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Application of Magnesium and Calcium Sulfate on Growth and Physiology of Forage Crops under Long-Term Salinity Stress

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[Introduction]

Approximately 8% of the world's irrigated land is located in arid and semi-arid areas where soil salinization occurs. Forage crops can be fed to cattle directly or processed through partial drying feeds can be classified as bulky feeds or concentrates as a result of this processing. Harsh environmental conditions, salt, drought stresses, and high temperature during the growing season increase polysaccharides in cell walls and reduce soluble carbohydrates, thereby leading to increased acid detergent fiber (ADF) and neutral detergent fiber (NDF), and decrease the crude protein (CP). Calcium and magnesium are the most abundant cations in plants. Plant nutrient deficiencies could occur when high concentrations of Na in the soil decrease the available Ca^{2+} and Mg^{2+}. Magnesium is identified as an essential nutrient of plant. Furthermore, the effect of $MgSO_4$ and $CaSO_4$ application on forage crops under long-term salt stress has not been thoroughly explored. As a result, the current study was designed to investigate and determine the effect of $MgSO_4$, $CaSO_4$ on forage crops grown in a saline environment.

[Material and Methods]

The experiments were carried out in a greenhouse at Chungnam National University from November 2021 to October 2022. Seeds of *T. pratense* (2 kg/ha) and *F. arundinacea* (1 kg/ha) were sown in 38.5 L pots (55x35x20 cm) with sandy clay soil on 4, November 2021. Experimental treatments were: control—namely CON (no stress, no additional application of $CaSO_4$, and $MgSO_4$); salinity stress—namely NaCl (100 mM NaCl); salinity + $MgSO_4$—namely 1 MS ($MgSO_4$ 1 mM + NaCl 100 mM); 2 MS ($MgSO_4$ 2 mM + NaCl 100 mM); and salinity + $CaSO_4$—namely 7.5 CS ($CaSO_4$ 7.5 mM + NaCl 100 mM); 10 CS ($CaSO_4$ 10 mM + NaCl 100 mM). The first measurement of biomass was done on 60 DAT, and second measurement was done on 120 DAT. The SPAD value, leaf area, photosynthetic rates, and elemental analysis, CP, NDF, ADF were measured.

[Results and Discussion]

Salinity stress and high temperature had a strong inhibitory effect on germination, seedling growth through osmotic stress, ion-specific phytotoxic effects and oxidative stress. Our results suggest that plant growth (total height, stem, and root lengths) was reduced in all treatments compared to the CON, and the height reduction in NaCl was highly pronounced when compared to other treatments, although the application of $MgSO_4$ and $CaSO_4$ showed superior adaptability when compared to solely salt applied plants. Furthermore, salinity decreased the SLA and SPAD values, and the SLA result was similar between the short-term and long-term treatments in both species. Some studies agreed to our finding that leaf area and SPAD values were reduced by increasing salinity concentration. Furthermore, photosynthesis is the most crucial process that occurs in plants. Our findings demonstrated that the use of MS and CS treatments was able to overcome the inhibitory effect of salt stress on the photosynthetic rate. Salinity stress caused an increase in levels of Na in all parts of the *T. pratense* and *F. arundinacea* in all treatments. The highest Na concentration was found in the roots followed by stem. Ca concentration in the leaf was found highest in T. pratense in short-term salinity exposure, which could be explained by the rapid increase in cytosolic calcium concentration. Crop quality is often indicated by crude protein and fiber. Our results suggest that treatments including sole salinity decreased the NDF and ADF content and increased the CP contents in both species. Our results showed a significant decrease in growth variables, dry weight, SLA, and photosynthesis rate; these are the most relevant parameters to evaluate the inhibition of growth induced under salinity stress. However, crop quality showed improved results under treatments. Therefore, it could indicate salt tolerance in both species.

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