RESULTS AND DISCUSSION

The present study was carried out over the four successive seasons of 1996/1997, 1997/1998, 1998/1999, 1999/2000 and 2000/2001, respectively. Screening was carried out in the first season for all the studied materials (three Pc lines; Pc 29, Pc 62 and Pc 63 and six new varieties, Sids 4, Sids 5, Sids 6, Sids 7, Sids 8 and Sids 9). Data were recorded on the second season (1997/1998) on the nine parents and the obtained F_1's originating from crossing the three Pc's with each of the Sids's varieties. These Pc lines were selected according to their efficiency to utilize some microelements as they contain some translocations. The present investigation was undertaken in order to focus on some selected segregants from F_2 and back-crosses populations that may contain one or more of the rye segments in the wheat genomes. In other words, to select substitution or/and additional segregants of wheat for the aim of combining the quality of wheat with the efficiency to utilize the microelements. Some Pc chromosomes were characterized by carrying genes responsible for Fe, Zn, Cu and Mn efficiency on the 5R, 4R, aluminium tolerance on the 4R. These studies were classified into three main categories as the following:-

1. Morphological studies on the main agronomic characters of these lines and some selected segregants from F_2 and back-crosses populations that may contain one or more of the rye segments in the wheat genomes.

2. Cytological studies on the chromosomal number in mitosis.

3. Efficiency of micronutritional genes in translocated wheat lines.

1. Morphological studies on the main agronomic characters of these lines and some selected segregants from F_2 and back-crosses populations that may contain one or more of the rye segments in the wheat genomes:-

Observed means and standard errors were estimated for the studied characters for wheat parents, Sids 4, Sids 5, Sids 6, Sids 7, Sids 8 and Sids 9 and for Pc parents; Pc 29, Pc 62 and Pc 63. Moreover, these characters were evaluated in the studied lines in the first season. The evaluated characters were plant height, flowering date, maturity date, spike length, number of grains per spike, number of spikelets per spike, 1000-kernel weight and grain yield of spike.

1. Plant height:-

Data recorded in Table (2) revealed the observed means and standard errors for the plant height character in parents. Some selected segregants from F_2 and back-crosses populations that may contain one or more of the rye segments in the wheat genomes were analyzed. (Table 2).

Parents:

The observed means of plant height in parents; Sids 4, Sids 5, Sids 6, Sids 7, Sids 8 and Sids 9 (hexaploid wheat) were 105.00, 105.00, 112.50, 97.50, 107.50 and 93.75 which showed great variability between parents as Sides 4, Sides 5, Sides 6 and Sides 8 revealed higher length while Sides 7 and Sides 9 revealed shorter length. Meanwhile, the lines; Pc 29, Pc 62 and Pc 63 were found to be more longer than the Sides parents (132.50, 136.25 and 135.00 cm, respectively). The standard deviations of parents also showed highly significant differences (2.34, 1.78, 3.90, 1.00, 4.16 and 3.36 for Sids's parents while 0.17, 2.56 and 1.78 for Pc's parents). These differences indicated that there was great variability in plant height between the selected lines while differences between individuals within each parent were mainly due to environmental conditions.

The plant height of the selected plants from F_2 population:

able (2): Means and standard deviations of some morphological and yield characters in wheat parents (Pc lines (hairy neck) and Sids varieties (non-hairy neck)).

Parents	Flowering Date	Maturity Date	Plant height	Spike length	Spikelets number	Grain weight/s	1000 grain weight
Pc 29	120.00±3.67	158.25±2.45	132.50±0.17	14.850±0.30	26.550±0.60	1.773±0.11	25.783±0.72
Pc 62	120.75±4.11	159.00±1.85	136.25±2.56	09.350±0.34	20.950±0.74	2.000±0.10	32.995±0.91
Pc 63	119.25±1.66	159.00±1.05	135.00±1.78	11.800±0.57	23.400±0.92	2.430±0.03	25.213±0.22
Sids 4	077.00±2.06	151.50±2.10	105.00±2.34	16.800±0.07	24.350±0.06	4.333±0.04	54.355±0.41
Sids 5	084.00±3.12	153.75±0.76	105.00±1.78	17.050±0.78	25.150±0.74	4.818±0.01	55.113±0.29
Sids 6	085.00±1.90	155.00±3.55	112.50±3.90	17.150±0.18	23.350±0.50	5.105±0.14	60.823±0.94
Sids 7	086.00±4.92	156.50±1.09	097.50±1.00	16.700±0.34	24.500±0.13	4.965±0.01	57.715±0.63
Sids 8	087.00±3.15	157.00±1.60	107.50±4.16	14.950±0.59	22.175±0.34	4.155±0.13	51.050±0.12
Sids 9	086.00±2.78	158.00±2.34	093.75±3.36	16.225±0.12	24.250±0.51	4.920±0.24	56.730±0.16

showed great variability between parents as Sides 4 and other Sids's parents which revealed shorter days to flowering (anthesis) while Sides 5, Sides 6, Sides 7, Sides 8 and Sides 9 revealed longer days to flowering. Meanwhile, the lines; Pc 29, Pc 62 and Pc 63 were found to be more longer days to flowering than the Sides parents (120.00, 120.75 and 119.25, respectively). The standard deviations of parents also showed highly significant differences (2.06, 3.12, 1.90, 4.92, 3.15 and 2.78 for Sids's parents while 3.67, 4.11 and 1.66 for Pc's parents). These differences indicated that there was great variability in flowering date between the selected lines while differences between individuals within each parent were mainly due to environmental conditions.

The flowering date of the selected plants from F_2 population:

Concerning the flowering date of the selected plants from the Pc 29 x Sids 5, the date to flowering ranged from 105 to 119 days. In case of Pc 29 x Sids 7, the observed means of the studied selected plants ranged from 99 to 106 day (Table 3).

For the selected plants from the Pc 62 x Sids 4, the observed means of flowering date ranged from 90 to 110 days. Concerning the selected plants from the Pc 62 x Sids 6, the

observed means of the selected plants ranged from 90 to 111 days. In case of the selected plants from the Pc 62 x Sids 7, the observed means of the studied selected plants ranged from 95 to 110 days. For the selected plants from the Pc 62 x Sids 8, the observed means of the studied selected plants ranged from 99 to 105 days. In case of the selected plants from the Pc 62 x Sids 9, the observed means of the studied selected plants ranged from 92 to 112 days (Table 4).

The selected plants from the Pc 63 x Sids 4, revealed that the observed means of flowering date ranged from 95 to 110 days. Concerning the selected plants from the Pc 63 x Sids 7, the observed means of the studied selected plants ranged from 100 to 120 days. For the selected plants from the Pc 63 x Sids 8, the observed means of the studied selected plants ranged from 105 to 120 days (Table 5).

The flowering date of the selected plants from BC_1 population:

The selected plants from the BC_1 of Pc 29 x Sids 4, revealed that the observed means of flowering date ranged from 77 to 110 days (Table 6).

For the selected plants from the BC_1 of Pc 62 x Sids 4, it showed a range of 78 to 102 days. Concerning the selected

ɔle 4: Means of some morphological and yield characters in some selected plants having ry neck of spike from F_2 population (Pc 62 X Sids parents)..

Genotypes / Characters	Selected plants from the F_2 population				
	1	2	3	4	5
(Pc 62 X Sids 4)					
Flowering date	100.00	090.00	110.00	110.00	105.00
Maturity date	170.00	177.00	160.00	159.00	166.00
Plant height	105.00	109.00	120.00	125.00	115.00
Spike length	021.00	012.50	018.50	012.30	021.70
Spikelets number	016.00	038.00	033.00	036.00	022.00
Grain weight/Spike	002.10	000.95	003.10	001.85	001.85
1000-grain weight	041.30	045.88	040.88	050.90	023.39
(Pc 62 X Sids 5)					
Flowering date	---	---	---	---	---
Maturity date	---	---	---	---	---
Plant height	---	---	---	---	---
Spike length	---	---	---	---	---
Spikelets number	---	---	---	---	---
Grain weight/Spike	---	---	---	---	---
1000-grain weight	---	---	---	---	---
(Pc 62 X Sids 6)					
Flowering date	095.00	103.00	106.00	111.00	090.00
Maturity date	108.00	170.00	166.00	166.00	160.00
Plant height	113.00	120.00	135.00	105.00	105.00
Spike length	020.00	016.10	016.20	013.00	014.20
Spikelets number	022.00	031.00	025.00	036.00	016.00
Grain weight/Spike	001.90	001.45	001.45	001.45	000.99
1000-grain weight	039.00	040.00	045.50	044.00	037.05
(Pc 62 X Sids 7)					
Flowering date	105.00	110.00	102.00	095.00	110.00
Maturity date	116.00	170.00	169.00	166.00	158.00
Plant height	090.00	095.00	120.00	105.00	100.00
Spike length	017.30	019.60	016.40	019.60	013.60
Spikelets number	031.00	020.00	011.00	022.00	022.00
Grain weight/Spike	004.00	002.45	000.90	002.45	004.00
1000-grain weight	030.10	034.00	029.60	028.20	035.14
(Pc 62 X Sids 8)					
Flowering date	104.00	099.00	105.00	105.00	100.00
Maturity date	164.00	158.00	166.00	166.00	166.00
Plant height	110.00	120.00	110.00	120.00	102.00
Spike length	015.50	017.50	010.00	013.10	010.00
Spikelets number	023.00	010.00	020.00	024.00	020.00
Grain weight/Spike	004.30	002.80	002.80	002.65	000.95
1000-grain weight	040.60	046.88	041.90	049.99	024.10
(Pc 62 X Sids 9)					
Flowering date	105.00	104.00	092.00	112.00	105.00
Maturity date	170.00	170.00	158.00	172.00	168.00
Plant height	120.00	105.00	110.00	105.00	125.00
Spike length	016.10	019.90	016.30	013.00	014.60
Spikelets number	022.00	034.00	016.00	024.00	011.00
Grain weight/Spike	003.45	003.45	004.10	003.40	004.30
1000-grain weight	061.50	032.50	044.10	025.05	042.50

plants from the BC_1 of Pc 62 x Sids 6, revealed that the observed means of flowering date ranged from 88 to 112 days. In case of the selected plants from the BC_1 of Pc 62 x Sids 9, the observed means of flowering date ranged from 98 to 103 days (Table 7).

The selected plants from the BC_1 of Pc 63 x Sids 4, revealed that the observed means of days to anthesis ranged from 87 to 101 days (Table 8).

The flowering date of the selected plants from BC_2 population:

Concerning the selected plants from the BC_2 of Pc 29 x Sids 6, it revealed a range of 82 to 100 days. In case of the selected plants from the BC_2 of Pc 29 x Sids 9, showed that the observed means of flowering date ranged from 85 to 110 days (Table 9).

For the selected plants from the BC_2 of Pc 62 x Sids 4, it showed a range of 95 to 115 days (Table 10).

Concerning the selected plants from the BC_1 of Pc 63 x Sids 9, revealed that the observed means of flowering date ranged from 95 to 115 days (Table 11).

2. Maturity date:-

The observed means of days to maturity in parents; Sids 4, Sids 5, Sids 6, Sids 7, Sids 8 and Sids 9 (hexaploid wheat) were 151.50, 153.75, 155.00, 156.50, 157.00 and 158.00 which showed great variability between parents as Sides 4 and other Sids's parents which revealed shorter days to maturity while Sides 5, Sides 6, Sides 7, Sides 8 and Sides 9 revealed longer days to maturity. Meanwhile, the lines; Pc 29, Pc 62 and Pc 63 were found to be more longer days to maturity than the Sides parents (158.25, 159.00 and 159.00, respectively). The standard errors of parents also showed highly significant differences (2.10, 0.76, 3.55, 1.09, 1.60 and 2.34 for Sids's parents while 2.45, 1.85 and 1.05 for Pc's parents). These differences indicated that there was great variability in maturity date between the selected lines while differences between individuals within each parent were mainly due to environmental conditions.

The maturity date of the selected plants from F_2 population:

In case of maturity date of the selected plants from the Pc 29 x Sids 5, the date to maturity ranged from 155 to 166 day. In case of Pc 29 x Sids 7, the observed means of the studied selected plants ranged from 153 to 170 days (Table 3).

For the selected plants from the Pc 62 x Sids 4, the observed means of maturity date ranged from 159 to 177 days. Concerning the selected plants from the Pc 62 x Sids 6, the observed means of the studied selected plants were ranged from 108 to 170 days. In case of the selected plants from the Pc 62 x Sids 7, the observed means of the studied selected plants ranged from 116 to 170 day. For the selected plants from the Pc 62 x Sids 8, the observed means of the studied selected plants ranged from 158 to 166 days. In case of the selected plants from the Pc 62 x Sids 9, the observed means of the studied selected plants ranged from 158 to 170 days (Table 4).

The selected plants from the Pc 63 x Sids 4, revealed that the observed means of maturity date ranged from 158 to 170 days. Concerning the selected plants from the Pc 63 x Sids 7, the observed means of the studied selected plants were ranged from 158 to 172 days. For the selected plants from the Pc 63 x Sids 8, the observed means of the studied selected plants ranged from 158 to 175 days (Table 5).

Table 5: Means of some morphological and yield characters in some selected plants having hairy neck of spike from F_2 population (Pc 63 X Sids parents)..

Genotypes / Characters	Selected plants from the F_2 population				
	1	2	3	4	5
(Pc 63 X Sids 4)					
Flowering date	105.00	105.00	100.00	110.00	095.00
Maturity date	170.00	170.00	168.00	158.00	158.00
Plant height	135.00	145.00	140.00	120.00	135.00
Spike length	010.00	017.21	009.20	015.00	009.20
Spikelets number	036.00	016.00	021.00	036.00	011.00
Grain weight/Spike	004.40	003.80	001.85	002.85	004.30
1000-grain weight	040.40	037.26	043.85	047.35	045.03
(Pc 63 X Sids 5)					
Flowering date	---	---	---	---	---
Maturity date	---	---	---	---	---
Plant height	---	---	---	---	---
Spike length	---	---	---	---	---
Spikelets number	---	---	---	---	---
Grain weight/Spike	---	---	---	---	---
1000-grain weight	---	---	---	---	---
(Pc 63 X Sids 6)					
Flowering date	---	---	---	---	---
Maturity date	---	---	---	---	---
Plant height	---	---	---	---	---
Spike length	---	---	---	---	---
Spikelets number	---	---	---	---	---
Grain weight/Spike	---	---	---	---	---
1000-grain weight	---	---	---	---	---
(Pc 63 X Sids 7)					
Flowering date	110.00	119.00	119.00	120.00	100.00
Maturity date	158.00	176.00	170.00	170.00	172.00
Plant height	115.00	120.00	120.00	130.00	135.00
Spike length	020.50	020.50	019.50	019.50	012.30
Spikelets number	032.00	032.00	030.00	030.00	015.00
Grain weight/Spike	004.30	004.30	004.30	003.30	005.20
1000-grain weight	055.10	043.21	040.10	071.00	065.30
(Pc 63 X Sids 8)					
Flowering date	120.00	120.00	109.00	105.00	115.00
Maturity date	168.00	158.00	172.00	172.00	175.00
Plant height	125.00	115.00	125.00	125.00	130.00
Spike length	017.00	010.20	015.60	009.60	009.20
Spikelets number	030.00	031.00	029.00	030.00	014.00
Grain weight/Spike	003.70	003.30	004.30	004.30	001.70
1000-grain weight	055.70	045.10	035.00	038.60	044.05
(Pc 63 X Sids 9)					
Flowering date	---	---	---	---	---
Maturity date	---	---	---	---	---
Plant height	---	---	---	---	---
Spike length	---	---	---	---	---
Spikelets number	---	---	---	---	---
Grain weight/Spike	---	---	---	---	---
1000-grain weight	---	---	---	---	---

Figure (3): Spike characteristics of selected plant from F_2 population of Pc 63 x Sids 4 showing the hairy neck (Ha1) from rye.

The maturity date of the selected plants from BC_1 population:

The selected plants from the BC_1 of Pc 29 x Sids 4, revealed that the observed means of maturity date ranged from 150 to 172 days (Table 6).

For the selected plants from the BC_1 of Pc 62 x Sids 4, it showed a range of 148 to 165 days. Concerning the selected plants from the BC_1 of Pc 62 x Sids 6, revealed that the observed means of maturity date ranged from 155 to 169 days. In case of the selected plants from the BC_1 of Pc 62 x Sids 9, the observed means of maturity date ranged from 150 to 178 days (Table 7).

The selected plants from the BC_1 of Pc 63 x Sids 4, revealed that the observed means of days to maturity ranged from 145 to 164 day (Table 8).

The maturity date of the selected plants from BC_2 population:

Concerning the selected plants from the BC_2 of Pc 29 x Sids 6, it revealed a range of 150 to 173 day. In case of the selected plants from the BC_2 of Pc 29 x Sids 9, showed that the

Table 6: Means of some morphological and yield characters in some selected plants having hairy neck of spike from BC_1 population (Pc 29 X Sids parents).

Genotypes / Characters	Selected plants from the BC_1 population				
	1	2	3	4	5
(Pc 29 X Sids 4)					
Flowering date	080.00	077.00	090.00	099.00	110.00
Maturity date	172.00	150.00	166.00	170.00	172.00
Plant height	122.00	118.00	110.00	108.00	112.00
Spike length	013.20	016.20	017.80	012.50	013.50
Spikelets number	030.00	020.00	023.00	020.00	019.00
Grain weight/Spike	004.60	003.50	005.60	004.40	004.80
1000-grain weight	060.20	063.18	058.30	053.50	051.30
(Pc 29 X Sids 5)					
Flowering date	---	---	---	---	---
Maturity date	---	---	---	---	---
Plant height	---	---	---	---	---
Spike length	---	---	---	---	---
Spikelets number	---	---	---	---	---
Grain weight/Spike	---	---	---	---	---
1000-grain weight	---	---	---	---	---
(Pc 29 X Sids 6)					
Flowering date	---	---	---	---	---
Maturity date	---	---	---	---	---
Plant height	---	---	---	---	---
Spike length	---	---	---	---	---
Spikelets number	---	---	---	---	---
Grain weight/Spike	---	---	---	---	---
1000-grain weight	---	---	---	---	---
(Pc 29 X Sids 7)					
Flowering date	---	---	---	---	---
Maturity date	---	---	---	---	---
Plant height	---	---	---	---	---
Spike length	---	---	---	---	---
Spikelets number	---	---	---	---	---
Grain weight/Spike	---	---	---	---	---
1000-grain weight	---	---	---	---	---
(Pc 29 X Sids 8)					
Flowering date	---	---	---	---	---
Maturity date	---	---	---	---	---
Plant height	---	---	---	---	---
Spike length	---	---	---	---	---
Spikelets number	---	---	---	---	---
Grain weight/Spike	---	---	---	---	---
1000-grain weight	---	---	---	---	---
(Pc 29 X Sids 9)					
Flowering date	---	---	---	---	---
Maturity date	---	---	---	---	---
Plant height	---	---	---	---	---
Spike length	---	---	---	---	---
Spikelets number	---	---	---	---	---
Grain weight/Spike	---	---	---	---	---
1000-grain weight	---	---	---	---	---

observed means of maturity date ranged from 148 to 178 day (Table 9).

For the selected plants from the BC_2 of Pc 62 x Sids 4, it showed a range of 150 to 161 day (Table 10).

Concerning the selected plants from the BC_1 of Pc 63 x Sids 9, revealed that the observed means of maturity date ranged from 150 to 170 day (Table 11).

4. Spike length:-

Table (2) showed the data on the main spike length for the studied parents as observed means and standard errors.

The observed means for parents were 16.800, 17.050, 17.150, 16.700, 14.950 and 16.225 for wheat parents (Sids 4, Sids 5, Sids 6, Sids 7, Sids 8 and Sids 9) while 14.850, 9.350 and 11.800 for Pc's parents (Pc 29, Pc 62 and Pc 63) showed highly significant differences between parents. The standard errors of parents also revealed highly significant differences (0.07, 0.78, 0.18, 0.34, 0.59 and 0.12 for Sids's parents while 0.30, 0.34 and 0.57 for Pc's parents).

These differences revealed that there was great variability in spike length between the selected parents while

differences between individuals within each parent mainly due to environmental conditions.

The spike length of the selected plants from F_2 population:

Concerning the spike length of the selected plants from the Pc 29 x Sids 5, the spike length ranged from 13 to 20 cm. In case of Pc 29 x Sids 7, the observed means of the studied selected plants ranged from 11.5 to 20 cm (Table 3).

For the selected plants from the Pc 62 x Sids 4, the observed means of spike length ranged from 12.30 to 21 cm. Concerning the selected plants from the Pc 62 x Sids 6, the observed means of the studied selected plants were ranged from 13 to 20 cm. In case of the selected plants from the Pc 62 x Sids 7, the observed means of the studied selected plants ranged from 13.60 to 17.30 cm. For the selected plants from the Pc 62 x Sids 8, the observed means of the studied selected plants ranged from 10 to 17.50 cm. In case of the selected plants from the Pc 62 x Sids 9, the observed means of the studied selected plants ranged from 13 to 19.90 cm (Table 4).

The selected plants from the Pc 63 x Sids 4, revealed that the observed means of spike length ranged from 9.20 to 17.21 cm. Concerning the selected plants from the Pc 63 x Sids 7, the observed means of the studied selected plants ranged

from 12.30 to 20.50 cm. For the selected plants from the Pc 63 x Sids 8, the observed means of the studied selected plants ranged from 9.20 to 17 cm (Table 5).

The spike length of the selected plants from BC_1 population:

The selected plants from the BC_1 of Pc 29 x Sids 4, revealed that the observed means of spike length ranged from 13.20 to 17.80 cm (Table 6).

For the selected plants from the BC_1 of Pc 62 x Sids 4, it showed a range of 13.60 to 17.20 cm. Concerning the selected plants from the BC_1 of Pc 62 x Sids 6, revealed that the observed means of maturity date ranged from 12.60 to 20.20 cm. In case of the selected plants from the BC_1 of Pc 62 x Sids 9, the observed means of spike length ranged from 13.80 to 17.20 cm (Table 7).

The selected plants from the BC_1 of Pc 63 x Sids 4, revealed that the observed means of spike length ranged from 15.80 to 17.20 cm (Table 8).

The spike length of the selected plants from BC_2 population:

Table 7: Means of some morphological and yield characters in some selected plants having hairy neck of spike from BC_1 population (Pc 62 X Sids parents).

Genotypes / Characters	Selected plants from the BC_1 population				
	1	2	3	4	5
(Pc 62 X Sids 4)					
Flowering date	097.00	078.00	100.00	100.00	102.00
Maturity date	157.00	165.00	154.00	150.00	148.00
Plant height	065.00	098.00	110.00	100.00	100.00
Spike length	015.20	016.80	017.20	015.50	013.60
Spikelets number	022.00	019.00	024.00	026.00	019.00
Grain weight/Spike	003.30	003.60	004.50	004.40	005.50
1000-grain weight	046.60	049.40	048.50	042.00	058.02
(Pc 62 X Sids 5)					
Flowering date	---	---	---	---	---
Maturity date	---	---	---	---	---
Plant height	---	---	---	---	---
Spike length	---	---	---	---	---
Spikelets number	---	---	---	---	---
Grain weight/Spike	---	---	---	---	---
1000-grain weight	---	---	---	---	---
(Pc 62 X Sids 6)					
Flowering date	112.00	088.00	110.00	106.00	100.00
Maturity date	155.00	160.00	169.00	157.00	155.00
Plant height	100.00	104.00	090.00	102.00	100.00
Spike length	016.80	014.20	020.20	015.50	012.60
Spikelets number	024.00	040.00	019.00	035.00	027.00
Grain weight/Spike	005.60	004.50	004.50	005.80	005.80
1000-grain weight	056.30	035.18	033.50	056.80	044.70
(Pc 62 X Sids 7)					
Flowering date	---	---	---	---	---
Maturity date	---	---	---	---	---
Plant height	---	---	---	---	---
Spike length	---	---	---	---	---
Spikelets number	---	---	---	---	---
Grain weight/Spike	---	---	---	---	---
1000-grain weight	---	---	---	---	---
(Pc 62 X Sids 8)					
Flowering date	---	---	---	---	---
Maturity date	---	---	---	---	---
Plant height	---	---	---	---	---
Spike length	---	---	---	---	---
Spikelets number	---	---	---	---	---
Grain weight/Spike	---	---	---	---	---
1000-grain weight	---	---	---	---	---
(Pc 62 X Sids 9)					
Flowering date	103.00	103.00	103.00	103.00	098.00
Maturity date	156.00	175.00	150.00	178.00	150.00
Plant height	096.00	108.00	106.00	092.00	105.00
Spike length	013.80	015.50	015.50	017.20	015.80
Spikelets number	042.00	025.00	018.00	027.00	035.00
Grain weight/Spike	002.70	004.20	003.60	004.30	004.40
1000-grain weight	042.30	030.60	058.18	055.50	049.70

Concerning the selected plants from the BC_2 of Pc 29 x Sids 6, it revealed a range of 14.60 to 19.20 cm. In case of the selected plants from the BC_2 of Pc 29 x Sids 9, showed that the observed means of spike length ranged from 10.30 to 18.50 cm (Table 9).

For the selected plants from the BC_2 of Pc 62 x Sids 4, it showed a range of 11.60 to 16.50 cm (Table 10).

Concerning the selected plants from the BC_1 of Pc 63 x Sids 9, revealed that the observed means of spike length ranged from 10.00 to 14.80 cm (Table 11).

5. Number of spikelets per spike:-

Table (2) showed the spikelets number per spike in parents as 24.350, 25.150, 23.350, 24.500, 22.175 and 24.250 for hexaploid wheat (Sids 4, Sids 5, Sids 6, Sids 7, Sids 8 and Sids 9, respectively) and 26.550, 20.950 and 23.400 for Pc's lines (Pc 29, Pc 62 and Pc 63, respectively) indicating the significant differences between parents in such character. The standard errors of parents also revealed highly significant differences (0.06, 0.74, 0.50, 0.13, 0.34 and 0.51 for Sids's parents while 0.60, 0.74 and 0.92 for Pc's parents).

These differences revealed that there was great variability in spikelets number per spike between the selected parents while differences between individuals within each parent were mainly due to environmental conditions.

The number of spikelets per spike of the selected plants from F_2 population:

In case of number of spikelets per spike of the selected plants from the Pc 29 x Sids 5, the number of spikelets per spike ranged from 20 to 32. In case of Pc 29 x Sids 7, the observed means of the studied selected plants ranged from 21 to 32 (Table 3).

For the selected plants from the Pc 62 x Sids 4, the observed means of number of spikelets per spike ranged from 16 to 38. Concerning the selected plants from the Pc 62 x Sids 6, the observed means of the studied selected plants ranged from 16 to 36. In case of the selected plants from the Pc 62 x Sids 7, the observed means of the studied selected plants ranged from 11 to 31. For the selected plants from the Pc 62 x Sids 8, the observed means of the studied selected plants ranged from 10 to 24. In case of the selected plants from the Pc 62 x Sids 9, the observed means of the studied selected plants ranged from 11 to 34 (Table 4).

The selected plants from the Pc 63 x Sids 4, revealed that the observed means of number of spikelets per spike ranged from 11 to 36. Concerning the selected plants from the Pc 63 x Sids 7, the observed means of the studied selected plants ranged from 15 to 32. For the selected plants from the Pc 63 x Sids 8, the observed means of the studied selected plants ranged from 14 to 31 (Table 5).

The number of spikelets per spike of the selected plants from BC_1 population:

The selected plants from the BC_1 of Pc 29 x Sids 4, revealed that the observed means of number of spikelets per spike ranged from 19 to 30 (Table 6).

For the selected plants from the BC_1 of Pc 62 x Sids 4, it showed a range of 19 to 26. Concerning the selected plants from the BC_1 of Pc 62 x Sids 6, revealed that the observed means of number of spikelets per spike ranged from 19 to 40. In case of the selected plants from the BC_1 of Pc 62 x Sids 9, the observed means of number of spikelets per spike ranged from 18 to 42 (Table 7).

The selected plants from the BC_1 of Pc 63 x Sids 4, revealed that the observed means of number of spikelets per spike ranged from 24 to 31 (Table 8).

Table 8: Means of some morphological and yield characters in some selected plants having hairy neck of spike from BC_1 population (Pc 63 X Sids parents).

Genotypes / Characters	Selected plants from the BC_1 population				
	1	2	3	4	5
(Pc 63 X Sids 4)					
Flowering date	096.00	087.00	095.00	098.00	101.00
Maturity date	157.00	164.00	155.00	155.00	145.00
Plant height	100.00	080.00	074.00	102.00	100.00
Spike length	017.20	015.80	016.20	016.50	015.60
Spikelets number	025.00	025.00	031.00	031.00	024.00
Grain weight/Spike	003.40	004.30	004.20	004.20	005.20
1000-grain weight	052.30	040.68	055.30	044.35	053.20
(Pc 63 X Sids 5)					
Flowering date	---	---	---	---	---
Maturity date	---	---	---	---	---
Plant height	---	---	---	---	---
Spike length	---	---	---	---	---
Spikelets number	---	---	---	---	---
Grain weight/Spike	---	---	---	---	---
1000-grain weight	---	---	---	---	---
(Pc 63 X Sids 6)					
Flowering date	---	---	---	---	---
Maturity date	---	---	---	---	---
Plant height	---	---	---	---	---
Spike length	---	---	---	---	---
Spikelets number	---	---	---	---	---
Grain weight/Spike	---	---	---	---	---
1000-grain weight	---	---	---	---	---
(Pc 63 X Sids 7)					
Flowering date	---	---	---	---	---
Maturity date	---	---	---	---	---
Plant height	---	---	---	---	---
Spike length	---	---	---	---	---
Spikelets number	---	---	---	---	---
Grain weight/Spike	---	---	---	---	---
1000-grain weight	---	---	---	---	---
(Pc 63 X Sids 8)					
Flowering date	---	---	---	---	---
Maturity date	---	---	---	---	---
Plant height	---	---	---	---	---
Spike length	---	---	---	---	---
Spikelets number	---	---	---	---	---
Grain weight/Spike	---	---	---	---	---
1000-grain weight	---	---	---	---	---
(Pc 63 X Sids 9)					
Flowering date	---	---	---	---	---
Maturity date	---	---	---	---	---
Plant height	---	---	---	---	---
Spike length	---	---	---	---	---
Spikelets number	---	---	---	---	---
Grain weight/Spike	---	---	---	---	---
1000-grain weight	---	---	---	---	---

The number of spikelets per spike of the selected plants from BC_2 population:

Concerning the selected plants from the BC_2 of Pc 29 x Sids 6, it revealed a range of 25 to 33. In case of the selected plants from the BC_2 of Pc 29 x Sids 9, showed that the observed means of number of spikelets per spike ranged from 21 to 37 (Table 9).

For the selected plants from the BC_2 of Pc 62 x Sids 4, it showed a range of 18 to 27 (Table 10).

Concerning the selected plants from the BC_1 of Pc 63 x Sids 9, revealed that the observed means of number of spikelets per spike ranged from 21 to 32 (Table 11).

6. Grain weight per spike:-

Table (2) showed the grain weight per spike in parents as 4.333, 4.818, 5.105, 4.965, 4.155 and 4.920 for hexaploid wheat (Sids 4, Sids 5, Sids 6, Sids 7, Sids 8 and Sids 9, respectively) and 1.773, 2.000 and 2.430 for Pc's lines (Pc 29, Pc 62 and Pc 63, respectively) indicating the significant differences between parents in such character. The standard deviations of parents also revealed highly significant

Table 9: Means of some morphological and yield characters in some selected plants having hairy neck of spike from BC_2 population (Pc 29 X Sids parents).

Genotypes / Characters	Selected plants from the BC_2 population				
	1	2	3	4	5
(Pc 29 X Sids 4)					
Flowering date	---	---	---	---	---
Maturity date	---	---	---	---	---
Plant height	---	---	---	---	---
Spike length	---	---	---	---	---
Spikelets number	---	---	---	---	---
Grain weight/Spike	---	---	---	---	---
1000-grain weight	---	---	---	---	---
(Pc 29 X Sids 5)					
Flowering date	---	---	---	---	---
Maturity date	---	---	---	---	---
Plant height	---	---	---	---	---
Spike length	---	---	---	---	---
Spikelets number	---	---	---	---	---
Grain weight/Spike	---	---	---	---	---
1000-grain weight	---	---	---	---	---
(Pc 29 X Sids 6)					
Flowering date	082.00	100.00	095.00	105.00	090.00
Maturity date	150.00	161.00	151.00	173.00	155.00
Plant height	110.00	105.00	094.00	106.00	110.00
Spike length	017.50	014.60	014.60	015.50	019.20
Spikelets number	027.00	033.00	029.00	026.00	025.00
Grain weight/Spike	002.40	003.50	004.10	004.30	003.20
1000-grain weight	056.30	038.18	036.50	053.80	040.70
(Pc 29 X Sids 7)					
Flowering date	---	---	---	---	---
Maturity date	---	---	---	---	---
Plant height	---	---	---	---	---
Spike length	---	---	---	---	---
Spikelets number	---	---	---	---	---
Grain weight/Spike	---	---	---	---	---
1000-grain weight	---	---	---	---	---
(Pc 29 X Sids 8)					
Flowering date	---	---	---	---	---
Maturity date	---	---	---	---	---
Plant height	---	---	---	---	---
Spike length	---	---	---	---	---
Spikelets number	---	---	---	---	---
Grain weight/Spike	---	---	---	---	---
1000-grain weight	---	---	---	---	---
(Pc 29 X Sids 9)					
Flowering date	110.00	110.00	088.00	099.00	085.00
Maturity date	165.00	170.00	178.00	160.00	148.00
Plant height	070.00	100.00	110.00	080.00	110.00
Spike length	010.30	013.60	014.60	018.50	014.80
Spikelets number	025.00	022.00	037.00	036.00	021.00
Grain weight/Spike	003.60	003.70	003.90	003.90	003.60
1000-grain weight	037.20	031.80	042.60	035.80	033.35

differences (0.04, 0.01, 0.14, 0.01, 0.13 and 0.24 for Sids's parents while 0.11, 0.10 and 0.03 for Pc's parents). These differences revealed that there was great variability in weight of grains per spike between the selected parents while differences between individuals within each parent were mainly due to environmental conditions.

Grain weight per spike of the selected plants from F_2 population:

In case of grain weight per spike of the selected plants from the Pc 29 x Sids 5, the grain weight per spike ranged from 1.60 to 4.00 gm. In case of Pc 29 x Sids 7, the observed means of the studied selected plants ranged from 3.50 to 4.00 gm (Table 3).

For the selected plants from the Pc 62 x Sids 4, the observed means of grain weight per spike ranged from 0.95 to 3.10 gm. Concerning the selected plants from the Pc 62 x Sids 6, the observed means of the studied selected plants ranged from 0.99 to 1.90 gm. In case of the selected plants from the Pc 62 x Sids 7, the observed means of the studied selected plants ranged from 0.90 to 4.00 gm. For the selected plants from the Pc 62 x Sids 8, the observed means of the studied selected plants ranged from 0.95 to 4.30 gm. In case of the selected plants from the Pc 62 x Sids 9, the observed means of

the studied selected plants ranged from 3.40 to 4.30 gm (Table 4).

The selected plants from the Pc 63 x Sids 4, revealed that the observed means of grain weight per spike ranged from 1.85 to 4.40 gm. Concerning the selected plants from the Pc 63 x Sids 7, the observed means of the studied selected plants ranged from 3.30 to 5.20 gm. For the selected plants from the Pc 63 x Sids 8, the observed means of the studied selected plants ranged from 1.70 to 4.30 gm (Table 5).

Grain weight per spike of the selected plants from BC_1 population:

The selected plants from the BC_1 of Pc 29 x Sids 4, revealed that the observed means of grain weight per spike ranged from 3.50 to 5.60 gm (Table 6).

For the selected plants from the BC_1 of Pc 62 x Sids 4, it showed a range of 3.30 to 5.50 gm. Concerning the selected plants from the BC_1 of Pc 62 x Sids 6, revealed that the observed means of grain weight per spike ranged from 4.50 to 5.80 gm. In case of the selected plants from the BC_1 of Pc 62 x Sids 9, the observed means of grain weight per spike ranged from 2.70 to 4.40 gm (Table 7).

The selected plants from the BC_1 of Pc 63 x Sids 4, revealed that the observed means of grain weight per spike ranged from 3.40 to 5.20 gm (Table 8).

Grain weight per spike of the selected plants from BC_2 population:

Concerning the selected plants from the BC_2 of Pc 29 x Sids 6, it revealed a range of 2.40 to 4.30 gm. In case of the selected plants from the BC_2 of Pc 29 x Sids 9, showed that the observed means of grain weight per spike ranged from 3.60 to 3.90 gm (Table 9).

For the selected plants from the BC_2 of Pc 62 x Sids 4, it showed a range of 2.40 to 3.80 gm (Table 10).

Concerning the selected plants from the BC_1 of Pc 63 x Sids 9, revealed that the observed means of grain weight per spike ranged from 4.00 to 5.10 gm (Table 11).

7. 1000-kernel weight:-

Table (2) revealed that 1000-kernel weight in parents were 54.355, 55.113, 60.823, 57.715, 51.050 and 56.730 gm for hexaploid wheat (Sids 4, Sids 5, Sids 6, Sids 7, Sids 8 and Sids 9, respectively) and 25.783, 32.995 and 25.213 for Pc's

Table 10: Means of some morphological and yield characters in some selected plants having hairy neck of spike from BC_2 population (Pc 62 X Sids parents).

Genotypes / Characters	Selected plants from the BC_2 population				
	1	2	3	4	5
(Pc 62 X Sids 4)					
Flowering date	107.00	109.00	095.00	115.00	115.00
Maturity date	150.00	160.00	160.00	161.00	158.00
Plant height	116.00	119.00	105.00	131.00	125.00
Spike length	011.60	012.80	013.30	016.50	013.50
Spikelets number	022.00	018.00	027.00	027.00	020.00
Grain weight/Spike	002.40	003.50	003.80	002.50	003.50
1000-grain weight	024.50	036.50	036.80	038.80	035.90
(Pc 62 X Sids 5)					
Flowering date	---	---	---	---	---
Maturity date	---	---	---	---	---
Plant height	---	---	---	---	---
Spike length	---	---	---	---	---
Spikelets number	---	---	---	---	---
Grain weight/Spike	---	---	---	---	---
1000-grain weight	---	---	---	---	---
(Pc 62 X Sids 6)					
Flowering date	---	---	---	---	---
Maturity date	---	---	---	---	---
Plant height	---	---	---	---	---
Spike length	---	---	---	---	---
Spikelets number	---	---	---	---	---
Grain weight/Spike	---	---	---	---	---
1000-grain weight	---	---	---	---	---
(Pc 62 X Sids 7)					
Flowering date	---	---	---	---	---
Maturity date	---	---	---	---	---
Plant height	---	---	---	---	---
Spike length	---	---	---	---	---
Spikelets number	---	---	---	---	---
Grain weight/Spike	---	---	---	---	---
1000-grain weight	---	---	---	---	---
(Pc 62 X Sids 8)					
Flowering date	---	---	---	---	---
Maturity date	---	---	---	---	---
Plant height	---	---	---	---	---
Spike length	---	---	---	---	---
Spikelets number	---	---	---	---	---
Grain weight/Spike	---	---	---	---	---
1000-grain weight	---	---	---	---	---
(Pc 62 X Sids 9)					
Flowering date	---	---	---	---	---
Maturity date	---	---	---	---	---
Plant height	---	---	---	---	---
Spike length	---	---	---	---	---
Spikelets number	---	---	---	---	---
Grain weight/Spike	---	---	---	---	---
1000-grain weight	---	---	---	---	---

56.80 gm. In case of the selected plants from the BC_1 of Pc 62 x Sids 9, the observed means of 1000-kernel weight ranged from 30.60 to 58.18 gm (Table 7).

The selected plants from the BC_1 of Pc 63 x Sids 4, revealed that the observed means of 1000-kernel weight ranged from 40.68 to 55.30 gm (Table 8).

1000-kernel weight of the selected plants from BC_2 population:

Concerning the selected plants from the BC_2 of Pc 29 x Sids 6, it revealed a range of 36.50 to 56.30 gm. In case of the selected plants from the BC_2 of Pc 29 x Sids 9, showed that the observed means of 1000-kernel weight ranged from 31.80 to 42.60 gm (Table 9).

For the selected plants from the BC_2 of Pc 62 x Sids 4, it showed a range of 24.50 to 38.80 gm (Table 10).

Concerning the selected plants from the BC_1 of Pc 63 x Sids 9, revealed that the observed means of 1000-kernel weight ranged from 24.40 to 56.18 gm (Table 11).

1. <u>Cytological studies on the chromosomal number in mitosis using C-banding technique .:-</u>

Table 11: Means of some morphological and yield characters in some selected plants having hairy neck of spike from BC_2 population (Pc 63 X Sids parents).

Genotypes / Characters	Selected plants from the BC_2 population				
	1	2	3	4	5
(Pc 63 X Sids 4)					
Flowering date	---	---	---	---	---
Maturity date	---	---	---	---	---
Plant height	---	---	---	---	---
Spike length	---	---	---	---	---
Spikelets number	---	---	---	---	---
Grain weight/Spike	---	---	---	---	---
1000-grain weight	---	---	---	---	---
(Pc 63 X Sids 5)					
Flowering date	---	---	---	---	---
Maturity date	---	---	---	---	---
Plant height	---	---	---	---	---
Spike length	---	---	---	---	---
Spikelets number	---	---	---	---	---
Grain weight/Spike	---	---	---	---	---
1000-grain weight	---	---	---	---	---
(Pc 63 X Sids 6)					
Flowering date	---	---	---	---	---
Maturity date	---	---	---	---	---
Plant height	---	---	---	---	---
Spike length	---	---	---	---	---
Spikelets number	---	---	---	---	---
Grain weight/Spike	---	---	---	---	---
1000-grain weight	---	---	---	---	---
(Pc 63 X Sids 7)					
Flowering date	---	---	---	---	---
Maturity date	---	---	---	---	---
Plant height	---	---	---	---	---
Spike length	---	---	---	---	---
Spikelets number	---	---	---	---	---
Grain weight/Spike	---	---	---	---	---
1000-grain weight	---	---	---	---	---
(Pc 63 X Sids 8)					
Flowering date	---	---	---	---	---
Maturity date	---	---	---	---	---
Plant height	---	---	---	---	---
Spike length	---	---	---	---	---
Spikelets number	---	---	---	---	---
Grain weight/Spike	---	---	---	---	---
1000-grain weight	---	---	---	---	---
(Pc 63 X Sids 9)					
Flowering date	103.00	095.00	106.00	115.00	115.00
Maturity date	170.00	160.00	159.00	150.00	161.00
Plant height	114.00	100.00	100.00	092.00	105.00
Spike length	011.50	010.00	010.60	014.80	012.80
Spikelets number	025.00	032.00	030.00	025.00	021.00
Grain weight/Spike	004.00	004.20	005.10	004.10	005.10
1000-grain weight	024.40	042.80	056.18	038.30	044.50

Table 14: Number of chromosomes detected in some selected plants (on the basis of hairy neck of spike) from F_2 population (Pc 63 X Sids parents) Using C-banding technique.

Genotypes / Characters	Number of chromosomes detected in mitosis through using C-banding technique in some Selected plants from the F_2 population				
	1	2	3	4	5
(Pc 63 X Sids 4)	5BS.5Bl-5RL + 41	5BS.5Bl-5RL + 41	5BS.5Bl-5RL + 41	5BS.5Bl-5RL + 41	5BS.5Bl-5RL + 41
(Pc 63 X Sids 5)	42	42	42	42	42
(Pc 63 X Sids 6)	42	42	42	42	42
(Pc 63 X Sids 7)	5BS.5Bl-5RL + 41	5BS.5Bl-5RL + 41	5BS.5Bl-5RL + 41	5BS.5Bl-5RL + 41	5BS.5Bl-5RL + 41
(Pc 63 X Sids 8)	5BS.5Bl-5RL + 41	5BS.5Bl-5RL + 41	5BS.5Bl-5RL + 41	5BS.5Bl-5RL + 41	5BS.5Bl-5RL + 41
(Pc 63 X Sids 9)	42	42	42	42	42

Table 15: Number of chromosomes detected in some selected plants (on the basis of hairy neck of spike) from BC_1 population (Pc 29 X Sids parents) Using C-banding technique.

Genotypes / Characters	**Number of chromosomes detected in mitosis through using C-banding technique in some Selected plants from the BC_1 population**				
	1	2	3	4	5
(Pc 29 X Sids 4)	5AS/5RI + 41	5AS/5RI + 41	5AS/5RI + 41	5AS/5RI + 41	5AS/5RI + 41
(Pc 29 X Sids 5)	42	42	42	42	42
(Pc 29 X Sids 6)	42	42	42	42	42
(Pc 29 X Sids 7)	42	42	42	42	42
(Pc 29 X Sids 8)	42	42	42	42	42
(Pc 29 X Sids 9)	42	42	42	42	42

Table 16: Number of chromosomes detected in some selected plants (on the basis of hairy neck of spike) from BC_1 population (Pc 62 X Sids parents) Using C-banding technique.

Genotypes / Characters	**Number of chromosomes detected in mitosis through using C-banding technique in some Selected plants from the BC_1 population**				
	1	2	3	4	5
(Pc 62 X Sids 4)	4BS.4BL-5Rl + 41	4BS.4BL-5Rl + 41	4BS.4BL-5Rl + 41	4BS.4BL-5Rl + 41	4BS.4BL-5Rl + 41
(Pc 62 X Sids 5)	42	42	42	42	42
(Pc 62 X Sids 6)	4BS.4BL-5Rl + 41	4BS.4BL-5Rl + 41	4BS.4BL-5Rl + 41	4BS.4BL-5Rl + 41	4BS.4BL-5Rl + 41
(Pc 62 X Sids 7)	42	42	42	42	42
(Pc 62 X Sids 8)	42	42	42	42	42
(Pc 62 X Sids 9)	4BS.4BL-5Rl + 41	4BS.4BL-5Rl + 41	4BS.4BL-5Rl + 41	4BS.4BL-5Rl + 41	4BS.4BL-5Rl + 41

Table 17: Number of chromosomes detected in some selected plants have hairy neck of spike from BC_1 population (Pc 63 X Sids parents) Using C-banding technique.

Genotypes / Characters	**Number of chromosomes detected in mitosis through using C-banding technique in some Selected plants from the BC_1 population**				
	1	2	3	4	5
(Pc 63 X Sids 4)	5BS.5Bl-5RL + 41	5BS.5Bl-5RL + 41	5BS.5Bl-5RL + 41	5BS.5Bl-5RL + 41	5BS.5Bl-5RL + 41
(Pc 63 X Sids 5)	42	42	42	42	42
(Pc 63 X Sids 6)	42	42	42	42	42
(Pc 63 X Sids 7)	42	42	42	42	42
(Pc 63 X Sids 8)	42	42	42	42	42
(Pc 63 X Sids 9)	42	42	42	42	42

Table 18: Number of chromosomes detected in some selected plants (on the basis of hairy neck of spike) from BC_2 population (Pc 29 X Sids parents) Using C-banding technique.

Genotypes / Characters	**Number of chromosomes detected in mitosis through using C-banding technique in some Selected plants from the BC_2 population**				
	1	2	3	4	5
(Pc 29 X Sids 4)	42	42	42	42	42
(Pc 29 X Sids 5)	42	42	42	42	42
(Pc 29 X Sids 6)	5AS/5Rl + 41	5AS/5Rl + 41	5AS/5Rl + 41	5AS/5Rl + 41	5AS/5Rl + 41
(Pc 29 X Sids 7)	42	42	42	42	42
(Pc 29 X Sids 8)	42	42	42	42	42
(Pc 29 X Sids 9)	5AS/5Rl + 41	5AS/5Rl + 41	5AS/5Rl + 41	5AS/5Rl + 41	5AS/5Rl + 41

Table 19: Number of chromosomes detected in some selected plants (on the basis of hairy neck of spike) from BC_2 population (Pc 62 X Sids parents) Using C-banding technique.

Genotypes / Characters	**Number of chromosomes detected in mitosis through using C-banding technique in some Selected plants from the BC_2 population**				
	1	2	3	4	5
(Pc 62 X Sids 4)	4BS.4BL-5RI +41	4BS.4BL-5RI +41	4BS.4BL-5RI +41	4BS.4BL-5RI +41	4BS.4BL-5RI +41
(Pc 62 X Sids 5)	42	42	42	42	42
(Pc 62 X Sids 6)	42	42	42	42	42
(Pc 62 X Sids 7)	42	42	42	42	42
(Pc 62 X Sids 8)	42	42	42	42	42
(Pc 62 X Sids 9)	42	42	42	42	42

Table 20: Number of chromosomes detected in some selected plants have hairy neck of spike from BC_2 population (Pc 63 X Sids parents) Using C-banding technique.

Genotypes / Characters	Number of chromosomes detected in mitosis through using C-banding technique in some Selected plants from the BC_2 population				
	1	2	3	4	5
(Pc 63 X Sids 4)	42	42	42	42	42
(Pc 63 X Sids 5)	42	42	42	42	42
(Pc 63 X Sids 6)	42	42	42	42	42
(Pc 63 X Sids 7)	42	42	42	42	42
(Pc 63 X Sids 8)	42	42	42	42	42
(Pc 63 X Sids 9)	5BS.5Bl-5RL + 41	5BS.5Bl-5RL + 41	5BS.5Bl-5RL + 41	5BS.5Bl-5RL + 41	5BS.5Bl-5RL + 41

Baum, 1991 found that the wheat chromosome 6B was the most frequently added to rye.

3. Efficiency of micronutritional genes in translocated wheat lines and their parents:

In rye (*Secale cereale L.*), there are loci on chromosome arm 5RL which give rise to increased copper(Cu)- and iron(Fe)-efficiency, respectively. Three different wheat-rye translocations each harboring a terminal segment of different size of the rye chromosome arm 5RL were identified by C-banding technique: Pc 29 (5AS/5RL), Pc 63 (5BS.5BL-SRL) and Pc 62 (4BS.4BL-5RL). The translocation break points were observed by chromosome C-banding technique and the sizes of the rye chromosome segments involved were determined by karyotype analysis. The Cu-efficiency gene (*Ce*) was physically mapped to the terminal region of 5RL, and the genes for mugineic acid and for hydroxymugineic acid synthetases involved in the strategy II of Fe-efficiency control to two intercalary regions of 5RL. In all wheat-rye translocation lines the *'Ce'* gene is linked to the dominant hairy neck character from rye ('Ha1'). This morphological trait can serve as a proper marker for a marker-based large-scale selection in wheat breeding.

Cereals considerably differ in their efficiency to acquire

and/or metabolize micronutrients. Genes influencing the micronutritional system are clustered on the homoeologous chromosome groups 4 and 5 (**Schlegel *et al.*,1991**). In rye *(Secale cereale* L.), loci on chromosome arm 5RL were found to control response to Cu-and Fe-shortage stress (**Schlegel *et al.*, 1993**). These genes may be used as suitable sources for crop improvement by chromosome engineering in alien species, especially in wheat for cultivation on marginal soils (**Graham 1984**). Here, it is a trial to select plants from the F2 and BC populations have the Cu-efficiency gene *'Ce'* to the terminal and the genes for mugineic acid and for hydroxymugineic acid synthetases *('Mas'* and *'Hinas')* involved in Fe-efficiency control to the intercalary regions of 5RL.

In studying the efficiency of Cu microelement on the Sids parents and Pc parents, it was found that severe reduction in grain weight in spikes of plants free from Cu (3 mg/bottle) as compared to those supplemented with Cu (60 mg Cu/bottle), Table 21. In wheat lines, the reduction in grain weight ranged from 36.56 % in Sids 4 and 8 up to 40.19 % in Sids 6. Meanwhile, The reduction in grain weight was ranged from 21.06 % in Pc 63 up to 46.45 % in Pc 29.

Although, in comparison to wheat, translocated Pc lines are preferably planted on light, sandy clay soils with bad

nutrient supply, severe iron shortage induced a considerable decrease of fresh matter production in young translocated wheat shoots (Pc lines), Table 21). The difference between the decrease of fresh matter production in Pc 29 (48.16 %), Pc 62 (61.53 %), Pc 63 (56.01 %) and the decrease of that in wheat (21.22 % for Sids 4, 23.89 % for sids 5, 17.65 % for Sids 6, 25.70 % for Sids 7, 29.12 % for Sids 8 and 32.47 % for Sids 9) is highly significant.

Since the shoot fresh weight cannot solely reflect iron efficiency, the symptom of mild chlorosis was substantiated by determining the chlorophyll contents (Tab.21). The response to Fe-shortage varied among the Pc lines (12.07 % in Pc 63, 16.97 % in Pc 62 to 53.68 % in Pc 29). Their efficiencies were elevated by genes from the 5RL arm. Meanwhile, The response to Fe-shortage varied among the wheat lines (5.74 % in Sids 4, 2.13 % in Sids 5, 18.76 % in Sids 6, 15.21 % in Sids 7, 19.70 % in Sids 8 and 20.53 % in Sids 9, respectively).

Table 22 revealed that the selected wheat-rye translocations from the F_2 populations of Pc 29 x Sids lines were detected only in Pc 29 x Sids 5 and Pc 29 x Sids 7.

For the segregants selected from Pc 29 x Sids 5 F_2 population, it was found that the percentage of grain yield decrease ranged from 25.91 % to 29.23 % due to the lack of

Table (21): Grain yield, fresh weight and chlorophyll contents of shoots in the studied parents.

Crosses studied	Grain yield/ main spike (a)	Grain yield/ main spike (b)	% of grain yield decrease	Fresh matter (mg) (c)	Fresh matter (mg) (d)	% of Fresh matter Decrease (mg)	(A+B)/ Fresh matter (c)	(A+B)/ Fresh matter (d)	% of (A+B) decrease
Pc 29	3.455	1.850	46.45 %	1302	675	48.16 %	855	396	53.68 %
Pc 62	3.100	2.050	33.87 %	1123	432	61.53 %	501	416	16.97 %
Pc 63	3.205	2.530	21.06 %	0416	183	56.01 %	439	386	12.07 %
Sides 4	4.650	2.950	36.56 %	0523	412	21.22 %	473	449	05.74 %
Sides 5	4.920	3.100	37.00 %	0565	430	23.89 %	422	413	02.13 %
Sides 6	5.300	3.170	40.19 %	0731	602	17.65 %	517	420	18.76 %
Sides 7	5.150	3.240	37.09 %	0782	581	25.70 %	526	446	15.21 %
Sides 8	4.525	2.870	36.57 %	0656	465	29.12 %	538	432	19.70 %
Sides 9	5.060	3.120	38.34 %	0736	497	32.47 %	570	453	20.53 %

- Grain yield evaluated from mature plants.
- Fresh matter and chlorophyll (A+B) measured from 28 days old plants.
- (a) : addition of 60 Cu / bottle. (b) : addition of 3 mg Cu / bottle.
- (c) : addition of 100 µM Fe-EDTA / bottle. (d) : Free of iron.

Cu in liquid media. Meanwhile, the percentage of fresh matter was reduced in a range of 23.08 % up to 46.72 % due to the lack of iron (Fe) in liquid media. The response to Fe-shortage through the determination of the chlorophyll contents varied among the selected plants as it ranged from 6.97 % to 16.92 %, Table (22).

Concerning the segregants selected from Pc 29 x Sids 7 F_2 population, it was showed that the percentage of grain yield decrease ranged from 21.43 % to 39.44 % as affected by the lack of Cu in liquid media. Moreover, the percentage of fresh weight was reduced in a range of 21.59 % up to 30.32 % due to the Fe shortage in liquid media. The response to Fe-shortage through the determination of the chlorophyll contents varied among the selected plants as it ranged from 11.71 % to 35.40 %, Table (22).

Obviously, the decrease reaction to iron shortage stress in the segregants was enhanced by the presence of chromatin from rye beyond the level in rye itself. At sufficient iron supply, however, the translocated segments of the 5RL arms evidently accelerated the growth of the segregants during the first weeks. Therefore, these segregant types can improve the seedling emergence in wheat.

Table22: Grain yield, fresh matter and chlorophyll contents of shoots in some selected plants having hairy neck of spike from F_2 population (Pc 29 X Sids parents).

Genotypes / Characters	Selected plants from the F_2 population				
	1	2	3	4	5
(Pc 29 X Sids 4)					
Grain yield/main spike (a)	---	---	---	---	---
Grain yield/main spike (b)	---	---	---	---	---
% of grain yield decrease	---	---	---	---	---
Fresh matter (mg) (c)	---	---	---	---	---
Fresh matter (mg) (d)	---	---	---	---	---
% of Fresh matter decrease (mg)	---	---	---	---	---
(A+B) Fresh matter (c)	---	---	---	---	---
(A+B) Fresh matter (d)	---	---	---	---	---
% of (A+B) decrease	---	---	---	---	---
(Pc 29 X Sids 5)					
Grain yield/main spike (a)	004.13	003.08	002.71	003.25	002.49
Grain yield/main spike (b)	003.06	002.27	001.92	002.30	001.78
% of grain yield decrease	**25.91 %**	**26.30 %**	**29.15 %**	**29.23 %**	**28.51 %**
Fresh matter (mg) (c)	914	572	546	427	503
Fresh matter (mg) (d)	487	440	362	305	317
% of Fresh matter decrease (mg)	**46.72 %**	**23.08 %**	**33.70 %**	**28.57 %**	**36.98 %**
(A+B) Fresh matter (c)	516	553	526	418	502
(A+B) Fresh matter (d)	462	471	437	389	460
% of (A+B) decrease	**10.47 %**	**14.83 %**	**16.92 %**	**06.97 %**	**08.37 %**
(Pc 29 X Sids 6)					
Grain yield/main spike (a)	---	---	---	---	---
Grain yield/main spike (b)	---	---	---	---	---
% of grain yield decrease	---	---	---	---	---
Fresh matter (mg) (c)	---	---	---	---	---
Fresh matter (mg) (d)	---	---	---	---	---
% of Fresh matter decrease (mg)	---	---	---	---	---
(A+B) Fresh matter (c)	---	---	---	---	---
(A+B) Fresh matter (d)	---	---	---	---	---
% of (A+B) decrease	---	---	---	---	---
(Pc 29 X Sids 7)					
Grain yield/main spike (a)	003.63	003.57	003.60	004.02	003.64
Grain yield/main spike (b)	002.22	002.31	002.18	002.93	002.86
% of grain yield decrease	**38.84 %**	**35.29 %**	**39.44 %**	**27.11 %**	**21.43 %**
Fresh matter (mg) (c)	622	653	677	706	645
Fresh matter (mg) (d)	459	512	480	492	464
% of Fresh matter decrease (mg)	**26.21 %**	**21.59 %**	**29.10 %**	**30.32 %**	**28.06 %**
(A+B) Fresh matter (c)	588	612	630	676	410
(A+B) Fresh matter (d)	472	438	407	490	362
% of (A+B) decrease	**19.73 %**	**28.43 %**	**35.40 %**	**27.51 %**	**11.71 %**
(Pc 29 X Sids 8)					
Grain yield/main spike (a)	---	---	---	---	---
Grain yield/main spike (b)	---	---	---	---	---
% of grain yield decrease	---	---	---	---	---
Fresh matter (mg) (c)	---	---	---	---	---
Fresh matter (mg) (d)	---	---	---	---	---
% of Fresh matter decrease (mg)	---	---	---	---	---
(A+B) Fresh matter (c)	---	---	---	---	---
(A+B) Fresh matter (d)	---	---	---	---	---
% of (A+B) decrease	---	---	---	---	---
(Pc 29 X Sids 9)					
Grain yield/main spike (a)	---	---	---	---	---
Grain yield/main spike (b)	---	---	---	---	---
% of grain yield decrease	---	---	---	---	---
Fresh matter (mg) (c)	---	---	---	---	---
Fresh matter (mg) (d)	---	---	---	---	---
% of Fresh matter decrease (mg)	---	---	---	---	---
(A+B) Fresh matter (c)	---	---	---	---	---
(A+B) Fresh matter (d)	---	---	---	---	---
% of (A+B) decrease	---	---	---	---	---

- Grain yield evaluated from mature plants.
- Fresh matter and chlorophyll (A+B) measured from 28 days old plants.

(a): Addition of 60 mg Cu / Bottle. (b): Addition of 3 mg Cu / Bottle.

(c): Addition of 100 µM Fe-EDTA / Bottle. (d): Free of iron.

Table (23) showed that the selected wheat-rye translocations from the F_2 populations of Pc 62 x Sids lines were detected only in Pc 62 x Sids 4 , Pc 62 x Sids 6, Pc 62 x Sids 7, Pc 62 x Sids 8 and Pc 62 x Sids 9.

In case of the segregants selected from Pc 62 x Sids 4 F_2 population, it was noticed that the percentage of grain yield decrease ranged from 33.23 % to 69.79 % due to the deficiency of Cu in liquid media. The percentage of fresh matter was decreased in a range of 20.74 % up to 60.59 % due to the shortage of iron (Fe) in liquid media. The response to Fe-shortage through the determination of the chlorophyll contents varied among the selected plants as it ranged from 32.88 % to 53.96 %, Table (23).

Concerning the segregants selected from Pc 62 x Sids 6 F_2 population, it was revealed that the percentage of grain yield decrease ranged from 40.78 % to 58.55 % due to the shortage of Cu in liquid media. In case of the percentage of fresh weight, it was reduced in a range of 39.20 % up to 54.46 % due to the shortage of iron (Fe) in liquid media. The response to Fe-shortage through the determination of the chlorophyll contents varied among the selected plants as it ranged from 51.17 % to 56.84 %, Table (23).

The segregants wheat-rye translocations selected from

Pc 29 x Sids 7 F_2 population showed that the percentage of grain yield reduction varied from 25.71 % to 52.02 % as affected by Cu shortage in liquid media. While the percentage of fresh weight was reduced in a range of 29.39 % up to 54.90 % due to the lack of iron (Fe) in liquid media. The response to Fe-shortage through the determination of the chlorophyll contents varied among the selected plants as it ranged from 21.20 % to 30.19 %, Table (23).

The segregated plants selected from Pc 29 x Sids 8 F_2 population showed that the percentage of grain yield reduction ranged from 34.25 % to 58.48 % due to the lack of Cu in liquid media. Moreover, the percentage of fresh weight was decreased in a range of 36.45 % up to 53.72 % due to the lack of iron (Fe) in liquid media. The response to Fe-shortage through the determination of the chlorophyll contents varied among the selected plants as it ranged from 26.18 % to 62.61 %, Table (23).

Concerning selected plants from Pc 62 x Sids 9 F_2 population, it was found that the percentage of grain yield decrease ranged from 24.66 % to 37.21 % due to the lack of Cu in liquid media. Meanwhile, the percentage of fresh weight was reduced in a range of 21.45 % up to 36.67 % due to the lack of iron (Fe) in liquid media. The response to Fe-shortage through the determination of the chlorophyll contents varied

Table 23: Grain yield, fresh matter and chlorophyll contents of shoots in some selected plants having hairy neck of spike from F_2 population (Pc 62 X Sids parents).

Genotypes / Characters	Selected plants from the F_2 population				
	1	2	3	4	5
(Pc 62 X Sids 4)					
Grain yield/main spike (a)	002.14	001.02	003.25	001.92	001.93
Grain yield/main spike (b)	001.01	000.47	002.17	000.58	000.74
% of grain yield decrease	**52.80 %**	**53.92 %**	**33.23 %**	**69.79 %**	**61.66 %**
Fresh matter (mg) (c)	638	647	815	622	665
Fresh matter (mg) (d)	372	255	646	278	280
% of Fresh matter decrease (mg)	**41.69 %**	**60.59 %**	**20.74 %**	**55.31 %**	**57.89 %**
(A+B) Fresh matter (c)	621	609	663	587	493
(A+B) Fresh matter (d)	320	313	445	275	227
% of (A+B) decrease	**48.47 %**	**48.60 %**	**32.88 %**	**53.15 %**	**53.96 %**
(Pc 62 X Sids 5)					
Grain yield/main spike (a)	---	---	---	---	---
Grain yield/main spike (b)	---	---	---	---	---
% of grain yield decrease	---	---	---	---	---
Fresh matter (mg) (c)	---	---	---	---	---
Fresh matter (mg) (d)	---	---	---	---	---
% of Fresh matter decrease (mg)	---	---	---	---	---
(A+B) Fresh matter (c)	---	---	---	---	---
(A+B) Fresh matter (d)	---	---	---	---	---
% of (A+B) decrease	---	---	---	---	---
(Pc 62 X Sids 6)					
Grain yield/main spike (a)	001.94	001.52	001.64	001.57	001.03
Grain yield/main spike (b)	000.88	000.63	000.70	000.83	000.61
% of grain yield decrease	**54.64 %**	**58.55 %**	**57.32 %**	**47.13 %**	**40.78 %**
Fresh matter (mg) (c)	527	630	685	643	582
Fresh matter (mg) (d)	240	383	368	326	310
% of Fresh matter decrease (mg)	**54.46 %**	**39.20 %**	**46.28 %**	**49.30 %**	**46.73 %**
(A+B) Fresh matter (c)	487	490	512	475	437
(A+B) Fresh matter (d)	214	227	250	205	196
% of (A+B) decrease	**56.06 %**	**53.67 %**	**51.17 %**	**56.84 %**	**55.15 %**
(Pc 62 X Sids 7)					
Grain yield/main spike (a)	004.06	002.55	000.98	002.48	004.20
Grain yield/main spike (b)	000.2.94	001.73	000.67	001.19	003.12
% of grain yield decrease	**27.59 %**	**32.16 %**	**31.63 %**	**52.02 %**	**25.71 %**
Fresh matter (mg) (c)	785	592	612	646	751
Fresh matter (mg) (d)	442	418	276	302	522
% of Fresh matter decrease (mg)	**43.69 %**	**29.39 %**	**54.90 %**	**53.25 %**	**30.49 %**
(A+B) Fresh matter (c)	635	533	631	625	669
(A+B) Fresh matter (d)	473	420	352	460	467
% of (A+B) decrease	**25.51 %**	**21.20 %**	**44.22 %**	**26.40 %**	**30.19 %**
(Pc 62 X Sids 8)					
Grain yield/main spike (a)	004.73	002.92	002.74	002.89	001.28
Grain yield/main spike (b)	003.11	001.41	001.36	001.20	000.57
% of grain yield decrease	**34.25 %**	**51.71 %**	**50.36 %**	**58.48 %**	**55.47 %**
Fresh matter (mg) (c)	782	699	676	685	613
Fresh matter (mg) (d)	497	360	388	317	387
% of Fresh matter decrease (mg)	**36.45 %**	**48.50 %**	**42.60 %**	**53.72 %**	**36.87 %**
(A+B) Fresh matter (c)	657	681	587	617	583
(A+B) Fresh matter (d)	485	378	325	253	218
% of (A+B) decrease	**26.18 %**	**44.49 %**	**44.63 %**	**58.99 %**	**62.61 %**
(Pc 62 X Sids 9)					
Grain yield/main spike (a)	003.52	003.56	004.38	003.44	004.42
Grain yield/main spike (b)	002.33	002.24	003.30	002.16	003.06
% of grain yield decrease	**33.81 %**	**37.08 %**	**24.66 %**	**37.21 %**	**30.77 %**
Fresh matter (mg) (c)	747	790	811	762	780
Fresh matter (mg) (d)	485	572	637	595	494
% of Fresh matter decrease (mg)	**35.07 %**	**27.59 %**	**21.45 %**	**21.92 %**	**36.67 %**
(A+B) Fresh matter (c)	687	665	810	675	623
(A+B) Fresh matter (d)	340	438	572	486	451
% of (A+B) decrease	**50.51 %**	**34.14 %**	**29.38 %**	**28.00 %**	**27.61 %**

- Grain yield evaluated from mature plants.
- Fresh matter and chlorophyll (A+B) measured from 28 days old plants.

(a): Addition of 60 mg Cu / Bottle. (b): Addition of 3 mg Cu / Bottle.
(c): Addition of 100 µM Fe-EDTA / Bottle. (d): Free of iron.

among the selected plants as it ranged from 28.00 % to 50.51 %, Table (23).

Table (24) revealed that the selected wheat-rye translocations from the F_2 populations of Pc 63 x Sids lines were detected only in Pc 63 x Sids 4 , Pc 63 x Sids 7 and Pc 63 x Sids 8.

The segregants wheat-rye translocations selected from Pc 63 x Sids 4 F_2 population showed that the percentage of grain yield reduction varied from 23.13 % to 47.95 % as affected by Cu shortage in liquid media. While the percentage of fresh weight was reduced in a range of 22.08 % up to 45.69 % due to the lack of iron (Fe) in liquid media. The response to Fe-shortage through the determination of the chlorophyll contents varied among the selected plants as it ranged from 26.62 % to 55.95 %, Table (24).

The segregants wheat-rye translocations selected from Pc 63 x Sids 7 F_2 population showed that the percentage of grain yield reduction varied from 20.51 % to 27.86 % as affected by Cu shortage in liquid media. While the percentage of fresh weight was reduced in a range of 14.78 % up to 26.06 % due to the lack of iron (Fe) in liquid media. The response to Fe-shortage through the determination of the chlorophyll contents varied among the selected plants as it ranged from 22.64 % to 33.16 %, Table (24).

The segregants wheat-rye translocations selected from Pc 63 x Sids 8 F_2 population showed that the percentage of grain yield reduction varied from 16.77 % to 53.51 % as affected by Cu shortage in liquid media. While the percentage of fresh weight was reduced in a range of 20.92 % up to 54.99 % due to the lack of iron (Fe) in liquid media. The response to Fe-shortage through the determination of the chlorophyll contents varied among the selected plants as it ranged from 23.49 % to 50.13 %, Table (24).

Table (25) revealed the selected wheat-rye translocations from the BC_1 populations of Pc 62 x Sids lines were detected only in Pc 29 x Sids 4.

The selected plants (wheat-rye translocations) from Pc 29 x Sids 4 BC_1 population showed that the percentage of grain yield reduction varied from 24.05 % to 29.96 % as affected by Cu shortage in liquid media. While the percentage of fresh weight was reduced in a range of 25.58 % up to 38.16 % due to the lack of iron (Fe) in liquid media. The response to Fe-shortage through the determination of the chlorophyll contents varied among the selected plants as it ranged from 17.82 % to 46.28 %, Table (25).

Table 24: Grain yield, fresh matter and chlorophyll contents of shoots in some selected plants having hairy neck of spike from F_2 population (Pc 63 X Sids parents).

Characters \ Genotypes	Selected plants from the F_2 population				
	1	2	3	4	5
(Pc 63 X Sids 4)					
Grain yield/main spike (a)	004.61	003.84	002.15	002.92	004.41
Grain yield/main spike (b)	003.48	002.35	001.27	001.52	003.39
% of grain yield decrease	**24.51 %**	**38.80 %**	**40.93 %**	**47.95 %**	**23.13 %**
Fresh matter (mg) (c)	972	865	683	661	874
Fresh matter (mg) (d)	753	493	471	359	681
% of Fresh matter decrease (mg)	**22.53 %**	**43.01 %**	**31.04 %**	**45.69 %**	**22.08 %**
(A+B) Fresh matter (c)	834	823	504	613	820
(A+B) Fresh matter (d)	612	573	234	270	597
% of (A+B) decrease	**26.62 %**	**30.38 %**	**53.57 %**	**55.95 %**	**27.20 %**
(Pc 63 X Sids 5)					
Grain yield/main spike (a)	---	---	---	---	---
Grain yield/main spike (b)	---	---	---	---	---
% of grain yield decrease	---	---	---	---	---
Fresh matter (mg) (c)	---	---	---	---	---
Fresh matter (mg) (d)	---	---	---	---	---
% of Fresh matter decrease (mg)	---	---	---	---	---
(A+B) Fresh matter (c)	---	---	---	---	---
(A+B) Fresh matter (d)	---	---	---	---	---
% of (A+B) decrease	---	---	---	---	---
(Pc 63 X Sids 6)					
Grain yield/main spike (a)	---	---	---	---	---
Grain yield/main spike (b)	---	---	---	---	---
% of grain yield decrease	---	---	---	---	---
Fresh matter (mg) (c)	---	---	---	---	---
Fresh matter (mg) (d)	---	---	---	---	---
% of Fresh matter decrease (mg)	---	---	---	---	---
(A+B) Fresh matter (c)	---	---	---	---	---
(A+B) Fresh matter (d)	---	---	---	---	---
% of (A+B) decrease	---	---	---	---	---
(Pc 63 X Sids 7)					
Grain yield/main spike (a)	004.34	004.37	004.38	003.39	005.26
Grain yield/main spike (b)	003.45	003.28	003.16	002.47	004.10
% of grain yield decrease	**20.51 %**	**24.94 %**	**27.86 %**	**27.14 %**	**22.05 %**
Fresh matter (mg) (c)	1017	932	1104	927	1293
Fresh matter (mg) (d)	826	782	829	790	956
% of Fresh matter decrease (mg)	**18.78 %**	**16.09 %**	**24.91 %**	**14.78 %**	**26.06 %**
(A+B) Fresh matter (c)	956	883	834	833	804
(A+B) Fresh matter (d)	639	649	618	579	622
% of (A+B) decrease	**33.16 %**	**26.50 %**	**25.90 %**	**30.49 %**	**22.64 %**
(Pc 63 X Sids 8)					
Grain yield/main spike (a)	003.75	003.28	004.63	004.28	001.85
Grain yield/main spike (b)	002.30	002.73	003.81	003.35	000.86
% of grain yield decrease	**38.67 %**	**16.77 %**	**17.71 %**	**21.73 %**	**53.51 %**
Fresh matter (mg) (c)	749	853	784	933	831
Fresh matter (mg) (d)	416	447	620	562	374
% of Fresh matter decrease (mg)	**44.46 %**	47.59 %	**20.92 %**	**39.76 %**	**54.99 %**
(A+B) Fresh matter (c)	677	782	654	745	750
(A+B) Fresh matter (d)	434	498	492	570	395
% of (A+B) decrease	35.89 %	**36.32 %**	**24.77 %**	**23.49 %**	**50.13 %**
(Pc 63 X Sids 9)					
Grain yield/main spike (a)	---	---	---	---	---
Grain yield/main spike (b)	---	---	---	---	---
% of grain yield decrease	---	---	---	---	---
Fresh matter (mg) (c)	---	---	---	---	---
Fresh matter (mg) (d)	---	---	---	---	---
% of Fresh matter decrease (mg)	---	---	---	---	---
(A+B) Fresh matter (c)	---	---	---	---	---
(A+B) Fresh matter (d)	---	---	---	---	---
% of (A+B) decrease	---	---	---	---	---

- Grain yield evaluated from mature plants.
- Fresh matter and chlorophyll (A+B) measured from 28 days old plants.

(a): Addition of 60 mg Cu / Bottle. (b): Addition of 3 mg Cu / Bottle.
(c): Addition of 100 µM Fe-EDTA / Bottle. (d): Free of iron.

Table 25: Grain yield, fresh matter and chlorophyll contents of shoots in some selected plants having hairy neck of spike from BC_1 population (Pc 29 X Sids parents).

Genotypes / Characters	Selected plants from the BC_1 population				
	1	2	3	4	5
(Pc 29 X Sids 4)					
Grain yield/main spike (a)	004.74	003.56	005.53	004.48	004.84
Grain yield/main spike (b)	003.60	002.58	003.93	003.20	003.39
% of grain yield decrease	**24.05 %**	**27.53 %**	**28.93 %**	**28.57 %**	**29.96 %**
Fresh matter (mg) (c)	649	719	684	807	759
Fresh matter (mg) (d)	483	484	423	586	547
% of Fresh matter decrease (mg)	**25.58 %**	**32.68 %**	**38.16 %**	**27.39 %**	**27.93 %**
(A+B) Fresh matter (c)	623	686	627	767	663
(A+B) Fresh matter (d)	512	501	496	412	467
% of (A+B) decrease	**17.82 %**	**26.97 %**	**20.89 %**	**46.28 %**	**29.56 %**
(Pc 29 X Sids 5)					
Grain yield/main spike (a)	---	---	---	---	---
Grain yield/main spike (b)	---	---	---	---	---
% of grain yield decrease	---	---	---	---	---
Fresh matter (mg) (c)	---	---	---	---	---
Fresh matter (mg) (d)	---	---	---	---	---
% of Fresh matter decrease (mg)	---	---	---	---	---
(A+B) Fresh matter (c)	---	---	---	---	---
(A+B) Fresh matter (d)	---	---	---	---	---
% of (A+B) decrease	---	---	---	---	---
(Pc 29 X Sids 6)					
Grain yield/main spike (a)	---	---	---	---	---
Grain yield/main spike (b)	---	---	---	---	---
% of grain yield decrease	---	---	---	---	---
Fresh matter (mg) (c)	---	---	---	---	---
Fresh matter (mg) (d)	---	---	---	---	---
% of Fresh matter decrease (mg)	---	---	---	---	---
(A+B) Fresh matter (c)	---	---	---	---	---
(A+B) Fresh matter (d)	---	---	---	---	---
% of (A+B) decrease	---	---	---	---	---
(Pc 29 X Sids 7)					
Grain yield/main spike (a)	---	---	---	---	---
Grain yield/main spike (b)	---	---	---	---	---
% of grain yield decrease	---	---	---	---	---
Fresh matter (mg) (c)	---	---	---	---	---
Fresh matter (mg) (d)	---	---	---	---	---
% of Fresh matter decrease (mg)	---	---	---	---	---
(A+B) Fresh matter (c)	---	---	---	---	---
(A+B) Fresh matter (d)	---	---	---	---	---
% of (A+B) decrease	---	---	---	---	---
(Pc 29 X Sids 8)					
Grain yield/main spike (a)	---	---	---	---	---
Grain yield/main spike (b)	---	---	---	---	---
% of grain yield decrease	---	---	---	---	---
Fresh matter (mg) (c)	---	---	---	---	---
Fresh matter (mg) (d)	---	---	---	---	---
% of Fresh matter decrease (mg)	---	---	---	---	---
(A+B) Fresh matter (c)	---	---	---	---	---
(A+B) Fresh matter (d)	---	---	---	---	---
% of (A+B) decrease	---	---	---	---	---
(Pc 29 X Sids 9)					
Grain yield/main spike (a)	---	---	---	---	---
Grain yield/main spike (b)	---	---	---	---	---
% of grain yield decrease	---	---	---	---	---
Fresh matter (mg) (c)	---	---	---	---	---
Fresh matter (mg) (d)	---	---	---	---	---
% of Fresh matter decrease (mg)	---	---	---	---	---
(A+B) Fresh matter (c)	---	---	---	---	---
(A+B) Fresh matter (d)	---	---	---	---	---
% of (A+B) decrease	---	---	---	---	---

- Grain yield evaluated from mature plants.
- Fresh matter and chlorophyll (A+B) measured from 28 days old plants.

(a): Addition of 60 mg Cu / Bottle. (b): Addition of 3 mg Cu / Bottle.
(c): Addition of 100 µM Fe-EDTA / Bottle. (d): Free of iron.

Table 26: Grain yield, fresh matter and chlorophyll contents of shoots in some selected plants having hairy neck of spike from BC_1 population (Pc 62 X Sids parents).

Genotypes / Characters	Selected plants from the BC_1 population				
	1	2	3	4	5
(Pc 62 X Sids 4)					
Grain yield/main spike (a)	003.26	003.74	004.37	004.49	005.62
Grain yield/main spike (b)	002.46	002.89	003.21	003.67	004.30
% of grain yield decrease	**24.54 %**	**22.73 %**	**26.54 %**	**18.26 %**	**23.49 %**
Fresh matter (mg) (c)	974	864	954	792	986
Fresh matter (mg) (d)	658	692	647	588	730
% of Fresh matter decrease (mg)	**32.44 %**	**19.91 %**	**32.18 %**	**25.76 %**	**25.96 %**
(A+B) Fresh matter (c)	749	683	730	751	774
(A+B) Fresh matter (d)	574	496	539	598	503
% of (A+B) decrease	**23.36 %**	**27.38 %**	**26.16 %**	**20.37 %**	**30.52 %**
(Pc 62 X Sids 5)					
Grain yield/main spike (a)	---	---	---	---	---
Grain yield/main spike (b)	---	---	---	---	---
% of grain yield decrease	---	---	---	---	---
Fresh matter (mg) (c)	---	---	---	---	---
Fresh matter (mg) (d)	---	---	---	---	---
% of Fresh matter decrease (mg)	---	---	---	---	---
(A+B) Fresh matter (c)	---	---	---	---	---
(A+B) Fresh matter (d)	---	---	---	---	---
% of (A+B) decrease	---	---	---	---	---
(Pc 62 X Sids 6)					
Grain yield/main spike (a)	005.82	004.62	004.43	005.74	005.87
Grain yield/main spike (b)	003.81	003.55	003.05	004.27	003.83
% of grain yield decrease	**34.54 %**	**23.16 %**	**31.15 %**	**25.61 %**	**34.75 %**
Fresh matter (mg) (c)	1193	1283	976	1087	1224
Fresh matter (mg) (d)	972	951	677	879	859
% of Fresh matter decrease (mg)	**18.52 %**	**25.88 %**	**30.64 %**	**19.14 %**	**28.65 %**
(A+B) Fresh matter (c)	780	704	811	765	899
(A+B) Fresh matter (d)	574	543	647	590	673
% of (A+B) decrease	**26.41 %**	**22.87 %**	**26.84 %**	**22.88 %**	**25.14 %**
(Pc 62 X Sids 7)					
Grain yield/main spike (a)	---	---	---	---	---
Grain yield/main spike (b)	---	---	---	---	---
% of grain yield decrease	---	---	---	---	---
Fresh matter (mg) (c)	---	---	---	---	---
Fresh matter (mg) (d)	---	---	---	---	---
% of Fresh matter decrease (mg)	---	---	---	---	---
(A+B) Fresh matter (c)	---	---	---	---	---
(A+B) Fresh matter (d)	---	---	---	---	---
% of (A+B) decrease	---	---	---	---	---
(Pc 62 X Sids 8)					
Grain yield/main spike (a)	---	---	---	---	---
Grain yield/main spike (b)	---	---	---	---	---
% of grain yield decrease	---	---	---	---	---
Fresh matter (mg) (c)	---	---	---	---	---
Fresh matter (mg) (d)	---	---	---	---	---
% of Fresh matter decrease (mg)	---	---	---	---	---
(A+B) Fresh matter (c)	---	---	---	---	---
(A+B) Fresh matter (d)	---	---	---	---	---
% of (A+B) decrease	---	---	---	---	---
(Pc 62 X Sids 9)					
Grain yield/main spike (a)	002.92	004.18	003.72	004.47	004.50
Grain yield/main spike (b)	001.46	003.68	001.95	003.65	003.69
% of grain yield decrease	**50.00 %**	**11.96 %**	**47.58 %**	**18.34 %**	**19.78 %**
Fresh matter (mg) (c)	637	874	643	904	863
Fresh matter (mg) (d)	431	630	479	788	676
% of Fresh matter decrease (mg)	**32.34 %**	**27.92 %**	**25.51 %**	**12.83 %**	**21.67 %**
(A+B) Fresh matter (c)	577	782	612	769	607
(A+B) Fresh matter (d)	317	613	470	644	463
% of (A+B) decrease	**45.06 %**	**21.61 %**	**23.20 %**	**16.25 %**	**23.72 %**

- Grain yield evaluated from mature plants.
- Fresh matter and chlorophyll (A+B) measured from 28 days old plants.

(a): Addition of 60 mg Cu / Bottle. (b): Addition of 3 mg Cu / Bottle.

(c): Addition of 100 µM Fe-EDTA / Bottle. (d): Free of iron.

Table (26) showed that the selected wheat-rye translocations from the BC_1 populations of Pc 62 x Sids lines were detected only in Pc 62 x Sids 4 , Pc 62 x Sids 6 and Pc 62 x Sids 9.

The selected plants (wheat-rye translocations) from Pc 62 x Sids 4 BC_1 population showed that the percentage of grain yield reduction varied from 18.26 % to 26.54 % as affected by Cu shortage in liquid media. While the percentage of fresh weight was reduced in a range of 19.91 % up to 32.44 % due to the lack of iron (Fe) in liquid media. The response to Fe-shortage through the determination of the chlorophyll contents varied among the selected plants as it ranged from 20.37 % to 30.52 %, Table (26).

The selected plants (wheat-rye translocations) from Pc 62 x Sids 6 BC_1 population showed that the percentage of grain yield reduction varied from 23.16 % to 34.75 % as affected by Cu shortage in liquid media. While the percentage of fresh weight was reduced in a range of 18.52 % up to 30.64 % due to the lack of iron (Fe) in liquid media. The response to Fe-shortage through the determination of the chlorophyll contents varied among the selected plants as it ranged from 22.87 % to 26.84 %, Table (26).

The selected plants (wheat-rye translocations) from Pc 62 x Sids 9 BC_1 population showed that the percentage of

grain yield reduction varied from 11.96 % to 50.00 % as affected by Cu shortage in liquid media. While the percentage of fresh weight was reduced in a range of 12.83 % up to 32.34 % due to the lack of iron (Fe) in liquid media. The response to Fe-shortage through the determination of the chlorophyll contents varied among the selected plants as it ranged from 16.25 % to 45.06 %, Table (26).

Table (27) showed the selected wheat-rye translocations from the BC_1 populations of Pc 63 x Sids lines were detected only in Pc 63 x Sids 4.

The selected plants (wheat-rye translocations) from Pc 63 x Sids 4 BC_1 population showed that the percentage of grain yield reduction varied from 14.52 % to 26.33 % as affected by Cu shortage in liquid media. While the percentage of fresh weight was reduced in a range of 43.05 % up to 56.36 % due to the lack of iron (Fe) in liquid media. The response to Fe-shortage through the determination of the chlorophyll contents varied among the selected plants as it ranged from 20.31 % to 36.54 %, Table (27).

Table (28) showed the selected wheat-rye translocations from the BC_2 populations of Pc 29 x Sids lines were detected only in Pc 29 x Sids 6 and Pc 29 x Sids 9.

Table 27: Grain yield, fresh matter and chlorophyll contents of shoots in some selected plants having hairy neck of spike from BC_1 population (Pc 63 X Sids parents).

Genotypes / Characters	Selected plants from the BC_1 population				
	1	2	3	4	5
(Pc 63 X Sids 4)					
Grain yield/main spike (a)	003.65	004.40	004.34	004.15	005.28
Grain yield/main spike (b)	002.90	003.74	003.71	003.26	003.89
% of grain yield decrease	**20.55 %**	**15.00 %**	**14.52 %**	**21.45 %**	**26.33 %**
Fresh matter (mg) (c)	1032	1065	983	1206	1108
Fresh matter (mg) (d)	486	576	429	568	631
% of Fresh matter decrease (mg)	**52.91 %**	**45.92 %**	**56.36 %**	**52.90 %**	**43.05 %**
(A+B) Fresh matter (c)	679	587	572	714	654
(A+B) Fresh matter (d)	465	394	363	569	430
% of (A+B) decrease	**31.52 %**	**32.88 %**	**36.54 %**	**20.31 %**	**34.25 %**
(Pc 63 X Sids 5)					
Grain yield/main spike (a)	---	---	---	---	---
Grain yield/main spike (b)	---	---	---	---	---
% of grain yield decrease	---	---	---	---	---
Fresh matter (mg) (c)	---	---	---	---	---
Fresh matter (mg) (d)	---	---	---	---	---
% of Fresh matter decrease (mg)	---	---	---	---	---
(A+B) Fresh matter (c)	---	---	---	---	---
(A+B) Fresh matter (d)	---	---	---	---	---
% of (A+B) decrease	---	---	---	---	---
(Pc 63 X Sids 6)					
Grain yield/main spike (a)	---	---	---	---	---
Grain yield/main spike (b)	---	---	---	---	---
% of grain yield decrease	---	---	---	---	---
Fresh matter (mg) (c)	---	---	---	---	---
Fresh matter (mg) (d)	---	---	---	---	---
% of Fresh matter decrease (mg)	---	---	---	---	---
(A+B) Fresh matter (c)	---	---	---	---	---
(A+B) Fresh matter (d)	---	---	---	---	---
% of (A+B) decrease	---	---	---	---	---
(Pc 63 X Sids 7)					
Grain yield/main spike (a)	---	---	---	---	---
Grain yield/main spike (b)	---	---	---	---	---
% of grain yield decrease	---	---	---	---	---
Fresh matter (mg) (c)	---	---	---	---	---
Fresh matter (mg) (d)	---	---	---	---	---
% of Fresh matter decrease (mg)	---	---	---	---	---
(A+B) Fresh matter (c)	---	---	---	---	---
(A+B) Fresh matter (d)	---	---	---	---	---
% of (A+B) decrease	---	---	---	---	---
(Pc 63 X Sids 8)					
Grain yield/main spike (a)	---	---	---	---	---
Grain yield/main spike (b)	---	---	---	---	---
% of grain yield decrease	---	---	---	---	---
Fresh matter (mg) (c)	---	---	---	---	---
Fresh matter (mg) (d)	---	---	---	---	---
% of Fresh matter decrease (mg)	---	---	---	---	---
(A+B) Fresh matter (c)	---	---	---	---	---
(A+B) Fresh matter (d)	---	---	---	---	---
% of (A+B) decrease	---	---	---	---	---
(Pc 63 X Sids 9)					
Grain yield/main spike (a)	---	---	---	---	---
Grain yield/main spike (b)	---	---	---	---	---
% of grain yield decrease	---	---	---	---	---
Fresh matter (mg) (c)	---	---	---	---	---
Fresh matter (mg) (d)	---	---	---	---	---
% of Fresh matter decrease (mg)	---	---	---	---	---
(A+B) Fresh matter (c)	---	---	---	---	---
(A+B) Fresh matter (d)	---	---	---	---	---
% of (A+B) decrease	---	---	---	---	---

- Grain yield evaluated from mature plants.
- Fresh matter and chlorophyll (A+B) measured from 28 days old plants.

(a): Addition of 60 mg Cu / Bottle. (b): Addition of 3 mg Cu / Bottle.
(c): Addition of 100 µM Fe-EDTA / Bottle. (d): Free of iron.

Table 28: Grain yield, fresh matter and chlorophyll contents of shoots in some selected plants having hairy neck of spike from BC_2 population (Pc 29 X Sids parents).

Characters \ Genotypes	Selected plants from the BC_2 population				
	1	2	3	4	5
(Pc 29 X Sids 4)					
Grain yield/main spike (a)	---	---	---	---	---
Grain yield/main spike (b)	---	---	---	---	---
% of grain yield decrease	---	---	---	---	---
Fresh matter (mg) (c)	---	---	---	---	---
Fresh matter (mg) (d)	---	---	---	---	---
% of Fresh matter decrease (mg)	---	---	---	---	---
(A+B) Fresh matter (c)	---	---	---	---	---
(A+B) Fresh matter (d)	---	---	---	---	---
% of (A+B) decrease	---	---	---	---	---
(Pc 29 X Sids 5)					
Grain yield/main spike (a)	---	---	---	---	---
Grain yield/main spike (b)	---	---	---	---	---
% of grain yield decrease	---	---	---	---	---
Fresh matter (mg) (c)	---	---	---	---	---
Fresh matter (mg) (d)	---	---	---	---	---
% of Fresh matter decrease (mg)	---	---	---	---	---
(A+B) Fresh matter (c)	---	---	---	---	---
(A+B) Fresh matter (d)	---	---	---	---	---
% of (A+B) decrease	---	---	---	---	---
(Pc 29 X Sids 6)					
Grain yield/main spike (a)	002.42	003.52	004.30	004.62	003.75
Grain yield/main spike (b)	001.53	002.68	003.48	003.82	002.16
% of grain yield decrease	**36.78 %**	**23.86 %**	**19.07 %**	**17.32 %**	**42.40 %**
Fresh matter (mg) (c)	352	494	907	1016	548
Fresh matter (mg) (d)	256	326	526	671	376
% of Fresh matter decrease (mg)	**27.27 %**	**34.00 %**	**42.01 %**	**33.96 %**	**31.39 %**
(A+B) Fresh matter (c)	638	771	690	763	673
(A+B) Fresh matter (d)	399	472	433	438	381
% of (A+B) decrease	**37.46 %**	**38.78 %**	**37.25 %**	**42.60 %**	**43.39 %**
(Pc 29 X Sids 7)					
Grain yield/main spike (a)	---	---	---	---	---
Grain yield/main spike (b)	---	---	---	---	---
% of grain yield decrease	---	---	---	---	---
Fresh matter (mg) (c)	---	---	---	---	---
Fresh matter (mg) (d)	---	---	---	---	---
% of Fresh matter decrease (mg)	---	---	---	---	---
(A+B) Fresh matter (c)	---	---	---	---	---
(A+B) Fresh matter (d)	---	---	---	---	---
% of (A+B) decrease	---	---	---	---	---
(Pc 29 X Sids 8)					
Grain yield/main spike (a)	---	---	---	---	---
Grain yield/main spike (b)	---	---	---	---	---
% of grain yield decrease	---	---	---	---	---
Fresh matter (mg) (c)	---	---	---	---	---
Fresh matter (mg) (d)	---	---	---	---	---
% of Fresh matter decrease (mg)	---	---	---	---	---
(A+B) Fresh matter (c)	---	---	---	---	---
(A+B) Fresh matter (d)	---	---	---	---	---
% of (A+B) decrease	---	---	---	---	---
(Pc 29 X Sids 9)					
Grain yield/main spike (a)	003.46	003.95	003.96	003.84	003.84
Grain yield/main spike (b)	002.49	002.77	002.35	002.56	002.58
% of grain yield decrease	**28.03 %**	**29.87 %**	**40.66 %**	**33.33 %**	**32.81 %**
Fresh matter (mg) (c)	589	497	564	439	460
Fresh matter (mg) (d)	362	347	398	277	217
% of Fresh matter decrease (mg)	**38.54 %**	**30.18 %**	**29.43 %**	**36.90 %**	**52.83 %**
(A+B) Fresh matter (c)	701	640	826	697	723
(A+B) Fresh matter (d)	324	361	473	402	498
% of (A+B) decrease	**53.78 %**	**43.59 %**	**42.74 %**	**42.32 %**	**31.12 %**

- Grain yield evaluated from mature plants.
- Fresh matter and chlorophyll (A+B) measured from 28 days old plants.

(a): Addition of 60 mg Cu / Bottle. (b): Addition of 3 mg Cu / Bottle.
(c): Addition of 100 µM Fe-EDTA / Bottle. (d): Free of iron.

The selected plants (wheat-rye translocations) from Pc 29 x Sids 6 BC_2 population showed that the percentage of grain yield reduction varied from 17.32 % to 42.40 % as affected by Cu shortage in liquid media. While the percentage of fresh weight was reduced in a range of 27.27 % up to 42.01 % due to the lack of iron (Fe) in liquid media. The response to Fe-shortage through the determination of the chlorophyll contents varied among the selected plants as it ranged from 37.25 % to 43.39 %, Table (28).

The selected plants (wheat-rye translocations) from Pc 29 x Sids 9 BC_2 population showed that the percentage of grain yield reduction varied from 28.03 % to 40.66 % as affected by Cu shortage in liquid media. While the percentage of fresh weight was reduced in a range of 29.43 % up to 52.83 % due to the lack of iron (Fe) in liquid media. The response to Fe-shortage through the determination of the chlorophyll contents varied among the selected plants as it ranged from 31.12 % to 53.78 %, Table (28).

Table (29) showed the selected wheat-rye translocations from the BC_2 populations of Pc 62 x Sids lines were detected only in Pc 62 x Sids 4.

The selected plants (wheat-rye translocations) from Pc 62 x Sids 4 BC_2 population showed that the percentage of

Table 30: Grain yield, fresh matter and chlorophyll contents of shoots in some selected plants having hairy neck of spike from BC_2 population (Pc 63 X Sids parents).

Genotypes / Characters	Selected plants from the BC_2 population				
	1	2	3	4	5
(Pc 63 X Sids 4)					
Grain yield/main spike (a)	---	---	---	---	---
Grain yield/main spike (b)	---	---	---	---	---
% of grain yield decrease	---	---	---	---	---
Fresh matter (mg) (c)	---	---	---	---	---
Fresh matter (mg) (d)	---	---	---	---	---
% of Fresh matter decrease (mg)	---	---	---	---	---
(A+B) Fresh matter (c)	---	---	---	---	---
(A+B) Fresh matter (d)	---	---	---	---	---
% of (A+B) decrease	---	---	---	---	---
(Pc 63 X Sids 5)					
Grain yield/main spike (a)	---	---	---	---	---
Grain yield/main spike (b)	---	---	---	---	---
% of grain yield decrease	---	---	---	---	---
Fresh matter (mg) (c)	---	---	---	---	---
Fresh matter (mg) (d)	---	---	---	---	---
% of Fresh matter decrease (mg)	---	---	---	---	---
(A+B) Fresh matter (c)	---	---	---	---	---
(A+B) Fresh matter (d)	---	---	---	---	---
% of (A+B) decrease	---	---	---	---	---
(Pc 63 X Sids 6)					
Grain yield/main spike (a)	---	---	---	---	---
Grain yield/main spike (b)	---	---	---	---	---
% of grain yield decrease	---	---	---	---	---
Fresh matter (mg) (c)	---	---	---	---	---
Fresh matter (mg) (d)	---	---	---	---	---
% of Fresh matter decrease (mg)	---	---	---	---	---
(A+B) Fresh matter (c)	---	---	---	---	---
(A+B) Fresh matter (d)	---	---	---	---	---
% of (A+B) decrease	---	---	---	---	---
(Pc 63 X Sids 7)					
Grain yield/main spike (a)	---	---	---	---	---
Grain yield/main spike (b)	---	---	---	---	---
% of grain yield decrease	---	---	---	---	---
Fresh matter (mg) (c)	---	---	---	---	---
Fresh matter (mg) (d)	---	---	---	---	---
% of Fresh matter decrease (mg)	---	---	---	---	---
(A+B) Fresh matter (c)	---	---	---	---	---
(A+B) Fresh matter (d)	---	---	---	---	---
% of (A+B) decrease	---	---	---	---	---
(Pc 63 X Sids 8)					
Grain yield/main spike (a)	---	---	---	---	---
Grain yield/main spike (b)	---	---	---	---	---
% of grain yield decrease	---	---	---	---	---
Fresh matter (mg) (c)	---	---	---	---	---
Fresh matter (mg) (d)	---	---	---	---	---
% of Fresh matter decrease (mg)	---	---	---	---	---
(A+B) Fresh matter (c)	---	---	---	---	---
(A+B) Fresh matter (d)	---	---	---	---	---
% of (A+B) decrease	---	---	---	---	---
(Pc 63 X Sids 9)					
Grain yield/main spike (a)	004.05	004.55	005.17	004.17	005.36
Grain yield/main spike (b)	003.34	003.72	003.94	002.85	003.70
% of grain yield decrease	**17.53 %**	**18.24 %**	**23.79 %**	**31.65 %**	**30.97 %**
Fresh matter (mg) (c)	1117	1203	1216	1009	1286
Fresh matter (mg) (d)	741	860	772	653	749
% of Fresh matter decrease (mg)	**33.66 %**	**28.51 %**	**36.51 %**	**35.28 %**	**41.76 %**
(A+B) Fresh matter (c)	787	701	659	711	766
(A+B) Fresh matter (d)	583	463	427	462	434
% of (A+B) decrease	**25.92 %**	**33.95 %**	**35.20 %**	**35.02 %**	**43.34 %**

- Grain yield evaluated from mature plants.
- Fresh matter and chlorophyll (A+B) measured from 28 days old plants.

(a): Addition of 60 mg Cu / Bottle. (b): Addition of 3 mg Cu / Bottle.

(c): Addition of 100 µM Fe-EDTA / Bottle. (d): Free of iron.

ENGLISH SUMMARY

The present studies were carried out four successive seasons of 1996/1997, 1997/1998, 1998/1999, 1999/2000 and 2000/2001, respectively. Screening was carried out through the first season for all the studied materials (3 Pc lines; Pc 29, Pc 62 and Pc 63 and 6 new varieties, Sids 4, Sids 5, Sids 6, Sids 7, Sids 8 and Sids 9), data were recorded on the second season (1997/1998) on the 9 parents and the obtained F_1's originated from crossing the three Pc's with each of the Sids's varieties. These Pc lines were selected according their efficiency to utilize from some microelements as they contain some translocations. The present investigation was undertaken in order to focus on some selected segregants from F_2 and back-crosses populations that may contain one or more of the rye segments in the wheat genomes. In other words, to select substitution or/and additional segregants of wheat for the aim of combining the quality of wheat with the efficiency to utilize the microelements. Some Pc chromosomes were characterized by carrying genes responsible for Fe, Zn, Cu and Mn efficiency (on the 5R), (4R), aluminium tolerance (on the 4R). These studies were classified into three main categories as the following:-

1. Morphological studies on the main economic characters of these lines and some selected segregants from F_2 and back-crosses populations that may contain one or more of the rye segments in the wheat genomes.

2. Cytological studies on the chromosomal number in mitosis.

3. Efficiency of micronutritional genes in translocated wheat lines.

1. Morphological studies on the main agronomic traits of these lines and some selected segregants from F_2 and back-crosses populations that may contain one or more of the rye segments in the wheat genomes:-

Observed means and standard errors were estimated for the studied characters for wheat parents, Sids 4, Sids 5, Sids 6, Sids 7, Sids 8 and Sids 9 and for Pc parents; Pc 29, Pc 62 and Pc 63. Moreover, these characters were evaluated in the studied lines in the first season. The evaluated characters were plant height flowering date, maturity date, spike length, number of grains per spike, number of spikelets per spike, 1000-kernel weigh and grain yield of spike.

1. Plant height:-

Parents:

The observed means of plant height in parents; Sids 4, Sids 5, Sids 6, Sids 7, Sids 8 and Sids 9 (hexaploid wheat) were 05.00, 105.00, 112.50, 97.50, 107.50 and 93.75 which showed great variability between parents as Sides 4, Sides 5, Sides 6 and Sides 8 revealed higher length while Sides 7 and Sides 9 revealed shorter length. Meanwhile, the lines; Pc 29, Pc 62 and Pc 63 were found to be more longer than the Sides parents (132.50, 136.25 and 135.00 cm, respectively). The standard deviations of parents also showed highly significant differences (2.34, 1.78, 3.90, 1.00, 4.16 and 3.36 for Sids's parents while 0.17, 2.56 and 1.78 for Pc's parents).

The plant height of the selected plants from F_2 and BC populations:

Concerning the selected plants from the segregated generations, there is a tendency in plant height character toward the Pc lines more than the Egyptian wheat lines (Sids parents).

2. Flowering date:-

Parents:

The observed means of days to flowering in parents; Sids 4, Sids 5 Sids 6, Sids 7, Sids 8 and Sids 9 (hexaploid wheat) were 77.00, 84.00, 85.00, 86.00, 87.00 and 86.00 which showed great variability between parents as Sides 4 and other Sids's parents which revealed shorter days to flowering (anthesis) while Sides 5, Sides 6, Sides 7, Sides 8 and Sides 9 revealed longer days to flowering. Meanwhile, the lines; Pc 29, Pc 62 and Pc 63 were found to be more longer days to flowering than the Sides parents (120.00, 120.75 and 119.25, respectively). The standard deviations of parents also showed highly significant differences (2.06, 3.12, 1.90, 4.92, 3.15 and 2.78 for Sids's parents while 3.67, 4.11 and 1.66 for Pc's parents).

The flowering date of the selected plants from F_2 and BC populations:

Concerning the flowering date of the selected plants from the segregated populations, the date to flowering tend to be early like the Egyptian wheat lines (Sids parents) and sometimes early than these lines.

3. Maturity date:-

The observed means of days to maturity in parents; Sids 4, Sids 5, Sids 6, Sids 7, Sids 8 and Sids 9 (hexaploid wheat) were 151.50, 153.75, 155.00, 156.50, 157.00 and 158.00 which showed great variability between parents as Sides 4 and other Sids's parents which revealed shorter days to maturity while

Sides 5, Sides 6, Sides 7, Sides 8 and Sides 9 revealed longer days to maturity. Meanwhile, the lines; Pc 29, Pc 62 and Pc 63 were found to be more longer days to maturity than the Egyptian Sides parents (158.25, 159.00 and 159.00, respectively). The standard deviations of parents also showed highly significant differences (2.10, 0.76, 3.55, 1.09, 1.60 and 2.34 for Sids's parents while 2.45, 1.85 and 1.05 for Pc's parents).

The maturity date of the selected plants from F_2 and BC populations:

Concerning the maturity date of the selected plants from the segregated populations, the date to maturity tend to be early like the Egyptian wheat lines (Sids parents) and sometimes early than these lines.

4. Spike length:-

The observed means for parents were 16.800, 17.050, 17.150, 16.700, 14.950 and 16.225 for wheat parents (Sids 4, Sids 5, Sids 6, Sids 7, Sids 8 and Sids 9) while 14.850, 9.350 and 11.800 for Pc's parents (Pc 29, Pc 62 and Pc 63) showed highly significant differences between parents. The standard errors of parents also revealed highly significant differences (0.07, 0.78, 0.18, 0.34, 0.59 and 0.12 for Sids's parents while 0.30, 0.34 and 0.57 for Pc's parents).

The spike length of the selected plants from F_2 and BC populations:

Concerning the spike length of the selected plants from the segregated generations, there are great variability in spike length with a tendency toward Egyptian wheat lines (Sids parents).

5. Number of spikelets per spike:-

Table (2) showed the spikelets number per spike in parents as 24.350, 25.150, 23.350, 24.500, 22.175 and 24.250 for hexaploid wheat (Sids 4, Sids 5, Sids 6, Sids 7, Sids 8 and Sids 9, respectively) and 26.550, 20.950 and 23.400 for Pc's lines (Pc 29, Pc 62 and Pc 63, respectively) indicating the significant differences between parents in such character. The standard deviations of parents also revealed highly significant differences (0.06, 0.74, 0.50, 0.13, 0.34 and 0.51 for Sids's parents while 0.60, 0.74 and 0.92 for Pc's parents).

The number of spikelets per spike of the selected plants from F_2 and BC populations:

In case of number of spikelets per spike of the selected plants from the segregated generations, the number of spikelets per spike ranged from 11 to 42 with a great variability.

6. Grain weight per spike:-

It was showed the grain weight per spike in parents as 4.333, 4.818, 5.105, 4.965, 4.155 and 4.920 for hexaploid wheat (Sids 4, Sids 5, Sids 6, Sids 7, Sids 8 and Sids 9, respectively) and 1.773, 2.000 and 2.430 for Pc's lines (Pc 29, Pc 62 and Pc 63, respectively) indicating the significant differences between parents in such character. The standard deviations of parents also revealed highly significant differences (0.04, 0.01, 0.14, 0.01, 0.13 and 0.24 for Sids's parents while 0.11, 0.10 and 0.03 for Pc's parents).

The grain weight per spike of the selected plants from F_2 and BC population:

In case of grain weight per spike of the selected plants from the these generations, the grain weight per spike ranged from 0.95 to 5.80 gm.

7. 1000-kernel weight:-

t was found that 1000-kernel weight in parents were 54.355, 55.113, 60.823, 57.715, 51.050 and 56.730 gm for hexaploid wheat (Sids 4, Sids 5, Sids 6, Sids 7, Sids 8 and Sids 9, respectively) and 25.783, 32.995 and 25.213 for Pc's lines; Pc 29, Pc 62 and Pc 63, respectively.

The standard errors of parents also revealed highly significant differences (0.41, 0.29, 0.94, 0.63, 0.12 and 0.16 for Sids's parents while 0.72, 0.91 and 0.22 for Pc's parents).

The 1000-kernel weight of the selected plants from F_2 and BC populations:

Generally, In case of 1000-kernel weight of the selected plants from the segregated generations, the 1000-kernel weight ranged from 24.10 to 71 gm.

2. Cytological studies on the chromosomal number in mitosis using C-banding technique .:-

Somatic chromosomes were counted on seed samples from some promising segregant plants of F_2 and back crosses populations under study and the two sets of parents (Sids parents and Pc's parents) beside the rye variety (Petkus). It was revealed that different chromosomal number in these segregants (41+1 translocation). Every chromosome pair is characterized by a specific banding pattern. 1R, 2R, 3R, 4R, 5R, 6R and 7R are the 7 pairs of the genome R of rye parent. Each chromosome had its identity as it differ from the other chromosomes in distribution of bands, position of centromer and the length of the two arms. The results obtained from the extensive study of mitotic chromosome variation in a number of segregant plants from the F_2 and back crosses populations

obviously indicate that these segregants were cytologically had the translocated segment (5RL.5AS) in case of using Pc 29 as a parent (4BS.4BL-5RL) in case of using Pc 62 as a parent and (5BS.5BL-5RL) in case of using Pc 63 as a parent.

3. Efficiency of micronutritional genes in translocated wheat lines and their parents:

In rye (*Secale cereale L.*), there are loci on chromosome arm 5RL which give rise to increased copper(Cu)- and iron(Fe)-efficiency, respectively. Three different wheat-rye translocations each harboring a terminal segment of different size of the rye chromosome arm 5RL were identified by C-banding technique: Pc 29 (5AS/5RL), Pc 63 (5BS.5BL-SRL) and Pc 62 (4BS.4BL-5RL). The translocation break points were observed by chromosome C-banding technique and the sizes of the rye chromosome segments involved were determined by karyotype analysis. The cu-efficiency gene (Ce) was physically mapped to the terminal region of 5RL, and the genes for mugineic acid and for hydroxymugineic acid synthetases involved in the strategy II of Fe-efficiency control to two intercalary regions of 5RL. In all wheat-rye translocation lines the 'Ce' gene is linked to the dominant hairy neck character from rye ('Ha1'). This morphological trait can serve as proper markers for a marker based large-scale selection in wheat breeding.

In studying the efficiency of Cu microelement on the Sids parents and Pc parents, it was found that severe reduction in grain weight in spikes of plants free from Cu (3 mg/bottle) as compared to those supplemented with Cu (60 mg Cu/bottle). In wheat lines, the reduction in grain weight ranged from 36.56 % in Sids 4 and 8 up to 40.19 % in Sids 6. Meanwhile, The reduction in grain weight was ranged from 21.06 % in Pc 63 up to 46.45 % in Pc 29.

Although, in comparison to wheat, translocated Pc lines are preferably planted on light, sandy clay soils with bad nutrient supply, severe iron shortage induced a considerable decrease of fresh matter production in young translocated wheat shoots (Pc lines). The difference between the decrease of fresh matter production in Pc 29 (48.16 %), Pc 62 (61.53 %), Pc 63 (56.01 %) and the decrease of that in wheat (21.22 % for Sids 4 23.89 % for sids 5, 17.65 % for Sids 6, 25.70 % for Sids 7, 29.12 % for Sids 8 and 32.47 % for Sids 9) is highly significant.

Since the shoot fresh matter amount cannot solely reflect iron efficiency, the symptom of mild chlorosis was substantiated by determining the chlorophyll contents. The response to Fe-shortage varied among the Pc lines (12.07 % in Pc 63, 16.97 % in Pc 62 to 53.68 % in Pc 29). Their efficiencies were elevated by genes from the 5RL arm. Meanwhile, The response to Fe-shortage varied among the wheat lines (5.74 % in Sids 4, 2.13 % in Sids 5, 18.76 % in Sids 6, 15.21 % in Sids 7, 19.70 % in Sids 8 and 20.53 % in Sids 9 respectively).

For the segregants selected from the F_2 and BC population, it was found that the percentage of grain yield decrease ranged from 25.91 % up to more than 50.00 % due to the lack of Cu in liquid media. Meanwhile, the percentage of fresh weight was reduced due to the lack of iron (Fe) in liquid media The response to Fe-shortage through the determination of the chlorophyll contents varied among the selected plants.