SUMMARY AND CONCLUSION

Response of some flax genotypes to mineral and biological nitrogenous fertilizer. This study was conducted at El-Gemmiza Agricultural Research Station, Gharbia Governorate during the two successive seasons 2002/03 and 2003/04.

The aim of the experiments was to study the effect of four flax genotypes (Sakha 1, S 2467/1, S 2419/1 and Blenka), four mineral nitrogen levels (zero, 25, 50 and 75 kg N/fed) and two biofertilization rates (bio & non bio) on vegetative growth characters after 90 days from sowing. Yield components per plant, yield per fed and quality characters were determined at harvest stage.

The soil of the experiments was clay loam in texture and contained 2.1% OM, with a pH value of 7.75. The preceding crop was maize (*Zea mays, L.*) in both seasons. The sub-sub plots area was 6 m2 (1/700 fed). Calcium super phosphate (15.5 kg P_2O_5) at a rate of 100 kg/fed was added during preparation the land. Nitrogen fertilizer was applied as ammonum nitrate (33.5%) was applied at two equal doses, one half before the 1st irrigation, the second half before the 2nd irrigation.

The normal cultural operations of flax growing in the region were followed. A split-split plot design with four replications was used. The main plots were devoled to flax genotypes, the sub-plots for nitrogen levels and the sub-sub plots for two biofertilization levels. The biofertilizer used was the lab produced *Azottin*, supplied from (**S. W. & E. R. I, ARC**), *Azottin* is mixture of four nitrogen fixing

bacteria from the four Genera *Azotobacter, Azosperillum, Bacillus* and *Klepsella* was applied mixed with sand were added prior sowing irrigation directly.

The results could be summarized as follows :

I-Growth characters:

1-Plant height (cm):

Significant differences were detected between the genotypes after 90 days from sowing the tallest genotypes were Sakha 1, and Blenka as compared to S 2419/1 and S 2467/1 in the first season. In the second season, the tallest genotypes were Blenka followed by Sakha 1.

Application of nitrogen levels significantly increased plant height of flax at 90 days from sowing in the two successive seasons. However, there was no significant difference in pplant height of this stage between 50 and 75 kg N/fed in the 1st season only. Adding of *Azottin* significantly increased plant height.

Plant height of flax was not significantly influernced by the interactions among the three experimental factors in both seasons.

2-Total fresh weight/plant (g):

The four genotypes showed significant differences in total fresh weight/plant of this stage for the two seasons. Sakha 1 had the highest weight 2.13 and 2.29 gms in the first and second seasons, respectively. The lowest total fresh weight/plant of this stage 1.34 and 1.37 gms was recorded by the fiber type Blenka genotype in the first and second seasons, respectively.

Total fresh weight significantly increased as a result of adding nitrogen level up to 75 kg N/fed in both seasons.

Azottin to flax seeds significantly increased total fresh weight/plant of this stage by 12.99 and 11.11% in the first and second seasons, respectively as compare to untreated plants.

All the effects of the interactions had no significant except that between genotypes with mineral N fertilizer in the second season one.

3-Total dry weight/plant (g):

Genotypes significantly differed in dry weight/plant. The highest value of dry weight after 90 days from sowing was recorded by Sakha 1, but the lowest was by Blenka cv.

Application of 25, 50 and 75 kg N/fed significantly increased total cdry weight/plant over the check treatment by 10.32, 36.45 and 45.48% in the first season, respectively, being 19.13, 34.90 and 49.33% in the second season for the respective N levels.

The dry weight/plant was significantly increased by interaction of *Azottin* by 17.78 and 18.66% in the first and second seasons, respectively, compared to without inoculation.

All effects of the interactions between the three experimental factors on total dry weight/plant were not significant except those between flax genotypes x nitrogen levels in the second season one.

4- Chemical analysis:

4.1-Nitrogen percentage in flax plants:

Significant differences were detected between the genotypes. The maximum value was 2.527 and 2.5514% by S. 2467/1 genotype in the first and second seasons, respectively.

Application of mineral nitrogen levels up to 75 kg N/fed caused a significant increase in nitrogen percentage 2.711 and 2.707% in the first and second seasons, respectively after 90 days from sowing.

Nitrogen percentage was significantly increased by *Azottin* by 0.078% in both seasons.

The interaction between flax genotypes and nitrogen levels induce significant effect on N% one in both seasons.

4.2- Phosphours percentage:

significant differences were detected among the four flax genotypes in P% in the first season one. S. 2467/1 genotype gave the highest P% 0.383 and 0.358% in the first and second seasons, respectively.

Nitrogen application affected it significant and positively. The highest increase was 0.073% at 75 kg N/fed.

Also, the inoculated seeds with *Azottin* significantly increased P% in the first season one.

The only significant interactins were those between genotypes and nitrogen levels in the first season.

4.3- Potassium percentage:

The four genotypes showed significant differences in K% in the first season one.

Mineral N fertilizer significantly increased K% gradually by increasing its levels in both seasons.

Potassium percentage was significantly increased by *Azottin* by 0.186 and 0.146% in 1st and 2nd seasons, respectively.

The interactions among the three factors did not significantly influence K% in both seasons.

II- Flowering date:

The four genotypes differed significantly for the two seasons in number of days to flowering. The earliest genotype was oil type S. 2419/1 (98.72) days, while the latest flowering genotypes was fiber type Blenka cv followed after 105.84 days.

The increase in nitrogen level up to 75 kg N/fed significantly delayed flowering by 2.90, 7.12 and 8.06 days in the first season, and by 3.41, 8.38 and 9.07 days in the second season, respectively. Biofertilizer delayed flowering by 1.42 and 1.55 days in the first and second seasons.

Genotypes x mineral nitrogen fertilizer had significant effect on flowering date in both seasons. The earliest flowering date was reached 93.63 days from oil type with 0 kg N/fed in both seasons.

III-Yield components:

1-plant height at harvest (cm):

Significant differences were detected between the four genotypes, the tallest plants 128.64 and 124.48 cm were with Sakha 1

in both seasons, respectively, while the shortest length were recorded by S 2419/1 (114.59) and 114.72 cm in the first and second seasons, respectively.

Increasing N level up to 75 kg N/fed significantly increased plant height at harvest. However, there was no significant difference in plant height between 50 and 75 kg N/fed levels in both seasons.

Plant height at harvest was significantly increased by the application of *Azottin* in the two seasons.

All the effects of the interactions among all experimental factors did not significantly affect plant height of flax in both seasons.

2-Technical length per plant (cm):

Blenka plants gave the highest technical length, while the lowest technical length was recorded by S 2419/1. Application of N levels up to 75 kg N/fed raised technical length/plant. In fact there was no significant difference in technical length/plant between 50 and 75 kg N/fed levels in both seasons.

Technical stem length was significantly affected by biofertilization in both seasons.

Non significant interactions were detected for among the three experimental factors on technical stem length/plant in both seasons.

3-Main stem diameter (m.m):

The stem thickness of Blenka and Sakha 1 was thicher than those of S 2467/1 and S 2419/1 in both seasons.

Main stem diameter of flax plant increased consistently as nitrogen level increased in the two seasons. Main stem diameter was

significantly increased by the application of *Azottin* in the second season only.

The only significant interactions were those between genotypes with mineral nitrogen levels in the second season.

4-Number of apical branches per plant:

Genotypes significantly differed in both seasons, S. 2467/1 gave the highest number of apical branches per plant, while the lowest number of apical branches/plant was recorded by Blenka.

Adding 75 kg N/fed significantly increased number of apical branches/plant. However, there was no significant difference in number of apical branches/plant between 50 and 75 kg N/fed levels in the second season.

Number of apical branches per plant was not significantly affected by *Azottin* application in both season.

Number of apical branches/plant in flax was not significantly influenced by the interactions among the three experimental factors in both seasons.

5-Number of capsules per plant:

The four genotypes showed significant differences in both season. S 2419/1 gave the highest number of capsules/plant, while the lowest number of capsules/plant, was recorded by Blenka.

Number of capsules/plant significantly increased as N levels increased up to 75 kg N/fed.

Adding *Azottin* significantly increaed the number of capsules in both seasons.

Genotypes X mineral N fertilizer had significant effect on number of capsules/plant in both seasons.

6-Number of seeds per capsules:

Results showed significant differences among the tested genotype in this trait. S 2419/1 gave the highest number of seeds/capsules, while the lowest number of seeds/capsules was recorded by Blenka.

Nitrogen fertilizer had a significant effect on number of seeds/capsule of flax in the two growing seasons.

Number of seeds/capsules was no significantly increased by the application of *Azottin* in the second seasons.

All the effects of the interactions were not significant except that between genotypes X nitrogen levels in the first season only.

7-Seed yield per plant (g):

Significant variations among genotypes were present, S 2419/1 gave the highest seed yield/plant (0.369 and 0.380 gms) for the first and second seasons, respectively. While the lowest seed yield /plant was recorded by Blenka.

Application of 25, 50 and 75 kg N/fed significantly increased seed yield/plant over the unfertilized treatment by 10.42, 23.55 and

32.43% in first season and by 14.01, 23.74 and 28.02% in the second season, respectively.

Azottin to flax seeds no significantly increased seed yield/plant in both seasons (0.308 and 0.304 g / plant).

Seed yield/plant in flax was significantly effected the interactions between genotypes X mineral nitrogen levels in both seasons. The maximum seed yield/plant was 0.421 and 0.415 gms in the 1st and 2nd seasons, respectively, which was produced by S. 2419/1 with 75 kg N/fed in both seasons.

8-Seed index (g):

The four genotypes showed significant differences in seed index. S 2419/1 gave the highest values, while the lowest values were recorded by Blenka in both seasons.

Increasing N levels from zero up to 75 kg N/fed. A significant increase in seed index in both seasons.

Seed index was significant increased by the application of *Azottin* in the first season.

No significant interactions were detected for the three experimental factors on seed index in both seasons except that between G X N in 1st season one.

9-Straw yield per plant (g):

Results indicated significant differences among the lested genotypes. S 2467/1 gave the highest straw yield/plant (2.244 and 2.123 gms) in the first and second seasons, respectively. While the

lowest straw yield/plant was recorded by Blenka (0.81 and 0.759 gms).

Increasing N rate up to 75 kg N/fed significantly increased straw yield/plant.

Azottin significantly increased straw yield/plant in both seasons.

All the effects of the interactions among the three factors on straw yield/plant were not significant except those between genotypes with mineral nitrogen levels in both seasons.

10-Fiber yield per plant (g):

Results showed significant differences among the tested genotypes, with the highest yield being produced by Sakha 1 (0.289 and 0.285 gms), while the lowest (0.122 and 0.114 gms) was recorded by Blenka.

Fiber yield/plant increased consistently as nitrogen levels increased in both successive seasons. Fiber yield/plant was significantly increased by the application of *Azottin* in both seasons.

The only significant interactions were those between genotypes of flax and mineral nitrogen levels in the first season.

IV-Straw, fiber, seed and oil yields/fed:

1-Straw yield per feddan (ton):

Significant differences were detected among the four genotypes in straw yield. The highest yielding one was S 24167/1 (4.444 & 4.439 ton/fed), while, the lowest straw yield/fed (2.521 & 2.481 ton/fed) was reached by Blenka in the first and second seasons.

Straw yield/fed significantly increased with increasing N levels from zero to 25, 50 and 75 kg N/fed by 14.98, 29.65 and 32.63% in first season and by 7.81, 18.17 and 20.87% in second season.

Azottin to flax seeds significantly increased straw yield/fed by and 5.54 and 4.65% in the first and second seasons, respectivelyly as compared to untratment plants.

Genotypes X mineral nitrogen fertilizer had significant effect on straw yield/fed in both seasons. The maximum of straw yield/fed was 4.859 and 4.847 tons/fed in 1^{st} and 2^{nd} seasons, respectively, which were recorded by S. 2467/1 with 75 kg N/fed.

2-Fiber percentage:

The four genotypes showed significant differences in fiber percentage for the two seasons. Blenka had the highest percentage 14.95 and 14.91% in both seasons, on ther other hand, S. 2419/1 genotype showed the lowest fiber percentage.

The fiber percentage of flax plants increased significantly by increasing nitrogen rate up to 50 kg N/fed in the first season. However differences in fiber percentage between 25, 50 and 75 kg N/fed were not significant in the first season.

Azottin to flax seeds significantly increased fiber percentage by 1.65 and 0.57% in first and second seasons, respectively.

No significant interactions were detected among the three experimental factors on fiber% in both seasons.

3-Fiber yield per feddan (kg):

The four genotypes showed significant differences in fiber yield/fed for the two seasons. Sakha 1 had the highest fiber weight

531.99 and 517.10 kg /fed in the first and second, respectively. The lowest fiber/fed 377.10 and 368.32 kg/fed in the first and second season, respectively was recorded by the fiber type Blenka.

The application of 25, 50 and 75 kg N/fed significantly increased fiber yield/fed over the check treatment by 16.57, 32.07 and 37.54% in the first season, respectively, being 8.09, 17.83 and 21.76% in the second season, respectively.

Azottin significantly increased fiber yield/fed by 8.44 and 5.32% in the first and second seasons, respectively.

Sakha 1 with 75 kg N/fed interactions were recorded the highest fiber yield/fed was 629.54 and 535.59 kg/fed in both seasons, respectively.

4-Seed yield per feddan (ton):

Results indicated significant differences among the tested genotype. strain 2419/1 gave the highest yield (1.118 and 1.145 tons/fed), while the lowest yield was recorded by Blenka (0.301 and 0.297 tons/fed).

Adding 75 kg N/fed significantly increased seed yield/fed by 30.27 and 40.14% over the unfertilized treatment in the 1st and 2nd seasons, respectively. The application of *Azottin* significantly increased seed yield/fed.

Seed yield/fed in flax was significantly influenced by the interactions between genotypes X nitrogen levels in both seasons. The maximum seed yield/fed was 1.228 and 1.350 tons in both seasons, produced by 75 Kg N and oil type of flax.

5-Oil percentage:

Significant differences were detected among the four genotypes in oil percentage, the highest yielding one was S 2467/1, while the lowest oil percentage was recorded by Blenka.

Oil percentage significantly increased with increasing N levels up to 75 kg N/fed in the two seasons.

Oil percentage was significantly increased by the application of *Azottin* in both seasons.

The only significant interactions were those between flax genotypes X mineral nitrogen levels in both seasons.

6-Oil yield per feddan (kg):

Results showed significant differences among the tested genotypes, with the highest yield being produced by S. 2419/1 (447.52 and 474.39 kg/fed in both seasons. While the lowest (103.40 and 100.03 kg/fed) was recorded by the Blenka. Oil yield per feddan of flax seeds significantly increased as a result of adding N level to 75 kg N/fed. The application of *Azottin* significantly increased oil yield per feddan by 9.23 and 8.59% in the 1^{st} and 2^{nd} seasons, respectively.

All the effects of the interactions were not significant except that between flax genotypes X N in both seasons, the maximum oil yield/fed was 505.40 and 561.18 kg/fed in 1^{st} and 2^{nd} seasons, respectively.

7-Fiber fineness:

Blenka flax genotype was the best genotype concerning fiber fineness and was significantly superior over all other genotypes having fiber fineness of 267.61 and 269.84 N m, while the coarst fiber was produced by S 2419/1 flax genotype (109.44 and 107.90 Um).

Increasing N level from zero to 25, 50 and 75 kg N/fed decreased fiber fineness by 3.50, 10.29 and 12.33% in the first season and by 2.86, 8.76 and 10.16% in the second season, respectively.

Azottin decreased fiber fineness by 1.87 and 2.58% in the first and the second season, respectively.

The best genotype concerning fiber fineness was 277.89 and 277.21 N.m in 1st and 2nd seasons, respectively, which was produced by Blenka with unfertilizer.

V-Nitrogen use efficiency (NUE):

1-Straw yield:

Strain 2467/1 recorded the highest values of N use efficiency for straw yield in both seasons. (0.022 and 0.016).

Adding 50 kg N/fed gave the highest values of NUE for straw yield/fed. *Azottin* to flax seeds before sowing gave the highest of NUE for straw yield in the first season (0.020).

The highest value of NUE for straw yield/fed was recordedby S. 2467/1 under 25 kg N/fed with *Azottin* trait (0.028) in the first season.

2-Fiber yield:

Sakha 1 recorded the highest value of N use efficiency for fiber yield (2.918) in 1st season one. The NUE reached to study a maximum of 2.505 and 1.450 in the 1st and 2nd seasons, respectively. When nitrogen applied at 25 and 50 kg N/fed in both seasons, respectively. Applying *Azottin* recorded the highest value of nitrogen use efficiency. The maximum of NUE for fiber yield was recorded by Blenka & S.2419/1 + 25 kg N/fed + *Azottin* trait.

3-Seed yield:

The oil types (S.2419/1 & S.2467/1) gaves the highest values of NUE for seed yield (0.005 and 0.007). Applying 25 kg N/fed produced the greatest of NUE for seed yield in the 1st season. *Azottin* to flax seed increased of NUE for seed yield in both seasons (0.004 and 0.005). The oil types (S.2419/1 & S. 2467/1) + 25kg N + *Azottin* recorded the highest value of NUE for seed yield (0.006).

4-Oil yield:

The highest of NUE for oil yield (0.005 and 0.007) was produced by the oil type (S. 2467/1 & S. 2419/1) in both seasons. Application of 50 kg N/fed produced the highest values of NUE for oil yield (0.004 and 0.005).

Biofertilization with *Azottin* increased of NUE for oil yield (0.004 and 0.005). The maximum of NUE for oil yield was produced by (S. 2467/1 & S. 2419/1) + 25 kg N/fed + *Azottin*.