategies in integrated systems.