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DIRECT SELECTION FOR GRAIN YIELD AND CORRELATED RESPONSE IN BREAD WHEAT UNDER NORMAL AND LATE SOWING DATES.*

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Abstract: The present investigation was carried out at Kom-Ombo Agric. Res. Stat., ARC, during the three growing seasons of 1999/2000, 2000/2001 and 2001/2002, to study the response to direct selection for grain yield under normal and late planting and estimate the correlated response of the other studied traits. The basic material used in this study consisted of 120 F_3 families stemmed from bread wheat cross [(C.271x INIA SIB/PAK) x(K134(60)/4/TOB/BMAN//BB/3/CA L)].

The results indicate significant differences among F_3 families for grain yield/plant, its components and biological yield/plant. Phenotypic coefficients of variability for traits under study ranged from 9.38% to 18.53% while gcv ranged from 9.20% to 17.32% under normal planting. On the other hand, pcv ranged from 9.49% to 19.89% while gcv ranged from 9.18% to 18.53% under late planting.

Broad sense heritability estimates for the studied traits ranged from 85.20% for grain yield to 96% for 1000-kw under normal planting while it ranged from 72.20% for grain yield to 93.50% for No. of kernels/spike under late planting. Heritability values for grain yield were (85.2 and 72.2%), (59.4 and 51.5%) and (54.5 and 41.2 %) for C_0, C_1 and C_2, under normal and late planting, respectively.

After two cycles of pedigree selection for grain yield/plant the observed response was 20.21 and 18.47% under normal and late planting, respectively, measured as deviation from F_3 bulk and 7.62 and 7.54% under normal and late planting, respectively, measured as deviation from the better parent. While, direct selection for grain yield/plant under normal planting was accompanied with an increase ranged from 12.04% for 1000-kw to 19.79% for No. of spikes/plant compared with population bulk. While, direct selection for grain yield/plant under late planting was accompanied with an increase ranged from 4.56% for No. of kernels/spike to 16.82 % for biological yield/plant.

Direct selection for grain yield at normal and late (heat stress) planting using pedigree selection method was effective in isolating lines have high yielding ability and some of yield components.

Key words: direct selection, grain yield, response, bread wheat, normal, late sowing dates.

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Introduction

In Egypt, population increase is creating new demands for food production under conditions of competition between agriculture, industry and municipalities for limited resources of land, water and capital. Therefore, cultivation has been expanded into marginal areas where drought and high temperature occur frequently. Terminal heat stress is a common abiotic factor responsible for reducing yield of wheat in Upper Egypt (Abdel- Shafi et al. 1999). Direct response to selection is dependent on the level of heritability; indirect response to selection is also dependent on the genotypic correlation. These two parameters provide sufficient information to evaluate the benefits of direct or indirect selection for an important trait (Wang and Baker 1989). Selection in early conditions is easier because genetic variation and heritability (h^2) are high. It is assumed that such selection can lead to the identification of cultivars able to perform well also in stress zones (Laing and Fisher 1977 and Whitehead and Allen 1990). However, these cultivars are not necessarily the best potential performance in stressed environments, particularly if they lack some morpho-physiological traits supposedly involved in stress resistance (Ceccarelli et al. 1991). The second school of plant breeders holds that nearly all crop production occurs under stress environments, and thereafter, plant breeders should select in stress environments (Atlin and Frey 1989 and Ceccarelli 1987).

Ortiz Ferrara et al. (1994) stated that high temperature stress indirectly reduces yield by directly affecting various yield components. Hence, grain yield as a selection criterion to select against heat stress remains the most reliable yardstick.

Saadalla and Hamada (1994) reported the effectiveness of selection and pedigree breeding methods based on grain yield, 1000-kernel weight and number of kernels/spike for improving wheat grain yield under heat- stressful environment.

El-Morshidy et al. (2000) recommended that under abiotic stress (heat and drought conditions), the breeder should compromise the relationship between an average of genotype and its stability parameters and so, the breeders are often, on request, required to recommend the highest yielding genotypes irrespective of whether a genotype is stable over all traits or not. El-Morshidy et al. (2001) found that high temperature during the duration of grain filling reduced dry matter, 1000-kernel weight and grain yield by 10.97, 10.67 and 16.52%, respectively, compared with the normal temperature prevailing during grain filling period in the optimal planting date. Abd El-Kareem and Morsi (2003) found that delaying sowing date led to reduction in wheat grain yield/fed. by an average of 27.88 % as compared with recommend sowing date. These results could be attributed to the delay in days to heading (late sowing) consequently, the influence of grain by high temperature prevailing during this period, hence, reducing grain yield/unit area.

Therefore, the present study was undertaken to: 1) study the response to direct selection for grain yield under early and late planting. 2) estimate the correlated response of the other studied traits.

Materials and Methods

The present study was carried out at Kom-Ombo, Agric. Res. Stat. ARC, Egypt, during 1999/2000, 2000/2001 and 2001/2002 successive seasons. The breeding materials used in this study consisted of 120 F_3-families of bread wheat (*Triticum aestivum* L. em Thell) traced back to random sample from F_2 single plants originated from a cross between "C.271x INIA SIB/PAK" (a Pakistanian cultivar) and "K134 (60)/4/TOB/BMAN//BB/3/CAL" (a line from CIMMYT/ICARDA). The Egyptian cultivar Giza 164, tolerant for heat stress was used as a check variety.

In 1999/2000 season, the 120 F_3 families as well as the F_3 bulk, original parents and the local check (Giza 164, a heat tolerant cultivar) were grown in the two sowing dates (20th of November and 20th of December) in a randomized complete block design with three replications. Each plot was a single row 3 m. long, 20 cm apart and 10 cm between grains within row. The cultural practices were carried out as recommended for wheat production. At harvest, grain yield/plant was weighted for all guarded plants in each row and each replicate at both sowing dates. Then the average of grain yield/plant for each family was calculated and the highest 24 families in grain yield were selected. The plant has the highest grain yield within selected families was selected to form F_4 families.

In 2000/001 season, two experiments, each consists of 24 selected families, F_4 bulk, parents and the check cultivar. The first experiment, consisted of 24 families selected from first sowing, was conducted under normal planting, while the second experiment, consisted of 24 families selected from second sowing was conducted under late sowing (heat stress). The experimental design, number of replicates and cultural practices were the same as the first season. Sowing dates were 18th Nov. and 16th Dec. At harvest, the highest 6 families from the 24 families were selected and the plant has the highest grain yield within the 6 families in each date was selected to form F_5 families.

In 2001/002 season, the F_5 bulk, parents, the check cultivar and 6 selected families under normal conditions were evaluated under normal conditions, normal sowing 19th Nov., and the same was done at late sowing 19th Dec. The experimental design, number of replicates and cultural practices were the same in the first and second seasons. Data were recorded on a random sample of ten guarded plants from each family in F_3, F_4 and F_5 generations. The mean of the ten plants were subjected to the statistical and genetical analysis. The characters studied were biological yield/plant, number of spikes/plant, number of kernels/spike, 1000-kernel weight and grain yield /plant.

Statistical analysis:

The statistical analysis were completed on plot mean basis, Genotypic and phenotypic variances, as well as heritability estimates were calculated from EMS of the variance of the selected families. The phenotypic (p.c.v) and genotypic (g.c.v) coefficients of variation were estimated using the formulae developed by Burton (1952). The observed response for selected families was measured as the difference between the mean of selected families and each of F_3 and F_5 bulk, best parent and check cultivar.

Results and Discussion

Evaluation of the base population

The analysis of variance (Table 1) indicated significant differences among the F_3 families under the two sowing dates conditions for all studied characters. Phenotypic (p.c.v.) and genotypic (g.c.v.) coefficients of variability (Table 1) ranged from (9.38 and 9.20) for 1000- kernel weight to (18.53 and 17.32) for number of spikes/plant under normal planting, respectively. The same trend was observed in the late planting (heat stress). These results indicate that variability was sufficient to use selection to improve these characters and it will be highly effective. These results are in line with those obtained by Amin, *et al.* (1992), Kherialla (1993), Yadav and Mishra (1993), Shoran and Shoran (1995), and Attia (2003) who reported that p.c.v. and g.c.v. were 15.06 and 9.10 % respectively in the F_3 families.

Heritability estimates in broad sense (h^2) (Table 1) as estimated from the expected mean squares (EMS) were 87.40, 93.50, 96.00, 92.20, and 85.20 % for number of spikes/ plant, number of kernels/spike, 1000-kernel weight, biological yield and grain yield, respectively under normal condition. The same trend was observed for the heritability of these characters under heat stress (late planting). These results are in agreement with findings of Deshmukh and Deshmukh (1987), Pawar *et.al.* (1988), Ghosheh (1989), Nasir Ul-Din *et.al.* (1992), El-Shazly *et. al.* (2000), and Kheriralla *et. al.* (2001).

Table (1): Mean squares, phenotypic (P.C.V %) and genotypic (G.C.V. %) coefficients of variability and heritability (h^2) values in the F_3 families for early (normal) and late planting (heat stress) conditions for all studied characters.

Items	Number of spikes/ plant	Number of kernels/ spike	1000- kernel weight	Biological yield/plant	Grain yield/plant
Normal planting:					
Reps	1.25	12.77	6.87	10.72	3.57
Families	5.72**	128.25**	73.55**	66.79**	13.14**
Error	0.71	8.26	2.90	5.20	1.95
P.C.V. %	18.53	12.90	9.38	10.97	14.32
G. C.V. %	17.32	12.47	9.20	10.54	13.22
H^2	87.40	93.50	96.00	92.20	85.20
Late planting:					
Reps	0.702	9.353	10.744	4.916	1.63
Families	4.23**	100.88**	66.36**	61.22**	12.76**
Error	0.561	7.039	4.308	5.08	3.54
P.C.V. %	19.89	13.20	9.49	12.46	17.80
G. C.V. %	18.53	12.73	9.18	11.94	15.13
H^2	86.50	93.00	93.50	91.70	72.20

** Significant at 0.01 level of probability.

Data in (Table 2), showed that delaying sowing date led to a reduction in no. of spikes, kernels/spike, 1000 kernel weight, biological yield/plant and grain yield/plant by 19.97, 13.32, 6.08, 15.72 and 20.74% as compared with recommended sowing date. These results agreed with these reported by Attia (1998), Acevdo (1991) and Kheiralla *et al.* (2001). Therefore, high temperature stress (late planting) indirectly reduces yield by directly affecting various yield components. Hence, grain yield as a selection criterion against heat stress remains the most reliable yardstick.

Mean number of kernels/spike (Table 2) ranged from 32.00 to 63.67 kernels/spike with an average of 50.69 under normal condition and ranged from 31.67 to 56.00 kernels/spike with an average of 43.94 under heat stress (late planting). It is clear that late planting reduced number of kernels/spike by 13.32 % when compared with normal planting. Similar results were obtained by

Acevdo (1991), who suggested that the main effect of high temperature after floral initiation is on the number of kernels per unit area.

Average of 1000- kernel weight was 52.77 and 49.56 gm with a range from 42.0 to 60.67 gm. and from 37.67 to 57.33 gm under normal and late planting conditions respectively, as shown in Table 2. 1000-kernel weight under heat stress decreased by 6.08 % as compared with normal condition. Similar results were reported by Vitkare *et al.* (1990) who found that 1000 – kernel weight decreased progressively with delay of sowing date. They stated also that increase of C° in temperature during the post anthesis period decreased 1000-kernel weight by of 4.33 gm.

Regarding to the average of biological yield/plant (Table 2) was 43.00 and 36.24 gm with a range from 31.80 to 60.50 gm and from 24.07 to 49.53 gm under normal and late planting, respectively. Biological yield/plant under late planting (heat stress) condition decreased by 15.72% as compared with normal planting. Similar results were reported by Kheiralla *et. al.* (2001) who found that heat stress reduced biological yield/plant by 12.19 % compared with normal planting.

Mean and range of the base population in F_3 generation before selection (Table 2) indicated that average grain yield/plant was 14.61 gm with a range from 10.70 to 21.37 gm/plant under normal condition, while under late planting (heat stress) average of grain yield/plant was 11.58 gm with a range from 7.43 to 17.83 gm/plant. Grain yield/plant under heat stress decreased by 20.74% as comparison of normal planting. These results agreed with those reported by Abd El-Shafi and Ageep (1993) they reported that late planting reduced grain yield by 19.00 % when compared with optimum sowing date in Upper Egypt.

Table(2): Means and range of the base population in F_3 generation before selection in the two sowing dates in 1999/2000 season.

Character	Time of planting				Reduction %
	Early planting		Late planting		
	Range	Mean ± S.E	Range	Mean ± S.E	
No. of spikes/plant	5.10-12.83	7.46±0.49	4.0-9.7	5.97±0.43	19.97
No. of kernels/spike	32.0-63.67	50.69±1.66	31.67-56.0	43.94±1.53	13.32
1000-kernel weight	42.0-60.67	52.77±0.98	37.67-57.33	49.56±1.20	6.08
Bio. yield/plant	31.8-60.5	43.0±1.32	24.07-49.53	36.24±1.30	15.72
Grain yield/ plant	10.7-21.37	14.61±0.81	7.43-17.83	11.58±1.09	20.74

Effect of selection for grain yield on P.C.V., G.C.V. and h^2

Results are presented in (Table 3) showed that phenotypic (P.C.V.) and genotypic (G.C.V.) coefficients of variability under normal sowing date (N) for grain yield/plant were 14.32 and 13.22% for F_3 families before selection, 6.85 and 5.28% for F_4 families after one cycle of selection (C_1) and 1.47 and 1.08% for F_5 families after two cycles of selection (C_2), respectively, while they were (17.80 and 5.13%), (5.71 and 4.10%) and (0.96 and 0.62%) under heat stress (S) condition for F_3, F_4 and F_5 families, respectively. It appears that C_1 families possessed considerable amount of genetic variability more than the C_2 families for grain yield/plant. Phenotypic and genotypic variances as indicated by σ^2_p and σ^2_G, decreased rapidly after two cycles of selection for this character. Consequently, small genetic variance, low heritability and small selection progress could be expected after the second cycle. These results indicated that two cycles of selection for grain yield in these material were enough to identify the performance of the promising genotypes. These results are in line with those obtained by Kheiralla (1993), Yadav and Mishra (1993) and Pawar *et. al.* (2000).

Table(3): Phenotypic (σ^2_P), Genotypic (σ^2_G) variances and corresponding coefficients of variability for grain yield/plant in F_3 before and after two cycles of selection under normal sowing (N) and heat stress (late sowing (S)) conditions.

Selection cycle	σ^2_P		P.C.V.%		σ^2_G		G.C.V.%		h^2	
	N	S	N	S	N	S	N	S	N	S
F_3 families (C_0)	4.38	4.25	14.32	17.80	3.73	3.07	13.22	15.13	85.20	72.20
F_4 selected families (C_1)	1.38	0.66	6.85	5.71	0.82	0.34	5.28	4.10	59.40	51.50
F_5 selected families (C_2)	0.11	0.03	1.47	0.96	0.06	0.01	1.08	0.62	54.50	41.20

Heritability estimated in broad sense (h^2) as estimated from the expected mean squares for grain yield/plant (Table 3) under normal and late planting conditions were 85.2 and 72.2%, 59.4 and 51.5% and 54.5 and 41.2% for F_3 families (C_0), F_4 families (C_1) and F_5 families (C2), respectively. Also, it is of interest to note that heritability estimates for grain yield/plant decreased from the F_3 to the F_5 generation. This could be due to the increase in the environmental variances as the homozygozity of the lines increased, which maximized the phenotypic relative to the genotypic variances. Similar results were reported by Pathak *et. al.* (1986), Ghosheh (1989), Ismail (1995), El-Shazly *et. al.* (2000) and Attia (2003) who found that heritabilty in broad sense was generally higher at normal sowing than at stress conditions and was relatively decreased with progress of selection and generation.

Response to direct selection for grain yield under different planting dates

The performance of the 24 and 6 selected families for grain yield and correlated traits in the first and second cycles of selection under different planting dates are shown in Tables (4 and 5). Direct selection for yield/plant led to an increase of 7.62 and 18.95% after the second cycle of selection compared to the best parent and the check cultivar Giza 164 in normal planting, but it was 7.54 and 14.46% under late planting, respectively. These results agree with those reported by Kheiralla (1989), he found that selection for grain yield per se was the most effective method in improving grain yield/plant. Wang and Baker (1989) pointed out that the direct response to selection depend upon the level of heritability.

The correlated response to selection for grain/plant:

Estimates of correlated response to selection for grain yield/plant under normal and late planting after two cycles are shown in Table(6). Direct selection for grain yield/plant under normal planting was accompanied with an increase of (15.52 and 19.79%) for number of spikes/plant, (7.45 and 16.35) for number of kernels/spike, (10.78 and 12.04%) for 1000-kernel weight and (12.22 and 12.62%) for biological yield/plant after the first and second cycle, respectively. Compared with F_5 bulk. On the other hand, the percentage of increase was 12.23 and 16.44% for number of spikes/plant, 1.0 and 3.72% for number of kernels/spike, 3.85 and 4.45% for 1000-kernel weight and 8.21 and 10.67% for biological yield/plant after the first and second cycles,

Table(4): Mean grain yield and its components of the 24 highest yielding families in the first cycle of selection under two

No. of selected family	Select criterion	Normal planting – Correlated response			
	G.Y/ plant	No. of spikes/ plant	No. of kernel/ spike	1000 k.w	Bio. Y./ plant
1	17.63	8.67	47.00	49.33	48.17
2	16.47	7.40	51.33	52.00	47.23
10	17.33	8.43	51.67	52.67	50.37
12	16.30	7.57	47.00	51.00	47.00
24	16.30	6.97	49.67	48.67	45.67
33	18.10	9.03	58.33	51.67	50.70
39	16.67	8.10	50.00	52.00	46.23
49	17.00	7.07	44.33	50.00	47.57
51	16.63	7.87	46.00	52.33	45.47
69	17.50	8.57	55.33	51.67	47.23
76	15.37	5.60	45.00	52.00	42.53
77	17.00	8.70	45.67	49.33	47.70
78	16.97	7.03	47.33	47.00	47.13
80	16.93	7.80	51.33	53.00	47.37
82	16.60	7.40	43.00	47.33	47.03
84	16.70	8.03	55.33	50.00	47.53
100	16.00	7.63	53.00	54.00	45.17
101	17.17	8.63	49.00	45.00	47.53
103	16.27	6.43	59.00	47.00	47.40
106	20.43	9.57	60.33	48.00	50.87
110	17.07	7.50	44.67	50.33	47.23
116	18.60	8.47	58.33	48.00	49.23
118	16.47	7.57	44.00	47.00	45.57
120	20.10	9.37	55.33	47.00	50.77
Mean	17.15	7.89	50.50	49.85	47.47
P_1	13.33	6.03	48.33	44.00	37.83
P_2	16.00	7.03	50.00	48.00	43.87
F_4 bulk	14.30	6.83	47.00	45.00	42.30
Check	15.20	6.97	46.00	44.67	43.53
$LSD_{0.05}$	2.12	0.95	2.13	1.65	1.94

No. of select. family	Select criterion	Late planting – Correlated response			
	G.Y/ plant	No. of spikes/ plant	No. of kernel/ spike	1000 k.w	Bio. Y./ plant
1	13.93	6.80	39.67	45.33	40.10
2	13.17	6.50	47.00	48.67	40.43
10	14.00	7.13	49.00	49.00	43.07
11	13.07	6.37	42.67	49.33	42.03
12	14.20	7.23	43.67	48.67	45.17
24	13.93	6.97	46.00	44.00	42.83
33	13.53	6.80	52.00	50.00	37.50
39	14.77	7.47	43.67	45.00	42.47
49	14.50	7.20	39.33	48.00	43.10
51	13.63	6.63	42.00	49.67	39.17
56	13.83	6.50	41.00	48.00	45.00
69	15.10	7.43	50.33	47.67	42.90
76	13.77	6.77	40.33	49.00	40.93
77	14.27	6.10	38.33	45.67	42.53
78	13.67	6.83	43.67	45.00	46.00
80	14.90	7.50	48.00	52.33	44.16
100	14.20	6.93	47.00	50.33	40.56
101	14.73	7.27	42.67	43.67	41.93
103	13.27	6.67	51.67	45.00	40.83
106	16.10	8.53	51.00	44.67	43.36
111	13.83	6.60	49.00	49.00	37.10
116	15.43	8.52	56.00	46.00	42.23
118	13.60	6.70	41.67	44.33	36.63
120	15.83	8.07	49.00	45.00	40.03
Mean	14.22	7.06	45.61	47.22	41.67
P_1	11.60	5.50	43.00	41.33	34.63
P_2	13.70	6.50	44.67	46.00	37.81
F_4 bulk	12.57	6.40	43.33	43.00	37.19
check	13.20	6.60	40.67	43.33	38.94
$LSD_{0.05}$	1.61	0.65	2.31	2.21	2.18

Table(5): Mean grain yield and its components of the 6 highest yielding families in the second cycle of selection under two environments.

No. of selected family	Normal planting					No. of select. family	Late planting				
	Select criterion	Correlated response					Select criterion	Correlated response			
	G.Y/ plant	No. of spikes/ plant	No. of kernel/ spike	1000 k.w	Bio. Y./ plant		G.Y/ plant	No. of spikes/plant	No. of kernel/spike	1000 k.w	Bio. Y./ plant
1	22.30	11.00	56.00	53.33	58.80	39	19.20	8.07	51.00	52.33	52.60
33	22.20	11.13	62.33	56.67	61.13	69	18.13	7.53	59.00	50.00	52.30
69	20.50	10.83	60.67	53.33	56.30	80	18.77	8.63	50.00	55.00	54.00
106	23.10	12.53	62.33	52.67	58.63	106	19.17	9.40	57.00	50.33	53.27
116	22.80	10.90	63.00	53.00	56.80	116	19.07	10.40	58.00	50.67	53.03
120	24.70	11.17	58.67	53.67	61.17	120	20.30	10.50	53.67	54.00	56.13
Mean	22.60	11.26	60.50	53.78	58.80	Mean	19.11	9.09	54.78	52.06	53.56
P_1	16.80	8.43	50.00	48.33	49.66	P_1	13.50	8.00	48.00	44.00	39.94
P_2	21.00	9.67	58.33	51.00	53.13	P_2	17.77	7.57	53.33	49.67	46.34
F_5 bulk	20.50	9.00	55.80	49.00	50.00	F_5 bulk	16.75	8.30	50.60	48.00	46.00
check	19.00	9.57	52.67	47.33	53.22	Check	16.67	8.47	47.67	45.33	47.20
$LSD_{0.05}$	0.70	0.62	1.56	1.31	1.72	$LSD_{0.05}$	0.45	0.38	1.75	1.58	0.93

Table(6): Realized gains and correlated response to selection for highest grain yield in the two cycles of selection under two environments.

Trait	Selection cycle	Response to selection as deviation from											
		Normal planting						Late planting					
		F_3 bulk		Best parent		Check Giza 164		F_3 bulk		Best parent		Check Giza 164	
		Unit	%	unit	%	unit	%	unit	%	unit	%	unit	%
		Direct response											
Grain yield/plant	C_1	2.85	19.93	1.15	7.19	1.95	12.83	1.65	13.13	0.52	3.80	1.02	7.73
	C_2	3.80	20.21	1.60	7.62	1.60	18.95	2.95	18.47	1.34	7.54	2.44	14.64
		Correlated response in											
Number of spikes/plant	C_1	1.06	15.52	0.86	12.23	0.92	13.20	0.16	10.31	0.56	8.62	0.46	6.97
	C_2	1.86	19.79	1.59	16.44	1.69	17.66	1.32	13.63	1.09	13.63	0.62	7.32
Number of kernels/ spike	C_1	3.50	7.45	0.50	1.00	4.50	9.78	2.28	5.26	0.94	2.10	4.94	12.15
	C_2	8.50	16.35	2.17	3.72	7.83	14.87	6.78	9.56	1.45	2.72	7.11	14.92
1000- kernel weight	C_1	4.85	10.78	1.85	3.85	5.18	11.60	4.22	9.81	1.22	2.65	3.89	8.98
	C_2	5.78	12.04	2.78	5.45	6.45	13.63	6.06	13.17	2.39	4.81	6.73	11.85
Biological yield/ plant	C_1	5.17	12.22	3.60	8.21	3.94	9.05	4.48	12.05	3.86	10.21	2.73	7.01
	C_2	6.59	12.62	5.67	10.67	5.58	10.48	7.71	16.82	7.22	15.58	6.36	13.47

respectively when compared with best parent. Likewise, the percentage of increase was 13.20 and 17.66% for number of spikes/plant, 9.78 and 14.87% for number of kernels/spike, 11.60 and 13.63% for 1000-kernel weight and 9.05 and 10.48% for biological yield/plant after the first and second cycles, respectively when compared with the check cultivar.

Meanwhile, direct selection for grain yield/plant (Table 6) under late planting (heat stress) was accompanied with an increase of 10.31 and 13.63% for number of spikes/plant, 5.26 and 9.56% for number kernels/spike, 9.81 and 13.17% for 1000-kernel weight and 12.05 and 16.82% for biological yield/plant after the first and second cycles of selection, respectively when compared with F_5 bulk. As well as, the percentage of increase was 8.26 and 13.63% for number of spikes/plant, 2.10 and 2.72% for number of kernels/spike, 2.65 and 4.81% for 1000-kernel weight and 10.21 and 15.58% for biological yield/plant after the two cycles of selection, respectively compared with best parent. Also, the percentage of increase was 6.97 and 7.32% for number of spikes/plant, 12.15 and 14.92% for number of kernels/spike, 8.98 and 11.85% for 1000-kernel weight and 7.01 and 13.47% for biological yield/plant after the two cycles of selection, respectively compared with the check cultivar. It is clear that 25% of the selected families for grain yield from the first cycle continue to give high grain yield in the second cycle and this refer to that grain yield is a quantitative character. These results indicated that direct selection and correlated response under normal planting were higher than under heat stress, indicating the direct response to selection is dependent on the level of heritability which was higher in normal planting than late planting (heat stress); indirect response to selection is also dependent on the association among these characters. These two parameters provide sufficient information to evaluate the benefits of direct or indirect selection for an important trait. These results are in line with those obtained by Haugerud and Cantrell (1984), Kheiralla (1989), Wang and Baker (1989), Ismail (1995), Tammam (1995), Mahdy *et al.* (1996) and Attia (2003).

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الانتخاب المباشر لمحصول الحبوب والإستجابة المرتبطة في قمح الخبز تحت ميعادى الزراعة العادى والمتأخر.*

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أجرى هذا البحث في محطة البحوث الزراعية بكوم أمبو التابعة لمركز البحوث الزراعية خلال ثلاث مواسم زراعية ١٩٩٩/٢٠٠٠ ، ٢٠٠٠ /٢٠٠١ و ٢٠٠١ /٢٠٠٢ وكان الهدف من هذا البحث :

(١) دراسة الاستجابة المباشرة للانتخاب لصفة المحصول تحت ميعادي الزراعة العادية والمتأخرة ، (٢) تقدير الاستجابة المرتبطة لباقي الصفات تحت الدراسة . ولإجراء ذلك تم استخدام ١٢٠ عائلة في الجيل الثالث ناتجة من تهجين سلالتين من قمح الخبز هما

(C.271 x INIA SIB/PAK)،(K134 (60)/4/ TB/ BMAN//BB /3/CAL)

اظهر تحليل التباين وجود اختلافات معنوية بين عائلات الجيل الثالث لصفات محصول الحبوب ومكوناته والمحصول البيولوجي .

وتراوح معامل الاختلاف المظهرى للصفات تحت الدراسة من ٩,٣٨ إلى ١٨,٥٣% بينما تراوح معامل الاختلاف الوراثى من ٩,٢٠ إلى ١٧,٣٢% تحت ميعاد الزراعة العادى ومن ناحية أخرى تراوح معامل الاختلاف المظهرى من ٩,٤٩ إلى ١٩,٨٩% ومعامل الاختلاف الوراثى من ٩,١٨% إلى ١٨,٥٣% تحت ميعاد الزراعة المتأخرة .

كذلك تراوحت تقديرات درجة التوريث بالمعنى العريض للصفات تحت الدراسة من ٨٥,٢٠% إلى ٩٦,٠% تحت ظروف الزراعة العادية ومن ٧٢,٢٠% إلى ٩٣,٥٠% تحت ظروف الزراعة المتأخرة .

بعد دورتين من الانتخاب لمحصول الحبوب/النبات بلغت الاستجابة ٢٠,٢١ و ١٨,٤٧ % تحت ظروف ميعادي الزراعة العادية و المتأخرة على التوالي كنسبة مئوية للانحراف عن متوسط العشيرة المجمعة للجيل الثالث و كانت الاستجابة ٧,٦٢ و ٧,٥٤ % تحت ميعادي الزراعة العادية والمتأخرة على التوالي كنسبة مئوية للانحراف عن أحسن الأباء. بينما أدى الانتخاب المباشر للمحصول تحت الظروف العادية إلى زيادة تراوحت من ١٢,٠٤% لصفة وزن الألف حبة إلى ١٩,٧٩% لصفة عدد السنابل/نبات بينما تراوحت الزيادة من ٩,٥٦% لعدد الحبوب فى السنبلة إلى ١٦,٨٢% لصفة المحصول البيولوجى للنبات مقارنة بالعشيرة المجمعة فى الجيل الثالث .

وبصفة عامة فإن الانتخاب المباشر لمحصول الحبوب فى ميعادى الزراعة العادى والمتأخر كان فعالاً فى عزل سلالات عالية القدرة المحصولية وبعض مكونات المحصول.

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