Potassium nitrate foliar applications maximise yield of salt tolerant wheat under saline conditions

Optimal supply of mineral nutrients at the right crop stage can be effective to ameliorate the deleterious effects of salinity and help to sustain productivity under salt stress. A trial in pot-grown wheat was performed in East Azerbaijan, Iran, to investigate the interactive effects of potassium nitrate as foliar spray and silicon (as K_2SiO_3) in the nutrient solution in alleviating NaCl-induced injuries. After laboratory screening of three winter wheat cultivars, the most salt tolerant (cv. Pishgam) was chosen to be used in a greenhouse trial. Five plants per pot (25 cm Æ) were grown in 1:1 perlite:vermiculite hydroponic substrate. Plants were watered daily with 1 L of Hoagland's nutrient solution (pH 5,6) and at the trifoliate stage three dosages of both NaCl (20; 60 and 100 mmol NaCl L^{-1}) and silicon (0; 2 and 4 mmol K_2SiO_3 L^{-1}) were added to the nutrient solution. Potassium nitrate foliar sprays in four concentrations (0; 0,5; 1 and 2 g/L) were applied twice, at stem elongation and booting stage. The treatments were arranged in a 4×3×3 factorial randomized complete block design with three replications.

Content of Na, K and Si in the whole plant at harvest and amount of proline and chlorophyll in the flag leaf, and relative water content and photosynthetic active radiation of the flag leaf at seed filling, were all significantly affected by the three factors salinity, potassium nitrate and silicon. It was found that NaCl stress significantly increased proline accumulation and sodium content in the plant tissues while it decreased potassium accumulation by plants. However, exogenous application of silicon and potassium nitrate reduced sodium uptake, increased

potassium and consequently improved plant weight, 100-seed weight, seed yield, ear length, and photosynthesis rate.

A strong positive correlation was found between K content of the plant and all yield parameters, and a strong negative correlation between these parameters and sodium content (Table 1). The flag leaf's relative water content, photosynthetic active radiation and chlorophyll content were strongly correlated with ear length, and ear length was an important determinant of seed yield.

The main factor influencing ear length positively, was the dosage of potassium nitrate in the foliar spray, and there was no interaction of KNO_3 dosage with salinity (Figure 1). Salinity decreased ear length, and there was an interaction between the effects of silicon and salinity on this parameter. The highest seed yield was obtained when 4 mmol L^{-1} silicon and 2 g L^{-1} potassium nitrate were applied. Salt stress decreased seed yield regardless of the silicon rate in the nutrient solution, but silicon application improved seed production at each level of NaCl.

The authors conclude that utilization of the salt-tolerant wheat cultivar (Pishgam) combined with two foliar applications of potassium nitrate (2 g L^{-1}) at stem elongation and the wheat booting stage and addition of silicon (4 mmol L^{-1}) in the fertigation can be a promising approach to obtain higher grain yield on saline lands.

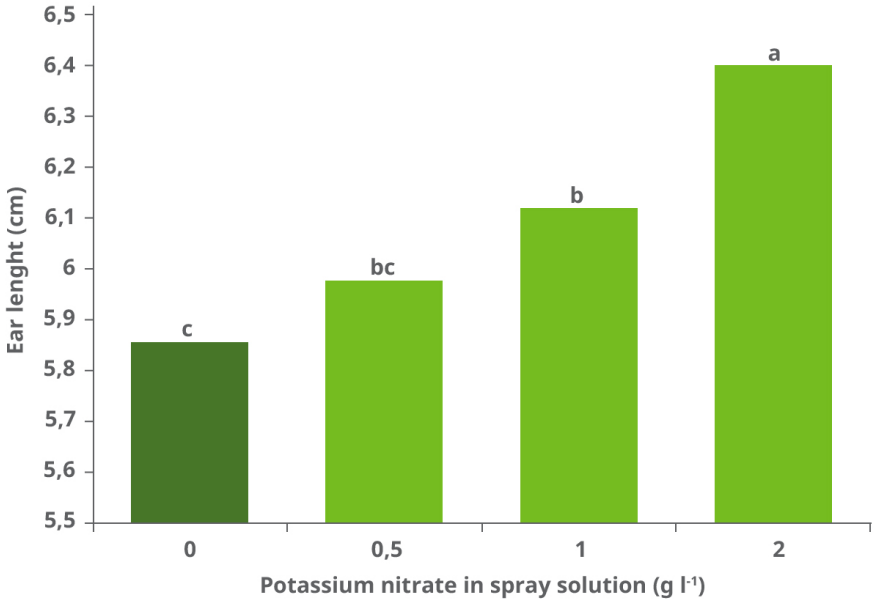

Figure 1. Main effect of potassium nitrate foliar application on ear length, averaged over all salt conditions and silicon rates. Columns labelled with the same letter are not significantly different (Duncan's, 5%).

Table 1. Correlation coefficients between different traits of wheat affected by salinity, silicon and potassium nitrate (ns=no statistically significant correlation).

-	A	B	C	D	E	F	G	H	I	J
A	1	-	-	-	-	-	-	-	-	-
B	-0,43	1	-	-	-	-	-	-	-	-
C	-0,43	Ns	1	-	-	-	-	-	-	-
D	-0,53	0,53	-0,19	1	-	-	-	-	-	-
E	-0,83	0,65	0,26	0,74	1	-	-	-	-	-
F	-0,43	0,47	ns	0,70	0,68	1	-	-	-	-
G	-0,75	0,66	ns	0,83	0,96	0,77	1	-	-	-
H	-0,79	0,68	ns	0,79	0,94	0,66	0,93	1	-	-
I	-0,86	0,60	ns	0,76	0,91	0,70	0,90	0,92	1	-
J	-0,82	0,62	0,21	0,60	0,86	0,46	0,81	0,85	0,82	1

A = Na
B = K
C = Si
D = Plant weight
E = Seed yield
F = 100 seed weight
G = Ear lentgh
H = Rel. water
I = Chlorophyll
J = Photosynthesis