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# SELECTION FOR EARLINESS, YIELD AND ITS COMPONENTS IN BREAD WHEAT

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## ABSTRACT

The objective of this study was estimate the response to individual plant selection in early generation through direct and indirect selection for increased grain yield was carried out. The selection intensity of 10 % approximately was used with direct selection of yield and with indirect selection using yield components in wheat, *i.e*. number of spikes per plant, number of kernels per spike and 1000-kernel weight in gm. In 2009/2010, promising lines in $F_5$ for each criterion were evaluated under flood irrigation at the Sids Agricultural Research Station conditions, Agricultural Research Center, Egypt. The high selected lines (20 lines) from direct and indirect selection for high yielding for each criteria (grain yield/plant "direct selection", number of spikes per plant, number of kernels per spike and 1000-kernel weight in gm "indirect selection") and the two parents also, two checks (Sids 12 and Sids 13) were evaluated in nested design with three replications in each population. In the first population, the selection of high number of grains/spike gave the highest grain yield/plant. In the second population the selection of high number of spikes/plant gave the highest grain yield/plant. The results indicated that selection for indirect selection was more efficient in breeding for word superior yielding $F_5$ lines.

## INTRODUCTION

Wheat is the world's most important strategic food crop. In Egypt, it is the main winter cereal crop. Breeding early maturing wheat (*Triticum aestivum, vulgares* L) cultivars is an important objective in most wheat improvement programs. Knowledge of the inheritance of early maturing, yield and its components are important to wheat breeders in developing short duration cultivars.

A crop breeding programs amid at increasing plant productivity requires consideration not only for yield, but also of its components which have direct or indirect contribution on yield.

Sidwell (1975) found indirect selection for grain yield based on kernel weight to be more effective than either direct selection for yield or indirect selection based on tiller number or average number of kernels per spike. Whereas Whan *et al.* (1982) found direct selection for grain yield to be ineffective, McNeal *et al.* (1978) found indirect selection based upon kernel weight and average number of kernels per spike to be most productive in this respect. Ketata *et al.* (1976), Sharma & Knott (1964), Sharma & Baghel (1972), and Sidwell *et al.* (1976) have also advocated indirect selection based upon kernel weight.

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*(refer to the ministry of agriculture and land reclamation- economic affairs sector).

Improvement of complex character like yield may be accomplished through component breeding (Grafius, 1964). Also, many workers suggested that selection for component traits can help to increase productivity.
The main objective of this study was:

Compare the effectiveness of indirect selected for yield *via* yield components with direct one for grain yield.

## MATERIALS AND METHODS

This study was carried out during the three successive seasons, i. e., 2007/2008, 2008/2009 and 2009/2010, at the Sids Agricultural Research Station conditions, Agricultural Research Center, Egypt.

The objective of this study was estimate the response to individual plant selection in early generation through direct and indirect selection for increased grain yield was carried out. The selection intensity of 10 % approximately was used with direct selection and with indirect selection using yield components in wheat, *i.e*, number of spikes per plant, number of kernels per spike and 1000-kernel weight in gm. The pedigrees of the parents of the two wheat populations are given in (Table 1).

**Table (1): The pedigrees of the parents of the two wheat populations.**

| Population pernt | Pedigree |
|---|---|
| P1 | WEAVER/WL3926//SW893064 |
| P2 | Desconocido #6/4/Bl 1133/3/Cmh 79A.955*2/ Cno 79//Cmh 79A.955/Bow's' |
| P1 | LFN/1158.57//PRL/3/HAHN/4/KAUZ/5/KAUZ |
| P2 | maya"s"/mon"s"//CMH74A.592/3/2* Sakha 8 |

In 2007/2008 growing season, two groups each consisted of 400 plants of $F_2$ populations were sown in the field in spaced 15 cm apart in one row 3 m long and 30 cm between rows. The sowing date was: 15 November in the 1$^{st}$ season ($F_3$ generation 2007/2008), was; 18 November in the 2$^{nd}$ season (2008/2009), and 19 November in the 3$^{rd}$ season (2009/2010). Under all studied methods, each selected plant, the two parents and the checks cultivar (Sids 12 and Sids 13) were represented by one row per plot. Other cultural practices were followed as recommended for wheat production in the area.

In 2009/2010 growing season, promising lines in $F_5$ for each criterion were evaluated under flood irrigation. The high selected lines (20 lines) from direct and indirect selection for high yielding for each criteria (grain yield/plant "direct selection", number of spikes per plant, number of kernels per spike and 1000-kernel weight in gm "indirect selection") and the two parents also, two checks (Sids 12 and Sids 13) were evaluated in nested design with three replications in each population.

The following characteristics were measured on random sample of 10 guarded plants in each plot in $F_5$ generation. The mean of the 10 plants were subjected to the statistical for: days to maturity, number of spikes per plant, number of kernels/spike, 1000-Kernel weigh and grain yield per plant

## RESULTS AND DISCUSSION

**The first population**

Selection for yield and yield components deserves considerable interest. A crop breeding program aimed to increasing plant productivity requires consideration interest not only of yield, but also of its components which have a direct and indirect bearing for yield. The present part was under taken to compare the efficiency of indirect selection for yield *via* yield components with direct selection for grains yield/plant.

Mean squares due to five selection criteria *i.e*. number of spikes/plant, 1000-grain weight and number of grain/spike (indirect selection), and high yield/plant (direct selection) were high significant (Table 2).

**Table (2): Mean squares for lines, four selection criteria and lines/selection criteria in the first cross ($F_5$-lines).**

| Source of variation | d.f | Days to maturity | No. of spikes/plant | No. of grains/spike | 1000- grain weight (g) | Grain yield/plant (g) |
|---|---|---|---|---|---|---|
| Rep | 2 | 7.554** | 82.077** | 27.154 | 0.336 | 14.001 |
| Lines | 79 | 122.760** | 33.968** | 284.003** | 163.976** | 329.682** |
| Methods | 3 | 86.089** | 38.004** | 389.019** | 1217.838** | 806.938** |
| Lines/Methods | 76 | 124.208** | 33.809** | 279.858** | 122.376** | 310.842** |
| Error | 158 | 0.921 | 3.858 | 20.086 | 2.566 | 18.131 |

**Significant differences between the five traits in number of spikes/plant, 1000-grain weight, number of grains/spike, days to maturity and high grain yield/plant.**

Generally, the selection of high number of grains/spike, gave the highest grain yield/plant, but without superiority of grain yield per plant and number of spikes/plant, followed by 1000-grain weight (Table 3).

**Table (3): Mean values of the four selection criteria in the first cross.**

| Selection criteria | Days to maturity | No. of spikes/plant | No. of grains/spike | 1000- grain weight (g) | Grain yield/plant (g) |
|---|---|---|---|---|---|
| No. of spikes/plant | 143.983 | 23.544 | 67.572 | 48.501 | 56.243 |
| No. of grains/spike | 142.050 | 21.689 | 65.249 | 49.475 | 57.053 |
| 1000- grain weight (g) | 142.350 | 22.750 | 62.638 | 57.934 | 49.468 |
| Grain yield/plant (g) | 144.483 | 23.133 | 68.266 | 48.901 | 57.000 |
| LSD 5% | 0.347 | 0.710 | 1.620 | 0.579 | 1.539 |
| LSD 1% | 0.459 | 0.938 | 2.141 | 0.765 | 2.034 |

In 1964, Grafius suggested that improvement of complex characters like yield may be accomplished through component breeding subsequently, many workers (Johanson *et al*. 1983; Singh *et al* 2001) suggested that selection for component traits can help to increase productivity. The present investigation expressed the selection for high number of grains/spike was more efficiency as indirect selection for yield gave the best one.

With respect to the effect of selection criteria on 1000-grain weight, the results revealed that selection for 1000-grain weight gave significant heavier grain index followed by selection high number of grains/spike.

However, selection of high number of spikes per plant gave the lowest one (Table 3).

Also, the selection criteria on number of spikes/plant, the results revealed that selection for number of spikes/plant and grain yield/plant gave significant higher number followed by selection high criteria of 1000-grain weight. However, selection of high number of grains/spike gave the lowest one (Table 3).

For the selection criteria on number of grains/spike, the selection of higher grain yield gave significant highest number of grains. However, the selection of number of spikes/plant gave the second of this trait, while, the selection criteria on number of grains/spike gave the third of number of grains/spike, but it was the first in grain yield/plant and earliest in maturity date.

Concerning grain yield/plant, the selection method of high number of grains/spike exhibited significantly higher value of this trait, but without superiority of than number of spikes per plant and grain yield/plant. However, selection for heavier grain index gives the lowest one. (Table 3).

The results indicated that selection for grain number, number of spikes/plant and 1000-grain weights were more efficient in breeding for word superior yielding $F_5$ lines.

It could be concluded that selection for number of grains/spike, for (indirect selection) three successive generations was successful in improving the mean grain yield in the $F_5$ lines.

The mean values of selected $F_5$ lines for maturity date, number of spikes/plant, 1000-grain weight, number of grains/spike and grain yield/plant were affected by selection criteria indirect selection *i.e*. (high number of grains/spike, heavier grain index and high number of spikes/plant) and direct selection (high grain yield/plant) are presented in Table (4).

For days to maturity; nineteen, eleven, thirteen and fourteen lines in the $F_5$ generation had significantly the earliest than the best parent with number of spikes/plant, number of grains/spike, 1000- grain weight and grain yield/plant, respectively.

This result is logically expected. The best lines were number 7 and 18 when selected with number of spikes/plant. However, number 13 when selected with number of grains/spike and number 5 and 7 when selected with 1000- grain weight.

For number of spikes/plant, two, three, four and four lines were significantly higher than the best parent with number of spikes/plant, number of grains/spike, 1000- grain weight and grain yield/plant, respectively (Table 4). This result is logically expected. The best lines were number 17 when selected with number of spikes/plant. However, number 2 when selected with number of grains/spike also, number 4 when selected with 1000- grain weight and number 9 when selected with grain yield/plant.

**Table (4): Mean performance of the $F_5$ selected lines from direct and indirect selection two parents and two check varieties in the first cross for the studied characters.**

| Selection criteria | # of line | Days to maturity | No. of spikes/plant | No. of grains/spike | 1000- grain weight (g) | Grain yield/plant (g) |
|---|---|---|---|---|---|---|
| No. of spikes/plant | 1 | 134.3 | 16.6 | 68.3 | 42.4 | 47.9 |
| | 2 | 149.3 | 23.5 | 62.6 | 47.7 | 58.2 |
| | 3 | 150.7 | 22.3 | 78.6 | 46.8 | 60.3 |
| | 4 | 146.0 | 22.9 | 51.6 | 41.4 | 58.0 |
| | 5 | 139.6 | 21.1 | 57.9 | 51.7 | 58.7 |
| | 6 | 151.0 | 27.1 | 63.1 | 52.5 | 68.1 |
| | 7 | 131.3 | 21.7 | 64.3 | 45.2 | 65.2 |
| | 8 | 150.0 | 24.7 | 62.5 | 49.5 | 56.9 |
| | 9 | 139.6 | 27.0 | 72.3 | 51.0 | 42.0 |
| | 10 | 150.3 | 22.2 | 77.4 | 47.3 | 66.0 |
| | 11 | 140.6 | 24.4 | 83.4 | 51.3 | 29.9 |
| | 12 | 148.3 | 27.0 | 75.3 | 39.0 | 48.3 |
| | 13 | 138.3 | 21.1 | 79.5 | 49.2 | 52.9 |
| | 14 | 150.6 | 22.9 | 55.4 | 53.3 | 68.7 |
| | 15 | 146.0 | 25.0 | 71.1 | 47.5 | 59.2 |
| | 16 | 135.0 | 24.5 | 67.7 | 49.3 | 42.9 |
| | 17 | 148.0 | 29.6 | 55.4 | 49.3 | 70.7 |
| | 18 | 132.6 | 22.2 | 62.1 | 55.9 | 41.1 |
| | 19 | 149.0 | 21.8 | 67.0 | 47.9 | 60.1 |
| | 20 | 148.6 | 22.4 | 75.1 | 51.0 | 69.2 |
| No. of grains/spike | 1 | 134.3 | 21.6 | 64.9 | 54.5 | 73.5 |
| | 2 | 134.3 | 26.7 | 49.5 | 40.5 | 65.1 |
| | 3 | 150.6 | 19.1 | 74.0 | 41.4 | 38.1 |
| | 4 | 136.0 | 16.6 | 70.1 | 47.1 | 58.4 |
| | 5 | 152.3 | 26.3 | 75.5 | 46.2 | 63.9 |
| | 6 | 136.6 | 21.3 | 91.1 | 46.4 | 58.1 |
| | 7 | 138.0 | 21.9 | 67.4 | 50.8 | 80.9 |
| | 8 | 142.0 | 20.1 | 72.9 | 54.7 | 50.1 |
| | 9 | 138.0 | 23.1 | 80.7 | 43.3 | 63.3 |
| | 10 | 140.0 | 21.8 | 55.2 | 49.1 | 71.7 |
| | 11 | 145.0 | 23.4 | 74.9 | 47.6 | 68.8 |
| | 12 | 139.0 | 20.7 | 72.3 | 49.4 | 59.1 |
| | 13 | 133.6 | 21.6 | 55.7 | 48.7 | 46.7 |
| | 14 | 148.3 | 19.4 | 53.1 | 42.0 | 55.3 |
| | 15 | 134.3 | 21.8 | 52.1 | 48.2 | 44.6 |
| | 16 | 150.0 | 20.0 | 53.7 | 45.9 | 34.5 |
| | 17 | 149.6 | 27.2 | 66.6 | 45.4 | 50.1 |
| | 18 | 140.6 | 20.8 | 48.2 | 52.8 | 45.8 |
| | 19 | 150.6 | 20.5 | 63.4 | 78.5 | 54.1 |
| | 20 | 147.3 | 18.8 | 62.7 | 56.1 | 58.3 |
| Parent 1 | | 143.3 | 20.1 | 62.8 | 47.3 | 54.5 |
| Parent 2 | | 134.9 | 21.1 | 67.5 | 50.3 | 61.3 |
| Over mean | | 143.1 | 22.7 | 65.9 | 51.1 | 55.0 |
| Sids 12 | | 135.4 | 14.6 | 72.9 | 47.8 | 61.5 |
| Sids 13 | | 139.9 | 16.3 | 67.6 | 41.8 | 64.5 |
| LSD 5% | | 1.552 | 3.175 | 7.245 | 2.590 | 6.884 |
| LSD 1% | | 2.051 | 4.197 | 9.576 | 3.423 | 9.098 |

**Table 4: (continued)**

| Selection criteria | # of line | Days to maturity | No. of spikes/plant | No. of grains/spike | 1000- grain weight (g) | Grain yield/plant (g) |
|---|---|---|---|---|---|---|
| 1000- grain weight (g) | 1 | 140.0 | 18.4 | 84.5 | 51.4 | 45.1 |
| | 2 | 136.0 | 22.1 | 53.7 | 55.1 | 43.7 |
| | 3 | 140.0 | 22.8 | 57.3 | 50.9 | 57.4 |
| | 4 | 148.0 | 28.2 | 66.4 | 61.1 | 64.5 |
| | 5 | 132.6 | 18.5 | 57.4 | 65.5 | 50.9 |
| | 6 | 151.0 | 24.5 | 53.9 | 60.0 | 60.3 |
| | 7 | 131.3 | 20.3 | 63.0 | 61.7 | 48.9 |
| | 8 | 134.0 | 24.8 | 53.5 | 51.7 | 57.3 |
| | 9 | 136.6 | 18.6 | 63.8 | 53.9 | 33.2 |
| | 10 | 150.3 | 19.7 | 67.7 | 51.3 | 36.1 |
| | 11 | 140.6 | 27.5 | 59.4 | 53.3 | 61.2 |
| | 12 | 148.3 | 22.3 | 66.3 | 63.0 | 37.4 |
| | 13 | 140.6 | 19.6 | 58.1 | 61.3 | 58.8 |
| | 14 | 151.3 | 26.0 | 53.1 | 50.2 | 43.9 |
| | 15 | 138.0 | 27.4 | 52.3 | 55.3 | 55.0 |
| | 16 | 135.0 | 19.2 | 63.3 | 61.2 | 45.3 |
| | 17 | 147.6 | 24.8 | 63.6 | 54.8 | 54.4 |
| | 18 | 147.3 | 21.3 | 83.8 | 62.0 | 37.1 |
| | 19 | 149.0 | 23.3 | 68.1 | 69.0 | 40.8 |
| | 20 | 149.0 | 24.7 | 62.6 | 65.1 | 56.9 |
| Grain yield/plant (g) | 1 | 141.3 | 16.9 | 67.4 | 44.8 | 52.2 |
| | 2 | 136.0 | 24.1 | 70.6 | 44.0 | 53.8 |
| | 3 | 141.0 | 24.6 | 65.6 | 43.4 | 63.3 |
| | 4 | 149.3 | 24.1 | 72.6 | 50.1 | 69.7 |
| | 5 | 136.0 | 23.1 | 65.1 | 49.6 | 63.8 |
| | 6 | 152.3 | 17.5 | 89.8 | 46.7 | 47.3 |
| | 7 | 136.6 | 23.4 | 68.4 | 62.0 | 68.7 |
| | 8 | 138.0 | 21.1 | 85.5 | 52.6 | 60.3 |
| | 9 | 153.0 | 35.5 | 61.2 | 45.3 | 55.9 |
| | 10 | 149.6 | 19.4 | 68.7 | 42.2 | 51.3 |
| | 11 | 141.3 | 29.9 | 64.6 | 44.4 | 62.4 |
| | 12 | 144.3 | 22.2 | 65.3 | 66.2 | 71.0 |
| | 13 | 141.0 | 28.3 | 64.4 | 41.8 | 55.6 |
| | 14 | 150.0 | 23.3 | 71.4 | 42.9 | 55.2 |
| | 15 | 141.3 | 26.2 | 82.8 | 52.6 | 55.7 |
| | 16 | 144.6 | 19.2 | 65.7 | 44.3 | 58.3 |
| | 17 | 147.3 | 19.2 | 62.9 | 44.6 | 48.7 |
| | 18 | 148.0 | 21.1 | 55.9 | 59.4 | 48.1 |
| | 19 | 149.3 | 22.8 | 55.8 | 52.0 | 46.7 |
| | 20 | 149.0 | 19.9 | 60.4 | 48.1 | 51.1 |
| Parent 1 | | 143.3 | 20.1 | 62.8 | 47.3 | 54.5 |
| Parent 2 | | 134.9 | 21.1 | 67.5 | 50.3 | 61.3 |
| Over mean | | 143.1 | 22.7 | 65.9 | 51.1 | 55.0 |
| Sids 12 | | 135.4 | 14.6 | 72.9 | 47.8 | 61.5 |
| Sids 13 | | 139.9 | 16.3 | 67.6 | 41.8 | 64.5 |
| LSD 5% | | 1.552 | 3.175 | 7.245 | 2.590 | 6.884 |
| LSD 1% | | 2.051 | 4.197 | 9.576 | 3.423 | 9.098 |

For number of grains/spike, one, two, two and three lines were significantly higher than the best cultivar Sids 12 with number of spikes/plant, number of grains/spike, 1000- grain weight and grain yield/plant, respectively. This result is logically expected. The best lines were number 11 when

selected with number of spikes/plant. However, line number 6 when selected with number of grains/spike also, number 1 when selected with 1000- grain weight and number 6 when selected with grain yield/plant.

For grain index, one, four, fifteen and three lines were significantly heavier than the best grand mean for selection high number of spikes/plant, number of grains/spike, 1000- grain weight and grain yield/plant, respectively.

The best lines were number 18 when selected with number of spikes per plant. However, number 19 when selected with number of grains/spike, number 19 when selected with 1000- grain weight and number 12 when selected with grain yield/plant.

Regarding grain yield/plant, the range of selected lines ranged from 29.932 g to 70.767 g; 34.511 g to 80.999 g; 33.218 g to 64.569 g and 46.782 g to 71.036 g when selection plants with number of spikes/plant, number of grains/spike, 1000- grain weight and heavier grain yield/plant, respectively. Also, six, five, one and four lines significantly surpassed higher grain yield/plant about the best cultivar Sids 13,
in the same order in addition, the best lines were number 6, 10, 14, 17 and 20 when selecting plants with high number of spikes/plant, number 1, 2, 7, 10 and 11 when selected for number of grains/spike, number 4 when selected for 1000- grain weight and number 4, 5, 7 and 12 for selection grain yield/plant.

It could be concluded that indirect selection for yield *via* number of grains per spike is more efficient than direct selection for yield.

The comparison of selection criteria revealed the efficiency of selecting for number of grains/spike and high grain yield/plant and then by number of spikes/plant and heavier grain index, in improving mean yield of $F_5$ lines in this cross and also extracting a higher number of high yielding lines (selection for high number of grains/spike, number of spikes/plant and heavier grain index). Also, it appeared that indirect selection for yield *via* number of grains/spike was more efficient than direct effects of selection for yield itself.

**The second population**

Selection for yield and yield components deserves considerable interest. A crop breeding program aimed at increasing plant productivity requires consideration interest not only of yield, but also of its components which have a direct and indirect bearing for yield. The present part was under taken to compare the efficiency of indirect selection for yield *via* yield components with direct selection for grain yield/plant.

Mean squares due to five selection criteria *i.e*. number of spikes/plant, 1000-grain weight and number of grains/spike (indirect selection), and high yield/plant (direct selection) were significant (Table 5).

**Table (5): Mean squares for lines four selection criteria and lines/selection criteria in the second cross ($F_5$-lines).**

| Source of variation | d.f | Days to maturity | No. of spikes/plant | No. of grains/spike | 1000- grain weight (g) | Grain yield/plant (g) |
|---|---|---|---|---|---|---|
| Rep | 2 | 8.254** | 4.954 | 4.516 | 7.204 | 108.651** |
| Lines | 79 | 101.442** | 88.296** | 285.730** | 89.310** | 620.862** |
| Methods | 3 | 66.233** | 860.054** | 2746.814** | 520.197** | 6560.208** |
| Lines/Methods | 76 | 102.832** | 57.832** | 188.582** | 72.302** | 386.414** |
| Error | 158 | 1.060 | 4.308 | 22.395 | 2.391 | 19.398 |

**Significant differences between the five traits in number of spikes/plant, 1000-grain weight, number of grains/spike and maturity and high yield/plant.**

Generally, the selection of high number of spikes/plant, gave the highest grain yield/plant and the second for number of grains/spike, grain yield/plant and 1000-grain weight (Table 6).

**Table (6): Mean values of the four selection criteria in the second cross.**

| Selection criteria | Days to maturity | No. of spikes/plant | No. of grains/spike | 1000- grain weight (g) | Grain yield/plant (g) |
|---|---|---|---|---|---|
| No. of spikes/plant | 144.317 | 21.000 | 60.355 | 51.215 | 65.191 |
| No. of grains/spike | 143.650 | 13.727 | 73.699 | 50.149 | 55.953 |
| 1000- grain weight (g) | 143.500 | 13.588 | 58.722 | 55.551 | 39.927 |
| Grain yield/plant (g) | 145.800 | 19.172 | 62.500 | 48.720 | 54.946 |
| LSD 5% | 0.372 | 0.750 | 1.711 | 0.559 | 1.592 |
| LSD 1% | 0.492 | 0.992 | 2.261 | 0.739 | 2.104 |

In 1964, Grafius suggested that improvement of complex characters like yield may be accomplished through component breeding subsequently, many workers ( Johanson *et al*., 1983; Singh *et al* 2001) suggested that selection for component traits can help to increase productivity. The present investigation expressed the selection for high number of spikes/plant was more efficiency as indirect selection for yield gave the lowest one.

With respect to the effect of selection criteria on 1000-grain weight, the results revealed that selection for 1000-grain weight gave significant heavier grain index followed by selection high number of spikes/plant and number of grains/spike. However, selection of high grain yield /plant gave the lowest one (Table 6).

Also, the selection criteria on number of spikes/plant, the results revealed that selection for number of spikes/plant gave significant high number of spikes/plant followed by selection high criteria of grain yield/plant. However, selection of high 1000- grain weight gave the lowest one (Table 6).

Also, the selection criteria on number of grains/spike, the results revealed that selection for number of grains/spike gave significant number followed by selection high criteria of grain yield/plant. However, selection of high 1000- grain weight gave the lowest one. But, it was the second in grain yield/plant and earliest nearly in maturity date (Table 6).

Concerning grain yield/plant, the selection method of high number of spikes per plant exhibited significantly higher value of this trait, followed by high number of grains/spike and grain yield per plant were detected, revealing that the selection criteria differed among them (Table 6).

The results indicated that selection for grain number, number of spikes/plant and 1000-grain weight were more efficient in breeding for word superior yielding $F_5$ lines.

It could be concluded that selection for number of spikes/plant, number of grains/spike, for (indirect selection) three successive generations was successful in improving the mean grain yield in the $F_5$ lines.

The mean values of selected $F_5$ lines for maturity date, number of spikes/plant, 1000-grain weight, number of grains/spike and grain yield/plant were affected by selection criteria indirect selection *i.e*. (high number of grains/spike, heavier grain index and high number of spikes/plant) and direct selection (high grain yield/plant) are presented in Table (7).

For days to maturity there are not lines in the F5 generation had significantly the earliest than the best parent with number of spikes/plant, number of grains/spike, 1000- grain weight and grain yield/plant.

For number of spikes/plant, ten, one, zero and three lines were significantly higher than the best parent with number of spikes/plant, number of grains/spike, 1000- grain weight and grain yield/plant, respectively (Table 7). This result is logically expected. The best lines were number 2 when selected with number of spikes/plant, number 8 when selected with number of grains/spike. Also, number 14 when selected with 1000- grain weight and number 12 when selected with grain yield/plant was detected.

For number of grains/spike, one, six, zero and one lines were significantly higher than the best cultivar Sids 12 with number of spikes/plant, number of grains/spike, 1000- grain weight and grain yield/plant, respectively. This result is logically expected. The best lines were number 14 when selected with number of spikes/plant, number of grains/spike with 1000- grain weight with grain yield/plant, respectively.

For 1000- grain weight, seven, four, ten and one lines were significantly heavier than the best grand mean for selection high number of spikes/plant, number of grains/spike, 1000- grain weight and grain yield/plant, respectively. The best lines were number 5 when selected with number of spikes/plant. However, number 18 when selected with number of grains/spike, number 1 when selected with 1000- grain weight and number 11 when selected with grain yield/plant.

Regarding grain yield/plant, the range of selected lines ranged from 42.879 g to 91.900 g; 35.211 g to 77.883 g; 26.547 g to 58.131g and 34.830 g to 65.800 g when selection plants with number of spikes/plant, number of grains/spike, 1000- grain weight and heavier grain yield/plant, respectively. Also, seven, three, zero and zero lines significantly surpassed higher grain yield per plant about the best parent, in the same order.

In addition, the best lines were number1, 2, 4, 5, 7, 9, 10 and 13 when selected plants with high number of spikes/plant, number 6, 9, and 17 when selected for number of grains/spike.

It could be concluded that indirect selection for yield *via* number of spikes/plant is more efficient than direct selection for yield.

**Table (7): Mean performance of the $F_5$ selected lines from direct and indirect selection two parents and two check varieties in the second cross for the studied characters.**

| Selection criteria | # of line | Days to maturity | No. of spikes/plant | No. of grains/spike | 1000- grain weight (g) | Grain yield/plant (g) |
|---|---|---|---|---|---|---|
| No. of spikes/plant | 1 | 137.3 | 27.0 | 66.8 | 52.1 | 76.9 |
| | 2 | 148.3 | 28.8 | 69.8 | 44.6 | 91.9 |
| | 3 | 152.3 | 21.2 | 61.5 | 49.0 | 50.2 |
| | 4 | 136.0 | 23.3 | 59.0 | 52.7 | 60.5 |
| | 5 | 148.6 | 19.7 | 49.1 | 61.4 | 76.7 |
| | 6 | 131.6 | 22.2 | 53.2 | 57.6 | 60.8 |
| | 7 | 147.3 | 21.8 | 65.8 | 50.4 | 67.7 |
| | 8 | 148.0 | 26.3 | 53.6 | 59.1 | 61.7 |
| | 9 | 148.0 | 27.5 | 63.7 | 43.6 | 74.5 |
| | 10 | 149.3 | 22.8 | 67.8 | 55.4 | 88.8 |
| | 11 | 147.6 | 16.1 | 60.0 | 48.1 | 62.7 |
| | 12 | 148.3 | 16.6 | 55.6 | 57.8 | 59.0 |
| | 13 | 140.6 | 23.1 | 62.3 | 47.2 | 85.6 |
| | 14 | 135.3 | 18.5 | 83.8 | 49.3 | 52.7 |
| | 15 | 145.0 | 22.4 | 57.3 | 55.9 | 58.6 |
| | 16 | 135.6 | 18.5 | 58.4 | 45.4 | 60.2 |
| | 17 | 141.6 | 15.9 | 49.3 | 47.3 | 63.8 |
| | 18 | 149.0 | 20.1 | 53.5 | 49.0 | 54.4 |
| | 19 | 143.6 | 13.5 | 61.7 | 40.6 | 53.3 |
| | 20 | 152.3 | 13.7 | 53.8 | 56.9 | 42.8 |
| No. of grains/spike | 1 | 133.6 | 10.2 | 73.1 | 52.6 | 58.2 |
| | 2 | 148.3 | 8.2 | 81.4 | 46.4 | 45.5 |
| | 3 | 152.3 | 11.8 | 64.0 | 50.8 | 44.4 |
| | 4 | 136.0 | 11.7 | 67.5 | 49.1 | 64.2 |
| | 5 | 148.6 | 8.6 | 80.9 | 47.7 | 49.1 |
| | 6 | 131.6 | 15.3 | 84.8 | 45.2 | 77.4 |
| | 7 | 147.6 | 12.5 | 77.4 | 43.7 | 66.1 |
| | 8 | 147.3 | 22.5 | 73.1 | 51.3 | 62.7 |
| | 9 | 148.0 | 21.5 | 73.0 | 58.2 | 74.9 |
| | 10 | 149.3 | 20.2 | 75.3 | 51.4 | 65.8 |
| | 11 | 147.6 | 12.7 | 85.3 | 48.5 | 35.2 |
| | 12 | 146.0 | 9.4 | 90.8 | 45.9 | 43.8 |
| | 13 | 140.6 | 15.3 | 81.6 | 50.2 | 60.1 |
| | 14 | 135.3 | 13.3 | 77.6 | 47.5 | 36.3 |
| | 15 | 145.0 | 16.2 | 62.5 | 44.1 | 55.7 |
| | 16 | 135.6 | 11.2 | 49.8 | 46.4 | 43.5 |
| | 17 | 141.6 | 19.7 | 67.8 | 56.2 | 77.8 |
| | 18 | 149.0 | 14.8 | 73.8 | 62.5 | 62.8 |
| | 19 | 143.6 | 10.0 | 72.1 | 49.5 | 50.3 |
| | 20 | 145.3 | 8.5 | 61.2 | 55.0 | 44.3 |
| Parent 1 | | 139.6 | 18.8 | 64.6 | 50.4 | 60.4 |
| Parent 2 | | 130.7 | 10.9 | 62.2 | 50.1 | 55.6 |
| Over mean | | 144.1 | 16.8 | 63.8 | 51.4 | 54.1 |
| Sids 12 | | 134.7 | 14.1 | 70.6 | 47.7 | 58.0 |
| Sids 13 | | 139.4 | 16.1 | 69.7 | 44.1 | 57.1 |
| LSD 5% | | 1.665 | 3.356 | 7.651 | 2.500 | 7.120 |
| LSD 1% | | 2.200 | 4.435 | 10.112 | 3.304 | 9.411 |

**Table 7: (continued)**

| Selection criteria | # of line | Days to maturity | No. of spikes/plant | No. of grains/spike | 1000- grain weight (g) | Grain yield/plant (g) |
|---|---|---|---|---|---|---|
| 1000- grain weight (g) | 1 | 147.6 | 7.2 | 55.6 | 66.3 | 47.3 |
| | 2 | 147.3 | 11.5 | 46.7 | 51.1 | 45.1 |
| | 3 | 148.0 | 9.3 | 55.6 | 55.1 | 36.5 |
| | 4 | 149.3 | 7.5 | 50.3 | 51.9 | 40.5 |
| | 5 | 148.3 | 17.1 | 62.4 | 55.5 | 26.5 |
| | 6 | 151.0 | 7.5 | 59.5 | 60.4 | 30.2 |
| | 7 | 152.3 | 10.1 | 57.6 | 63.9 | 35.2 |
| | 8 | 136.0 | 14.8 | 64.4 | 49.5 | 31.8 |
| | 9 | 131.6 | 9.6 | 65.6 | 51.8 | 34.5 |
| | 10 | 141.3 | 10.8 | 53.2 | 55.8 | 33.6 |
| | 11 | 144.6 | 15.2 | 51.4 | 51.1 | 47.4 |
| | 12 | 140.6 | 10.4 | 57.5 | 61.2 | 33.7 |
| | 13 | 134.3 | 14.4 | 62.1 | 53.4 | 23.3 |
| | 14 | 145.0 | 21.5 | 61.5 | 47.8 | 53.4 |
| | 15 | 140.6 | 20.4 | 57.2 | 52.1 | 46.6 |
| | 16 | 150.6 | 19.8 | 58.0 | 63.5 | 45.6 |
| | 17 | 135.3 | 17.6 | 61.0 | 60.3 | 50.3 |
| | 18 | 141.0 | 21.6 | 64.7 | 51.8 | 48.7 |
| | 19 | 144.6 | 8.3 | 75.0 | 54.2 | 29.3 |
| | 20 | 140.0 | 16.2 | 54.3 | 53.2 | 58.1 |
| Grain yield/plant (g) | 1 | 147.3 | 13.2 | 62.1 | 51.8 | 46.6 |
| | 2 | 140.6 | 13.3 | 56.6 | 52.1 | 34.8 |
| | 3 | 143.6 | 18.2 | 61.5 | 47.5 | 47.6 |
| | 4 | 148.6 | 21.3 | 70.8 | 50.5 | 60.6 |
| | 5 | 151.3 | 20.7 | 64.6 | 48.0 | 65.8 |
| | 6 | 148.6 | 18.1 | 65.6 | 47.1 | 63.8 |
| | 7 | 146.6 | 18.5 | 56.8 | 51.8 | 56.7 |
| | 8 | 148.6 | 20.6 | 68.0 | 46.7 | 56.7 |
| | 9 | 146.6 | 19.0 | 55.2 | 43.9 | 56.4 |
| | 10 | 150.6 | 19.6 | 60.1 | 40.8 | 63.1 |
| | 11 | 136.3 | 21.2 | 51.7 | 54.6 | 61.6 |
| | 12 | 146.3 | 26.1 | 63.8 | 50.7 | 61.4 |
| | 13 | 133.6 | 24.5 | 65.1 | 50.7 | 60.0 |
| | 14 | 148.3 | 23.1 | 53.1 | 52.8 | 52.6 |
| | 15 | 153.0 | 13.5 | 63.0 | 47.0 | 44.5 |
| | 16 | 150.3 | 18.4 | 55.1 | 45.5 | 45.5 |
| | 17 | 141.3 | 13.7 | 83.7 | 45.0 | 59.5 |
| | 18 | 144.6 | 21.3 | 66.6 | 46.8 | 60.5 |
| | 19 | 140.6 | 20.8 | 62.1 | 51.4 | 41.8 |
| | 20 | 148.3 | 17.5 | 63.6 | 48.6 | 58.6 |
| Parent 1 | | 139.6 | 18.8 | 64.6 | 50.4 | 60.4 |
| Parent 2 | | 130.7 | 10.9 | 62.2 | 50.1 | 55.6 |
| Over mean | | 144.1 | 16.8 | 63.8 | 51.4 | 54.1 |
| Sids 12 | | 134.7 | 14.1 | 70.6 | 47.7 | 58.0 |
| Sids 13 | | 139.4 | 16.1 | 69.7 | 44.1 | 57.1 |
| LSD 5% | | 1.665 | 3.356 | 7.651 | 2.500 | 7.120 |
| LSD 1% | | 2.200 | 4.435 | 10.112 | 3.304 | 9.411 |

The comparison of selection criteria revealed the efficiency of selecting for number of spikes/plant followed by number of grains/spike and then by grain yield/plant and heavier grain index, in improving mean yield of $F_5$ lines in this cross and also extracting a higher number of high yielding lines (selection for high number of grains/spike, number of spikes/plant and heavier grain index). It also appeared that indirect selection for yield *via* number of spikes/plant was more efficient than direct effects of selection for yield.

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## الانتخاب للتبكير والمحصول و مكوناتة فى قمح الخبز

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**[٢] قسم بحوث القمح ، معهد بحوث المحاصيل الحقلية ، مركز البحوث الزراعية**

الهدف من هذه الدراسة تقدير استجابة النباتات للانتخاب فى الاجيال المبكرة، من خلال الانتخاب المباشر والغير مباشر لزيادة محصول الحبوب بها تحت شدة انتخاب ١٠% تقريبا فى عشيرتين مع الانتخاب المباشر للمحصول و غيرالمباشر باستخدام مكونات المحصول وهي (عدد السنابل بالنبات والحبوب بالسنبلة و وزن الالف حبة). فى موسم ٢٠٠٩/٢٠١٠، في مركز البحوث الزراعية بمحطة بحوث سدس عشرون سلالة في الجيل الخامس تم تقيمها تحت ظروف الرى بالغمر. ٢٠ سلالة اختبرت للمحصول (انتخاب مباشر) و ايضا الصفات الاخري عدد السنابل بالنبات و الحبوب بالسنبلة و وزن الالف حبة و تاثير التبكير فى النضج (الانتخاب الغير مباشر) مع الاباء وصنفين للمقارنة (سدس ١٢ وسدس ١٣) فى تصميم قطاعات كاملة العشوائية مع ثلاث مكررات وايضا التحليل الشبكي. فى العشيرة الاولي كان الانتخاب لصفة عدد الحبوب بالسنبلة قد أعطي اعلى محصول بينما فى العشيرة الثانية فان عدد السنابل فى النبات قد أعطى أعلى محصول. هذه النتائج تدل على كفاءة الانتخاب الغير مباشر فى تحسين المحصول.

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