5. SUMMARY

The breeding materials used herein included six parents P_1 (S.2419/1), P_2 (Giza 8), P_3 (Ariane-R_3), P_4 (S.strain 1), P_5 (Gawhar-552) and P_6 (Bombay). This investigation was carried out at Giza Agric. Res. Station, Agric. Res. Center during the two successive seasons of 1998/1999 and 1999/2000. In the first season, the six flax parental genotypes were sown at 9th November 1998, the crosses were made between them in all possible combinations, without reciprocals, to obtain fifteen hybrid seeds. In the second season, the parental genotypes and their 15. crosses were evaluated. The experiments were arranged in a randomized complete block design with three replicates. The experimental units consisted of single ridge 3 meters long and 20 cm apart. Plants within row were 5 cm apart. Nitrogen fertilizer was added at a rate of 30 kg N/feddan (low level) in case of the first experiment and at a rate of 45 kg N/feddan (moderate level) in the second experiment. At maturity ten guarded plants were selected at random from each plot and the following measurements were recorded. Plant height (cm), technical length (cm), stem diameter (mm), fiber length (cm), straw yield/plant (g), fiber yield/plant (g), number of capsules/plant, number of seeds/capsule, weight of 1000 seeds (g), seed yield/plant (g) and oil percentage.

The results and conclusions obtained could be summarized as follows:

1- The analysis of variance for each experiment (30 kg and 45 kg N/fed) and the combined analysis revealed that nitrogen

levels mean squares were significant for all studied traits. Also, it showed that mean values in all studied traits were higher at 45 kg N/fed.

2- Highly significant genotypes mean squares were obtained for all the studied traits in both N levels as well as the combined analysis, indicating the wide diversity between the parental materials used in the present study. Significant genotypes x fertilizer nitrogen levels interaction mean squares were obtained in all traits except number of number of seeds/capsule.

3- The mean squares of parents, crosses, parents vs. crosses, parents x nitrogen levels and crosses x nitrogen levels were highly significant for all traits except number of seeds/capsule. These results indicated that, parents and crosses differed in their mean performance in all traits under test. Also, it revealed that parents and crosses varied in their response to nitrogen levels.

4- The results indicated that P_1 (S.2419/1) and P_4 (S.strain 1) recorded the highest values in straw yield, fiber yield, plant height and number of capsules/plant. The results indicated that [(1x4) S.2419/1 x S_1, (1x2) S.2419/1 x Giza 8, (3x4) Ariane x S_1, (2x4) Giza 8 x S_1 and (4x6) S_1 x Bombay] recorded higher straw yield, fiber yield, plant height and number of capsules/plant.

5- The crosses (1x3) S.2419/1 x Ariane, (1x5) S.2419/1 x Gawhar and (2x5) Giza 8 x Gawhar showed the desirable heterotic effects over both nitrogen fertilizer levels for seed yield/plant. The crosses (3x4) Ariane x S_1 followes by (4x6)

S_1 x Bombay and then by (2x4) Giza 8 x S_1 gave the highest values of heterotic effects relative to the better parent values in the combined analysis for fiber yield.

6- The mean squares associated with general and specific combining ability were significant for all traits at each nitrogen levels as well as the combined analysis, revealing that additive and non-additive gene effects were involved in determining the performance of single cross progeny. Also, results showed that all the traits expressed significant GCA/SCA ratios which exceeded the unity, indicating the predominance of additive and additive by additive gene action in the inheritance of each trait.

7- The mean squares of the interaction between nitrogen levels and both types of combining ability were significant for all traits except no. of seeds/capsule indicating that magnitude of both additive and non additive types of gene action varied from one nitrogen level to another.

8- With the exception of; 1000-seed weight, no. of capsules/plant, seed yield/plant and straw yield per plant, it is fairly evident that mean squares of SCA x nitrogen levels/SCA were much higher than GCA x nitrogen levels/GCA. Such results indicated that non-additive gene effects were much more influenced by the nitrogen fertilizer levels than additive genetic effects in these traits.

9- The two parental strains S.2419/1 (P_1) and Strain 1 (P_4) gave the highest $\hat{g}_i$ effects for number of capsules/plant, straw yield, oil percentage and fiber yield at both fertilizer levels as well as the combined analysis, also, significantly

superior over other parents. In addition, S.2419/1 seemed to be good combiner for 1000-seed weight and seed yield/plant showing significant superiority than other parents.

10- For both straw and fiber yields, the six crosses (1x5) S.2419/1 x Gawhar, (1x6) S.2419/1 x Bombay, (2x6) Giza 8 x Bombay, (3x5) Ariane x Gawhar, (4x5) S_1 x Gawhar and (4x6) S_1 x Bombay gave the highest S_{ij} effects in the combined analysis.

11- Concerning seed yield/plant, the best parental combinations were (1x3) S.2419/1 x Ariane, (1x5) S.2419/1 x Gawhar, (3x4) Ariane x S_1, (3x6) Ariane x Bombay and (5x6) Gawhar x Bombay at N_1; (1x3) S.2419/1 x Ariane, (2x6) Giza 8 x Bombay, (3x4) Ariane x S_1 and (3x5) Ariane x Gawhar at N_2; and (1x3) S.2419/1 x Ariane, (1x5) S.2419/1 x Gawhar, (3x4) Ariane x S_1 and (3x5) Ariane x Gawhar in the combined analysis.

12- Significant and negative correlation coefficient values between parental mean (Yr) and (Wr + Vr) for each array were obtained for stem diameter, no. of capsules/plant, seed yield/plant, straw yield/plant, 1000-seed weight and fiber yield at both nitrogen levels; and oil percentage at 30 kg N/fed. This indicated that the increasers genes were dominant over decreasers. However, high and positive correlation coefficients between two variables were detected for plant height, technical length and fiber length, revealing that the decreasers genes were dominant over increasers.

13- With the exception of stem diameter at 45 kg N/fed and number of capsules/plant at 30 kg N/fed., high to moderate heritability values in narrow sense were detected for all traits, indicating that most of genetic variance may be due to additive type of gene action.

Fertilizer susceptibility index (FSI):

The mean performances of genotypes were used for estimating susceptibility index to low nitrogen level by using three methods (equations): 1) Fischer and Maurers (1978), 2) stress/non stress and 3) (non stress-stress)/nonstress were used for most traits.

1- Mean squares of (FSI) for genotypes were significant for all traits except number of seeds/capsule.

2- The three crosses (3x5) Ariane x Gawhar, (3x6) Ariane x Bombay and (4x5) S_1 x Gawhar for seed and fiber yields/plant, and the two crosses (3x5) Ariane x Gawhar and (5x6) Gawhar x Bombay for straw yield gave desirable susceptibility index for low level (stress) of nitrogen fertilizer.

3- The mean squares associated with general combining ability (GCA) for FSI were significant for all traits except plant height and oil percentage in the third and second methods, respectively. The mean squares associated with specific combining ability of FSI were significant for all traits except number of capsules/plant, straw yield/plant and oil percentage in the second method. Also, the results indicated that additive type of gene action was more important part of the total genetic variability for all traits except plant height.

4- The parental line S.2419/1 expressed undesirable $\hat{g}$ effects of FSI for number of capsules/plant, seed, fiber, straw yields/plant by the three methods. Also, the parental variety Ariane R_3 (P_3) expressed significant desirable $\hat{g}_1$ effects of FSI in the three methods used for plant height, no. of capsules/plant, straw yield/plant, 1000-seed weight and fiber yield. The variety Gawhar 552 could be considered as an excellent parent in breeding programs aimed to release a high yielding (seed and fiber) variety under low nitrogen level as stress environment.

5- The three methods used to estimate FSI gave the same results for each parent in all traits.

6- The two crosses (1x3) S.2419/1 x Ariane and (4x5) S_1 x Gawhar for fiber length, the two crosses (1x3) S.2419/1 x Ariane and (3x4) Ariane x S_1 for straw yield, and cross (3x6) Ariane x Bombay for seed yield/plant expressed significant desirable S_{ij} effects of FSI in the three methods.