INTRODUCTION

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I- Effect of radiation :

1- General :

Radiosensitivity widely varies, not only between different plant species but also between different conmecial varieties within the same species **(Fujil and Matsunura, 1958)** as well as between different strains **(Smith,1942)**. It was reported that within the same variety the differences are probably due to physiological conditions rather than to the seed size **(Froier and Gustofason, 1944)**.

It was also reported that within certain plant families large differences in response to radiation were shown by species of Leguminaseae and labiatae, while in others (Gramineae) the differences were small and in some others (cruciferae) there were none. Moreover, in some individual species (Pisum sativum, Phaseolus vulgaris) considerable variations in response to radiation occurred between varieties, while in others, (Triticum vulgare) no variation was found taking into consideration that there were differences between the reaction carried out in the laboratory and those performed in the field. It was also shown that radiation resistance was affected by the size of the seed within the family and species. Large seeded species of Leguminosae such as Vicia faba, Pisum sativum and _Phaseolus vulgaris_ were sensitive while small seeded species of forage crops were resistant to radiation **(Preobrazenskoja, 1959).**

Bair _et al._ (1956) and Wood (1958) stated that the ionizing radiation could affect the biological material through changes at cell surface. **Thromson _et al._ (1952)** suggested changes in cytoplasmic permeability of unknown nature including induced alteration viscosity **(Virgin and Ehrenberger, 1953).**

2- Effect of gamma radiation on seed germination and seedling growth :

Exposure of the seeds of _Possifora edulls_ and _P. fostida_ to 1-2.5 Krad increased both the germination percentage and the survival of the germinated seeds. Doses within the same range also accelerated seed germination by 7 days **(Torne and Rant Desai, 1975).**

By irradiating barley grains with different doses of gamma rays ranging from 10-30 Krad before sowing, no differences in germination under laboratory conditions were observed, while germination and survival of seedlings decreased in a linear manner in the field with the increase of radiation doses **(Goswami, 1975).** The germination percentage of _Papaver somniferum_ seeds was increased from 62% to 85% by gamma irradiation at the dose of 20 Krad.

However, the same dose has reduced the germination percentage of <u>P. rhoeos</u> from 80% to 52% **(Graver and Dhanju, 1979).**

Recently, **Azer (1982)** reported that significant increase in the germination percentage could be achieved when seeds of sugar beet were gamma irradiated at 4 or 8 Krad.

Sydorenka (1962) found that presowing exposure of maize kernels with 1 or 2 K.red stimulated and raised the energy of germination power by 17-20%. Similarly, **Romenokii <u>et al.</u> (1963)** reported that pre-sowing irradiation of maize grains by gamma doses up to 10 Krad had a stimulatory effect on germination rate while higher doses inhibited it.

Siyanova (1963) and Matsumura (1966) found that higher doses of gamma-rays caused significant decrease in the germination rate of wheat cultivars and delayed germination and seedling emergence.

Amer and Hakeem (1964) stated that irradiated wheat grains with gamma rays by the rate of 4,7,12,16,20 and 25 Krad did not affect the germination percentage and rate. **El-Bastawesy and El-Masry (1971)** also found no significant effect of irradiation with 0.5, 1,2,4,8 and 16 Krad doses on germination rates, but higher does (32 and 64 K. rad) decreased the germination age and rates.

Singh (1971) concluded that gamma-rays doses of 10,20 30 and 40 Krad caused a significant decrease in germination percentage of maize grains.**Marcos _et al._(1972)** showed that increasing the dose of gamma irradiation to 12 and 24 Krad significantly decreased the germination percentage of barley grains, while 34 K. rad completely inhibited it.

Iqbal _et al._ (1974) in their trials on _Zea mays_ showed that the percent of germination increased significantly only at 5 K. rad.

Vasti and Jenson (1984) pointed out that exposing barley kernels to gamma rays doses at a rate of 4,6,10 and 20 Krad in the laboratory decreased the dry weight of top per seedling from 23.8 to 23.3, 17.2, 12.3 and 12.5 mg respectively and increased as well the mortality ratio treatment.

Singh and Anderson (1975) observed that germination percentage and growth rate were inhibited partially by 50 to 62% by presowing irradiated grains with 20 to 40 K. rad and almost completely at higher ones.

Irradiating wheat grains with low doses of gamma rays accelerated germination **(Séric, 1958)** while other investigators observed little or no effect in response to radiation in case of <u>Triticum vulgare</u> **(Preolorazenskaza, 1959)**. On the other hand, high doses of radiation are capable of causing severe damage to living structure **(Kuzin, 1961)**.

Irradiating wheat grains with gamma rays up to 16000 rad had no statistically significant effect on the germination percentage compared **(Sharbash *et al.*, 1973)**. These results are in harmony with those obtained on wheat **(Preolokazenskoja, 1959; Paienzone, 1960)**. Higher doses were associated with progressive raduction in germination percentage **(Kuzin,1961; Sjnj and Hvostova, 1962 and Sharma and Boyes, 1962)**.

Eid *et al.* (1983) stated that low radiation 10^4 rad and 5 X 10^4 rad, increased the germination power of the studied barley grains.

Shahine (1976) irradiated the dry seeds of two wheat species <u>(T. durum and T. acestivum)</u> with gamma rays at doses of 0.5-64 Krad. The qualitative and quantitative characters such as germination percentage, mature plant characters, grain yield and protein percentage in the seeds have been compared to those of the control treatment. The two species behaved differently in the above characters. The doses 2 and 4 Krad for <u>durum</u>, and those of 0.5 to 2 Krad for the <u>vulgare</u> wheat gave positive effect for most of the studied characters.

3- **Effect of gamma radiation on shoot growth :**

Many plants grown from gamma irradiated seeds gave faster growth of green top and roots and increased the yields of fresh and dry organic matter in plants **(Kahan, 1973)**.

Raafut *et al.* (1970) and Sharabash *et al.* (1973) evaluated the plant height of wheat plants under different doses of gamma-rays and observed that doses higher than 7.5 Krad were inhibitory.

Joshi *et al.* (1971) exposed dry barley grains to gamma rays up to 62 K. rad and let them to germinate and grow in the dark. A linear inverse relationship was found to exist between radiation exposure and growth as well as with macromolecular contents from 13 to 55 Krad. Regression of these ciriteria as radiation exposure was highly significant.

The low doses of gamma-radiation (1 Krad or below) increased plant height, number of tillers and biological yield of barley plants **(El-Bastawesy and El-Masry, 1971)**. In this respect, **Sharabash <u>et al.</u> (1973)** found that low doses of gamma-rays, below 1 Krad increased the plant height, number of tillers and dry matter of wheat plants. Increasing the dose up to 10 Krad did not affect significantly the plant height and biological yield of barley plants **(Marie, 1972)**. On the other hand, higher doses (10-30 K. rad/significantly decreased the aforementioned parameters **(Al-Kwaity <u>et al.</u>, 1972)**.

Sharabash <u>et al.</u> (1973) found that irradiating wheat grains with gamma rays until 16 Krad had no statistical significant effect on the germination percentage compared to the control, whereas, irradiating wheat grains with 1 to 2 Krad increased the dry weight,plant height and number of tillers per plant. Higher doses depressed the growth of wheat plants.

Sharabash (1974) observed that the low doses stimulated the growth of wheat plants i.e plant height, number of tillers and shoot dry weight, while high doses depressed it.

Abou-Hegazi (1980) studied the effect of irradiation at 5,10, and 40 Krad of gamma rays on hard wheat cultivar "Dakar" and soft wheat cultiver Giza 155. The plant height of both cultivars was significantly increased, i.e by a rate of 8% at 10 Krad. Cultivar "Dakar" however reflected a significant increase in number of tillers.

Iqibal (1980) exposed three cultivars of Triticum aestivum to acute gamma rays at three developmental stages, i.e. L-leaf, ear emergence and anthesis. Plants that were exposed to 0.5 and 1.25 K. rad had in general a stimulatory effect on plant height and tillering at leaf stage. An adverse effect on the above mentioned characters at ear emergence and anthesis stages of development was observed.

Constantin *et al.* (1976) exposing soybean seeds to gamma-rays (15-40 K. rad) reduced plant height and seed yield, the decreases developed as the dose was increased. This was confined by **Harb (1981)**. **Bhattacharya (1977)** treated the soybean dry seeds with gamma-rays (10-50 Kard) the lowest dose increased plant height, number of buds, seed yield, and seed index, while the higher doses reduced them.

Several mechanisms which may, individually or in combination, bring about the effect of radiation may explain inhibition or promotion of growth through auxin distraction **(Quaster and Baer, 1950)**, inhibition of the auxin synthesis **(Gordon, 1957)**, disturbance of phenols metabolism **(Koplov and Kuzin, 1964)**, formation of physiological active substances **(Romani, 1966)**, limiting nutritional levels **(Went and Thimann,1937)**,inhibition of mitosis and/or chromosome damage **(Gunckel and Sparrow, 1961)** and chromosome volume **(Sparrow *et al.*, 1961 and 1963)**.

Puzakova *et al.* (1979) evaluated the effect of gamma radiation on grains and vegetating plants of winter wheat. The small doses activate the physiological processes while the higher ones inhibit them.

Saleh and El-Shouney (1974) found that highest plant height, number of tillers and spikes per plant and weight of the shoot system and grains were obtained from irradiated grains with dose of 3.0 K. rad.

Mohamed et al. (1985) stated that maximum length was obtained by presowing exposure wheat grains with gamma radiation at rate of 2 K. rad when plants were irrigated once during tillering stage.

4- Effect of gamma-radiation on leaf growth :

Irradiating corn, rays and barley grains with 2,5 Krad and squash seeds with 400 rad, increased the number of leaves per plant **(Goranov, 1972)**. On the other hand, **Walter (1969)** found that the radiation doses tended to decrease the number of leaves per plant.

Irradiating sugar beet seeds with 4 and 8 Krad before sowing has significantly increased the number of leaves per plant, fresh and dry weight of leaves, length and diameter of roots and fresh and dry weight of roots during the growth season **(Azer, 1982)**.

5- Effect of gamma-radiation on fresh and dry weight :

In several experiments, it was found that exposing seeds of pearl millet to 19 Krad reduced the forage yield percent. Irradiated dry seeds of *Zea mays* with 5,10,15 and 20 Krad gamma rays showed no significant change in the dry weight of shoots **(Burton and Powell, 1971; Iqbal *et al.*, 1974 and Natargar and Marie, 1961)**.

Azer (1982) reported that irradiating sugar beet seeds with 8 Krad significantly increased the yield of roots per feddan, length and diameter of roots and fresh and dry weight of roots at harvesting time.

Also, **Fowler and Macqueen (1972)** did not observe any practical change in yield or other agronomic traie of spring wheat.

Gorge _et al._ (1972) examined the affect of presowing exposure of barley grains to 3 Krad gamma irradiation on the drought resistance behaviour of plants.The plants were subjected to wilting treatments at tillering stage and were maintained so for ten days. Presowing exposure of seeds to gamma irradiation induced drought tolerance in barley plants. It did not only improve the growth behavior but also maintained an active metabolism in plants even under wilting conditions.

Rodziowiez (1982) studied the effect of radiation on barley plants by exposing them to gamma-rays from 0.25 to 10 Krad at 12 stages of development. Doses up to 2 Krad had a little effect on grain setting, doses up to 4 Krad did not prevent normal grain production, while above these doses it was not lethal and even at 10 Krad over 50% of plants produced grains.

Chauban _et al._ (1984) irradiated dry grains of the 6-rowed barley variety to gamma-rays (2.5 Krad) and found that the mutants were superior to control plants in total grain yield.

Larik and Kum (1984) found that gamma-rays induced significant positive shift of productivity/day, grains/ spike, yield/plant, 1000-grain weight and harvest index. Maximum spike length was obtained by irradiating with a higher dose (6 Krad) under irrigating once at grain filling stage.

Andonov <u>et al.</u> (1983) exposed barley grains to 15 Krad gamma rays before sowing. They found a positive correlation between grain weight/ear and both 1000-grain weight and grain number/ear, and a negative value of correlation between grain number/ear and 1000 grain weight.

Mohammed <u>et al.</u> (1985) exposed wheat grains variety "Lu 26" to different doses of gamma rays and found a significant reduction in plant height resulted in a greater number of spikelets per spike and grains per spike. However, they showed a significant adverse effect on 1000 grain weight and grain yield/ha. Plant height was positively but non-significantly correlated with spike length, grain/spike, 1000-grain weight, dry matter yield, grain yield/plot and harvest index. However, it was negatively correlated with number of spikelets/spike. Grain yield/plant showed highly significant and positive increased stem length, number of branches, pods, and seeds as well as seed yield/plant, with the maximum value at 4 Krad.Significant decreases to the same traits were obtained due, to the doses of 16 and 20 Krad. In general, higher doses than 4 kr, significantly reduced seed number/pod.

7- **Effect of gamma-radiation on carbohydrate changes :**

Azer (1982) working on sugar beet reported that irradiating dry seeds with different doses of gamma rays (1-12 Krad) decreased the total soluble sugars percentage, and non-reducing sugars percentage in the roots. Meanwhile on significant changes were recorded for the reducing sugars percentage in the roots. The same author observed a significant increase in the absolute amount of total soluble sugars and non reducing sugars for seeds irradiated with 4,8,16 and 32 Krad.

Race et al. (1978) found that reducing sugars in wheat flower irradiated with 0.02 to 1 Krad were increased by 5.92% more than the control. However, deastatic activity, expressed as maltose values, was significantly much more in wheat flower treated with 0.02 Krad than that treated with 1 Krad.

Sirry et al. (1980) studied the changes in irradiated wheat grains with successive doses up to 80 Krad and found added that treatments of 80 and 40 Krad showed the lowest values of reducing sugars followed by those of 20,10,5 Krad while the nonirradiated control showed the highest values.

Dorgham (1991) stated that the percentage of reducing sugars, non reducing sugar, total carbohydrates and ash were not affected significantly by presowing irradiation (2.5,5 Krad) of wheat grains.

Eid *et al.* (1983) observed that radiation doses increased the reducing, non-reducing and total sugars contents of barley grains. On the contrary, the starch content was decreased with the increase in radiation doses.

The change in carbohydrate fractions of irradiated wheat grains was studied by **Anathaswany *et al.* (1970)** where they found an increase in reducing sugars level by using doses ranged from 20 to 200 Krad. The sensitivity of starch to amylolysis increased with radiation doses.

Arman *et al.* (1978) revealed that gamma-irradiation (50 Krad) of corn seeds markedly stimulated the synthesis of sucrose in the seedlings but inhibited the formation of fructose. Also, **Kurchone *et al.* (1979)** studied the effect of gamma radiation on some enzymes in barley grains during germination. They concluded that the sensitive enzymes to irradiation, were those which metabolize phosphate compounds (e.g phosphomonoesterases, phosphodiesterase and ATP-ase). The resistant enzyms were those which metabolize carbohydrate compounds such as α-and β-amlyase, β-glucosidase, β-galactosidase and β-1,3-gluconase.

8-Effect of gamma-radiation on nitrogen and lipids changes

Jiraček et al. (1970) found that gamma rays decreased the amino acids content of wheat, glutamic acid, arginine, proline and lysine in the shoots, while it increased amino buteric acid.

Iqbal et al. (1974) found that increasing gamma-rays to 10 or 15 Krad significantly increased total and free amino acids in roots of Zea mays.

Tsanov (1982) found that increasing gamma-rays to 10 and 15 Krad increased the variation of protein content in wheat grains, a negative correlation was found between protein content and grain weight.

Yankulov et al. (1982) indicated that treated barley grains with 18,28 or 38 Krad of gamma-rays increased the protein by 1-4% than the original plants. A negative correlation was found between protein content and plant height.

Morad *et al.* (1977) exposed wheat grains to gamma irradiation with doses of 25,50,75 and 100 Krad. The total protein content was significantly decreased with increasing the dose level and the free amino acids increased markedly in irradiated samples than in the controls. This might be due to the radiolytic effect of gamma irradiation on peptide linkages of amino acids in wheat protein.

Tsanov (1982) found that increasing gamma rays to 10 and 15 Krad increased the variation of protein content in wheat grains. A negative correlation was found between protein content and grain weight.The componental structure of proteins in wheat plants grown from irradiated seeds was studied by means of polyacrylamide gel electrophoresis Under the influence of stimulative inhibitory or lethal doses of presowing irradiation, the protein did not change qualitatively or quantitively.

Dorgham (1991) stated that the protein content in the grain showed a significant reverse relationship with presowing irradiation. The ability of grain proteins to absorb and retain water was decreased by increasing presowing gamma irradiation dose up to 5 Krad. Also, these negative effects of gamma irradiation on wet gluten % and hydration % might be attributed to the radiolytic effect of gamma irradiation on peptide linkage of amino acids in wheat protein.

Shadi (1983) stated that TLC analysis showed that doses higher than 10 Krad caused a noticable increase in free fatty acid amounts. This increase was accompanied by relative decrease in triglycerides. GLC analysis revealed that gamma radiation caused a noticable degradation to different fatty acids of soybean seed oil. The more pronounced effect was found under the influence of doses higher than 10 Krad. Subsequently, the chemical analysis showed that, these higher doses, caused a gradual increase in acid and peroxide values, while ester number, iodine value and unsaponifiable matter were decreased markadly.

Hasean <u>et al.</u> (1988) stated that phospholipids proportionally decreased as the dose of irradiation increased. Some unsaturated fatty acids disappeared during irradiation. These changes may be due to the conversion of some unsaturated fatty acids into saturated ones during irradiation treatment.

El-Sayed <u>et al.</u> (1979) stated that gamma irradiation doses ranged from 50-200 Krad had no significant effect on total saturated or unsaturated fatty acids. A dose of 200 Krad led to a significant increase in lenoletic acid on the account of insignificant decrease in palmetic acid.

II- Effect of salinity :

1- General :

Plant water stress or water deficit is caused by either excessive loss of water or inadequate absorption or a combination of both **(El-Shahaby, 1981)**. It is characterized by decrease in water content, osmotic potential and total water potential accompanied by loss of turgor, closure of stomata and decreased in growth.

The effect of water stress by salinization on germination, growth and yield of many species of plants have been reported **(Hutton,1971, Abdalla,1973, El-Shahaby, 1981, El-Deep, 1984)**.

The first effect in treatments of salinity for a given crop generally retard germination with little or no effect on ultimate number of seedlings. Higher levels of salinity approvate the delay in emergence and decrease final germination percentage **(Heikal *et al.*, 1982 and Deep, 1984)**.

In this connection, **Hussein (1985)** pointed out that the inhibitory effect of salt stress on germination could be related to the effect of low water potential on enzymatic activity and not to the limiting water uptake. **Kohan and Poljokoff-Mayber (1968) and Greenway and Osmond (1972)** demonstrated that saline environment could alter the activity of certain enzymes extracted from plants subjected to salinity stress.

Most of the soil salts are neutral with the exception of the carbonates of sodium and potassium. Hence, soil containing an excess of any of the neutral salts are designated as salty or saline soils. They are known collectively, however, as white alkali soils, from the white incrustation usually produced by them. The highly alkaline soils containing carbonates of sodium or potassium are called black alkali because of the dark caloured incrustation which these salts produce by their solvent action on the organic matter of the soil. In many places where vegetation is sparce, the colour is brown or dark brown instead of black **(Weaver and Clements, 1938).**

2- Effect of salinity on seed germination and seedling growth :

Seed germination and consequently seedling growth respresent the first stages of plant life which face the drastic soil conditions. It was recorded that salinity induced a reduction in the rate of germination and a delay in the emergence of plumules of many seeds **(Uhvits, 1946; Maliwal and Paliwal, 1967; Chatterton and Mekell, 1969; Norlyon and Epstein, 1975; Jonsson and Nillsson, 1977; Nukaya *et al.*, 1977; Ladiges *et al.*, 1981; Singh, 1982 and Heikal and Shaddad, 1981,1982).**

germination of these seeds. This was due to the decreased rate of water absorption with increasing the osmotic pressure levels, which in turn reduced the rate of germination **(Parmar and Moore, 1968)**. The retarding or the inhibiting effects of salinity on germination vary according to the plant type and even to the cultivar used **(Genkel,1961; Sarin and Narayanam, 1968 (a); Torres Bernal et al., 1974; Selim and Ahmed,1975 and Heikal and Shaddad, 1981,1982)**.

The variations in the response of the germinanting seeds depend, mainly, on the type and concentration of the salinizing agent as well as on the type of the seed germination of Sesbnia aegyptica and was inversely related to increasing levels of water stress,salinity and alkalinity. **Seita and Narang (1985)** found that salinity in 150 mM $NaHCO_3$ decreased the germination percentage of pea seeds to 35%. **Kudret (1987)** found that sodium chloride inhibited or delayed seed germination according to its concentration

The sensitivity to salinization differed according to the stage of the plant development. **Novikov, 1942; Mehta and Lesai,1958 and Dregne, 1964,** showed that cotton plants were more sensitive to salinity during germination and flowering stages, whereas at intermediate stages they were more tolerant. **Oseledats (1959)** studied the effect of sodium chloride and sodium sulphate on tobacco seedlings and found that low concentrations (0.002-0.005%) of these salts,applied separately or together, stimulate the growth of the sprouts. However, concentrations of 0.01 to 0.02% had no effect on the sprout growth. Higher concentration, on the other hand, prolonged the developmental phases and caused stunting and loss of plants. When the concentration of the salt increased to 0.4% or more, sprouting stopped completely.

Germination is reduced in presence of high salt content rations and the growth of plants grown under such condition is adversely affected **(Abdel-Salam, 1970)**.

Dewey (1960) studied the salt tolerance of agropyron and found that, as salinity increased the percentage of germination was decreased, while, germination time was increased lenearly.

3- **Effect of salinity on shoot growth** :

Several investigations reported that salinity was shown to induce reduction of the shoot growth of various crops **(Wilson et al., 1970; Hulton,1971; El-Shaurbagy and Missak, 1975; Sheoran and Gary, 1978)**.

Bejaoui (1985) found that NaCl decreased fresh weight and elongation of root and shoot of soybean plants. **Richardson et al. (1986)** stated that irrigation of sorghum

Salinity seemed to result in creating bad physiological conditions for development of plants which, of course, should be expected to be reflected on all metabolic processes whose effect on the absorption process is well established (**Epstein and Sorger, 1966 and El-Leboudi _et al._, 1974**).

Hefni _et al._ (1984,a) stated that some stimulatory effect on dry matter accumulation, plant height and leaf area were shown under relatively low salinity levels and the reverse effect was true on the highest one.

4- Effect of salinity on leaf growth :

The toxic effect of salinity have been demonstrated on leaves of many plants. **Bernstein and Hayward (1958)** showed that the increased concentration of both sodium and chloride ions caused leaf burn in different plant species. **Bernstein (1959)** observed the production of smaller and way coated leaves in the salt-affected vegetables.**Strognov (1962)** stated that chloride salinity induced a thickening of cotton leaves. The leaf area of some plants was reduced under the effect of salinity (**Meiri and Polyakoff, 1968 and Nabih _et al._, 1971**).

Schubert _et al._ (1987) found that NaCl salinization decreased the number and area of leaves of _Zea mays_ Cv.

Pioneer 3900 and CV Dokalb XL 75. **Yasseen et al. (1987)** studied the effect of sodium chloride on leaf growth of two barley cultivars (Block local and Arivat) and found that salinity decreased the area of leaves of both cultivars by reducing the number and volume of cells.

5- Effect of salinity on fresh and dry weight :

Ogo and Niskikava (1959) stated that NaCl salinization decreased the water content in some crop plants. **Nieman (1962) and John Boyer (1964)** found that both fresh and dry weights were reduced to approximately 50% at the highest salinity level.The addition of NaCl to the nutrient medium increased the ratio of fresh weight to dry weight; thus water contents were higher in the plants grown in the presence of NaCl.

Heikal (1976) observed that the fresh and dry weights of sunflower and radish plants were decreased only at high level of salinity, whereas that of wheat was not affected by all salinity levels used (up to 6000 ppm). **Bejaoui (1985)** showed that NaCl induced an inhibition of soybean fresh weight. **Ioneva (1985)** stated that fresh and dry masses of shoots and roots of wheat and tomato plants change with the osmotic potential changes.

Abdel-Aziz et al. (1985) stated that increasing salinity levels significantly decreased seed germination, fresh and dry weights, carbohydrates, N,P and K concentrations and uptake of soybean seedlings. The chloride content was increased with increasing soil salinization, while soil salinization up to 1.0 g NaCl/kg soil significantly decreased the soluble carbohydrates of soybean seedlings.

6- Effect of salinity on yield production :

The cultivated soil in Egypt contains relatively high amount of soluble salts, 2-15 mm hos/cm at 25°C (**Shabasey, 1960 and Korkor, 1969**). The presence of such salts in the root medium is known to have adverse effects on plant growth and consequently the yield (**Bernstein and Hayward, 1958; Strogenov *et al.*,1970 and Bakr *et al.*,1971**).Successful agriculture on saline soils requires the use of crops capable of producing a satisfactory yield under moderate intensities of salt accumulation. However, **Magisted *et al.* (1943)** reported that plant varieties respond differently to different climatic conditions and salt constituents.

Crop tolerance to salinity has usually been established as the yield reduction produced by a given level of soluble salts in the growing media as compared with yields obtained under nonsaline conditions (**Bernstein,1974**). High salt concentration in the soil solution may facilitate the uptake of one or more of the ions present resulting in an accumulation of one or more of these ions and consequently disturb the normal metabolism of the plant **(Epstein,1972).**

Barley, wheat and oats are not tolerant to salinity as their yields decreased to 50% by low concentrations of soluble salt **(Lanken,1962).** On the contrary, **Lipman _et al._ (1929)** stated that wheat, barley and peas show a very high resistance to NaCl and that under some environmental conditions NaCl is stimulant to wheat, even at concentration of 4000 ppm or more.

Abdel-Mottaleb _et al._ (1984) the accumulation of the soluble salts in the cultivated soils directly reduces their productivity it as a result of osmotic pressure of soil solution, specific toxicity of soluble ions or hydrolysis of the soluble salts on soil reaction.

Kishk and Shalaby (1984) stated that barley and broad bean plants showed marked decrease of yield under high salinity level.

The adverse effect of salinity, like other stresses was ascribed by some investigators as being mainly due to inbalanced hormonal content **(Presco and O'Leary, 1972),** where the ratio of promotors to inhibitions may be a limiting factor. The disturbance of hormonal balance appears to induce even under low stress conditions varying according to the degree of tolerance (**Ben-Zoini _et al._, 1967**).

Abdou _et al._ (1971), pointed out that increasing salts concentration in the substrate lead to progressive decreasing in strow yield of barley and grain production. Also increasing levels of salinity (120-160 mg/L)decreased wheat yield and increased soil salinity progressively.

Hefni _et al._ (1984,b) stated that grain yield was affected with different salinity levels in a manner nearly similar to that detected with dry weight.

7- Effect of salinity on carbohdyrate changes :

Strogonov and Ostapenko (1946a and b), Bernstein and Hayward (1958) and Strogonov (1962) stated that carbohydrate concentrations were high in plants grown under saline conditions. In such plants, the accumulation of carbohydrates was observed to be more rapid than their utilization for the formation of new cells and tissues. However, **Bernstein (1959 & 1960)** found that at low to moderate salinity levels, sugars increased, whereas at high levels,a decrease in the sugar was observed (**Akoplan, 1957**).

Zhukovakaya _et al._ (1972) found that salts (NaCl and Na_2SO_4) decreased the stored carbohydrate contents and delayed carbohydrate metabolism by inhibiting the synthesis and the activity of necessary enzymes when barley and sunflower seeds were germinated in solutions of 0.1 and 0.2 N NaCl and 0.04 and 0.075 M Na_2SO_4.**Azab (1976)** stated that different levels of salinity decreased monosaccharides content of germinated cotton seeds.

In Daucus carota, the content of the monosaccharides decreased with increasing salt stress, whereas the amount of sucrose increased. The level of inositol remained constant but that of pintol, the major free low molecular weight carbohydrate, increased, **Gorham et al., 1981)**. Although the role of sugar in osmoregulation in many higher plants is unclear, there are some examples where sugars have a major role in gemerating turgor, e.g. in young seedlings **(Pitman et al., 1971 and Boyer and Meyer, 1980)**.

Gill and Singh (1985) found that tolerant varieties of paddy have faster rate of seed germination under salt stress condition than sensitive varieties due to early induction of amylase activity, higher rate of water absorption, followed by rapid decrease in starch and greater release of soluble sugars. This atributes to adapative susceptibility mechanisms under salt stress condition.

Perry _et al._ (1987) found that the reducing sugars concentrations fell in the salt treated excised beet root tissue. This indicated that salts were replacing sugars in the vacuole and releasing them for metabolism. The changes in salt and sugar concentrations were not equal because there was an increase in osmotic pressure and turgor pressure. **Goyal _et al._(1987)** found that in the light,salts induced conversion of starch into glycerol by the unicellular halotolerant green alga _Dunaliella tertiolecta._

Sarin and Narayanan (1968,b) found that soluble sugars content decreased in wheat seeds germinated under high salinity level.

Shalaby and Kishk (1985) stated that NaCl seed pretreatment induced the greatest enhancement of carbohydrate accumulation, whereas the reverse effect was noticed with the application of KCl-foliar treatment. The effeciency of the applied treatments in yield enhancement seemed to be correlated with the ability of wheat plants to elevate the values of carbohydrate protein ratio.

8- Effect of salinity on nitrogen changes :

Bernstein (1960) reported that the nitrogen content of plants increased at high levels of NaCl **Chen *et al.* (1964)** suggested that the increase in total-N of aerial parts of citrus seedlings was due to increased translocation of nitrogen from the roots. It was found that salinization resulted in some disturbances in nitrogen metabolism of treated plants **(Gotes *et al.*, 1966; Kahan and Poljakoff-Mayber, 1968; Wilson *et al.*, 1970; El-Shourbagy and Missak, 1975 and Haikal, 1975).**

Stragonov (1962) observed that cotton plants grown in salinized media, showed extensive breakdown of protein and reduction of amides. Several investigators reported that salinity caused a reduction in the total nitrogen content **(Wilson *et al.*, 1970; Huton, 1971; Lashin and Atanasiu, 1972; Abdalla, 1973; Shimese, 1973; El-Shourbagy and Missak, 1975 and Heikal, 1976).**

It was recorded that the protein contents of various plant tissues declined under saline or drought conditions. This was attributed to an increased proteolysis and or decreased protein synthesis **(Vaadia and Waisal, 1967)** as well as to a retarded transmination process **(Zholevitch and Koretshayer, 1959)**, which resulted in an accumulation of ammonia. **Strogonov (1964)** and **Kleinkopf *et al.* (1976)** recorded an accumulation of proteins in the leaves of the salt tolerance druce plant.

When seeds were sown in saline environment their metabolism was altered, especially the nitrogen metabolism of the embryoaxis **(Prisco and O'Leavy, 1970 and Presco, 1971)**. It has been demonstrated that the activity of certain enzymes extracted from plants grown in saline environment may be altered **(Porath and Poljakoff-Mayber, 1964 and Greenway and Osmand, 1972)**. It was suggested that salinity may inhibit germination of these species by its effects on the activity of the enzymes responsible for the mobilization of the protein reserve of the cotyledons **(Presco et al., 1976)**.

Ramagopal (1987) showed significant protein changes induced by salinity stress in two barley varieties; a salt tolerant variety and a salt sensitive one.

Proline was shown to be accumulated in the tissues of plants exposed to saline substrate **(Palfi and Jahasz, 1970 Stewart and Lee, 1974; Chu et al., 1976 and Gorham et al., 1981)**. **Pulich (1986)** suggested that proline functioned as an organic osmoticum in sea grasses grown at various salinities.

Joshi (1986) found that concentrations of alanine, aspartic acid, glutamic acid, glycine, proline and serine were more than isoleucine, leucine, methionine and valine in *Salicornia brachiata* at varying natural sea water salinities. Proline accumulation was shown not to be the only indicator of salt stress in soybean plants since its increased with salinity as did some of the other amino acids **(Wethered and Jennings, 1985 and Kishere _et al._, 1987)**.

Gausman _et al._ (1964) concluded that irrigation of four species of grasses with salinized water containing $CaCl_2$ and NaCl was associated with differences in the percentage of nitrogen. On the other hand, **Iwake _et al._ (1958)** on rice and **Khalil _et al._ (1967)** on corn found that N-content increased with increasing salinity and this increase may be due to the increase in availability of nitrogen due to the higher solubility of N-compounds in sodium salts or to exchange reaction.

Hefni _et al._ (1984) stated that the grains produced from highly salinized plants were markedly lower in their protein content as compared with their carbohydrate content that being slightly diminished

The impaired protein synthesis as well as the stimulation of protein breakdown in the salt affected plants have been abundantly reviewed **(Prisco and O'Leary, 1972)**.

Helal (1977) stated that NaCl salinity decreased the total N-content to 89% in barley, 83% in wheat and 87% in corn as compared with the corresponding controls. NaCl salinity reduced the production of dry matter to 91% in barley, 83% in wheat and 63% in corn.

It was noticed that the free amino acids, glutamic, glycine and aspartic) play the main role in the biosynthesis of the different amino acids in salt-stressed plants **(Hamed <u>et</u> <u>al.</u>,1977)**. The relative percentage of the three amino acids was taken as an indication for the synthesis of amino acids. It was found that increasing Na-chloride concentrations in nutrients caused accumulating one or more of these three amino acids in a free form at the expen of the other free amino acids. There were some differences in the mode of action of Na-salt on the biosynthesis of those three amino acids.

There were also some differences between the three crops in the accumulation of amino acids. The fluctuation of the percentages of the three dominant amino acids were very small in barley plants which are known by their its high tolerance towards salinity.

Both specific salt and water stress have an influence upon the synthesis of amino acids in higher plants. It had been also found that high salt concentration may induce an accumulation of certain amino acids.

Hamed _et_ _al._ (1977) stated that the use of the higher Na-concentration in nutrients of the cotton seedlings increased their total amounts of free amino acids, but the lower one reduced it. This trend was noticed in shoots with a parallel decrease in roots.

Increasing the concentration of Na-salt in nutrients proportionally increased the total amounts of free amino acids in barley seedlings. Only the percentages of glycine and glutamic acid were relatively increased, while the proline and aspartic amino acids were relatively constant or decreased.

III- Interaction effect of salinity and radiation :

Seleman (1986) stated that the interactions between irradiation and salinity are effective on the physiological prameters. i.e carbohydrate and nitrogen contents.

Kishk (1984) stated that the application of gamma irradiation on sunflower seeds appeared to be effective for dry matter accumulation in shoots as well as for yield stimulation under saline conditions, but it was without any effect on the plant height. The convenient dose for inducing the increase of fresh and dry weight/plant under saline conditions appeared to be 1.5 Krad. Irradiation was also stimulative for the biological yield under low salinity level (3000 ppm) especially when applied at lower dose (0.5 Krad) and effective under high salinity level (5000 ppm) with increasing irradiation dose to 1.5 Krad. Although irradiation to any of the applied doses of gamma rays was without any effect on seed yield/plant under unsaline conditions, it had a clear stimulative effect under different salinity levels.

In addition, the application of gamma rays tended to counteract the depressive effect of salinity on Ca^{++} and Mg^{++} content. Either the relative or absolute contents of total carbohydrate that have been decreased under saline condition tended to elevate with the application of gamma irradiation.

The application of pre-sowing irradiation of seeds to some promotive doses of gamma rays have been pointed out in some plant species **(Kishk and Shalaby, 1984,a)**.

Kishk and Shalaby (1984,b) stated that the irradiation of soybean seeds stimulated to some extent, the growth under different salinity levels. However, under lower salinity conditions (3000 ppm) increasing irradiation dose to 1.5 Krad, seemed to be more favourable for growth activation. While under 5000 ppm salinity level, the different doses of gamma irradiation were similar to their effect under lower irradiation dose.

Furthermore, marked increases in the yield resulted by the application of 1.5 and 4.5 Krad under tap water irrigation and 3000 ppm salinity level, respectively; whereas, under high saline conditions, the application of 1.5 Krad appeared to be more favourable for yield stimulation.

In general, as indicated from the studies on salt telerance induction of some crops, germination, vegetative growth and yield could be improved by exposing the seeds before sowing to suitable doses of gamma rays **(Kuzin,1963, Sparrow,1965, Tavear, 1966, Joshi and Ledoux, 1970 and Ali and Robisky, 1983)**.

AIM OF THE PRESENT WORK

The present work was carried out to investigate the possible effect of gamma-radiation, soil salinity and the interaction between them on the growth and metabolism of soybean (Glycine-max var. Clark) and barley (Hordeum vulgaris var Giza 121) plants cultivated in pots. The approach adopted was to study the possible effects of three different levels of gamma-radiation; 100,200 and 400 Gy and/or soil salinity (0.5, 1.5 and 2.5 bar) on :

1- Germination, growth flowering and fruiting responses of soybean and barley plants at three growth stages.
2- Changes in both the total amount and the relative composition of carbohydrate and nitrogen contents in two growth stages of the shoots of the two plants.
3- Changes in both the total amount and the relative composition of carbohydrate and nitrogen contents in fruits of the two plants.
4- Changes in lipids in the fruits of both plants.