YIELDING ABILITY AND COMPETITION OF WHEAT VARIETAL MIXTURES AND THEIR COUNTERPARTS IN PURE STAND

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Abstract

No research on varietal blends of wheat in Egypt has been published. The purpose of this study was to determine if blends of wheat cultivars would be more productive than pure stands when grown under Egyptian conditions. Also, this study aims to evaluate the competitive ability of Egyptian wheat varieties. All of the 15 possible two-cultivar mixures of six wheat (*Triticum aestivum* L.) varieties and their counterparts were evaluated for yielding ability and competitive effect in two seasons 1992/93 and 1993/94. Four 2-cultivar blends averaged more than 20% for grain yield per acre of the mean of their components and 13.7% over the highest yielding component. The best combination was Sakha 61 to Sakha 69 since each one of its components had the highest competitive ability, 41% and 30% for grain yield respectively. Also, Sakha 61 and Giza 157 had high positive competitive ability.

The effect of competitive ability on grain yield is important and has implications for the breeder, who can use cultivars with high competitive ability as components of varietal blends . Competition effects for yield appeared to be associated with number of spikelets per spike and number of kernels per spike. The mean competitive effect (U') was generally small in comparison to the mean genetic effect (u). However, the highest relative competitive effect for grain yield was 36.8% for the mixture of Sakha 61 : Giza 157.

INTRODUCTION

The genetic structure of agricultural varieties of self-pollinated crop plants may take various forms. Typically, varieties are genetically uniform or occur as mixtures of closely related and phenotypically similar genotypes. The intervarietal mixtures are the type most widely proposed as alternative population structures. The yielding ability of mixtures in certain cases over the best component or over the mean performance of components. However, the performance of heterogeneous populations is adequately predicted by the mean performance of components. Rao and Prasas (1984) studied the grain yield and its components in three spring wheat genotypes in pure stands as well as in their binary mixed stands. They found that the majority of the mixed stands tended to outyield mid-monoculture yield rather than the pure stand yield of the better component genotype. They concluded that intergenotypic competition is a strong force in changing the behaviour of heterogeneous populations. Sakai (1955) has defined competition in a genetic context as the effect of interaction operating between individuals of different genotypes within a population .

Jensen and Federer (1965) pointed out that in the autogamous cereals where varieties are usually made of one genotype, the effect of intergenotypic competition has been principally a plant breeding consideration only durin the period of strain comparison; procedural measures in plot handling attempt to remove or minimize inter-plot responses.

Roy (1976) reported that competitve ability was expressed largely through plant survival critical competition must therefore, have occurred early in plant growth. The most competitive genotypes, as shown by survival also tended to have higher ear number, yeld per ear and yield per plant, showing a continuation of effective competition into the tillering and ear formation stages. He found that ear length, spikelet number and grains per spikelet were comparatively less affected by intergenotypic competition.

Brim and Schutz (1968) have shown that overcompensation can occur when certain pairs of soybean genotypes are grown together in a competitive situation. With over-compensation, the yield increase of the other genotype, consequently a net gain in yield of the mixture was observed. Sage (1971) found that the changes in yield of varieties in mixtures were mainly due to changes in yield per ear or ear size rather than changes in the number of ears produced on each plant.

Robert (1994) found that plant height was the character most associated with increased competitivenses among the wheat cultivars. But factors such as earley growth rates tillering ability and leaf area may also affect crop weed interactions.

Simmonds (1962) pointed out that the effect of competition on mean performance is generally small. The sign of competitive ability however, may be either positive or negative, and this could lead to changes in the ranking of populations, compared with the ranking of the means of the individual genotypes grown in pure culture that make up the populations. In rice, the character most strongly correlated with increases weed competitiveness was plant height (Kwon *et al* 1991).

MATERIALS AND METHODS

Materials and experimental procdure :

Six wheat varieties and all their fifteen 2-variety mixtures, were used to estimate the yielding ability, competitve ability and competitive effects for the blends and their counterparts. The six varieties used were Sakha 61, Skha 69, Sakha 92, Giza 157, Giza 160 and Giza 164. These varieties and their mixtures were grown at the Research Centre, Faculty of Agriculture, Cairo University, Giza, Egypt in two seasons, 1992/93 and 1993/94. Each experiment was lain out using partially balanced lattice design as given in Steel and Torrie (1980) with six replications. The mixtures were constituted in each season by blending equal wieght of seeds of the components .

Yielding ability estimation :

The yielding ability and the mean relative yields of mixed stands were calculated using the formulae (DE Wit and VAN DEN bergh, 1965) :

Yielding ability (HYA %) = (Y mix / Y mono) x 100

Mean relative yield (MYA% = (Ymix / Y mid-mono) x 100

Where,

Ymix = Mean performance of mixed stand

Ymono = Mean performace of the highest component genotype when grown in pure stand .

Y mid-mono = Mid-mono culture performance

$$= \frac{\text{Yaa mono} + \text{Y bb mono}}{2} \quad \text{where}$$

Yaa mono = pure stand performance of genotype a .

Ybb mono = pure stand performance of genotype b.

Competitive ability estimation :

The following equation was used by Fehr (1973) to compute the competitive ability of a cltivar : Competitive ability % = {The mean performance of a cultivar in competition-the mean performance of a cultivar in pure stand) x 100} . Because the separation of the different genotypes was impossible in each blend, we assumed that the performance of a cultivar in competition equals half of the mixed stand unit .

Esimation of the genetic and competitive effects :

on Sakai's (1955) method, the mean (μ) and additive (a") effects in Based mixed culture and mean (μ) and additive (a) effects for their pure culture counter parts and also competitve mean (μ') and additive (a') effects were computed using the following equations :

$E_{G1/p} = \mu + a$

$E_{G2/p} = \mu - a$

$E_{G1/M} = \mu + \mu' + a + a'$

$E_{G2/M} = \mu + \mu' + a + a'$

$\mu'' = \mu + \mu'$

$a'' = a + a'$

Where Eg1/and Eg2/p are the expected performance in pure stand of the two homozygous genotypes G1 and G2. EG1/ μ and Eg2/μ are the expected performance in mixed culture of the two homozygous genotype G1 and G2.

RESULTS AND DISCUSSION

1- Yielding ability :

Relative yielding ability to mid-parent (MYA) and to the highest parent (HYA) for the following yield characters are given in Table 1 .

Number of kernels per spike :

The mixtures C1 : C4, C2 : C5, C2 : C6, C3 : C6 and C4 : C5 were superior since they had the highest yielding ability values and increased their higher counterparts with range from 5 to 17 percent. Ten mixtures yielded out their mid nono culture and the increases of kernels per spike ranged from 1 to 27 percent and only two mixtures, Sakha 61 with Giza 157 and Giza 1.57 with Giza 160 showed yielding ability greater than 20%,

Kernels weight of spike :

The five mixed stands, C1 : C2, C1 : C4, C3: C4, C3 : C6 and C2 : C6 produced their higher yielding by 19, 24, 5, 15 and 15 percentages, respectively. Nine mixture gave positive yielding ability values when compared to mid-mono culture. However, the mixtures Sakha 61 with Sakh 69 and Sakha 92 with Giza 157 had yielding ability greater than 20% .

Number of spikes per one meter :

The mixtures C1 : C4, C2 : C3 and C3 : C6 gave higher yielding ability values by 3.2 and 1 percent, respectively. Five mixtures were superior and had higher yielding values when compared to midmono culture. Only one mixture Sakha 69 with Giza 160 had yielding ability greater than 60%.

100 kernel weight :

Three mixed stands which were C1 : C2, C1 : C5 and C3 : C5 out yielding the higher component genotypes by 1,10 and 3 percent respectively. Eight mixtures gave positive yielding ability values when compared to mid-mono cultre. Two mixtures, Sakha 69 and Sakha 61 with Giza 160 had yielding ability greater than 10%.

Grain yield :

Grain yield of all 1:1 blends was claculated as a percentage of the mean yield of the component cultivars grown in pure stands (Table 1). The four blends C1:C2, C1: C4, C3 : C4 and C4 : C5 averaged more than 20% of their component means, while the two blends C3: C5 and C4 : C6 averaged close to that of their mean of the two components grown in pure stands. When the yiedling ability was calcualted as a percentage of the highest yielding component, four blends C1: C2, C1: C4, C3 : C4 and C4 : C5 showed higher yielding component genotypes by 30.2, 10.6, 10.5 and 3.6 percent respectively, (Table 3). The majority of the mixed stands tended to outyield mid-mono culture yield rather than the pure stand yield of better component genotype. However, a reduction in yield below the component mean was observed in other blends and ranged from 6.6% for C2 : C3 to 21% for C5 : C6. The variabilities for studied characters were estimated by using variance and coefficient of variance for each mid parent and highest parent yielding abiliy. The grain yield had the highest variability values compared to other characters, while the 100 kernel weight had the minimum variability in case of highest parent yielding ability.

II- Comptitive ability :

As presented in Table 2 the competitive was estimated for each counterparts of each blend and also as average value for the following characters:

a - Number of spikelets per spike :

Giza 160 (C5) was the best competitor variety for number of spikelets per spike, since it gave the highest average of competitve ability (7.4) compared to the other genotypes, which ranged from 0.2% for Sakha 69 to 6.0% for Giza 157. It should also be noted that genotype (C5) gave 4% increase when it was mixed with Sakha 61, while it gave 10% increase when it was mixed with Sakha 69 (C2). Giza 157 and Sakha 61 were good competitors for number of spikelets per spike, while Giza 157 had a larger range since it ranged from 8% with each of Giza 160 and Sakha 92 to 2% with Giza 164 . Sakha 61 (C1) gave a higher value of competitive ability (7%) with Giza 157 and low value (3%) with each of Giza 164 and Giza 160. The other three genotypes Sakha 69, Sakha 92 and Giza 164 were poor competitors for the same character (Table 3).

b- Number of kernels per spike :

Giza 164 and Giza 160 were the highest counterparts for competition since their competitive ability were 10.4% and 9.8, respectively. They were good competitors with all studied genotypes except for Sakha 61. Saka 61 and Sakha 69 had mid value of competitive ability averaging 5.8% and 4.2%, respectively. Sakha 61 was a very good competitor with most genotypes studied for number of kernels per spike, and was very poor with Giza 160. Sakha 69 was a good competitor with only Giza 160 and Giza 164 (Table 3). Sakha 92 and Giza 157 had very low competitive ability means and were very good competitors with Sakha 61.

C- Number of plants/m :

Sakha 61 (C1) was a good competitor since its number of plants/m in a competitive situation was more than in pure stand. The competitive ability of (C1) was

Table 2. Competitive ability (%) for six wheat cultivars, Sakha 61 (C_1), Sakha 69 (C_2), Sakha 92 (C3), Giza 157 (C4) Giza 160 (C5) and Giza 164 (C6) in varietal blends and averaged meaning (X) for grain yield and yield component characters.

Genotypes 1:1 Blends	Number of spikelets per spike	Number of kernels per spike	Number of spikes per m	Weight of kernels per spike	100 kernels weight	Grain yield
$C_1 : C_2$	5 : - 2	7:-2	7:-2	0.5:-1.3	0.23:0.5	41:30
$C_1 : C_3$	3: 2	1:21	-12:-18	-1:-17	6:5	-23:-28
$C_1 : C_4$	7:7	39:17	18:3.0	22:29	19:5	20:37
$C_1 : C_5$	3:4	-23:-20	7:-15	19:-4	9:13	00:-25
$C_1 : C_6$	3:-7	5:-2	-6:-8	12:4	17:14	-14:-27
$C_2 : C_3$	3:2	-3:-15	2:5	0.0:12	-12:00	-11:-10
$C_2 : C_4$	2:5	-1:-8	-4:-10	16:-2	10:-11	-23:4.0
$C_2 : C_5$	1:10	10:26	13:-2	4:19	3:24	-8:-26
$C_2 : C_6$	-3:1	17:19	-12:-5	19:-55	7:-2	-8:-6
$C_3 : C_4$	1:8	0.0:5	-2:-10	14:34	-12:-29	8:34
$C_3 : C_5$	-3:5	-7:2	9:-8	-7:-2	8:16	-2:-22
$C_3 : C_6$	1:4	5:22	1:5	25:15	16:-0.5	-2:-11
$C_4 : C_5$	8:8	1:36	-4:-12	28:29	-3:12	43:-6
$C_4 : C_6$	3:-1	2:7	-5:7	4:8	-0.5:0.0	35:-6
$C_5 : C_6$	9:4	5:6	-15:5	6:-2	15:3	-22:-11
X						
C1	4.2	5.8	2.8	10.5	10.2	4.8
C2	0.2	4.2	-0.6	7.5	1.7	-4.0
C3	-0.2	0.6	-1.0	5.4	3.4	6.2
C4	6.0	1.8	-5.2	18.6	-7.9	29.0
C5	7.4	9.8	-10.4	9.6	16.0	-20.2
C6	0.2	10.4	0.8	-6.0	2.9	-11.0

(2.8%) in average. Only Giza 164 (C6) gave a slight increase in number of plants in one meter, while the other genotypes showed a reduction in percentage of plant survivals in mixtures at harvest compared to their pure stand performance (Table 3). Sakha 61 gave 2% decrease in plant/m when it was mixed with Sakha 92 (C3) while it gave a positive value (18%) of competitive ability for the same trait when mixed with Giza 157 (C4).

d- Weight of kernels per spike :

Giza 157 was the best competitor for kernels weight per spike since it gave the highest average of competitive ability (18.6%) compared to the other genotypes which their competitive ability ranged from 10.5 for Sakha 61 (C1) to -6.0% for Giza 164 (C6). The competitive ability of Giza 157 (C4) was 34% when was mixed with Sakha 92 (C3) while it had a negative value (-2%) when mixed with Sakha 96 (C2). The four genotypes, Sakha 61 (C1), Sakha 69 (C2), Sakha 92 (C3) and Giza 160 (C5) gavea large average of competitive ability while Giza 164 (C6) gave a negative averages for it was a very poor competitor with Sakh 69 (C2). Giza 164 can be mixed therefore with Sakha 92 for its high weight of kenrnels per spike (Table 2).

e- 100 kernel weight :

All gentotypes showed increase in the weight of 100 kernels in mixing situation except Giza 157 while those in creases ranged from 16% for Giza 160 to 1.7% for Sakha 69. The genotypes (C5) gave 24% increase in this trait when it was mixed with Sakha 69 (C2) while it gave 12% when it was mixed with Giza 157 (C4). It should be noted that Sakha 61 was a good competitor for weight of 100 kernels with each of Giza 157, Giza 160 and Giza 164. The other three genotypes tended to decrease in this trait although they showed increase in mixing situation over their pure stand. Only Giza 157 gave in average a negative competitive ability for 100 kernel weight (Table 2).

f- Grain yield :

Cultivars of wheat differ in their competitive ability when grown in a mixture or blend (Table 2). The results have shown that over compensation can occur when certain Paris of wheat genotypes are grown together in a competitive manner. The competitive ability of a cultivar was measured by its performance in competition compared with its performance in pure stand. A good competitor is one that has

Table 3. Estimation of the genetic and competitive effects for four wheat mixtures and Sakha 61/Sakha 69 (C1:C2, Sakha 61/Giza 157 (C1:C4), Sakh 92/Giza 157 (C3:C4 and Giza 157/Giza 160 (C4:C5).

Mixture	Trait	Effects					
		μ	μ'	μ"	a	a'	a"
C1 : C2	Crain yield	1.9	0.7	2.6	0.1	-0.1	0.0
	100 kernel weight	3.1	0.2	3.3	0.3	-0.2	0.1
	Weight of kernel/sp	1.2	0.4	1.6	0.1	-0.1	0.0
	No.of kernel / sp	40.0	1.0	41.0	2.0	-2.0	0.0
	No. of kernel / m	70.7	1.3	72.0	3.3	-3.3	0.0
C1 : C4	Crain yield	1.7	0.5	2.2	0.1	-0.1	0.0
	100 kernel weight	3.2	0.1	3.3	0.5	-0.5	0.0
	Weight of kernel/sp	1.1	0.4	1.5	0.0	-0.5	-0.5
	No.of kernel / sp	41.7	11.8	53.5	3.8	-3.8	0.0
	No. of kernel / m	73.0	8.5	81.5	5.5	-5.5	0.0
C3 : C4	Crain yield	1.8	0.4	2.2	0.2	-0.2	0.0
	100 kernel weight	3.3	-0.7	2.6	0.4	-1.8	-1.4
	Weight of kernel/sp	1.2	0.3	1.5	-0.1	0.1	0.0
	No.of kernel / sp	46.7	1.3	48.0	-1.2	1.2	0.0
	No. of kernel / m	75.2	-5.0	70.2	3.3	-3.5	-0.2
C4 : C5	Crain yield	2.0	0.3	2.3	0.3	-0.3	0.0
	100 kernel weight	3.2	-0.1	3.1	0.5	-0.4	0.1
	Weight of kernel/sp	1.3	0.2	1.5	0.2	-0.2	0.0
	No.of kernel / sp	41.2	9.3	50.5	-4.2	4.2	0.0
	No. of kernel / m	82.2	-7.2	75.0	3.8	-3.8	0.0

greater yield in a competitive situation than in pure stand, and a poor competitor is the one which produce low yield in a competitive situation. Strong and weak competitor gentoypes were assessed on the basis of Fehr formula (1973) .

Only C2, C5 and C6 showed negative competitive ability with all other genotypes, while the three other genotypes gave positive values. The combination C1 : C2 had the highest compeive ability (41 % and 30%, respectively). Also, C1 : C4 had a high positive competitive ability (20 and 37%, respectively). In the other hand, the blends C1 : C3, C1 : C6, C2 : C3: C2 : C4 and C2 : C5 showed negative competitive ability. The effect of competition on grain yield is important and has implications for breeder, who can use the cultivars with high copetitive ability as counterparts in the blending from year to year. Competition effects for yield appeared to be associated with number of spikelets per spike and number of kernels per spike .

Estimation of the genetic and competitive effects :

Plant breeders and geneticists often appear to be unaware of the potential importance of inter-genotypic competition on genetic parameter estimation. This could be due in part to the complexity of the models available for analysis. Hamblin and Rosielle (1978) assumed that it is possible to identify and grow genotypes in pure and mixed culture and they formulated the models as follows :

Genotype	Frequency	Pure culture genotypic value	mixed culture genotypic value
AA	P2	$\mu + a$	$\mu'' + a''$
Aa	2pq	$\mu + d$	$\mu'' + a''$
aa	q2	$\mu - a$	$\mu'' - a$

where

$\mu'' = \mu + \mu'$
$a'' = a + a'$
$d'' = d + d'$

The pure culture model is the simple mean-additive-dominance model that is widely used in quantitative genetic studies (Mather and Jinks 1971). The mixed culture model is conceptually identical to the pure culture model except that the mean (μ''), additive (a'') , and dominance (d'') effects in mixed culture are related to their pure culture counterparts, μ , a and d through the competitive effecs μ' , a' and d', respectively. The competitive effecs μ' , a' and d' are unique properties of the genotpyes and the mixture in which they are grown. As presented in Table 3 the mean competitive effect (μ") was generally small in comparison to the mean genetic effect (μ), and ranged from 36.8% increase for grain yield to 1.8% increase in number of spikes/m for the mixture C1:C2, while the highest relative competitive effects (μ') in the mixtures C1 : C4 and C3 : C4 were for weight of kernels/sp (36.4% and 25.6%, resepectively). In the mixture C4:C5 the number of kernels was 22.6% for N. per spike. The sign of μ', however may be either positive or negative for the number of spikes/m in the blends C3 : C4 and C4 : C5, and this could lead to changes in ranking of populations compared with that of the individual genotypes grown in pure stand. This observation agrees with the conclusions of Hamblin and Rosielle (1978) and Simmonds (1962), that the effect of competition on mean performance is generally small. The genetic and competitive effects were estimated by equating observed values in pure and mixed culture to their expectations under the assumptions of the additive dominance model.

The effect of competition on additive genetic values (a") was not large and ranged from-a to less than zero thus narrowing the difference between the two homozygotes. The results of this investigation revealed that intergenotypic competition is a strong force in changing the behaviour of heterogeneous populations. In mixed populations, which are perpetuated year after year without artificial selection, desirable genotypes may be lost in a few generations as the genotypes that survive may possess high competitive ability and not necessarily high yielding ability.

In plant breeding procedures, selection of genotypes is done from a heterogeneous population based on visual characters. Rajeswara Rao and Rajendra Prasad (1984) suggested that competitive ability of a genotype may mislead the breeder as to the suitability of a genotype for selection, but for agronomists, the competitive ability is a desirable trait as genotypes with high competitive ability can successfully suppress weed growth, utilize available resources more efficiently and thus prove to be agronomically superior to those with low competitive ability.

Varieties proposed to be used as counterparts for desirable blends:

The performance of the five varieties, Sakha 61, Sakh 69, Sakha 92, Giza 157 and Giza 160 in pure stand is compared with the respective two-variey mixtures for grain yield, weight of 100 kernel, weight of kernels per spik number of spikes per one meter and number of kernels per spike (Figs. 1, 2, 3, 4 and 5, respectively) .

Four of the two-variey mixtures were higher in grain yield, and weight of kernel per spike. The observed performances of mixtures were greater than their highest component for three mixtures , C1:C2, C1 : C4 and C3 : C4. Superiority of mixture performances compared with highest component means ranged from (30%) for C1 : C2, to (10%) for (C1 : C4) and (C3 : C4) but the increase above component means was somewhat higher on the average for two counterparts of the mixture C4 : C5. There was very close agreement between the performace of grain yield and weight of kernel per spike. Since there was superiority of the same three mixtures C1 : C2, C1: C4 and C3: C4 in compared to the high component of the mixture. The mixture, Giza 157 : Giza 160 yield less than the high component in grain yield and mean of 100 kernel weight by only (8%) and (12%) respectively. There did appear to be a slight negative association of performance level of the mixture C3 : C4 for mean of 100 kernel weight and in C3 : C4 and C4 : C5 for number of spikes / m. The mixture, Sakha 61 with Giza 157 gave the largest gain for most of yield and yield components with largest gain for most of yield and yield components with respect to the high component but was quite low in component mean performance .

Our results agree with the general trends that have been observed in cereals with respect to grain yield and yield components above component means.

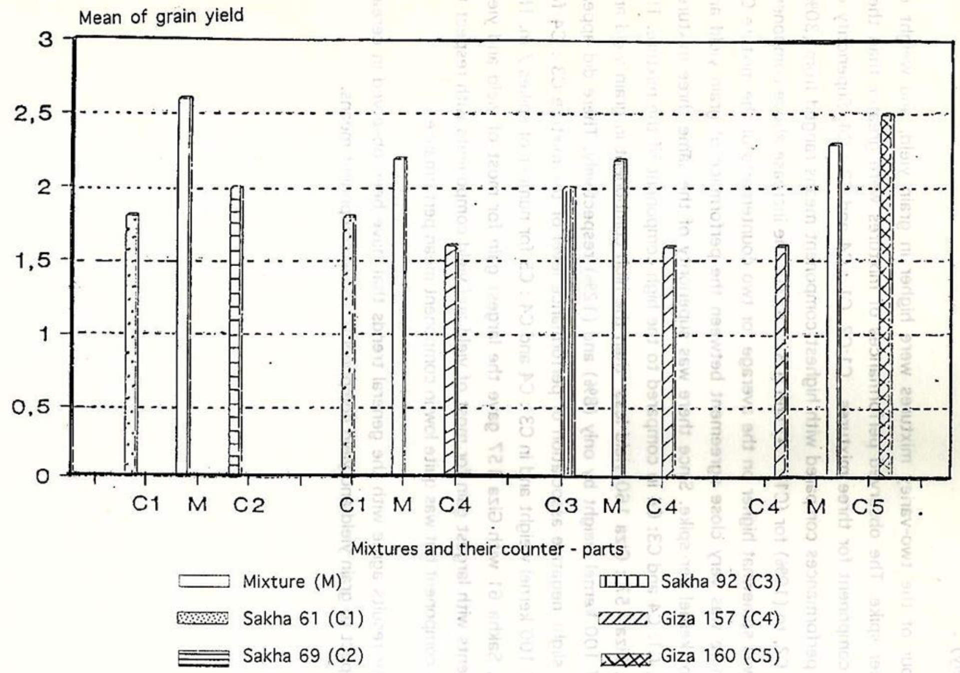

Fig. 1 : Mean of grain yield of four verietal wheat mixtures and their counterparts.

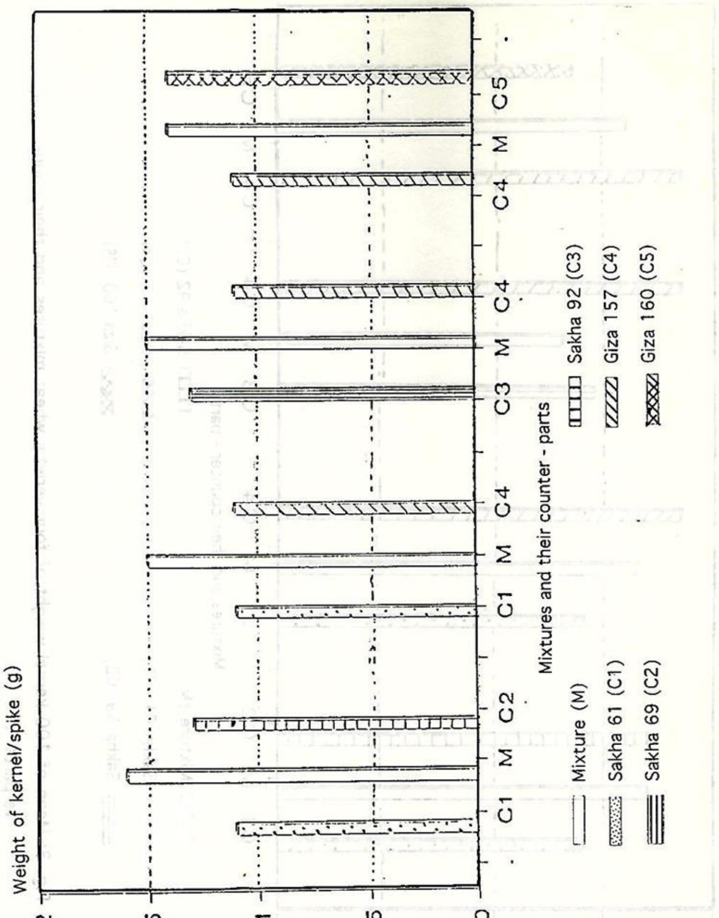

Fig. 2: Mean of kernel weight of four varietal wheat mixtures and their counterparts

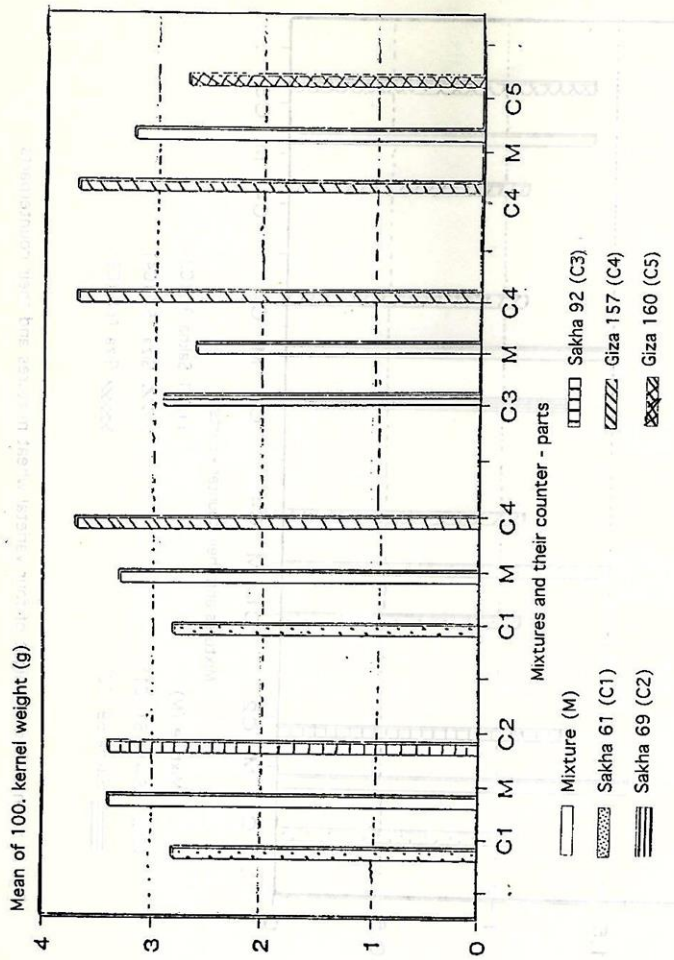

Fig. 3: Mean of 100 kernel weight of four verietal wheat mixtures and their counterparts .

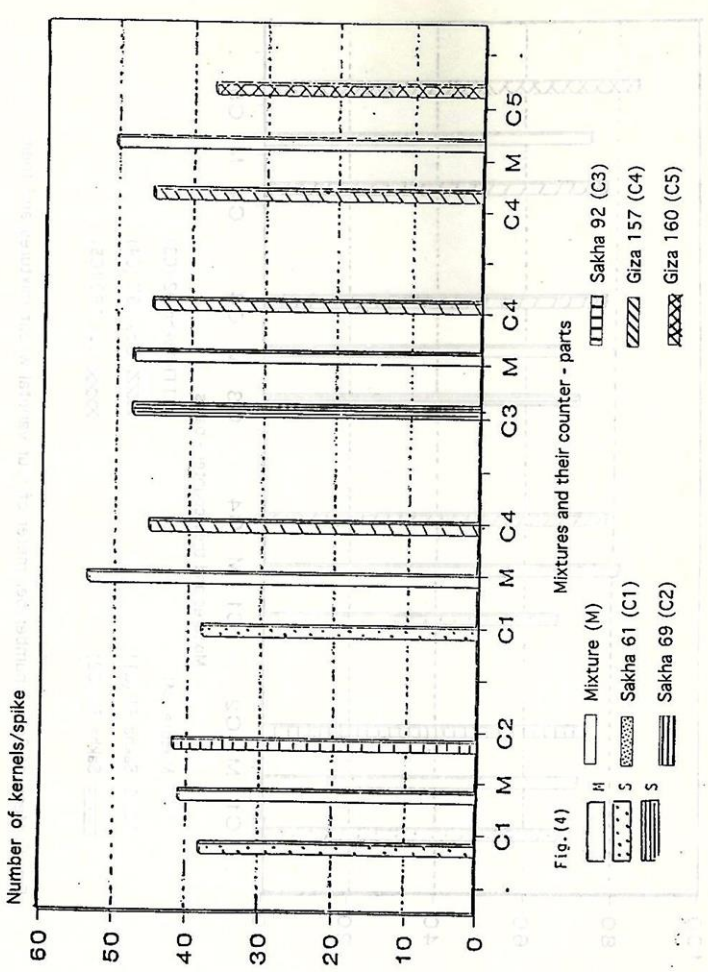

Fig. 4. Mean of kerhel number per spike of four varietal wheat mixtures and their counterparts .

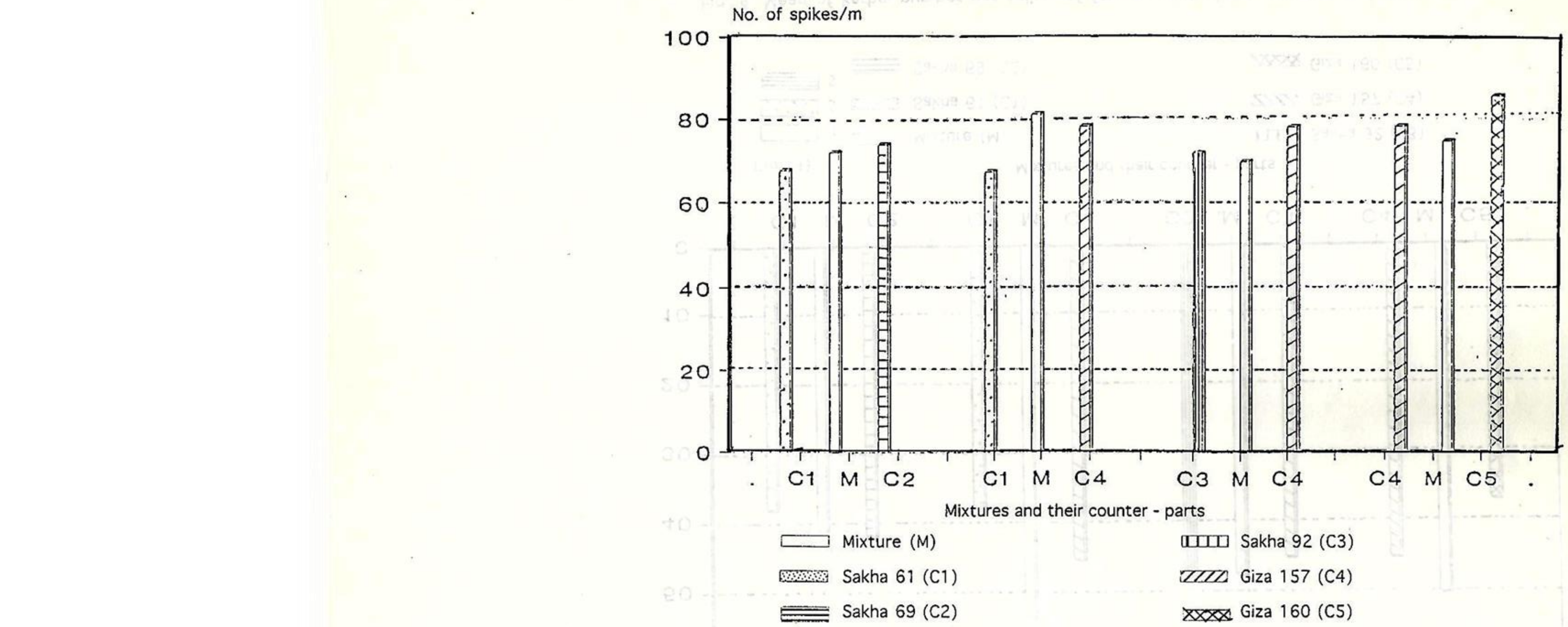

Fig. 5. Mean of Spikes number per meter of four varietal wheat mixtures and their counterparts .

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القدرة المحصولية والتنافسية فى مخاليط القمح الصنفية ومكوناتها فى الحالة الفردية

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٢ مركز البحوث الزراعية - وزارة الزراعة .
٣ الادارة العامه التقاوى - وزارة الزراعة .

أجريت عديد من الدراسات على المخاليط الصنفية فى عديد من المحاصيل فى الخارج ولكن فى مصر لمْ تنشر أبحاث فى هذا المجال لذا كان الغرض من هذه الدراسة تحديد ما اذا كانت مخاليط القمح الصنفية ستكون أكثر انتاجية من الاصناف المكونة لها فيما لو زرعت منفردة. كما استهدفت الدراسة تحديد القدرة التنافسية للأصناف المصرية وقد استخدم فى الدراسة ستة أصناف من القمح هى سخا ٦١ ، سخا ٦٩ ، سخا ٩٢ ، جيزة ١٥٧ ، جيزة ١٦٠ ، جيزة ١٦٤ وكذلك أيضا جميع المخاليط الثنائية الممكنة منها وعددها ١٥ خليطا وتم زراعتها فى تجربتين حقليتين خلال الموسمين الزراعيين ٩٢ / ٩٣ - ٩٣/٩٤ وكانت أهم النتائج المتحصل عليها من هذه الدراسة مايلى :

كانت المخاليط الاربعة سخا ٦١ مع سخا ٦٩ ، سخا ٦١ مع جيزة ١٥٧ ، سخا ٩٢ مع جيزة ١٥٧ ، جيزة ١٥٧ مع جيزة ١٦٠ اعلي انتاجية للحبوب باكثر من ٢٠٪ من متوسط الصنفنين المكونين لكل منهما وحوالي ١٣٫٧٪ اكثر من المكون الأعلي لكل منهم في حالة الزراعة المنفردة .

وكان افضل خليط هو سخا ٦١ وسخا ٦٩ حيث كان كل من المكونين أعلى قدره تنافسية وكانت قدرتهما التنافسية بالنسبة لصفة محصول الحبوب ٤١٪ و ٣٠٪ على التوالى . إن التأثير التنافسى لصفة محصول الحبوب يعتبر هام لمربي النبات حيث يمكنه من استخدام الأباء ذات القدره العالية علي التنافس في الخلط من عام الي اخر . كما ان القدره التنافسيه لصفه المحصول كانت مرتبطة مع القدرة النافسية لعدد الحبوب فى السنبلة .

متوسط التأثير التنافسى (U') يعتبر صغيرا نسبيا بالمقارنة بمتوسط التأثير الوراثى (U) على الرغم من أن أعلى تأثير تنافسى نسبى كان لمحصول الحبوب (٣٦٫٨ ٪) فى الخليط المكون من سخا ٦١ مع جيزة ١٥٧ .