Theme 1
Status and trends of global soil nutrient budget

The potential of silicon, Trichoderma, and organic matter to promote the growth of forage sorghum under saline stress

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INTRODUCTION

The element silicon is widely reported in the literature as an attenuator to saline stress, arousing interest in vegetable production (CANTUÁRIO et al., 2014). Silicon improves plant resistance to abiotic stresses, such as soil salinity, acting mainly in photosynthetic regulation, activation of antioxidant enzymes, forming a silica barrier in the roots to reduce the passage of salts to the shoot and increase production osmoregulatory (COSKUN et al., 2016). In addition, when combined with other mitigators, the mitigation capacity of silicon can be improved.

Organic matter of animal origin promotes improvements in the soil and enables more favorable cultivation conditions in the face of the salinization process or the use of saline areas. In addition, it has a low acquisition cost or is readily available in most rural properties. According to Freire and Freire (2007), organic conditioners (cattle manure) contribute to the reduction of the percentage of exchangeable sodium (ESP) in the soil, possibly due to the release of CO_2 and organic acids during the decomposition of organic matter, in addition, to act as a source of calcium and magnesium, which can replace sodium in the exchange complex.

Trichoderma harzianum is a fungus that has a symbiotic relationship with plant roots and releases various compounds that improve plant resistance to abiotic stresses, especially salinity (AFZAL et al., 2006). In addition to improving root growth, antioxidant enzyme activity, osmoregulatory production, and photosynthetic rate, which are mechanisms that control the level of salinity tolerance (ZHANG et al., 2019).

The works reported in the literature have studied the isolated effects of these saline stress mitigators, and efforts need to be made to test the effectiveness of their interaction. With this, the objective was to investigate the ability of Trichoderma harzianum and organic matter to maximize the action of silicon as attenuating salinity and promoting plant growth in sorghum.

METHODOLOGY

The study was carried out in the field, at the Parnamirim Irrigated Agriculture Station – EAIP, of the Federal Rural University of Pernambuco, Parnamirim, Pernambuco, Brazil (8º 5' 19" S; 39º 34' 40" W, altitude 390 m). The climate of the region is characterized as semiarid type BSwh', according to the characterization of Köppen. The experiment was installed in a Fluvisol, classified as saline according to Richards (1954).

The experiment was arranged in a randomized block design, with five treatments and four replications. The treatments consisted of testing the effectiveness of the attenuating Trichoderma harzianum (T) and organic matter (OM) to improve the performance of silicon (SI) in mitigating salinity in sorghum (Sorghum bicolor [L.] Moench), cv. Sudan. Thus, the treatments were: control (sorghum without attenuating); sorghum + SI; sorghum + SI + OM; sorghum + SI + T; and sorghum + SI + T + OM. The spacing adopted was 0.50 m between rows and 20 plants per linear meter. The dimensions of the experiment were 20.0 x 16.5 m for the total area, 4 x 4 m for the plots, and 2 x 2 m for the useful plots.

The study was conducted between June and September 2021, totaling 90 days. During this period, there was no rainfall. The experiment was irrigated using a drip irrigation system, with emitters spaced at 40 cm and an application interval of 48 hours. Irrigation was performed based on the total replacement of crop evapotranspiration (ETc) (ALLEN et al., 1998). The water for irrigation came from an artesian well. The water was classified as C4S1, with a very high risk of promoting soil salinization and a low risk of sodification, according to Richards (1954).

T. harzianum was applied via soil, applying 39.06 mL of solution per linear meter, following the planting line. The solution concentration was 250 mL 20 L-1, as recommended by the manufacturer.

Potassium silicate, the source of silicon used in this work, was applied twice via soil and two foliar applications. 39.06 mL m-1 linear was applied under both conditions.

The organic matter, composed of goat manure, was applied at the time of sowing in the proportion of 50 t ha-1.

At the end of the cycle, biometry was performed to determine the height, stem diameter, and the number of tillers of the plants. Data were subjected to analysis of variance and the Scott-Knott test at the level of 5% probability, using the statistical program Rstudio (R Core Team, 2019).

RESULTS

Both T. harzianum and organic matter in association with silicon, and the interaction between the three, promoted a significant increase in plant growth compared to the control (Figure 1A). Isolated silicon did not promote a significant difference for this same variable. Silicon increased plant height by 14.78%, and when associated with OM, T. harzianum, or a mixture of both, this increase was 30.62%. Due to the high saline concentration present in the soil, silicon alone could not alleviate the damage caused by salts to plants. There was no significant difference in stem diameter (Figure 1B). The highest values were found for the control and the SI + T treatment (Figure 1C).

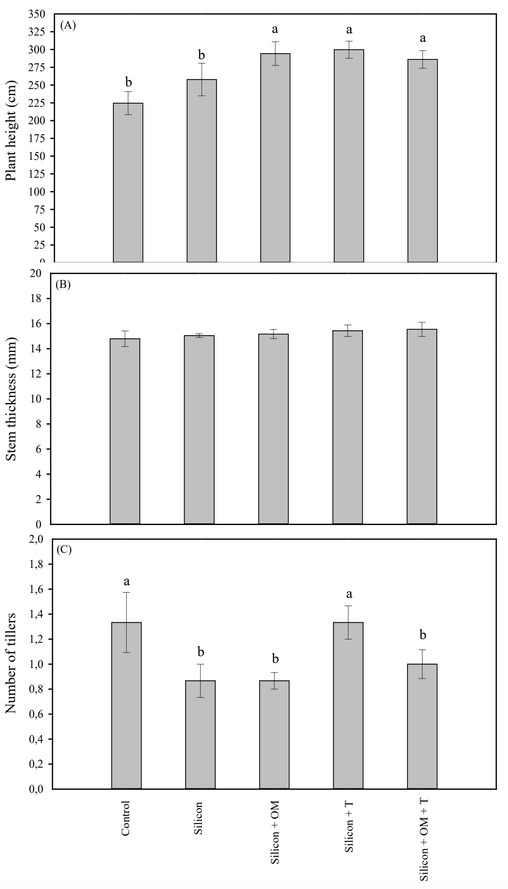

Figure 1. Plant height (A), stem thickness (B), and the number of tillers (C) in sorghum plants under saline stress as a function of the use of tested attenuators.

CONCLUSIONS

The results proved that the combination of silicon with *Trichoderma harzianum* or organic matter is more effective in alleviating the harmful impacts of salts on the growth of sorghum plants.