



Re-Livestock
RESILIENT FARMING SYSTEMS

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Re-Livestock Abstracts

MULTISPECIES GRASSLANDS: IS THIS THE SOLUTION TO CLIMATE CHANGE AND SUSTAINABLE DAIRY CATTLE SYSTEMS?2

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Multispecies grasslands: Is this the solution to climate change and sustainable dairy cattle systems?

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Application: This study will advance understanding of how multi-species swards influence production performances and methane emissions in dairy cows. Findings will provide a scientific basis for developing sustainable feeding strategies. Future research will focus on elucidating underlying microbial mechanisms and nutrient interactions, supporting further innovation in reducing emissions and improving animal efficiency.

Introduction: The global livestock sector faces the dual challenge of meeting the rising demand for animal protein while mitigating its environmental impact. Ruminants are a major source of anthropogenic methane (CH₄), a potent greenhouse gas (Hargreaves and Rees, 2025). While feed additives have been widely investigated for methane mitigation, agronomic strategies such as the use of multi-species swards (MS) offer a complementary, natural approach (Thomson and Albornoz, 2023). MSS, comprising grasses, legumes, and forbs, are hypothesised to improve nutritional composition and modify rumen fermentation, potentially leading to reduced methanogenesis and enhanced animal performance (Hassan et al., 2025). This in vivo study tests the hypothesis that grazing on multi-species swards mitigates methane emissions and improves productivity in lactating dairy cows compared to traditional grass or grass-clover systems (Teagasc, 2023).

Materials and methods: A total of 45 lactating Holstein dairy cows were allocated to 15 blocks balanced by lactation number, calving date, milk yield, live weight, and body condition score. Within each block, cows were randomly assigned to one of three grazing treatments: (1) a perennial ryegrass (*Lolium perenne*) monoculture supplemented with 9 kg of DM concentrate d⁻¹ (G, control group), (2) a perennial ryegrass and white clover (*Trifolium repens*) mixture with the same concentrate level (G/C), and (3) a multi-species sward (MS) consisting of perennial ryegrass, timothy (*Phleum pratense*), white clover, red clover (*Trifolium pratense*), plantain (*Plantago lanceolata*), chicory (*Cichorium intybus*), and birdsfoot trefoil (*Lotus corniculatus*), also supplemented with 9 kg of DM concentrate d⁻¹. The 10-week experiment was conducted under a rotational grazing system. Concentrates were provided through the milking parlor and via individual C-Lock GreenFeed units (C-Lock Inc., Rapid City, SD). Live weight was automatically recorded daily after milking, and milk yield was measured at each milking event. Weekly composite milk samples were collected and analysed for fat, protein, lactose, urea, and somatic cell count using infrared spectroscopy (MilkoScan FT6000, Foss Analytical, Denmark). Individual gas exchanges (CH₄, CO₂, H₂, and O₂) were measured daily using the GreenFeed system. Data were analysed using linear mixed-effects models in R (version 4.3.2), with treatment, week, and their interaction as fixed effects, and cow and block



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as random effects. Pairwise comparisons were adjusted using Tukey's HSD test, and statistical significance was declared at $P < 0.05$.

Results: Milk yield was significantly increased by treatments compared to G ($P < 0.01$). The MS treatment consistently increased milk yield compared to G at weeks 2, 4, 8, and 10 ($P < 0.05$), while G/C yield was higher than G at weeks 4, 6, and 10. Live weight was higher for G/C than for G at week 10 ($P = 0.027$). Critically, methane emission intensity (CH₄ per unit of milk produced) was significantly reduced in treatments compared to G ($P = 0.021$). Compared to G, MS decreased CH₄ intensity at weeks 4 and 6, while G/C decreased it at weeks 6 and 8 ($P < 0.05$). While there is no effect showing in the other weeks. This indicates that a time-dependent and treatment-specific reduction in methane emission intensity was observed, with MS showing earlier effects (weeks 4 and 6) and G/C exhibiting later responses (weeks 6 and 8), potentially reflecting rumen microbial adaptation and changes in lactation dynamics. Daily production of CH₄ decreased in G/C at week 8 compared to G ($P < 0.05$). For milk composition, in the treatment effect, both G/C and MS decreased fat percentage but increased lactose percentage and milk urea concentration compared to G ($P < 0.05$), aligning with typical responses to improved protein supply and energy balance from diverse swards.

Conclusions: This study shows that multi-species swards offer a practical agroecological solution for more sustainable and productive grazing dairy systems. The multi-species (MS) treatment increased milk yield, while both MS and grass-clover (G/C) swards significantly lowered methane intensity at specific time points during the experimental period. These results provide strong in vivo evidence that pasture diversification can enhance productivity and environmental performance, supporting the transition toward low-emission dairy production systems.



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