Different Water Regimes and the Nitrogen Nutrition Index in Ryegrass Pastures

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Nitrogen (N) is one of the primary nutrients used by forage plants, and root nitrogen absorption is highly dependent on soil water content. As climate change models predict an increase in extreme weather events in the coming decades, the intensity of rainfall is likely to become more extreme, leading to heightened risks of flooding and soil erosion. Ryegrass pastures succeeding rice in paddy fields are particularly vulnerable to such conditions, which are expected to worsen. Thus, the objective of this study was to evaluate the nitrogen nutrition index (NNI) in ryegrass *(Lolium multiflorum)* plants under waterlogging conditions in the subtropical region of Brazil. The experiment was conducted at the Agronomic Experimental Station of the Federal University of Rio Grande do Sul, located in Eldorado do Sul-RS, Brazil, between May and November 2022. The experimental design was a completely randomized block with split plots and three replications. The treatments consisted of two water regimes: waterlogged soil and no irrigation, and three different nitrogen doses (0, 75, and 150 kg N ha^{-1} as ammonium nitrate). The cutting regime followed the "Rotatinuous" concept, with sward targets simulating rotational stocking in 10 m x 5 m plots. When the plants, monitored twice a week, reached an average height of 20 cm, three random cuts of forage mass close to the ground were performed within a 0.25 m² frame. After collection, mowing was done mechanically, removing 40% of the initial sward height, leaving a residual height of 12 cm. The biomass samples were then dried and weighed to determine dry matter content. Subsequently, the samples were ground and analyzed for nitrogen content (Nact) in their tissues using the Kjeldahl method. To calculate the NNI, the formula used was: NNI = Nact / Ncrit, onde Ncrit = a x W^{-b} where a is the critical N uptake when W (biomass) = 1tha^{-1} and b is the allometric ratio between the relative N uptake rate and the relative biomass accumulation rate, Nact=concentration of N in biomass e Ncrit = a critical concentration below which the accumulation of W decreases. The data were subjected to ANOVA at a 5% significance level, and means were compared using Tukey's test, also at a 5% significance level. There was no significant difference in total biomass production between the water regimes. However, biomass production was lower for the 0N treatment (2,031 ± 560 kg DM ha^{-1}) when compared to the 75N and 150N doses (4,136 ± 350 and 4,771 ± 413 kg DM ha^{-1}, respectively). The treatment without irrigation and N0 showed an NNI of 0.22 ± 0.03, which was lower than that observed for the 75N treatment, which had an NNI of 0.34 ± 0.02. The 150N dose (0.31 ± 0.03) did not differ significantly from either of the other treatments. In contrast, the waterlogged treatment resulted in a lower NNI (0.29 ± 0.02) compared to non-waterlogged soil. The excess water in the soil negatively affected ryegrass by reducing the availability of oxygen to the plant roots, leading to hypoxia or anoxia. This anaerobic environment hampers the metabolic activity of roots, negatively affecting their absorption capacity. Therefore, it is concluded that NNI can be adversely affected by soil water saturation, which decreases N use efficiency in ryegrass.

Keywords: Nitrogen fertilization, soil waterlogging, biomass production