Optimization of nitrogen use efficiency in ryegrass pastures

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Brazil is the world leader in pasture-based cattle farming, highlighting the importance of optimizing pasture utilization through efficient fertilization. This study aimed to assess the efficiency of nitrogen (N) use from different fertilizer sources in ryegrass (*Lolium multiflorum* Lam.) pastures in southern Brazil. The experiment was conducted at the Experimental Station of the Federal University of Rio Grande do Sul, in Eldorado do Sul, during 2021 and 2022. Twelve paddocks, each approximately 1.5 hectares (ha), were utilized arranged in a randomized complete block design with four treatments and three replicates. The treatments included a control (no N), urea (46% N), ammonium nitrate (NH_4NO_3, 32% N), and a mixture of ammonium nitrate with calcium and sulfur (NH_4NO_3+, 27% N + 5% Ca + 3.7% S). Fertilized paddocks received 60 kg N ha^{-1} in each stocking season. Pasture management was conducted under continuous stocking with put-and-take animals to maintain swards at 20 cm, following the "Rotatinuous" grazing concept (i.e., sward target that decrease grazing time per unit of dry matter ingested). The daily herbage accumulation rate was monitored using three grazing exclusion cages per paddock. The total herbage production over the stocking season was determined by summing up the herbage mass at the beginning of the stocking season and the herbage accumulation for each stocking period. The plant's total nitrogen content was measured using the Kjeldahl digestion method. The agronomic efficiency (AE) of N was calculated using the equation: AE=PP-PP0F, where PP is the primary production of the fertilized treatments (kg DM ha^{-1}), PP0 is the primary production (kg DM ha^{-1}) in the control treatment, and F is the amount of nitrogen applied in the pasture. The application of N increased the total N content of the fertilized pastures at the beginning of grazing for all N sources. However, after 28 days, there were no significant differences in N content among treatments, indicating a reduction in forage quality as the phenological cycle advanced . N use efficiency was highest in the NH_4NO_3+Ca+S treatment, producing 63.3 kg of DM.ha^{-1} per kg of applied N, compared to 35.07 kg of DM.ha^{-1} for urea and 28.6 kg of DM.ha^{-1} for NH_4NO_3. The synergy between S, Ca, and N in the NH_4NO_3+Ca+S treatment was presumed to be a factor for increased efficiency in ryegrass. This study highlights the importance of selecting the appropriate N source and balancing the N, S, and Ca to maximize fertilizer efficiency in ryegrass pastures.

Keywords: Grazing, Pasture management, Ryegrass, Nitrogen (N), Fertilizer sources, Agronomic efficiency