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Estimation of Genetic Gain from Selection Using Independent Culling Levels in Egyptian Cotton (*G. barbadense* L.) under Normal and Saline Soils

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SALINITY limits plant growth and progressively decreases the optimal yield of crops worldwide. This work aimed to compare the efficiency of single trait selection and independent culling levels (ICL) for six traits in improving the seed cotton yield (SCY/P) under normal and saline soils. The genetic material was the F_2-population of the cross-G.*90× G.86* (long staple). Two experiments were carried out at normal and saline soils (EC about 13). The performance of different traits under normal soil were better than under salinity stress. The correlations indicated that the high yielding plants were early, high in fiber length, strength, and fineness under both environments. Days to first flower showed negative correlation with all traits except Pressley index under both environments. Genotypic and phenotypic coefficients of variability were greatly depleted by selection. Narrow sense heritability (h^2) in single trait selection was higher at stress than at normal soil when selection practiced at normal soil, and vice versa for selection at saline soil. In the ICL method the h^2 was higher at normal soil evaluation than at saline soil for selection at both environments. Single trait selection proved that selection under optimum environment performed well under optimum, and selection under stress was better under stress. Otherwise, ICL method of selection did well under salinity stress. These results agree with the opinion of selection under the environment of production.

Keywords: Genotypic coefficient of variation, Independent culling levels, Narrow sense heritability, Pedigree selection, Salinity stress.

Introduction

Salinity is the second-most prevalent abiotic stress after drought, which not only limits plant growth but also progressively decreases the optimal yield of crops worldwide (Gao et al., 2016). More than 45 million hectares of irrigated land worldwide have been damaged by salt, and 1.5 million hectares are excluded from production each year because of high salinity levels in the soil (Munns & Tester, 2008). Cotton is considered one of the leading crops in salt-affected soils, which is salt and drought-tolerant but vulnerable to waterlogging (Guo et al., 2015; Zhang et al., 2016). A threshold salinity level at which initial yield of cotton declines is 7.7dS m^{-1} with a 50% reduction in yield at 17.0dS m^{-1} (Sharif et al., 2019; Farooq et al., 2021; Sikder et al., 2020). Salinity stress involves changes in various physiological and metabolic processes, depending on severity and duration of the stress (James et al., 2011). Generally salt tolerance in cotton has been associated with Na^+ exclusion. High salinity reduces N and P uptake in cotton. One of the cotton varieties tested i.e. '*CIM-473*' showed more resistance to the salts and was recommended for salinity affected areas (Anjum et al., 2005). After a series of experiments, the genotypes*, NIAB-135, NIAB-512*, and *FH-152* could be used to develop breeding strategies for improving salinity tolerance in cotton (Munawar et al., 2021). Salinity adversely affected the

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root length, shoot length, root weight, shoot weight, chlorophyll contents, reduction in fiber length, fiber strength and Micronaire values, whereas an increase in lint percentage have been reported under saline conditions in both *G. hirsutum* and *G. barbadense* (Farooq et al., 2021). Under salinized (NaCl) conditions the GCA mean square values were higher than those of SCA indicating the pre-dominance of additive effect for all the traits (Ashraf, 2002). Selection for cotton will be problematic due to masking effects of environment and imply rigorous and careful selection of salt tolerant genotypes (Farooq, 2019). Otherwise, selection for salt tolerance is possible at any growth stage of the crop in inter- and intraspecific crosses populations because of the high additive component of variation in the salt tolerance of cotton. The uptake and accumulation of toxic ions (Na+ and Cl–) in tissues of plants subjected to saline conditions appears to be due to the mechanism of partial ion exclusion (exclusion of Na+ and/or Cl–) in cotton. Maintenance of high tissue K/Na and Ca/Na ratios is suggested to be an important selection criterion for salt tolerance in cotton (Farooq et al., 2021). The hybrids showed differential responses to salinity level ranging from susceptible to more tolerant. High broad sense heritability for salt tolerance suggests that selection would be very useful in the early segregating generations of cotton breeding programed for salinity tolerance (Khan et al., 2001). Under saline condition, plant height was greatly reduced for about 37-52%, followed by reduction in number of fruiting sympodia of about 49-72% compared with normal condition. Therefore, the reductions in cotton yield under stress condition, could be due to reduction in the boll production because of fewer flowers and the increase in boll abortions (Mahmoud et al., 2018). Differential responses of cultivars in seed germination and seedling growth were observed (Munis et al., 2010). Otherwise, lower narrow sense heritability found in normal and in salt stress condition shows that selection could not be done for the genetic improvement under normal as well as salt stress condition in earlier generations and it must be postponed until later generations (Shakeel et al., 2017). Under salinized (NaCl) conditions both additive and dominance gene effects were responsible for the inheritance of different traits. The GCA mean square values were higher than those of SCA indicated the pre-dominance of additive effect for all the traits (Ashraf & Ahmad, 2000). The cotton genotypes with good vegetative growth without salt stress had also good vegetative growth under salt stress (Basal, 2010).

Up till now developed cotton varieties against salt tolerance through genetic engineering is unable to achieve the required commercial production level because of minute salt tolerance or not good agronomic practices (Shehzad, 2019). However, the variation in cotton germplasm could be used to develop salt tolerant varieties with the aid of marker assisted selection (Sharif et al., 2019).

In Egyptian cotton (*G. barbadense* L.) Mahdy et al. (2006, 2007, 2009a, b, 2012), Abd El Sameea et al. (2020) isolate high yielding and early families after two cycles of pedigree selection started in the F_2-generation either from early or late planting. Broad sense heritability either from early or late planting was high for most traits because of the selection and evaluation was in one location for one year. Selection index proved to be an efficient breeding method to improve cotton yield. The index involved lint yield/plant, bolls/plant and seeds/boll, followed by selection index involved lint yield/plant, bolls/plant and lint/seed, and selection index involved lint yield/plant and lint/seed were superior to all selection procedures in the actual genetic gain (Mabrouk, 2020). Two cycles of recurrent selection in Upland cotton and *G. barbadense* increased means of lint and seed cotton yield and bolls/plant and preserved genetic variation (Jin & Zhang, 2005; El-Lawendey et al., 2008).

Independent culling involves establishing minimum culling levels for each trait and selectin only is for the individuals that meet these minimum levels. The application of independent culling can be to multiple traits simultaneously or to individual traits sequentially. Using optimal culling levels, independent culling and index selection lead to comparable genetic gains (Batista et al., 2021). This article aimed to compare the single trait selection with independent culling levels in improving yield and its attributes under normal and saline soils.

Materials and Methods

The present study was carried out at Al-ghoraizat village, Maragha city (Latitude: 26°

41' N, Longitude: 31° 35'E), Sohag governorate (saline soil) and Izbat Al-Hama, Tema city, Sohag governorate (normal soil) (Latitude: 26°54'N, Longitude 31° 25'E) during the three summer seasons of 2018 -2021.

Soil analysis

Soil samples were collected and mixed for each of the two experimental cites at vertical depths of 0-60cm. Soil physical and chemical properties (Table 1) were measured according to Israelsen & Hansen (1962), Blake & Hartge (1986), Gee & Bauder (1986).

The soil texture in the normal soil was silty clay loam/clay and clay in the saline soils, respectively (Table1). Furthermore, the results explained that the saline soil was under a medium saline soil class; however, the soil wasn't alkaline according to Na^{+}, Ca^{+2}, and Mg^{+2} meq/L concentrations, where the sodium adsorption ratio was 11.03. In addition, the changes in EC values were insignificant during the three seasons. Likewise, organic matter content was in the same range through the three seasons. In the same manner, N, P, K contents in the soil were the same during the three seasons. On the other hand, soils containing high concentrations of soluble salts will interfere with the normal growth and development of crops where plants are grown in this soil often seem under salinity and drought stressed even when adequate water is available because the osmotic potential of the soil prevents the roots from absorbing water. As well as the availability of the nutrients N, P, and K affected by soil salinity.

TABLE 1. Physical and chemical properties of the upper 60cm depth of the experimental normal and saline soils in 2018, 2019 and 2020 seasons

Item	Normal soil			Saline soil		
	Seasons					
	2018	2019	2020	2018	2019	2020
Sand%	19	21	20	19	18	20
Silty%	48	51	50	23	22	21
Clay%	33	28	30	58	60	59
Soil texture	Silty clay loam/clay			Clay		
S. P.	67.0	66.0	67.0	57	56	58
pH(1:1)	7.66	7.60	7.64	8.6	8.5	8.7
O.M	1.68	1.70	1.69	1.11	1.20	1.15
$CaCo_3$%	3.88	3.90	3.98	-	-	-
EC (mm/cm)	1.65	1.63	1.60	13	13.5	14
SO_4 meq/L	2.0	3.0	3.0	38.6	37.8	38.1
Cl meq/L	4.0	4.0	4.0	55.2	54.6	54.9
HCO3 meq/L	10.0	9.5	10.0	52.4	52.2	52
Ca^{+2} meq/L	8.0	7.5	7.0	12.6	12.4	12.1
Mg^{+2}meq/L	6.0	6.18	6.24	59	59.6	59.2
Na^{+} meq/L	2.09	2.25	2.36	57	66.2	57.3
Total N%	1.6	1.8	1.7	1.2	1.4	1.3
Total P (ppm)	5.192	5.537	5.385	4.192	4.380	4.285
Total K (ppm)	223	231	229	211	205	209

S.P.= saturation percentage, EC = electrical conductivity, OM = organic matter, Total N% = total nitrogen, Total P (ppm)= total phosphorus, Total K= total potassium.

Field experiments

In the three seasons of 2018 -2020 planting date ranged from the 27th and 30th March. Seeds were sown in rows 60cm apart and 40cm between hills. After full emergence, seedlings were thinned to one plant per hill. The recommended cultural practices were adopted throughout the growing seasons. In season 2018, 400 hills were sown from the bulk seeds in the F_2 -generation of the cross (*G.90× G.86*) under each of saline and normal soils along with the two parents. At the end of the season the 10 superior plants in each trait were saved (single trait selection), along with 10 plants for independent culling levels for 6-trait; seed cotton yield/plant (SCY/P, g), lint yield/plant (LY/P, g), lint %, boll weight (BW, g), number of bolls/plant (NB/P), and lint index (LI, g) were saved from each experiment. The ICL levels are presented in Table 2. In season 2019, the selected families along with the two parents were evaluated. After harvest the best five families for each trait and the ICL method were saved from normal and from saline soils separately. In season 2020 all the selected families in the F_4-generation were evaluated under both environments. The RCBD with three replications was used in the F_3- and F_4-generations, and the plot size was two rows (20 plants). The recorded traits were SCY/P, LY/P, lint %, NB/P (was counted during the two pickings divided by number of plants), BW (was estimated as the average weight of 25 random sound bolls picked before the first pick from each plot), seed index (SI, g), number of seeds / boll (NS/B) (estimated as boll weight (100-lint %) / seed index), lint index (LI, g) estimated as (weight of lint cotton in a sample/weight of seeds in this sample) × seed index), plant height (PH, cm), days to first flower (DFF) (was measured as the days from sowing to the appearance of the first flower on five plants in each plot and for each plant in the F_2-generation), fiber fineness (Mic) (fineness was expressed as Micronaire reading), fiber length, mm (UHML) , fiber strength as Pressley Index (PI). The technological properties were measured by the H.V.I instrument manufactured by USTER Technologies, Inc. (a testing machine capable of measuring many cotton fiber properties including length, uniformity, Micronaire/fineness, strength, color, etc...).

Statistical analysis

The analysis of variance, phenotypic (σ^2p) and genotypic variance (σ^2g) and significance tests were performed as outlined by Steel et al. (1997) on a plot-mean basis. The statistical model of the randomized complete block design is

$$Y_{ij} = \mu + \eta i + \Sigma_j + e_{ij}$$

where, i = 1,2,3, ⋯, t and j = 1,2, ⋯, b, with t treatments and b blocks; μ is the overall mean based on all observations; ηi is the effect of the *i*th treatment response; Σ_j is the effect of *j*th block; and e_{ij} is the corresponding error term, which is assumed to be independent and normally distributed with a mean of zero and constant variance.

In the random model of the RCBD, the genotypic variance (σ^2g) = (MSg − MSe)/r, phenotypic variance (σ^2p) = σ^2g + MSe/r, MSg = genotypes mean square, MSe = error mean square, and r = number of replications.

The genotypic (GCV) and phenotypic coefficients of variation were estimated as:

GCV% = (σg/mean) × 100, PCV% = (σp/mean) × 100

where, σg and σp = genotypic and phenotypic standard deviations, respectively.

The broad sense heritability (H) and the genetic advance were computed using the formula adopted by Falconer (1989) as follows:

Broad sense heritability (H%) = (σ^2g/σ^2p) × 100

The expected genetic gain in the F_2 = k× σp× H

where, the environmental variance $\sigma^2_E = (\sigma^2_{P1} + \sigma^2_{P2})/2$, σ^2p = F_2 variance, $\sigma^2g = \sigma^2p - \sigma^2_E$, σ^2_{P1} = variance of the first parent, σ^2_{P2} = phenotypic variance of the second parent, and k is the selection intensity from selecting 10% of the superior plants.

The narrow sense heritability (h^2) was estimated via parent–offspring regression, as outlined in Smith & Kinman (1965).

The observed genetic gain was calculated as a percentage from the mid-parent. The significance of the direct and correlated observed genetic gain was calculated using least significant difference (LSD).

LSD for mid-parent observed gain = $t_{\alpha \times}$ ((MSE/(r × f) + MSE/(r × 2))$^{0.5}$,

where, t_α = tabulated t at 0.05 or 0.01 level of probability, r = number of replications, MSE = error mean squares, and f = number of families.

TABLE 2. The ICL levels in the F_2 and F_3- generations

Generation	Evaluation environment	SCY/ P, g	LY/P, g	Lint %	BW, g	NB/P	LI, g
F2	Normal soil	85.37	32.10	36.77	2.80	28.35	5.93
	Saline soil	43.20	14.64	33.69	2.10	20.18	5.65
F3	Normal soil	102.53	39.03	36.97	2.91	31.91	5.75
	Saline soil	43.7	15.36	33.78	2.1	20.94	5.54

SCY/P= seed cotton yield/plant, LY/P= lint yield/plant, BW=boll weight, NB/P= number of bolls/plant, LI= lint index

Results and Discussion

Selection

Description of the base population (F_2-generation)

Mean seed cotton yield/plant (SCY/P, g) of the parents *Giza90* and *Giza86* was 104.67 and 94.06g under normal soil, and 46.16 and 45.92g under salinity stress with reduction% of 55.90 and 51.18%, respectively (Table3). Mean SCY/P, g of the F_2 was 69.47 and 41.36g under normal soil and salinity stress; respectively, with reduction% of 40.46. The F_2 mean was less than the two parents showing under dominance towards the low yielding parent. The phenotypic (PCV%) and genotypic (GCV%) coefficients of variability of SCY/P were high in the F_2 and accounted for 19.72 and 13.91% under normal soil and 10.28 and 8.86% under salinity stress; respectively, indicating possibility of selection. Furthermore, the variation expressed as the minimum and maximum values for all traits in the F_2-generation nearly covered the range of the parents for yield and yield components under both environments indicating feasibility of selection. The variability was high in yields and NB/P and low for the other traits. The broad sense heritability ranged from 0.70% for BW to 66.49% for UHM length under normal soil, and from 20.64% for BW to 90.52% for PH under saline soil. This variability resulted in expected genetic advance in percentage of the mean of 0.02% for BW and 11.99% for SCY/P under normal soil, and 0.98% for DFF and 15.99% for PH. The low variability in the F_2 -generation certainly due to that the two parents are relatives (long-staple × long staple cotton). In general, the results indicated that the performance of different traits under normal soil were better than under salinity stress. These results agree with some researchers and contradict others. Tang et al. (2009) noted genetic coefficient of variation of seed cotton yield/plant, lint yield/plant and bolls/plant were 16.64, 14.71 and 10.65%, respectively. Lint percentage and boll weight showed the highest broad-sense heritability of 89.1 and 81.85%, respectively. The lowest broad-sense heritability was found for lint yield/plant (55.05%). Mahdy et al. (2012) under clay soil found high estimates of coefficient of variation for lint% and high estimates of heritability of 0.79 and 0.81, and large expected gains of 21.14 and 23.45% for two populations. Likewise, El-Lawendey & El-Dahan (2012) under clay soil noted highest predicted and realized gains for lint yield in the direct and indirect selection for both of lint yield and bolls/plant. El-Dahan (2016) reported high predicted genetic advance for lint yield/plant which exceeded 50% of the F_3 generation mean.

Phenotypic correlation among traits

The correlation coefficient is a helpful tool to assess the component character on which selection can be based for improving yield. The correlations among traits in the F_2-generation are presented in Table 4. The correlations of SCY/P with the other traits were positive and significant ($P \leq 0.01$) and depended in descending order for LY/P, NB/P, PH, SI, and BW under normal soil, and LY/P, PH, BW, NB/P, SI, and NS/B under saline soil. Seed cotton yield showed negative and significant ($P \leq 0.01$) correlation with the DFF under both environments, indicating that the yield depended on early plants. The high yields were negatively correlated with Micronaire reading under normal soil, vice versa under saline soil, and positive with UHM length and PI under both environments. The correlations of LY/P behaved the same as SCY/P. Results indicated that the high yielding plants were early, fine (negative Micronaire reading) and high in fiber length and strength under both environments. Lint% and LI were more correlated with LY/P than SCY/P and higher under salinity than under normal soil.

Lint index showed positive high correlation with lint%. Days to first flower showed negative correlation with all traits except PI under both environments. This may be caused by low deposition of cellulose in later mature plants, which slightly increased flat bundle strength because of the increase in number of fibers per unit weight. These results are in line with those reported by Joshi & Patil (2018), Nawaz et al. (2019) and Amein (2020). Likewise, Chapepa (2020) and Mahdi & Emam (2020) indicated that earliness index and production rate index had a high and positive correlation with seed cotton yield per plant, while days to the first flower appearance, days to the first boll opening and mean maturity date showed negative correlation with seed cotton yield per plant. Rahman et al. (2020) came to the same conclusion.

Variances and means after two cycles of selection

The second cycle selections either under normal or saline soil were evaluated in the F_4-generation under both environments. Selection for SCY/P under normal soil showed significant ($p \leq 0.01$) differences among the selected families for SCY/P, LY/P, lint%, DFF, and UHM length when evaluation was done under the normal soil, while evaluation under saline soil the differences among families were significant for all traits except NS/B, Mic, and UHM length (Tables 5, 6). Nearly the same trend was observed when selection practiced for LY/P. These results indicate that the salinity stress was more efficient than normal soil to detect the differences among selected families.

Mean squares of the selection criteria was significant either selection practiced under normal or saline soils indicating the presence of remained variability after two cycles of selection. Most of the correlated traits were significant under both environments, except for the technological properties which were least affected by environments in most cases. These results are in line with those reported by Mahdy et al. (2001a, 2009b) and Tang et al. (2009).

Coefficients of variation and heritability

Genotypic and phenotypic coefficients of variability (Tables 7, 8) were greatly depleted by selection from F_2 to F_4- generation. Genotypic coefficient of variation in SCY/P under normal soil decreased from 13.91% in the F_2 to 4.90% in $F_{4,}$ and for LY/P decreased from 13.91 to 5.91%. Such decrease was observed for the other selection criteria either selection practiced at normal or saline soils except for BW at both environments and LI at saline oil. Although the differences between the selected families were significant, the selection may not be feasible in these materials in the F_4- generation due to the very low coefficient of genetic variation. Conversely, Mahdy et al. (2012) **a**fter two cycles of selection for SCY/P noted that the remained genetic coefficient of variability was sufficient for further cycles of selection and was 16.20 and 11.32% for two populations. Abd El Sameea et al. (2020) after two cycles of selection for SCY/P, the retained genetic coefficient of variability was 34.00 and 13.75 for pop I and pop II, respectively.

The GCV in selection criteria were higher in the F_4-generation under salinity stress than under normal soil in four out of six criteria (Lint%, BW, NB/P, and LI). Mahdy et al. (2007) found that the genotypic coefficient of variability in seed cotton yield/plant was higher in the late sowing date (adverse environment) than in early sowing date (favorable environment) in two populations. Early, Bucio Alanis & Hill (1966) stated that under poor or adverse environment the differences between genotypes can be detected. These results are in line with those reported by Mahdy et al. (2001a, b), Tang et al. (2009) and Hassaballa et al. (2012).

Concern selection by the ICL method of the same six traits, the PCV and GCV depressed greatly after two cycles of selection as in single trait selection (Table 8).

Heritability in broad sense after two cycles of selection (Tables 7, 8) was slightly higher when the selected families evaluated at normal than saline soil irrespective of selection environment. Generally, estimates of broad sense heritability were high because of the evaluation at one season, in which families mean squares was inflated by the confounding effects of families by location and years interactions. It ranged from 68.75% for NB/P to 81.70% for lint% (selection and evaluation at normal soil), and from 65,26% for SCY/P to 91.31% for NB/P (selection at N and Evaluation at S). Selection at saline soil, the estimates ranged from 68.87% for SCY/P to 88.75% for lint% (evaluation at N), and from 63.68% for LY/P to 89.73% for LI (evaluation at salinity stress).

TABLE 3. Means of the studied traits with their standard errors (SE) in the F_2, parents, phenotypic (PCV%) and genotypic (GCV%) coefficients of variation, reduction % (Red%), broad sense heritability in (H) and genetic advance (GA) under selection of 10% superior plants

Item	SCY/ P, g	LY/P, g	Lint%	BW, g	NB/P	SI, g	NS/B	LI, g	DFF	PH, cm	Mic	UHML mm	PI
Normal Soil													
F_2- generation													
Mean ± SE	69.47± 0.69	24.67± 0.27	35.41± 0.06	2.78± 0.22	24.96± 0.01	9.28± 0.02	19.34± 0.04	5.92± 0.02	77.54± 0.09	148.01± 0.12	3.77± 0.01	32.48± 0.03	9.32± 0.01
Max	119.32	43.75	38.92	3.30	38.52	10.10	22.74	6.71	81.00	155.00	4.20	33.90	9.90
Min	36.94	12.61	27.95	2.40	13.19	8.70	16.50	4.17	73.00	144.00	3.20	31.20	9.00
PCV%	19.72	21.69	3.60	6.48	17.48	3.15	4.59	5.311	2.310	1.621	6.23	1.89	2.45
GCV%	13.91	13.91	2.69	0.54	13.59	1.49	2.48	4.10	0.718	0.642	3.35	1.55	0.68
H%	49.73	41.12	55.73	0.70	60.39	21.65	29.09	59.70	9.66	15.69	28.83	66.49	8.56
GA	11.99	3.87	1.25	0.06	4.64	0.11	0.46	0.33	0.30	0.66	0.12	0.72	0.03
GA/ Mean%	11.99	3.87	1.25	0.02	4.64	0.11	0.45	0.33	0.30	0.66	0.12	0.72	0.03
Giza 90													
Mean ± SE	104.67± 2.08	40.04± 0.87	38.22± 0.11	2.85± 0.07	36.70± 0.03	9.83± 0.05	17.94± 0.16	6.30± 0.33	69.64± 0.35	151.40± 0.45	4.02± 0.04	32.71± 0.08	9.92± 0.04
Max	125.20	48.40	39.25	3.10	47.46	10.40	19.52	6.58	73.00	155.00	4.50	33.50	10.30
Min	88.45	33.46	36.94	2.60	32.55	9.50	15.65	6.04	67.00	148.00	3.70	32.00	9.50
PCV%	9.91	10.81	1.49	5.05	9.77	2.46	4.52	2.58	2.53	1.49	5.40	1.20	2.19
Giza 86													
Mean ± SE	94.06± 1.80	36.17± 0.77	38.42± 0.21	2.80± 0.29	33.62± 0.02	9.26± 0.77	18.58± 0.24	6.74± 0.05	76.44± 0.39	152.76± 0.43	4.02± 0.04	32.82± 0.06	9.98± 0.05
Max	111.20	43.50	40.19	3.20	36.13	10.00	20.97	6.99	80.00	158.00	4.30	33.50	10.50
Min	78.30	29.90	36.00	2.30	30.46	8.80	15.97	5.80	73.00	149.00	3.70	32.10	9.50
PCV%	9.57	10.71	2.75	7.47	4.44	4.18	6.32	3.42	2.59	1.40	4.39	0.97	2.57

TABLE 3. Cont.

Item	SCY/ P, g	LY/P, g	Lint%	BW, g	NB/P	SI, g	NS/B	LI, g	DFF	PH, cm	Mic	UHML mm	PI
Saline soil													
F_2- generation													
Mean ± SE	41.36± 1.477	13.40± 0.252	32.32± 0.176	2.00± 0.13	20.73±	8.47±	15.95	5.66	60.49	72.65	3.63	32.36	8.69
Red%	40.46	45.69	8.72	28.21	16.91	8.70	17.53	4.43	21.98	50.91	3.55	0.38	6.74
Max	39.87	13.40	33.84	2.00	21.55	8.50	17.18	6.64	64.00	65.20	4.15	32.89	9.00
Min	32.10	9.20	28.50	1.70	16.89	7.50	13.00	4.76	56.00	62.50	3.12	31.12	8.00
PCV%	10.28	13.11	4.54	8.23	6.28	5.20	6.97	7.03	4.17	10.03	7.83	1.80	3.66
GCV%	8.86	6.24	3.95	5.01	7.01	1.18	3.66	5.20	1.52	9.54	4.86	1.56	2.81
H%	74.17	22.78	75.87	20.64	24.43	3.21	27.56	54.82	13.33	90.52	38.46	75.28	58.82
GA	5.55	0.70	1.96	0.06	0.56	0.02	0.54	0.38	0.59	11.61	0.19	0.77	0.33
GA/ Mean%	13.42	5.26	6.06	2.99	2.70	0.29	3.38	6.78	0.98	15.98	5.30	2.38	3.79
Giza 90													
Mean ± SE	46.16± 6.41	14.95± 0.771	32.36± 0.077	2.18± 0.01	21.20± 1.09	8.79± 0.07	16.82± 0.45	5.46± 0.02	59.77± 1.61	65.99± 0.64	3.56± 0.012	32.72± 0.02	9.46± 0.01
Red%	55.90	62.66	15.34	23.57	42.23	10.54	6.24	13.30	14.18	56.41	11.41	-0.02	4.64
Max	55.42	18.00	33.41	2.60	25.12	9.60	19.62	6.06	65.00	69.00	3.90	33.30	9.90
Min	35.80	11.42	31.07	1.90	16.99	7.70	14.39	5.01	55.00	63.10	3.10	32.20	9.00
PCV%	12.27	13.13	1.91	8.80	10.99	6.56	8.94	5.77	4.75	2.71	6.80	0.87	2.52
Giza 86													
Mean ± SE	45.92± 6.196	14.97± 0.744	32.59± 0.131	2.58± 0.01	17.79± 0.44	9.08± 0.01	19.10± 0.18	5.33± 0.01	65.04± 0.60	69.02± 1.38	3.72± 0.01	32.33± 0.02	9.10± 0.01
Red%	51.18	58.60	15.18	7.87	47.08	1.93	-2.79	21.01	14.91	54.82	7.36	1.47	8.74
Max	55.23	18.50	34.65	2.80	21.51	9.60	20.73	5.72	68.00	73.50	4.10	33.00	9.40
Min	35.60	11.60	30.94	2.20	15.47	8.70	17.02	4.67	62.00	64.40	3.30	31.80	8.80
PCV%	12.12	12.88	2.48	6.52	8.29	2.85	4.95	3.92	2.66	3.80	5.44	0.91	1.80

Max= maximum value, Min= minimum value, SCY/P= seed cotton yield/plant, LY/P= lint yield/plant, BW=boll weight, NB/P= number of bolls/plant, SI= seed index, NS/B= number of seeds/boll, LI= lint index, DFF= days to 1st flower, PH= plant height, Mic= Micronaire reading, UHML= upper-half mean length, PI= Pressley index.

TABLE 4. Correlations among traits in the F_2 generation under normal (above diagonal) and saline soils environments (below diagonal)

	SCY/P,g	LY/P, g	Lint%	BW, g	NB/P	SI, g	NS/B	LI,g	DFF	PH	Mic	UHML	PI
SCY/P,g		0.99**	0.42**	0.47**	0.94**	0.62**	0.05	0.07	-0.75**	0.83**	-0.57**	0.73**	0.87**
LY/P, g	0.95**		0.55**	0.49**	0.92**	0.63**	0.02	0.19**	-0.74**	0.82**	-0.56**	0.69**	0.80**
Lint%	0.48**	0.72**		0.35**	0.35**	0.33**	-0.16**	0.84**	-0.28**	0.33**	-0.12**	0.02	0.06
BW, g	0.80**	0.81**	0.53**		0.15**	0.72**	0.76**	-0.07	-0.48**	0.47**	-0.11*	0.06	0.05
NB/P	0.60**	0.50**	0.10	-0.01		0.43**	-0.23**	0.10	-0.66**	0.75**	-0.56**	0.76**	0.87**
SI, g	0.48**	0.49**	0.33**	0.46**	0.20*		0.19**	-0.25**	-0.55**	0.58**	-0.28**	0.30**	0.32**
NS/B	0.42**	0.36**	0.07	0.66**	-0.19*	-0.33**		-0.28**	-0.18**	-0.13**	0.10*	-0.13**	-0.55**
LI,g	0.11**	0.33**	0.71**	0.18*	-0.05	-0.43**	0.32**		0.03	0.001	0.03	-0.16**	-0.13**
DFF	-0.76**	-0.69**	-0.26**	-0.56**	-0.49**	-0.46**	-0.31**			-0.76**	0.37**	-0.54**	-0.60**
PH	0.85**	0.80**	0.38**	0.71**	0.45**	0.26**	0.52**	0.17*	-0.69**		-0.50**	0.66**	0.70**
Mic	0.82**	0.76**	0.32**	0.51**	0.70**	0.52**	0.08	-0.01	-0.81**	0.70**		-0.47**	-0.45**
UHM	0.77**	0.72**	0.11	0.49**	0.61**	0.81**	0.13	-0.02	-0.82**	0.68**			0.85**
PI	0.73**	0.70**	0.34**	0.47**	0.56**	0.37**	0.16	0.05	0.21**	0.76**	0.65**	0.62**	

*, **; significant at 5% and 1% level of probability; respectively, SCY/P= seed cotton yield/plant, LY/P= lint yield/plant, BW= boll weight, NB/P= number of bolls/plant, SI= seed index, NS/B= number of seeds/boll, LI= lint index, DFF= days to 1st flower, PH= plant height, Mic= Micronaire reading, UHML= upper-half mean length, PI= Pressley index.

TABLE 5. Mean squares of the studied traits in the F_4-generation selected under normal soil (N) and evaluated under both environments

Sel. criterion	Eval. Env.	Item	SCY/P,g	LY/P, g	Lint%	BW, g	NB/P	SI, g	NS/B	LI,g	DFF	PH	Mic	UHML	PI
SCY/P,g	N	Entries	123.91**	23.09**	0.630**	0.019	5.99	0.083	0.221	0.074	7.85**	14.44	0.056	0.263**	0.017
		Error	30.89	3.84	0.102	0.005	3.94	0.078	0.769	0.052	1.09	13.06	0.036	0.077	0.026
	S	Entries	8.52**	3.906**	1.04**	0.052**	12.96**	0.140**	1.10	0.120**	18.41**	34.92**	0.043	0.075	0.335**
		Error	2.96	1.26	0.29	0.013	2.878	0.033	0.82	0.040	1.46	6.63	0.027	0.051	0.041
LY/P, g	N	Entries	124.39**	22.87**	0.410	0.026**	6.57	0.057	0.620	0.023	7.762**	15.07	0.034	0.223**	0.013
		Error	31.01	4.272	0.165	0.008	4.70	0.078	0.917	0.053	1.143	10.60	0.032	0.066	0.025
	S	Entries	8.32	3.82**	1.11**	0.036**	13.61**	0.121**	2.66**	0.024	17.07**	13.18	0.038	0.083	0.518**
		Error	2.73	1.27	0.328	0.014	2.99	0.033	0.81	0.041	1.48	6.62	0.029	0.062	0.045
Lint%	N	Entries	622.24**	76.76**	1.411**	0.059	77.72**	0.082	1.88**	0.135**	16.93**	17.11**	0.160**	0.900**	0.008
		Error	16.06	2.71	0.258	0.008	1.214	0.034	0.532	0.035	0.889	5.254	0.026	0.068	0.020
	S	Entries	9.24**	2. 757**	0.294**	0.04**	5.983	0.241**	1.25**	0.190**	6.82**	5.603	0.091**	0.125	0.015
		Error	3.08	0.919	0.061	0.013	1.685	0.061	0.440	0.040	1.63	11.817	0.026	0.073	0.042
BW, g	N	Entries	708.24**	106.27**	1.49**	0.019**	77.29**	0.132**	1.003**	0.081**	15.82**	16.71	0.075**	0.658**	0.004
		Error	21.96	2.998	0.097	0.004	2.006	0.021	0.243	0.021	1.730	7.262	0.021	0.046	0.025
	S	Entries	5.58**	2.80**	1.05**	0.037**	0.869	0.074**	0.254	0.151**	7.04**	76.87**	0.109**	0.099	0.066
		Error	1.63	0.86	0.06	0.010	1.779	0.013	0.421	0.013	1.47	11.87	0.031	0.087	0.062
NB/P	N	Entries	128.87**	24.17**	0.468	0.089**	9.52**	0.056	2.54**	0.031	8.66**	12.93	0.036	0.253**	0.014
		Error	29.57	4.68	0.164	0.007	2.97	0.057	0.625	0.029	1.28	10.96	0.031	0.073	0.032
	S	Entries	7.76**	3.73**	1.11**	0.060**	13.58**	0.094**	1.297	0.072**	12.09**	8.44	0.042	0.073	0.382**
		Error	2.43	1.11	0.29	0.016	1.18	0.030	0.874	0.046	1.66	7.89	0.029	0.071	0.048
LI,g	N	Entries	877.38**	114.58**	1.61**	0.076**	99.78**	0.390**	1.96**	0.183**	27.49**	13.96	0.136**	1.13**	0.049**
		Error	15.95	2.57	0.255	0.010	0.998	0.017	0.388	0.034	1.111	7.397	0.029	0.077	0.016
	S	Entries	9.17**	3.19**	0.385**	0.051**	3.98**	0.187**	0.65	0.169**	6.82**	2.984	0.035	0.125	0.018
		Error	2.36	0.930	0.064	0.015	1.216	0.060	0.52	0.040	1.82	9.175	0.025	0.049	0.029
ICL	N	Entries	95.97**	14.83**	0.64**	0.02	10.34**	0.11	0.01	0.04	7.98**	15.048	0.07	0.29**	0.01
		Error	29.73	4.13	0.13	0.008	3.08	0.05	0.83	0.03	1.22	8.381	0.02	0.03	0.02
	S	Entries	276.66**	41.39**	1.02	0.12**	14.11**	0.21**	2.54**	0.103**	11.20**	22.09	0.09**	0.206	0.05**
		Error	25.25	4.18	0.36	0.01	5.27	0.04	0.44	0.031	1.65	10.09	0.03	0.092	0.01

Eval. Env.= evaluation environment, S= saline soil, SCY/P= seed cotton yield/plant, LY/P= lint yield/plant, BW= boll weight, NB/P= number of bolls/plant, SI= seed index, NS/B= number of seeds/boll, LI= lint index, DFF= days to 1st flower, PH= plant height, Mic= Micronaire reading, UHML= upper-half mean length, PI= Pressley index.

TABLE 6. Mean squares of the studied traits in the F_4-generation selected under saline soil (S) and evaluated under both environments

Sel. criterion	Eval. Env	Item	SCY/P,g	LY/P, g	Lint%	BW, g	NB/P	SI, g	NS/B	LI,g	DFF	PH	Mic	UHML	PI
SCY/P,g	N	Entries	73.99**	15.87**	0.995	0.027**	6.92	0.057	0.597	0.054	11.20**	21.11	0.042	0.099	0.024
		Error	23.027	3.663	0.346	0.008	4.15	0.046	0.430	0.022	1.659	12.944	0.027	0.070	0.020
	S	Entries	14.77**	3.93**	2.33**	0.052**	9.94**	0.207	3.42**	0.120	3.635	123.74**	0.062	0.227	0.133**
		Error	3.41	1.29	0.73	0.008	3.30	0.104	0.87	0.087	5.778	7.20	0.045	0.129	0.042
LY/P, g	N	Entries	73.44	16.23**	0.971	0.032**	5.480	0.079	0.585	0.056	11.20**	16.44	0.053	0.090	0.022
		Error	25.87	5.030	0.616	0.011	5.182	0.056	0.492	0.067	1.659	10.56	0.024	1.067	0.021
	S	Entries	16.58**	4.13**	2.30**	0.049**	3.83**	0.19	2.98**	0.120	3.206	41.68**	0.073	0.457	0.336
		Error	5.01	1.50	0.66	0.009	1.16	0.09	0.75	0.075	6.492	8.259	0.050	0.136	0.038
Lint%	N	Entries	256.16**	36.26**	1.13**	0.050**	15.84**	0.135**	0.980**	0.099**	11.52**	19.76**	0.042	0.159	0.033**
		Error	22.807	3.547	0.128	0.007	3.216	0.044	0.309	0.026	1.83	10.90	0.028	0.071	0.020
	S	Entries	50.46**	5.94**	2.01**	0.03**	17.61**	0.454**	1.701	0.482**	6.49	101.10**	0.094	0.77**	0.32**
		Error	7.90	1.07	0.60	0.01	2.69	0.07	1.126	0.042	4.61	11.50	0.039	0.127	0.052
BW, g	N	Entries	140.83**	20.20**	1.02**	0.020**	14.28**	0.102	0.604	0.010	11.31**	22.15**	0.042	0.151	0.023
		Error	23.68	3.99	0.325	0.004	3.06	0.044	0.273	0.032	1.93**	11.61	0.023	0.074	0.021
	S	Entries	17.78**	3.76**	1.49**	0.048**	5.55	0.459**	2.83	0.144	2.190	46.55**	0.045	0.414**	0.157**
		Error	6.53	1.25	0.46	0.014	3.67	0.102	1.51	0.082	5.667	6.57	0.045	0.141	0.047
NB/P	N	Entries	44.476	7.327	0.211	0.084**	14.10**	0.032	2.38**	0.021	11.74**	12.44	0.020	0.131	0.009
		Error	22.604	3.240	0.135	0.014	1.91	0.031	0.74	0.022	1.55	12.44	0.028	0.060	0.031
	S	Entries	6.77**	3.54**	4.51**	0.042**	13.39**	0.25**	1.11	0.18	7.52**	88.53**	0.095	1.48**	0.087
		Error	1.93	1.42	0.90	0.013	3.25	0.06	1.18	0.08	1.97	10.44	0.057	0.05	0.042
LI,g	N	Entries	226.65**	30.52**	0.78**	0.102**	8.41**	0.258**	1.62	0.119**	11.93**	13.873	0.055	0.128	0.015
		Error	25.67	4.09	0.147	0.016	1.91	0.030	0.74	0.024	1.29	12.397	0.020	0.095	0.038
	S	Entries	12.31**	3.64**	1.35**	0.029	6.75**	0.398**	3.28**	0.526**	13.048	72.79**	0.221**	0.350**	0.259**
		Error	4.09	1.211	0.29	0.015	2.14	0.070	0.73**	0.054	5.238	14.35	0.047	0.086	0.047
ICL	N	Entries	20.07**	3.06**	1.11**	0.045**	12.66**	0.232**	1.37**	0.23**	9.04**	39.60**	0.104**	0.089	0.385**
		Error	6.52	0.83	0.114	0.009	1.17	0.041	0.43	0.03	1.66	9.46	0.030	0.117	0.054
	S	Entries	31.32**	5.36**	1.06**	0.081**	2.51	0.315**	3.35**	0.038	3.82	58.33**	0.08	0.80**	0.152
		Error	9.27	0.78	0.26	0.016	2.29	0.091	0.73	0.048	5.65	9.06	0.04	0.11	0.050

Eval. Env.= evaluation environment, N=normal soil, SCY/P=seed cotton yield/plant, LY/P= lint yield/plant, BW=boll weight, NB/P=number of bolls/plant, SI=seed index, NS/B=number of seeds/boll, LI=lint index, DFF=days to 1st flower, PH=plant height, Mic= Micronaire reading, UHML=upper-half mean length, PI=Pressley index.

TABLE 7. Genotypic (GCV) and phenotypic (PCV) coefficients of variation, heritability in broad (H) and in narrow sense (h_2) for single trait selection in the F_4- generation under normal (N) and saline (S) soils

Sel Env.	Eval Env.	Item	SCY/P, g	LY/P, g	Lint%	BW, g	NB/P	LI
N	N	GCV%	4.90	5.91	1.63	2.223	3.97	3.47
		PCV%	10.04	11.62	3.20	4.473	8.49	6.83
		H%	75.06	81.32	81.70	77.62	68.75	81.24
		h 2	0.40	0.41	0.27	0.012	0.17	0.62
	S	GCV%	3.01	6.07	0.81	4.65	8.09	3.38
		PCV%	3.72	7.43	0.91	5.44	8.47	3.87
		H%	65.26	66.75	79.25	72.97	91.31	76.33
		h 2	0.76	1.71	0.65	0.04	0.15	0.09
S	N	GCV%	3.66	4.62	1.520	2.25	5.26	0.993
		PCV%	4.41	5.56	1.613	2.53	5.66	3.121
		H%	68.87	69.01	88.75	79.09	86.42	79.73
		h 2	0.15	0.13	2.32	0.23	0.44	0.17
	S	GCV%	3.90	5.51	1.97	4.84	8.00	6.23
		PCV%	4.45	6.90	2.35	5.75	9.20	6.57
		H%	76.91	63.68	70.15	70.83	75.73	89.73
		h 2	0.14	0.041	0.55	0.19	0.178	0.172

Sel. Env.= selection environment, Eval. Env.= evaluation environment, SCY/P= seed cotton yield/plant, LY/P= lint yield/plant, BW= boll weight, NB/P= number of bolls/plant.

TABLE 8. Genotypic (GCV) and phenotypic (PCV) coefficients of variation, heritability in broad (H) and in narrow sense (h^2) for ICL method in the F_4 – generation under normal(N) and saline (S) soils

Sel Env.	Eval Env.	Item	SCY/P,g	LY/P, g	Lint%	BW, g	NB/P	LI
N	N	GCV%	4.31	4.63	1.10	2.02	4.43	0.98
		PCV%	5.19	5.45	1.24	2.60	5.29	2.12
		H%	69.02	72.16	79.30	60.54	70.19	21.33
		h 2	0.54	0.52	0.58	0.88	0.57	1.10
	S	GCV%	9.13	9.37	1.25	6.42	5.13	2.51
		PCV%	9.58	9.88	1.56	6.73	6.48	3.01
		H%	90.87	89.90	64.50	90.94	62.58	69.88
		h 2	0.143	0.146	0.40	0.17	0.17	0.85
S	N	GCV%	4.70	5.66	1.71	5.67	8.290	4.58
		PCV%	5.72	6.64	1.80	6.33	8.702	4.91
		H%	67.51	72.86	89.65	80.40	90.75	86.84
		h 2	1.38	0.76	0.47	0.27	0.39	0.42
	S	GCV%	5.75	7.66	1.50	6.63	1.27	0.954
		PCV%	6.85	8.30	1.74	7.40	4.29	1.961
		H%	70.38	85.31	74.80	80.27	8.79	23.68
		h 2	0.56	0.59	0.36	0.51	0.66	0.21

Sel. Env.= selection environment, Eval. Env.= evaluation environment, SCY/P= seed cotton yield/plant, LY/P= lint yield/plant, BW= boll weight, NB/P= number of bolls/plant, LI= lint index.

Heritability in narrow sense as estimated by parents-offspring regression was low compared to heritability in broad sense. It ranged from 0.012 for BW (selection and evaluation at normal soil) to 2.32 for lint% (selection at saline and evaluation at normal soli). Generally, h^2 was higher at stress than at normal soil when selection practiced at normal soil, and vice versa for selection at saline soil. After two cycles of selection the broad sense heritability of lint yield/plant was very high (0.97). However, realized heritability was 0.87 and 0.39 for pop 1 and 0.66 and 0.45 for pop II in cycle I and cycle 2, respectively (Abd El Sameea et al., 2020).

In the ICL method the h^2 it was higher at normal soil evaluation than at saline soil for selection at both environments.

Mean, direct observed genetic gain for single trait selection

The direct observed genetic gain after two cycles of selection for SCY/P at normal soil (Table 9) was positive and significant (P≤0.01) from the mid-parent (11.68%) and better parent (10.74%) when evaluation was at normal soil, but the evaluation under salinity stress showed significant gain from the mid-parent (7.03%) and insignificant from the better parent (6.69%). Otherwise, selection under salinity stress gave significant gain (P≤0.05) from mid-parent of 8.8% and 8.24% at normal and salinity stress evaluation, respectively. Selection for LY/P showed the same trend. Generally, for all selection criteria, the performance at normal soil was better than at saline soil irrespective of selection environment, and selection at saline soil was better in performance at saline soil. These results agree with the opinion of selection under the environment of production. However, Richards (1996) and Betrán et al (2003) suggested selection under favorable environment, and some believe in selection under typical drought conditions (Ceccarelli, 1987; Ceccarelli & Grando, 1991b). Many researchers believe in selection under both favorable and stressed conditions (Clarke et al., 1992; Fernandez, 1992). Jinks & Connolly (1973, 1975) studied stability in *Schizophyllum commune* and concluded that, the sensitivity to environment was reduced if selection and environment effects were in opposite direction. Keim & Kronstad (1979) proposed that, an ideal cultivar for stress-prone environments should have high yield in the most severely stressed environment expected, and a strong response (b>1) to more favorable environments. Ceccarelli & Grando (1991a, b) indicated that selection environment affects the performance of barley materials. The higher stability genotypes were selected under low yielding environment. Falconer (1990) reviewed experiments and indicated that antagonistic selection was significantly better than synergistic for changing the mean.

Independent culling levels method of selection (ICL)

The ICL method of selection (Table10) included six traits; SCY/P, LY/P, lint%, NB/P, BW, and lint index. The observed genetic gain indicated that ICL method of selection at salinity stress was better than at normal soil. Seed cotton yield/ plant, LY/P, lint%, NB/P, BW and LI performed well at salinity stress than at normal soil.

TABLE 9. Means, direct observed genetic gains after two cycles of single trait selection in percentage from the mid-parent (OG% "MP") and the better parent (OG%"BP") under saline (S) and normal soils (N)

Sel Env.	Eval Env.	Item	SCY/P, g	LY/P, g	L%	BW, g	NB/P	LI
N	N	Mean C2	113.43	42.11	37.91	3.17	37.20	6.40
		OG%(MP)	11.68**	13.16**	3.46**	5.28**	10.13**	6.97**
		OG%(BP)	10.74**	12.30**	3.37**	4.99**	9.54**	4.78**
	S	Mean C2	45.27	15.19	34.34	2.04	25.13	6.14
		OG%(MP)	7.03*	6.37**	1.71	3.39**	16.98**	7.86
		OG%(BP)	6.69	6.01	1.66	2.10**	15.12**	6.42
S	N	Mean C2	112.43	41.80	38.15	3.19	38.29	6.37
		OG%(MP)	8.80*	9.69**	3.39**	5.16**	12.47**	6.69**
		OG%(BP)	8.04	9.03**	3.22**	4.59**	12.24**	6.04**
	S	Mean C2	49.84	17.00	34.81	2.20	22.97	6.37
		OG%(MP)	8.24*	7.53**	1.05**	6.02**	1.91**	4.02**
		OG%(BP)	8.20*	7.30**	0.82	5.02**	1.02*	1.80

Sel. Env.= selection environment, Eval. Env.= evaluation environment, SCY/P= seed cotton yield/plant, LY/P= lint yield/plant, BW= boll weight, NB/P= number of bolls/plant, LI= lint index

TABLE 10. Direct observed genetic gains after two cycles of ICL selection method in percentage from the mid-parent (OG% "MP") and the better parent (OG%"BP") at saline (S) and normal soils (N)

Sel Env.	Eval Env	Item	SCY/P,g	LY/P, g	Lint%	BW, g	NB/P	LI
N	N	Mean C2	108.98	40.77	37.42	3.11	35.05	6.00
		OG%(MP)	7.30**	9.55**	2.12**	3.42**	3.80**	0.14
		OG%(BP)	6.40	8.72	2.04*	3.14**	3.24*	-1.91
	S	Mean C2	100.27	37.59	37.47	3.00	33.46	6.14
		OG%(MP)	-2.90*	-1.33*	1.56*	-1.10	-1.70	3.01
		OG%(BP)	-3.65	-1.93	1.39	-1.63	-1.90	2.38
S	N	Mean C2	45.22	15.22	33.65	1.92	23.61	5.75
		OG%(MP)	12.27**	14.72**	2.16**	2.75**	9.65**	4.72**
		OG%(BP)	12.22	14.44	1.95*	1.40	8.35*	3.67
	S	Mean C2	47.13	16.10	34.16	2.21	21.32	5.74
		OG%(MP)	10.79**	13.60**	2.679*	12.27**	-3.784**	-2.377
		OG%(BP)	12.04	15.60	2.095	12.54*	-2.753	-2.706

Sel. Env.=selection environment, Eval. Env.= evaluation environment, SCY/P=seed cotton yield/plant, LY/P= lint yield/plant, BW=boll weight, NB/P=number of bolls/plant, LI=lint index.

Finally, it could be concluded that the results of single trait selection proved that selection under optimum environment performed well under optimum, and selection under stress was better under stress. Otherwise, ICL method of selection did well under salinity stress. Tang et al. (2009) indicated that the efficiency of the selection index consisting of lint yield/plant, bolls/plant, number of fruiting branches, number of boll position was higher than that of selection for lint yield/plant alone by 12.06%. El-Lawendey & El-Dahan (2012) found that conventional selection index was better than direct selection in improving lint yield and boll weight. NaiYin & Jian (2014), El-Dahan (2016), and Soliman (2018) stated that selection index was better than single trait selection.

Conclusion

The F_2 mean was less than the two parents showing under dominance towards the low yielding parent. The variability was high in yields and NB/P and low for the other traits. This variability resulted in expected genetic advance in percentage of the mean ranged from 0.02% for BW and 11.99% for SCY/P under normal soil, and from 0.98% for DFF and 15.99% for PH under saline soil. In general, the results indicated that the performance of different traits under normal soil were better than under salinity stress. The correlations in the F_2 indicated that the high yielding plants were early, fine (low Micronaire reading) and high in fiber length and strength (PI) under both environments. Days to first flower showed negative correlation with all traits except PI under both environments. Two cycles of single trait selection and ICL method were achieved. The second cycle selections were evaluated under both environments. The analysis of variance in the F_4- generation indicated that the salinity stress was more efficient than normal soil to detect the differences among selected families. Genotypic and phenotypic coefficients of variability were greatly depleted by selection from F_2 to F_4- generation. The GCV in selection criteria were higher in the F_4-generation under salinity stress than under normal soil in four out of six criteria. In single trait selection, the h^2 was higher at stress than at normal soil when selection practiced at normal soil, and vice versa for selection at saline soil. In the ICL method the h^2 was higher at normal soil evaluation than at saline soil for selection at both environments. Finally, it could be concluded that the results of single trait selection proved that selection under optimum environment performed well under optimum, and selection under stress was better under stress. Otherwise, ICL method of selection did well under salinity stress.

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التقدم الوراثى المشاهد من الانتخاب فى القطن المصرى (جوسيبيوم باربادنس) فى التربه العاديه والتربه الملحيه

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لا تؤدي الملوحة إلى الحد من نمو النبات فحسب، بل تؤدي أيضًا إلى انخفاض تدريجي في المحصول في جميع أنحاء العالم. ويعتبر القطن من المحاصيل الرائدة في التربة المتأثرة بالملوحة. تهدف هذه الدراسه إلى مقارنه كفاءه الانتخاب للصفه الواحده والانتخاب بالمستويات المستبعده لسته صفات فى تحسين محصول القطن الزهر للتربه العاديه والتربه الملحيه . كانت مواد البحث الجيل الثانى للهجين جيزه90 × جيزه 86. اجريت تجربه فى الارض العاديه واخرى فى الارض الملحيه (13 ملليموز).كان الاداء للصفات المختلفه افضل فى الارض العاديه عن الارض الملحية. وتشير نتائج الارتباط فى الجيل الثانى إلى ارتباط ارتفاع محصول الزهر معنويا بالنعومه والمتانه وطول الشعر فى البيئتين. وكان هناك ارتباط سالب بين عدد الايام حتى تفتح اول زهره مع كل الصفات عدا دليل البرسلى فى البيئتين. وانخفض معامل الاختلاف الوراثى والمظهرى بشده بالانتخاب من الجيل الثانى إلى الجيل الرابع . وعند الانتخاب لطريقه الصفه الواحده فى الارض العاديه كان معامل التوريث بالمعنى الضيق اعلى عند التقييم فى الارض الملحيه عنه فى الارض العادية، والعكس صحيح عند الانتخاب فى الأرض الملحية. اما عند الانتخاب بالمستويات المستبعده فكان معامل التوريث اعلى فى الارض العادية سواء اجرى الانتخاب فى العادية او الملحية. أثبت الانتخاب للصفة الواحدة أن الانتخاب في ظل البيئة المثلى كان أداءً المنتخبات جيدًا تحت البيئة المثلى، وأن الاختيار تحت الاجهاد الملحى كان أفضل. وبخلاف ذلك، فإن طريقة الانتخاب بالمستويات المستبعده كانت جيدة في ظل إجهاد الملوحة. هذه النتائج تتفق مع رأي اجراء الانتخاب في ظل بيئة الإنتاج.