OPTIMIZING WINTER BARLEY (*HORDEUM VULGARE* L.) YIELD AND SOIL HEALTH: IMPACTS OF FOLIAR NUTRIENTS AND PRIMARY TILLAGE PRACTICES ON PRODUCTIVITY AND CO_2 EMISSIONS

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Sustainable precision farming techniques are vital for ensuring global food security and addressing the challenges of climate change. A field study conducted at the Hungarian University of Agriculture and Life Sciences in Gödöllő between 2023 and 2024 explored the impact of soil tillage and foliar nutrient application on winter barley yields, related traits, and soil CO_2 emissions. The experiment utilized a split-plot design with three replications, incorporating four foliar nutrient treatments (Control, Bio-cereal, Bio-algae, and MgSMnZn Blend) and two primary tillage methods (plowing and cultivator). Results revealed that soil CO_2 emissions varied across crop growth stages under both tillage systems, though tillage type itself showed no direct influence. Similarly, leaf chlorophyll content remained unaffected by both tillage and nutrient treatments. Nutrient applications significantly influenced plant height, leaf area index (LAI), and thousand kernel weights (TKW) across the seasons. Both tillage and nutrient treatments had a significant impact on the number of productive tillers and consistently affected grain yield over the two seasons. Furthermore, the interaction between tillage and nutrient treatments significantly influenced grain yield and TKW. Among all treatment combinations, bio-cereal nutrients paired with plowing resulted in the highest values for most parameters throughout the study. These findings highlight the potential of combining bio-cereal nutrient treatments with plowing to improve winter barley yields. Notably, soil CO_2 emissions were highest during the reproductive stage of the crop, exceeding levels observed during earlier growth stages.