# DIFFERENTIAL SODIUM AND POTASSIUM ACCUMULATION RELATED TO SODICITY TOLERANCE IN WHEAT

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## Summary

Five wheat genotypes were grown in pots under different soil sodicity levels. Sodium and potassium contents at tillering phase in leaves showed marked varietal differences. Varieties tolerant to sodicity were characterised by a lower Na/K ratio in striking contrast to the sensitive genotypes.

## Introduction

Soil sodicity, impairs the normal growth of plants. Drastic reductions in plant growth are associated with large sodium accummulation in shoot resulting in cationic imbalance (Ayaub and Ishag, 1974). The influence of sodicity on yield and chemical composition in many crops have been extensively studied (Pearson and Bernstein, 1958 ; Mehrotra and Dass, 1973). In wheat and barley increase in exchangeable sodium of soil resulted in increase in sodium accumulation and depletion of potassium (Moustafa *et al.*, 1966). Soil sodicity causes imbalance in the tissue concentration of nutrients in paddy and barley (Agarwal *et al*,, 1964).

The knowledge of physiological processes in sensitive and adaptive genotypes of wheat, to sodic condition is scanty. Hence, a pot study was undertaken to investigate—(1) sodium (being the predominant cation in the soil) and (2) potassium (the absorption of which is affected because of antagonistic effect of sodium) of sensitive and tolerant genotypes of wheat.

## Materials And Methods

Experiment was conducted at the CSSRI, Karnal in Rabi 1976-77 in porcelain pots containing sodicity levels of ESPs 7, 29, 43, 51 and 62. These levels of soil sodicity were obtained by spraying known concentrations of sodium bicarbonate over thin layers of normal soil having ESP 7. These layers were kept in moist condition for many days. The pots were filled uniformaly after mixing each level of soil thoroughly at proper moisture level. Five varieties of wheat, were selected. They were Kharchia, HD 2009, HP 916, HD 4530 and HD 4502. The selection of these varieties was primarily based on the results of previous investigations showing

Kharchia as a tolerant genotype, HD 2009 as moderately tolerent (Joshi, 1976) and HD 4530 as a sensitive type (CSSRI Ann Rept p. 56). Recommended doses of NPK were applied to the pots. Sampling for sodium and potassium contents was done at the tillering phase from all the treatments of soil alkalinity except at ESP 62 where either plants failed to survive or enough material was not available for the analysis. Data on grain yield were recorded. Leaf sodium and potassium contents were estimated using a flame photometer.

## RESULTS AND DISCUSSION

Data obtained in this respect at various levels of ESP are presented in Table I. Grain yield can be used as a criterion for sodicity tolerance, Kharchia, by lesser reduction in yield and hence is a tolerant veriety whereas HD 4502 and 4530 have higher reductions and are sensitive types. Our previous findings showing Kharchia as

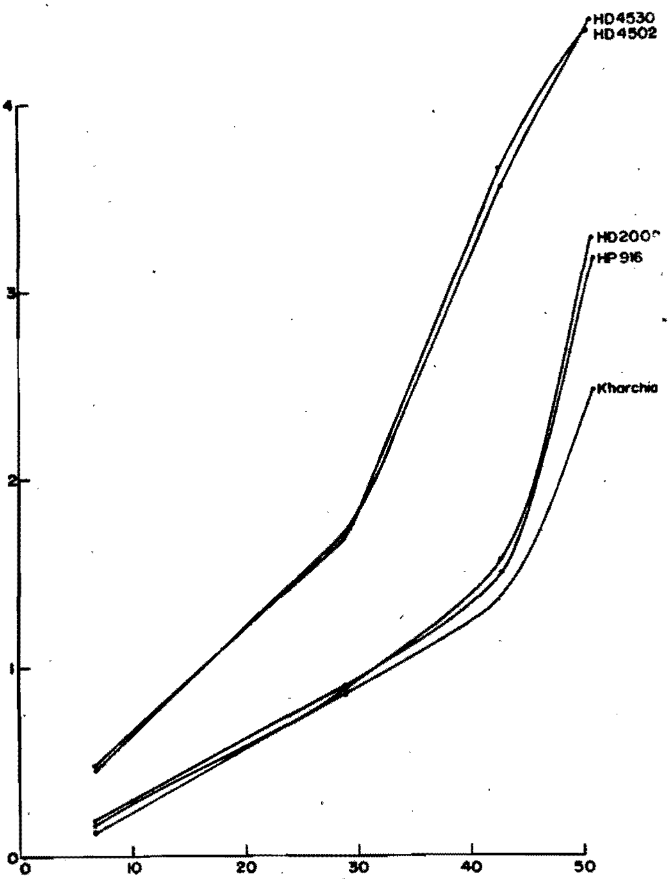


Fig. 1. Relationship between soil ESP and leaf sodium content at tillering phase in wheat.

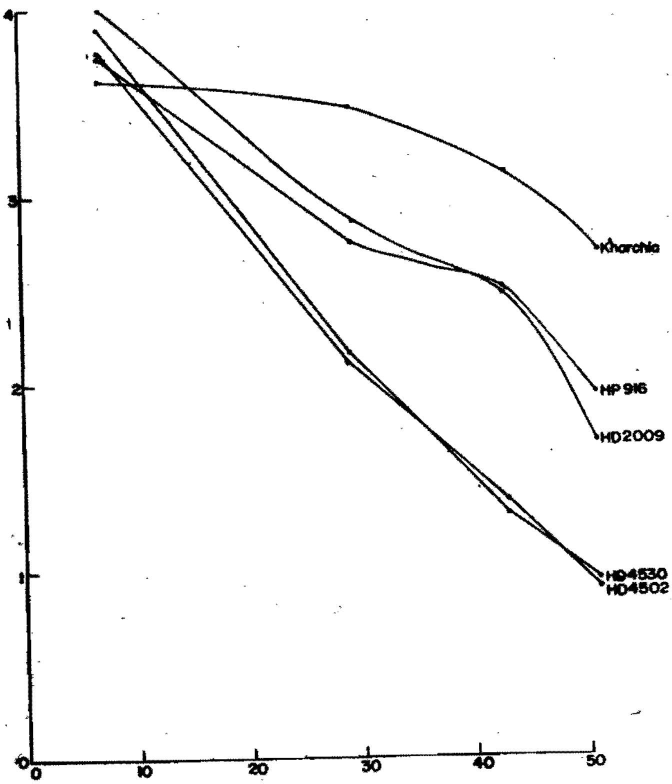


Fig. 2. Relationship between soil ESP and leaf K content at tillering phase in wheat.

a tolerant variety and HD 4530 as a highly sensitive one (Joshi, 1976), are confirmed during the present investigation.

*Table I. Grain yield (g/plant) of wheat, as influenced by ESP showing tolerant and sensitive responses of the varieties*

| Varieties | Exchangeable sodium percentage | | | | | |
|---|---|---|---|---|---|---|
| | 7 | 29 | 43 | 51 | 62 | Mean |
| Kharchia | 3.68 | 2.95 | 2.48 | 1.78 | 0.78 | 2.33 |
| HP 916 | 3.45 | 2.19 | 1.56 | 0.77 | 0.00 | 1.59 |
| HD 2009 | 3.93 | 3.07 | 1.65 | 0.38 | 0.00 | 1.80 |
| HD 4530 | 3.43 | 2.26 | 0.75 | 0.00 | 0.00 | 1.28 |
| HD 4502 | 3.16 | 1.81 | 0.79 | 0.00 | 0.00 | 1.15 |

C.D. at 5% for varieties and ESP = 0.10
Interaction = 0.21

Results of sodium and potassium analysis (Figs 1 and 2) show that sodium content increases with the rise in exchangeable sodium in the soil in all the genotypes. The potassium content, on the other hand, exhibited a reverse trend-a fact also observed by Agarwal *et al.* (1964) and Moustafe *et. al.* (1966). Marked genotypic differences in accumulation of sodium (Fig. 1) and depletion in potassium (Fig. 2) content were obtained. The depletion of potassium is comparatively lesser in Kharchia which is a tolerant type (Table I). A sharp fall was observed in potassium contents of the varieties HD 4502 and HD 4530. Since potassium is vital for various physiological and biochemical processes, it seems likely that sharp fall in the plant-potassium content may be indirectly responsible for the sensitive response. Interrelationship between sodium and potassium indicates that values of Na/K increase with the rise of soil ESP (Fig. 3).

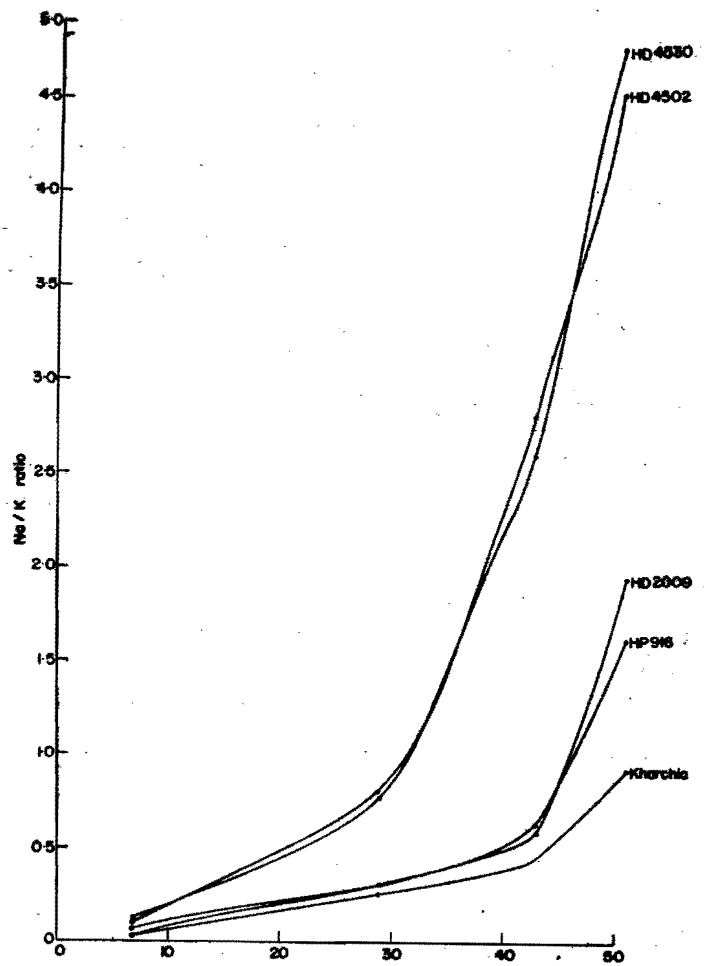


Fig. 3. Relationship between soil ESP and leaf Na/K ratio in wheat.

Such increase was observed by Mehrotra and Dass (1973). The sensitive varieties, HD 4502 and HD 4530 (Table I), are characterised by higher Na/K values. In the tolerant varieties, e.g., Kharchia, Na/K ratio was strikingly lower. A low Na/K ratio in Kharchia was also observed in our previous studies (CSSRI Ann. Rept, 1976). It may be added that Murty and Janardhan (1971) noted that tolerant rice genotypes were marked by low salt accumulation.

Based on the findings of the present investigation, it may be inferred that wheat varieties having lower leaf Na/K ratio at the tillering phase under soil sodicity conditions are the more tolerant ones. It is, proposed that this technique can be used for identifying sodicity tolerant genotypes in segregating plant populations.

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