SUMMARY AND CONCLUSION

The present investigation was carried out through the two successive summer seasons of 1982 and 1983 at the Experimental Farm at the Faculty of Agriculture at Moshtohor. Four experiments were conducted to study the effect of fertilization and some growth regulators on vegetative growth, flowering behaviour, fruit yield and quality of okra plants.

The First Experiment:

This study was performed to investigate the influence of three phosphorus levels; 0, 32 and 64 kg P_2O_5/fad. within three potassium levels; 0, 24 and 48 kg K_2O/fed. on growth, chemical composition of plant foliage, flowering characteristics, fruit yield and quality of okra plants. The main results could be summarized as follows:

1. Phosphorus application at its medium level (32 kg P_2O_5/fed.) significantly promoted stem diameter, fresh and dry weight of plant foliage than either the highest level (64 kg P_2O_5/fad.) or the control treatments. Moreover, increasing phosphorus levels up to 64 kg P_2O_5/fed. had the most favourable effect on number of branches and leaves per plant. The application of 24 kg K_2O/fad. significantly increased number of leaves, fresh and dry weight per plant compared with that received 48 kg K_2O/fad. or the control. Meanwhile, stem length and number of branches per plant were not significantly affected due to potassium application.

With regard to the combined effect of phosphorus and potassium on plant growth characteristics, it was noticed that the medium level of both nutrients (32 and 24 kg P_2O_5 and K_2O/fad. respectively) proved to be the best treatment in increasing fresh and dry weight of plant foliage. Okra plants received 64 kg P_2O_5 within 48 kg K_2O/fad. exceeded other plants regarding number of leaves per plant.

2. Phosphorus application at 32 kg P_2O_5/fad. had a pronounced significant effect in increasing N, P and K accumulation in okra plant foliage as compared with the heavy P-application (64 kg P_2O_5/fad./ or the control treatments. Moreover, there was an increasing trend of total carbohydrates accumulation in okra plant foliage with increasing levels of P-fertilization as compared with the control.

Potassium application generally seemed to promote N, P,K and total carbohydrates accumulation in okra plant foliage. Plants supplied with 24 kg K_2O/fed. were superior in this respect. Heavy K-application (48 K_2O/fed.) significantly depressed such studied items. The combination of phosphorus and potassium fertilizers at their medium levels (32 kg P_2O_5 and 24 kg K_2O/fad.) showed generally the most enhancing effect in increasing nutrients accumulation in okra plant foliage.

3) Phosphorus application significantly accelerated flowering time for about 3-4 days. However, number of flowers per plant and fruit setting percentage were not significantly affected as a result of phosphorus application. Phosphorus fertilizer especially at its highest level (64 kg P_2O_5/fad.) significantly increased number of nodes that bearing the first flower.

Potassium application slightly enhanced all studied flowering characteristics, but the differences failed to reach the level of significance.

Flowering characteristics were mainly affected by increasing levels of P-fertilizer except the position of the first flower which responsed to either P and/or K application. Thus plants supplied with 0 kg P_2O_5 within 48 kg K_2O/fad. produced its first flower at the lowest node position.

4. Phosphorus application did not exert promotive effects on average fruit weight, number of fruits per plant, fruit yield per plant, early and total fruit yield per feddan as compared with the control treatment.

Potassium application, especially at the highest level (48 kg K_2O/fed.), led to a significant increase in average fruit weight, fruit yield per plant, early yield and total yield per faddan as compared with either the lowest level of K fertilizer or the control treatments. Meanwhile, no

significant differences could be detected in number of fruits per plant as a result of K-application. No significant differences could be detected between the interactional treatments with respect to average fruit weight, number of fruits and fruit yield per plant as well as per faddan. However, the use of 0 kg P_2O_5/fad. combined with 48 kg K_2O/fad. tended to improve fruit yield and its components.

5. P-fertilization generally decreased N, P, K and total carbohydrates accumulation in fruits of okra plant. K-application seemed to promote gradually the accumulation of N, P, K and total carbohydrates accumulation in fruits of okra plant. K-application seemed to promote gradually the accumulation of N, P, K and total carbohydrates. N as well as K content of fruits were significantly increased by the use of 0 kg P_2O_5 combined with 48 kg K_2O/fad. P and total carbohydrates accumulation in fruits were not significantly affected by phosphorus and potassium fertilizer combinations.

The Second Experiment:

This study was performed to investigate the influence of five varieties; Balady, Eskandarani, White velvet, Golden Coast and Clemson Spineless within three planting dates; March 20th, April 5th and April 20th on growth, chemical composition of plant foliage, flowering characteristics, fruit yield and quality of okra plants. The

main results could be summarized as follows:

1. The cvs. White velvet and Eskandarani possessed the highest vegetative growth characteristics as stem length and diameter, number of leaves and branches and fresh and dry weight per plant. Balady and Golden coast were intermediate, meanwhile Clemson spineless ranked last in this respect.

   With regard to planting date it was found that okra plants grown in April 20th were of longer and thicker stems. The highest number of leaves, fresh and dry weight per plant were obtained when plants were grown in March 20th, followed by April 20 th. The cvs. Eskandarani and White velvet showed the best adaptation and responsiveness to all planting dates, especially to the first one (March 20th).

2. Plants of cv. Eskandarani exceeded these of all other cultivars in N content of their foliage, followed by Balady and White velvet. With regard to P, K and total carbohydrates accumulation, White velvet plants were the best of all cultivars, followed by Eskandarani. Other cultivars i.e., Balady, Golden Coast and Clemson Spineless showed no significant differences between each other in this respect.

   The first planting date (March 20th) showed the highest N, P, K and carbohydrates accumulation in plant foliage. Plants of cv. Clemson Spineless showed the

highest N and these of cv. White Velvet showed the highest P, K and carbohydrates accumulation in their foliage, especially when grown at the earliest planting date (March 20th).

3. The least days elapsed from seed sowing to the anthesis of the first flower were observed by plants of cvs. Clemson Spineless and White velvet, whereas these of Baladdy were the latest ones. The same trend was also noticed with regard to the first flower position. Studied varieties did not show significant differences regarding number of flowers per plant, whereas a slight relative increase in fruit setting percentage was detected by Eskandarani and Golden coast.

Delaying planting date from March 20th up to April 20th pushed plants gradually to flower earlier and also affected positively the first flower node position. However, contra trend was noticed concerning number of flowers per plant and fruit setting percentage. The cv. Clemson Spineless sown late in April, 20th showed the shortest period required for the anthesis of the first flower, although no significant differences between used cultivars within all planting dates were detected. Among all cultivars, clemson spineless and Golden coast showed the lowest position of the first flower within all planting dates. The highest number

of flowers per plant was obtained by cvs. White Velvet, Balady and Clemson Spineless for the first, second and third planting dates, respectively.

4. Introduced cultivars, i.e., White Velvet, Golden Coast and Clemson spineless exceeded local ones; Balady and Eskandarani in fruit yield characteristics. Plants of cv. White Velvet produced the highest number of fruits per plant as well as the highest fruit early yield, meanwhile these of Golden coast and fruit yield per plant as well as per feddan. Early planting (March, 20th), followed by the second one (April, 5th) improved all fruit yield characteristics with the exception of average fruit weight. The cvs. White Velvet and Golden Coast exceeded the remainder cultivars in fruit yield productivity, especially when grown at the first planting date (March, 20th).
5. Okra plants of cvs. Golden Coast followed by White Velvet and Clemson Spineless surpassed these of local ones i.e., Balady and Eskandarani in total N, P, K and carbohydrates accumulation in their fruits. The second planting date mostly increased fruit nutrients accumulation, followed by the first one, whereas, the late planting date ranked last in this respect.

Plants of cv. Golden Coast showed best responsiveness in P accumulation in their fruits for all planting dates.

With regard to carbohydrates accumulation, cvs. White Velvet and Clemson Spineless were superior in the first and second planting dates, respectively. Concerning N and K accumulation in fruits, differences were not significant.

The third experiment:

This study was performed to investigate the effect of salinity and variety on growth, chemical composition, flowering and fruit yield of okra. This experiment included 35 treatments which were the combinations of 7 levels of salinity (tap water + 60, 80 and 100 meq./L for each of the two salts; NaCl and Na_2SO_4) within 5 varieties (Balady, Eskandarani, White Velvet, Golden Coast and Clemson Spineless). The main results can be summarized as follows:

1. The application of NaCl or Na_2SO_4 at 60 and 80 meq./L significantly decreased plant fresh and dry weight than the control. However, the application of 100 meq./L promoted it. The cv. White Velvet was favourably responsed to salinity application. Meanwhile, contra trend was observed by cv. Balady.

   The application of NaCl or Na_2SO_4 at 60 meq./L had a depressive effect on plant height compared with the control. However, NaCl at 100 meq./L and Na_2SO_4 at 80 meq./L enhanced significantly plant height. The cv. White Velvet was favourably responsed to NaCl especially at the highest dose of 100 meq./L. Meanwhile cv. Balady seemed to be the most sensitive variety in this respect.

2. A. The cvs. Eskandarani, White Velvet and Golden coast showed the highest chlorophyll a, b and carotene

respectively. Balady and Eskandarani cultivars seemed to be more tolerant to NaCl, whereas Golden Coast was the most tolerant cultivar to Na_2SO_4 application.

The chlorophyll a, b and carotene differed among varieties depending on the specific ion effect, doses and sources of salts.

B. The cvs. Clemson Spineless and Golden Coast showed the highest polyphenol oxidase activity. Meanwhile, maximum activity of peroxidase enzyme was differed among Golden Coast, Balady and Eskandarani according to the season of growth.

The application of NaCl at 60 meq./L showed a depressive effect on polyphenol oxidase activity but at 80 and 100 meq./L an increase in such activity was detected. Increasing levels of Na_2SO_4 tended to decrease the polyphenol oxidase activity, especially at the highest dose i.e., 100 meq./L. The behaviour of NaCl on peroxidase activity was much similar to that of NaCl on polyphenol oxidase activity. Meanwhile the use of Na_2SO_4 at 60 or 80 meq./L led to a decrement in the activity. However, versus state of increment was noticed at 100 meq./L.

The cv. Golden coast showed the highest activity of polyphenol oxidase enzyme especially when supplied with

100 meq./L of NaCl. Meanwhile, the cv. Eskandarani showed the most increase in peroxidase enzyme activity especially at 100 meq./L of NaCl. The cv. Balady showed a decrement in peroxidase activity as a result of all salinity treatments.

C. The cv. White Velvet surpassed other varieties in N, P, K and total carbohydrates accumulation in plant foliage. Meanwhile, the Clemson Spineless ranked last in this respect. NaCl or Na_2NO_4 application at 60 and 80 meq./L significantly decreased the accumulation of N, P, K and total carbohydrates compared with the control. However, the application of 100 meq./L either as NaCl or Na_2SO_4 promoted significantly the accumulation of such nutrients. The cv. White Velvet responsed favourably to NaCl and Na_2SO_4 especially at the highest dose i.e., 100 meq./L. Meanwhile, the cv. Balady showed the most negative responses in the accumulation of these nutrients by all salinity treatments.

3. The cvs. White Velvet and Clemson Spineless required the least number of days for flowering meanwhile, cvs. Balady and Eskandarani might be considered as late varieties. The NaCl or Na_2SO_4 application at 60, 80 and 100 meq./L led to an enhancement of flowering. Okra plants of cvs. Clemson spineless and White Velvet showed the most favourable response and flowered earlier

especially at 100 meq./L of either NaCl or Na_2SO_4.

4. The cv. Clemson Spineless showed the largest and cv. Balady expressed the smallest average fruit weight. Meanwhile, the cv. Balady showed the highest fruit number followed by White Velvet, Eskandarani, Golden Coast and Clemson Spineless. Moreover, the cv. Clemson Spineless surpassed the other varieties with respect to total fruit yield.

The fruit number was increased as a result of NaCl and Na_2SO_4 application. Total fruit yield of okra plant was increased as a result of either NaCl or Na_2SO_4 application at any used rate. The cv. Clemson Spineless surpassed other tested varieties and produced the highest fruit yield especially at 100 meq./L of either salts.

Fourth Experiment:

This experiment was conducted to study the effect of some growth regulators and salinity on growth, chemical composition, flowering and fruit yield of okra. This experiment included 49 treatments which were the combinations of (7 concentrations of some growth regulators i.e., GA_3, NAA and CCC each with two conc. i.e., 25 and 50 ppm of GA_3; 50 and 100 ppm of NAA as well as 100 and 200 ppm of CCC plus the control which was distilled water) within (7 levels of salinity i.e., control (Tap water) + 60, 80 and 100 meq./L to each of NaCl and Na_2SO_4). Obtained results could be summarized as follows:

1. The application of either GA_3, NAA or CCC within all used doses significantly depressed plant growth than the control. Fresh and dry weight per plant were higher in plants sprayed with NAA followed by GA_3 and low in plants sprayed with CCC whereas no significant variances were detected in plant growth due to the concentrations of each growth regulators.

   NaCl or Na_2SO_4 application had a depressive effect on fresh and dry weight of okra plant as compared with the control treatment.

   Most growth regulator treatments i.e., GA_3, NAA or CCC within all used concentrations failed to increase plant growth than the control which unsprayed with growth

regulators. However, no significant effect in increasing plant height compared with those sprayed with distilled water as a result of growth regulator treatments was detected.

NaCl or Na_2SO_4 application had a depressive effect on plant height of okra as compared with the control treatment. Increasing the salinity level of irrigation solution from 60, 80 to 100 meq./L gradually tended to reduce okra plant height.

GA_3 at 50 ppm combined with 60 or 80 meq./L of either salts promoted plant height as shown in 1982 season. The application of NAA at 50 ppm decreased plant height of okra grown under 80 & 100 meq./L of NaCl and 60 & 80 meq./L of Na_2SO_4. The application of CCC at 100 or 200 ppm makes okra plants more tolerant to salinity application i.e., 60, 80 or 100 meq./L each of NaCl or Na_2SO_4

2. A. Spraying okra plants with NAA especially at 50 ppm had the highest chlorophyll-a and the lowest chlorophyll-b content as compared with the other growth regulator treatments. Whereas, plants sprayed with CCC had the lowest chlorophyll-a and the highest chlorophyll-b and carotene content.

Increasing levels of NaCl and Na_2SO_4 gradually decreased chlorophyll a, b and carotene content of leaves. Variances

were more pronounced between the low and high level of salt application i.e., 60 and 100 meq./L.

Spraying plants with GA_3 had no promotive effect on chlorophyll-a & carotene but had a promised effect on chlorophyll-b, that is, in plants grown under salinity stress. Using NAA at 50 ppm had a favourable effect on chlorophyll-a content in plants grown under 60 and 80 meq./L of Na_2SO_4. The same concentration of NAA had not the same effect with NaCl. The chlorophyll-b showed an increase and carotene content a decrease as a result of the NAA interaction within salinity. Meanwhile, spraying plants with CCC had no effect on chlorophyll-a increment. The chlorophyll b showed response to CCC application and carotene content were increased in plants grown under salinity levels.

B. The growth regulators of low concentrations led to increment in the activity of polyphenol oxidase and peroxidase significantly.

The low doses of NaCl and Na_2SO_4 led to an increase in polyphenol and peroxidase enzyme activity.

GA_3 led to an increase in the activity of polyphenol oxidase in plants grown under salinity. Meanwhile, the peroxidase activity was decreased when sprayed with GA_3 especially at 25 ppm. The same trend was noticed in plants sprayed with NAA. The CCC spraying led to decrement in polyphenol oxidase activity especially at

the highest doses of salts. The same trend was noticed with peroxidase activity but Na_2SO_4 at 100 meq./L led to slight increment in the activity.

C. The control treatments surpassed those sprayed with growth regulators in nutrients accumulation of N, P, K and total carbohydrates. The difference in nutrients accumulation between the concentrations of the growth regulators was not significant, but such difference was significant between GA_3, NAA and CCC treatments.

NaCl and Na_2SO_4 application, in general, had a depressive effect on N, P, K and total carbohydrates. Such depression was significant as compared with the control.

The spraying of GA_3, NAA and CCC on plants grown under different levels of salinity did not have a promised effect in increasing the accumulations of N, P, K and total carbohydrates. The NAA showed a promised effect in increasing the accumulation of nutrients as compared with GA_3 or CCC.

3. The used growth regulators (GA_3, NAA and CCC) led to enhancing flowering time as compared with the control. Flowering time was reduced consistently as the salinity levels increased from 60, 80 to 100 meq./L. Spraying GA_3, NAA and CCC at lower concentrations seemed to enhance flowering time without significant differences, in plants grown under salinity.

4. Spraying okra plants with NAA at 100 ppm or CCC at 200 ppm increased total fruit yield per plant than that sprayed with GA_3 or the control. The increment in fruit yield per plant as a result of NAA or CCC application was due to the increase in average fruit weight since the fruit number was not considerably increased. The fruit total yield was not decreased by any treatment of salt application than the control. Moreover, okra plants supplied with 60 meq./L of NaCl or 80 meq./L Na_2SO_4 produced higher total yield than that of the control. The NaCL promoted average fruit weight, while, Na_2SO_4 had a promotive effect on number of fruits per plant.

The application of GA_3, NAA and CCC showed an increase in total fruit yield per plant grown under salinity levels and sources with the exception of that grown under Na_2SO_4 which did not response to GA_3 application.

As regard to the number of fruits per plant, it was found that, GA_3 at 50 ppm and NAA at 100 ppm increased the number of fruits in plants grown under 80 meq./L of either salts. The CCC application with its two concentrations did not show any considerable effect on increasing number of fruits per plant that grown under salinity stress.

The GA_3 improved average fruit weight in plants grown at 60, 80 and 100 meq./L of NaCl. Negligible response of GA_3 on the effect of Na_2SO_4 was noticed with respect to the average fruit weight. Whereas, NAA and CCC at used concentrations improved average fruit weight in those plants supplied with salinity solutions.

From the preceeding results of the four experiments we came up to the conclusion with respect to fruit yield characteristics that:

1. P-application had no effect on fruit yield and its components as compared with the control. Whereas, K at the highest level (48 kg K_2O/fed.) led to increment in fruit yield and its components especially average fruit weight. No significant differences in average fruit weight, number of fruits, fruit yield per plant as well as fruit yield per feddan were detected. The use of 0 kg P_2O_5/fed. within 48 kg K_2O/fed. led to improvement in fruit yield and its components and increment in nitrogen and potassium contents in fruits.
2. The introduced cultivars (White velvet, Golden Coast and Clemson Spineless) surpassed local ones (Balady and Eskandarani) in fruit yield and its components as well as nutrients accumulation in fruits. The first planting date (March, 20th) followed by second planting date (April, 5th) led to improvement in fruit yield characteristics. The White Velvet and Golden

coast surpassed the other cultivars in fruit yield when planting was done in the first planting date.

3. Cultivar under study differed in growth, chemical composition, time of flowering and fruit yield per plant as a result of sodium chloride and sulphate application. The cv Clemson Spineless surpassed other cultivars in fruit yield especially at 100 meq./L for each of the two salts.
4. The cv. Balady responsed to growth regulators especially NAA and CCC in increasing fruit yield per plant that grown under salinity stress. GA_3 had no effect on plants irrigated with sodium sulphate solution.