RESULTS AND DISCUSSION

The present investigation aimed to study the response of four flax genotypes (Sakha 1, S. 2467/1, S. 2419/1 and Blenka) to fertilization with four the mineral nitrogen levels (zero, 25, 50 and 75 kg N/fed and biofertilizer (*Azottin*) on vegetative growth characters, straw, fiber, seed and oil yields per feddan and technical characters of flax plants.

I-Vegetative growth characters:

1-Total plant height (cm):

Mean values of total plant height at 90 days from sowing as affected by the tested flax genotypes, nitrogen fertilizer levels, biofertilization and their interactions in 2002/03 and 2003/04 seasons are presented in Table (5).

a) Genotypes performance:

Results in Table (5) show that the tested four genotypes differed significantly in total plant height of this stage. It was clear that the tallest plants in the first season were those of Sakha 1 (66.92 cm), followed by Blenka (65.70 cm), while the shortest plants were recorded by the oil types S 2467/1 and S 2419/1 genotypes 61.37 and 62.19 cm, respectively. In the second season, it was clear that the tallest plants were shown with Blenka genotype (67.10 cm), followed by Sakha 1 (66.04 cm) while the shortest length was recorded by S. 2467/1 (62.37). Data show remarkable differences in this character among the tested genotypes. Meanwhile S 2419/1 genotype came in the intermediate in this concern.

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Generally, the present results are mainly due to the genetically creations. These results are in agreement with those obtained by **El-Gazzar (1990), Abou-Kaied (1992), El-Gazzar (1997), El-Maghraby (1997), Zahana (1999) and Omar (2002).**

b) Effect of mineral nitrogen fertilizer:

The effect of nitrogen level on flax plant height of this stage was significant in both seasons. The results in Table (5) show that applying nitrogen at 25, 50 and 75 kg/fed significantly increased flax plant height over the check treatment by 7.21, 18.65 and 21.52%, respectively in 2002/03 season, coresponding to 9.23, 17.95 and 22.28% in 2003/04 season, for the respective nitrogen levels. The differences in plant height of this stage were significant between all nitrogen levels in the first season. It could be concluded that nitrogen is an essential element for flax growth and a good supply of nitrogen is necessary for vegetative growth and photosynthetic activity of the growing flax plants. Similar results were also obtained by **El-shimy *et al.* (1993), Abdel-Fatah (1994), Zedan (1994), Hussein (1996), El-Gazzar (1997), El-Sweify *et al.* (1997), El-Azzouni (1998), El-Gawish (2000) and El-Gazzar (2001).** While, **El-Gazzar and El-Kady (2000)** mentioned that nitrogen fertilization did not significantly affect any change in the plant height of this stage in both seasons.

c) Response to nitrogen fixer biofertilization:

The results in Table (5) show that *Azottin* inoculotion to flax seeds at sowing significantly increased plant height of this stage in the two growing seasons.it was increased from 62.54 to 65.55 cm i.e. 4.81% in the first season and from 63.34 to 66.17 cm i.e. 4.48%

in the second season, respectively. The positive effect of inoculation seeds could be attributed to nitrogen fixation and production of growth promoting substances, (**Ishac, 1989).** The positive effect of biofertilization was detected also by **Kabesh *et al.* (1989), Noor *et al.* (1989), Afify *et al.* (1994), Hamed (1998), El-Gazzar (2000), Abd El-Samie *et al.* (2002), El-Azzouni *et al.* (2003) and Wahba (2003).** While, **El-Karamity (1997)** revealed that plant height was not affected by inoculation lentil plants in both seasons.

d) Interaction effect:

The results in Table (5) show that all effects of the interaction among all experimental factors did not significantly affect plant height at 90 days from sowing of flax in both seasons. The same trend was obtained by **Abd El-Samie *et al*. (2002) and Zahana (2004).**

2-Total fresh weight per plant (g):

a) Genotypes performance:

Mean values of total fresh weight per plant of this stage (90 days after sowing) as affected by genotypes in 2002/03 and 2003/04 seasons are presented in Table (6). With regarded to genotypes, data show significant differences in total fresh weight per plant of this stage in both seasons. Results indicated that the highest weight was recorded by Sakha 1 cv. (2.13 and 2.29 gms) in the first and second seasons, respectively, followed by the oil types S 2467/1 and S 2419/1 genotypes in the two seasons. The lowest total fresh weight per plant of this stage (1.34 and 1.37 gms) was recorded by the fiber type Blenka genotype in the 1st and 2nd seasons, respectively.

T6

b) Response to mineral nitrogen levels:

The results in Table (6) show that nitrogen application significantly affected total fresh weight per plant of this stage for the two seasons.

In 2002/03 season, applying 25, 50 and 75 kg N/fed, increased total fresh weight per plant of this stage by 12.99, 27.27 and 48.70%, respectively compared with the check treatment.

In 2003/04 season, the results indicated the parallel increases in total fresh weight per plant of this stage with the four nitrogen levels zero, 25, 50 and 75 kg N/fed which gave 18.54, 35.10 and 50.33% increment over the check treatment, respectively. Nitrogen element plays a key role in plant growth of both shoot and root. It plays an important role in development and function of protoplasm, being as essential constituents of all proteins which created new plant cells, encourge cell division and meristematic activity, such effect resulted in an increase in cell number and size, **(Marschner, 1995)**. Similar results were obtained on flax by **Hella *et al.* (1990), Khair *et al.* (1991), Abd El-Fatah (1994), Hussein (1996) and El-Gawish (2000).**

c) Response to nitrogen fixer biofertilization:

Data in Table (6) indicate that adding *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 compared to untreated plants. Similar results were also reported by **El-Gazzar and El-Kady (2000) and El-Shazly and Darwish (2001).**

d) Interaction effect:

Results presented in Table (6) indicate that all effects of the interactions were not significant except that between genotypes x nitrogen levels in the second season only. In 2003/04 season, the highest significant value for total fresh weight/plant (3.04 gms) was recorded by genotype Sakha 1 with 75 kg N/fed. While, the lowest (1.14 gms) value for this stage was detected when genotype Blenka given 0 kg N/fed.

3-Total dry weight per plant (g):

a) Genotypes performance:

The results presented in Table (7) show clearly that significant differences were found in total dry weight per plant of this stage (after 90 days from sowing) at the two successive seasons. The dual type Sakha 1 flax genotype was the hieghest total dry weight per plant which recorded 0.423 and 0.450 gms in 2002/03 and 2003/04 seasons, respectively, the lowest total dry weight per plant was obtained by the fiber type Blenka genotype 0.268 and 0.272 gms. While, the oil types S 2467/1 and S 2419/1 flax genotypes came in the intermediate in this concern. The same trend in total dry weight/plant was obtained by **El-Gazzar (1990), Mourad *et al.* (1990), El-Gazzar (1997), El-Maghraby (1997), Zahana-Afaf (1999) and Omar (2002).**

b)Response to mineral nitrogen levels:

Total dry weight per plant of this stage increased significantly at the level of 75 kg N/fed than all nitrogen levels in the two seasons Table (7). Total dry weight per plant increased at a rate of 75 kg N/fed by 10.32, 26.45 and 45.48% in the first season and by

T7

19.13, 34.90 and 49.33% in the second season than that of zero, 25 and 50 kg N/fed, respectively, without significant differences in total dry weight per plant of this stage between 50 and 75 kg N/fed in both seasons. **Marschner (1995)** indicated that the effect of N fertilizer on accumulating dry matter may be due to increasing photosynthetic area which resulted in increasing photosynthetic gains. These results agree with these obtained by **Khair *et al.* (1991), Mohamed (1991), Zedan (1994), Hussein (1996), El-Gazzar (1997), El-Gawish (2000) and El-Gazzar (2001).** While, **El-Gazzar and El-Kady (2000)** entioned that N fertilization did not affect any change in the total dry weight per plant in both seasons.

c) Effect of nitrogen fixer biofertilization:

Biofertilization did show positively significant effect on total dry weight per flax plant of this stage in the two growing seasons Table (7). The dry weight per plant increased from 0.343 to 0.404 gms i.e. (17.78%) in 2002/03 season and from 0.343 to 0.407 gms i.e. (18.66%) in 2003/04 season, respectively. These results are in harmony with those obtained by **Alagawadi and Anwar (1988), Badr El-Din and Moawed (1988), Afify *et al.* (1994), El-Karamity (1997), El-Gazzar (2000), Hamissa *et al.* (2000) and El-Shazly and Darwish (2001).**

d) Interaction effect:

All effects of the interactions between the 3 experimental factors on total dry weight/plant were not significant except those between flax genotypes and N in the second season one Table (7).

The highest value of this trait was recorded for genotype Sakha 1 with the application of 75 kg N/fed being 0.595 gms. On the other hand, the lowest value for this trait was recorded for Blenka supplied with 0 kg N/fed being 0.222 gms.

4.1- Nitrogen percentage:

a) Genotypes performance:

Nitrogen percentage in flax plants at 90 days from sowing was significantly affescted by genotypes in 2002/03 and 2003/04 growing seasons are listed in Table (8). Data showed that N% reached its maximum value by the oil type S 2467/1 flax genotype in both seasons with an average of 2.527 and 2.514% in the first and second seasons, respectively. S 2419/1 genotype was the second highest in N% of this stage. The lowest N% 2.415 and 2.388% in 1st and 2nd seasons was obtained by Blenka cv. The present results are mainly due to the genetically creations. These results are in agreement with those obtained by **El-Nimr *et al.* (1997).**

b) Response to mineral nitrogen levels:

From data in Table (8) it can be also noticed that the measured nitrogen percentage in flax plants at 90 day from sowing. Application of 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. That may be due to the state of maintainant blance in the content of mineral nutrient within the treated plants with higher levels of nitrogen. Similar results were obtained by **Power *et al*. (1990), Chourasia and Dixit (1993) and El-Nimr *et al* (1997).**

T8

c) Effect of nitrogen fixer biofertilization:

Mean values of nitrogen percentage in flax plants at 90 days from sowing Table (8) significantly increased with *Azottin* inoculation seeds in both seasons. The results showed that the application of biofertilization significantly increased N percentage by 0.078% in the first and second seasons. The positive effect of biofertilization was detected also by **Alagawadi and Guar (1988), Fares (1997), Hamissa *et al.* (1999) and Wahba (2003).**

d) Interaction effect:

The results in Table (8) showed that all effects of the interactions were not significant except that between genotypes x nitrogen levels in both seasons.

The highest N% was 2.780% in the first season which was obtained by S.2419/1 + 75 kg N/fed and was 2.729% in the second season which was obtained by Sakha 1 + 75 kg N/fed.

4.2- Phosphorus percentage:

a) Genotypes performance:

Differences in phosphourus percentage of this illicated by genotypes during both seasons are showen in Table (9). Strain 2467/1 genotypes gave the highest P% of this stage 0.383 and 0.358% in the first and second seasons, respectively. The lowest P% was recorded by Blenka cv. 0.354 and 0.335% in both seasons, respectively. The highest means of P% of this stage in S. 2467/1 and S. 2419/1 as oil types are attributed to the differences in the genetical constitution of the genotypes. These results are in harmony with those mentioned by **El-Nimr *et al*. (1997).**

T9

b) Response to mineral nitrogen levels:

The effect of N levels on P% of this stage, Table (9). The results showed that the application of 25, 50 and 75 kg N/fed significantly increased P percentage by 0.026, 0.052 and 0.074% in the first season and by 0.029, 0.060 and 0.072% in the second season. Similar results were obtained by **Power *et al.* (1990), Chourasia and Dixit (1993) and El-Nimr *et al.* (1997).**

c) Effect of nitrogen fixer biofertilization:

Mean values of phosphours percentage in flax plants at 90 days from sowing, Table (9) significantly increased with *Azottin* inoculation seeds in both seasons. The results showed that the application of biofertilization in significantly increased phosphours % by 0.039 and 0.038 % in the first and second seasons, respectively. The positive effect of biofertilization was detected also by **Alagawadi and Gaur (1988), Fares (1997), Hamissa *et al.* (1999) and Wahba (2003).**

d) Interaction effect:

The results in Table (9) indicated that the only significant interactions were those between genotypes and mineral N levels in 2002/03 season one. The significant genotypes X N indicated that the highest phosphours percentage of this stage in 2002/03 season reached 0.423 resulting from S.2467/1 + 75 kg N/fed.

4.3- Potassium percentage:

a) Genotypes percentage:

Average of potassium percentage this stage in response to the studied flax genotypes during 2002/03 and 2003/04 seasons are tabulated in Table (10). In the 2003/04 season, there were insignificant differences among the tested flax genotypes, while in the first season 2002/2003, results showed significant differences in K% of this stage. The fiber type Blenka cv. recorded the highest K% of this stage 3.170 and 3.216%. On the other side the lowest one was notest from oil type S 2419/1 genotype 3.026 and 3.188% in both seasons, respectively. Sakha 1 and S 2467/1 genotypes came in the intermediate in this concern. Similar findings are in agreement with those obtained by **El-Nimr *et al.* (1997).**

b) Response to mineral nitrogen levels:

Concerning the effect of mineral nitrogen levels on plant potassium %, the results in Table (10) showed that the application of 25, 50 and 75 kg N/fed increased K% over the check treatment by 0.207, 0.396 and 0.333%, respectively. In 2002/03 season, coresponding to 0.111, 0.146 and 0.160 % in 2003/04 season. Similar results were obtained by **Power *et al*. (1990) and El-Nimr *et al*. (1997).**

c) Response to nitrogen fixer biofertilization:

Mean values of potassium percentage in flax plants at 90 days from sowing Table (10) significantly increased with *Azottin* inoculation seeds in both seasons. The resultsw showed that the application of biofertilizer significantly increased K% by 0.186% in the first season and by 0.146% in the second season. The positive effect of biofertilization was detected also by **Hamissa *et al*. (1999) and Wahba (2003).**

T10

d) Interaction effect:

The results in Table (10) indicated that all effects of the interactions were not significant except that between genotypes X mineral N levels in 2002/03 season. The significant genotypes X N indicated that the highest K % in 2002/03 season reached 3.254 resulting from S.2419/1 + 50 kg N/fed and Blenka + 75 kg N/fed.

II- Flowering date (days):

The number of days from sowing to 50% of blooms emergence from the boot of four flax genotypes as effected by nitrogen fertilizer levels, biofertilizer and their interactions over the two seasons are presented in Table (11).

a) Genotypes performance:

The results in Table (11) showed that the evaluated genotypes varied significantly in flowering date in both seasons successively. In 2002/03, the earliest flowering cultivar was strain 2419/1 it flowered after 98.72 days, followed by strain 2467/1 flowered after 103.19 days and Sakha 1 flowered after 105.25 days, while the latest flowering cultivar was Blenka cv. flowered after 105.69 day. The same variation on flowering date was observed in 2003/04 season. Blenka cv. was latest cultivar being flowering after 106.00 day followed by Sakha 1, strain 2467/1 and S 2419/1 after 104.59, 104.03 and 0.97.47 days respectively. Similar results were also reported by **El-Gazzar (1990), Abou-Kaied (1992), El-Gazzar (1997), Prodhan *et al.* (1999) and Zahana-Afaf (1999).**

T11

b) Response to mineral nitrogen levels:

The effect of nitrogen on flowering date was very clear in both seasons, Table (11). The application of 25, 50, and 75 kg N/fed significantly delayed flowering by 2.90, 7.12 and 8.06 days in the first season, compared with the unfertilized plants, respectively. The corresponding increases in flowering date in the second season were 3.41, 8.38 and 9.06 days for the same respective nitrogen levels.

It is quite evident that nitrogen encouraged the vegetative growth of flax plants and extended the growth stage by a period reaching 9 days at the highest N level 75 kg N/fed, showing its vital role in plant growth and the formation of vegetative organs of flax plants. Similar results were reported by **El-Gazzar (1997),** he found that increasing N level from 0 up to 60 kg /fed significantly delayed flowering by 7.18 days.

c) Response to nitrogen fixer biofertilization:

The results in Table (11) showed that inoculated seed with *Azottin* delayed flowering significantly compared to without inculation in the two seasons. Biofertilizer delayed flowering by 1.42 and 1.55 days in the first and sercond season, respectively. The delaying percent reached to 1.39 and 1.52% in the first and second seasons, respectively. This may by attribuuted to activated growth due to surplus nitrogen suppled by biofertilization effect. **Abou El-Ela (2001)** found slight delay in date of heading with the application biofertilizer.

d) Interaction effect:

The result in Table (11) showed that all effect of the interactions were not significant except that between genotypes x nitrogen levels in both seasons.

The significant genotypes x nitrogen indicated that the earlist flowering date was reached 93.63 days from S.2419/1 with 0 kg N/fed in both seasons. On the other hand, the latest flowering date was reached 109.25 days from S.2467.1 by applying 75 kg N/fed.

III-Yield components at harvest:

1- Plant height (cm):

a) Genotypes performance:

Statistical analysis revealed that the four flax genotypes significantly differed in total plant height in the two seasons are shown in Table (12). It was clear that the tallest plants 128.64 and 124.48 cm were with Sakha1 in both seasons, respectively, followed by Blenka genotype 127.41 and 120.79 cm, while the shortest length significant value for this traits were recorded by the oil type S 2419/1 (114.59 and 114.73 cm) and S. 2467/1 (123.51 and 119.86 cm) in the first and second seasons, respectively, came in the intermediate in this concern. Generally, the present results are mainly due to the genetically creations.

These results are in agreement with those obtained by **El-Gazzar (1990), El-Sweify (1993), Saad (1995), El-Sweify and Moustafa (1996), Salama (1996), El-Gazzar (1997), El-Sweify *et al.* (1997), El-Shimy and Moawed (2000), Dubey (2001), El-Gazzar and Abou-Zaied (2001), El-Deep (2002), El-Sweify (2002). Mousa (2002) and El-Azzouni *et al.* (2003).**

T12

b) Response to mineral nitrogen levels:

Plant height at harvest increased significantly as nitrogen fertilizer increased up to 50 kg N/fed. This was true in the two successive seasons, Table (12). Increasing N levels from zero to 25, 50 and 75 kg N/fed increased plant height by 5.64, 22.98 and 20.35% in 2002/03 season and by 9.13, 25.59 and 22.61% in 2003/2004 season, respectively. However, the difference between 50 and 75 kg N/fed levels was significant in both seasons. The vital role of N and its necessiry for protoplasm formation, photosynthesis activity, cell division and merestimatic activity in plant organs is clearly illustrated. Similar results were also reported on flax by **Zedan (1990), El-Moursi and El-Farouk (1991), Mohamed (1991), Abd El-Fatah (1994), Abd El-samie and El-Bially (1996), Abou-Zaied (1997), Singh and Verma (1997), El-Azzouni (1998), El-Gawish (2000), Abd El-Samie *et al.* (2002) and Zahana-Afaf (2004).** On the other hand, **El-Gazzar and El-Kady (2000)** mentioned that N fertilizer levels of (30, 40, 50 and 60 kg N/fed) did not differ significantly from each other concerning the effect on plant height.

c) Effect of nitrogen fixer biofertilization:

Biofertilization did show positively significant effect on flax plant height at harvest in the two growing seasons. It was increased from 120.22 to 126.85 cm (equal 5.51%) in 2002/03 season and from 115.87 to 124.06 cm (equal 7.07%) in 2003/04 season, respectively in Table (12). **Ishac (1989)** reported that, the positive effect of inoculation flax seeds may due to plant harmones produced and activated growth,**.** Similar result were also reported by **Kabesh *et al.* (1989), Noor *et al.* (1989), Afify *et al.* (1994), Hamed (1998), El-Gazzar (2000), Abd El-Samie *et al.* (2002), El-Deeb (2002), El-Azzouni *et al.* (2003) and Wahba (2003).**

d) Interaction effect:

The results in Table (12) indicated clearly that each experimental factors acted independently in affecting plant height in both seasons. These results are in harmony with those obtained by **El-Shimy et al. (1993), El-Gazzar and AbouZaied (2000) and Zahana (2004).**

2-Technical stem length per plant (cm):

a) Genotypes performance:

Results in Table (13) indicated that there were significant differences in technical stem length in two seasons. It is clear that the Blenka (fiber type) gave the highest technical stem length 115.95 and 110.63 cm in the first and second serasons, respectively, while the lowest technical stem length 93.00 and 92.84 cm in 2002/03 and 2003/04 seasons, respectively was recorded by (oil type) S. 2419/1. In other words, it can be stated that Blenka cv. was the best in the technical stem length, followed by Sakha1 and S 2467/1 genotypes which came in the intermediate in this concern. The present resultes are mainly due to the differences in the genetical structure of the genotypes and agree with those reported by **Saad (1995), El-Gazzar (1996), El-Sweify and Moustafa (1996), Salama (1996), El-Shimy and Moawed (2000), El-Deeb (2002), El-Sweify (2002) and El-Sweify *et al.* (2003).**

T13

b) Response to mineral nitrogen levels:

It looks to be true that the application of nitrogen levels up to 75 kg N/fed raised technical stem length in the two seasons as shown in Table (13). The differences in technical stem length were significant between all nitrogen levels except 50 and 75 kg N/fed in both seasons. Technical stem length exceeded by 8.66, 28.89 and 27.25% in the first season and 11.14, 30.86 and 27.24% in the second season as a result of the application of nitrogen at 25, 50 and 75 kg N/fed, respectively. as compared with zero level of nitrogen. It looks to be true that N levels increased consistently both stem and technical lengths in the two seasons. This is to be expected since nitrogen is one of the important mineral which affects cell division and cell elongation as well. These results were along the same line with those obtained by **Ghanem (1990), Hella *et al.* (1990), Zedan (1990), Mohamed (1991), Zahana-Afaf (1991), El-Shimy *et al.* (1993), Zedan (1994), Abd El-Samie and El-Bially (1996), Hussein (1996), El-Gazzar (1997), El-Azzouni (1998), Hamed (1998), Omar (1998), El-Gawish (2000), El-Gazzar (2001), Abd El-Samie *et al.* (2002), El-Gazzar and Kineber (2002) and Zahana-Afaf (2004).** However, **Nasr El-Din *et al.* (1991) and El-Gazzar and El-Kady (2000)** mentioned that nitrogen fertilization did not significantly affect in the technical stem length in both seasons.

c) Effect of nitrogen fixer biofertilization:

Data in Table (13) inoculated flax seeds with *Azottin* increased technical stem length at harvest significantly compared to without inoculation in 2002/03 and 2003/04 seasons.

In both seasons, the technical stem length increased significantly by 7.94% and by 10.84%, respectively. Similar results were also obtained by **Afify *et al.* (1994), Hamed (1998), El-Gazzar (2000), Abd El-Samie *et al.* (2002), El-Deeb (2002) and El-Azzouni *et al.* (2003).**

d) Interaction effect:

The results presented in Table (13) indicated that all effects of the interactions among the three factors were not significant in both seasons. These results are in harmony with those obtained by **El-Farouk et al. (1982), Leilah (1993) and Zahana-Afaf (2004).**

3-Main stem diameter (m.m):

a) Genotypes performance:

Data collected in Table (14) show the averages of main stem diameter as affected by the four studied flax genotypes during 2002/03 and 2003/04 seasons. In both seasons, evaluated flax genotypes markedly varied among them in stem diameter S. 2467/1 oil type gave the greatest stem diameter where the main values were 2.134 and 2.197 mm, followed by S. 2419/1 oil type 2.120 and 2.055 mm in the first and second seasons, respectively. The thinner measurement was obtained from fiber type Blenka genotype 1.114 and 1.102 mm at the first and second seasons respectively, while dual type cultivar Sakha 1 came in the intermediate in this concern. The present results are mainly due to the differences in the genetical constitutions of the tested cultivars under study. These results are in harmony with those obtained by **Mourad *et al.* (1990), Zedan (1990), El-Sweify (1993), Kineber (1994), Zedan (1994), El-Nimr *et al.* (1997), Abd El-Samie *et al.* (2002), El-Deeb (2002), Omar (2002) and Zahana-Afaf (2004).**

T14

b) Response to mineral nitrogen levels:

Data revealed that in Table (14) significant differences among the four nitrogen levels in the two seasons on main stem diameter.

Increasing N doses from zero to 25, 50 and 75 kg N/fed increased main stem diameter by 8.12, 15.71 and 22.76% in the first season and by 9.24, 23.41 and 27.59% in the second season, respectively. This increment may be due to the increase of cambium cells division activity induced by nitrogen application. The results obtained herein are in accordance with those obtained by **Zedan (1990), El-Azzouni (1992), El-Shimy *et al.* (1993), Zedan (1994), Abou-Zaied (1997), El-Gazzar (1997), El-Sweify *et al.* (1997), El-Azzouni (1998), El-Gawish (2000), El-Gazzar (2000), Abd-El-Samie *et al.* (2002) and El-Gazzar and Kineber (2002).** While**, Nasr El-Din *et al.* (1991), El-Kady *et al.* (1995), Hussein (1996) and El-Gazzar and El-Kady (2000)** mentioned that increasing N levels did not have significant effect on main stem diamete. On other hand, **Omar (1998)** found that main stem diameter significantly decreased by increasing nitrogen level from zero to 60 kg N/fed in the two seasons.

c) Effect of nitrogen fixer biofertilization:

The results in Table (14) showed that biofertilization, with N-fixing bactria gave a significant increase in main stem diameter at harvest, in the second season only.

Main stem diameter per plant at harvest increased by 6.98% in the first season and by 5.63% in the second season, respectively. The positive effect of biofertilization was detected also by **Afify *et***

***al.* (1994), El-Gazzar (2000), Abd El-Samie *et al.* (2002), El-Deeb (2002) and El-Azzouni *et al.* (2003).**

d) Interactions ecffects:

The results in Table (14) showed that the only significant interactions were those between genotypes X mineral N levels in the second season. The significant G x N indicated that the highest main stem diameter in 2003/04 season reached 2.415 m.m, resulting from 2.467/1 with 75 kg N/fed.

4-Number of apical branches per plant:

a) Genotypes performance:

Mean values of number of apical branches per plant in response to the studied flax genotypes during 2002/03 and 2003/04 seasons are listed in Table (15). In both seasons, evaluated flax genotypes markedly varied among them in number of apical branches per plant. S 2467/1 genotype recorded the highest numbers 6.244 and 5.878 of apical branches / plant, followed by S 2419/1 genotype 5.994 and 5.600 branches and Sakha 1 (5.250 and 5.306) in the the first and second seasons, respectively, while the lowest one was notest from Blenka 2.441 and 2.344 in both seasons, respectively. The highest means of number of apical branches per plant in S 2467/1 and S 2419/1 as oil type are attributed to the differences in the genetical constitution of the genotypes. These results are in harmony with those mentioned by **El-Gazzar (1990), Kineber (1991), El-Sweify (1993), Zedan (1994), El-Nimr *et al.* (1997), Zahana-Afaf (1999), Abd El-Samie *et al.* (2002), El-Deeb (2002), Omar (2002) and Zahana-Afaf (2004).**

T15

b) Response to mineral nitrogen levels:

Data collected in Table (15) indicate that the tested nitrogen levels had a significant effect on number of apical branches per plant over both seasons, raising nitrogen levels from 25 to 50 and 75 kg N/fed significantly increased number of apical branches per plant from 2.10 to 11.75 and 16.75% in the first season and from 6.71 to 11.80 and 13.76% in the second season, respectively. However, the difference between 50 and 75 kg N/fed levels was insignificant in the second season only. The increase in number of apical branches per flax plant with the increase of nitrogen level up to 75 kg N/fed can be ascribed to the active role of nitrogen in building up proteins and meristematic activity. These finding are in good agreement with those obtained by **Ghanem (1990), Zedan (1990), salama (1991), Zedan (1994), Abd El-Samie and El-Bially (1996), El-Gazzar (1997), El-Nimr *et al.* (1997), Hamed (1998), El-Gawish (2001), Abd El-Samie *et al.* (2002) and El-Gazzar and Kineber (2002).** Howver, **El-Gazzar and El-Kady (2000)** mentioned that nitrogen fertilization did not significantly affect on number of apical branches in flax plant.

c) Effect of nitrogen fixer biofertilization:

The results showed that no significant differences in number of apical branches per plant at harvest as affected by *Azottin* in both seasons as shown in Table (15).

Similar results were also reported by **El-Karamity (1997), Hamed (1998) and Abd El-Samie *et al.* (2002).**

d) Interaction effect:

The results in Table (15) indicated clearly that each experimental factors acted independently in affecting number of apical branches/plant in both seasons.

5-Number of capsules per plant:

a) Genotypes performance:

Results presented in Table (16) show the average of number of capsules per plant for tested genotypes. It is evident that the genotypes significantly differed with regard to number of capsules per plant. Averages for both seasons showed that the highest number of capsules/plant was recorded by S 2419/1 (44.13 and 35.12) for the first and second seasons, respectively, followed by S 2467/1 genotype (37.73 and 33.32) for the two seasons, respectively. The lowest number of capsules per plant 7.23 and 7.31 in 2002/03 and 2003/04 seasons, respectively, was produced by fiber type Blenka cultivar. The genotype dual type Saka 1 came in the intermediate in this concern. It could be concluded that the oil type genotypes S 2419/1 and S 2467/1 were superior the dual type and fiber type genotypes Saka 1 and Blenka in regard to number of capsules per plant. Similar results were also reported by **El-Gazzar (1990), Mourad *et al.* (1990), El-Shimy *et al.* (1993), El-Sweify (1993), Sharief (1993), Saad (1995), El-Sweify and Moustafa (1996), El-Nimr *et al.* (1997), El-Kassaby *et al.* (1999), Zahana-Afaf (1999), El-Deeb (2002), El-Sweify *et al.* (2003) and Zahana-Afaf (2004).**

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b) Response to mineral nitrogen levels:

Number of capsules per plant of flax increased significanly as nitrogen levels fertilizer increased up to 75 kg N/fed in the two successive seasons Table (16). Number of capsules/plant increased consistently by increasing N levels. Number of capsules per plant increased by 35.18, 67.34 and 72.91% in the first season and by 17.96, 40.28 and 53.62% in the second season one as a result of increasing nitrogen from zero to 25, 50 and 75 kg N/fed, respectively. The differences in number of capsules/plant were significant between all N levels in the two seasons.

This result is expected for the favourable effect of nitrogen on growth and meristemic activity as well as enhancing stem development and their flowering branches. These findings are coincide with those of **Abd El-Samie and El-Bially (1996), Hussein (1996), Kholosy *et al.* (1996), Abou-Zaied (1997), Zedan *et al.* (1997), El-Azzouni (1998), Hamed (1998), Omar (1998), El-Gawish (2001), El-Gazzar (2001), El-Gazzar and Abou–Zaied (2001), Abd El-Samie *et al.* (2002) and Zahana-Afaf (2004).** While**, Nasr El-Din *et al.* (1991)** mentioned that increasing nitrogen level from 30 to 60 kg N/fed did not have a significant effect on number of capsules per plant.

c) Effect of nitrogen fixer biofertilization:

Results from Table (16) showed significant differences in number of capsules per plant due to biofertilization application in both seasons. Number of capsules per plant increased from 26.50 to 30.75 (i.e. 16.04%) in the first season and from 23.57 to 25.16 (i.e. 6.75%) in the second season, respectively. These results are in agreement with those reported by **Afify *et al.* (1994), El-Karamity (1997), Hamed (1998), Hamissa *et al.* (1999), El-Gazzar and El-Kady (2000) and El-Deeb (2002).**

d) Interaction effect:

The results in Table (16) showed that all affects of the interactions were not significant except that between genotypes X nitrogen levels in both seasons. The highest number of capsules/plant was 51.89 capsules in the first season, which was obtained by S. 2419/1 + 50 kg N/fed and 41.69 capsules in the second season, which was obtained S. 2419/1 with 75 kg N/fed.

6-Number of seeds per capsule:

a) Genotypes performance:

Average number of seeds per capsule tabulated in Table (17) show the average number of seeds per capsule for tested genotypes. From these results, it is evident that the genotypes significantly differed with regard to number of seeds/capsule. The oil type flax S 2419/1 gave the highest number of seeds per capsule 6.459 and 6.269 in the first and second seasons, respectively. On the contrary, the lowest ones were those by the other fiber type flax Blenka 6.113 and 5.703 in 2002/03 and 2003/04 seasons, respectively, S 2419/1 and Sakha 1 genotypes came in the intermediate in this concern. Similar findings are in agreement with those obtained by **Mourad *et al.* (1991), El-Sweify (1993), Zedan (1994), Saad (1995), El-Sweify and Moustafa (1996), Moustafa *et al.* (1998), El-Kassaby *et al.* (1999) and Omar (2002).**

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b) Response to mineral nitrogen levels:

Data observed on number of seeds per capsule was similar to that obtained on number of capsules/plant as shown in Table (17). Nitrogen fertilizer had a significant effect on number of seeds per capsules of flax in both seasons. Increasing nitrogen level uo to 75 kg N/fed caused a significant increase in number of seds per capsules in the two seasons. There was no significant difference in number of seeds/capsules between 50 and 75 kg N/fed in the second season only. Increasing N level from zero to 25, 50 and 75 kg N/fed increased number of seeds/capsule by 7.52, 17.38 and 21.39% in the first season and by 7.14, 11.62 and 13.44% in the second season, respectively. These results may be due to the positive effect of N on the formation of sexual organs, pollination, fertilization and on meristematic activity of seeds **(Marschner, 1995)**. Similar results were obtained by **Abou-Zaied (1991), El-Hindi *et al.* (1992), Abd El-Samie and El-Bially (1996), Abou-Zaied (1997), Sing and Verma (1997), Zedan *et al.* (1997), Omar (1998) and El-Gazzar (2000).** On the other hand, **Nasr El-Din *et al.* (1991), El-Azzouni (1992), Hussein (1996) and Zahana (2004)** Mentioned that nitrogen fertilization did not affect the number of seeds per capsules.

c) Effect of nitrogen fixer biofertilization:

Biofertilization, with *Azottin* incresed significantly number seeds per capsule in the first season one, as shown in Table (17). Applying *Azottin* to flax seeds increased number of seeds per capsule by 3.33 and 1.34% in 2002/03 and 2003/04 seasons, respectively. Similar results were also obtained by **El-Karamity**

(1997), Hamissa *et al.* (1999), El-Gazzar and El-Kady (2000), El-Shazly and Darwish (2001) and El-Deeb (2002).

d) Interaction effect:

The results in Table (17) showed that all effects of the interaction were significant except that between genotypes and mineral N levels in the first season. The maximum number of seeds per capsule was 7.113 seeds in the first season, which was recorded by S.2467/1 + 75 kg N/fed.

7-Seed yield per plant (g):

a) Genotypes performance:

With regard to the seed yield per plant, there were significant differences among genotypes in the two growing seasons are listed in Table (18). Strain 2419/1 flax genotype recorded the highest means of this trait 0.369 and 0.380 gms for the first and second seasons, respectively. While S 2467/1 flax genotype came in the second rank 0.365 and 0.360 gms in 2002/03 and 2003/04 seasons, respectively. On the other side Blenka flax genotype came in the last rank which recorded 0.169 and 0.148 gms in the first and second seasons, respectively. The increase in seed yield/plant could be attributed to the increase in number of capsules/plant as well as number of seeds/capsules. These are mainly due to the differences in the genetically make up of the tested genotype and this finding are in agreement with those obtained by **Mourad *et al.* (1990), Kineber (1991), El-Sweify (1993), Zedan (1994), Saad (1995), El-Sweify *et al.* (1996), El-Gazzar (1997), El-Nimr *et al.* (1997), Moustafa *et al.* (1998), El-Deeb (2002), El-Refaie (2003) and El-Sweify *et al.* (2003).**

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b) Response to mineral nitrogen levels:

Results in Table (18) show that increasing nitrogen level significantly increased seed yield per plant in the two successive seasons. Increasing N rate from zero to 25, 50 and 75 kg N/fed increased seed yield/plant by 10.42, 23.55 and 32.43% in the first season and by 14.01, 23.74 and 28.02% in the second season, respectively. The differences in seed yield/plant were significant between all N levels in the two seasons. Such increase in seed yield per plant may be due to the benifical effect of nitrogen on growth and development of flax plant. Similar results were reported by **Samui *et al.* (1995), Kholosy *et al.* (1996), Abou-Zaied (1997), Vyas (1997), Zedan *et al.* (1997), El-Azzouni (1998), Hamed (1998), Omar (1998), El-Gawish (2001), El-Shimy and Moawed (2000), El-Gazzar and Abou-Zaied (2001), Abd El-Samie *et al.* (2002) and Zahana-Afaf (2004).**

c) Effect of nitrogen fixer biofertilization:

Concerning the effect of inoculation flax seeds on the seed yield/plant, the results in Table (18) showed no significant effect of applying *Azottin* when compared without inoculation in the two seasons. The positive effect of biofertilization was detected also by **Afify *et al.* (1994), Hamed (1998), El-Shazly and Darwish (2001) and Abd El-Samie *et al.* (2002)** reported that the positive effect pf biofertilization**.**

d) Interaction effect:

The results in Table (18) showed that all affects of the interactions were not significant except that between genotypes x mineral N levels in both seasons.

However, the maximum seed yield/plant was 0.421 and 0.415 gms in the first and second seasons, respectively. Which was produced by S.2419/1 with 75 kg N/fed in both seasons.

8-Seed index (g):

a) Genotypes performance:

Results in Table (19) show the average of seed index as affected by the experimented flax genotypes during 2002/03 and 2003/04 seasons. In both seasons there were significant differences among the tested flax genotypes in 1000-seed weight. The oil type S 2419/1 flax genotype was the highest seed index which recorded 11.33 and 11.16 gms, followed by the other oil type S. 2467/1 (10.94 and 10.82 gms) the lowest seed index were 4.44 and 4.17 gms for the first and second seasons, respectively was produced by the fiber type Blenka flax genotype. The marked differences in seed index are mainly due to the differences in the genetical make up of the tested genotypes. Similar results were also reported by **Zedan (1990), Kineber (1991), El-Sweify (1993), Zedan (1994), El-Sweify *et al.* (1996), Abou-Zaied (1997), El-Gazzar (1997), El-Nimr *et al.* (1997), Moustafa *et al.* (1998), El-Kassaby *et al.* (1999), Zahana-Afaf (1999), El-Deeb (2002), El-Refaie (2003), El-Sweify *et al.* (2003) and Zahana-Afaf (2004).**

b) Response to mineral nitrogen levels:

Data presented in Table (19) exist that nitrogen levels affected significantly seed index in the two successive seasons. In both seasons, the differences were significant between all nitrogen levels. Seed index reached its maximum weight at 75 kg N/fed. On the other hand, the minimum weight was obtained at zero level of

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nitrogen in the two growing seasons. Increasing N level from zero to 25, 50 and 75 kg N/fed increased seed index by 4.73, 8.54 and 11.66% in the first season and by 3.50, 7.23 and 9.22% in the second season, respectively. The increase in the seed index with the increase in nitrogen levels can be attributed to the active role of nitrogen in building up partions which induce cell division and initiat meristmatic activity. These results agree with those obtained by **Hussein (1996), Kholosy *et al.* (1996), Abou-Zaied (1997), El-Gazzar (1997), El-Nimr *et al.* (1997), El-Azzouni (1998), Hamed (1998), Omar (1998), El-Gawish (2001), El-Shimy and Moawed (2000), El-Gazzar and Abou-Zaied (2001), Abd El-Samie *et al.*(2002) and Zahana-Afaf (2004).** On the other hand, **Nasr El-din *et al.* (1991), El-Shimy *et al.* (1993), Hussein (1996), El-Gazzar and El-Kady (2000) and Duby (2001)** found that nitrogen fertilization did not affect the seed index of flax plant.

c) Effect of nitrogen fixer biofertilization:

The effect of *Azottin* application on seed index, the results in Table (19) showed a positive and significant effect of the application of biofertilizaer in only the first season. The results indicated that applying *Azottin* increased seed index by 2.31 and 1.23% in the first and second seasons, respectively. The positive effect of biofertilization on seed index was reported by **El-Karamity (1997), Hamed (1998) and Abd El-Samie *et al.* (2002).**

d) Interaction effect:

Results presented in Table (19) indicated that all effects of the interactions were not significant except that between genotypes x nitrogen levels in the first season.

In 200/03 season, the highest significant weight for 1000 seeds which was recorded (12.17 gms) for genotype S. 2419/1 with 75 kg N/fed.

9-Straw yield per plant (g):

a) Genotypes performane:

Analysis of variance showed that the four flax genotypes significantly differed in straw yield per plant at the two successive seasons Table (20), where the oil type flax genotype S. 2467/1 gave the greatest straw yield/plant where the main values were 2.244 and 2.123 gms in the first and second seasons, respectively. While, the fiber type flax genotype Blenka was the lowest in mean values of this characters 0.819 and 0.758 gms in 2002/03 and 2003/04 seasons, respectively.

Generally the highest straw yield per plant was recorded by the oil type, while the lowest straw yield per plant was obtained by the fiber types. These present results are mainly due to differences in the genetical constitution of the four genotypes, where the oil type had the better performance of branching in the top of the plants and the increase in main stem diameter. Similar results were also obtained by **Gaafar *et al.* (1990), Kineber (1994), Zedan (1994), El-Sweify and Moustafa (1996), Abou-Zaied (1997), El-Deeb (2002), El-Sweify (2002), El-Sweify *et al.* (2003) and Zahana-Afaf (2004).**

b) Response to mineral nitrogen levels:

Nitrogen fertilizer had a significant effect on straw yield of flax plant in the two successive seasons Table (20). Data obtained on straw yield per plant was similar to that obtained on total plant

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height in the two seasons. Straw yield per flax plant reached its maximum weight at 75 kg N/fed. Whereas, it was at the minimum weight at zero level of nitrogen in the two seasons. Here, it could be noted that the differences in straw yield per plant were significant between all nitrogen levels. This was true in the two successive seasons. Straw yield/plant increaed by 19.44, 32.44 and 38.74% in the first season and by 14.17, 35.54 and 43.96% in the second as a result of increasing N levels from zero to 25, 50 and 75 kg N/fed, respectively. This may be due to the increment of plant growth by increasing N levels. This result clears the essential role of nitrogen in growth of flax plants. These results are in harmony with those obtained by **Abou-Zaied (1997), Hussein (1996), Kholosy *et al.* (1996), Abou-Zaied (1997), El-Gazzar (1997), El-Nimr *et al.* (1997), El-Azzouni (1998), Hamed (1998), Omar (1998), El-Gawish (2001), El-Shimy and Moawed (2000), El-Gazzar and Abou-Zaied (2001), Abd El-Samie *et al.* (2002) and Zahana-Afaf (2004).** On the other hand, no significant differences were obtained in straw yield per plant due to increasing nitrogen levels by **Nasr El-Din *et al.* (1991) and El-Gazzar and El-Kady (2000).**

c) Effect of nitrogen fixer biofertilization:

It is apparent that inoculation with *Azottin* increased straw yield/plant significantly compared to without inoculation in the two seasons as shown in Table (20). Applying *Azottin* to flax seeds before sowing increased straw yield/plant by 5.14 and 5.39% in first and second seasons, respectively. These results are in agreement with these reported by **Sarig *et al.* (1984), Omar *et al.* (1991), Hamed (1998), (El-Gazzar (2000), Abd El-Samie *et al.* (2002) and El-Azzouni *et al.* (2003).**

d) Interaction effect:

The results showed that all effects of the interactions among the factors on straw yield/plant were not significant except those between genotypes and nitrogen levels in both seasons Table (20).

G x N interaction showed that the highest straw yield/plant was recorded 2.503 and 2.459 gms in the first and second seasons, respectively. This was obtained by S.2467/1 + 75 kg N/fed.

10-Fiber yield per plant (g):

a) Genotypes performance:

Average fiber yield per plant tabulated in Table (21) show that there were significant differences among the tested genotypes in both seasons. Sakha 1 genotype recorded the highest fiber yield per plant 0.289 and 0.285 gms in the first and second seasons, respectively. The lowest ones were notest from Blenka genotype 0.122 and 0.114 gms in 2002/03 and 2003/04 seasons, respectively. While, the oil type flax S 2467/1 and S 2419/1 genotypes came in the intermediate in this concern. These results are in harmony with those reported by **El-Gazzar and Abou-Zaied (2001), El-Hariri *et al.* (2001), El-Azzouni *et al.* (2003), El Refaie (2003) and Zahana-Afaf (2004).**

b) Response to mineral nitrogen levels:

Data in Table (21) show that fiber yields per plant was significantly affected by nitrogen levels. Each increase in nitrogen levels from zero to 25, 50 and 75 kg N/fed significantly increased fiber yield per plant from 18.32 to 33.51 and 39.27% in the first season and from 14.67 to 36.96 and 47.28% in the second season,

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respectively. The differences in fiber yield per flax plant were significant between all N levels in the two seasons. The present results are in agreement with those obtained by **Zedan (1990), Zedan (1994), Abou-Zaied (1997), El-Gazzar (1997), Omar (1998), El-Gawish (2001), El-Shimy and Moawed (2000) and El-Gazzar** and **Abou Zaied (2001)** who found positive response to nitrogen application of flax. The non-significant response to adding N reported by others such as **El-Gazzar and El-Kady (2000).**

c) Effect of nitrogen fixer biofertilization:

Fiber yield/plant of flax were significantly affected by bactrial inoculation in the two successive seasons, Table (21). Biofertilization, with N2 fixing bactria increased significantly fiber yield/plant by 4.80% in 2002/03 season and by 6.76% in the second season. Similar results were also reported by **Hamed (1998), El-Gazzar and El-Kady (2000) and El-Azzouni *et al.* (2003).**

d) Interaction effect:

The results in Table (21) indicated that the only significant interactions were those between genotypes of flax and nitrogen levels in 2002/03 season. The significant flax genotypes x nitrogen levels indicated that the highest fiber yield/plant reached 0.326 gms, resulting from Sakha 1 with 75 kg N/fed.

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

1-Straw yield per feddan (tons):

The effects of nitrogen application, biofertilization and their interactions on straw yield/fed of the four flax genotypes, for the two successive seasons are presented in Table (22).

a) Genotypes performanc:

Results in Table (22) revealed that the differences in straw yield per feddan among the genotypes used in this investigation were highly significant during the two seasons. Data showed that the highest straw yield per feddan was produced by S 2467/1 which yield 4.444 and 4.439 tons/fed in the first and second seasons, respectively, followed by the other oil type S 2419/1 flax genotype 4.372 and 4.318 tons/fed. While the lowest yield was recorded by the fiber type flax Blenka 2.521 and 2.481 tons/fed. The dual type sakha 1 flax genotype came in the intermediate in this concern. The present results are mainly due to the genetical creation of the tested genotypes and may be due to the variation in seeding rates for the two types of flax genotypes oil types (S 2467/1 and S 2419/1) were seeded with 90 kg/fed. Meanwhile the dual types Sakha1 were seeded with 70 kg/fed, while the fiber type flax Blenka were seeded with 40 kg/fed. These results are in harmony with those obtained by **Mourad *et al.* (1990), El-Shimy *et al.* (1993), Kineber (1994), Zedan (1994), El-Kady *et al.* (1995), Saad (1995), Shafshak *et al.* (1995), El-Sweify and Moustafa (1996), El-Gazzar (1997), Mahmoud (1998), Moustafa *et al.* (1998), El-Kassaby *et al.* (1999) and El-Sweify *et al.* (2003).**

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b) Response to mineral nitrogen levels:

Nitrogen levels caused a significant increase in straw yield per feddan in the two seasons. The differences in straw yield were significant between all nitrogen levels in the two growing seasons. Application of 25, 50 and 75 kg N/fed increased straw yield over the check treatment by 14.98, 29.65 and 32.63% in the first season and by 7.81, 18.17 and 20.87 in the second season, respectively.

Straw yield reached its maximum weight 4.268 and 4.117 tons/fed at 75 kg N/fed, wheras it reached minimum weight 3.218 and 3.406 tons/fed at zero level of nitrogen for the first and second seasons, respectively. This result is to be expected since nitrogen increased plant growth. These results can be explained by the favourable effects of nitrogen on growth of plants. Similar results were obtained by **Abd El-Samie and El-Bially (1996), Hussein (1996), Abou-Zaied (1997), El-Gazzar (1997), El-Nimr *et al.* (1997), El-Azzouni (1998), Hamed (1998), Omar (1998), Sarode *et al.* (1998), El-Khoby (1999), El-Gawish (2001), El –Gazzar (2000), El-Gazzar and El-Kady (2000), El-Shimy and Moawed (2000), Abd El-Samie *et al.* (2002), El-Gazzar and Kineber (2002) and Zahana-Afaf (2004)**. However, **Nasr El-Din *et al.* (1991)** mentioned that increasing N levels from 30 to 60 kg N/fed did not have a significant effect on straw yield per feddan.

c) Effect of nitrogen fixer biofertilization:

The results in Table (22) showed that inoculated seed with *Azottin* before sowing significantly increased straw yield per feddan in the two successive seasons. It was increased from 3.736 to 3.943 ton/fed i.e. 5.54% in the first season and from 3.718 to 3.891

ton/fed i.e. 4.65% in the second season, respectively. These results agree with those of **Sarig *et al.* (1984), Omar *et al.* (1991), Afify *et al.* (1994), Shams El-Din and Abdrabou (1995), El-Karamity (1997), Hamed (1998), El-Gazzar (2000), El-Gazzar and El-kady (2000), Hamissa *et al.* (2000), Abd El-Samie *et al.* (2002), El-Deeb (2002) and El-Azzouni *et al.* (2003).**

d) Interaction effect:

The results in table (22) showed that all effects of the interactions were not significant except that between genotypes x mineral nitrogen levels in both seasons.

The highest of straw yield/fed was 4.859 tons/fed in the first season, and was 4.847 tons/fed in the second season which were recorded by S.2467/1 + 75 kg N/fed. Similar results were also obtained by **El-Farouk *et al*. (1982), Hella (1987), El-Shimy *et al*. (1993), Leilah (1993), Abou Zaied (1997) and (2000), Abdel-Samie *et al.* (2002) and Zahana-Afaf (2004).**

2-Fiber yield/fed (kg):

Data listed in Table (23) showed that fiber per feddan were significant differences among the tested flax genotypes during 2002/03 and 2003/04 seasons. Results indicated that the highest yield was recorded by Sakha 1 (531.99 and 517.10 kg/fed), followed by S 2467/1 genotype 480.48 and 474.19 kg/fed in the first and second seasons, respectively. The lowest fiber yield per feddan 377.10 and 368.32 kg /fed was obtained by Blenka flax genotype. The oil type flax S 2419/1 came in the intermediate in this concern 447.89 and 460.41 kg/fed in 2002/03 and 2003/04 season, respectively. These results are logical ones due to the parents

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of Sakha 1 genotype are fiberous, while the parents of other tested genotypes are seeding genotypes and the results of fiber yield per feddan coincided with those of straw yield/fed. These results are in harmony with those reported by **Gaafar *et al.* (1990), Kineber (1991), El-Shimy *et al.* (1993), Moustafa (1994), Zedan (1994), Abou-Shetaia *et al.* (1996), Salama (1996), Moustafa *et al.* (1998), El-Gazzar and Abou-Zaied (2001), El-Sweify (2002), Mousa (2002), Omar (2002), El-Azzouni *et al.* (2003) and Zahana-Afaf (2004).**

b) Response to mineral nitrogen levels:

Results in Table (23) show an increase in fiber yield/fed in the straw successive seasons with increasing nitrogen levels from zero up to 75 kg N/fed. increasing N rate from zero to 25, 50 and 75 kg N/fed increased fiber yield per fed by 16.57, 32.07 and 37.54% in the first season and by 8.09, 17.83 and 21.76% in the second season, respectively. The differences in fiber yield per feddan were significant between all N levels in the two seasons. These results were expected since nitrogen increased flax growth expressed in terms of technical stem length and consequently fiber yield. The same trend was obtained by **Zedan (1990), Abou-Zaied (1991), El-Moursi and El-Farouk (1991), Salah and El-Farouk (1991), El-Hindi *et al.* (1992), Zedan (1994), Hussein (1996), Abou-zaied (1997), El-Gazzar (1997), El-Nimr *et al.* (1997), Kineber *et al.* (1997), El-Azzouni (1998), Omar (1998), El-Gawish (2000), El-Gazzar (2000), El-Shimy and Moawed (2000) and Zahana (2004)**. On the other hand, **Abd El-Fatah (1994), El-Gazzar and El-Kady (2000) and El-Gazzar and Kineber (2002)** mentioned that increasing nitrogen level significantly decreased fiber yield per feddan in both seasons.

c) Effect of nitrogen fixer biofertilization:

Data in Table (23) and (2) inoculated flax seeds with *Azottin* increased fiber yield/fed significantly compared to without inoculation in the two growing seasons. Biofertilization with *Azottin* increased fiber yield/fed by 8.44% (from 440.77 to 477.96 kg/fed) in the first season and by 5.32% (from 443.21 to 466.77 kg/fed) in the second season, respectively as compared with an inoculated seeds. These findings are in a harmony with those of **Hamed (1998), and El-Azzouni *et al.* (2003)**. On the other hand, **El-Gazzar (2000)** mentioned that seed inoculation with *Rhizobactiren* did not significantly affected fiber yield.

d) Interaction effect:

All effects of the interactions between the three experimental factors on fiber yield/fed were not significant except those between flax genotypes x mineral nitrogen levels in both seasons Table (23). The highest fiber yield/fed was 629.54 and 535.59 kg/fed in the first and second seasons, respectively. Which was obtained by Sakha 1 + 75 kg N/fed.

The present results are in agreement with those reported by **Abou Zaied (1997), El-Gazzar and Abou Zaied (2000) and Abd El-Samie *et al.* (2002).**

3-Fiber percentage:

a) Genotypes performance:

The data presented in Table (24) showed that the fiber percentage significantly differed among the four genotypes during the two seasons of study. Results indicated that the highest fiber percentage was recorded by the fiber type flax Blenka cv. 14.95 and 14.91% in the two seasons, respectively. On the other hand, oil type flax S 2419/1 genotype showed the lowest fiber percentage, which was 10.07 and 10.38 % in 2002/03 and 2003/04 seasons, respectively. The dual type flax Sakha 1 genotype came in the intermediate in this concern which was 12.99 and 12.99% in both seasons. This results are in agreement with these obtained by **El-Gazzar (1990), Zedan (1990), Subotinas (1991), El-Sweify and Moustafa (1996), El-Sweify *et al.* (1996), Salama (1996), Abou-Zaied (1997), El-Gazzar (1997), El-Nimr *et al.* (1997), El-Deeb (1998), El-Hariri *et al.* (2001), El-Deeb (2002), El-Sweify (2002), El-Sweify *et al.* (2003) and Zahana-Afaf (2004).**

b) Response to mineral nitrogen levels:

Results in Table (24) show that the nitrogen fertilizer levels had significant effect on fiber % in the two seasons. The fiber percentage of flax plants increased significantly by increasing nitrogen rate up to 50 kg N/fed in the first season. The differences in fiber percentage between 50 and 75 kg N/fed were not significant in the first season. On the other hand, there were a significant differences between all N levels in fiber percentage except between 50 and 75 kg N/fed in the second season. Increasing N levels from zero to 25, 50 and 75 kg N/fed increased fiber percentage by 0.17,

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0.20 and 0.16% in the first season and by 0.03, 0.07 and 0.08% in the second season, respectively. Similar results were obtained on flax by **Nada (1995), Abou-Shetaia *et al.*(1996), Awad *et al.* (1997), El-Gazzar (1997), El-Azzouni (1998), Omar (1998), Vashishatha (1998), Mostafa (1999), El-Gazzar (2000), El – Gawish (2001) and El-Gazzar and Kineber (2002).** While **Ghanem (1990), Hussein (1996), El-Nimr *et al.* (1997), El-Gazzar and El-Kady (2000) and El-Gazzar and Abou-Zaied (2001)** mentioned that nitrogen fertilizer did not affected the fiber pe rcentage.

c) Effect of nitrogen fixer biofertilization:

The results in Table (24) showed that inoculated seeds with *Azottin* before sowing significantly increased fiber percentage in the two growing seasons. Fiber percentage increases were 0.20 and 0.07% in the first and second seasons, respectively. Similar results were also obtained by **Hamed (1998), El-Gazzar and El-Kady (2000) and El-Azzouni *et al.* (2003).** However, **El-Gazzar (2000)** mentioned that seed inoculation with *Rhizobactiren* did not significantly affected fiber %.

d) Interaction effect:

The results in Table (24) indicated that clearly that each experimental factor acted independently in affecting fiber percentage in both seasons.

4-Seed yield per feddan (tons):

a) Genotypes performance:

The results presented in Table (25) show significant differences were found in seed yield per feddan at the two successive seasons, The oil type flax genotypes S 2419/1 and S 2467/1 were the highest in mean values 1.118 and 1.145 & 1.102 and 1.140 tons in 2002/03 and 2003/04 seasons, respectively. While the lowest seed yield per feddan 0.301 and 0.297 tons were notest from fiber type cultivar Blenka. The dual type flax Sakha 1 genotype came in the intermediate in this concern. The present results are mainly due to the genetical variation possessed by the tested genotypes and agree with those obtained by **El-Gazzar (1990), Mourad *et al.* (1990), Kineber (1991), El-Shimy *et al.* (1993), El-Sweify (1993), Zedan (1994), Saad (1995), El-Sweify and Moustafa (1996), Kineber and El-Kady (1996), El-Nimr *et al.* (1997), Moustafa *et al.* (1998), El-Deeb (2002), El-Refaie (2003) and Zahana-Afaf (2004).**

b) Response to mineral nitrogen levels:

Data presented in Table (25) indicate that nitrogen levels significantly affected seed yield/fed in the both seasons.

Increasing nitrogen level from zero to 25, 50 and 75 kg N/fed increased seed yield per feddan by 12.88, 27.81 and 30.27% in the first season and by 14.31, 31.67 and 41.16% in the second season, respectively. There was no significant difference in seed yield/fed between 50 and 75 kg N/fed in the first season only. However, in the second season, the differences in seed yield were significant between all nitrogen levels. Nitrogen appliation enhanced the growth

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of flax plants, number of apical branches/plant, number of capsules/plant, number of seeds/capsules and seed index which in turn increased the seed yield per plant. This might account much for the increased seed yield due to nitrogen application. These results are in harmony with those obtained by **Chaubey and Dwivedi (1995). Sami *et al.* (1995), Kholosy *et al.* (1996), Abou-Zaied (1997), Awad *et al.* (1997), El-Azzouni (1998), Mostafa (1999), El –Gazzar (2000), Dubey (2001). El-Gazzar (2001), El-Gazzar and Kineber (2002) and Zahana-Afaf (2004).** On the other hand, **Nasr El-Din *et al.* (1991), Salama (1991) and Abd El-Fatah (1994)** mentioned that nitrogen fertilization did not affect any change in the seed yield per feddan in both seasons.

c) Effect of nitrogen fixer biofertilization:

Biofertilization did show positively significant effect on seed yield/fed in 2002/03 and 2003/04 seasons are shown in Table (25). *Azottin* increased significantly seed yield per feddan from 0.825 to 0.894 tons/fed by (8.36%) in 2002/03 season and from 0.838 to 0.912 tons/fed by (9.18%) in 2003/04 season, respectively. These results agree with those of **Sarige *et al.* (1983), Alagawadi and Gaur (1988), Badr El-Din and Moawad (1988), Kabesh *et al.* (1988), Omar *et al.* (1991), Youssef *et al.* (1993), Afify *et al.* (1994), Shams El-Din and Abdrabou (1995), El-Karamity (1997), Hamed (1998), El-Gazzar (2000), El-Gazzar and El-Kady (2000), Abd El-Samie *et al.* (2002), El-Deeb (2002) and El-Azzouni *et al.* (2003).**

d) Interaction effect:

All the effects of the interactions between the experimental factors were not significant except that between flax genotypes and mineral nitrogen levels in both seasonsa, Table (25).

The maximum seed yield/fed was 1.228 tons in the first season, which was recordedby S.2419/1 + 75 kg N/fed, whereas the maximum seed yield/fed was 1.350 tons in the second season, produced by S.2467/1 and 75 kg N/fed.

Similar results were also reported by **Leilah (1993), Abou Zaied (1997) and Zahana-Afaf (2004).**

5-Oil percentage:

a) Genotypes performance:

The results given in Table (26) indicated that the oil percentage was significantly affected by genotypes. Data showed that oil percentage reached its maximum values by the oil type flax S. 2419/1 genotype in both seasons with an average of 40.48 and 40.33% in the first and second seasons, respectively, which was significantly higher than in all other genotypes. S. 2467/1 genotype was the second highest and the lowest oil percentage was obtained by Blenka genotype. It is worthly to note that S 2419/1 was also superior with regard to seed index, seed yield per plant as well as feddan showing its superiority in seed and oil production among the other tested flax genotypes. The present are quite expected and are mainly due to the differences in the genetical construction of the tested genotypes. Similar results were also reported by **El-Gazzar (1990), Zedan (1990), Kineber (1991), El-Sweify (1993), Zedan (1994), El-Sweify and Moustafa (1996), El-Maghraby (1997), El-Nimr *et al.* (1997), El-Kassaby *et al.* (1999) and El-Refaie (2003).**

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b) Response to mineral nitrogen levels:

Data in Table (26) show that oil percentage of flax seeds increased significantly by increasing nitrogen rate up to 75 kg /fed in the two successive season. Application of 25, 50 and 75 kg N/fed increased oil percentage over the check treatment by 0.93, 2.03 and 2.50% in 2002/03 season and by 0.63, 2.13 and 2.75% in 2003/04 season, respectively. However, the differences in oil percentage were significant between all nitrogen levels in the two seasons. These results are in agreement with those reported by **Zedan (1990), Kheir *et al.* (1991), Zedan (1994), Nada (1995), Abou-Shetaia *et al.* (1996), Abou-Zaied (1997), El-Gazzar (2000), El-Gazzar and El-Kady (2000) and Zahana (2004)**. On the other hand, **Salama (1991), Patidor and Lal (1992). Reddaih *et al.* (1993), Abd El-Fatah (1994), El-Nimr *et al.* (1997), Zedan *et al.* (1997), El-Gazzar and Abou-Zaied (2001) and El-Gazzar and Kineber (2002)** found that the mean value of oil % was significantly decreased with the increase in N fertilization. While, **El-Moursi and El-Farouk (1991), Salah and El-Farouk (1991), Abd El-Fatah (1994), Hussein (1996), Dubey *et al.* (1997) and Omar (1998)** mentioned that the applied nitrogen level did not exert any significant effect on seed oil percentage.

c) Effect nitrogen fixer biofertilization:

The effect of biofertilization on oil % significantly increased in the two seasons as shown in Table (26). Applying *Azottin* to flax seeds before sowing significantly increased oil percentage by 0.48 and 0.54% in 2002/03 and 2003/04 seasons, respectively. Similar results were also reported by **Hamed (1998), El-Gazzar (2000) and Abd El-Samie *et al.* (2002).**

d) Interaction effect:

Results presented in Table (26) indicated that the only significant interactions were those between flax genotypes x mineral nitrogen levels in both seasons.

The highest significant value for oil percentage was 41.69 and 41.61% in the first and second seasons, respectively. Which was recorded for genotype S.2419/1 with 75 kg N/fed in both seasons.

6-Oil yield per feddan (kg):

Table (27) indicates the averages of oil yield/fed as affected by the tested flax genotypes, nitrogen fertilizer levels, biofertilizer and their interactions in 2002/03 and 2003/04 seasons.

a) Genotypes performance:

In connections with the effect of flax genotypes, data listed in Table (27) show that the four flax genotypes statisfactorily manified this character. In both seasons, the oil type flax S. 2419/1 genotype recorded the highest oil yield per feddan 447.51 and 474.39 kg/fed, followed by S. 2467/1 genotype 445.27 and 457.40 kg/fed in the first and second seasons, respectively. While, the lowest oil yield were notest from the fiber type flax Blenka cv. 103.40 and 100.03 kg/fed which significantly decreased oil yield. This result may be attributed to the differences in the genetical construction of the tested genotypes and their higher seed yield per feddan on one hand and of high oil percentage. Similar results were reported by **El-Gazzar (1990), Kineber (1991), El-Sweify (1993), Sharief (1993), El-Sweify and Moustafa (1996), Kineber and El-Kady (1996), El-Maghraby (1997), El-Nimr *et al.* (1997), Moustafa *et al.* (1998), El-Kassaby *et al.* (1999), Abd El-Samie *et al.* (2002), El-Deeb (2002) and El-Refaie (2003).**

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b) Response to mineral nitrogen levels:

There was a gradual increase in oil yield/fed in the two season with increasing N doses from zero up to 75 kg N/fed Table (27). Increasing N rate from zero to 25, 50 and 75 kg N/fed increased oil yield per feddan by 15.86, 35.54 and 38.72% in the first season and by 16.62, 46.60 and 53.53% in the second season, respectively. However, the difference between 50 and 75 kg N/fed levels in the first season was insignificant. While, the differences in oil yield/fed were significant between all N levels in the second season.

The increase in oil yield/fed by raising nitrogen level is to be expected since nitrogen rates increased oil percent and seed yield/fed as well. These results coincide with the findings of **Abou-Zaied (1991), El-Moursi and El-Farouk (1991), Salah and El-Farouk (1991), El-Hindi *et al.* (1992), Hussein (1996), El-Kady (1999), El-Gazzar (2000), El-Gazzar and El-Kady (2000) and Zahana-Afaf (2004).** On the other hand, **El-Nimr *et al.* (1997)** reported that application of 95 kg N/fed decreased the value of oil yield kg/fed.

c) Effect of nitrogen fixer biofertilization:

Highly significant effects were detected for biofertilizer on oil yield fed in both seasons Table (27). Percentage increases were 9.23 and 8.59% in the first and second seasons, respectively. The positive effect of biofertilization on oil yield/fed was reported by **Hamed (1998), El-Gazzar and El-Kady (2000), El-Shazly and Darwish (2001) and El-Azzouni *et al.* (2003).**

d) Interactions effect :

Results presented in Table (27) indicated that the all effects of the interactions were not significant except that between flax genotypes x mineral nitrogen levels in both seasons.

The maximum oil yield/fed was 505.40 and 561.18 kg in the first and second seasons, respectively. Which was produced by S.2419/1 + 75 kg N/fed in both seasons.

Generally, nitrogen levels affected significantly yield of flax plant, straw, fiber, seed and oil yields/fed reached their maximum value at the higher nitrogen level 75 kg N/fed. and the minimum weight of these characters were obtained at zero level of nitrogen. There was a consistent increase in these traits as nitrogen level increased. These results reflects the impotant role of nitrogen to flax plants.

Nitrogen is an important essential elements for growth as well as yield of plant. Nitrogen also represents one of the main components of protein in flax seed.

7-Fiber fineness (N.m):

a) Genotypes performance:

Results of fiber fineness as affected by genotypes in both seasons are listed in Table (28). In both seasons, there were significant differences among the tested flax genotypes in fiber fineness. Data showed that 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

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N.m, while the coarst fiber was produced by S 2419/1 flax genotypes with a value of 109.44 and 107.90 N.m in 2002/03 and 2003/04 seasons, respectively. It is worthly to note that the best genotype regarding fiber fineness were also the best ones concerning technical length per plant and fiber percentage. These results are mainly due to the differences in the genetical make up of the tested genotypes. Similar results were reported by **El-Gazzar (1990), Zedan (1990), Subotinas (1991), El-Sweify and Moustafa (1996), Salama (1996), Abou-Zaied (1997), El-Gazzar (1997), El-Nimr *et al.* (1997), El-Deeb (1998), El-Hariri *et al.* (2001), El-Deeb (2002), El-Sweify (2002), El-Refaie (2003), El-Sweify *et al.* (2003) and Zahana-Afaf (2004).**

b) Response to mineral nitrogen levels:

It is also evident from Table (28) that increasing nitrogen level from zero up to 75 kg N/fed significantly decreased fiber fineness in the two successive seasons. 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 2002/03 season and by 2.86, 8.76 and 10.17% in 2003/04 season, respectively. The differences in fiber fineness were significant between all N levels in the two seasons. These results agree with those obtained by **Kineber (1994), Zedan (1994), Abou-Zaied (1997), El-Gazzar (1997), El-Nimr *et al.* (1997), Zedan *et al.* (1997), El-Azzouni (1998), Omar (1998), El-Gazzar (2000), El-Gazzar and El-Kady (2000), El-Gawish (2001), El-Gazzar (2001), El-Gazzar and Abou-Zaied (2001) and El-Gazzar and Kineber (2002)** who found positive response to N application of flax.

c) Effect of nitrogen fixer biofertilization:

Data in Table (28) inoculated flax seeds with *Azottin* decreased fiber fineness significantly compared to without inoculation in the two seasons. *Azottin* decreased fiber fineness by 1.86 % (from 168.67 to 165.53 Nm) in the first season and by 2.57% (from 170.43 to 166.05 Nm) in the second season, respectively. These results are in agreement with those of **El-Deeb (2002).** While, **El-Gazzar (2000)** mentioned that *Rhizobactiren* did not significantly affected fiber fineness.

d) Interaction effect:

Results presented in Table (28) showed that the all effects of the interactions were not significant except that between flax genotypes x mineral nitrogen levels in both seasons.

The maximum fiber fineness was 277.89 and 277.21 (N.m) in the first and second seasons, respectively. Which was produced by Blenka with level zero kg N/fed.

V-Nitrogen use efficiency (NUE):

1-Straw yield/fed:

Results presented in Table (29) show that N economic efficiency for straw yield/fed of four flax genotypes as affected by mineral and biological nitrogenous fertilizer in 200/03 and 2003/04 seasons.

a) Genotypes performance:

In both seasons, there were significant differences among the tested flax genotypes of NUE for straw yield/fed are tabulated in Table (29).

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Data showed that the highest of NUE for straw yield/fed was produced by S. 2467/1 which 0.022 in the 1st season and 0.016 in the 2nd season.

b) Response to mineral nitrogen levels:

It is clearly from the same Table that adding 50 kg N/fed gave the highest values of NUE foe straw yield/fed in the first season (0.019), while in the second season (0.012). On the other hand, applying the highest mineral nitrogen levels i.e 75 kg N/fed gave the lowest values in the both seasons (0.015 & 0.010).

Sisson *et al.*, (1991) reported that the efficiency of N use decreased as nitrogen levels were increased.

c) Effect of nitrogen fixer biofertilization:

Concerning the effect of inoculation flax seeds on NUE for straw yield/fed, the results in Table (29) showed no significant effect of applying *Azottin* when compared without inoculation in the two seasons. However, applying *Azottin* to flax seeds gave the height NUE 0.020 when compared with the control treatment 0.015 in the 1st season.

d) Interaction effect:

The results presented in Table (29) indicated that all effects of the interactions among the three factors were not significant on NUE in both seasons. Moreover, the highest value of NUE for straw yield/fed was recorded by S. 2467/1 under 25 kg N/fed with *zottin* trait (0.038) in 1st season.

2-Seed yield/fed:

a) Genotypes performance:

Results in Table (30) indicated that there were significant variations among flax genotypes of nitrogen use efficiency for seed yield/fed in both seasons. It is clear that the oil types (S. 2419/1 & S. 2467/1) gaves the highest values of NUE for seed yield (0.005 & 0.004) in the first and second seasons, respectively. While, the lowest values (0.001) in both seasons was recorded by fiber type Blenka cv.

b) Response to mineral nitrogen levels:

Results in Table (30) show the values of N use efficiency for seed yield as affected by nitrogen fertilizer application in 2002/03 and 2003/04 seasons. The results showed that applying 25 kg N/fed produced the greatest NUE in 2002/03 season 0.004 and 0.005 in 2003/04 season. On the other hand, applying the highest nitrogen levels i.e 75 kg N/fed gave the lowest values in both seasons 0.003 and 0.004. **Sisson *et al*. (1991)** reported that the efficiency of N use decreased as nitrogen levels were increased.

c) Effect of nitrogen fixer biofertilization:

The effect of biofertilization on NUE for seed yield no significantly increased in the two seasons as shown in Table (30).

d) Interaction effect:

The difference among all effects of the interactions in both seasons were insignificant in Table (30). The results showed that the oil type S. 2419/1 by 25 kg N/fed with *Azottin* recorded the highest value of NUE in the 1st season 0.006. while, S. 2467/1 + 25 kg N/fed *Azottin* gave the highest NUE in the 2nd season 0.012.

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3-Oil yield/fed:

a) Genotypes performance:

Analysis of variance showed that flax genotypes significantly differed in NUE for oil yield at the two successive seasons. Where the oil type (S. 2467/1 and S. 2419/1) were the highest values of NUE for the oil yield (2.427 & 3.564) in the 1st and 2nd seasons, respectively.

b) Response to mineral nitrogen levels:

Data presented in Table (31) showed that the values of NUE for oil yield significantly affected by nitrogen fertilizer application in both seasons. Application of 50 kg N/fed produced the highest values of NUE for yield (1.931 & 2.463) in the 1st and 2nd seasons, respectively (Table 31).

C) Effect of nitrogen fixer biofertilization:

Significant effect was detected for biofertilization on NUE for oil yield in both seasons, Table (31). Biofertilization with *Azottin* increased of NUE for oil yield from 1.556 to 1.816 in the first season and from 1.824 to 2.247 in the second season, respectively.

d)Interaction effect:

The results in Table (31) indicated no significant interaction effect among the three experimental factors on N use efficiency for oil yield in both seasons. The results showed that the maximum of NUE for oil yield in 2002/03 seasons was 3.246 was produced by S. 2467/1 under 25 kg N/fed with *Azottin* trait. In 2003/04 season, the highest values of NUE for oil yield was 4.799 which was produced by S. 2419/1 under 25 kg N/fed with *Azottin* trait.

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