Salinity Tolerance of Some Mungbean Varieties

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**Abstract:** Salinity tolerances of four mungbean (*Vigna radiata* L.) varieties (King, VC-21, VC-15, and Kawmy-1 (local)) were tested in pot trial under three levels of salinity Zero (control), 2000 and 4000 ppm NaCl). Growth, yield, yield components and chemical composition in seeds of four mungbean varieties were compared at different levels of salinity. Results showed that VC-15 variety produced the highest dry matter (DM) of stems and leaves. Also, leaf area (LA) and leaf area index (LAI) at 35 (DAP) On the other hand VC-21 variety came in the first order at 50 (DAP) in the same characters. All growth characters of four varieties decreased with increasing salinity levels. The reduction was severe in 4000 ppm level compared to 2000 ppm. King variety recorded very convergent values under three salinity levels. VC-21 variety surpassed other varieties in pods/plant, seeds/plant, seed yield/plant, N % in seeds and seeds/pod. King was superior in branches/plant, VC-15 seeds contain highest P % but King contain highest K % and lowest content of Na (ppm) in seeds. Yield and yield components and K % in seeds decreased with increasing salinity levels. Treatments of 4000 ppm recorded highest P % and Na (ppm) in seeds. Interaction of VC-21 x control was the best in branches/plant, pods/plant, seeds/pod, seeds/plant but VC-15 x control gave the highest seed index. Seeds of King variety x control contain the highest K% but Kawmy-1 x 4000 ppm gave the best content of P % and Na (ppm) in seeds.

**Keywords:** Mungbean (*Vigna radiata* L. wilczek), Varieties, Saline water, Growth, Yield, Chemical composition.

**INTRODUCTION**

Mungbean (*Vigna radiata* L. wilczek) is a summer pulse crop with short duration (70-90 days) and high nutritive value. The seeds contain 22-28 % protein, 60-65 % carbohydrates, 1-1.5 % fat, 3.5-4.5 % fibers and 4.5-5.5 ash, it has many effective uses, green pods in cooking as peas, sprout rich in vitamins and amino acids. This crop can be used for both seeds and forage since it can produce a large amount of biomass and then recover after grazing to yield abundant seeds[14]. It can be used in broilers diets as a non-traditional feed[9]. There were large differences between introduced varieties in Egypt[9]. Australian variety (King) and some selected genotypes imported from (AVRDC) Taiwan were adapted under Egyptian conditions and recommended by them as promising varieties in many regions beside Kawmy-1 the local registered variety[2,7-10,19].

Salinity is one of the most severe environmental stresses and affects crop production. Generally, salinity problems increase with increasing salt concentration in irrigation water. The reduction in production mungbean cultivars reach up to 50% under salt stress[13]. The growth reduction in *Vigna spp* under salt stress resulted from a combination of ions toxicity and altered water relations that cause large accumulation of sodium and magnesium ions and reduced calcium and potassium concentration in the shoots and roots. Moreover, water potential, osmotic potential, transpiration, stomatal conductance and hydraulic conductance decreased as salinity increased[16].

Under Egyptian conditions there was shortage in production of summer legumes. Mungbean is a short duration crop produce large amount of biomass in summer season. So it can be easily grown in the newly reclaimed sandy soil and irrigate by saline water. Therefore, this study was carried out to investigate the varietal differences in productivity of mungbean for seeds and irrigate by saline water.

**MATERIALS AND METHODS**

A pot trial was conducted in the greenhouse of Field Crops Department at National Research Centre during summer season of 2003 to investigate the effect of salinity water on growth, yield and its components and chemical composition of four mungbean varieties. The experimental treatments can be described as follows:

- **A-Varieties**
  - 1-King
  - 2-VC-21
  - 3-VC-15
  - 4-Kawmy-1

- **B-Salinity**
  - 1-Control (Tap water)
  - 2-2000 (ppm)
  - 3-4000 (ppm)
The experimental soil was analyzed according to the method described by Chapman and Pratt [5].

Earthenware pots of 30 cm diameters and 30 cm depth each of them was filled with 8.5 kg sandy soil and having the following characteristics: sand 94%, pH 8.3, organic matter 0.85%, CaCO₃ 0.35%, EC 0.07 mmhos/cm, total N 3.1 mg N/100 g and 1.7 mg P/100 g. (taken from South El-Tahrir province El-Behaira Governorate)

Mungbean seeds of four varieties which were (VC-21, VC-15) selected from 23 genotypes imported from (AVRDC) Asian Vegetable Research and Development Centre, Taiwan in 1996, evaluated and adapted by project Evaluation of growth and yield of mungbean under Egyptian conditions [13], the third variety was (King) imported from Australia and the fourth was (Kawmy-1) the local registered variety as a control sown in 31-5-2003. Three weeks after planting the plants were thinned to two plants per pot. NPK were added at the rates of 1.59g/pot (20kg N/fed.) as ammonium nitrate 33%; 2g/pot (32kg P₂O₅/fed.) as calcium super phosphate 16% P₂O₅; 0.5 g/pot (24kg/fed.) as potassium sulphate 48% k₂O, Phosphorus was added before planting ;both of nitrogen and potassium fertilizers were applied after thinning and before the second irrigation. After thinning, Mungbean plants were subjected to irrigation with two levels of salt concentration (2000 ppm, 4000 ppm) in addition to tap water served as control. Salt solutions at different NaCl concentration were prepared by dissolving NaCl in deionised water that was also used during whole experimental period. Irrigation stopped two weeks before harvest.

Pots were arranged as a factorial experimental in Complete Randomized Block Design with 12 replicates. Six replicates were taken for two vegetative samples at 35 and 50 days from planting at vegetative and pudding forming stages to determine stems and leaves dry weight leaves area (LA) and leaves area index (LAI). LA=total dry weight of leaves (gm)/plant x area of disk sample/dry weight of the same disk sample(gm). LAI= unit leaves area (cm)/unit ground area (cm).

Six replicates were devoted to determine yield characters. At harvest time, the above ground phytosamples were taken and the pods were counted, weighted and shalled to obtain seed yield /plant. Seed index= weight of 100 seeds (gm).

The collected data were subjected to the proper statistical analysis according to Snedecor and Cochran [18]. The least significant difference (LSD) was used to compare the means. N; P; K and Na in seeds were analyzed according to the method described by Chapman and Pratt [5].

RESULTS AND DISCUSSIONS

Data presented in Figure 1 show effect of varieties and salinity levels on dry weight of stems and leaves/plant, (LA) and (LAI) at 35 and 50 days after planting.

Effect of varieties on growth characters:

Dry weight of stems and leaves: It is clear that VC-15 variety gave the heaviest stems and leaves weight/plant at age of 35 days then it came in the second order at age of 50 days while VC-21 came in the first order in both characters at 50 (DAP). The result indicated that VC-21 had tallest vegetative growth period and best sufficiency in dry matter production compared to King, VC-15 and Kawmy-1 varieties.

Leaves area (LA): Figure 1 show that VC-15 came in the first order at 35 days after planting but VC-21 variety gave the highest (LA) at age of 50 (DAP) followed by VC-15 Kawmy-1 and King varieties.

Leaf area index (LAI): Data of LAI gave the same trend of (LA) ; VC-15 was the first at age of 35 days followed by VC-21 and VC-21 gave the best (LAI) at 50 days after planting which reveal that VC-21 gave the best land area canopy compare to the other varieties.

Effect of salinity levels on growth characters: Data presented in figure 1 clear that varieties the which given tap water gave the best results for all growth characters in both ages 35 and 50 (DAP) . The use of saline water (different concentration) for irrigation resulted in decreases in dry weight of leaves/plant; stems/plant; leaves area and leaf area index at 35 and 50 (DAP) However, the use of moderate saline water (2000 ppm) caused a limited decreased in these characters, compared with the control treatment (Tap water). These growth characters were gradually decreased by increasing salt concentration. The depression in dry matter accumulation is mainly due to increase in Na and Cl under high salt stress caused a reduction in the activity of CO₂ fixation in photosynthesis and a decrease in the enzymatic activity such as inhibition of chlorophyllase enzyme activity which is known to be responsible for synthesis in the metabolic processes [16]. Similar observation were reported by Ibrahim [12], and Raptan et al [18].

Effect of interaction between varieties and salinity on growth characters: It is worthy to mention that mungbean varieties differed under salinity level in all growth characters .At the age of 35 (DAP) the interaction
of VC-15 variety x control gave the best result for plant stems and leaves weight (LA) and (LAI). Furthermore, the same interaction had less reduction under increasing salinity level from 2000 ppm to 4000 ppm.

At the age of 50 days, interaction between VC-21 variety and control gave the highest value for all studied growth characters.

It is noteworthy to mention that although King variety did not record the first order under salinity levels for growth characters it recorded very convergent values under three salinity levels, thus it can be concluded that King variety may be tolerant salinity up to 4000 ppm level.

**Effect of varieties on yield, yield components and chemicals composition:** Data presented in Table (1) showed significant differences between varieties in yield, yield components and chemicals composition of seeds, except no. of seeds/pod.

Plants of King variety produced the greatest number of branches and the highest seed index followed by VC-15 and VC-21 while Kawmy-1 was the last in both characters. VC-21 had the superior in no. of pods/plant, no. of seeds/plant, and produced the highest seed yield/plant and highest N content in seeds.

El Kramany reported that King variety was superior compared to other varieties in all studied attributes.

El Kramany et al. and Amany stated that King variety was superior than Kawmy-1 and some exotic varieties under the effect of bio-and chemical fertilizers. Also, Zeidan et al. obtained the same results under different row spacing.

Due to chemical composition variety VC-15 seeds contain the highest P % followed by Kawmy-1, King and VC-21. This results was in accordance with those obtained by El Kramany et al. King variety showed less amount of Na (ppm) and highest amount of K%, but Kawmy-1 showed the opposite trend; highest amount of Na (ppm) and lowest amount of K%, thus, it can be concluded that King variety was more salt tolerant than Kawmy-1. This results was in accordance with those obtained by Raptan et al. who stated that the tolerant varieties gave less amount of Na(ppm) than the susceptible one.

**Effect of salinity on yield, yield components and chemical composition:** Data in Table (2) indicated that the use of saline water for irrigation resulted significant effect in number of branches/plant, but the differences between 2000 ppm and 4000 ppm concentration of salinity were not statistically significant. Similar result were obtained by Raptan et al. Also observed from the same Table that increasing salinity level resulted a significant reduction in number of pods per plant, whereas the reduction in number of pods per plant with saline water 2000 ppm and 4000 ppm was 30.44 and 43.91%, respectively, compared to the respective plants which irrigated with tap water. These results were supported with the findings obtained by Ibrahim et al. who reported that increasing in salinity levels caused a decrease in number of pods per plant.

As for the effect of salinity on no. of seeds/pod, the data in Table (2) indicated that increasing the level of salinity water from tap water to 4000 ppm, significantly decreased no. of seeds per pod. These results were supported with the findings obtained by Fauzia et al. who reported that number of grains/pod was 4.1, 3.7, and 3.5 when the plants were grown in 1.4, 5.0 and 7.5 ds/m of soil salinity, respectively. Also, Raptan et al. added that the reduction in number of seeds per pod of the plants which irrigated with 100 mm NaCl was 50% as compared to the plants which irrigated with tap water.

The results in Table (2) showed that seed index tended to decrease significantly with increasing in salinity levels. Such decrease in the 100-seed weight was expected because salinity as an environmental stress decreases the days to maturity and consequently decreases the period of seed development and affected seed filling that means that the plants of the control treatment set their pods and filled their seeds under favourable condition, compared to those plants subjected to salinity stress.

Also it was observed from the same Table (2) that increasing in salinity level resulted a significant reduction in seed yield per plant, whereas the reduction in seed yield per plant of the plants which irrigated with 2000 ppm and 4000 ppm was 48.35, 71.15%, respectively. These findings were in agreement with the results obtained by Salim and Pitman who reported that increasing in salinity levels resulted in a decrease in seed yield (g/plant).

Due to chemical composition of seeds; N % and K % were decreased by increasing salt concentration irrigation water (Table 2). These observations were supported by Raptan et al., they reported that total N and K accumulation decreased by salinity levels. But P % and Na (ppm) were significantly increased by using high saline water in irrigation (Table 2). These results are in harmony with those obtained by Ibrahim and Raptan et al. who stated that Na + accumulation increased with the increasing salinity levels.

**Effect of interaction varieties x salinity on yield, yield components and chemical composition:** Data presented in table (3) and Fig. (2) show that interaction of VC-21 x
control which irrigated by tap water produced greatest number of branches by insignificant differences, pods and seeds/plant also it has highest seed yield/plant by insignificant differences and greatest seed/pod.

Plants of VC-15 which irrigated by tap water (control) gave the highest seed yield/plant by N content in seeds.

Due to chemical composition of seeds there were significant differences between treatments N, P, K % and Na (ppm) in seeds.

Interaction of VC-21 x control recorded the highest N content in seeds.

Seeds of King variety x control contain the highest K % but interaction of Kawmy-1 x 4000 ppm gave seeds contain the highest P % and Na (ppm).

King variety recorded the best results under 2000 and 4000 ppm salinity level in no. of branches/plant; seed
Figure 1: Growth characters of 4 mungbean varieties as affected by 3 rates of salinity levels
Figure 2: Effect of interaction varieties x irrigation salinity levels on yield, its components and N% in seeds

Figure 2: Effect of interaction varieties x irrigation salinity levels on yield, its components and N% in seeds

index and K% in seeds also, the greatest no. of seeds/pod/plant and seed yield/plant under 4000 ppm salinity level.

VC-21 variety came in the first order under 2000 ppm salinity level in no. of seeds/pod/plant and seed yield/plant; VC-15 gave the greatest no. of pods/plant and highest P% in seeds but seeds of Kawmy-1 contain the highest Na%.

Under 4000 ppm salinity level VC-21 variety produce the greatest no. of pods/plant. Seeds of Kawmy-1 contain the highest N, P and Na%.

Conclusion
It is worthy to mention that King variety had superior yield and most yield components under 2000 and 4000 ppm salinity level, these result was in accordance with those obtained in growth characters, thus it can be concluded that King variety may be tolerate salinity up to 4000 ppm level with less reduction.

REFERENCES