International Journal of Water Resources and Environmental Sciences 11(2): 22-32, 2022
ISSN 2311-2492

DOI: 10.5829/idosi.ijwres.2022.11.2.11132

# Effect of Soil Amendments on Mungbean Varieties Irrigated With Saline Water on Growth, Yield and Chemical Composition

*E.M. Abd El-Lateef, M.S. Abd El-Salam, M.F. El-Karamany, B.A. Bakry, T.A. Elewa and A.S.M. Younis*

Field Crops Res. Dept., Agric. Biol. Res. Inst.,
National Research Centre, 33 El-Buhouth St., Dokki, Giza, Egypt

**Abstract:** *Objectives*: Water shortage is increasing in the agricultural sector in Egypt. Alternative water resources such as saline well water is considered unconventional resources for irrigation water. *Methods*: Pot experiments were conducted in the greenhouse of the Field Crop Department at National Research Centre in the 2021 and 2022 summer seasons to study the effect of irrigation with different salt water levels *i.e.,* distilled water (S0), 1000ppm (S1), 1500ppm (S2) and 2000 ppm (S3)) on growth and yield of two mungbean varieties (T44 and VC1973A) fertilized with different organic fertilizers (inorganic fertilizer, FYM and plant compost). *Results*: The results showed that VC1973A variety significantly exceeded T44 variety in dry matter formation and leaf area per plant at 50 days from sowing as well as yield and yield components *i.e.*; the number of pods and seeds plant$^{-1}$, pod and seed yield plant$^{-1}$ and 100-seeds weight while T44 exceeded VC1973A in plant height, biological and straw yield plant$^{-1}$. Significant differences among fertilizer resources were reported and the composted plant materials surpassed the other two sources (inorganic and FYM) in a number of pods and seeds plant$^{-1}$, pod and seed yield plant$^{-1}$ as well as biological and straw yield plant$^{-1}$ and 100-seeds weight. Significant reductions in mungbean studied characters were reported due to irrigation with saline water. Gradual reductions were evident as salinity increased in irrigation water compared with distilled water. Seed yield reductions were 17, 35 and 54% of the control treatment yield when irrigation took place with 1000, 1500, and 2000ppm, respectively. The interaction between variety and fertilizer resource showed that the VC1973A variety when fertilized with composted plant material produced the highest seed yield, also the same variety was more tolerant to salinity than T44 variety. Moreover, it seems that compost had the ability to mitigate salinity effects on mungbean yield. Saline water irrigation significantly affected carbohydrate content in mungbean leaves. Irrigation with saline water affected the soluble carbohydrates and a gradual decrease was noticed with increasing concentrations of salinity. A high concentration of carbohydrates occurred in the distilled water (control treatment), whereas the lowest concentration was observed at the treatment of S3. Significant differences among salinity treatments were reported on protein and proline concentration. Salinity caused an increase in proteins and proline of the plant tissues, a gradual increase occurred with increasing concentration levels of salinity. *Conclusion*: It could be concluded from this study that mungbean varieties varied in their productivity and respond well to fertilizing with composted plant material more than inorganic or FYM. Both mungbean varieties were sensitive to saline water irrigation and the application of composted plant material mitigate such effect.

**Key words:** Mungbean · Saline water · Fertilizer sources · Yield · Chemical constituents

## INTRODUCTION

Due to water crises, governments are obliged to find additional water resources that should be taken into consideration to manage the expected water demand. One of the alternative water resources is saline well water as an unconventional resource for irrigation water. Several investigations have considered the direct incorporation of saline water in irrigation systems. These studies covered the development and breeding of some salt-resistant

**Corresponding Author:** Prof. Dr. E.M. Abd El-Lateef, Field Crops Res. Dept., Agric. Biol. Res. Inst., National Research Centre, 33 El-Bohouth St., Giza, Egypt.

plants, selecting salinity-tolerant plant species for cultivation, employing the alternating irrigation technique between fresh water and diluted saline water and strengthening the nutritional status of a plant to enhance the resistance potential to salinity damage [1-3]. The involvement of saline water in the irrigation system is an urged solution to fill the gap between increasing water need and limited freshwater resources in arid and semiarid areas [4]. However, using such type of water has adverse effects on agriculture production. Most literature mentioned the negative effects of saline environments on the yield, plant fresh and dry weight, and the physiological processes inside the plants [5-10]. Moreover, most literature mentioned the negative effects of saline environments on the yield, plant fresh and dry weight and on physiological processes inside the plants [5-10]. They indicated that the harmful impact of salinity initiated via decreasing water potential at the rhizosphere area, due to the accrual of salts; increasing the osmotic pressure; reducing stomatal conductance; disruption of nutrients balance and increasing ratio of Na content to the other minerals in plant cells.

One method for decreasing negative salinity effects is the incorporation of organic materials into the soil [11, 12], due to their beneficial effects on soil's physical, chemical and biological properties [13-15]. The positive biological effects are most likely caused by the positive effect of available carbon © derived from the added organic matter to microbial cells allowing their adjustment to osmotic stress by producing osmolytes, which counteract osmotic stress [16, 17, 12]. The addition of organic amendments and crop residues is meant to reduce the negative effects of soil salinity on the mineralization processes in paddy rice soils, where conditions are temporarily anaerobic and thus potentially adding additional stress to part of the microbial community. Organic amendments, such as rice straw or manure alleviate some of the negative effects of salinity on soil microorganisms and microbial processes. As hypothesized, the addition of rice straw allows soil microbial communities, in particular, fungi to better adapt to the osmotic stress making use of the added energy to maintain their metabolism or even forming additional biomass, which, as expected, results in increased N immobilization.

Mungbean [*Vigna radiata* (L.) Wilczek] is cultivated on >6 million ha in the warmer regions of the world and is one of the most important pulse crops. It is a short duration (65– 90 days) grain legume having wide adapt ability and low input requirements [18]. Cultivation of the crop extends across a wide range of latitudes (40° N orS) in regions with diurnal temperatures of the growing season are > 20°C [19].

Several attempts have been conducted to incorporate mungbean in Egyptian agriculture as a sole crop [20, 21] or through intercropping [22]. However, due to the great competition of summer crops on the same land or water resources mungbean chance of wide spreading is limited. Therefore, as an alternative way it is essential to evaluate mungbean growth and productivity in marginal newly reclaimed soils under scarce or poor water characteristics. At the same time, it is well known that the mungbean is a relative drought crop but it is sensitive to salinity [19], the reduction of mungbean cultivars due to salt stress was estimated up to 50% [23, 24]. Mungbean varied in their ability to tolerate water stress [25], also, Bahr [26] stated that organic fertilizing can improve mungbean yield in the newly reclaim sandy soils.

## MATERIALS AND METHODS

Pot experiments were conducted in the greenhouse of the Field Crop Department at National Research Centre in the 2021 and 2022 summer seasons to study the effect of irrigation with different saline water levels on two mungbean varieties fertilized with different organic fertilizer sources. The trial included the following treatments:

**Two Varieties:** VC1973A( imported from AVRDC) and T44 imported from India

**Fertilizer Resources:** Included three types: Inorganic fertilizer NPK (20-31-24).Nitrogen was applied as ammonium nitrate 33.5%, P as calcium superphosphate 15.5% $P_2O_5$ and K as $K_2O$. Farmyard manure (FYM) manure and composted plant material were applied with quantities equivalent to 5 t fed$^{-1}$

**Salinity Treatments:** It was applied through saline water irrigation where the salt type used in irrigation water was mainly the chloride mixture suggested by Strogronov [27] at 1000, 1500 and 2000 ppm as well as distilled water as the control treatment. The components of the salt mixture were $MgSO_4$ (10 g ml$^{-1}$), $CuCO_4$ (1 gm l$^{-1}$), NaCl (78 g ml$^{-1}$), $MgCl_2$ (2 gm l$^{-1}$), and $CaCO_3$ (9 gm l$^{-1}$). Earthenware pots of 30cm diameter and 30cm depth were filled with 10 kg of sandy soil. The pots were arranged according to the study factors in a complete randomized block design (CRBD) with 6 replicates. The organic manures were applied and incorporated to the surface layer of each assigned pot at a rate of 84 g $pot^{-1}$ before sowing at a rate that represents 5 t $fed^{-1}$. The chemical analysis of the soil was (pH 7.87; EC 0.22 ds $m^{-1}$; OM 0.73; N 1256 ppm; P 26 ppm; K 864 ppm; Fe 8026 ppm; Mn 95.4 ppm; Zn 18.7 ppm; Cu 9.8 ppm).

Mungbean seeds were sown on May 11$^{th}$ and 15$^{th}$ in the 1$^{st}$ and 2$^{nd}$ seasons, respectively and irrigated with distilled water until complete germination. Two weeks later, the plants were thinned at 5 plants per pot. Inorganic fertilizers were applied at the rates of 1.6 g $pot^{-1}$ (20 kg N $fed^{-1}$), 2 g $pot^{-1}$ (32 kg $P_2O_5$ $fed^{-1}$) and 0.5 g $pot^{-1}$ potassium sulphate (24 kg $K_2O$ $fed^{-1}$). Phosphatic fertilizer was applied before sowing while nitrogen and potassium were applied after thinning. Mungbean plants were subjected to irrigation with saline water or distilled water according to the treatment irrigation took place at weekly intervals and was stopped two weeks before harvest. After 50 days from sowing dry weight and leaf area per plant were determined, at full maturity yield and yield components were determined. For estimation of the soluble carbohydrates and proteins in mungbean composite leaf samples from each salinity treatment regardless the other treatments at 50 days from sowing, (200) mg of fresh weight of the leaves were taken and crushed with (10) ml. of distill water, then the solution centrifuged for (1) minutes and the clear solution was heated in water bath at (50) ? for (30) minutes. The centrifuge process was repeated again for (15) minutes and then the absorbance of the clear solution was measured by spectrophotometer (Spectro SC Labomed Inc. U.S.A.) at the wave length (490) nm. for carbohydrates and (600) nm. for proteins. The total carbohydrates and protein were estimated according to the procedure described by [28]. The estimation of proline in plant tissues according to the procedure described by [29].

The obtained data were subjected to the proper statistical analysis according to [30]. Since the trends were similar in both seasons, the homogeneity test was carried out according to Bartlet's test and the combined analysis of the data was applied. Treatment means were compared using Duncan's Multiple Range test at 5% level

## RESULTS

**Effect of Variety, Fertilizer Treatment and Saline Water Irrigation on Growth and Yield of Mungbean Characteristics:** Data presented in Table (1) and Fig. (1) show that the VC1973A variety significantly exceeded T44 variety in all the studied characteristics except plant height and biological yield per plant, from the same table, the data clearly show that fertilizing mungbean with inorganic form significantly increased leaf area per plant as compared with the other two organic fertilizer sources. The composted plant material application treatment significantly exceeded the inorganic and FYM in plant height, pod number, pod weight and the number of seeds per pod as well as seed index, biological, straw and seed yields per plant.

Data presented in the same table clearly show significant reductions in mungbean studied characters due to irrigation with saline water. Gradual reductions were evident in leaf area per plant, number and weight of pods and seeds per plant, seed index and biological, straw and seed yields per plant as salinity increased in irrigation water compared with distilled water (control treatment) (Fig. 2). Seed yield reductions were 17, 35 and 54% of the tap water treatment yield when irrigation took place with saline water at levels of 1000, 1500 and 2000 ppm, respectively compared with control (distilled water) treatment( Fig. 3).

Data presented in Table (2) show the interactions between the studied factors (Variety× Fertilizer source). It is clear from the interaction between variety and fertilizer resources that both VC1973A and T44 varieties had the ability to benefit from the composted manure than that of other fertilizer resources which reflected on most of the studied characters; *i.e.*, number and weight of pods per plant as well as biological straw and seed yields per plant. The interaction between variety and salinity level (Table 3) induced significant differences in all characters except leaf area per plant, plant height and pod weight per plant. Significant reductions in most mungbean characters were reported in a descending manner as salinity levels increased. Also, in general, VC1973A variety seemed to be more tolerant to salinity levels (Fig. 4). From Table 4, it could be recognized that the interaction between fertilizing resource and salinity level significantly affected mungbean characters except for leaf area per plant. Also, the effect of the interaction (variety × salinity level) on mungbean yield characteristics is shown in Table (5). In general, salinity levels caused significant reductions of mungbean characters but the application of composted plant material seemed to have positive effects on most of the mungbean characters especially under the high levels of saline water (1500 and 2000 ppm). Such improvement in mungbean tolerance when composted plant material was applied is clear and evident.

Table 1: Effect of variety, fertilizer treatment and saline water irrigation on growth and yield of mungbean characteristics

| Treatment | | Plant height (cm) | LA plant$^{-1}$ (dm$^2$) | No. of pods plant$^{-1}$ | No. of seeds plant$^{-1}$ | Dry wt. of pods plant$^{-1}$ (g) | Biol. yield plant$^{-1}$ (g) | Straw yield plant$^{-1}$ (g) | Seed yield plant$^{-1}$ (g) | 100 seed wt. (g) |
|---|---|---|---|---|---|---|---|---|---|---|
| Variety | T44 | 53.3 | 1.7 | 61.7 | 6.3 | 10.4 | 2.8 | 9.3 | 6.8 | 2.0 |
| | VC1973A | 61.7 | 1.9 | 53.7 | 7.0 | 11.0 | 3.3 | 10.2 | 8.2 | 2.5 |
| | LSD at 0.05 | 3.1 | 0.1 | 0.3 | 0.2 | 0.1 | 0.4 | 0.4 | 0.1 | 0.1 |
| Fertilizer source | Inorganic fertilizer | 51.2 | 1.7 | 51.2 | 6.3 | 10.2 | 3.1 | 9.3 | 7.3 | 2.0 |
| | FYM | 58.8 | 1.9 | 58.8 | 5.9 | 10.6 | 2.6 | 8.2 | 6.2 | 2.0 |
| | Plant compost | 62.5 | 1.8 | 62.5 | 7.8 | 11.3 | 3.3 | 11.8 | 9.1 | 2.7 |
| | LSD at 0.05 | 3.7 | 0.2 | 0.3 | 0.3 | 0.17 | 0.5 | 0.5 | 0.1 | 0.1 |
| Salinity level | Distilled water (control) (S0) | 76.7 | 2.1 | 76.7 | 9.1 | 12.1 | 4.4 | 15.2 | 12.1 | 3.1 |
| | 1000 ppm (S1) | 59.9 | 1.9 | 59.9 | 7.2 | 11.6 | 3.1 | 9.8 | 7.2 | 2.5 |
| | 1500 ppm (S2) | 52.0 | 1.7 | 52.0 | 6.1 | 10.5 | 2.5 | 8.4 | 6.4 | 2.0 |
| | 2000 ppm (S3) | 41.5 | 1.6 | 41.5 | 4.2 | 8.7 | 2.1 | 5.7 | 4.3 | 1.4 |
| | LSD at 0.05 | 4.3 | 0.2 | 0.4 | 0.3 | 0.20 | 0.6 | 0.6 | 0.1 | 0.1 |

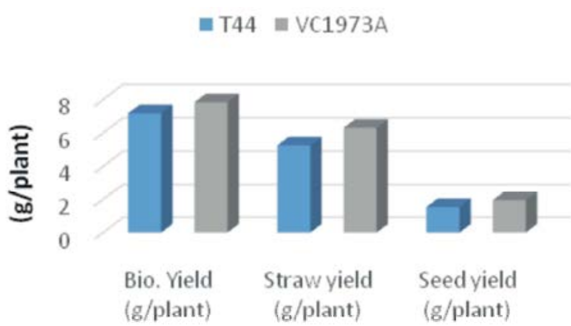


Fig. 1: Effect of varietal differences on mungbean yield

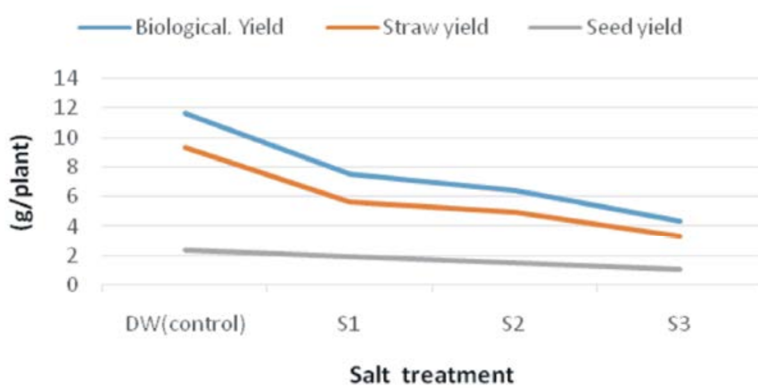


Fig. 2: Effect of saline water irrigation plant$^{-1}$ (g) on mungbean yield

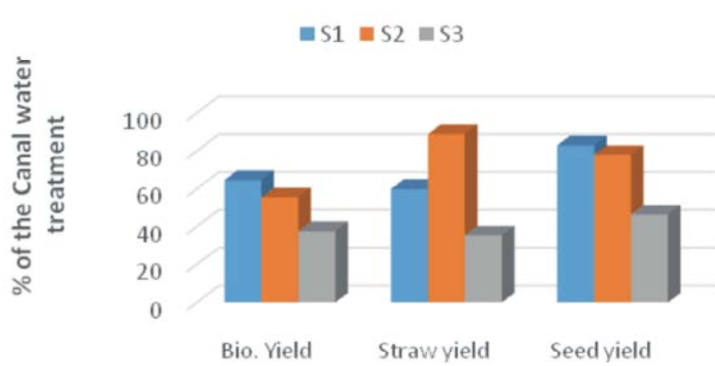


Fig. 3: Effect of saline water irrigation on mungbean yield reduction (%) relative to the distilled water (control treatment)

Table 2: Effect of the interaction ( variety x fertilizer treatment) on growth and yield of mungbean characteristics

| Variety | Fertilizer source | Plant height (cm) | LA plant$^{-1}$ (dm$^2$) | No. of pods plant$^{-1}$ | No. of seeds plant$^{-1}$ | Dry wt. of pods plant$^{-1}$ (g) | Biol. yield plant$^{-1}$ (g) | Straw yield plant$^{-1}$ (g) | Seed yield plant$^{-1}$ (g) | 100 seed wt. (g) |
|---|---|---|---|---|---|---|---|---|---|---|
| T44 | Inorganic fertilizer | 42.7 | 2.3 | 7.5 | 11.2 | 3.7 | 9.9 | 8.6 | 1.5 | 5.2 |
| | Chicken manure | 58.3 | 1.5 | 5.8 | 10.9 | 2.8 | 8.5 | 8.0 | 1.9 | 6.4 |
| | Plant compost | 58.9 | 1.5 | 7.6 | 11.0 | 3.3 | 12.1 | 11.4 | 2.6 | 7.2 |
| VC1973A | Inorganic fertilizer | 59.6 | 1.4 | 5.1 | 9.3 | 2.6 | 8.6 | 6.1 | 2.5 | 6.4 |
| | Chicken manure | 59.3 | 1.8 | 5.9 | 10.3 | 2.3 | 8.0 | 5.8 | 2.2 | 6.1 |
| | Plant compost | 66.1 | 1.7 | 8.0 | 11.5 | 3.4 | 11.4 | 8.7 | 2.8 | 5.5 |
| | LSD at 0.05 | 5.3 | 0.2 | 0.5 | 0.4 | 0.2 | 0.7 | 0.7 | 0.1 | 0.1 |

Table 3: Effect of interaction (variety x saline water irrigation) on growth and yield of mungbean characteristics

| Variety | Salinity level | Plant height (cm) | LA plant$^{-1}$ (dm$^2$) | No. of pods plant$^{-1}$ | No. of seeds plant$^{-1}$ | Dry wt. of pods plant$^{-1}$ (g) | Biol. yield plant$^{-1}$ (g) | Straw yield plant$^{-1}$ (g) | Seed yield plant$^{-1}$ (g) | 100 seed wt. (g) |
|---|---|---|---|---|---|---|---|---|---|---|
| T44 | Distilled water (control) (S0) | 72.2 | 2.1 | 9.1 | 12.1 | 4.6 | 14.4 | 11.1 | 3.3 | 7.8 |
| | 1000 ppm (S1) | 57.6 | 1.9 | 7.8 | 11.9 | 3.4 | 8.4 | 5.4 | 3.0 | 6.6 |
| | 1500 ppm (S2) | 46.7 | 1.7 | 6.6 | 10.8 | 2.7 | 9.0 | 6.7 | 2.2 | 6.0 |
| | 2000 ppm (S3) | 36.8 | 1.5 | 4.5 | 9.3 | 2.4 | 5.6 | 4.1 | 1.5 | 4.6 |
| VC1973A | Distilled water (control) (S0) | 81.3 | 2.0 | 9.2 | 12.0 | 4.2 | 15.9 | 13.1 | 2.8 | 7.9 |
| | 1000 ppm (S1) | 62.2 | 1.8 | 6.5 | 11.3 | 2.9 | 11.2 | 9.1 | 2.1 | 6.4 |
| | 1500 ppm (S2) | 57.2 | 1.5 | 5.6 | 10.2 | 2.4 | 7.9 | 6.1 | 1.7 | 5.7 |
| | 2000 ppm (S3) | 46.2 | 1.2 | 4.0 | 8.0 | 1.7 | 5.8 | 4.5 | 1.3 | 4.0 |
| | LSD at 0.05 | NS | NS | NS | 0.6 | 0.5 | 0.3 | 0.8 | 0.8 | 0.2 |

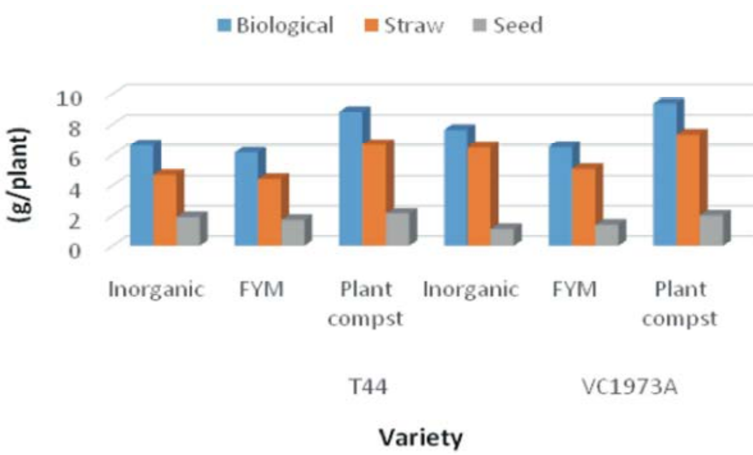


Fig. 4: Effect of the interaction(variety × fertilizer source) on mungbean yield

Table 4: Effect of interaction(fertilizer source × salinity level) on mungbean yield characteristics

| Fertilizer source | Salinity level | Plant height (cm) | LA plant$^{-1}$ (dm$^2$) | No. of pods plant$^{-1}$ | No. of seeds plant$^{-1}$ | Dry wt. of pods plant$^{-1}$ (g) | Biol. yield plant$^{-1}$ (g) | Straw yield plant$^{-1}$ (g) | Seed yield plant$^{-1}$ (g) | 100 seed wt. (g) |
|---|---|---|---|---|---|---|---|---|---|---|
| Inorganic fertilizer | Distilled water (control) (S0) | 65.0 | 2.3 | 9.4 | 12.0 | 4.4 | 13.8 | 9.8 | 3.4 | 7.4 |
| | 1000 ppm (S1) | 52.3 | 1.9 | 7.0 | 11.4 | 3.9 | 9.7 | 4.1 | 3.2 | 5.9 |
| | 1500 ppm (S2) | 46.5 | 1.7 | 5.4 | 9.5 | 2.3 | 8.5 | 7.0 | 2.5 | 5.1 |
| | 2000 ppm (S3) | 41.0 | 1.5 | 3.6 | 8.1 | 1.9 | 5.1 | 3.5 | 0.9 | 2.4 |
| FYM | Distilled water (control) (S0) | 82.9 | 1.8 | 8.1 | 11.6 | 3.7 | 14.3 | 10.5 | 2.9 | 8.4 |
| | 1000 ppm (S1) | 67.3 | 1.8 | 6.2 | 11.4 | 2.5 | 7.0 | 4.3 | 2.3 | 6.7 |
| | 1500 ppm (S2) | 51.0 | 1.6 | 5.4 | 10.5 | 2.3 | 7.0 | 5.6 | 2.0 | 6.3 |
| | 2000 ppm (S3) | 34.1 | 1.5 | 3.8 | 8.9 | 1.7 | 4.7 | 2.6 | 1.8 | 4.0 |
| Plant compost | Distilled water (control) (S0) | 82.2 | 2.0 | 9.9 | 12.6 | 5.0 | 17.4 | 13.0 | 3.6 | 7.7 |
| | 1000 ppm (S1) | 60.1 | 1.8 | 8.3 | 12.0 | 3.0 | 12.6 | 7.9 | 3.4 | 7.1 |
| | 1500 ppm (S2) | 58.4 | 1.5 | 7.6 | 11.5 | 2.9 | 9.8 | 7.6 | 2.2 | 6.6 |
| | 2000 ppm (S3) | 49.4 | 1.1 | 5.4 | 9.0 | 2.5 | 7.4 | 6.1 | 1.9 | 7.3 |
| | LSD at 0.05 | 7.5 | NS | 0.4 | 0.7 | 0.6 | 0.3 | 1.0 | 1.0 | 0.2 |

Data presented in Table (5) reveal significant effects due to the interaction (variety × fertilizer resource × salinity level) on mungbean characters except for leaf area per plant. The results show the complexity of such interaction out in general the data show that mungbean variety VC1973A when fertilized with plant compost was more tolerant to salinity exhibited by irrigation water than that of T44 variety.

Table 5: Effect of the triple interaction (variety × fertilizer resource × salinity level) on mungbean characteristics

| Variety | Fertilizer source | Salinity level | Plant height (cm) | LA plant$^{-1}$ (dm$^2$) | No. of pods plant$^{-1}$ | No. of seeds plant$^{-1}$ | Dry wt. of pods plant$^{-1}$ (g) | Biol. yield plant$^{-1}$ (g) | Straw yield plant$^{-1}$ (g) | Seed yield plant$^{-1}$ (g) | 100 seed wt. (g) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| T44 | Inorganic fertilizer | Distilled water (control) (S0) | 54.6 | 2.7 | 10.3 | 12.8 | 5.1 | 13.2 | 9.8 | 3.4 | 7.4 |
| | | 1000 ppm (S1) | 46.2 | 2.2 | 9.1 | 12.6 | 4.3 | 7.3 | 4.1 | 3.2 | 5.9 |
| | | 1500 ppm (S2) | 37.1 | 2.1 | 6.8 | 10.0 | 2.6 | 9.5 | 7.0 | 2.5 | 5.1 |
| | | 2000 ppm (S3) | 33.2 | 2.1 | 3.9 | 9.3 | 2.6 | 4.4 | 3.5 | 0.9 | 2.4 |
| | FYM | Distilled water (control) (S0) | 81.3 | 1.6 | 7.5 | 11.5 | 3.4 | 13.4 | 10.5 | 2.8 | 8.4 |
| | | 1000 ppm (S1) | 74.8 | 1.6 | 6.1 | 11.3 | 3.1 | 6.6 | 4.3 | 2.3 | 6.7 |
| | | 1500 ppm (S2) | 49.4 | 1.5 | 5.9 | 11.1 | 2.9 | 7.6 | 5.6 | 2.0 | 6.3 |
| | | 2000 ppm (S3) | 28.0 | 1.5 | 3.7 | 9.7 | 1.8 | 4.4 | 2.5 | 1.8 | 4.0 |
| | Plant compost | Distilled water (control) (S0) | 80.6 | 2.0 | 9.4 | 12.1 | 5.1 | 16.6 | 13.0 | 3.6 | 7.7 |
| | | 1000 ppm (S1) | 52.0 | 1.7 | 8.1 | 11.9 | 2.7 | 11.3 | 7.9 | 3.4 | 7.1 |
| | | 1500 ppm (S2) | 53.7 | 1.4 | 7.2 | 11.3 | 2.5 | 9.8 | 7.6 | 2.2 | 6.6 |
| | | 2000 ppm (S3) | 49.4 | 0.9 | 5.9 | 8.9 | 3.0 | 8.0 | 6.1 | 1.9 | 7.3 |
| VC1973A | Inorganic fertilizer | Distilled water (control) (S0) | 75.4 | 1.9 | 8.5 | 11.3 | 3.7 | 14.4 | 12.2 | 2.1 | 1.4 |
| | | 1000 ppm (S1) | 58.5 | 1.5 | 4.9 | 10.2 | 3.5 | 12.1 | 10.3 | 1.7 | 2.0 |
| | | 1500 ppm (S2) | 55.9 | 1.2 | 3.9 | 9.0 | 2.0 | 7.5 | 6.2 | 1.2 | 1.1 |
| | | 2000 ppm (S3) | 48.8 | 0.8 | 3.3 | 6.8 | 1.3 | 5.8 | 4.9 | 0.8 | 1.3 |
| | FY M | Distilled water (control) (S0) | 84.5 | 2.1 | 8.8 | 11.7 | 4.0 | 15.1 | 12.2 | 3.0 | 8.5 |
| | | 1000 ppm (S1) | 59.8 | 1.9 | 6.2 | 11.5 | 1.9 | 7.4 | 5.5 | 1.9 | 6.4 |
| | | 1500 ppm (S2) | 52.7 | 1.8 | 4.9 | 10.0 | 1.7 | 6.3 | 4.8 | 1.5 | 6.2 |
| | | 2000 ppm (S3) | 40.3 | 1.5 | 3.9 | 8.1 | 1.6 | 4.9 | 4.0 | 1.0 | 3.4 |
| | Plant compost | Distilled water (control) (S0) | 83.9 | 1.9 | 10.4 | 13.0 | 4.9 | 18.2 | 14.8 | 3.4 | 6.6 |
| | | 1000 ppm (S1) | 68.3 | 1.8 | 8.5 | 12.1 | 3.2 | 13.9 | 11.3 | 2.6 | 6.4 |
| | | 1500 ppm (S2) | 63.1 | 1.5 | 8.1 | 11.7 | 3.3 | 9.8 | 7.4 | 2.3 | 5.0 |
| | | 2000 ppm (S3) | 49.4 | 1.3 | 4.9 | 9.1 | 2.1 | 6.7 | 4.6 | 2.1 | 3.9 |
| | LSD at 0.05 | | 10.6 | NS | 1.0 | 0.8 | 0.5 | 1.4 | 1.4 | 0.3 | 0.2 |

Table 6: Effect of salinity level on carbohydrates, proteins and proline content (µg/gm) in mungbean leaves

| Salinity level | Carbohydrates (µg/gm) (Fresh weight) | Proteins (µg/gm) (Fresh weight) | Proline (µg/gm) (Dry weight) |
|---|---|---|---|
| Distilled water (control) (S0) | 39.6 | 98.4 | 7.2 |
| 1000 ppm (S1) | 33.6 | 110.4 | 9.6 |
| 1500 ppm (S2) | 20.4 | 159.6 | 13.2 |
| 2000 ppm (S3) | 18.0 | 169.2 | 16.8 |
| LSD at 0.05 | 4.3 | 14.2 | 1.9 |

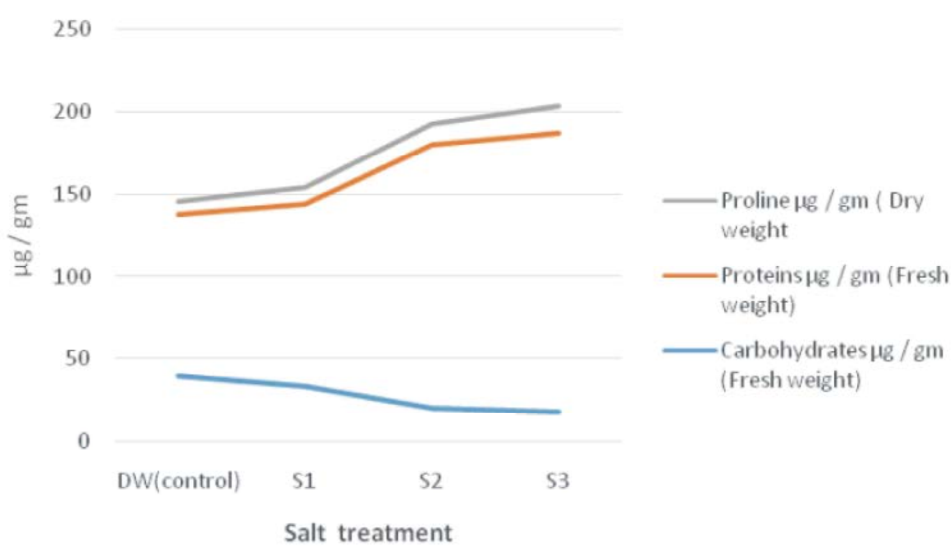


Fig. 5: Effect of salinity level on carbohydrates, proteins and proline content (µg/gm) in mungbean leaves

**Chemical Constituents in Mungbean Leaves:** Data presented in Table (6) and Fig. (5) show the effect of salinity on constituents in mungbean leaves regardless the variety and fertilizer treatment. Irrigation with saline water significantly affected the soluble carbohydrates and a gradual decrease was noticed with increasing concentrations of salinity. A high concentration of carbohydrates (39.6) µg/gm occurred in the distilled water at a control treatment, whereas the low concentration (33.6) µg/gm was observed at the treatment of S2. Significant differences between a control and the other treatments occurred. The high concentration of carbohydrates (39.6) µg/gm occurred under distilled water(control treatment), whereas the low concentration (18) µg/gm was observed at the treatment of S3. Significant differences among the control and the other treatments were evident.

From the same table it is observed that salinity causes an increase in proteins and proline of the plant tissues, a gradual increase occurred with increasing concentration levels of salinity. The low concentrations of protein and proline (110.4 and 9.6) µg/gm occurred on the Distilled water(control treatment) respectively, while the high concentrations (169.2 and 16.8) µg/gm were noticed at the treatment (S3). Significant differences among salinity treatments were reported on protein and proline concentration.

## DISCUSSION

The superiority of VC1973A variety in most of the yield characters is evident due to the genotypic difference. Several investigators tested the VC1973A variety with other mungbean varieties in different environments and came to similar conclusions [25, 26]. Mungbean showed decreased growth, photosynthesis and yield at high salinity, but postponed pod ripening during the spring resulted in reduced pod-shattering [31, 32]. A study by Hasanuzzaman *et al.* [33] on screening mungbean germplasm for salt tolerance in the spring season identified a few resistant genotypes for saline areas. NaCl stress, combined with other types of stress, resulted in organ-specific changes in polyamine content in mungbean plants and affected enzyme activity.

Organic amendments, such as rice straw or manure alleviate some of the negative effects of salinity on soil microorganisms and microbial processes. The addition of rice straw allows soil microbial communities, in particular, fungi to better adapt to the osmotic stress which leads to forming additional biomass. The significant performance of the composted manure compared to the other two resources could be attributed to the nature of the compost ingredients which are composed of plant materials and residues in origin and cause a slow release of macro and micro-nutrients Several investigators pointed out to the response of mungbean varieties to the organic fertilizing alone or combined with the chemical or bio- fertilizers [26]. The positive response of mungbean plants to organic fertilizer especially compost was reported by [26]. Also, mungbean variation in their ability to salt tolerance was reported by [34-35]. Wichern *et al.* [12] reported that the addition of organic amendments increased soil respiration. Manure (M) resulted in a 2-fold increase in respiration compared to the control treatment.

Many previous studies (Wichern *et al.* [12]; Iqbal *et al*. [13]) and recently qualitatively summarized by Leogrande and Vitti [15], concluded that soil respiration assessed by $CO_2$-evolution was reduced by soil salinity for most of the treatments with and without organic matter addition. However, the addition of organic matter increased soil respiration substantially, even under saline conditions, which was observed in studies of [12, 13]. The organic matter thus provides a means to reduce the negative effects of soil salinity on soil microorganisms [14, 15]. One reason for this is the enhanced availability of energy-rich C-containing compounds in the organic amendments, which allow soil microorganisms to synthesizesise osmolytes to counteract the osmotic pressure from elevated salinity or to invest in metabolic processes for detoxification and cell repair [16, 17, 12].

The reductions in mungbean characteristics were expected and reported by several investigators; Raptan *et al.* [35] reported similar reductions in mungbean traits in 1000-grain weight (57%), leaf weight (54%), plant height (52%), seeds per pod (50%). They reported also that salinity caused greater reductions in grain yield than the straw and roots of *Vigna* spp . Similar results were reported by [34].

Salinity stress causes a significant reduction in mungbean yield (Abd-Alla *et al*. Saha *et al*.) [36, 37] through a decline in seed germination, root and shoot lengths, fresh mass and seedling vigor and varies with different genotypes [38, 39]. The salt injury also leads to pronounced symptoms like enhanced chlorosis, necrosis and decreased content of chlorophyll and carotenoids in mungbean [40, 41]. NaCl stress had a more deleterious effect on roots than shoots, with a sudden dip in root growth-associated traits [37]. Most of the mungbean cultivars tolerate salt to an extent. Photosynthetic activity of mungbean is reduced due to reduced function of electron transport and instability of pigment-protein complex [38]. High salinity results in a decrease in total leaf area and stomatal opening [42]. Proline and glycine betaine levels in roots and shoots increased in mungbean (tolerant) cultivar 'T 44' subjected to NaCl stress at seedling stage [43]. The interaction between variety and salinity level induced significant differences in all characters Some investigators pointed out to the genotypical differences in growth response to salinity among cultivars within a crop species [44, 45].

The results show the complexity of the triple interaction. In general, the data show that mungbean variety VC1973A when fertilized with composted manure was more tolerant to salinity exhibited by irrigation water than that of Kawmy-1 variety. In this respect, Sehrawat *et al*. [46] reported the effect of salt stress (two levels: 50 and 75 mM NaCl) on two mungbean varieties and found significant variations and adaptability in both varieties. The plants in early growth stages were more resistant compared at reproductive stages [31, 32]. Salinity and associated osmotic stress severely constrained plant growth, physiology and yield traits. In general, the tolerant cultivar 'Pusa Vishal' exhibited less reduction in growth and yield traits than 'Pusa Ratna.

**Chemical Constituents:** The depression of plant growth may be due to the effect of salinity on the protein bonds of green pigments It was found that the adverse relationship between salinity and growh, that high salinity affected the protein bonds of green pigments and caused a cute decrease on the chlorophyll content. Raptan *et al*. [47] reported that salinity decreased total-N and Hassan *et al*. [48] found that salinity decreased total-N and protein-N contents, but proline content increased with increasing salinity and accumulated in different organs of mungbean plants under salt effect as described. Abdul-Wahid *et al*. [49] reported that salt-induced injury symptoms on mungbean such as enhanced chlorosis and necrosis and decreased content of chlorophyll a, b and carotenoid. Furthermore, salt stress reduced total soluble sugars, proteins, free amino acids, sugars and soluble protein [50]. The tolerance of plants to the osmotic stress was based on the construction process on the number of the defense proteins, the plants defense against the effect of salinity by the osmoregulation process which continues by the biosynthesis of the solutes on the cells [51]. The increase of the proline concentration on the tissues of plants that grow in a saline environment was resulted from the imbalance on the osmoregulation inside the cells, that was due to the increases of salts in the growth medium. The increases in proline concentrations in the cells to creation the case of osmotic balance inside the cells especially between vacuoles and the cytoplasm [52]. The important properties of salinity tolerance were due to the dominance of protein and some of the amino acids especially proline in the plants. These organic compounds increased according to the increase in salinity [53]. These results are in accordance with [54].

## CONCLUSION

It could be concluded from this study that mungbean varieties varied in their productivity and respond well to fertilizing with composted plant material more than inorganic or FYM. Both mungbean varieties were sensitive to saline water irrigation and the application of composted plant material mitigate such effect. The importance of this work is throwing the light on the possibility of using the saline groundwater wells upto moderate salinity levels .

## REFERENCES


1. Feizi, M., M. A. Hajabbasi and B. Mostafazadeh-Fard, 2010. Saline irrigation water management strategies for better yield of safflower (*Carthamus tinctorius* L.) in an arid region. Aust. J. Crop Sci., 4(6): 408-414.
2. Genc, Y., J. Taylor, G. Lyons, Y. Li, J. Cheong, M. Appelbee, K. Oldach and T. Sutton, 2019. Bread wheat with high salinity and sodicity tolerance. Front. Plant Sci., 10: 1280.
3. Sang, H., W. Guo, Y. Gao, X. Jiao and X. Pan, 2020. Effects of alternating fresh and saline water irrigation on soil salinity and chlorophyll fluorescence of summer maize. Water, 12: 3054. doi:10.3390/w12113054.
4. Hanjra, M.A. and M.E. Qureshi, 2010. Global water crisis and future food security in an era of climate change. Food Policy, 35: 365-377.
5. Hussein, M.M., S.M. El-Ashry and D.M. Mubarak, 2015a. Effect of some potassium sources on growth and mineral status of Egyptian clover. Am.-Eurasian J. Sustain. Agric., 9(8): 1-7.

6. Hussain, Z., R.A. Khattak, M. Irshad, Q. Mahmood and P. An, 2016b. Effect of saline irrigation water on the leachability of salts, growth and chemical composition of wheat (*Triticum aestivum* L.) in saline-sodic soil supplemented with phosphorus and potassium. J. Soil Sci. Plant Nutr., 16(3): 604-620.
7. Zahra, N., Z.A. Razaand and S. Mahmood, 2020. Effect of salinity stress on various growth and physiological attributes of two contrasting maize genotypes. Braz. Arch. Biol. Technol., 63. doi.org/10.1590/1678-4324-2020200072.
8. Rani S., M.K. Sharma, N. Kumar and Neelam, 2019. Impact of salinity and zinc application on growth, physiological and yield traits in wheat. Current Science, 116(8): 1324-1330.
9. Musyimi, D.M., G.W. Netondo and G. Ouma, 2007. Effect of salinity on gas exchange and nutrients uptake in Avocados. J. Biol. Sci., 7(3): 496-505.
10. Gadallah, M.A. and T. Ramadan, 1997. Effects of zinc and salinity on growth and anatomical structure of *Carthamus tinctorius* L. Biologia Plantarum, 39(3): 411-422.
11. Luedeling, E., M. Nagieb, F. Wichern, M. Brandt, M. Deurer and A. Buerkert, 2005. Drainage, salt leaching and physico-chemical properties of irrigated man-made terrace soils in a mountain oasis of northern Oman. Geoderma, 125: 273-285. doi: 10.1016/j.geoderma.2004.09.003.
12. Wichern, J., F. Wichern and R.G. Joergensen, 2006. Impact of salinity on soil microbial communities and the decomposition of maize in acidic soils. Geoderma 137: 100-108. doi: 10.1016/j.geoderma.2006.08.001.
13. Iqbal, M.T., R.G. Joergensen, C. Knoblauch, R. Lucassen, Y. Singh and C. Watson, 2016. Rice straw addition does not substantially alter microbial properties under hypersaline soil conditions. Biol. Fertil. Soils, 52: 867-877. doi: 10.1007/s00374-016-1126-4.
14. Chahal, S.S., O.P. Choudhary and M.S. Mavi, 2017. Organic amendments decomposability influences microbial activity in saline soils. Arch. Agron. Soil. Sci., 63: 1875-1888. doi: 10.1080/03650340.2017.1308491.
15. Leogrande, R. and C. Vitti, 2019. Use of organic amendments to reclaim saline and sodic soils: a review. Arid Land Res. Manage., 33: 1-21. doi: 10.1080/15324982.2018.1498038.
16. Killham, K. and M.K. Firestone, 1984. Salt stress control of intracellular solutes in streptomycetes indigenous to saline soils. Appl. Environ. Microbiol., 47: 301-306. doi: 10.1128/AEM.47.2.301-306.1984.
17. Schimel, J.P., W.J. Scott and K. Killham, 1989. Changes in cytoplasmic carbon and nitrogen pools in a soil bacterium and a fungus in response to salt stress. Appl. Environ. Microbiol., 55: 1635-1637. DOI: 10.1128/AEM.55.6.1635-1637.1989.
18. Nair, R.M., R. Schafleitner, L. Kenyon, R. Srinivasan, W. Easdown and R.W. Ebert, 2012. Geneticimprovement of mungbean. SABRAOJ. Breed. Genet., 44: 177-190.
19. Lawn, R.J. and C.S. Ahn, 1985. Mungbean (*Vigna radiate*. L., Wilczek/ *Vigna mungo*. L., Hepper), " in Grain legume Crops, eds R.Summerfiled and E.H. Roberts (London).
20. Abd EI-Lateef, E.M., N.I. Ashour and T.G. Behairy, 1998. Effect of varietal differences on mungbean (*Vigna radiate*(L.) Wilczek) yield and yield components. Bull. NRC., 23(3): 367-381.
21. Ashour, N.I., T.G. Behairy, E.M. Abd EL-Lateef and M.M. Selim, 1993. Mungbean (*Vigna radiata* or *Phaseolus aureus* Roxb). A new introduced crop in Egypt. Bull. NRC, Egypt, IS(4): 325-324.
22. Abd El-Lateef, E.M., A.A. Yaseen, A.K.M. Salem, M.S. Abd El-Salam, M.A.A. Farrag, T.A. Elewa and Aml, R.M. Yousef, 2022. A Comparative Study Between Open-Pollinated and Maize Hybrids (*Zea mays* L.) Intercropped with Mungbean (*Vigna radiata* L. Wilczek) on Yield, Land Use Efficiency and Gross Monetary Value. American-Eurasian Journal of Agronomy, 15(1): 20-27.
23. Harbir, S., B.P. Malik and H.C. Sharma, 1889. Relative performance of mungbean (*Vigna radiata* (L.) Wilczek) cultivars under varying levels of soil salinity. Haryana J. Agron., 5(2): 171-173.
24. Singh, D.P. and B.B. Singh, 2011. Breeding for tolerance to abiotic stresses in mungbean. J. Food Legumes, 24: 83-90.
25. EI-Karamany, M.F., Magda H. Mahmoud and O.A. Nofal, 2003. Effect of late foliar application with urea and potassium fertilization on yield, yield components and chemical composition of two mungbean varieties. Egypt. J. Appli. Sci., IS(12): 177- I85.
26. Bahr, A. Amany, 2002. Effect of bio-and organic fertilizer on the yield of some mungbean cultivars. Egypt. J. Appli. Sci., 17(7): 117-126.
27. Stroganov, B.P., 1962. Physiological Basis of the Salt Tolerance of Plants (under different types of soil salinization).Izd. Akad, Nauk, USSR, Moscow.

28. Herbert, D., P.J. Phillips and R.E. Strange, 1971. Methods in microbiology. Morris, J.R. and Robbins, D.W. (eds). Academic Press. London, New York. (Chapter 3).
29. Bates, L.S., R.P. Walderm, and I.D. Teare, 1973. Rapid determination of free proline for water-stress studies. Plant and Soil., 39: 205-208.
30. MSTAT-C, 1988. MSTAT-C, a microcomputer program for the design, arrangement and analysis of agronomic research. Michigan State University, East Lansing.
31. Sehrawat, N., K.V. Bhat, R.K. Sairam, N. Tomooka, A. Kaga and Y. Shu, 2013a. Diversity analysis and confirmation of intra-specific hybrids for salt tolerance in mungbean (*Vigna radiata* L. Wilczek). Int. J. Integr. Biol., 14: 65-73.
32. Sehrawat, N., K.V. Bhat, R.K. Sairam and P.K. Jaiwal, 2013b. Screening of mungbean (*Vigna radiata* L. Wilczek) genotypes for salt tolerance. Int. J. Plant Anim. Environ. Sci., 4: 36-43.
33. Hasanuzzaman, M., M.A. Hossain, J.A.T. Silva and M. Fujita, 2012. Plant responses and tolerance to abiotic oxidative stress: antioxidant defenses is a key factors. In: Bandi, V., Shanker, A.K., Shanker, C., Mandapaka, M. (Eds.), Crop stress and its management: perspectives and strategies. Springer, Berlin, pp: 261-316.
34. Zayed, M.A. and I.M. Zeid, 1998. Effect of water and salt stresses on growth, chlorophyll, mineral ions and organic solutes contents and enzymes activity in mungbean seedlings. Biolgia Plantarum, 40(3): 351-356.
35. Raptan, P.K., A. Hamid, Q.A. Khaliq, A.R.M. Solaiman, J.U. Ahmed and M.A. Karim, 2001. Salinity tolerance of black gram and mungbean: I-Dry matter accumulation in different plant parts. Korean J. Crop Sci., 46(5): 380-386.
36. Abd-Alla, M.H., T.D. Vuong and J.E. Harper, 1998. Genotypic differences in nitrogen fixation response to NaCl stress in intact and grafted soybean. Crop Sci., 38:72. doi: 10.2135/cropsci1998.0011183X0038 00010013x.
37. Saha, P., P. Chatterjee and A.K. Biswas, 2010. NaCl pretreatment alleviates salt stress by enhancement of antioxidant defense and osmolyteaccumulation in mungbean (*Vigna radiata* L. Wilczek). Indian J. Exp. Biol., 48: 593-600.
38. Promila, K. and S. Kumar, 2000. *Vigna radiata* seed germination under salinity. Biol. Plant., 43: 423-426. doi: 10.1093/pcp/pcs040.
39. Misra, N. and U.N. Dwivedi, 2004. Genotypic difference in salinity tolerance of green gram cultivars. Plant Sci., 166: 1135-1142. doi: 10.1016/j.plantsci.2003.11.028.
40. Gulati, A. and P.K. Jaiwal, 1993. *In vitro* selection of salt resistant *Vigna radiate* (L.) Wilczek plants by adventitious shoot formation from cultured cotyledon explants. J. Plant Physiol., 142: 99-102. doi: 10.1016/S0176-1617(11)80114-8.
41. Wahid, A. and M.H.R. Ejaz, 2004. Salt injury symptom, changes in nutrient and pigment composition and yield characteristics of mungbean. Int. J. Agric. Biol., 6: 1143-1152.
42. Nandini, C. and M. Subhendu, 2002. Growth regulator mediated changes in leaf area and metabolic activity in mungbean under salt stress condition. Indian J. Plant Physiol., 7: 256-263.
43. Misra, N. and A.K. Gupta, 2006. Interactive effects of sodium and calcium on proline metabolism in salt tolerant green gram cultivar. Am. J. Plant Physiol., 1: 1-12. doi: 10.3923/ajpp.2006.1.12.
44. Duvick, D.N., R.A. Kleesee and N.M. Frey, 1981. Breeding for tolerance of nutrient imbalance and constraints of growth in acid alkaline saline soil. J. Plant Nutr., 4: 111-129.
45. Yo Se, P.B., 1983. Rationale of selection for specific nutritional characters in crop improvement with (*Phaseolus vulgaris* L.) as a case study. Plant and Soil, 72: 351-364.
46. Sehrawat, N., M. Yadav, K.V. Bhat, R.K. Sairam and P.K. Jaiwal, 2015. Effect of salinity stress on mungbean [*Vigna radiata* (L.)] during consecutive summer and spring seasons. J. Agric. Sci., 60: 23-32. doi: 10.2298/JAS1501023S.
47. Raptan, P.K., A. Hamid, Q.A. Khaliq, A.R.M. Solaiman, J.U. Ahmed and M.A. Karim, 2001. Salinity tolerance of blackgram and mungbean: II. Mineral ions accumulation in different plant parts. Korean. J. Crop Sci., 46: 387-394.
48. Hassan, N.M., M.S. Serag and F.M. El-Feky, 2004. Changes in nitrogen content and protein profiles following in vitro selection of NaCl resistant mungbean and tomato. Acta. Physiol. Plant., 26: 165-175.
49. Abdul-Wahid, Mansoor-Hameed and Ejaz-Rasul, 2004. Salt injury symptom, changes in nutrient and pigment composition and yield characteristics of mungbean. Int. J. Agri. And Biol., 6: 1143-1152.

50. Dhingra, H.R. and P.K. Sharma, 1993. Biochemical and mineral composition of young healthy and shrivelled mungbean (*Vigna radiate* L. Wilczek) seeds in response to salinity. Indian. J. Plant. Physiol., 36: 115-117.
51. Serrano, R., F. Culianz-Macia and V. Moreno, 1999. A glimpse of the mechanisms of ion homeostasis during salt stress. J. Exp. Bot., 50: 1023-1036.
52. Naidu, B.P., 2003. Production of betaine from Australian Melaleuca spp. for use in agriculture to reduce plant stress .Aus. J. Exp. Agric., 43: 1163-1170.
53. Abo-Zaid, A.N., 2000. Plant hormones and agriculture application. The Arabic parlor of promulgation and distribution. 2nd Ed. Cairo, Egypt.
54. Saffan, S.E., 2008. Effect of salinity and osmotic stresses on some economic plants. J. Agric. Res. and Biol. Sci., 4(2): 159-166.