SUMMARY

V. SUMMARY AND CONCLUSION

Three experiments were carried out at the Experimental Farm and Laboratory of the Faculty of Agriculture, Moshtohor, Zagazig University during the seasons of 1992, 1993 and 1994. This study was conducted to evaluate some bean cultivars under various irrigation frequencies. Moreover, improving tolerance of plants to water-stress either by using some chemical compounds or by interspecific hybridization may also taken in concedration.

The first experiment: Evaluation of some bean cultivars under drought conditions:

This study was conducted during 1992 and 1993 summer seasons to evaluate common bean cultivars (*Phaseolus vulgaris* L.) i.e. Giza 3; Giza 6 and Contender as well as those of Tepary ones (*Phaseolus acutifolius*) i.e. PI 319443 and Tepary 13 under different irrigation water frequencies i.e. irrigation every 2, 3, 4 or 5 weeks when the soil moisture at irrigation time reached 42-49, 31-39, 21-29 or 15-18% of the field capacity reflecting 3489, 3110, 2930 or 2699 m^3/fad., respectively as average of both seasons added through 6, 4, 3 or 2 irrigations, on plant vegetative growth and its chemical and anatomical constituents as well as flowering characteristics, dry seed yield and its components and finally the efficiency of water utilization (m^3/kg dry seeds). A split-plot design was used, where the irrigation treatments were arranged in the main plots and cultivars were distributed randomly in the sup-plots. Obtained results can be summarized as follows:

1- Plants of both Tepary lines were taller and produced more branches and leaves compared with those of common bean cvs. However, plants of common bean cultivars showed superiority in case of fresh as well as dry weight of their leaves, stems and total plant. Individual leaf area of common bean plants reached about 5-fold that of Tepary ones. Decreasing water supply (6 to 2 irrigations throughout the growing season) gradually

decreased all studied vegetative growth parameters of all tested bean cultivars. Plants of Tepary lines were less affected and proved to be more tolerant to water-stress as compared with those of common bean ones.

2- Leaves of both Tepary lines exerted higher amounts of photosynthetic pigments (chlorophyll a and b), T.S.S., sugars (reducing and non-reducing) and free proline compared with all common bean ones. In this respect, sugars fractions and free proline were steadily and negatively affected as irrigation water increased and vice-versa.

3- Great variability was noticed among all tested cultivars regarding earliness of flowering, pod set (%), number of pods/plant and number of seeds/pod, whereby plants of Tepary bean cultivars showed superiority compared with those of common bean. Addition of 2 irrigations throughout the growing season corresponding to (2699 m^3/fad.) resulted in the least values of the aforementioned characteristics which were gradually improved as the number of irrigations increased (up to 6 irrigations 3489 m^3/fad.).

4- Among all tested cultivars, Giza 6 showed the highest values regarding pod weight and the weight of 100 seeds, meanwhile both Tepary lines ranked last in this respect. Contra trend was noticed in case of dry seed yield/plant and total dry seed yield/fad., as PI 319443 was the favourite and Giza 6 was the worst one. There were significant progressive and constant increments in total dry seed yield and its components of all tested bean cultivars as irrigation frequencies increased. Regarding the effeciency of water utilization, Tepary bean cultivars were the most efficient as they needed the least amount of water. PI 319443 Tepary line showed superiority in this respect compared with those of common bean as it needed 3.6 m^3 (as average of both seasons) to produce 1 kg of dry seeds compared with Contender cv. which needed about 67%

more water to produce the same weight unit of dry seeds. Generally, utilized water was decreased as number of irrigations throughout the growing season was increased.

5- Dry seeds of PI 319443 contained the highest contents of reducing, non reducing and total sugars as well as total carbohydrates followed by Tepary 13, Giza 3 and Contender, meanwhile those of Giza 6 ranked last in this respect. The increase in moisture stress through prolongation of irrigation intervals was accompanied by the increase in sugar fractions and the decrease in total carbohydrates in dry bean seeds an vice versa.

6- Anatomical studies cleared that plants of tolerant bean cultivars to drought-stress (Tepary 13) are characterized by enormous thickness of their blades and its fractions i.e. palisade and spongy tissues as well as upper and lower epidermis in addition to the increase in the number of their palisade layers and the decrease in the thickness of the midrib and the diameter of the widest vessel which play an important role in reducing water lost through evaporation process from the surface of the leaves.

Based on the above findings, the Tepary bean lines used in this experiment can be considered a good source for drought resistance which can be transferred to the local common bean cultivars through interspecific hybridization.

The second experiment: Effect of some chemical compounds on common bean plants grown under water stress:

This experiment was conducted during 1992 and 1993 summer seasons as an attempt to improve the tolerance of Giza 3 cv. plants grown under water-stress through spraying plants twice, 35 and 45 days from seed sowing, with either CCC at 500, 1000 and 2000 ppm or vapor gard at 2, 4 and 6%. Plants recieved two irrigations throughout its growing season i.e. irrigation every 5 weeks, starting after complete emergence, when the soil reached

15-18% from its field capacity. Total quantity of applied water reached 2699 m^3/fad. as average of both seasons.

A randomized complete block design with four replicates was adopted. Obtained results can be summarized as follows:

1- Foliar spray with increasing levels of CCC caused a steadily significant dwarfing effect on plant height. On the other hand, using vapor gard led to progressive enhancive effects on plants height compared with untreated control. Spraying with either CCC or vapor gard with all used concentrations proved to affect positively number of branches and leaves, fresh and dry weight and leaves area per plant. In general, CCC at 1000 ppm or vapor gard at 6% showed superiority in this regard.

2- Photosynthetic pigments i.e. chlorophyll a and b as well as carotenoids and T.S.S. contents of leaves were increased reaching its maximum values by application of either CCC at 1000 ppm or vapor gard at 6%. Giza 3 cv. bean plants grown under water stress exerted the highest accumulation of sugars fractions (reducing and non-reducing) and total carbohydrates in their leaves and stems and free proline in their leaves when sprayed with CCC or vapor gard at its highest used concentrations i.e. 2000 ppm or 6%, respectively compared to all used treatments.

3- Spraying bean plants with each of the chemicals used, especially at its highest concentrations seemed to improve its tolerance to water stress through shortening the number of days elapsed from seed sowing to the anthesis of the first flower, enhancing pod set (%) and increasing number of pods/plant and seeds/pod.

4- Total dry seeds yield and its components i.e. average pod weight, weight of 100 seeds, seed yield per plant as well as per faddan and the effeciency of utilized water were markedly and positively affected as water stressed bean plants were sprayed

with any one of the used chemical compounds, especially at 1000 ppm for CCC and 6% in case of vapor gard.

5- Spraying plants twice with different concentrations of the chemical compounds showed positive and progressive effects on dry seed content of reducing, non-reducing and total sugars as well as total carbohydrates. Among all used treatments, the highest concentrations of CCC (2000 ppm) and vapor gard (6%) reflected the highest values in this respect.

6- Thickness of mysophyll tissue (palisade and spongy tissues) as well as upper and lower epidermis, in addition, vascular region, upper and lower collenchyma tissues of the midrib, number of palisade layers and bundels and the diameter of the widest vessel tended to be increased as a result of spraying water-stressed Giza 3 common bean plants with any one of the used chemicals, especially at its highest concentrations compared with those of the control. Such increasing tendency in the thickness of palisade and spongy tissues and number of palisade layers as well as number of cells which contain the mesophyll tissue and photosynthetic pigments may justify the improvment of photosynthetic process and consequently the increase in total dry seed yield.

The third experiment: Interspecific hybridization:

This study was conducted during 1993 and 1994 seasons to transfer genes responsible for tolerance to water-stress from Tepary bean line (Tepary 13) to the local and the most economical common bean cultivars (Giza 3 or Contender) through interspecific crossing. In addition, biotechnological techniques were employed to overcome the problem of sexual hyridization between Tepary and common beans, mainly embryo abortion, through the use of pod and embryo culture techniques. The obtained results can be summerized as follows:

1- Percentages of pod set were very low for the crosses Giza 3 X Tepary 13 (0.67%) and Contender X Tepary 13 (0.86%). Plants

of the interspecific hybrids failed in pod setting due to the high percentages of pollen grains sterility of the aforementioned crosses, respectively.

2- Culturing immature pods of the studied interspecific crosses in liquid modified MS media gave an obvious increase in pod weight within 28 days which reached 72.6% and 34.4% for the crosses Giza 3 X Tepary 13 and Contender X Tepary 13, respectively. Simultaneously, pods were increased in length by 12.1% and 10.7% for the aforementioned crosses, respectively. Such progress in pods development verifies the potential of using pod culture technique to recover hybrid embryos of such interspecific crosses.

3- Using embryo culture techneque, medium (1) showed the highest percentage of survived embryos which formed regular shoots with chlorophyll as well as normal roots. This medium proved to be more efficient than medium (3) in rescuing the hybrid embryos of the interspecific crosses between the Tepary and common beans. This may be due to the exemption of medium (1) from cytokinins, replenishment with casin-hydrolysate and its adequate sucrose content (20 mg/L). The sucrose concentration used in medium (1) gave an appropriate osmotic pressure which is necessary for successful growth of the cultured hybrid embryos. Generally, cultured hybrid embryos of the cross Contender X Tepary 13 significantly preceded those of the cross Giza 3 X Tepary 13 concerning forming normal roots and shoots with chlorophyll in both culture media 1 and 3.

Embryos cultured on medium (2) did not form shoots or roots but they developed only undifferentiated callus tissue. This could be due to its relatively higher concentration of IBA (0.5 mg/L) accompanied with low concentration of kinetin (0.1 mg/L).

4- Medium (D) which was derivated from medium (2) proved to be the best for the propagation and prolifiration of the hybrid embryo-derived callus. This may be due to its highest concentration of kinetin (4 mg/L) compared with medium a, b and C which contained 1, 2 and 3 mg/L, respectively.

Generally, the genetic variations concerning tolerance to water-stress observed among the common and Tepary bean cultivars/lines is of great value in breeding beans for drought resistance. The anatomical and chemical analysis conducted in this work may help in understanding the nature of drought resistance. Spraying common bean plants grown under water-stress conditions with either 2000 ppm CCC or 6% vapor gard may be recommended to improve its tolerance through the diminishing of the depressive effects of such adverse conditions on plants growth and productivity. The success achieved in this study concerning the survival of hybrid embryos of the crosses between the common and Tepary beans will ease the process of transferring genes which control drought from the Tepary bean to our local common bean cultivars.