Short Communication

SPECIFIC ION EFFECT ON THE EARLY GROWTH IN WHEAT *(TRITICUM AESTIVUM* L.)

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Studies were carried out in the glass-house in plastic pots (15 cm dia.) in sand culture using Hoagland nutrient solution to find out the specific ion effect on the early seedling growth in wheat (*Triticum aestivum L*), c.v. K-227. Seeds were sown in sixteen different solutions of chloride, sulphate, nitrate, carbonate salts of sodium, potassium, calcium and magnesium used each at —2 bar osmotic po ential. Osmotic as well as salt stress decreased tremendously almost all the parameters of growth studied (germination, plant hegiht, fresh and dry weight of roots and shoots). There was lesser reduction in growth in potassium and calcium salts than that in sodium and magnesium salts. Overall effect of anions showed that carbonate, bicarbonate, dihydrogen phosphate salts reduced growth more than chloride, sulphate and nitrate salts. In general, the crop growth response varied not only with the type of the cation but also depended on the accompanying anion.

The information available on crop performance under different saline conditions is very limited (Paliwal, 1972) and response to the specific salt ions is still very scarce. To understand better the physiology of crop growth under different types of saline conditions, it is essential to know the specific salt ion effect on the different growth parameters especially the germination and early seedling growth which limits the final crop yield. With the above consideration in view, investigations were carried out on the effect of different salt ions-cations and anions on the different parameters of early crop growth in wheat.

The present investigations were carried out in the glass-house at the Department of Plant Physiology, Waite Agricultural Research Institute, University of Adelaide. Adelaide (S.A.). Twenty seeds of wheat (*Triticum aestivum L.*). C.V. K-227 were sown in each plastic pot (15 cm dia.) containing washed sand (sand culture). The solutions of chloride, nitrate, sulphate and carbonate salts of sodium, potassium, calcium, magnesium and polyethylene glycol (PEG) each at—2 bar osmotic potential salinity level, prepared in Hoagland nutrient solution (full strength)

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were added before sowing to the pots according to the saturation percentage of the sand used (i.e., 20% sat. %). Thereafter, the irrigations were made every third day by adding distilled water to bring the water content to the field capacity level. The nutrient solutions with the desired salinity were renewed every week. The temperature during the growing period was maintained at 25°C maximum and 15°C minimum and the photo-period being 11 hours light and 13 hours dark. Each set of experiment was replicated four times. The plants were maintained for 25 days after sowing and then sampled. Before sampling the growth data, i.e. germination, growth of shoot and root, fresh and dry weight, etc. were recorded.

The data obtained in the present study show that PEG (osmotic stress-2 bars) did not affect much the germination percentage (Table I). But Malival (1967) and others found that emergence was delayed and percentage germination decreased in wheat and other crops as the degree of salinity increased. This descrepancy may be due to the moderate salinity level used in the present study. Besides the total salt concentration, specific salt ions seem to affect the germination differedtially. Germination percentage recorded 7 days after sowing showed that it was not significantly affected under potassium and calcium salts but it was reduced to a great extent in sodium and magnesium salts. In respect to the effect of different anions, the germination percentage except in sulphate salts was reduced to a great extent and it was reduced by 6-9 per cent under chloride and carbonate salts, 17-21 per cent in nitrate and dihydrogen phosphate and by 48 per cent in nitrate and dihydrogen phosphate and by 48 per cent in bicarbonate salts. Germination percentage was rather increased in potassium sulphate, calcium sulphate, but it was greatly reduced under sodium chloride, sodium bicarbonate, calcium nitrate, magnesium nitrate, and potassium dihydrogen phosphate. It was reduced by 40-50 per cent under sodium nitrate and sodium bicarbonate. Khetawat *et al.* (1967) also found sulphate to be less harmful than chloride at germination stage in case of wheat but in case of opnion carbonate and bicarbonate ions were found to be more harmful than others on equal salt concentrations basis. While studying the effect of anions on 5 varieties of sorghum and two of paddy, Paliwal and Gandhi (1968) observed that the adverse effect of anions was in the order of HOC_3 7 CO_3 7 NO_3 7 SO_4 in solution culture upto salt concentration of 16 meq/l.

Fresh weight of roots (mg/plant) was significantly reduced under all the stress treatments, but the response varied under different salt ions. Except for potassium salts the reduction in fresh weight of roots was as great as under the osmotic stress caused bp PEG. Similar reduction was less under chloride salts as compared to that in the other salt anions and it was maximum under carbonate, bicarbonate and dihydrogen phosphate. Almost similar trend was observed in respect to dry weight

of roots. Fresh weight of shoot (plant tops-mg/plant) was reduced under all the stress treatments except chloride and carbonate salts, and it was maximum under bicarbonate and dihydrogen phosphate salts. The reduction in fresh weight was almost the same in respect to the effect of different cations. Except under sodium chloride and potassium chloride there was a reduction in fresh weight of the shoots and there was maximum reduction under sodium bicarbonate and potassium dihydrogen phosphate. Similar trend of response was observed in regard to dry weight of shoots.

Table I. Specific ion effect on germination (% after 7 days), fresh and dry weights (mg/plant) of shoots in wheat cv K-227

Cations/ Anions	Control	PEG	Na	K	Ca	Mg	Mean
(i) *Germination* (%)							
Control	73.3	...	...	...	...	...	73.3
PEG	...	77.5	...	...	...	...	77.5
SO_4	...	...	24.1	89.8	80.2	70.0	78.7
Cl	...	...	61.7	70.0	79.2	65.5	69.1
NO_3	...	...	24.1	78.3	50.8	63.3	54.1
CO_3	...	...	66.7	...	...	...	66.7
HCO_3	...	...	32.7	...	...	...	32.7
H_2PO_4	...	...	...	53.3	...	...	58.3
Mean	73.3	77.5	52.0	72.8	70.0	66.3	...
(ii) *Weight roots* (*mg/plant*)							
Control	347 (95)	...	...	...	...	...	347 (95)
PEG	...	174 (63)	...	...	...	...	174 (63)
Cl	...	...	268 (41)	322 (56)	184 (27)	103 (12)	219 (34)
SO_4	...	...	161 (21)	285 (26)	196 (73)	149 (31)	198 (38)
NO_3	...	...	...	191 (35)	116 (24)	206 (35)	171 (31)
CO_3	...	...	...	...	...	...	...
HCO_3	...	...	131 (17)	...	...	...	131 (17)
H_2PO_4	...	...	...	100 (16)	...	...	100 (16)
Mean	347 (95)	174 (63)	187 (26)	266 (33)	163 (41)	153 (26)	...
(iii) *Weight shoots* (*mg/plant*)							
Control	330 (131)	...	...	...	...	...	330 (131)
PEG	...	254 (75)	...	...	...	...	254 (75)
Cl	...	...	352 (114)	331 (98)	240 (78)	244 (83)	292 (88)
SO_4	...	...	238 (79)	238 (64)	294 (97)	270 (68)	260 (77)
NO_3	...	...	... (...)	295 (81)	227 (78)	228 (69)	250 (76)
CO_3	...	...	311 (78)	...	...	...	311 (78)
HCO_3	...	...	185 (55)	...	...	...	185 (55)
H_2PO_4	...	...	...	116 (58)	...	...	116 (58)
Mean	330 (131)	256 (75)	272 (81)	245 (75)	254 (84)	247 (67)	...

Note : Figures given outside the brackets are fresh weights and within the brackets are dry weights.

In general, salinity due to potassium and calcium salts showed lesser reduction in crop growth as compared to that in salts of sodium and magnesium. The more damaging effects of sodium carbonate and bicarbonate and potassium dihydrogen phosphate on growth may be due to high pH effects rather than specific salt ion effects. Salts of nitrate were more harmful than chloride and sulphate salts. The present studies suggest that the response in respect to the crop growth may vary accordingly to the type of the salt and may depend not only on the specific cation but also on the accompanying anions.

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