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Growth of Wheat and Gram Under *Saline-Alkali Field Conditions*

by

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Introduction: Soluble salts above a critical limit produce harmful effects to plant growth. It may be either due to increased osmotic pressure of the soil solution or unavailability of water. Plant growth is also depressed when the soil is highly saturated with exchangeable sodium or by the toxicity of some specific ion like boron. The degree to which a plant can resist salinity, alkalinity or toxicity of boron is a characteristic property of a crop or its varieties. This property of the crop is generally kept in mind while selecting crops for growing under saline-alkali conditions. Salt tolerance property of crops has been found very useful in overcoming the hazardous effect of salts on plant growth and yield has been successfully utilised in managing arid and semiarid areas of western countries. Differences between species and varieties regarding salt tolerance have been reported by Ayers *et al* (1952), Richard (1954), Bernstein and Hayward (1958) and Hayward and Bernstein (1958). Similar information on agricultural crops in India is not available in relation to the severity and magnitude of the problem. Only recently some work on these lines has been reported by Desai *et al* (1957), Mehta and Desai (1959), Mehrotra and Gangwar (1964), Asana and Kale (1965) and Maliwal and Paliwal (1966).

Most of the results on salt tolerance of crops are based on either germination or pot culture studies. It is, therefore, proposed to examine the effect of saline-alkali conditions on the growth of wheat and gram in the natural environment of the fields, and also to find out their limits of salinity, alkalinity and boron tolerance.

Experimental: A number of cultivators' fields were examined in Khanjhawala and Alipore Block of Delhi for saline-alkali conditions in relation to plant growth. Some representative ones growing wheat and gram and showing different shades in growth as best, medium and poor or worst as judged on the visual basis were selected for this purpose. The factors other than salinity were kept at minimum by selecting observation plots either in the same field or as close as possible so that their texture, structure, topography *etc.* do not change much. Soil samples taken from 0–23cm. were analysed for conductivity, sodium absorption ratio (SAR), boron, carbonate and bicarbonate contents in the saturation extract by methods

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as recommended in U. S. D. A. Hand Boook No. 60 (1954). The pH was determined in 2·5 soil to water ratio by Beckman pH meter. The soils of Nangal Thakran and Pithampura are loam while those of Mundka are loamy sand.

Results and Discussion: *Wheat:* The analysis of wheat growing soils presented in Table 1. shows that the pH value of all the soils is in the alkaline range and varies from a value of 8·5 to 9·7. The good and moderately affected plots show a slightly lower value at about nine, whereas the more affected ones have generally higher values than this. The data on sodium absorption ratio (SAR) does not show significant differences for soils showing best and medium growth except one while it is very high in plots showing poor growth. It can also be seen from the same table that the conductivity values of the saturated extract generally follow the order of plant growth. The average conductivity value for six good looking plots is 5·37 m. mhos per cm. respectively taking averages of three and five plots. Boron concentration of the soils shown in the last column of the table also follows the growth pattern to some extent. The analysis of the extracts also showed that carbonate was completely absent and though bicarbonate was noted there was insignificant difference in these plots.

Gram: The analysis of soils growing gram shows (Table 1) that these soils are also alkaline in reaction (pH 8·6—9·6). The pH values for the best looking plots ranged from 8·6 to 9 while it increased slowly with the decrease of growth and the highest value of 9·6 was noted for the worst plot. The conductivity value of the saturated extract of these soils ranges widely from a value of 0·65 to m. mhos/cm. The plots showing best growth have comparatively quite low values ranging from 0·9 to 2·0 while those showing medium growth or moderately salt affected ones ranges from a value of 4·65 to 2·6. On the other hand fields showing poor or worst crop growth have their conductivity values from 2·4 to 8·0. Regarding SAR the values for best growing plots is nearly two in general and for moderately affected fields, it is nearly 4·5 while plots with poor growth recorded SAR values of about 17. The boron content of these soils is generally very low and there are insignificant differences between themselves. The bicarbonate concentration was so variable in all the shades of growth that it was difficult to draw any definite conclusion and the presence of carbonate was not noted in any of the samples growing gram also.

Considering the average values it could be seen that both crops are fairly tolerant to pH upto a value of 9·0 under the existing field conditions. Regarding salinity, wheat grows very well upto a conductivity value of 5·37 and moderately upto 6·5. The growth becomes very poor at a value of

TABLE 1.

Soil analysis and crop growth

S. No.	Location	Crop performance	pH	Conductivity m. mhos/cm.	Na	Ca+Mg. mo/l.	S. A. R.	Boron ppm.
I	WHEAT :							
1.	Sultanpur Dabas F. N. 1.	Best Growth	8·70	4·70	26·29	20·71	8·19	0·50
2.	,, ,, F. N. 2.	do.	8·80	2·00	13·46	6·54	5·27	0·50
3.	,, ,, F. N. 3.	do.	9·15	4·50	37·37	7·63	19·16	0·40
4.	Alipore	do.	8·70	7·00	39·48	30 52	10·12	0·60
5.	Pithampura	do.	9·50	3 00	26·00	4·00	26·46	1·10
6.	Nangal Thakran	do.	8·80	11·00	90·00	20·00	34·80	0·80
		Mean	8·94	5·37	38 77	14·90	17·17	0 65
7.	Alipore	Medium	8·60	9·00	50·76	89·24	7·61	0·80
8.	Pithampura	do.	9·80	4·00	33·60	6·40	18·78	0·90
9.	Nangal Thakran	do.	8·80	6·50	53 00	12 00	21 60	0·90
		Mean	9·07	6·50	44·34	35·88	15 99	0 87
10.	Sultanpur F. N. 2.	Poor	9·65	6·30	59·73	3·27	47·03	0 80
11.	,, F. N. 3.	do.	9·10	22·00	191·66	28·34	53·36	1·10
12.	Alipore	do.	9·20	15·00	141·19	8 81	66·90	0·30
13.	Pithampura	do.	8·60	12·50	88·60	26 40	27·14	1·10
14.	Nangal Thakran	do.	8·80	21·00	84·80	25·20	52·10	1·60
		Mean	8·67	15·36	113·20	18·40	49·30	0·98

TABLE 1 *(Contd.)*

S. No.	Location		Crop performance	pH	Conductivity m. mhos/cm.	Na	Ca+Mg. me/l.	S. A. R.	Boron ppm.
II GRAM:									
1.	Khampur	F. N. 1.	Best Growth	8·80	0·90	3·55	5·45	2·15	0·25
2.	,,	F. N. 2.	do.	9·00	2·00	12·91	7·09	6·90	0·20
3.	,,	F. N. 3.	do.	8·60	1·33	3·69	9·81	1·66	0·35
4.	,,	F. N. 4.	do.	8·65	0·90	3·55	5·45	2·15	0·30
5.	Alipore		do.	8·90	0 90	4·10	4·90	2·63	0·25
			Mean	8·80	1·21	5·56	6·54	3·10	0·27
6.	Khampur	F. N. 1	Medium	8 90	0·75	4·23	3·27	3·33	0·25
7.	,,	F. N. 2	do.	8·70	0 65	2·14	4·36	1·45	0·25
8.	,,	F. N. 3	do.	8·80	2 60	16·19	9·81	7·29	0·20
9.	Alipore		do.	9·20	2·00	12·37	7·63	6·34	0·30
			Mean	8·80	1·50	8·73	6·27	4 60	0·24
10.	Khampur	F. N. 1	Poor	9·50	8·00	57·11	22·89	16·89	0·40
11.	,,	F. N. 2	do.	9 00	5·00	39·10	10·90	16·78	0·30
12.	,,	F. N. 3	do.	9·15	6·00	45·23	14·27	16·77	0·50
13.	,,	F. N. 4	do.	9·45	2 50	20 64	4·36	14·36	0·30
14.	Alipore		do.	9·60	4·50	37·37	7·63	19·16	0·30
			Mean	9·34	5·20	39·89	12·01	16 79	0·31

TABLE 2.

Coefficient of Correlation (r) *between various characteristics and water soluble boron.*

S. No.	Factors	All combined	Soil growing wheat	Soil growing Gram
1.	Boron *vs.* electrical conductivity	+ 0·720*	+ 0·506	+ 0 685*
2.	Boron *vs.* sodium absorption ratio (SAR)	+ 0·930*	+ 0 936*	+ 0 549 ‡‡
3.	Boron *vs.* pH	+ 0·300	+ 0·004*	+ 0·304

* Significant at 1% level. ‡‡ Significant at 5% level.

15·36. This value is very high even for more tolerant crops. In the case of gram it grows quite well upto a conductivity value of 1·2 and fairly well upto 1·5 and at a value of 5·2 it is worst. Thus the relative values of salt tolerance for gram are much lower than those of wheat. In the case of SAR value which is generally taken as an index of exchangeable sodium status, wheat is fairly tolerant upto a value of 16·5 and at higher SAR values (19·8) this seems to affect the plant growth very much. As gram is less tolerant to salinity in comparison to wheat, the same can be said about it for the limits of SAR values. The highest limits of salinity and SAR where gram shows very poor and stunted growth wheat seems to flourish quite well. These results are in conformity with those of Agarwal and Yadav (1956) and Mehrotra and Gangwar (1964) for these crops.

In the case of gram, boron does not seem to affect the growth significantly alone upto a concentration of 0·3 ppm. as all the soils are showing boron concentration in the range of 0·2 to 0·3 ppm. which is the safe limit. On the contrary, wheat is quite tolerant upto 0·65 ppm. and seems to be gradually affected by its high concentrations. A critical limit of 0·7 ppm. of boron as given by Richards (1954) seems to apply to wheat under these field conditions.

Thus it can be concluded that wheat is more tolerant than gram with respect to boron, salinity and alkalinity of soils. As this study reflects an integrated effect of salinity, alkalinity and boron it will be too much to take these limits on an individual basis for these crops growing on all types of soils.

Inter-Relationship Between Soil Characteristic and Water Soluble Boron: It appears from Table 1 that water soluble boron increases with the electrical conductivity, sodium absorption ratio of the saturated extract and pH of the soils. The coefficient of correlation between electrical conductivity and water soluble boron, when calculated combining all the soils irrespective of the crop growth growing both wheat and gram, comes out to be +0·720 which is statistically significant at one per cent level (Table 2). Similar positive correlations between water soluble boron and electrical conductivity have been observed by Singa and Kanwar (1963) for Punjab soils. The regression equation has been found out to be $Y = 0{\cdot}0447x + 287$ where Y is water soluble boron in ppm and X is the electrical conductivity in m. mhos/cm. at 25°C. This shows that water soluble boron will increase with further increase in the degree of salinisation. Water soluble boron also shows a very high positive correlation $r = +0{\cdot}93$ with the sodium absorption ratio which is significant at 1% level. The coefficient of determination (r^2) comes out to 86·5 which shows that 86·5 per cent of the soils

have their high boron content due to high SAR of these soils. Saline-alkali soils of Punjab also show such relationship as reported by Singh and Kanwar (1963). The regression equation comes out to be $y = 0{\cdot}019x + 0{\cdot}203$ where y is water soluble boron and x is the SAR. When these soils growing different crops were statistically examined separately for these relationships, the correlation of boron with electrical conductivity was found significant at 1% level only for gram soils. The correlations of boron *versus* SAR was however, found significant at 1% level in the case of wheat and at 5% level for gram soils. Soil heterogenity and salt tolerance characteristics of these crops seem responsible for these differences in relationship. There was no significant correlation between water soluble boron and pH taking these soils either crop wise or combined together.

Since electrical conductivity and sodium absorption ratio of the saturated extract showed a significant positive correlation with the water soluble boron, the accumulation aud alkalinisation. Thus it is apparent that high boron content will pose an additional problem in these saline alkali soils of Delhi.

Summary: Studies on growth of wheat and gram under saline-alkali field conditions of some Delhi villages have been made. The growth of these crops was related with soil characteristics as pH, electrical conductivity, sodium absorption ratio and water soluble boron of the saturated extract. The integrated effect of these soil characteristics showed that wheat is more tolerant than gram. Inter relationships of these soil characteristics showed that water soluble boron is positively correlated both with electrical conductivity and sodium absorption ratio of the saturated extract. However, there was no such correlation between water soluble boron with pH of the soils.

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Resource Efficiency in Milk Enterprise

by

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Introduction : India has the largest bovine population with nearly one-fourth of world cattle and 60 per cent of world's buffaloe population. Yet, the contribution from these animal resources to the national income is only about three and a half per cent on account of low productivity in this sector. Generally, productivity is not measured in relation to input factors as concentrates, green fodder *etc* since, whatever is available on the farm as a bye-product is fed to cattle without going into detail about the needs of the animal and the input factors that have to be supplied. The low productivity and high cost of maintenance of dairy animals have of late set the farmers to examine the possibilities of substitution in dairy ration with a view to bring down the cost and to increase the profits.

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