Studies on genetic variability for water deficiency tolerant in some rapeseed genotypes

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Abstract

Seeds of 14 double haploid lines and two cultivars of spring rapeseed (*Brassica napus*) Fido and Serw4 were grown in irrigated soil under normal and water stress conditions. The experiments were conducted in El-Serw Agricultural Research Station, North Delta of Egypt during 2002/2003 and 2003/2004 seasons. Genetic variability were recorded for seed yield, oil content, 1000 seed weigh, number of branches/plant and plant height. The stress tolerance index revealed that the genotypes double haploids lines Dh16, DhL46 and cultivars serw4 recorded high stress tolerance and yield potential. Harvest index, days to 50% flowering and total dry mater were also studied.

Key words: Rapeseed, water deficiency, seed yield, oil content,total dry mater and genetic variability

Introduction

Oilseed rape became a new oil crop in Egypt which may reduce the gap between the local production and consumption of the edible oil. But this new crop faces difficulties to compete with the main crops in the Nile valley land during winter seasons. The new reclaimed land outside the valley is the target for rapeseed growing. The most of these land is located in the desert with shortage of irrigating water. Therefore new genotypes adapted and tolerant to water deficiency is very essential for the success of rapeseed growing (Keshta 1998 and 1999). A crop improvement program must be based on adequate variability for the desired trait, and indeed considerable variability for tolerance of drought has been observed among and within species (Epstein et al 1980). Various screening procedures have been devised for identifying tolerant lines or even individual plants within species (Epstein 1977, Kingsbury and Epstein 1984, Shanon 1979 and Norlyn and Emanuel 1989)

One of the rapid breeding method for the development of new improved rapeseed cultivars is producing homozygous diploid lines(DHL) derived from the natural occurring haploid plants (Thompson 1979). He illustrated that trails results from spring and winter rape showed that occasional homozygous diploid lines yielded consistently more oil per/ha than the parental varieties. Loof (1975) considered that comparatively homozygous lines would not include all the desirable characteristics of winter rapeseed e.g. extremes winter-hardiness and resistant to diseases, necessary to give variety sufficient adaptability to different soil and climatic condition.

The purpose of this study is to evaluate some homozygous diploid lines of spring rapeseed produced from the natural occurrence haploid plants with the two cultivated cultivars Fido and Serw4 under normal and water stress conditions.

Materials and Methods

The evaluated 14 genotypes of double haploid lines (DHL),Fido and Serw 4 of spring rapeseed (*B.napus*) were grown in irrigated soil under normal (6 irrigations), and water deficiency (3 irrigations) conditions in the experimental farm of El Serw Agricultural Research Station. Two field experiments were carried out during 2002/2003 and 2003/2004.The randomized complete blocks design in factorial arrangements was used with four replications.The area of each plot was 10 m^2 (5 rows×0.5 m width×4 m long). Seeds were sown in hills during the first week of November (5gm / plot) in both seasons. The fertilizers of P and K (40 kg P_2O_5 + 30kg K_2O/ha) were applied during land preparation and the nitrogen fertilizer (120 kg N /ha) was applied in two equal doses, half during land preparation and the other at the time of the second irrigation.. Plants were hand thinned three weeks after sowing leaving one plant/hill. Observations were recorded on five plants selected from the inner rows for the studied characters; and were harvested at the end of the season and air-dried to determined thousand seed weight,seed yield /ha,, oil content, 1000seed weight, number of branches per plant and plant height.Days to flowering were estimated from sowing date to 50% flowering. Harvest index and total dray matter were also recorded. Oil content was estimated according to the procedures of A.O.A.C (1975). The stress tolerant index :The value of any character studied of each genotype at the normal irrigation level (R1) considered being 100 and the value of the same character of each genotype at the level of water deficiency is considered as a percentage of R2 level. It was calculated as the following formula: Stress tolerant index = (R_2 / R1)x100.

The data were statistically analyzed according to Gomez and Gomez (1984).

Results and Discussion

Effect of water deficiency: Results presented in Tables (1,2) show that average of days to 50% flowering, plant height, number of branches per plant,1000-seed weight, seed yield per hectare, oil content, total dry matter and harvest index were significantly decreased by increasing the deficiency by 2.8, 38.3, 37.3, 29.5, 57.6, 14.5, 44.0 and 25.0 % respectively. Therefore, plant height, 1000- seed weight, seed yield /ha and total dry matter characters were more injurious than the other traits. Days to 50% flowering were reduced from 1 to 6 days and the reductions were greater in the late flowering lines. The highest two yielded lines (DhL16 and DHL46) showed the highest values of number of branches / plant and plant height. The weight of 1000-seed were also affected by increasing water stress level and the range was between 2.8 to 3.6 gm. The two homozygous lines DHL16 and DHL146 lines out yielded Fido and serw4 in seed yield kg/ha by 35% and 23 % respectively and they exceed DH1 by 75.0 and 59.5 %. These results were true since they gave the highest values of the studied trait under the level of water stress condition. On the other hand, although DhL52 produced the highest yield under the normal condition, it was not the best under the water stress level.

Oil content revealed difference reductions among the lines, the highest oil content obtained from DHL16,DHL46,Fido and Serw4 although they were not the best under norma condition. Total dry matter is the result of the previous studied characters and it was reduced about 44%. The reduction in these characters caused by water deficiency could be attributed to increasing somatic pressure of the soil solution to a point which restarted or reduced the intake of water resulting in water stress in the plant and decreasing cell division, cell elongation and cell initiation

The data also presented in Tables 1&2 showed significant defrences among genotypes and stress condition in all studied traits, but it was varying from character to another and from line to another.

***Stress Tolerance Index* (*STI*):** The value in this study express water deficiency tolerance of any character. In another ward, the highest value is the highest drought tolerance. Data presented in Table (3) showed difference values among lines and among characters. For plant height, the highest values obtained from DHL16and followed by Fido. The data showed that the lowest value obtained form cv Serw4 (48%) while the highest values were obtained from DHL146 and DHL16. Oil content was also affected but less than the other characters, and the highest values obtained from DHL16, DHL46 and Serw4.The STI of 1000- seed weight is not acting similar because the highest seed yielding lines were not recorded the highest values. STI seed yield presented in this study showed that the highest seed yielding lines under stress condition (DHL16and DHL46) recorded the highest STI (53 and 52%).Harvest index did not act the same,while the highest seed yielding genotype did not record the STI of seed yield, the lines Serw 4 and Fido recorded the STI (90 and 88%). The STI of seed yield expressed water deficiency tolerance for all traits, while the highest seed yielding line under the normal condition (HDL52}did not gave the same result under the stress level. In general, the two homozygous diploid lines DHL16 and DHL46 recorded the highest STI of number of branches /pl, Plant height, seed yield kg/ ha. These results proved that there are genetically variation among the lines in agronomic characters and water deficiency tolerance These results were also correspondent with that obtained by Keshta (1998&1999), Thompson (1979), Epstein (1975) and Loof (1975).Table 3: Water deficiency tolerance index of some characters of some rapeseed cultivars and some homozygous diploid lines.

Table 1: Averages of some characters of the rapeseed DHLs, Fido and Serw4 under two levels irrigations IR1&IR2 in 2003/2004 seasons

Genotypes	Days to 50% flowering.			Branches number/p			Plant height			1000 seed weight		
	IR1	IR_2	Mean	IR_1	IR2	Mean	IR_1	IR_2	Mean	IR_1	IR_2	Mean
Fido	105	104	105	7.3	4.2	5.8	169	108	139	4.1	2.8	3.5
Serw4	108	107	108	8.1	5.7	7.8	141	101	122	4.6	3.1	3.9
DHL1	110	108	109	9.4	5.3	7.4	157	118	136	4.5	3.0	3.8
DHL2	111	108	110	7.6	4.2	5.9	169	093	133	4.8	3.1	3.9
DHL3	111	109	110	8.3	4.0	6.2	141	110	126	4.5	3.2	3.9
DHL4	107	104	105	8.0	4.3	6.2	167	095	131	4.7	3.6	4.2
DHL5	108	106	107	8.1	5.1	6.6	215	117	186	4.1	3.0	3.6
DHL16	104	101	102	9.2	7.3	8.3	188	140	164	4.9	3.4	4.2
DHL18	113	109	111	7.0	4.1	5.6	221	107	164	4.5	3.1	3.8
DHL19	109	106	107	6.9	4.3	5.6	205	117	161	4.3	2.9	3.6
DHL46	101	99	100	8.8	7.0	7.9	176	102	139	4.7	3.5	4.1
DHL51	110	108	109	8.4	5.3	6.9	189	107	184	3.9	3.1	3.5
DHL52	112	109	110	9.0	5.4	7.2	181	110	146	4.7	2.9	3.8
DHL53	109	105	107	7.6	4.5	6.1	179	126	153	4.2	3.0	3.6
DHL55	113	108	110	8.1	5.6	6.9	156	118	137	3.9	2.8	3.4
DHL58	111	105	108	6.8	4.3	5.6	198	107	153	4.7	3.3	4.0
Mean	109	106		8.1	5.0		178	111		4.4	3.1	
LSDat5%S			1.6			1.6			36			0.3
G			2.1			1.4			30			0.4
GXS			2.4			1.9			65			0.6

Conclusions

This study provides, evidence that natural occurring haploid plants could be a rapid source for genetically diversity which could be useful to find genotypes with high drought tolerance in rapeseed. Some homozygous diploid lines tested in this study were similar under the normal irrigation and others were more tolerance to water deficiency and out yielded others under the stress level in yield and yield component. The two homozygous diploid lines (DHL16 and DHL46) characterized with high drought tolerance and early mature, therefore they could be successfully grown better in land affected by water stress.

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Table 2: Averages of some characters of rapeseed DHLs and the cultivated lines (Fido & Sera4) under two levels of irrigations (IR1.&IR2) over 2002/2003 and 2003/2004 seasons

Genotype(G)	Seed yield kg/ha.			Oil content			Total dry matter kg/ha			Harvest index		
	IR1	IR2	Mean	IR1	IR2	Mean	IR1	IR2	Mean	IR1	IR2	Mean
Fido	1965	810	1373	46.7	38.3	42.3	5688	3240	1620	0.34	0.25	0.30
Serw4	2280	1050	1665	45.3	46.3	42.8	7670	3890	5780	0.30	0.27	0.28
DHL1	2664	1160	1912	45.9	39.3	42.6	8195	3915	6055	0.33	0.29	0.31
DHL2	2360	920	1640	45.8	39.1	42.5	5950	3833	4892	0.40	0.24	0.32
DHL3	2610	1030	1820	45.1	38.2	41.2	7080	3960	5520	0.37	0.26	0.32
DHL4	2390	675	1533	45.7	37.1	41.4	6230	2812	4521	0.38	0.24	0.31
DHL5	2385	870	1627	46.2	36.3	41.3	6745	3480	5113	0.35	0.25	0.30
DhL16	2465	1292	1879	45.9	40.8	43.4	6070	3747	4908	0.41	0.34	0.38
DHL18	2010	940	1475	45.2	38.2	47.1	5636	3480	4558	0.38	0.27	0.33
DHL19	1675	830	1253	46.1	38.3	42.2	6310	3190	4750	0.32	0.26	0.29
Dh146	2590	1418	2004	45.5	41.1	43.3	7220	4137	5678	0.36	0.34	0.35
DHL51	2215	835	1525	44.3	38.3	41.3	6375	3100	4738	0.34	0.27	0.31
DHL52	2870	786	1828	45.6	37.1	41.4	7280	3030	5155	0.39	0.26	0.34
DHL53	1855	795	1325	46.6	36.6	41.6	6340	3180	4760	0.29	0.25	0.27
DHL55	1935	805	1370	44.1	37.3	40.7	6655	3220	4937	0.29	0.25	0.27
DHL58	1865	935	1400	45.2	38.9	42.1	6345	3395	5120	0.29	0.27	0.26
Mean		2261	959		44.9	38.4		6140	3463		0.36	0.27
LSD(5%) for S			187.			0.9			341			0.03
G			224			1.1			415			0.04
GxS			308			1.8			621			0.06

Table 3: Water deficiency tolerance index of some characters of some rapeseed cultivars and some homozygous diploid lines.

Genotypes	Branches number	plant height	oil content	1000-seed wt (gm)	seed yield kg/ ha	total dry matter /ha	harvest index
Fido	58	48	82	42	41	70	74
Serw4	70	60	89	46	46	55	90
DHL1	56	61	86	43	44	35	88
DHL2	55	64	85	39	40	54	60
DHL3	48	68	85	39	39	47	70
DHL4	54	64	82	28	28	38	64
DHL5	63	60	79	31	37	52	71
Dh16	79	62	89	52	52	62	83
DHL18	59	64	85	47	47	45	71
DHL19	63	68	83	50	49	47	70
DhL46	80	67	90	53	54	66	62
DHL51	65	55	86	38	38	47	79
DHL52	60	55	81	26	27	33	62
DHL53	59	61	72	43	43	51	86
DHLF55	69	61	85	42	42	49	86
DHLF58	63	59	86	51	50	62	86
Mean	63	61	84	38	42	59	75
LSD at 5%	0.9	3.7	2.4	3.9	5.1	4.2	1.5