

**COMPARISON OF THE YIELD AND VEGETATIVE  
CHARACTERISTICS OF TWO STRAINS OF  
AGROPYRON ELONGATUM. ( HOST ) BEAUV.  
GROWN UNDER DIFFERENT SALINITY LEVELS.**

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## THE PROBLEM

The need to have additional land for farming in order to provide food for the ever increasing population has stimulated the interest of economists, agriculturists and government planning agencies to develop the vast range lands of Northern UAR. A considerable areas of these range lands are regarded as salt affected soils in which most crops cannot make normal growth owing to the high concentration of soluble salts in the root zone. The primary source of these salts in soils is rock minerals from which salts are released, accumulate and become concentrated on the soil surface. In addition, the use of irrigation water containing too much salt as well as the bad management of soil under even good irrigation water can cause these soils to become saline. This situation frequently occurs in the UAR deserts where dry farming is practiced and in cultivated lands which mainly depend on artesian water containing high amount of salts. Within the Nile valley, several fertile areas became saline and their productive capacity had been decreased as a result of using irrigation water containing high concentration of soluble salts as well as the poor management of these lands. One opportunity for meeting the

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future needs lies in reclamation of salt affected soils. Reclamation of these areas by the common practices of drainage and leaching are often costly or impractical, particularly, in arid or semi-arid zones. Where reclamation is not practical, an alternate approach to improve these lands is to introduce species, varieties and strains of plants tolerant to a relatively high concentration of salts and can be economically grown under such condition. Forage crops particularly grasses include some of the most tolerant species which can be profitably grown in recent reclaimed lands and salt affected soils. Wide difference of salt tolerance was observed among different species as well as between the various varieties and strains that belong to a given species.

Tall wheat grass Agropyron elongatum. (Host) Beauv. can grow well on saline and sodium affected soil (184) and it is listed (39,121,123) as one of the most tolerant species to high exchangeable sodium percentage in the soil solution. It was also reported that this grass produces more forage yield on soils too sodium affected to grow other useful crops (28) and that its root penetration was about eleven feet deep in these soils (140).

Agropyron elongatum is grown along the coastal region

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of UAR and is considered as one of the important palatable and nutritive native forage plants of this region, within which many areas are characterized with their high level of salinity.

This work was designed to investigate the effect of salinity level on the growth, chemical contents and forage yield of two strains of Agropyron elongatum ( native strain grown naturally at Ras El-Hekma Research Station and an introduced strain from Utah, USA).

## 2. REVIEW OF LITERATURE

Salinity had a detrimental effect on the growth of plants. This influence is attributed to specific and non specific effects. The specific effect is due to the concentration of the various ion species with respect to one another; less frequently to the absolute level of any one element. The injuries of this specific effect are of a physiological nature (96) and presumably being the result of some interactions between salts and the organic substances of the cell (114). The non specific effect is due to the total concentration of salts of the soil solution (OP.) regardless of their kind and proportions. This depressing influence of the non specific effect on plants may be attributed to its effect on the water uptake (90) and occurrence of growth inhibitions (22) through any one of the following mechanisms:

- a) inability of subcellular osmotic units to adjust to higher osmotic pressure,
- b) osmotic adjustment which may itself limit the growth and,
- c) effect on certain enzymes.

## 2.1. Toxic Effect of Specific Ions.

The injurious effect of salinity on plant growth is not in all cases proportional to the osmotic pressure of the saline solution. However, each of the various components which are presented in saline solution, may have some specific toxic effect on plants over and above that which can be caused by the osmotic pressure of the soil solution (70).

The literature related to the toxic effects of ions on plants has been reviewed by Magistad (100), Mibashan (107) and Hayward and Wadleigh (75).

### 2.1.1. Specific toxic effect of sodium ion :

The accumulation of sodium ion within the plant tissues may be associated with a depression of the other cations to the extent that unfavourable cationic balance may be induced (130, 131).

On the other hand, Hayward (71) reported that the specific toxic effects may arise from the exclusion of sodium when accompanied with the accumulation of anions from the substrate, and added that it is doubtful if such cases should be classed as sodium ion toxicity. The same author pointed out that there is a relatively little evidence to indicate

difficult to ascertain and several may be operative simultaneously, while the exact mechanism probably will result from the penetration into the cell of the ionized toxic substance or from the fact that such penetration is difficult or impossible. However, it is commonly known that the bivalent cations (particularly  $\text{Ca}^{++}$ ), are probably coagulants and reduce the permeability of the membrane. In addition, Maune and Dulack (104) drew attention to the phenomenon of a "physiological toxicity" caused by the ionic disequilibrium of the nutrient medium.

Masaowa (102) reported that application of  $\text{CaCl}_2$  to soil culture was more toxic to flax than application of  $\text{NaCl}$ . Since the chloride ion accumulated to high levels in the plant in  $\text{CaCl}_2$  cultures and  $\text{Ca}^{++}$  was also presented in large amounts, she ascribed the plant response to  $\text{Cl}^-$  toxicity and to an unfavourable  $\text{Ca}^{++}/\text{K}^+$  ratio.

Gauch and Wadleigh (60) studied the absorption of nutrients by dwarf red kidney beans grown on saline substrate using two treatments, one having  $\text{NaCl}$  as the added salt and the other  $\text{CaCl}_2$ . They found that plants in the  $\text{CaCl}_2$  treatments had less growth than those in the  $\text{NaCl}$  and attributed the difference largely to poorer root growth in the calcium chloride

treatments. The same authors indicated that larger total amounts of sodium, phosphorous and potassium absorbed by the plants treated with NaCl in which  $\text{Na}^+$  predominated in the roots, than by plants treated with  $\text{CaCl}_2$ . They suggested that the differential effects of  $\text{Na}^+$  and  $\text{Ca}^{++}$  on the hydration of colloides may be involved, and that the inverse effect of  $\text{Na}^+$  versus  $\text{Ca}^{++}$  on the permeability of cells to salts may be a major factor in explaining the results obtained. Wadleigh et al. (180) investigated the mineral composition of orchard grass grown on soils salinized with various salts and found that the high concentration of the calcium ion in the soil solution may be lethal to orchard grass when the associated ion is either chloride or nitrate. They mentioned that since the calcium nitrate treatments resulted in the accumulation of only small amount of chloride ion in the plant tissues, it could be concluded that the chloride toxicity under this condition is not involved.

### 2.1.3. Specific toxic effect of magnesium ion:

High accumulation of  $\text{Mg}^{++}$  in the substrate has been found to be toxic to plants over and above any inhi-

hibition in growth that is associated with osmotic pressure. Trelease and Trelease (171) stated that  $Mg^{++}$  injury to wheat is mainly controlled by the  $Mg^{++}/Ca^{++}$  ratio, although the injury may be influenced by other materials. Ratner (130) indicated that above normal amounts of replaceable  $Mg^{++}$  lead to unfavourable  $Ca^{++}/Mg^{++}$  relations. Gauch (58) associated  $Mg^{++}$  injury with an inadequate supply of  $Ca^{++}$ . Wadleigh and Gauch (178) found that guayule was killed when sufficient  $MgCl_2$  was added to a nutrient solution to produce one atmosphere osmotic pressure, whereas red kidney beans showed only a 10 percent reduction under similar condition.

#### 2.1.4. Specific toxic effect of chloride ion :

The mechanism of  $Cl^-$  toxicity has been investigated by Garner et al. (57) in their working on tobacco. When there was a high accumulation of chloride ion in tobacco leaves they found a pronounced reduction in the malic acid content and also noted that the normal amylolytic activity was disturbed and the leaves became gorged with starch. The toxic effects of chloride ion have been noted by many investigators but there has been some tendency to regard  $Cl^-$  toxicity as

showed that germination of seeds was retarded by salts in solutions and the degree of delayed germination and injury to seeds and seedlings was in direct proportion to the osmotic pressure of the saline solution. If the osmotic pressure was high enough, no germination of seeds occurred, but it was noted that various species of agricultural plants showed differential salt tolerance at a given salt concentration.

Stewart (163) studied the effect of increasing salinity on the germination of the cereal and legumes and listed their relative salt tolerance in the following descending order: barley, rye, wheat and oats. For legumes, his order for salt tolerance was: peas, red clover, alfalfa and white clover.

Harris (70) tested the germination of barley, wheat, corn, sugar beets, oats, field peas and alfalfa at salt level ranging from no salt to 10,000 ppm. using various salts singly and in combinations. He found great variation among crops in respect to germination in saline substrates and listed the crop tested in the following descending order

of salt tolerance: barley, oats, wheat, alfalfa, sugar beets, corn and field peas. More recent studies have confirmed this early work ( 9, 12, 142, 143, 157, 173).

Shive (157) used a sand culture method to test the germination of beans and corn at osmotic pressure ranging from 0.5 to 8.0 atmospheres and found that the retardation of seed germination was directly related to the amount of water absorbed by seeds which in turn is dependent upon the concentration of the soil solution.

Rudolf's ( 142, 143) used presoaked seeds and subsequent germination on beds of filter papers with single salts at osmotic pressure up to 7 atmospheres. The germination percentage and root growth decreased with increasing the concentration of salts.

Aycers and Hayward (12) studied the effect of increasing sodium chloride on the germination of alfalfa, barley, red kidney beans, corn, onions and sugar beets. The levels of salinity ranged from 0.05 to 0.4 percent NaCl on dry soil basis. The osmotic pressure of the soil solution calculated from the electrical conductivity of the saturation extract