RESULTS AND DISCUSSION

IV-RESULTS AND DISCUSSION

IV.1- Genetic attributes and effect of selection in early generation

IV.1.1- Number of Spikes per plant

Results in Table 3-a; revealed significant progresses by selection from F_3. Selected plants average (F_{3S}) showed excess percentages of 121, 49, 90 and 104% (realized response) over F_3 mean values of the four populations; respectively. F_4 population however, showed depression in average performances. While the first two populations yielded statistically the same as their respective F_3 (11-6%), the other two populations were still having better performance with 32 and 39 % increase over their F_3 population.

These results may be due to reflection of the dominant or non-additive gene action, being more obvious in the first two populations. The other two populations may be supported more by some minor genes.

Previous results concerning combing ability effect **(El-Hosary *et al.*, 2000)** had shown the ratio GCA / SCA = 0.542 indicating non-additive effects. Also, the first population which showed the greatest depression in F_4 had also scored significantly the highest and negative specific combining ability effects (-0.869**), to indicate predomination of non- additive gene effects.

Mahdy (1988b) using F_3, F_4 and F_5 generations of the population, Giza 158/sonora 64, found that the predicted gain for number of spikes / plant ranged from –24.10 to 16.3%. The realized gain was –11.3 to 18%. **Nanda *et al.* (1990)** obtained genetic advance of 21.4 tillers/plants, **Chander *et al.* (1993)** studying the effect of intermitting and genetic advance in F_2 populations of two wheat populations indicated that the genetic advance for number of tillers / plant ranged from 42.17 to 56.86%.

The consistent and significant generation regressions, F_3/F_2 and F_4/F_3, between families mean squares and different signs of regression coefficients may suggest continuing segregation in different directions of non additive and/or dominant genes and in concordance with the conclusion of dominance genetic effects (Table: 3-b).

Variance components of both generations; F_3 and F_4 generally revealed the high importance of genetic variance which was estimated as broad sense heritability, i.e. 73-89% for F_3 and 60-88% for F_4 (Table 3-c).

Applying regression concept the estimates of narrow sense heritability, e.g. $h^2_{n.s3}$; $h^2_{n.s4}$ showed low to moderate estimates, e.g. 0.14-0.41 in F_3 and 0.21-0.50 in F_4' associated with very humble expected genetic gain of 0.16-0.61 spike/plant in F_3 compared with 0.20-0.66 spikes/plant in F_4, leading to expect no valuable additive effect.

Including both generations in partitioning variance showed that the non-additive variance accounted for almost 100% of the genetic variances of the four populations. This implies that different breeding methods rather than pedigree methods, can be pursued.

Alexander *et al.* (1984) reported that the realized heritability of number of tillers/ plant was 13-29% **Islam *et al.* (1985a)** indicated that over dominance affected number of tillers/plant. **Mustafa *et al.* (1986)** found that over dominance and depression control number of tillers as broad sense heritability ranged within 6-79%. **El-Sherbeny *et al.* (2000)** showed that the estimates of the additive effect were significant for all traits in all populations except for plant height in the first population. Moreover, dominance effects were significant in all populations for all traits except for number of spikes per plant (first and second populations) and 100-grain weight (third population). Epistatic effects were significant for almost all the studied traits. **Hamada (1988)** obtained 7% narrow sense heritability for number of spikes/plant by using regression of F_2/F_3 and F_4 generations. **Khiralla (1993) and Khiralla *et al.* (1993)** and **Gupta and Verma (2000)** obtained 45% broad sense heritability for number of spikes/plant.

These results may show the importance of applying the concept of diallel population analyses to screen for the most valuable populations to continue pedigree method of breeding to realize the highest performance, or determine other method for successful breeding and realize the highest performance.

Table (3-a): Average number of spikes / plant in F_2, F_3 and F_4 for the four populations as affected by selection.

P.op.		Population 1		Population 2		Population 3		Population 4	
		$\bar{x}$ ± L.S.D.	R.S. %	$\bar{x}$ ± L.S.D.	R.S. %	$\bar{x}$ ± L.S.D.	R.S. %	$\bar{x}$ ± L.S.D.	R.S. %
F_{3p}		2.76 ± 0.21		2.90 ± 0.14		2.00 ± 0.12		1.96 ± 0.12	
F_{3S}		6.10 ± 0.21	121	4.33 ± 0.09	49	3.80 ± 0.16	90	4.00 ± 0.06	104
F_{4p}		2.47 ± 0.13	-11	2.73 ± 0.14	-6	2.64 ± 0.14	32	2.72 ± 0.10	39
L.S.D. 0.05	$F_{3p} - F_{3S}$	0.30		0.17		0.20		0.13	
	$F_{3S} - F_{4p}$	0.25		0.17		0.21		0.07	
	$F_{3p} - F_{4p}$	0.25		0.20		0.18		0.16	

R.S: Response by selection from F_{3p}

Table (3-b): Regression mean square of no. of spikes / plant.

Fx / Fy	S.O.V	Population 1	Population 2	Population 3	Population 4
F_3/F_2	Joined	8.90 *	12.00	2.76*	3.58*
	Families	5.99**	2.75**	5.16**	3.29**
	Pure errors	1.69	0.84	0.56	0.62
F_4/F_3	Joined	6.34**	2.06*	10.67**	0.03
	Families	1.55**	5.25**	1.32*	2.23**
	Pure errors	0.59	0.61	0.62	0.50

Table (3-c): Genetic attributes of no. of spikes / plant.

	Estimate	Population 1	Population 2	Population 3	Population 4
G.C.A. effect	P_1	-0.204*	0.337	0.337	-0.413**
	P_2	0.221*	0.063	-0.004	-0.004
S.C.A. effect	$P_1 \times P_2$	-0.869**	0.386	0.481	-0.436
GCA/SCA		0.542			
F_3/F_2	$h^2_{b.s}$	0.73	0.78	0.89	0.82
	GS_1	1.08	0.84	1.10	0.79
	$h^2_{n.s}$	0.41	0.18	0.14	0.17
	GS_2	0.61	0.19	0.17	0.16
F_4/F_3	$h^2_{b.s}$	0.71	0.88	0.74	0.60
	GS_1	0.67	1.16	0.74	0.48
	$h^2_{n.s}$	0.21	0.50	0.28	0.45
	GS_2	0.20	0.66	0.28	0.36
Total variance	H	9.01	13.87	6.53	1.92
	D	-0.36	-0.05	-0.18	-0.12

IV.1.2- Number of kernels/spike:

Mean values of number of kernels/spike over different generations (Table 4-a) showed significant progress by selection, where selected F_4 parents (F_3s) realized 74, 61, 67 and 59% extra kernels/spike as compared with F_3 population. In F_4 these values decreased but still surpassing values of their respective F_{3p}, population, especially for the first three populations with 58, 40 and 65%, respectively. Reversily, was the case in the fourth population.

These results may reflect the importance of additive type of gene action in the four populations previously indicated by GCA/SCA ratio of 3.128 by (**El-Hosary** ***et al.*** **2000**)***;*** the valuable continuity of pedigree method to improve such trait and accordingly the final yield as suggested by **Mitkees** ***et al.*** **(1992) and Haggag** ***et al.*** **(1992).**

In support of these outcomes; regression ANOVA (Table 4-b) showed significant regression of offspring on their parental population, being more obvious in F_4/F_3 compared with F_3/F_2, suggesting segregation of more minor additive genes.

Regression being positive for F_4/F_3, and in consistency with their F_4 averages the first and the fourth populations, suggested more potentiality for increasing number of kernels/spike,. (Table 4-a).

Highly significant mean squares between and within families, especially in F_4 may indicate more segregation to occurs in late generations suggesting delaying selection to late generations for more segregation of minor additive genes for higher number of kernels/ spike to take place.

Partitioning mean squares (Table 4-c) showed that the genetic variances accounted for 35-88% of phenotypic variance in F_3 population compared to 84-95% for F_4, reflecting again more segregation of additive minor genes to happen at late generations. These results were supported by narrow sense heritability estimates measured, from F_3/F_4 and F_4/F_3 regression, which ranged from 49-74% for the first, 28-100% for the second to give genetic improvement of 20.8, 14.4, 17.16, and 6.15 kernels/spike, i.e., 49, 38, 41 and 13%. Including F_3 and F_4 genetic variances in calculating variance components, results revealed the prevalence of additive effects, which accounted for 100% of the genetic variance in three of the populations (1, 2 and 4) as the third population was mostly controlled by dominance or non-additive effect.

Khalil *et al.* (1979), Islam *et al* (1985b), Joshi (1987), Nanda *et al.* (1990), Shekhawat *et al.* (2000) and Mehla *et al.* (2000*)* reported additive genetic variance to be more important in the control of number of kernels/spike.

Mahdy ***(1988a)*** obtained expected genetic gain of 77-80% by selection for number of kernels/spike compared with 8.7% by **Nanda *et al (1990)***, 34.38% by **Amin *et al., (1992),*** 14.82-22.12% by ***Chander et al. (1993).***

These results indicate the useful lness of selection for increased number of kernels/spike in all populations even with the third population. Also, results may show valuable success for increasing final grain yield, indirectly via increasing number of kernels ***(*Haggag *et al.,* 1992 and Mitkees *et al.,* 1992*).***

On the other hand, results could show the importance of using diallel population analysis as early as F_1 to screen for the most valuable populations for successful breeding to increase number of kernels/spike.

Table (4-a): Average number of kernels / spike in F_2,F_3 and F_4 for the four populations as affected by selection.

P.op.		Population 1		Population 2		Population 3		Population 4	
		$\bar{x} \pm$ L.S.D.	R.S. %	$\bar{x} \pm$ L.S.D.	R.S. %	$\bar{x} \pm$ L.S.D.	R.S. %	$\bar{x} \pm$ L.S.D.	R.S. %
F_{3p}		26.70 ± 1.27		26.71 ± 1.32		25.57 ±1.07		28.38 ± 1.25	
F_{3S}		46.57 ± 0.66	74	43.09 ± 0.61	61	42.78 ± 0.62	67	45.11 ± 1.60	59
F_{4p}		42.16 ± 1.93	58	37.47 ± 1.56	40	42.23 ± 5.76	65	46.05 ± 1.39	62
L.S.D 0.05	$F_{3p} - F_{3S}$	1.43		1.54		1.24		2.03	
	$F_{3S} - F_{4p}$	2.04		1.68		2.02		2.12	
	$F_{3p} - F_{4p}$	2.31		2.04		2.20		1.87	

R.S: Response by selection from F_{3p}

Table (4-b): Regression mean square of no. of kernels / spike.

Fx / Fy	S.O.V	Population 1	Population 2	Population 3	Population 4
F_3/F_2	Joined	22.38	29.92	323.24*	57.32
	Families	356.14**	131.08	224.49**	560.85**
	Pure errors	79.22	79.53	56.27	62.75
F_4/F_3	Joined	251.56*	2687.65**	2471.10**	44.93
	Families	878.54**	510.64**	346.97**	1163.94**
	Pure errors	60.43	64.38	98.84	55.612

Table (4-c): Genetic attributes of no. of kernels / spike.

	Estimate	Population 1	Population 2	Population 3	Population 4
G.C.A. effect	P_1	3.713**	3.92**	3.921**	-3.863**
	P_2	-1.563**	-1.704	-0.504	-0.504
S.C.A. effect	$P_1 \times P_2$	-10.625**	2.045	-4.221**	4.962**
GCA/SCA	3.128*				
F_3/F_2	$h^2_{b.s}$	0.84	0.35	0.76	0.88
	GS_1	9.89	2.30	6.15	11.07
	$h^2_{n.s}$	0.49	0.56	0.53	0.74
	GS_2	5.77	3.68	4.29	9.31
F_4/F_3	$h^2_{b.s}$	0.92	0.91	0.84	0.95
	$G.S_1$	19.93	15.24	14.27	20.87
	$h^2_{n.s}$	0.96	0.86	1.00	0.28
	GS_2	20.80	14.40	17.16	6.15
Total variance	H	-1297	-1173	583	-1246
	D	216	154	40	221

IV.1.3- Weight of 1000-kernels:

Selected F_4 parents (F_3s) surpassed significantly their respective F_3 population with 50, 109, 26 and 36% (Table 5-a). These values decreased, due to segregation in F_4 but still greater than those of F_3 by 15, 68, 14, and 20% suggesting considerable additive type of gene action in controlling 1000-kernel weight.

Regression analysis (results Table 5-b) supports this conclusion. Coefficients of regression were significantly positive for almost all populations. The significant regression and families mean squares reflect continuous segregation, and may suggest existence of some non-additive effects. The previous estimate of GCA / SCA estimate of 0.682 **(El-Hosary *et al.* *2000*)**, supports the prevalence of non-additive gene action (Table 5-c).

Partitioning F_3 and F_4 variances showed high estimates of broad sense heritability ranging within 88-99% and 74 - 98%, for the two generations, respectively.

Applying regression among generations to estimate narrow sense heritability resulted in considerably higher estimates in F_3/F_2 (30-100%) compared with F_4/F_3 (27–64%) indicating decreased additive effects as compared with the non-additive as shown from the expected genetic advance detected for the fourth population. Estimates of F_3 were 15.24, 20.94, 5.47, and 11.62 g/1000-kernel (42, 82, 19, and 36%), compared with 5.73, 7.11, 9.22, and 2 g/1000-kernel (14, 16, 28, and 5%) in F_4 for the four populations, respectively.

Considerably moderate to high estimates of heritability were reported by **Busch and Kofoid (1982), Li and Yang**

(1985) and Walls and Kofoid (1986), with ranging of 38 to 92.5. However, very low values of expected genetic advance for 1000-kernel weight, were obtained by several workers, e.g. 0-1.72% by **Hamada (1988)**, -4.3–18% by **Solomony (1988)**, -0.3–8.6% by **Mahdy (1988b)** and 14.38 % by **Amin *et al.* (1992)** supporting the outcome of prevalence of non-additive genetic effects.

Including the third and fourth generations in computing variance components, revealed the prevalence of dominance (non-additive) genetic except for the third population which agreed with its high narrow sense heritability and expected genetic advance, indicating that selection for heavier kernels directly in this population, could be useful in improving grain yield .

Effect types of gene action in controlling 1000-kernel weight were reported by different workers, depending on the material under study. **Khalil *et al.* (1979); Mehla *et al.* (2000) and Hamada *et al.* (2002)** found that non-additive gene effects predominated gene action controlling 1000-kernel weight. **Aslam *et al.*, (1985)**, reported both additive and non-additive effects. **Nada *et al.* (1990)**, also found predominance of additive and additive X additive types.

However, as early as F_1, successful breeding program for valuable populations could be predicted according results of diallel population on analysis.

IV.1.4- Grain yield, (g/plant):

Data in Table (6-a) showed early high performance by selection for grain yield, in spite of continued segregation, as known for such a complex trait of grain yield. While the progress reached 99 – 180% in F_3s (F_4 parents) over F_3 population means, it decreased to 25 and 91% for the first two populations, but increased to 139–180 for the last two population.

Whan *et al.* (1981*)* found considerable improvement in grain yield by selection in early or late generations. While high yielding genotypes may be lost by delaying selection, this was counteracted by the better productive value of late generations due to their greater homozygosity and homogeneity. In another work, **Whan *et al.* (1981)** showed that there was higher correlation between lines from the F_4 and F_5 than between lines from F_2 and F_3, due to greater homozygosity in later generation. However, it does not necessary follow that selection in late generations well give greater improvement. The genetic variation and generation means might reduce so that selection in F_4, would be no better than in F_2.

These results, on the other hand, may suggest the operation of both additive and non additive types of gene action, and are not in concordance with previous results of diallel analysis ***(*El-Hosary *et al.* 2000),** which resulted in GCA/ SCA of 0.698.

However, the low or insignificant joint regression as compared with those between families over the two generations Table (6-b) may be due to non-additive genetic effects.

In support of these outcomes, the F_3/ F_2 narrow sense heritabilities Table (6-c) were comparatively very low (9-15%) as compared to those of broad sense (67 - 85%). In F_4/ F_3, the situation was improved, as narrow sense estimated heritability increased (35-65%) due to segregation and accumulation of additive minor genes, especially for the second and the fourth populations, whereas broad sense heritability estimates were decreased being 47 and 65% so that expected genetic gain by selection reached 1.14 and 2.44 g/plant (29 and 54%).

Including both generations in computing variance components (Table 6-c) supported the previous results in that dominance effect accounted for most completely genetic variance for the first and the third populations while in the second and the fourth populations were variance components completely of additive type, i.e. 100% of genetic variance.

These results reflect those obtained for number of kernels/ spike, indicating the importance of indirect selection for via this component are in full agreement with results reported by **Mitkees *et al.*(1992) and Haggag *et al.* *(1992)*.**

On the other hand, the GCA/SCA may not suffice, act as predictive value for complex trait such as grain yield, as well as its components as number of kernels. Also, **Hansel. (1984*),*** pointed out that the efficiency of selection for complex characteristic by a sub trait, depends on the heritability of the complex characteristic (h^2_c); heritability of sub trait (h^2_s) and the genotypic correlation between them r_{sc}. Indirect selection, then, is more efficient than direct selection when the product h^2_s X r_{sc} exceeds h^2_c.

Table (6-a): Average grain yield in F_2,F_3 and F_4 for the four populations as affected by selection.

P.op.		Population 1		Population 2		Population 3		Population 4	
		$\bar{x}$ ± L.S.D.	R.S. %	$\bar{x}$ ± L.S.D.	R.S. %	$\bar{x}$ ± L.S.D.	R.S. %	$\bar{x}$ ± L.S.D.	R.S. %
F_{3p}		2.05 ± 0.19		2.94 ±0.20		1.52 ± 0.13		1.60 ± 0.11	
F_{3S}		5.73 ± 0.25	180	5.85 ± 0.14	99	3.67 ± 0.17	141	3.72 ±0.13	133
F_{4p}		3.91 ± 0.71	91	3.67 ± 0.21	25	3.63 ± 0.21	139	4.48 ± 0.26	180
L.S.D 0.05	$F_{3p} - F_{3S}$	0.31		0.24		0.21		0.17	
	$F_{3S} - F_{4p}$	0.37		0.25		0.27		0.29	
	$F_{3p} - F_{4p}$	0.33		0.29		0.25		0.28	

R.S: Response by selection from F_{3p}

Table (6-b): Regression mean square of grain yield.

Fx / Fy	S.O.V.	Population 1	Population 2	Population 3	Population 4
F_3/F_2	Joined	5.96*	2.09	0.20	0.19
	Families	9.32**	9.31**	5.06**	1.92**
	Pure errors	1.30	1.61	0.72	0.64
F_4/F_3	Joined	21.83**	0.80	0.90	3.35
	Families	2.86*	22.41**	5.46**	33.73**
	Pure errors	1.71	1.24	1.51	2.19

Table (6-c): Genetic attribute of grain yield.

		Population 1	Population 2	Population 3	Population 4
G.C.A. effect	P_1	-0.681**	-0.393**	-0.393**	-0.247**
	P_2	0.753**	0.715**	-0.147	-0.147
S.C.A. effect	$P_1 \times P_2$	2.498**	1.081**	1.143**	0.798**
GCA/SCA		0.698			
F_3/F_2	$h^2_{b.s}$	0.85	0.82	0.85	0.67
	GS_1	1.52	1.38	1.01	0.48
	$h^2_{n.s}$	0.15	0.09	0.09	0.09
	GS_2	0.27	0.15	0.11	0.06
F_4/F_3	$h^2_{b.s}$	0.72	0.94	0.69	0.93
	GS_1	1.38	2.28	1.01	3.49
	$h^2_{n.s}$	0.35	0.47	0.40	0.65
	GS_2	0.67	1.14	0.59	2.44
Total variance	H	7.25	-10.35	7.36	-63.15
	D	0.37	2.39	-8.52	8.05

IV.2- Direct and indirect selection criteria

IV.2.1- The first population (Bani Sweif 1 x Sohag 1):

Results show that in the first population mean squares of the four criteria of selection; no. of spikes / plant, no. of kernels / spike, 1000-kernel weight and grain yield / plant shown in (Table 7). Significant differences between criteria in grain yield and its components.

Table (8) shows the effect of selection criteria on the four traits . Selection for high no. of spikes / plant gave the highest no. of spikes / plant and resulted in high grain yield / plant.

Concerning the differences between selection criteria for no. of kernels / spike, it is clear that selection criteria significant by affected this trait. The highest number of kernels / spike was achieved via selection for high no. of kernels / spike followed by high grain yield/plant. However, selection for heavier 1000-kernel weight. This result was logic expected **Mitkees. (1991), and Haggag (1991)**.

Haugerad and Cantrell (1984) found significant gains for kernel weight (2.80-3.40 mg) in one population and (1.70-3.80 mg) in the second population. Results indicated that improvement of kernel weight was associated with decrease in number of kernels/spike.

Islam *et al.* (1985 a) indicated that direct F_3 line selection for yield components was more effective than selection for yield *per se.* F_3 selections for number of kernels/spikelet gave positively correlated response for most yield components and yield/plant at two planting densities. Selection for number of kernels/spike resulted in positively correlated responses in yield

Table (7): Mean square for the four selection criteria and lines four selection in the first population.

Source of variation	d.f	No of spikes /plant	No .of Kernels /spike	1000-kernel weight	Grain yield g/plant
Rep.	2	$0.65^{n.s}$	$26.09^{n.s}$	5.78^{**}	$1.32^{n.s}$
Line	39	1.11^{**}	83.90^{**}	70.43^{**}	6.31^{**}
Selection criteria	3	4.16^{*}	298.8^{**}	300.75^{**}	9.01^{**}
Lines / sel. Cri.	36	0.89^{**}	65.99^{**}	51.24^{**}	6.09^{**}
Error	78	0.27	32.62	1.61	1.18

components (except kernel weight) and yield/plant at high density. Selection for kernel weight in both populations gave significant increases in yield/plant at low density.

With respect to the effect of selection on 1000-kernel weight, the results revealed that selection for heavier 1000-kernel weight gave heavier seed index followed by selection of high number of spikes / plant. However, selection of high no. of kernels / spike gave the lowest one.

Loffler *et al.* (1983) used recurrent selection to improve yield in wheat. They obtained a decrease of 0.2 mg in kernel weight and a decrease of 73.0 grain/m^2 in grain yield from two cycles of selection.

Generally, selection of high no. of spikes / plant, gave the highest grain yield / plant, no. of spikes / plant and the second for no. of kernels / spike and seed index. As early as **1964, Grafius** suggested that improvement of complex characters like yield may be accomplished through components breeding. Similarly, many workers **(Takeda and Frey, 1976; McNeal *et al.,* 1978; Johanson *et al.,* 1983; Bahi and Vinod, 1991; Kumar and Bahi, 1992)** came to the same conclusion. In this study showed that the present first population expressed selection for high number of spikes / plant was more efficient as indirect selection for high yield. This result may be due to significant SCA effects for no. of spikes / plant and grain yield / plant and that P_2 (Sohage 1) was a good combiner for no. of spikes and grain yield / plant. Also, P_1 (Bani Swieff 1) gave significantly higher g_i effects for no. of grains / spike. **El-Hosary *et al.* (2000).**

It could be concluded that selection for high no. of spikes / plant in the three successive generations was successful for improving the high grain yield / plant in F_5 generation in this population.

Mean squares due to selected lines and lines/methods were significant for all the studied traits (four traits) Table (7).

The mean values of selected F_5 lines for yield and its components were affected by selection criteria (indirect i.e., no. of spikes / plant, no. of kernels / spike, and 1000-kernel weight and direct selection high grain yield / plant).

For no. of spikes / plant, four and three lines were significantly higher than population mean or best parent when selected plants with high no. of spikes and grain yield / plant, respectively (Table 9). This result is logically expected. The best lines were no. 10 when selected with high no. of spikes and no. 8, 6 and 10 when selected plants with high grain yield / plant.

For no. of kernels / spike, the line no. 2 when selecting plants with high no. of kernel significantly, surpassed the grand mean or best parent .For 1000-kernel weight, one and two; one and one; two and eight and zero and three lines exhibited significant grain index than best parent and grand mean when selected plants with high no. of spikes, no. of kernel / spike, 1000-kernel weight and grain yield / plant, respectively.

Table (8): Mean values of the four selection in the first population.

Selection Criteria \ Trait	No of Spikes/ Plant	No. of Kernels /Spike	1000- kernel Weight	Grain Yield g/plant
No of Spikes/Plant	4.87[a]	44.26[b]	39.34[b]	8.51[a]
No .of Kernels /Spike	4.05[c]	48.56[a]	36.31[c]	7.17[b]
1000- kernel Weight	4.14[c]	40.86[b]	43.93[a]	7.72[b]
Grain Yield (g/plant)	4.49[b]	44.96[ab]	38.90[b]	7.78[b]
L .S. D 0.05	0.27	2.95	0.66	0.56
L. S. D 0.01	0.36	3.91	0.88	0.75

Regarding grain yield / plant, the range of selected lines was from 6.49 to 11.23; 5.79 to 10.71; 6.44 to 10.09 and 6.26 to 10.09 when selecting plants with high no. of spikes / plant, no. of kernels / spike, 1000-kernel weight and grain yield / plant, respectively. Also, five and two; one and one; two and one, and three and one lines significantly surpassed higher grain yield / plant than best parent and grand mean, respectively in the same order. In addition, the best lines were, no. 4 and 7 when selecting plant with high no. of spikes / plant, no. 3, 9 and 6 when selecting plants with high number of kernels / spike, 1000-kernel weight and grain yield / plant, respectively.

It could be concluded that indirect selection for yield via no. of spikes/plant is more efficient than direct selection for yield *per se*.

The comparison revealed the efficiency of selection for number of spikes/plant followed by heavier seed index in improving mean yield of F_5 lines in this population and also extracting a higher number of high yielding lines (selection for high no. of spikes/plant and heavier seed index). Similar observations have been reported by other workers in bread wheat. **(Nass, 1973; McNeal *et al.,* 1978; Johanson *et al.,* 1983 and Tejbir *et al.,* 2003)**.

It is interesting to examine the combining ability with regard to seed yield of parents involved in the populations which yielded a relatively high proportion of lines which excelled the check significant in terms of seed yield. This information was available from the populations studied by **(El-Hosary *et al.,* 2000).**

Table (9) Mean performance of the selected F_5 four selection criteria in the first population.

Selection criteria	Treats / No. of line	Spikes / Plant	Kernels/Spike	1000-Kernel Weight	Grain Yield (g/plant)
Spikes / Plant	1	4.63	40.40	38.67	7.24
	2	4.33	53.40	38.03	8.80
	3	4.33	39.77	37.40	6.49
	4	5.23	45.17	47.30	11.23
	5	4.50	45.90	39.00	8.09
	6	5.03	43.70	41.17	9.05
	7	5.37	46.07	42.47	10.50
	8	5.37	42.63	41.70	9.54
	9	4.30	43.77	36.03	6.76
	10	5.57	41.77	31.70	7.40
Kernels/Spike	1	4.23	48.33	36.73	7.52
	2	4.37	55.07	32.07	7.73
	3	4.37	49.53	49.53	10.71
	4	3.97	46.40	32.43	5.97
	5	3.87	43.47	36.33	6.12
	6	3.90	46.80	32.33	5.90
	7	4.07	46.60	33.33	6.36
	8	3.20	50.73	35.67	5.79
	9	4.33	45.97	36.37	7.24
	10	4.17	52.73	38.33	8.40
1000 Kernel Weight	1	3.67	44.57	43.67	7.09
	2	4.30	36.43	41.20	6.44
	3	3.97	38.67	42.20	6.48
	4	3.57	26.10	49.20	7.42
	5	4.63	46.50	42.90	9.24
	6	4.03	45.13	42.80	7.79
	7	4.17	43.13	41.10	7.38
	8	4.10	41.27	42.63	7.21
	9	5.13	45.20	43.47	10.09
	10	3.87	41.67	50.10	8.07
Grain Yield (g/plant)	1	4.33	53.10	37.03	8.50
	2	3.27	48.50	39.90	6.32
	3	4.07	38.70	44.80	7.06
	4	4.63	42.13	37.20	7.27
	5	3.77	45.00	37.00	6.26
	6	5.40	44.53	42.03	10.09
	7	4.60	43.77	36.27	7.31
	8	5.43	51.33	31.97	8.89
	9	4.00	38.00	43.47	6.61
	10	5.40	44.57	39.33	9.48
X		4.39	44.66	39.62	7.8
P1		4.32	44.4	30.97	5.94
P2		3.86	40.75	43.8	6.89
L.S.D .05		0.85	9.33	2.07	1.78
L.S.D .01		1.12	12.40	2.78	2.37

IV.2.2- The second population (Bani Sweif 3 x Sohag 2):

Results in table 10 show that generally, selection of heavier grain index gave the highest 1000-grain weight, high no. of kernels / spike and grain yield / plant, also selection of high number of kernels / spike gave the highest no. of kernels / spike, number of spikes and grain yield / plant. In addition, the selection of spikes / plant exhibited gave the highest no. of spikes / plant exhibited the highest no. of spikes and grain yield / plant (Table 11). **Grafius (1964)** suggested that improvements of complex characters such as yield may be achieved via components breeding.

Nass (1973); Ialam *et al.* (1985a) and Hamada (1988) suggested that selection for component traits can help in increasing productivity. In this population, it is clear that selection for these components of yield (indirect selection) was more efficiency than direct selection for yield it self.

Concerning the differences between selection criteria on number of spikes / plant, it is clear that selection criteria significantly affected no. of spikes / plant. The highest no. of spikes / plant was obtained from selection for no. spikes/plant followed by high grain yield/plant. However, the selection of 1000-grain weight gave the lowest one (Table, 11).

With respect to the effect of selection criteria on no. of kernels / spike, the results revealed that selection for number of kernels / spike gave significantly higher no. of spikes/ plant gave lowest one (Table, 11).

Table (10): Mean square for the four selection criteria and lines/selection criteria in the selection Fs lines of the second population.

Source of variation	d.f	No of spikes/ plant	No .of kernels/ spike	1000 grain weight	Grain yield (g/plant)
Rep.	2	0.52^{*}	$4.53^{n.s}$	$3.68^{n.s}$	$1.08^{n.s}$
Line	39	1.51^{**}	30.93^{**}	71.10^{**}	7.9^{**}
Selection critaria	3	5.84^{**}	95.79^{**}	406.21^{**}	3.84^{**}
Lines / sel. Cri.	36	1.15^{**}	25.52^{**}	43.13^{**}	8.20^{**}
Error	78	0.13	1.93	1.74	.63

For grain index, the selection of heavier seed index exhibited significantly higher value of this trait.

Concerning the effect of selection criteria on grain yield / plant, the selection of heavier grain index gave significantly highest grain yield / plants followed by selection of high no. of kernels / spike and then by selection of high no. of spikes / plant (Table, 11).

Mean square due to line and lines/selection criteria were significant for yield and the three yield component are presented in Table (10).

The mean values of selected F_5 lines for no. of spikes / plant, no. of kernels / spike, 1000-kernel weight and grain yield / plant were affected by selection criteria (indirect and direct selection) are presented in Table (12).

For no. of spikes / plant, seven and six , one and one, one and one and three and two lines gave significantly higher than mean value of high no. of spikes / plant, no. of kernels / spike, 1000-kernel weight and grain yield / plant, respectively. This result is logically expected.

For no. of kernels / spike, three and one, nine and four, seven and five, and four and two lines gave significantly higher than mean values of best parent and overall mean, when selected plants were characterized by high no. of spikes / plant, no. of kernels/spike, 1000-kernel weight and grain yield/plant, respectively. For this trait the selected plants with high no. of kernels/ spike and heavier grain gave high no. of lines surpassing the overall mean.

Table (11): Mean values of the four selection in the second population.

Trait / Selection Criteria	No of spikes/ plant	No .of kernels/ spike	1000- kernel weight	Grain yield (g/plant)
No of spikes /plant	4.82 ^{a}	46.36 ^{c}	34.38 ^{d}	7.72 ^{a}
No .of kernels/ spike	4.05 ^{a}	50.32 ^{a}	39.15 ^{b}	7.78 ^{a}
1000- kernel weight	3.78 ^{b}	49.05 ^{a}	42.81 ^{a}	7.99 ^{a}
Grain yield (g/plant)	4.21 ^{a}	47.21 ^{b}	36.23 ^{c}	7.22 ^{b}
L .S. D 0.05	0.19	0.72	0.68	0.41
L. S. D 0.01	0.25	0.96	0.91	0.55

With respect to 1000-kernel weight, five and two, nine and five, ten and nine, and seven and two lines gave significantly higher than best parent and overall mean, when selected plants were characterized by high no. of spikes / plant, no. of kernels / spike, 1000-kernel weight and grain yield / plant, respectively.

Regarding grain yield / plant, selected lines ranged from 5.68 to 10.54; 5.70 to 10.29; 6.41 to 12.36 and 5.46 to 10.24 when selection was practiced for plants with high no. of spikes / plant, no. of kernels / spike, 1000-grain weight and grain yield / plant, respectively. Also, two and six; two and seven two and six, and two and five lines exhibited significantly overall mean and best parent in the same order. In addition, the best lines were no. 5, no. 3, no. 7 and no. 7 derived from selected plants with heavy seed index, no. of spikes / plant, no. of kernels / spike and seed yield / plant, respectively (Table, 12).

Generally, it could be concluded that indirect selection for yield via high no. of kernels / spike and heavy seed index was more efficient than direct selection for *yield per se*.

The comparison revealed the efficiency of selection for no. of kernels / spike and 1000-kernel weight in improving mean yield of F_5 lines. It also indicate that indirect selection for yield via either no. of kernels / spike or heavier grain index was more efficient than direct selection for yield. Similar observations have been reported by other workers. **Nass (1973); Ialam *et al.*, (1985a) and Hamada (1988)** reported that selection for no. kernels/spike or heavier seed index was more effective in extracting maximum value of high yielding F_5 lines than other methods.

The population (Bani Sweiff 3 × Sohage 2) gave the highest (SCA) effects for no. of spikes, 1000-kernel weight and grain yield / plant, and the parent weight and grain yield / plant, and the parent P_1 (Bani Sweiff 3) was a good combiner for yield components and P_2 (Sohage 2) for grain yield. Apparently, the population with H x L general combining ability effects responded to selection pressure for no. of kernels / spike and heavier grain index. It seems that sufficient additive genetic variation for high no. of kernels / spike and heavier grain index was present in the base material leading to fixation of transgressive segregates. It is of interest to examine the combining ability with regard to grain yield.

Table (12) Mean performance of the selected F_5 four selection criteria in the second population.

Selection criteria	Treats / No. of line	Spikes / Plant	Kernels/Spike	1000-Kernel Weight	Grain Yield (g/plant)
Spikes / Plant	1	4.07	44.20	31.60	5.68
	2	4.10	42.17	34.30	5.90
	3	4.90	51.70	41.60	10.54
	4	4.87	47.00	29.80	6.83
	5	4.77	44.80	41.70	8.90
	6	5.60	50.17	34.00	9.55
	7	5.23	44.00	31.30	7.21
	8	4.13	47.83	30.40	5.99
	9	5.17	45.03	38.73	9.00
	10	5.37	46.70	30.37	7.61
Kernels/Spike	1	4.40	50.37	36.43	8.07
	2	4.03	52.77	38.20	8.12
	3	3.73	49.00	31.13	5.70
	4	3.80	51.63	41.03	8.08
	5	3.43	47.30	41.13	6.69
	6	4.47	51.27	42.07	9.64
	7	5.10	48.33	41.77	10.29
	8	4.00	50.03	40.17	8.02
	9	3.20	52.07	41.17	6.86
	10	4.30	50.47	38.43	8.34
1000- Kernel Weight	1	4.00	53.17	42.10	8.98
	2	4.13	52.27	43.20	9.33
	3	3.50	51.33	41.53	7.48
	4	3.57	49.70	41.73	7.39
	5	5.17	51.13	46.73	12.36
	6	4.30	45.73	41.10	8.08
	7	3.40	51.97	38.93	6.87
	8	3.23	43.67	45.77	6.46
	9	3.30	43.77	45.10	6.51
	10	3.20	47.73	41.90	6.41
Grain Yield (g/plant)	1	4.30	52.77	38.00	8.66
	2	4.07	44.30	31.60	5.70
	3	4.30	42.87	31.30	5.77
	4	3.43	51.67	41.63	7.41
	5	4.77	47.73	41.27	9.38
	6	4.87	46.90	29.47	6.72
	7	5.60	45.63	40.07	10.24
	8	3.27	48.40	34.50	5.46
	9	4.07	46.63	36.50	6.94
	10	3.47	45.23	37.97	5.96
$\bar{X}$		4.22	48.24	38.14	7.73
P1		3.89	41.2	28.33	4.54
P2		4.1	45.33	30.02	5.58
L.S.D .05		0.59	2.27	2.15	1.30
L.S.D .01		0.77	3.01	4.38	1.70

IV.2.3- The third population (Bani Sweif 3 x Sohag 3):

Mean squares due to four selection criteria showed high significance (Table, 13).

Table (14) shows the effects of selection criteria on the four traits under study. For no. of spikes / plant, selection for high no. of spikes / plant gave the highest no. of spikes / plant as compared to the other selection criteria.

Concerning differences between selection criteria on no. of kernels / spike., it is clear that selection criteria significantly affected no. of kernels / spike. The highest no. of kernels / spike was recorded from selection for high no. of kernel / spike followed by high no. of spikes / plant and then by seed index.

With respect to the effect of selection criteria on 1000-kernel weight, the results revealed that selection for 1000-kernel weight gave significantly heavier seed index followed by selection for high no. of spikes / plant. On the other side, selection of high no. of kernels / spike gave the lowest grain index.

For grain yield / plant, the selection criteria of heavier seed index and high number of spikes / plant exhibited significantly the highest values of grain yield. Reversely, the selection criteria of high no. of kernels and high grain yield / plant gave the lowest one.

Generally, selection of heavier seed index and high number of spikes / plant gave the highest values of grain yield / plant.

Mean square due to selected F_5 lines showed significant differences among all traits (Table 13).

Table (13): Mean square for the four selection criteria and lines/selection criteria in the selection Fs lines of the third population.

Source of variation	d.f	No of spikes /plant	No .of Kernels /spike	1000-kernel weight	Grain yield (g/plant)
Rep.	2	$0.05^{n.s}$	4.41^{*}	$0.99^{n.s}$	$0.36^{n.s}$
Line	39	0.2^{*}	37.79^{**}	98.54^{**}	2.46^{**}
Selection critaria	3	0.91^{**}	27.77^{**}	252.6^{**}	6.03^{**}
Lines / sel. Cri.	36	$0.14^{n.s}$	38.62^{**}	85.70^{**}	2.16^{**}
Error	78	0.09	1.65	0.73	0.29

Mean values of F_5 lines for yield and its components were affected by selection criteria (indirect i.e., no. of spikes / plant, no. of kernels / spike and 1000-grain weight and direct selection of high yield / plant).

However, only average values of number of spikes/plant and grain yield / plant recorded significant progress more than F_4 expected values but non didn't reach the best parent similar similarly was results of other treats. This may be attributed to transgressive segregation of dominant genes, in absence of additive effect.

The selection criteria of no. of spikes/plant, resulted in 4 lines superior in kernels/spike, i.e., no. 1, 4, 5 and 8, 5 lines with heavy kernels, i.e., no. 2, 3, 4, 7 and 10, and four high yielding line, i.e., 1, 2, 4 and 5 but more could exceed neither the population mean on the best parent in no. spikes/plant. This best four lines are those number 1, 2, 4 and 5.

For no. of kernels/spike only the two lines 6 and 10 did produce number of kernels/spike more than the best parent, beside four lines (1, 5, 8 and 9) with heavy kernels but only two lines (5 and 9) as the highest yielding.

By selection for heavy kernels we obtained three lines, i.e., 5, 6 and 9 with higher kernels/spike than the highest parent, all with heavy kernels lines, as compared to the heaviest parent. The highest yielding lines were five, i.e., 1, 2, 6, 7 and 9.

The most elite high yielding lines obtained by indirect selection were three lines, i.e., 1, 5 and 9. Direct selection for grain yield produce three lines with high number of kernels/spike (1, 2 and 9), four lines

For no. of spikes / plant, the two lines no. 1 and 5, when selecting plants with high no. of spikes significantly surpassed the grand mean only.

Regarding grain yield / plant, the selected lines was from 4.23 to 7.81; 4.26 to 6.95; 5.32 to 6.97 and 3.87 to 6.80 when selection was practiced for plant with high no. of spikes / plant, no. kernels / spike, heavy seed index and high grain yield, plant, respectively. Also, four and three, two and two five and one and two and one lines surpassed significantly the best parent and grand mean in the same order. (Table, 15)

It could be concluded that selection of high no. of spikes / plant and heavier seed index gave the highest mean values of grain yield / plant and high no. of promosing F_5 lines. In support of the results **Ketata *et al.*, (1976b); Busch and Kofoid (1982); Guzhovyu L. (1986); McNeal *et al.*, (1978); Singh *et al.* (2001) and Tejbir *et al.* (2003)** suggested that selection for component traits can help in increase productivity.

Table (14): Mean values of the four selection in the third population.

Selection Criteria \ Trait	No of spikes/ plant	No .of Kernels /spike	1000-kernel weight	Grain yield (g/plant)
No of spikes/plant	3.56 [a]	46.24 [b]	37.85 [b]	6.19 [a]
No .of kernels/spike	3.19 [b]	47.38 [a]	36.07 [c]	5.45 [b]
1000-kernel weight	3.20 [b]	45.88 [b]	42.36 [a]	6.21 [a]
Grain yield (g/plant)	3.30 [b]	45.06 [c]	36.37 [c]	5.40 [b]
L .S. D 0.05	0.15	0.66	0.44	0.29
L. S. D 0.01	0.21	0.88	0.59	0.37

Table (15) Mean performance of the selected F_5 four selection criteria in the third population.

Selection criteria	Treated / No. of line	Spikes / Plant	Kernels/Spike	1000-Kernel Weight	Grain Yield (g/plant)
Spikes / Plant	1	3.97	51.67	32.20	6.62
	2	3.40	46.67	49.27	7.81
	3	3.43	41.23	43.83	6.23
	4	3.60	48.60	39.97	6.98
	5	4.17	53.40	30.70	6.84
	6	3.67	42.53	34.40	5.36
	7	3.27	45.13	42.43	6.26
	8	3.20	49.53	36.47	5.77
	9	3.60	38.93	30.27	4.23
	10	3.33	44.70	39.00	5.82
Kernels/Spike	1	3.00	43.90	38.60	5.08
	2	3.13	45.63	29.77	4.26
	3	3.10	47.83	35.27	5.23
	4	3.20	46.67	31.30	4.68
	5	3.13	47.37	45.83	6.79
	6	3.10	49.83	34.00	5.25
	7	3.30	46.97	32.53	5.04
	8	3.37	46.47	37.17	5.81
	9	3.33	48.03	43.43	6.95
	10	3.20	51.07	32.83	5.36
1000 Kernel Weight	1	3.30	44.00	45.00	6.54
	2	3.03	45.27	43.70	6.00
	3	3.13	45.33	41.53	5.90
	4	3.20	41.67	43.00	5.74
	5	3.17	48.80	41.50	6.41
	6	3.43	49.13	39.57	6.67
	7	3.00	46.07	45.80	6.33
	8	3.17	43.00	39.07	5.32
	9	3.23	50.50	42.70	6.97
	10	3.33	45.00	41.70	6.24
Grain Yield (g/plant)	1	3.70	52.00	33.63	6.45
	2	3.13	49.43	29.33	4.55
	3	3.20	46.73	45.47	6.80
	4	3.20	44.27	27.37	3.87
	5	3.33	41.33	37.87	5.22
	6	3.30	42.57	34.57	4.85
	7	3.03	44.87	44.50	6.05
	8	3.10	41.10	44.23	5.64
	9	3.43	49.33	36.50	6.16
	10	3.77	38.97	30.23	4.43
$\bar{X}$		3.32	46.14	38.16	5.81
P1		3.8	46.2	25.86	4.54
P2		3.3	45.75	35.70	5.39
L.S.D .05		0.49	2.09	1.40	0.88
L.S.D .01		0.65	2.79	1.86	1.17

IV.2.4- Fourth population (Bani Sweif 2 x Sohag 2):

Mean squares due to four-selection criteria were highly significant, revealing that the selection effects differed from each other (Table, 16).

Table (17) shows the effect of selection criteria on four traits under study.

The highest no. of spikes / plant was recorded from selection for high no. of spikes / plant followed by selection to high grain yield / plant. While, the selection to heavier seed index gave the lowest one.

With respect to the effect of selection criteria on no., of kernels/spike, the selection of high no. of kernels/ spike gave significantly higher value followed by selection to heavier seed index as the selection of high no. of spikes / plant gave the lowest one.

Concerning the effect of selection criteria on 1000-kernel weight, the selection of heavier grain index gave significant the highest value followed by selection to high grain yield / plant. However, the selection of high no. of kernels / spike and no. of spikes / plant gave the lowest ones.

For grain yield/ plant, the selection criteria of heavier seed index exhibited significantly the highest value of grain yield, followed by either selected plants with high no. of kernels or grain yield / plant. The other three selection criteria were insignificantly different.

Mean square due to lines were significant for the four studied traits (Table, 16).

The mean values of selected F_5 lines for no. of spikes/plant, no. of kernels/spike, 1000-kernel weight, and grain yielded/plant were affected by selection criteria (direct and indirect selection) are presented in Table (17).

However, only average value of spikes/plant exceeded the respective F_4 expectation (Table, 18)

For no. of spikes / plant, line no. 2 when selecting plants with high no. of kernels / spike and lines no. 2 and 6 when selecting plants with high grain yield / plant gave significantly higher than grand mean. However, none of the other selected lines gave significantly higher than the best parent.

For no. of kernels / spike, two and one, seven and six, three and two and two and zero lines surpassed significantly population mean and best parent when selection was practized for high no. of spikes / plant, no. of kernels / spike, 1000-kernel weight and grain yield / plant, respectively, these results are logically expected.

For 1000-kernel weight, one and two; two and two; seven and seven; and two and two lines exhibited significantly higher than grand mean and best parent when selected plants with high number of spikes / plant, no. of kernels / spike, 1000-kernel weight and grain yield / plant, respectively. This results is logically expected. The best lines were no. 4, 5 and 6 when selected plants with heavier kernels and no. 5 and 7 when selected plants with high grain yield / plant. This result may be due to the parent (P1) was considered a good combine for this trait.

Table (16): Mean square for the four selection criteria and lines / selection criteria in the selection Fs lines of the Four population.

Source of variation	d.f	No of spikes /plant	No .of Kernels /spike	1000-kernel weight	Grain yield (g/plant)
Rep.	2	$0.2^{n.s}$	$0.47^{n.s}$	$2.97^{n.s}$	0.93^{*}
Line	39	0.60^{**}	60.45^{**}	101.30^{**}	2.86^{**}
Selection criteria	3	1.30^{**}	197.47^{**}	293.93^{**}	2.15^{**}
Lines / sel. Cri.	36	0.49^{*}	49.04^{**}	85.22^{**}	2.92^{**}
Error	78	0.14	0.36	1.25	0.31

Table (17): Mean values of the four selection in the four population.

Selection Criteria \ Trait	No of spikes /plant	No .of Kernels /spike	1000-kernel weight	Grain yield (g/plant)
No of spikes/plant	4.12^{a}	43.80^{d}	29.53^{c}	5.32^{b}
No .of kernels/spike	3.82^{b}	49.35^{a}	29.28^{c}	5.55^{b}
1000-kernel weight	3.67^{c}	45.45^{b}	36.03^{a}	5.96^{a}
Grain yield (g/plant)	4.06^{a}	44.05^{c}	31.28^{b}	5.51^{b}
L .S. D 0.05	0.19	0.31	0.58	0.29
L. S. D 0.01	0.27	0.41	0.77	0.37

Regarding grain yield / plant, the range of selected lines was from 4.35 to 6.48; 3.38 to 7.48; 4.71 to 7.38 and 4.07 to 6.92 when selecting plants with high no. of spikes / plant, no. of kernel / spike, 1000-kernel weight and grain yield / plant, respectively. Also, two lines gave significantly higher grain yield / plant than either the grand mean or the best parent when selecting plants with high no. of kernels / spike, 1000-kernel weight and grain yield / plant, respectively (Table, 18).

Generally the lowest efficiency of selection for most traits especially improving grain yield / plant in the F_5 lines. Apparently, the population with L x L g_i effects status was also low in responding to selection pressure for yield and most of its components. Whereas, significant positive sij effects were shown most of for no. of kernels / spike and grain yield / plant. While, the other two traits gave insignificant sij effects. However, 1000-kernel weight, one parent P_1 (Bani Swieff 2) gave significant positive g_i effects. **El-Hosary *et al., (2000)*.**

Table (18) Mean performance of the selected F_5 four selection criteria in the fourth population.

Selection criteria	Treats / No. of line	Spikes / Plant	Kernels/Spike	1000-Kernel Weight	Grain Yield (g/plant)
Spikes / Plant	1	4.00	43.83	34.10	5.98
	2	4.00	47.33	32.43	6.13
	3	4.97	44.27	28.90	6.35
	4	4.43	46.47	24.73	5.09
	5	4.03	38.00	28.57	4.38
	6	4.00	54.33	29.67	6.48
	7	3.67	38.87	30.57	4.35
	8	4.03	46.37	28.37	5.30
	9	4.03	37.60	28.67	4.35
	10	4.00	40.90	29.33	4.80
Kernels/Spike	1	3.67	54.33	24.67	4.91
	2	4.97	51.87	28.83	7.42
	3	4.00	47.33	24.03	4.55
	4	3.77	51.13	28.77	5.56
	5	3.33	49.73	34.43	5.71
	6	3.80	51.23	38.40	7.48
	7	3.87	45.47	29.53	5.18
	8	3.83	46.53	29.40	5.25
	9	3.07	46.37	23.77	3.38
	10	3.93	49.50	30.97	6.03
1000- Kernel Weight	1	3.77	42.90	34.43	5.56
	2	4.00	46.47	34.33	6.39
	3	3.30	49.43	28.83	4.71
	4	3.40	51.10	39.70	6.90
	5	3.13	46.93	39.20	5.77
	6	3.33	45.43	48.70	7.38
	7	4.17	44.67	31.40	5.84
	8	3.80	44.03	30.70	5.14
	9	3.87	45.93	34.63	6.15
	10	3.97	37.60	38.40	5.72
Grain Yield (g/plant)	1	3.73	44.07	24.73	4.07
	2	4.97	48.20	28.90	6.92
	3	4.00	45.93	24.03	4.42
	4	4.00	48.73	29.50	5.74
	5	3.80	36.50	39.73	5.51
	6	4.60	44.67	31.33	6.43
	7	3.80	37.60	48.03	6.85
	8	3.93	45.47	28.73	5.14
	9	4.03	46.37	29.37	5.49
	10	3.73	42.93	28.40	4.55
X		3.92	45.66	31.53	5.58
P1		3.30	48.32	27.53	4.39
P2		4.83	38.33	30.14	5.58
L .S.D .05		0.61	0.98	1.83	0.91
L .S .D .01		1.61	3.87	3.29	0.34