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EFFECT OF SALINITY ON SOME *BRASSICA* OILSEED VARIETIES *

RAZIUDDIN ANSARI

Division of Plant Physiology
Atomic Energy Agricultural Research Centre, Tandojam

Abstract

Growth performance of S-5, S-9 and S-N varieties of *Brassica campestris* L. (Sarson) and R-11-1, R-II-32 and R-II-40 varieties of *Brassica juncea* L. (Raya) were tested in soil having 0.2, 0.4 and 0.6% of sodium chloride and sodium sulphate in equal proportions. With increasing salt concentrations plant height, grain and plant dry weight, magnesium and potassium contents generally decreased, while days to flowering, ash, nitrogen, phosphorus, calcium and sodium contents increased. Taking plant growth as an index, all varieties were relatively tolerant upto 0.4% salinity whereas at 0.6% salinity effects were pronounced.

Introduction

Soil salinity is commonly observed under arid climates and in soils suffering from impaired drainage. Under low rainfall or insufficient irrigation and high evaporation, the salts accumulate at the soil surface making it difficult for the crops to grow. This, accompanied with raised water tables due to the construction of new canals and barrages, makes the problem worse. Leaching salts and lowering the water table through installation of tubewells may help, but high expenses do not make this possible for every farmer. Hence cultivation of salt tolerant crop varieties may be advisable to get more economical returns in saline soils. An investigation was carried out to study the behaviour of some oilseed varieties in saline soils.

Materials and Methods: S-5, S-9 and S-N varieties of *Brassica campestris* L. (Sarson) and R-II-1, R-II-32 and R-II-40 varieties of *Brassica juncea* L. (Raya) were grown in plastic pots containing 12 pounds of soil. Sodium chloride and sodium sulphate were added in equal proportions to make 0.2, 0.4 and 0.6% salt concentration. All the pots received ammonium sulphate at the rate of 60 pounds nitrogen per acre. The pots were arranged in a glass house according to a randomized complete block design with three replicates. Two plants per pot were maintained. Plant height was taken at 14 days interval. Harvesting was done 14 weeks after sowing, when plants were oven dried and ashed for nitrogen, phosphorus, potassium, calcium and sodium analysis, (Jackson, 1958). In order to study the competitiveness of calcium/magnesium and potassium/sodium, these ratios were calculated.

Separate experiments were conducted to study the effect of salts on the germination of crop varieties in enamelled trays containing three pounds of soil and 0.2,

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0.4 and 0.6% salt concentrations. In each tray 100 seeds were sown. The trays were arranged in a randomized complete block design with three replicates. Arcsin transformations (Snedecor, 1964) were made prior to data analysis of germination counts as percent of control.

Results and Discussion

There was a general decrease in germination (percent of control) of all varieties in saline media (Table 1). Germination in *B. campestris* depicted a similarity between S-5 and S-9 as well as S-5 and S-N. S-9 was superior to S-N. In *B. juncea* R-II-1 was better than R-II-32 and R-II-40. Germination for later two was similar.

Table 1. Effect of salinity on germination (as percent of control) of oilseed varieties.

Varieties	Percent salts added 0.0	0.2	0.4	0.6	Means*
S — 5	100.0	61.3	55.2	49.0	66.4
S — 9	100.0	63.6	55.7	51.1	67.6
S — N	100.0	55.5	53.8	47.1	64.1
Means**	100.0	60.1	54.9	49.1	—
L.S.D. 0.05 (i) Salts = 3.82 (ii) Varieties = 3.30 (iii) Interaction = N.S.					
R-II-1	100.0	94.3	91.1	68.6	88.5
R-II-32	100.0	89.5	73.3	54.9	79.4
R-II-40	100.0	87.0	65.8	42.7	73.9
Means **	100.0	90.3	76.7	55.4	—
L.S.D. (i) Salts — 7.11 (ii) Varieties — 6.16 (iii) Interaction — N.S.					

* Means for comparing the varieties.

** Means for comparing the salts.

Table 2. Effect of salinity on height (cms) of *Brassica campestris* varieties.

Varieties	Salinity %	Weeks after sowing 2	4	6	8	10	12	14
	0.0	8.4	10.8	13.5	17.0	46.0	71.4	80.0
S — 5	0.2	6.7	8.7	11.0	14.5	38.0	62.5	65.5
	0.4	5.0	6.7	9.5	12.0	15.0	39.0	44.4
	0.6	3.5	5.0	8.0	8.5	10.5	30.5	40.0
	0.0	10.0	13.3	15.0	18.4	37.7	78.4	96.5
	0.2	8.3	10.0	13.4	15.0	25.0	70.0	83.5
S — 9	0.4	6.5	8.4	11.7	13.3	16.7	25.0	28.0
	0.6	5.0	6.7	10.0	11.0	11.8	13.3	16.7
	0.0	8.5	10.0	13.3	21.7	37.0	97.3	100.0
S — N	0.2	6.7	8.4	11.7	20.0	33.4	88.4	95.0
	0.4	5.0	6.7	10.0	16.7	20.0	52.4	63.4
	0.6	3.5	5.0	7.5	13.5	16.0	26.7	36.7

Table 3. Effect of salinity on height (cms) of *Brassica juncea* varieties.

Varieties	Salinity %	Weeks after sowing 2	4	6	8	10	12	14
	0.0	8.3	10.0	13.3	16.7	61.7	88.4	96.0
	0.2	6.8	8.3	10.0	13.3	57.4	85.0	91.7
R—II—1	0.4	5.0	6.7	8.4	11.7	25.0	46.6	50.0
	0.6	3.5	5.0	6.7	8.4	13.3	16.7	20.0
	0.0	8.3	10.0	11.0	23.3	53.4	96.5	100.0
R—II—32	0.2	6.7	8.4	10.0	20.0	46.6	92.8	96.4
	0.4	5.0	6.6	8.3	15.0	18.4	26.7	46.5
	0.6	3.5	5.0	6.7	11.7	14.7	16.7	17.4
	0.0	8.4	10.0	11.7	21.3	36.6	86.7	92.4
R—II—40	0.2	6.6	8.3	10.0	18.4	31.7	83.4	90.0
	0.4	5.0	6.6	8.3	13.3	16.6	25.0	26.7
	0.6	3.4	5.0	6.6	11.7	13.5	15.0	17.4

Growth of all the varieties was stunted in saline soils, though height reduction was not very pronounced during initial growth (Table 2, 3). The salinity effects became visible eight weeks after germination, probably at a time when the plants reached their maximum growth period. As judged from the height reduction due to salinity in *B. campestris*, variety S-5 was most tolerant followed by S-N and S-9. In *B. juncea* plant height for R-II-40 was more adversely affected at 0.4% than R-II-1 and R-II-32. Both the crops in the control and those in 0.2% salt concentration were found to flower at the same time. A flowering delay of 8 to 10 days in *B. compestris* and 4-5 days in *B. juncea* was observed at 0.4%. Plants in 0.6% salt concentration did not flower. No varietal differences were observed in either crop as regards their straw and grains weights (Table 4, 5).

Table 4. Effect of salinity on mean straw weight (gms/pot) of oilseed varieties.

Varieties	Percent salts added				Means*
	0.0	0.2	0.4	0.6	
S — 5	5.09	4.58	2.43	0.89	3.22
S — 9	6.15	5.40	1.99	0.54	3.52
S — N	6.29	4.72	3.07	1.17	3.81
Means**	5.84	4.90	2.49	0.87	—
L.S.D. 0.05 i) Salts = 0.69 ii) Varieties = N.S. iii) Interaction = N.S.					
R—II—1	5.50	5.17	3.07	1.74	5.16
R—II—32	6.19	5.82	3.36	1.32	5.56
R—II—40	6.21	4.89	3.02	1.36	5.16
Means**	5.97	5.29	3.15	1.47	
L.S.D. 0.05 i) Salts = 0.81 ii) Varieties = N.S. iii) Interaction = N.S.					

* Means for comparing the varieties.

** Means for comparing the salts.

Table 5. Effect of salinity on mean grain weight (gms/pot) of oilseed varieties.

Varieties	Percent salts added				Means*
	0.0	0.2	0.4	0.6	
S — 5	1.78	1.58	0.42	—	1.26
S — 9	1.46	0.50	0.20	—	0.72
S — N	1.03	0.74	0.15	—	0.64
Means**	1.42	0.94	0.26	—	—
L.S.D. 0.05 i) Salts = 0.45 ii) Varieties = 0.45 iii) Interaction = N.S.					
R—II—1	1.15	1.50	0.21	—	0.95
R—II—32	1.24	0.75	0.09	—	0.69
R—II—40	1.04	1.17	0.25	—	0.82
Means**	1.14	1.14	0.18	—	—
L.S.D. 0.05 i) Salts = 0.23 ii) Varieties = N.S. iii) Interaction = N.S.					

* Means for comparing the varieties.

** Means for comparing the salts.

Increase in osmotic pressure of the soil solution as well as accumulation of harmful ions affects plant growth in saline soils. Such conditions have been reported to delay flowering (Hassan et al, 1970) and decrease germination and yield (Ayers, 1952, 1953; Chatterson et al, 1969; Kaddah, 1963). The growth variations obtained here for *B. campestris* and *B. juncea* are attributed to the physiological scarcity of water due to increased osmotic pressure so common in saline soils, (Ayers et al, 1951; Lunin & Stewart, 1961; Peterson, 1961).

Under salinity, the osmotic adjustment is attained through accumulation of ions in tissue that resulted in increased ash, nitrogen, phosphorus, calcium and sodium, and decreased potassium and magnesium contents (Ayers & Eberhard, 1960; Bernstein & Ayers, 1951, 1953; Bernstein et al, 1966; Lunt et al, 1957). In the present study the chemical composition as influenced by salinity levels, irrespective of varieties, showed a general tendency towards a decrease in magnesium and potassium with an increase in ash, nitrogen, phosphorus calcium and sodium contents (Table 8, 9). These contents differed amongst varieties of both crops (Table 6, 7).

Table 6. Mean chemical composition of *Brassica campestris* varieties, irrespective of salinity levels.

Constituent %	Varieties S — 5	S — 9	S — N
Ash	29.012a	29.850a	25.625b
Nitrogen	1.552b	1.907a	2.205a
Phosphorus	0.101a	0.091b	0.105a
Calcium	1.893b	2.283a	2.393a
Magnesium	0.262b	0.329a	0.227b
Potassium	0.424b	0.519a	0.419b
Sodium	0.051b	0.046a	0.048ab

Values sharing same alphabets within horizontal columns are not significantly different. There was no interaction between salts and varieties.

Table 7. Mean chemical composition of *Brassica juncea* varieties, irrespective of salinity levels.

Constituent %	Varieties R—II—1	R—II—32	R—II—40
Ash	23.818c	28.343a	26.420b
Nitrogen	2.283b	2.431a	2.429a
Phosphorus	0.109b	0.097a	0.098a
Calcium	1.225b	1.647a	1.373b
Magnesium	0.118c	0.181a	0.157b
Potassium	0.429b	0.456a	0.421b
Sodium	0.063a	0.063a	0.055b

Values sharing same alphabets within horizontal columns are not significantly different. There was no interaction between salts and varieties.

Table 8. Mean chemical composition of *Brassica campestris* as influenced by salinity levels, irrespective of varieties.

Constituent %	Percent salt added			
	0.0	0.2	0.4	0.6
Ash	18.063d	26.197c	29.537bc	38.613a
Nitrogen	1.217c	1.747b	1.979ab	2.206a
Phosphorus	0.079c	0.084c	0.096b	0.137a
Calcium	1.744c	2.163b	2.357ab	2.493a
Magnesium	0.370a	0.290b	0.227c	0.204c
Potassium	0.520a	0.478b	0.436c	0.383d
Sodium	0.042c	0.046bc	0.050b	0.056a

Values sharing same alphabets within horizontal columns are not significantly different. There was no interaction between salts and varieties.

Table 9. Mean chemical composition of *Brassica juncea* as influenced by salinity levels, irrespective of varieties.

Constituent %	Percent salts added			
	0.0	0.2	0.4	0.6
Ash	17.983c	19.650c	27.926b	39.213a
Nitrogen	1.291c	1.643c	2.841b	3.749a
Phosphorus	0.077c	0.089bc	0.099b	0.139a
Calcium	1.233b	1.275b	1.507a	1.643a
Magnesium	0.207a	0.170b	0.121c	0.111c
Potassium	0.485a	0.485b	0.421c	0.378d
Sodium	0.053c	0.059b	0.063ab	0.068a

Values sharing same alphabets within horizontal columns are not significantly different. There was no interaction between salts and varieties.

Table 10. Ca: Mg and K: Na ratios in oilseeds as affected by salinity.

Ratios	Varieties	Percent salts added			
		0.0	0.2	0.4	0.6
Ca: Mg	S — 5	2.50	4.10	6.07	6.13
	S — 9	2.40	4.00	5.45	6.63
	S — N	3.97	5.61	7.29	9.65
	R — II — 1	3.53	5.63	9.16	10.22
	R — II — 32	3.57	4.41	6.90	8.67
	R — II — 40	3.60	3.91	7.01	8.18
K: Na	S — 5	6.57	5.56	4.67	3.40
	S — 9	8.35	8.25	6.08	5.38
	S — N	6.97	5.74	4.79	3.47
	R — II — 1	5.19	4.18	3.58	3.25
	R — II — 32	5.12	4.75	4.02	3.28
	R — II — 40	5.90	4.88	4.15	3.27

For both *B. campestris* and *B. juncea* varieties, increased Ca: Mg and decreased K: Na ratios with increasing salt concentrations existed (Table 10). Potassium/sodium and calcium/magnesium are probably taken up by plants from similar sites on roots, depicting possible competitiveness. Plants of *B. campestris* and *B. juncea* in this study provided increased calcium and sodium, with decreased magnesium and potassium contents. These magnitudes were quite similar indicating equal salt tolerance. Although comparable citations were not available regarding Ca: Mg, K: Na ratios, it may be mentioned that Francois & Bernstein (1964) working on safflower grown in saline media reported an increase in Ca: K ratios due to increasing calcium and decreasing potassium contents.

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