1- INTRODUCTION

In Egypt the increase in population demands should be faced by parallel increase in food production. Nowadays most arable soils suffer from a relative shortage in Nile water, therefore, the use of different sources of water types, such as underground, drainage, sanitary drainage, and sea waters for irrigating potential agricultural lands is considered inevitable.

Under the arid conditions prevailing in Egypt and the traditional irrigation practices need, salt accumulation arises as a serious problem. Many problems may take place in soil as a result of using saline water for irrigation. Salinity has an indirect effect on soil microflora. Microorganism activities such as ammonification and nitrification could be inhibited by salinization. Irrigation with saline water may affect either directly or indirecty the availability of some nutrients, that may lead to imbalanced utilization of a state essential nutrients by plants.

The harmful effects of excessive salts in the root media may be permanent, when roots pass through saline soil layers. There are several methods to induce the salt tolerance property of plants. These methods are based on the fact that salt affect seeds depending on the time of treatment and the salt concentration.

Salt tolerance is an important specific property for some crops, which at any time during their life cycle, are exposed during water absorption by specific effects of constituents ions in the saline media, or total salt concentration.

The presowing treatments were tested as means for inducing salt tolerance of plants and according by the yields of various agricultural crops on saline soils in many cases was increased. Wheat, being a main food crop in the world and being moderately salt tolerance, was selected for this study.

The aim of this work would be outlined in two objectives :

a- The first objective is to define the most suitable concentration of growth regulators, amino acids and macro or micronutrients, for pretreatment wheat seeds leading to the highest yield when use diluted sea water for irrigation.

b- The second objective is to investigate the effect of seed pretreatment in growth regulators, amino acids and macro or micronutrients on growth characters, some chemical components and yield.

2- REVIEW OF LITERATURE

2-1- Effect of salinity on growth, yield and yield components of wheat plants :

The major inhibitory effect of salinity on plant growth has been attributed to (a) osmotic inhibition of water availability, (b) toxic effect of the ions, and (c) nutrition imbalance caused by such ions (Gupta, 1977). Depending upon the type and concentration of salts, the plant species and varieties, and the environmental conditions, one of these factors may dominate (Greenway, 1973). The osmotic effect is less important than the other effects since, to some extent, it is counter-balanced because the higher salt concentration in the nutrient medium leads to an increase in the rate of ion uptake. This lowers the water potential in the plant roots and stimulates water uptake, which raises cell turgor and the turgidity of plant tissues. The change in osmotic potential of higher plants (including accumulation of compatible organic solutes in cytoplasm) as a means of maintaining a positive water balance is known as osmotic adjustement or osmoregulation (Turner and Jones, 1980).

El- Gabaly and Madkour (1965), showed that salt tolerance followed the decreasing order; Barley, wheat and bean. Poor growth ensured from an average 19.3 mmhos/cm electrical conductivity and 71.9 % Na in the most resistant crops , and from 8.5 mmhos/cm and 58 % soluble Na in the least resistant cultivars.

Asana and Kaile (1965), on certain cultivars of wheat grown under salinized conditions found that, salinity reduced tillering, dry weight, plant height and leaf area as compared with nonsalinized controls.

Singh and Narain (1980) indicated that there was only a small reduction in grain yield of wheat irrigated with saline water having electrical conductivity up to 8 mmhos / cm.

Zwaik (1980) found that straw yield of wheat plants and total dry matter content decreased with increase in salinity (0.64, 2, 4, 6 and 8 mmhos/ cm which was obtained by diluting with sea water and adjusting to constant SAR 7), grain yield was unaffected by salinity up to EC 8 and responded only to moisture at 6 mmhos/cm, but at 8 mmhos/ cm both grain and straw yields were depressed and K: Na ratio are low.

Balki and Padole (1982) showed that the grain yield of wheat was reduced significantly due to medium and high salinity levels.

Ahmed (1985) found that seedling growth of wheat plants in 10 and 20 % sea water was similar to that of the control but was reduced by further increases in salinity levels.

Sawhney (1986) stated that percentage germination of wheat plants was significantly reduced by diluted sea water to 8000, 12000 and/or 16000 ppm with Hoagland nutrient solution. Also radicle length, plumule length and root length were reduced by salt concentration more than 8000 ppm. After 30 days growth, seedling height decreased with increasing salt concentration.

Ehsan et al. (1986) found that salinity levels of 2 and 7.5 mmhos/cm had no effect on seedling mortality of wheat plants but increasing salinity above 7.5 mmhos/cm gave increasing mortality rates.

El- Sherbieny et al. (1986) pointed out that, the efficiency of spike dry matter production of wheat plant grown in sand culture, increased with increasing the salinity of irrigation water up to (0, 44 or 88 meq NaCl/ liter), though the opposite was observed for shoot and spike dry matter yield.

Klimok et al. (1986) concluded that, germination in water and especially in a salt solution produced the most vigorous growth in seedling of spring wheat.

Kumar et al. (1987) reported that increasing salinity of the irrigation water to 8 or 12 mmhos/cm, at different Cl: SO_4 ratios, decreased grain yield of wheat plants. Also, irrigation with saline water at Cl: SO_4 ratio (1: 1) gave markedly higher yields than irrigation with saline waters containing other ion ratios.

Kemal and Rahim (1988) stated that salinity below 75 mM NaCl had little effect on photosynthesis of spring wheat varieties but a large effect on grain yield and dry matter production was obtained. Also, salinity increased root / shoot ratio and stomatal density.

Van- Hoorn and Hoorn (1991) found that wheat appeared to be less tolerant during early seedling growth than during germination and later growth was achieved under three saline water irrigation treatments with initial chloride concentrations of 30, 60 and 90 meq/ liter.

2.2. Effect of salinity on mineral composition of wheat plants :

Chaudhary et al. (1974) noticed that uptake of N, P and K by wheat decreased with increase in salinity, however, they found that high salinity caused relatively greater reduction in the uptake of P than of N and K. Also, they found that salinity decreased P but increased N content in grain , it would thus appear that salinity not only affectes the absorption of P but also its translocation to the grain.

Chhipa and Lal (1978) found that high NaCl content and sodium absorption rate of the irrigation water decreased N, P and K in the grain and straw in general.

Janardhan et al. (1979), in a field experiment with wheat using NaCl in the irrigation water at conductivity levels of 4 and 8 mmhos/cm, found that increasing salinity increased uptake of Na and reduced uptake of K, resulting in a reduction in the K: Na ratio in the plant from 5.4 to 3.0.

Bhola et al. (1980) stated that no significant difference in grain protein content of wheat irrigated with saline waters of 0.3- 16 mmhos/cm.

El- Sheweikh (1980) showed that increasing salinity levels up to 4000 ppm led to increase N, P and K percentages and contents in stems and leaves of wheat plants, while increasing the salinity levels up to 6000, 8000 or 10000 ppm caused a decrease in total contents and percentage. Also, he showed that increasing salinity levels led to increase sodium percentage as well as total sodium content, in both leaves and stems.

Nath et al. (1982) found that Na and Ca + Mg contents of wheat grain and straw increased with increase in salinity (2- 20 mmhos/cm); K content was not affected.

Kang and Judel (1984) reported that the amounts of C^{14} found in the various chemical fractions (amino acids, organic anions, carbohydrates, proteins, lipids, insoluble residue) of young spring wheat plants, decreased with increasing salinity. Also, increasing salinity had no major effect on the nutrient concentrations (N, P, K, Ca, Mg) in the shoots, whereas the concentration of Na, and especially of Cl increased markedly. They assumed that the excessive Na and Cl concentrations in the shoots were responsible for the yield depressions.

Koszanski and Karczmarczyk (1985) stated that, irrigation with sea water (undiluted or diluted with an equal volume of water) increased spring barley and oat plants contents of N, P, K, Ca, Zn and especially Mg and Na but reduced Fe content.

Rabie et al. (1985) found that uptake of N, P and K and protein content of wheat grain increased at 0.3 % soil salinity and then decreased with increasing soil salinity up to 0.9 % which was severely depressive.

Dravid and Goswami (1986) reported that increasing soil salinity from 0.05 to 14.9 mmhos/cm, significantly decreased P, K, Ca, Mg and S uptake in wheat and maize. Also, addition of Fe and Zn to N, P and K fertilizers led to an increase in the yield and nutrients uptake resulted from mitigate the adverse effects of salinity.

El- Sherbieny et al. (1986) pointed out that salinity level of 44 meq NaCl/ liter (medium) resulted in the highest contents of Fe, Mn and Zn in shoots and spikes. Spike Fe content was consistently much lower than in the shoots; the mean values of micronutrient translocation rates followed the order Fe $<$ Mn $<$ Zn but no characteristic relationships could be observed between the salt tolerance of the tested wheat c.v. and their Fe, Mn and Zn contents.

Sharma and Yadav (1988) found that increasing levels of ESP reduced Fe and Mn uptake by wheat plants though their concentration in soils was increased.

Bilski (1988) reported that addition of 40 mmol $CaSO_4$ /dm^3 and 10- 20 mg Zn/ Kg substrate limited the toxic effect of NaCl, whilest, K or N had less effect. Also, Ca and N reduced the Na concentration in wheat plant tissues under saline conditions and Ca reduced Cl uptake.

Maas and Poss (1989) found that K uptake was severely inhibited by salt stress imposed during the vegetative stage of wheat plant but not when imposed in the reproductive stage.

Nour et al. (1989) pointed out that increasing salinity (0.2 and 0.4 %) of wheat seedlings grown in clay loam soil, decreased N, P and K uptake.

Lal and Lal (1990) found that N, P, K and Ca uptake of wheat plants, grown in loamy sand soil decreased while that of Na increased with increases in both electrical conductivity and sodium adsorption ratio. Also, uptake of N, P, K and Ca increased while that of Na decreased as rate of N, P and K application increased.

Chauhan et al. (1991) reported that irrigation with saline water increased Na content, while N, P, K, Ca and Mg contents of wheat plant were not affected by salinity at 6 dS/ m but were reduced at 12 dS/m.

2.3. Effect of seed presoaking with different treatments on growth, yield and yield components of wheat plants under saline conditions :

2.3.1. Seed pretreatments with growth regulators :

High accumulation of salts in the root zone depresses the plant growth as a result of high osmotic pressure between the soil and seed phases. These effects are further multiplied by the presence of some toxic ions in the root environment (Richards,1954; Hayward and Bernstein, (1958).

Attempts have been made to overcome those detrimental effects of salts upon seed emergence and plant growth, one of which now under trial is the presoaking treatment of seeds with some growth regulators at different concentrations. Such treatments could successfully enhance seed emergence, plant growth and root system in various crop species by inducing salt tolerance (Asana *et al.*, 1955).

Sarin (1961) found that presoaking wheat seeds in IAA, enhanced the root production by the salt supply. Sarin (1962) reported that soaking wheat seeds in 5 ppm IAA increased shoot dry weight by 50 % and grain yield by 31 % when soil was treated with 0.1 % Na_2SO_4 for the first year and 0.15 % for two years.

Darra *et al.* (1970) stated that presoaking of wheat seeds with growth regulators had significant positive effects on the germination. They reported also that all growth promoters are highly active only at selective concentrations and that too at a particular set of salinity, SAR and boron levels.

Seed presoaking in growth regulators helped in the production of more tillers. Also both IAA and NAA were superior to GA and IBA, as shown by findings of Bhardwaj (1962).

In different studies of Bhardwaj and Rao (1955), Jain (1968) and Dave and Gaur (1970), grain yields of different crops were increased with presoaking treatments of growth regulators.

Gibberellic acid has been reported to be quite useful for overcoming the growth suppression induced by high salinity and increased production of crop yields (Hayashi, 1940; Wittwer and Bukovac, 1957; Wiggans and Martin, 1961).

Singh and Darra (1971) found that presoaking of wheat seeds in IAA at concentrations of 50, 100, 200 or 300 ppm, under high salinity conditions with sodium adsorption ratio increased tillering, while plant height was increased by both GA and IAA. All the growth- regulating substances (IAA, IBA, NAA and GA) increased the dry weight of shoots and grain yield to some extent. The best responses were obtained with 200 ppm IAA which increased shoot weight by 64 % and grain yield by 63 %.

Darra et al. (1973), in study of wheat seeds, soaked for 24 hours in 10, 20, 50 or 100 ppm of GA, IBA, IAA or NAA and germination with saline solutions at 0, 3, 6 or 9 atm. osmotic pressure was compared with that of untreated seeds; they found that auxines (IAA, IBA and NAA) had little effect at 0 atm. but promoted emergence at 3- 9 atm. It was concluded that the beneficial effect of hormones was a result of increased water- absorption and could improve the early growth of wheat in saline soils.

Darra and Saxena (1974) stated that under salt stress condition, IAA presoaking treatments of wheat seeds helped to increase crop yield of wheat.

Harvinder et al. (1974), in pot trials, irrigated wheat grown from seed soaked for 24 hours in 50, 100, 200 or 300 ppm GA, IAA, IBA or NAA with water of conductivity 12 mmhos / cm, a Na absorption ratio of 30 and B contents of 2 or 4 ppm. They indicated that B, IAA or NAA increased tillering, GA and IAA at all concentrations and IBA and NAA at high concentrations increased plant height. All concentrations of IBA and at low concentrations of IAA and GA increased root length while NAA showed no effect. Also, IAA and NAA at all concentrations and IBA and GA at high concentrations increased both shoot dry matter and grain yields. The growth regulators were more effective at the higher B level under saline- alkaline conditions.

Chhipa and Lal (1978) indicated that presoaking of wheat seeds in 200 ppm of both IAA and IBA under two qualities of irrigation water, increased germination, plant height, tillering, grain yield and straw compared with untreated seeds.

Chhipa and Lal (1988) reported that seed presoaking of wheat in 200 ppm IAA or IBA increased the plant height, tillering, grain and straw yields when grown on sodic soil.

Parasher and Varma (1988) found beneficial effects of soaking wheat seeds with GA_3 on plant height, root length, fresh and dry weight of stem, roots and leaves which were increased under saline conditions (9.1 mmhos/cm) as compared with those under non- saline conditions and were greatest at a salinity level of 6 mmhos/ cm.

2.3.2. Seed pretreatments with amino acids :

The influence of high salt concentrations on plant nitrogen metabolism was considered through many studies. Joshi *et al.* (1962) showed that the marine plants produced much more amino acids and less organic acids than terresterial plants, when they fix carbon dioxide in the dark. In a homogenate from the spinach leaf, the percent of CO_2 fixed as amino acids was greater in the presence of NaCl than in its absence. Likewise, Webb and Burley (1965) found that the obligate salt marsh plants produced comparatively more amino acids than non- obligate ones. Also, they showed that the non- obligate salt tolerant plant *Spartina alterni-*

flora was pushed over to the production of amino acids when it was treated with NaCl.

Cusido et al. (1987) showed that the K deficiency induced by salinity stress increased the levels of free- amino acids, especially the aspartic acid, glutamic acid and proline.

Salt injury based on the alterations in intermediary and secondary nitrogen metabolism under saline stress conditions was extensively studied on the glycophyte plant species. Strogonov (1964) reported that the salt stressed plants exhibited accumulations of amino acids and amines, some of these compounds are toxic and therefore, inhibitory to plant growth. Strogonov et al. (1972) showed evidence that such compounds could be puterscine, which accumulate in the tissues of many salt stressed glycophytes.

A number of investigators concluded that the tolerant plants contain high levels of some particular amino acids. High concentrations of proline (Goas, 1965; Stewart and Lee, 1974; Triechel, 1975; Stewart et al., 1978), and glycine betaine (Storey and Wyn Jones, 1975; Story et al., 1977; Stewart et al., 1978), and B- alanine betaine (Larher and Hamelin, 1975; Stewart et al., 1978) have been found in tissues of halophytes collected from saline habitates and in plants grown in the laboratory. Stewart et al. (1978) showed that the accumulation capacity of proline, glycine betaine and B- alanine was markedly different in higher plant halophytes. Thus, some species accumulated proline, others glycine betaine, still others accumulated both amino acids, whilst some species accumulated neither. An interesting correlation between the capacity of some plants to accumulate specific amino acids and their ability to resist or tolerate particular environmental stress was observed by Stewart and Larher (1980). Thus, the higher the plant capacity to accumulate proline, the higher its ability to tolerate a number of stresses, including salinity, freezing and drought. They further reported that, many halophytes not only accumulate proline but also exhibit significant increase in tissue water content under salinity stress. This led to the suggestion that the accumulation of proline, asparagine and glycine betaine may provide some means of protecting electrolyte- sensitive sites against damage in salt- stressed cells.

Gupta et al. (1982) showed that the accumulation of proline was rapid in barley tissues, but only in plants that adapted to salinity applied. However, the tendency of proline accumulation was high in relatively salt sensitive barley varieties, according to Gill (1983).

Lone and Wyn Jones (1985) studied the effect of exogenous glycine betaine and proline on the salt tolerance of barley embryos in culture. Their results showed that :

1- Both solutes enhanced salt tolerance of embryos and were absorbed by embryo plantlet shoots to levels comparable to those found in halophytes.

2- The data suggested that, two different mechanisms may be responsible for the enhanced tolerance observed with the solutes :

a- Exogenous proline resulted in a significant exclusion of Na and Cl from the shoot tissue without apparently affecting absorption by the root tissue. Shannon (1984); Torello and Ricf (1986) and Warren and Pulich (1986) interpreted the significance of proline in salinity stress alleviation in this manner: Proline and sugars are subjected to enzymatic breakdown and may be rapidly converted to useful metabolic intermediates for growth and energy.

b- In contrast, exogenous glycine betaine did not have such a marked effect on xylem transport, and the enhanced tolerance could be due to increase ion compartmentation or a direct protective effect of the solute. Finally, the authors suggested that, probably more than 26 u mole g^{-1} fresh weight of endogenous proline is required to obtain better growth of any barley cultivar under salt stress conditions.

The effect of exogenous and endogenous proline on salt stressed barley embryos was experimentally investigated by Jones and Gorham (1986), who suggested the presence of an interaction between the organic solutes and ionic transport.

Amer (1989) found that foliar application of combined amino acids proline and glutamic acid at 5 ppm concentration increased both fresh and dry weights of barley plants, grown in washed sand under irrigation sea water diluted to 30 % of its origin salinity, by 111.2 % and 49.2 %, respectively as compared with the control. Also, he stated that, foliar application (proline + glutamic) at 5 ppm concentration through the most sensitive period i.e. seedling stage of barley grown in pots on both sandy and calcareous soils treated with chicken manure and irrigated with 50 % sea water increased both straw and grain yield by 34 % and 72 % for sandy and calcareous soils, respectively when compared with that under normal agricultural conditions of Egypt.

2.3.3. Seed pretreatments with macronutrients :

Presoaking of seeds in salt solutions containing certain plant nutrients has been reported to increase the yield of various crops (Gusev and Rajdrogov 1938; Roberts 1948; Narayanan and Gopal Krishnan 1949; Abichandani and Ramish, 1951).

Promis (1953) reported that soaking grain seeds in a concentrated solution containing a number of nutrients including N, P and K promoted early emergence and deep rooting and consequently an increase in yield was obtained.

Moriya (1956) pointed out that when seeds of rice were soaked in phosphate solution, an increase was observed in plant growth particularly the roots. He added that 1.0-0.05 molar solution was the most effective concentration.

Manolov (1957) showed that the rate of germination of tobacoo seeds was markedly increased when being soaked for 12 hours in a 0.5 % H_3PO_4 solution.

Ells (1963) treated tomato seeds with a solution containing both K_3PO_4 and KNO_3 salts followed with drying. Results showed an advanced seedling emergence by periods up to 5 days. He stated that the primary effect was due to certain enzyme activation occuring in seeds held in the moist conditions.

Massoud (1969) studied the effect of soaking alfalfa seeds for 24 hours in three different concentrations of KH_2PO_4 solution 0.0, 0.5 and 1.0 molar on P uptake and growth of alfalfa plants grown on calcareous soil. The results indicated that seed soaking in 0.5 molar KH_2PO_4 solution before planting (seed pretreatments) in combination with half the dose of phosphatic fertilizer usually applied to the soil, resulted in a pronounced increase in both the phosphorus uptake and dry matter of plants.

El- Gendy (1973) found that pretreatment of alfalfa seeds with solutions containing phosphate salts of either potassium or calcium resulted in a marked enhancement effect for growth and higher phosphate content of plants developed on either sand culture or calcareous soil than those developed from untreated seeds particularly at soaking period of six hours. Most favourable concentration level of the indicated material was 0.25- 0.5 molar for KH_2PO_4.

Padole (1979) stated that soaking wheat seeds in 1-2% urea or KH_2PO_4 for 6 hours increased the grain yield as compared with either non soaking or water soaking seeds.

Venger et al. (1983) reported that the treatments of spring wheat seed with solutions of macronutrients and trace-elements for 20 hours accelerated the earlier growth stages.

2.3.4. Seed pretreatments with micronutrients :

Winifred (1948) treated oat seeds separately with either $KMnO_4$ or $MnSO_4$ solutions of 0.25, 0.125 or 0.063 molar, seeds were dried in air at 22- 25°C. In field experiments on a Mn-deficient soil, results showed that the seeds treated with 0.25 molar $MnSO_4$ produced the most normal plants.

Nuzhnova (1955) studied the effect of seed pretreatment and plant spray with solutions consisting of 0.02 % H_3BO_3, 0.05% $MnSO_4$, $ZnSO_4$ and $CuSO_4$ and 0.01% $(NH_4)_2MoO_2$ on the yield of tomato plants in greenhouse. These treatments led to earlier seed germination, stimulation of blossom and, fruit development as well as higher yield.

Vasileva (1957) found that Mn was effective on wheat crop grown on gray meadow soil especially when seeds were soaked in a 0.05 % $MnSO_4$ solution. Dutoit (1962) reported that soaking maize seeds in a 0.01 % solution of Mn for 8 hours depressed the growth of plants and consequently yield was discouraged.

On the other hand, Gleris and Tamassy (1962) found that soaking pea seeds in a solution containing Mn previous to sowing resulted in a significant increase in yield plants. Results were confirmed by Trishin et al. (1963) who reported that soaking corn seeds in a solution containing 0.4 % $MnSO_4$ for 5- 6 hours resulted in a stimulated plant growth and development of the root system.

Regarding zinc, Shkol'nik and Chirkova (1958) carried out certain greenhouse experiments in which corn seeds were given a presowing treatments with Zn solution and which was also added later to soil. The results revealed that Zn increased the yield of ground parts of corn growing in the soil having the pH 5.4 and not in those grown on the soil of pH 6.

Efimov (1961) used a 0.02 % $ZnSO_4$ solution to soak corn seeds for 24 hours as well as in spraying or wetting of oat seeds, both being dried out after treatment. The presowing treatment increased the dry matter yield of both corn and oats especially when grown on soil fertilized with manure and superphosphate.

Dutoit (1962) reported that soaking maize seeds for 8 hours in a 0.01 % solution of Zn presowing suppressed growth and yield. Contrary results were obtained by Gleris and Tamassy (1962) who mentioned that soaking pea seeds in a solution containing Zn gave a significant increase in the yield of plants.

Trishin et al. (1963) reported that soaking corn seeds in a 0.2 % $ZnSO_4$ solution for 5- 6 hours at 18- 20°C resulted in a stimulated development of root system along with an increase in yield.

Padole (1979) stated that soaking wheat seeds in 0.02 - 0.04 % $ZnSO_4$ or $MnSO_4$ solutions for 6 hours increased the grain yield, compared with unsoaked or water- soaked seeds.

Regarding some other micronutrients, Manchanda and Bhandari (1976) reported a positive but nonsignificant increase in grain yield of wheat by 40 % as compared with 17.6% and 15.2 % due to seed presoaking in irrigation water as compared with soaking in NaCl and Na_2SO_4 solutions (2.5 - 3.5 %), respectively.

Puntamkar et al. (1971) noticed that presoaking of wheat seeds for 24 hours in 1, 2 and 3 % solutions of NaCl, Na_2SO_4 and $MgCl_2$ increased the yield significantly in saline soil (12.6 mmhos/ cm).

Mehta et al. (1979) sowed wheat seeds soaked for 24 hours in 1, 2 and 3 % solutions of sodium chloride, sodium sulphate and calcium chloride on a sandy loam soil salinized by adding sodium chloride to develop 0.1- 0.8 % salt levels. At low salinity levels (0.1 and 0.2 %) seeds soaking in calcium chloride was letter than soaking them in sodium chloride for obtaining high grain yields, but the effect of sodium chloride was increased at higher salinity levels. Also they found that soaking in 3 % sodium sulphate was the best treatment.

Devender Kumar and Singh (1980) studied the effects of wheat seed presoaking in saline soil of (6, 12 and 16 mmhos/cm), when soaked in saline water (2.1 mmhos/cm) for (0, 4 and 8 hours), they found that treatment presoaking seed did not give significant effects. That was attributed to short duration of seeds soaking treatment and low salinity of initial soil and irrigation waters.

2.4. Effect of seed presoaking with different treatments: on mineral composition of wheat plants under saline conditions :

2.4.1. Seed pretreatments with growth regulators :

The beneficial effects of some growth regulators may be on account of the increased surface area of roots, number of roots per plant and overall accelerated metabolic activation, Strogonov (1964) and Porath and Poljakoff Mayber (1965).

The increased uptake of various nutrients and decreased in sodium with IAA gets support from the work of Jain (1968), and Sethi (1968).

Darra and Saxena (1973) stated that uptake of N, P and K increased significantly in the grain, when the maize seeds were soaked for 24 hours in 50, 100, 200 or 300 ppm IAA solution, under different salinity regimes of soil. While significant decrease in the uptake of sodium with the use of IAA, especially under saline condition.

Darra and Saxena (1974) reported, in field experiment, that N, P and K uptake were increased in wheat yield, when seed presoaked in IAA solutions (50, 100, 200, 300 ppm), under different salinity regimes; while uptake of Na and Fe were decreased.

Chhipa and Lal (1978) found that presoaking wheat seeds in IAA, under two qualities of irrigation waters increased N, P and K in the grain yield, while Na content was decreased.

Padole (1979) showed that N, P and K content were increased in grain yield of wheat, when seeds were soaked in (20- 40) ppm of IAA or NAA.

Starck and Kozinska (1980) stated that K&P uptake was inhibited by NaCl treatment of bean (Phaseolus vulgaris) but inhibition of K was alleviated by application of GA_3, also GA_3 increased P and Ca content but decreased Na uptake.

On the other hand Balki and Padole (1982) observed an increase of N, P, and K uptake in wheat grain yield with seed soaking in IAA, NAA and GA under medium and high level of salinity.

Filatova and Malyugina (1984) exported that seed treatment of wheat with 3 mg IAA or GA eliminated the adverse effect of salinity on nucleic acid contents in wheat seedlings grown in solutions containing NaCl or Na_2SO_4.

Filatova (1984) stated that seed treatment with 3 mg IAA eliminated the marked changes in the activity of polyphenol oxidase, peroxidase and ascorbate oxidase and in oxidized and reduced vitamin C and glutathione contents of wheat seedlings grown under saline conditions.

Filatova _et al._ (1985) found that seed treatment with growth regulators (not specified) promoted normalization of the redox processes and affected accumulation of free and bound ions in wheat plants grown under saline conditions.

Filatova (1986) reported that seed treatment with IAA and GA promoted the normalization of N metabolism in wheat seedlings grown under saline conditions.

Salama and Abdel- Basset (1987) stated that, soaking wheat seeds in solutions containing IAA or GA_3 at 10- 4 M for 3 hours, followed by soaking in NaCl solutions at -2, -4, -6, -8 or -10 bar, increased protein content and reduced amino acids content in wheat seedlings at each salinity level.

Chhipa and Lal (1988) pointed out that presoaking wheat seeds in 200 ppm IAA or IBA increased N, P and K uptake in grain and straw yield while decreased Na uptake when grown on sodic soils.

2.4.2. Seed pretreatments with macro and micronutrients:

Chhipa and Lal (1978) reported that presoaking of wheat seeds in distilled water, 1 % $MgCl_2$ and 3 % NaCl, under two qualities of irrigation waters, increased N, P and K in the grain and straw yields, while Na content was decreased.

El- Gendy (1973) found that presoaking of alfalfa grown on calcareous soils, in solutions containing phosphate salts of either potassium or calcium and sulphate salts of either Mn or Zn developed plants of higher phosphate content than those developed from untreated seeds particularly at soaking period of 6 hours. Most favourable concentration level of the indicated materials was 0.25- 0.5 M for the potassium phosphate, 0.5 % for sulphate salts of either Mn or Zn.

Padole (1979) showed that, soaking wheat seeds in 0.02- 0.04 % $ZnSO_4$ or $MnSO_4$ and 1- 2 % urea or KH_2PO_4 for 6 hours increased N, P, and K in grain yield compared with unsoaked or water- soaked seeds.

Ashour et al. (1977) indicated that presoaking seeds of wheat in H_3BO_3 solution tended to increase protein- N and chlorophyll contents when compared with untreated seeds.

2.5. Nutrient flow rates into roots :

A nutrient or element has to move to the root and be contacted directly by the root surface in order to be absorbed. For a relatively immobile nutrient like P, and, to some extent, K, the amount of root produced by the plant becomes important in the uptake process of these nutrients.

The process of nutrient absorption by plants growing in soil may be divided into three steps : (a) the movement of the nutrient from the soil to the root surface; (b) the movement of the ion from the exterior of the root to the interior of the root; and (c) the translocation of the nutrients from the root to the shoot.

Two proceses are involved in the movement of nutrients through the soil to the root surface. Three processes are involved, mass- flow of soil water, mass- flow and root interception (Barber et al., 1963). The process that has the greatest effect on availability for a particular nutrient depends on the concentration of the nutrients in the water which moves toward the plant root (through the mass flow process) as a result of water uptake by plant root, the amount of water uptake which dictates the flow rate of this water, and the rate of nutrients uptake by the plant root.

Barber (1962) revealed that when more of nutrient is moved to the root than the root absorbs, the nutrient accumulates at the root interface and mass- flow becomes, therefore, the dominant factor in determing the nutrient availability. Diffusion only enters the picture in so far as it reduces the concentration at the root surface by back diffusion into the soil. Diffusion is the dominant factor controlling availability when mass flow brings only a small fraction of the nutrient required by the plant root. Absorption by the plant root establishes a concentration gradient along which the nutrients diffuse to the root. Soil factors which influence the size of the concentration gradient and the magnitude of the diffusion coefficient will influence the rate at which the nutrient reaches the plant root and, hence, its availability.

Barber et al. (1962) discussed the effect of soil type on the mass-flow and diffusion of ion movement. They found that the rate of ion movement to the root by mass-flow depends on reconcentration of the nutrients in the water which flows to the root and the rate of flow of the water. The amount of water absorbed for each gram of plant material produced gives the relationship between the rate of flow of water and the nutrient requirement of the plant. The nutrients content of the water which flows to the root might be estimated by analysing the nutrient content of saturation extract of the soil. The level of soil moisture had some effect on the nutrient content of the extract. When mass-flow do not provide the needed nutrients to the root surface, a concentration gradient about the root would be established as the root depleted the nutrients at its surface. Nutrients such as potassium and phosphorus would diffued to the root. The rate of diffusion would depended on the concentration gradient and the diffusion coefficient. The concentration gradient dependes on the level in the soil.

Several investigators studied the relationship between soil solution and the root system in the soil. Williams (1948), found that rate of intake of phosphorus and nitrogen were expressed per unit weight of root system. With nitrogen, the supply of which was the same for all treatments, large initial effects of phosphorus treatment, on the rates of intake were accounted for interms of differences in the ratios of roots to shoots. The percentage phosphorus contents of the stems, leaves and roots fell ultrimately to lower values with a moderate supply of phosphorus than they did with the deficient supply. A more efficient re-utilization of phosphorus in the plants receiving the greater supply was favoured as an interpretation of this dilution effect.

Nye (1966) studied the effect of soil and plant characteristics on the rate of uptake. The treatment was applicable to phosphorus and potassium. The uptake should increase with the root absorbing power until diffusion through the soil becomes limiting. Absorption by unit surface area of root increases at the root radius decreases. A root hair was shown to interfere quickly with the uptake of adjacent hairs. The hairs increase absorption by the root because they could exploit rapidly the soil between the hairs, and they had the effect of extending the effective root surface to their tips.

Newman and Andrews (1973) found that, potassium uptake per unit amount of root was generally lower the higher the root density, suggesting that roots were competing with each other for potassium even at the lowest density. In contrast, phosphorus uptake showed a good correlation with root growth irrespective of root density or plant age. Phosphorus uptake during a period was more closely and consistently correlated with root growth during that period than with the total amount of root on the plant. The results can be explained in terms of ion supply to the root surface, taking into account the diffusion coefficients of the ions and the approximate distances between neighbouring roots.

Barber (1974) stated that nutrient absorption is a primary function of root system of the plant. The rate of nutrient absorption by the root frequently determines the growth rate of the crcp. The properties of the root system that are important are : (1) the amount of roots unit of nutrient required, (2) the maximum rate that the root can absorb nutrients per unit of root, and (3) the effect of applying nutrients to any part of the root system on the uptake rate of the roots in contact with the nutrients. His observations on Zea mays and Glycine max seedlings indicated that for both P and K, uptake per meter of root were much higher when plants were 4 to 6 days old than when 19 days old. Experiments with older Zea mays plant indicated that the rates continued to decrease untill the plants entered the reproductive stage of growth. When calculations were made assuming uptake was mainly by young roots, uptake rates were still much greater for young plants but the differences were less.

Mengel and Barber (1974) gave information on changes in the rate of nutrient uptake per unit of plant root length (nutrient flux) during the growth of plants for evaluating the capacity of the soil to supply sufficient nutrient to the root surface. Nutrient uptake rates per plant per day were calculated and divided by mean root length to get nutrient flux into the root as related to plant age. Nutrient flux was greatest at the first sampling, decreased rapidly with increased plant age until plants were 70 days old, and then remained relatively constant. Mean flux into the root was similar in both years despite large grain yield differences between years. As the flux may be biased downward with older plants because of lower uptake rates by moremature tissue, efforts were made to overcome the bias by assuming that only roots less than 5 days old actively absorbed nutrients. Flux calculations on this basis still decreased as the plant developed, but the differences were smaller. The reduction in nutrient flux with age may explain why some plants show P deficiency symptoms during early growth but later recover from the deficiency. The reduction in nutrient flux as the plant develops may be due to the lower requirement of contact the fertilizer nutrient. They found a decrease in nutrient uptake rates of roots with plant age may be an indication of a decrease in effectively absorbing root area, as a fraction of total root area, due to progressive suberization of the older parts of the root system. Insufficiency of K in nutrient solution seemed to depress ($P < 0.01$) P uptake even when P is adequate in the solution. This result could mean that K ion is essential in activitity P- specific ion absorption sites on the root surface.