Summary

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This study aimed to increase salt tolerance of mung bean plants *Vigna radiata* (L) Wilczek, cv. Kawmy–1 by mean of nursery hardening treatments and nutrients foliar application in the permanent field.

The present investigation consisted of two experiments at nursery and field experiment as follows:-

1- Nursery Experiment: -

It was carried out under green house conditions at Desert Research Center (DRC) EL Mataria , Cairo , Egypt in the summer seasons of 2001 and 2002.

Seed were sown in foam trays filled with vermiculite and peatmoss 1:1 v/v and supplied with macro and micronutrients, seeds were irrigated with tap water for 8 days till full germination.

Then Hardening salinity levels started and included 4–treatments of salt tolerance for mung bean seedlings during nursery. Then seedlings were irrigated with saline water obtained from a well at Ras–Suder of 4000 ppm. Irrigations water was diluted to reach the required level for each hardening salinity treatment as follows:

Control treatment : Seedlings were irrigated with tap water of 200 ppm during the nursery period i.e, 8 + 12 = 20 days.

Low salinity level: Seedlings were irrigated with 2000 ppm for 12 days and also supplied tap water each third day.

Gradually Salinization: Seedlings were irrigated with four salinity levels 1000, 2000, 3000 and 4000 ppm for two days of each concentration and irrigated with tap water at 3 days intervals i.e this treatment extended for 20 days.

High salinity level: Seedlings were irrigated with 4000 ppm for 12 days and also received tap water at 3 days intervals.

A complete randomized design with 3 replicates was adopted. Each replicate included 10 nursery trays and each tray included 209 plants.

2- Field Experiment: -

This experiment was carried out during the two summer seasons of 2001 and 2002. Seedlings obtained from nursery experiment i.e., after the 4 hardening salinity treatments were transplanted in the open field under sandy saline conditions of the Agric. Expt. Station, DRC, Wadi Suder South - West Sinai governorate, Egypt. Plants were irrigated with well water of 3500± 100 ppm.

Studies aimed to investigate the effect of 5 – foliar application treatments on salinity tolerance of mung bean plants, Plants sprayed 2 times at 20 and 35 days after transplanting with P, K and Zn and TDZ as follows:

- **Plants sprayed with 0.5% H_3PO_4, 2 % Liquid-K, 0.25 % Zn-EDTA, 1 ppb TDZ or Control treatment; which sprayed with tap water.**

This experiment included 20 treatments arranged in a split plot design with three replicates The five. foliar applications treatments arranged in the main plots and the four nursery salinity adaptation treatments survived in the sub – plots.

The main results could be summarized as follows:

1-Nursery Experiment:

Effect of hardening salinity levels of irrigation water during nursery period on

1-1 Growth characteristics of Mung Bean seedlings:-

Results showed that seeding irrigated using the gradual system of increasing saline water from 1000,2000,3000 and 4000 ppm, showed the

highest seedling growth at 20 days after sowing, expressed as seedling height, root length, fresh and dry weight. Differences in seedlings growth were significant between gradual saline system as compared with low and high levels of salinity hardening. Whereas, seedlings irrigated with tap water; control 200 ppm gave the highest seedling growth compared with thus salinized; followed by those irrigated with gradual salinity level, followed by those of the low salinity level (2000 ppm) and then the high salinity level (4000 ppm) in a descending order.

1-2 Survival % of seedlings:-

Results showed that control plants which irrigated with tap water (200 ppm) gave the highest survival of 100% followed by those irrigated with low salinity level (2000 ppm), followed by those irrigated gradually with 1000, 2000, 3000 and 4000 ppm of saline water. However, seedlings received high salinity level of irrigation water (4000 ppm) decreased survival % to the minimum reached 49.00%.

2-Field Experiment:

The effect of foliar application treatments within nursery hardening salinity levels on vegetative growth characteristics; chemical composition of foliage, seed yield and its components could be summarized as follows:

2.1.Vegetative growth characteristics of Mung Bean plants grown under saline conditions as affected by:

2.1.a Effect of Foliar application treatments

All used foliar application treatments with P, K, Zn and TDZ significantly increased Mung Bean growth parameters; plant height, number of leaves, leaf area, fresh and dry weight of plant foliage as compared with the control which irrigated with tap water (200 ppm) as shown in both seasons. Number of branches per plant was also improved

by P, K, and Zn foliar application but it was not significantly affected by TDZ application, as a general trend in both seasons.

Whereas, spraying plants with H_3PO_4 (0.5%) showed the most effective and favourable stimulation on plant growth compared with all other treatments. These results were true in the two investigation seasons. Moreover, control plants irrigated with tap water (200 ppm) gave the lowest plant growth at flowering stage, followed by those treated with TDZ (1ppb) Zn (0.25 %), Liquid K 2% and then H_3PO_4 (0.5%) in ascending order.

2.1.b Effect of hardening salinity treatments during nursery period:

Results showed that seedlings irrigated with low saline water (2000 ppm) during the nursery period showed the highest plant growth expressed as plant height, No. of branches, leaf area, No. of Leaves or branches per plant fresh and dry weight per plant with a significant differences as compared with all other treatments of salinity hardening. Moreover, control plants irrigated with tap water (200 ppm) gave the lowest plant growth at flowering stage, followed by those irrigated with high salinity level (4000 ppm) and then the gradual level of 1000, to 4000 ppm in a descending order, these results were true in both seasons of 2001 and 2002

2.1.c Effect of the interaction between foliar application x salinity levels treatments.

The interaction between foliar application x salinity levels treatments had no significant effect on all growth parameters except fresh and dry weight/plant, during both seasons.

Results indicated that plant foliage sprayed with H_3PO_4 (0.5%) and previously treated in nursery with low salinity level 2000 ppm gave the highest fresh and dry weight of Mung Bean plant foliage followed by

liquid K (2%) as a foliar application within the same hardening salinity level.

2.2 Chemical Composition of Mung Bean foliage grown under saline conditions as affected by:

2.2.a Foliar application treatments :

All used foliar application treatments significantly increased chemical composition of Mung Bean foliage; total chlorophyll, total carbohydrate, total protein phosphorus, potassium, calcium and zinc content as compared with the control which irrigated with tap water (200 ppm). On the other hand there was significant decrease in both of proline and sodium

Whereas, spraying plants with H_3PO_4 (0.05%) had the most effective and favorable stimulation effect on plant growth compared with all other treatments. Moreover, control plants irrigated with tap water had the lowest chemical composition at flowering stage, followed by those treated with TDZ (1ppb), Zn (0.25 %), Liquid K 2% and then H_3PO_4 (0.5%) in ascending order. On the other hand, proline and sodium content recorded an apposite trend; the lowest value with spraying plants with H_3PO_4 (0.05%), Liquid K 2% , Zn (0.25 %) and TDZ (1ppb) in an ascending order.

2.2.b Hardening salinity treatments during nursery period:

Results showed that seedlings irrigated with low saline water (2000 ppm) during the nursery period showed the highest chemical expressed as; total chlorophyll, total carbohydrate, total protein, phosphorus, potassium, calcium and zinc with a significant differences as compared with all other treatments of salinity hardening. On the other hand plants treated with the low saline water (2000 ppm) had the lowest significant values of both of proline and sodium content of foliage at flowering stage.

Moreover, control plants irrigated with tap water showed the lowest chemical composition at flowering stage, followed by those irrigated with high salinity level (4000 ppm) and then the gradual level of 1000, to 4000 ppm in an ascending order. On the other hand , prolin and sodium content recorded the lowest value with low saline water (2000 ppm) followed by those irrigated with the gradual level of 1000, to 4000 ppm and then high salinity level (4000 ppm) in an ascending order.

2. 2. c Interaction between foliar application x hardening salinity treatments during nursery period:

The interaction between foliar application x hardening salinity treatments had no significant effect on all chemical compounds except total chlorophyll, proline, phosphorus and zinc. Generally, plants sprayed with H_3PO_4 (0.5%) on foliage with in low hardening salinity level (2000 ppm) during nursery recorded the heights mean values for total chlorophyll, phosphorus and zinc which reached 3.297% , 2.267 mg/g and 0.613 mg/g respectively. Plants irrigated only with tap water (2000ppm) in nursery and non sprayed in the field (control x control) achieved the lowest mean values for total chlorophyll, proline, phosphorus and zinc. On the other hand, the combination of H_3PO_4 (0.5%) as a foliar application within low hardening salinity level (2000 ppm) during nursery period showed the lowest mean values for proline which reached 0.968µM/g fresh wt. Whereas, the control x control recorded the heights mean values for proline content which reached 7.667µM/g.

The obtained results in this study indicated that H_3PO_4 (0.5%) as a foliar application with low salinity level interaction was the best for total chlorophyll, phosphorus and zinc, followed by liquid K (2%) as a foliar application with the same hardening salinity level.

2-3 Yield and Yield components of Mung Bean plants grown under saline condition as affected by:

2.3.a Foliar application treatments:-

Results showed that all used foliar application treatments increased yield and its components expressed as pod length, number of pods, No. of seeds, 100-seed weight, pod weight, pod yield, seed weight and seed yield per plant and per faddan compared with the control (200 ppm) Whereas, using H_3PO_4 (0.5%) treatments gave the highest a significant increase in all parameters of yield components in two seasons this increment of dry seed yield per faddan was 116.5% over than the control.

In this respect, the lowest value showed was the control treatment (200 ppm). These results were true in both seasons of 2001 and 2002.

2.3.b Effect hardening salinity treatments during nursery period on yield and yield components of Mung Bean grown under saline conditions:-

Results showed that seedlings irrigated with low saline water (2000 ppm) during 12 days of the nursery period showed the highest yield and its components expressed as pod length, No. of pod, No. of seed, 100 seed weight, pod yield, seed weight and seed yield with a significant differences as compared with all other treatments of salinity hardening. Moreover, plants, irrigated with tap water (200 ppm) control gave the lowest yield, followed by those irrigated with high salinity level (4000 ppm) and then the gradual level of 1000 to 4000 ppm in a descending order. These results were true in both seasons of 2001 and 2002.

2.3.c Effect of the interaction between foliar application x salinity levels treatments on yield and yield components of Mung Bean Plants.

The effect of interaction between foliar application and salinity levels treatments on yield and yield components of Mung Bean plant during both growing seasons. Foliar application salinity levels treatments

interaction was significant with pod length, No. of pods / plants, 100 seed weight (g) in 2001 and 2002 growing seasons in addition seed yield kg/fed during 1st season only. on the other hand, non significant effect was detected with foliar application and salinity levels treatments interaction on No. of seed / peed, pod weight g/plant pod yield kg/fad, and seed weights g/plant during both growing seasons in addition to seed yield kg/feed in 2002 growing season.

It is evident from the obtained results that H_3PO_4 (0.5 %) with low salinity level treatment interaction was the best treatments these finding Mung Bean mainly due to the role of pH.

2.4. Chemical composition of mung bean seeds produced under saline conditions as affected by:

2.4.a Foliar application treatments

All used foliar application treatments (0.5% H_3PO_4, 2% K, 0.25% Zn,-EDTA, and 1ppb TDZ) significantly increased chemical content of mung bean seeds; total protein, phosphorus and potassium, as compared with the control which irrigated with tap water (200 ppm).

Whereas, spraying plants with H_3PO_4 (0.5%) showed the most effective and favourable stimulation on chemical content of mung bean seeds compared with all other treatments due to its high total protein, phosphorus and potassium content of seeds. Moreover, control plants irrigated with tap water (200 ppm) had the lowest total- protein, as well as P, K, content of mung bean seeds, followed by those treated with TDZ (1ppb), Zn-EDTA (0.25 %), Liquid-K 2% and then H_3PO_4 (0.5%) in an ascending order.

2.4.b Hardening salinity treatments during nursery period:

Seedlings irrigated with low saline water (2000 ppm) during the nursery period showed the highest total protein, phosphorus and potassium content of seeds with a significant differences as compared

with all other treatments of salinity hardening. Moreover, control plants irrigated with tap water (200 ppm) had the lowest total protein, phosphorus and potassium, content of seeds followed by those irrigated with high salinity level (4000 ppm) and then the gradual level (1000 to 4000 ppm) in an ascending order.

2.4.c Interaction between foliar application x hardening salinity treatments during nursery:

Results showed that potassium content of mung bean seeds were not significantly affected by these interaction treatments. However, total protein and phosphorus content of mung bean seeds were significantly affected due to the interaction treatments. Control plants within all foliar application treatments showed the lowest nutrients uptake (P) and total protein of mung bean seeds. Plants sprayed with H_3PO_4 (0.5%) within low hardening salinity (2000 ppm) during nursery recorded the highest mean values for total protein and phosphorus content which reached 26.233% , 6.121 mg/g respectively. It was clear that plants irrigated with low salinity level (2000 ppm) during nursery showed higher total protein and phosphorus content within all foliar application treatments. Meanwhile, H_3PO_4 (0.5%) followed by liquid K (2%) within low adaptation level (2000 ppm) showed the most favourable effect on P, and total protein content of foliage and seeds as compared with all other interaction treatments. Zn and TDZ application within all hardening salinity levels comes in the second rank with respect to P and total protein content.

Conclusion:

1- According to the results obtained it could be concluded that the adaptation by using 2000 ppm well water during 12 days through nursery is recommended to get the highest survival, growth, dry seed yield with the best quality.

2- According to mung bean plants grown in sandy soil of Ras-Sudr Sinai and irrigated with salty well water 3500±100 ppm spraying plants with H_3PO_4 0.5% gave the highest plant growth, mineral content and depressed proline and Na^+ content of plant foliage which led to the highest dry seed yield reached 116.5% more than the control. Spraying plants with Liquid-K2% also improved dry seed yield and increased it by 45.6% than the control. Therefore, spraying mung bean plants grown under salinity stress two times with H_3PO_4 0.5% or Liquid-K2% could be recommended to increase salinity tolerance and dry seed yield.