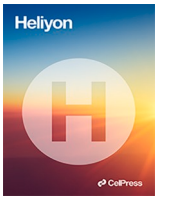
Heliyon 10 (2024) e38159

Contents lists available at ScienceDirect

Heliyon

journal homepage: www.cell.com/heliyon



Research article

Role of organic amendments in improving the morphophysiology and soil quality of *Setaria italica* under salinity

Israt Jahan Irin [a,*], Mirza Hasanuzzaman [b]

[a] Department of Agronomy, Khulna Agricultural University, Khulna, 9100, Bangladesh
[b] Department of Agronomy, Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka 1207, Bangladesh

ARTICLE INFO

Keywords:
Duckweed
Organic amendments
Rhizobium bacteria
Soil bacteria
Soil fertility

ABSTRACT

Salinity negatively impacts soil fertility by impairing the development and physiological functions of foxtail millet plants. Organic amendments have emerged as a viable solution in the reclamation and management of salinity inflicted soils and improve the performance of crop. In this regard, a pot experiment was carried out to examine the effect of organic amendments (OAs) on soil quality and its influence on the growth and physiology of foxtail millet under saline and non-saline condition. The findings indicated that under salt stress conditions, the levels of proline, hydrogen peroxide (H_2O_2), and electrolyte leakage (EL) risen, whilst other physiological parameters decrease in foxtail millet. However, the addition of OAs, particularly dhaincha and biochar (BC), has shown a promising salt tolerant amendment among others. Its addition improved the growth performance of salinity-stressed plants, including plant height, fresh and dry biomass, simultaneously decreased sodium ion (Na^+) and improved calcium (Ca^{2+}), potassium (K^+), and nitrate ion (NO_3^-). They also increased proline build up by 6–17 %, reduced H_2O_2 (19–38 %) and malondialdehyde (16–18 %). Furthermore, they elevated the relative water content (RWC) (25 %), chlorophyll content, and reduced EL (29–50 %). Once more, dhaincha and BC enhanced the number of rhizobia, phosphorus-solubilizing bacteria (PSB) and overall bacterial population in the soil. In saline soil, daincha and BC could enhance soil organic matter (628 %), total nitrogen (1630 %), available phosphorus (32–38 %), and exchangeable potassium (54–73 %). A potential strategy for improving *setaria italica* performance under salt is suggested to be the following order, dhaincha > biochar > vermicompost > duckweed. The study would assist stakeholders in these salinity-prone areas in strategizing the use of OAs to their fallow land for cultivation and agricultural activities.

1. Introduction

Salinity is a significant abiotic factor limiting crop growth, yield, and the sustainability of cultivable land in agricultural soils worldwide. According to FAO data, the global extent of salt-affected soils covers 424 million hectares of topsoil and 833 million hectares of subsoil, accounting for 73 % of the land [1]. Celleri et al. [2] and Shahid et al. [3] report that more than 1.2 billion hectares of land are affected by salinity globally and this figure is rapidly increasing by 10 million hectares per year, adversely affecting crop yields. Salinity impacts plants by causing oxidative stress, osmotic stress and ion toxicity, all of which hinder seedling growth and

* Corresponding author.
E-mail addresses: isratjahankau20@gmail.com (I.J. Irin), mhzsauag@yahoo.com (M. Hasanuzzaman).

https://doi.org/10.1016/j.heliyon.2024.e38159
Received 8 May 2024; Received in revised form 11 September 2024; Accepted 18 September 2024
Available online 19 September 2024
2405-8440/© 2024 Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).