

CONTENTS

Page

1. INTRODUCTION	1
2. REVIEW OF LITERATURE	4
2.1. Gene action and heritability.....	4
2.2. Phenotypic and genotypic coefficients of variation	12
2.3. Phenotypic and genotypic correlation coefficients	15
2.4. Basis for selection indices	21
2.5. The efficiency of different selection procedures.....	23
2.6. Variability in oil content and associated with some characters.....	30
3. MATERIALS AND METHODS	32
4. RESULTS AND DISCUSSION	60
4.1. Type of Gene Action	60
4.1.1. Generation means	60
4.1.2. Scaling test, F_2 -deviation and BC-deviation.....	62
4.1.3. Gene action effects.....	64
4.1.4. Potence ratio, and heritability estimates	67
4.1.5. Predicted genetic advance	70
4.2. Selection Procedures	71
4.2.1. Selection index and phenotypic trait selection.....	71
4.2.1.1. Variance components.....	71
4.2.1.2. Means, ranges, phenotypic and genotypic coefficients of variation and heritability estimates.....	75
4.2.1.3. Phenotypic and genotypic correlation....	95
4.2.1.4. The phenotypic weights (b's).....	101

4.2.1.5.	Predicted and realized genetic advances of lint yield.....	105
4.2.1.6.	Correlated response to selection for lint yield and unselected traits.....	112
4.2.2.	Recurrent selection.....	117
4.2.2.1.	Mean performance and mean square estimates.....	117
4.2.2.2.	Genetic variability and predicted genetic advance.....	120
4.2.2.3.	Evaluation of recurrent selection hybrids.....	122
4.2.2.4.	Phenotypic and genotypic correlation .	130
4.2.3.	Comparative efficiency of the different selection procedures.....	134
4.2.4.	Effect of phenotypic selection for sccd index on seed characters.....	136
4.2.4.1.	Mean performance	140
4.2.4.2.	Genetic variability for seed characters .	140
4.2.4.3.	Heritability estimates.....	141
4.2.4.4.	Phenotypic correlations and actual advances	141
5.	SUMMARY.....	143
6.	LITERATURE CITED.....	152
7.	APPENDIX.....	167
	ARABIC SUMMARY	

5. SUMMARY

The purpose of this study was to obtain information regarding; (1) type of gene action, (2) both broad and narrow sense heritabilities, (3) phenotypic, genotypic and environmental variances, (4) magnitudes of the phenotypic and genotypic correlations, (5) relative effectiveness of within and between different selection procedures in improving lint yield, (6) correlated response between selected and unselected traits, (7) effect of selection procedure on genetic variation, and (8) effect of phenotypic selection for seed index on oil percentage in F_4 and S_0 generations.

The present investigation was carried out at Sakha Experimental Farm, Sakha Agricultural Research Station, during 2000, 2001 and 2002 growing seasons.

Six populations experiments

In 2000, the two crosses (G. 45 x G. 75) and (G. 88 x G. 89) with their six populations; P_1 , P_2 , F_1 , BC_1 , BC_2 and F_2 were evaluated in two separate experiments.

The following characters were assessed:

1. Lint yield/plant (g).
2. Bolls/plant.
3. Seeds/boll.
4. Lint/seed (g).
5. Lint percentage.
6. Seed index (g).
7. 100-seed volume (cm^3).
8. Seed density (g/cm^3).
9. Heavy seed (%).
10. Micronaire reading.
11. Pressley index.

Summary

The obtained results were:

1. The scaling tests, F_2 -deviation and BC-deviation showed significant values for most studied characters in the two crosses indicating that there were non-allelic gene interactions.
2. All types of gene effects were significant and govern the inheritance of the most studied characters with some exceptions indicating that selection procedures based on the accumulation of additive effects should be successful in improving most of the characters under investigation.
3. The potence ratio values indicated that there was an existence of overdominance for bolls/plant, seed index and seed density in the two crosses as well as 100-seed volume (cross I), lint yield/plant, lint/seed, lint percentage and heavy seed percentage (cross II), however, other characters expressed partial dominance.
4. High heritability values in broad sense were observed for lint yield/plant and lint percentage in both crosses, in addition to bolls/plant and micronaire reading (cross I), seeds/boll, lint/seed and seed index (cross II).
5. High to moderate narrow sense heritability estimates were found for all characters except seed density in the two crosses, 100-seed volume, heavy seed percentage and pressley index (cross I) and seeds/boll (cross II).
6. The difference between broad and narrow sense heritabilities may be due to the presence of non-additive gene action in the inheritance of most characters.
7. The highest predicted genetic advances as a percent of F_2 mean ($\Delta g\%$) were achieved for lint yield/plant and bolls/plant in the

two crosses, lint/seed, 100-seed volume and heavy seed percentage in the cross II. Low predicted genetic advances were detected for seed density in the two crosses, 100-seed volume and pressley index in cross I.

Selection procedures:

The materials of this part consisted of three populations; G. 45 x G. 75, G. 87 x G. 89 and G. 86 open-pollinated. The selection procedures were as follows:

I. Selection index and phenotypic trait selection

The 5% superior plants for lint yield/plant (x_w), bolls/plant (x_1), seeds/boll (x_2) and lint/seed (x_3) were chosen from each population. Selected elite plants were 50, 49, 48 plants of four characters in the three populations, respectively.

In 2001, part of selfed seeds of the 50, 49, 48 selected progenies in the three populations were evaluated with the two parents and a random sample of F_3 and S_1 seeds (bulked seeds). Three replications per progeny in RCB design was used. All F_3 and S_1 progenies in the three nursery fields were selfed to produce F_4 and S_2 seeds.

The 50, 49 and 48 progenies were ranked using twelve selection procedures involving the four characters. The three superior progenies of each selection index were determined using 6.00, 6.12 and 6.25% selection intensity for the three populations, respectively. A total of 10, 13 and 11 progenies covering these selection indices, and their selfed seeds were evaluated with the two

parents and a random sample of F_4 and S_2 (bulked seeds) in a randomized complete block design with three replications in 2002.

2. Recurrent selection

In 2001, selfed seeds of the eight parents (four superior plants in lint percentage and four elite plants in seed index) of recurrent selection were sown and a half diallel hybridization was made and 28 hybrids were obtained.

In 2002 season, the 28 hybrids with their eight selected parents were compared with the two original parents and bulked seeds were planted in a randomized complete block design with three replications for each population.

3. Seed characters

The (5%) 15 superior plants in seed index were selected in each population. In 2001 season, selfed seeds of the 15 progenies of each population were evaluated. In 2002 season, selfed seeds of the 3 elite progenies in oil percentage were evaluated with the two parents and a random sample of F_4 and S_2 seeds of the three populations in a randomized complete block design with three replications.

The characters used in this part were:

1. Lint yield/plant (g).
2. Bolls/plant.
3. Seeds/boll.
4. Lint/seed (g).
5. Lint percentage.
6. Seed index (g).
7. 100-seed volume (cm^3).
8. Seed density (g/cm^3).
9. Heavy seed (%).
10. Oil percentage.

Summary

The data justify the following conclusions

Selection index and phenotypic trait selection

1. The phenotypic variance components in F_4 and S_2 generations were higher than F_3 and S_1 for all studied characters with the exception of lint percentage in populations I and II. The increase in phenotypic and most genotypic variances in F_4 and S_2 generations is due to the efficiency of selection procedures application which create substantial genetic variation.
2. Comparing the means of F_3 and S_1 generations with those of F_4 and S_2 ones showed that the means of F_4 and S_2 generations surpassed those of F_3 and S_1 for all studied characters except seeds/boll in the three population.
3. Both lint yield and bolls/plant exhibited the highest phenotypic and genotypic coefficients of variation estimates in the three populations; however, seeds/boll, lint/seed, lint percentage and seed index showed moderate to low variabilities.
4. High heritability values in broad sense were observed for lint yield and bolls/plant in the three populations, while the remaining characters, estimates widely fluctuated over the successive generations of selection probably due to the varied environmental factors.
5. The phenotypic and genotypic correlations between lint yield/plant and bolls/plant in the three populations were positive and highly significant. Insignificant positive or negative correlations between lint yield/plant and seeds/boll were shown in almost all generations for the three populations. r_p and r_g of lint yield with lint/seed had been increased from F_2 to F_4 and from S_0 to S_2 generations for the three populations

except population II which showed increase from F_2 to F_3 only. r_p and r_g between lint yield and lint percentage were high and positive relationship and increased from F_2 to F_4 and from S_0 to S_2 generations in most studied generations. Lint yield/plant showed significant and positive with seed index in F_2 and S_0 generations of the three populations.

6. Deletion of lint yield (x_w) resulted in major adjustments of phenotypic weights of the other yield components to compensate for the loss of this variable. While the deletions of bolls/plant (x_1) and/or seeds/boll (x_2) and/or lint/seed (x_3) had little effects on the magnitude of weights of lint yield.
7. The highest predicted genetic advances of lint yield from F_3 and S_1 means occurred when using the indices I_{23} (populations I and II) and I_{12} (population III). The highest predicted genetic advances of lint yield from F_4 and S_2 means occurred when using the indices I_{x_w} (populations I and III) and I_{x_1} (population II).
8. The highest realized genetic advances for lint yield were when applying the indices I_{x_3} (population I), I_{123} (population II) and I_{x_2} (population III).
9. The deviations of realized advance from predicted advance for lint yield/plant were positive and high in all indices in population III.
10. The highest predicted responses to selection for lint percentage and seed index in F_4 generation were by using the indices I_{x_3} and I_{x_2} for population I, and I_{23} and I_{x_3} for population II, respectively.

Recurrent selection

1. Both phenotypic and genotypic variances were significant and large in magnitude for all studied characters in the three populations, except seeds/boll in population III. The increase in σ_p^2 and σ_g^2 is due to new recombinations which create substantial genetic variation.
2. The 28-hybrids had the highest means of lint yield/plant, bolls/plant and seeds/boll compared with the better parent for populations I and II. The same-hybrids mean performance was higher than Giza 86 pure line mean for lint/seed, lint percentage and seed index in population III.
3. The estimates of phenotypic and genotypic coefficients of variation were large in magnitude for all the studied characters in the three populations except for seeds/boll and lint percentage in population III.
4. Phenotypic and genotypic correlations between lint yield/plant and bolls/plant were positive and highly significant; the relationship of lint yield/plant with seeds/boll and seeds/boll with seed index showed insignificant positive or negative r_p and r_g in the three populations. Lint yield/plant and each of lint/seed or seed index exhibited weak negative phenotypic and genotypic associations in populations I and II; r_g was significant and positive in population III.
5. The highest predicted genetic advances were achieved for lint yield/plant, bolls/plant, lint/seed and seed index in the three populations. High to low values of GCV were found to be associated with high to low genetic advances in most studied characters in the three populations.

Comparative efficiency of the different selection procedures in improving lint yield

1. In population I, the direct phenotypic selection procedure for lint yield only (I_{x_w}) was superior to the other selection procedures in F_4 generation. The ranks of actual relative efficiencies relative to selection for lint yield alone (I_{x_w}) were 274.60% for recurrent selection, 221.69% for I_{x_3} and 158.20% for $I_{w_{123}}$, I_{w_1} and I_{w_2} .
2. Concerning population II, the recurrent selection and index I_{x_1} were more efficient than the other selection procedures in F_4 generation. The ranks of actual relative efficiencies relative to selection for lint yield alone (I_{x_w}) were 550.00% for recurrent selection, 532.14% for I_{123} and I_{13} , 405.36% for I_{x_3} and 296.43% for I_{23} .
3. Regarding population III, both recurrent selection and index I_{x_w} were superior to the other selection procedures in S_2 generation. Phenotypic selection of seeds/boll (I_{x_2}), index I_{23} and recurrent selection showed the highest percent of actual advance compared with phenotypic selection for lint yield alone (I_{x_w}).

Effect of phenotypic selection for seed index on seed characters

1. Generally, residual genetic variability as expressed by σ^2_g and GCV, indicates that the large magnitude of variability still left in oil percentage and 100-seed volume in populations II and III, and heavy seed percentage in population III.
2. Phenotypic selection for seed index in F_2 and S_0 generations and for oil percentage in F_3 and S_1 generations afterwards was

Summary

- effective for improving oil percentage due to the presence of transgressive segregation for oil percentage in population III.
3. High heritability values in broad sense were observed for oil percentage in the three populations, seed index, 100-seed volume and heavy seed percentage in population III, and seed density in populations II and III. Low heritability values in broad sense were found for seed density in population I and seed index in population II.
 4. Oil percentage showed positive and high correlation with seed index and 100-seed volume in populations I and II, and with seed density in population III.
 5. Both population I and III showed high values of actual advance for oil percentage, seed index and 100-seed volume.