

Genetical analysis for manipulation of microelements efficiency in wheat

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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 (1997/1998) on the 9 parents and the obtained F₁'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 F₂ 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 following:-

1. Morphological studies on the main economic characters of these lines and some selected segregants from F₂ 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 F₂ 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.

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 105.00, 112.50, 97.50, 107.50 and 93.75 which showed great variability between parents as Sids 4, Sids 5, Sids 6 and Sids 8 revealed higher length while Sids 7 and Sids 9 revealed shorter length. Meanwhile, the lines; Pc 29, Pc 62 and Pc 63 were found to be more longer than the Sids parent; (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 parent; while 0.17, 2.56 and 1.78 for Pc's parents). The plant height of the selected plants from F₂ 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 state:- 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 Sids 4 and other Sids's parents which revealed shorter days to flowering (anthesis) while Sids 5, Sids 6, Sids 7, Sids 8 and Sids 9 revealed longer days to flowering. Meanwhile, the lines; Pc 29, Pc 62 and Pc 63 found to be more longer days to flowering than the Sids parent; (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 parent; while 3.67, 4.11 and 1.66 for Pc's

parents). The flowering date of the selected plants from F2 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 51.50, 53.75, 55.00, 56.50, 57.00 and 58.00 which showed great variability between parents as Sids 4 and other Sids's parents which revealed shorter days to maturity while Sids 5, Sids 6, Sids 7, Sids 8 and Sids 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 Sids parents (58.25, 59.00 and 59.00, 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 parent ;). The maturity date of the selected plants from F2 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 F2 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 parent i). 5. Nur fiber of spikelets per spike: -Table (2) showed the spikelets number per spike in parent; 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 parent 3 while 0.60, 0.74 and 0.92 for Pc's parents). The number of spikelets per spike of the selected plants from F2 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 6 to 42 with a great variability. 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 parent; while 0.11, 0.10 and 0.03 for Pc's parents). The grain weight per spike of the selected plants from F2 and BC population: In case of grain weight per spike of the selected plants from the these generations, the grain weight per spike range (from 0.95 to 5.80 gm). It was found that 1000-kernel weight in parents were 54.35f, 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 F2 BC populations: Generally, In case of 1000-kernel weight of the selected plants from the segregated generations, the 1000-kernel weight range from 24.10 to 71 gm. 2. Cytological studies on the chromosomal number in mitosis using C-banding technique: -;omatic chromosomes were counted on seed samples from some promising segregant plants of F2 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 F2 and back crosses populations and obviously indicate that

these segregants were cytologically had a the translocated segment (5RL.5AS) in case of using Pc 29 as parent (4BS.4BL-5RL) in case of using Pc.62 as a parent and (5BS.f;BL-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 f.RL which give rise to increased copper(Cu)- and iron(Fe)-efficiency, respectively. Three different wheat-rye translocations each harboring a terminal segment of different C-size of the rye chromosome arm 5RL were identified by 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 '1C.?' gene is linked to the dominant hairy neck character from rye ('Hal'). This morphological trait can serve as a proper marker for a marker based large-scale selection in wheat breeding.

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/b) 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 46.4.5% 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).

or the segregants selected from the F2 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.