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Comparative Effect of Nitrogenous Fertilizers on Mobilization and Absorption of Phosphorus by Wheat in Saline - sodic Soil

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Introduction

Salt-affected areas in the world are about 1,120 million hectares (mha), of which the extent of saline soils is 397 mha and sodic soils have 434 mha. Like other arid and semi-arid regions, soil salinity is also a major problem for agriculture and crop cultivation. The salt-affected area in Pakistan is 6.70 mha. Salt stress affects 20% of total farmed land and 50% of irrigated regions across the world [1].

In Pakistan, wheat production is low in salt-affected regions where 64% of yield losses and 14% of irrigated land are affected by salinity [1]. Proper nutrient management in salt-affected soils can ameliorate the adverse effects of salinity on crop yields. Nitrogen (N) and phosphorus (P) significantly improve the growth as well as yield of crop in saline-sodic soils. In salt-affected soils, nutrients use efficiency is decreased particularly if the nutrients are not well matched to plant vegetative growth [2]. But P has low mobility and high fixation rates; particularly in calcareous soils, saline soil has a significant effect on P mobility and bioavailability. Due to high pH, the majority and the used P is fixed in the soil with calcium and magnesium. A small fraction (10 - 20%) is available to the crop and remaining is fixed. In the low pH soils, the P is fixed with iron and aluminum and becomes unavailable to plants. But up to 80% P can be recovered in many soils using proper management practices [3]. Furthermore, N addition and its availability increases the N deposition in soil and thus changes soil P availability, altering the balance between P and N supply through manipulating the soil properties such as pH and phosphate activity. Keeping in view the effect of N on P availability, the current study the following objectives were carried out to achieve:

1. To check the comparable impact of various P and N fertilizers on wheat growth in salt-affected soil.
2. To check the effect of N fertilization on P availability in saline soils.

Methodology

A pot experiment was carried out to study the production response of wheat (*Triticum aestivum* L.) to different N and P-fertilizers to check the P absorption by wheat under saline-sodic soils.

Table 1: Treatment plan.

Treatments	Description
T1	Control
T2	DAP + CAN
T3	DAP + AMS
T4	SSP + Urea
T5	SSP + CAN
T6	SSP + AMS

Three forms of nitrogen as urea, calcium ammonium nitrate (CAN) and ammonium sulphate (AMS) and two forms of phosphorus *viz.* diammonium phosphate (DAP) and single super phosphate (SSP) were applied with four replications under completely randomized design (CRD). Soil properties (pH, EC, SAR), while N and P in soil and plants were analyzed. Plant height, relative water content, root, shoot fresh and dry weight were also recorded.

Table 2: Fertilizers application rates.

Fertilizers	Application rates (kg ha^{-1})
DAP	184
SSP	424
CAN	512
AMS	636
K	60
Urea	288

Results and Discussion

The maximum shoot fresh weight (5.67 g plant^{-1}), plant height (76 cm), spike length (11.3 cm), grain weight (4.0 g), root length (16 cm) P concentration in shoot (0.35%), Olsen P (8 ppm) and N in shoot (0.45%) was observed in saline soil with the application of AMS compared to control. In this research we conclude that application of ammonium sulfate and SSP both in combination increased plant growth on salt-affected soil.

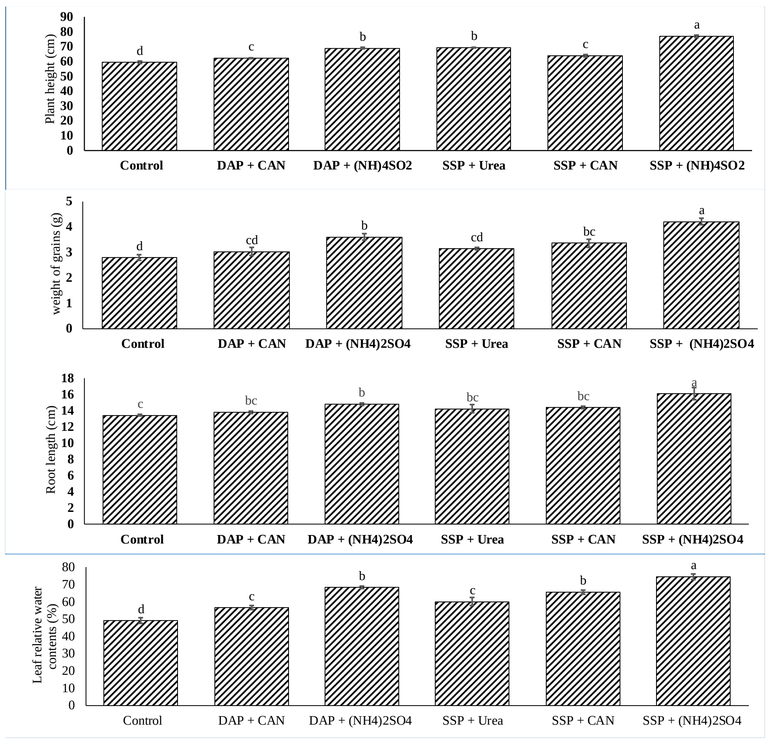

Figure 1: Effects of applied treatments on wheat growth, yield, and physiological attributes.

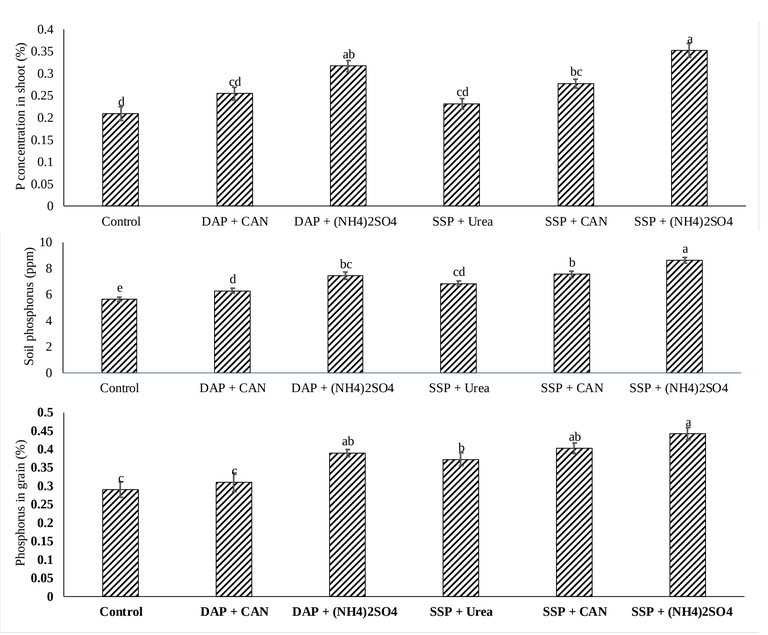

Figure 2: Effects of applied treatments on P concentration in soil and wheat.

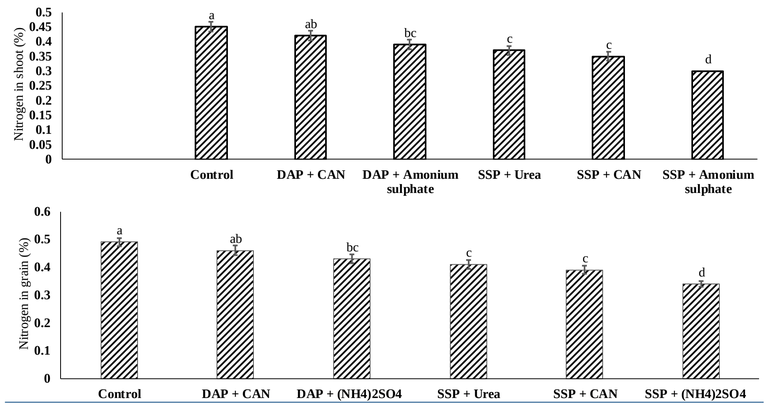

Figure 3: Effects of applied treatments on N concentration in soil and wheat plants.

Conclusions

Among all three N fertilizers, application of CAN, AMS and SSP showed more increase in soil P availability. Moreover, SSP is effective in increasing plant growth in saline-sodic soils. Nitrogen concentration in shoots of wheat plant also affected by saline soils, however application of nitrogenous fertilizers and DAP showed increase in the N concentration of wheat. N concentration was observed to be increased remarkably with the application of urea compared to other nitrogenous fertilizers So, it was concluded that all N and P fertilizers increased wheat growth, particularly AMS and phosphatic fertilizer in the form of SSP in saline-sodic soil.

References

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International Network of Salt-Affected Soils

Salt-affected soils: threats and potentials

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