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Regeneration and utilization of salt-affected soils using salt-tolerant grass species

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Introduction

Salt-affected soils cover substantial areas particularly in arid and semi-arid zones with an increasing trend under changing climatic conditions. Regeneration and utilization of these soils is important for sustainable development in the affected areas. Moderately and highly saline soils, where conventional agriculture is not possible, are most suitable for saline agriculture (Negacz *et al*., 2022). Salt-tolerant plant species including crops, trees, shrubs, and grasses offer an economical and sustainable solution for the regeneration of the salt-affected soils and transferring these areas into sustainable agro-ecosystems (Saqib *et al*., 2020). This study demonstrates the potential of five salt-tolerant grass species to regenerate and utilize the salt-affected soils.

Figure 1: View of the growth of grasses in the salt-affected field.

Methodology

Five grass species including *Leptochloa fusca, Panicum antidotale*, *Sorghum Sudanese*, *Chloris gayana*, and *Cymbopogon martini* were planted in a salt-affected field. The field was cultivated and prepared for sowing and planting. Irrigation was done with poor quality tubewell water as and when required following flood irrigation method. Soil and water samples were collected and analyzed at the start and harvesting of the experiment. The sampling and analyses of these soil and water samples were carried our following standard techniques and procedures for the purpose. The grasses were harvested at an interval of six months, and plant height and shoot fresh weight were recorded. Plant samples were collected, oven-dried, dry ashed, acid dissolved and analysed for Na^+, K^+ and Cl^- following Saqib *et al.* (2020).

Table 1: Growth performance of different grass species in salt-affected field

Grasses	Height (cm)	weight (kg m^{-2})
Leptochloa fusca	264d	5.48 c
Panicum antidotale	321b	22.6 b
Sorghum sudanese	401a	35.6a
Chloris gayana	295c	6.24c
Cymbopogon martini	244.5d	7.03c

Table 2: Leaf ionic composition of different grass species in salt-affected field

Grasses	Na^+ (mmol g^{-1} dry wt.)	K^+ (mmol g^{-1} dry wt.)	Cl^- (mmol g^{-1} dry wt.)
Leptochloa fusca	0.319 b	0.169 e	0.353 b
Panicum antidotale	0.265 c	0.187 de	0.336 b
Sorghum sudanese	0.376 a	0.151 i	0.421 a
Chloris gayana	0.222 d	0.211 d	0.270 de
Cymbopogon martini	0.196 de	0.161 ef	0.305 c

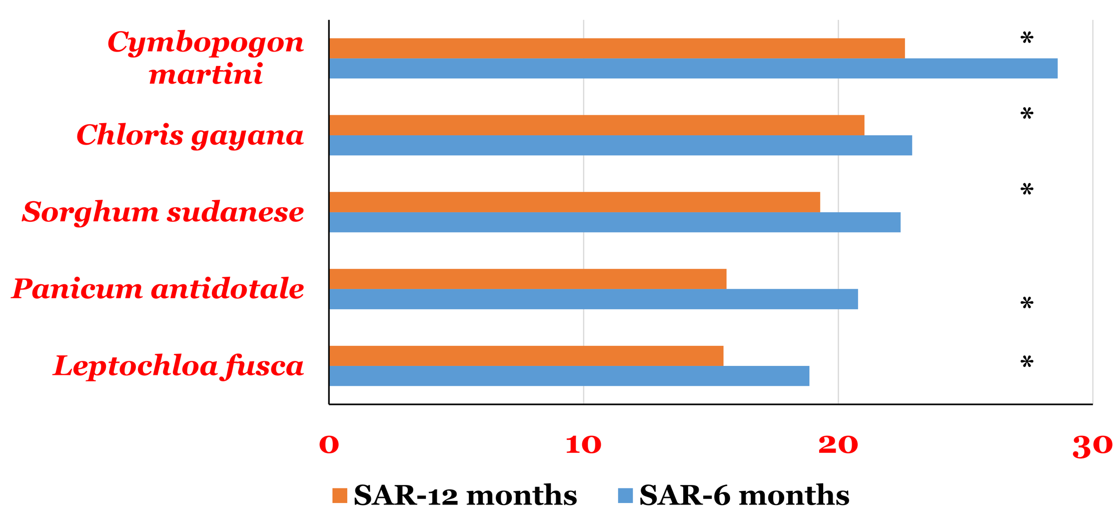

Figure 2: Rehabilitation of salt-affected soil in terms of reduced SAR (sodium adsorption ratio; $(mmol\ L^{-1})^{1/2}$)

Results and Discussion

The grass species differed significantly for their growth performance. The plant height was maximum for *Sorghum sudanese* and was minimum for *Cymbopogon martini*. The fresh weight was maximum for *Sorghum sudanese* and minimum fo*Leptochloa fusca* which was statistically at par with *Chloris gayana* and *Cymbopogon martini* (Table 1). Different grass species differed significantly for leaf sodium, potassium and chloride accumulation (Table 2). Chemical properties of soil under experiment showed significant differences among different grass species however, a significant regeneration of the salt-affected soil has been observed based on the soil analysis (Figure 2-3).

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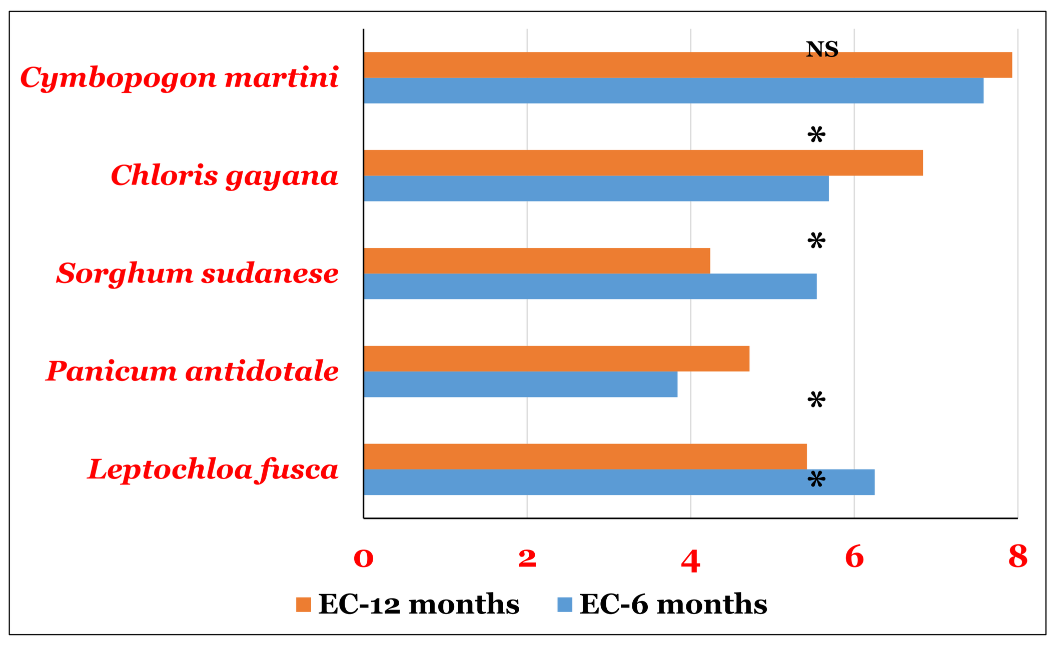

Figure 3: Rehabilitation of salt-affected soil in terms of reduced EC (electrical conductivity; dS m^{-1})

The better performance of *Sorghum sudanese* in biomass production relates positively with leaf potassium and negatively with leaf sodium and chloride. However, the vice versa is true for the poor performance of *Cymbopogon martini*. Therefore, maintenance of high shoot potassium and low shoot sodium and chloride are important for salt-resistance and basis of genotypic differences (Saqib et al. 2020). Most of the grass species were successful in regenerating the salt-affected soil based on soil EC, SAR and pH, however with different potential of different grasses (Figure 2-3).

Conclusions

The grass species reported here can be successfully used for regeneration and utilization of salt-affected soils however they differ in salt tolerance and regeneration potential.

References

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