Egypt. J. Plant Breed. 11(3): 357-366 (2007)

VARIATION IN SALT TOLERANCE AMONG SOME CANOLA GENOTYPES

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Oil Crops Res. Sec., Field Crops Res., Inst., Agric., Res. Cen. Giza

ABSTRACT

Ten canola genotypes were evaluated for yield and their components under salt affected soil during the two seasons (2005/2006 and 2005/2006). All genotypes varied significantly for all tested characters. Genotype Serw 4 had the highest seed yield/pl and seed/fed. Phenotypic and genotypic variance for days to 50%flowering, 100% flowering and plant height were high, while low values were obtained for No .of branches /pl. and seed yield/fed. Estimates of broad sense heritability (h_b) were high for days to 50% and 100% flowering, seed yield /fed and oil% in the two seasons and their combined. The magnitude of variation using G.C.V% and P.C.V% was high for seed yield/pl. and seed yield/fed. Expected genetic advance was high for days to 50% and 100% flowering and seed yield/fed in both seasons as well as their combined and slightly high for oil% and seed yield/pl. Cluster analysis divided the present canola accessions, at level 90% into three groups: G1 (2 stocks), G2 (2 stocks), G3 (2stocks) and 4 stocks were ungrioped according to difference in all studied traits.

Key words: ***Canola, Variability, Salt tolerance, Heritability, Genetic advance, Cluster analysis.***

INTRODUCTION

Canola (*Brassica napus*, L.) is one of the most important oil seed crops all over the world. The variability available in phenotypic segregating material is important in a selection program of any crop. The variation in quantitative characters is masked by environmental effect. The inherent ability of crop plants to withstand the effects of elevated salt concentration in their root- zone and still produce a measurable agricultural product defines the magnitude of crop tolerance or resistance to salinity. Ayers and Westcot (1985) define a salinity problem as a condition where the salts in solution within the crop root zone accumulate in concentrations which decrease crop yield. In the context, Francois and Mass (1985) and Ulery *et al* (1998) identified decreases in crop yield in response to increasing root-zone salinity. Shannon *et al* (1994) reported that salinity generally slows the rate of crop growth, resulting in plants with smaller leaves, shorter stature, and reduced economic yield. Meanwhile, Shannon and Grieve (1999) stated that degree to which growth is curtailed by salinity differs with crop species and variety.

Cluster analysis facilitates the selection of genotypes in a breeding program. Thus, cluster analysis is useful for categorizing the germplasm accessions into similar groups and describing the variation among these accessions as found by Ivory *et al* (1991), Gizlice *et al* (1996), Karmakar *et*

al (1998), Abdalla *et al* (2000)and Shafik (2000). Therefore, the present study was conducted to investigate. 1) the genetic diversity in some canola varieties known for their salt tolerance, and 2) to identify the similarity among these canola accessions for most important yield components in a salt affected soil using cluster analysis.

MATERIALS AND METHODS

Ten genotypes of canola including the commercial variety Pactol and nine other genotypes, namely $N.A_2$ from Poland, N. A_{16} from Chicoslofakia, $N.A_{1011}$, $N._{A1012}$ and $N.A_{1013}$ from Australia, Serw4, Serw6 and Serw46 Egyption breeding lines and cultivars and $N.A_{288}$ from F.A.O. were evaluated in a randomized block design with three replications in the El-Arish Agricultural Research Station (A.R.S) during the winter seasons 2005/2006 and 2006/2007. Each entry was sown in four rows of 3 meter long. Distance between rows was 50 cm and distance between hills within rows was 20cm with 2 plants left per hill after thinning. The cultural practices were done according to the recommended methods. The canola entries under study belong to the species of *Brassica napus* which belongs to Cruciferae family.

Table (1) shows soil samples from two depth of 00-30 and 30-60 cm that were collected from the experimental site at El-Arish Agricultural Research Station to determine some chemical characteristic, soil saturation extract conductivity (EC), pH, cations and anions were determined according to Page *et al* (1982).

Table1. Chemical soil analysis at El- Arish Agricultural Research Station: electric conductivity, EC (ds/m),soluble salts (%), pH, soluble cat ions (Ca^+, Mg^+, Na^+ and K^+), anions (CO_3^-, HCO_3^- ,Cl^- and SO_4^-)and Ca^+Mg , $CaCo_3$(%).

property	Soil depth (cm)	
	00 - 30	30 -60
PH	8.7	9.0
soluble salts		
EC (ds/m)	27	0.36
Salts (%)	14	0.11
Soluble cations (meq/100 soil)	0.58	
Ca^{++}	0.64	0.58
Mg^{++}	0.76	0.72
Na^+	0.82	0.78
K^+		0.02
Soluble anions (meq/100 soil)	-	
CO_3^-	0.00	-
HCO_3^-	0.20	0.00
Cl^-	1.21	0.21
SO_4^-		1.24
Ca^+Mg%	1.22	1.28
$CaCo_3$%	6.33	6.60

Table (2) shows the chemical analysis of the water used in the irrigation of the experimental site. The analysis was done according to Jackson (1973). The following traits were recorded on five guarded plants per plot: number of days from planting to 50 and 100% flowering, plant height (cm), number of branches/pl., seed yield /pl. (g), seed yield /fed (ton) and oil %. All the obtained data were computed according to Mather and Jinks (1982).

Table2. Chemical analysis of the water at El- Arish Agricultural Research Station and Chemical analysis of Nile water.

Property	sample	
	El-Arish station	Nile water
pH	7.30	
T.s.s ppm	47.90	26.90
EC (ds/m)	6.50	0.42
Soluble cations (meq/L)		
Ca^{++}	20.60	2.48
Mg^{++}	13.56	2.10
Na^{+}	41.17	1.54
K^{+}	0.47	0.22
Soluble anions (meq/L)		
CO_3^{-}	0.00	-
HCO_3^{-}	1.04	2.58
Cl^{-}	38.79	1.20
SO_4^{-}	35.96	2.50
RSC	0.00	-
PSP	55.40	-
SP	54.00	-
SAR	10.00	1.02
Adj SAR	19.90	-

Cluster analysis was performed using the average linkage procedure: (un-weighted pair-group method using arithmetic average) UPGMA developed by Sokel and Michener (1958).

RESULTS AND DISCUSSION

Mean performance and variability

Means and ranges for seven characters in ten canola genotypes tested in a salty land are presented in Table (3). The data revealed that the genotype N.A.$_2$ had the lowest mean for days to 50 and 100% flowering in 2005/2006, 2006/2007 and their combined. Plant height ranged from 117.3 – 130.7 in 2005/2006, from 97.0 – 111.7 in 2006/2007 and from 108.0 – 117.9 in their combined. With respect to number of branches / pl. the genotype N.A.$_{1012}$ recorded a superior mean number of branches /plant. Seed yield/pl. ranged from 11.7 - 21.3, 10.7 -15.0 and 11.4 -18.2g in 2005/2006, 2006/2007 and their combined, respectively. The new commercial cultivar Serw4 recorded the highest seed yield/pl. (21.3, 15.0 and 18.2g) in both

Table 3. Means (X) and ranges (R) for phonological and yield characters of ten genotypes tested in a salt affect soil during 2005/2006, 2006/ 2007 and their combined.

Genotype	Days to 50% flowering			Days 100% flowering			Plant height (cm)			No.of branches /pl.			Seed yield/ pl.(g)			Seed yield / fed (ton)			Oil %		
	2005/ 2006	2006/ 2007	comb	2005/ 2006	2006/ 2007	comb	2005/ 2006	2006/ 2007	comb	2005/ 2006	2006/ 2007	comb	2005/ 2006	2006/ 2007	comb	2005/2006	2006/ 2007	comb	2005/ 2006	2006/ 2007	comb
N.A.$_{1013}$	94.0	92.7	93.4	101.7	100.3	101.0	121.7	111.7	116.7	4.0	2.3	3.2	11.7	11.0	11.4	0.41	0.36	0.39	41.6	38.6	40.1
N.A$_{1011}$	95.3	97.0	96.2	102.3	102.3	102.3	117.3	108.3	112.8	4.3	3.7	4.0	13.3	11.7	12.5	0.44	0.44	0.44	42.8	39.4	41.1
N.A$_{14}$	92.3	91.0	91.7	99.0	99.3	99.2	124.0	111.7	117.9	3.3	2.7	3.0	18.0	12.3	15.2	0.42	0.37	0.40	42.9	42.6	42.8
N.A.$_{2}$	87.3	88.0	87.7	96.3	96.0	96.2	120.3	97.7	109.0	3.3	2.7	3.0	15.3	14.3	14.8	0.54	0.52	0.53	44.3	43.4	43.8
N.A$_{208}$	91.7	92.7	92.2	99.0	100.0	99.5	125.0	103.7	114.4	4.3	3.0	3.7	12.3	10.7	11.5	0.42	0.37	0.40	43.7	47.3	45.5
N.A.$_{1011}$	95.7	95.7	95.7	103.7	103.7	103.7	118.0	98.0	108.0	4.0	2.3	3.2	14.0	12.0	13.0	0.51	0.48	0.50	38.9	39.2	39.0
Serw4	99.3	98.3	98.8	108.0	107.0	107.5	121.7	105.0	113.4	3.3	2.7	3.0	21.3	15.0	18.2	0.59	0.54	0.57	42.1	41.2	41.7
Serw6	97.7	97.3	97.5	105.7	105.7	105.7	130.7	97.0	113.9	3.3	3.0	3.2	14.7	13.3	14.0	0.56	0.52	0.54	44.9	43.5	44.2
Serw46	94.0	92.0	93.0	102.0	101.0	101.5	124.0	108.3	116.2	3.7	3.0	3.4	11.7	11.0	11.4	0.43	0.37	0.40	42.8	41.6	42.19
Pactol	90.0	88.3	89.2	97.0	97.7	97.4	126.3	101.7	114.0	3.3	3.0	3.2	13.3	14.3	13.8	0.45	0.46	0.46	46.0	43.9	45.0
LSD$_{0.05}$	5.1	3.8	3.1	5.6	3.9	3.3	11.8	12.1	11.5	1.1	1.6	1.4	3.8	2.9	2.3	0.02	0.03	0.20	0.22	0.28	0.25
$\bar{X}$	93.7	93.3	93.5	101.5	101.3	101.4	122.9	104.3	113.6	3.7	2.8	3.3	14.6	12.6	13.6	0.48	0.44	0.46	43.0	42.1	42.5
R	87-99.3	88-98.3	87.7-98.3	96-109	96.108	96.2-109	117.3-130.	97-111.7	108-117.9	3.3-4.3	2.3-3.7	3.0-4.0	11.7-21.3	10.7-15.0	11.4-18.2	0.41-0.59	0.36-0.54	0.39-0.57	38.9-46.0	39.2-47.3	39.0-45.5

seasons and their combined, respectively. Regarding oil % it ranged from 38.9 – 46.0 % in2005 /2006, from 39.2 – 47.2 % in 2006/2007 and from 39.0 – 45.5 % in their combined.

Seed yield / fed (ton) ranged from 0.41 – 0.59 with mean of 0.48 in 2005/ 2006, from 0.36 – 0.54 with of mean 0.44 in 2006-2007 and from 0.39 – 0.57 with mean of 0.46 for their combined. The genotype Serw4 recorded the highest seed yield / fed (0.59, 0.54 and 0.57) in both seasons and their combined, respectively. It was higher than the old commercial variety (Pactol) by 31.1, 17.3 and 23.9% in 2005/2006, 2006/2007 and their combined respectively.

The phenotypic and genotypic variance (δ^2_{ph} and δ^2_g), phenotypic and genotypic coefficients of variability (P.C.V. and G.C.V.), heritability estimates in broad sense (H %) and genetic advance at 5% selection on intensity (ΔG) are given in Table (4). Phenotypic variance (δ^2_{ph}) for days to 50 and 100% flowering and plant height in both seasons as well as their combined were high, Meanwhile, low values were obtained for No. of branches/pl. in each season and their combined. With respect to genotypic variance (δ^2_g) for plant height, No of branches/pl. and seed yield/fed the reduction was 100% in the two seasons and their combined, this indicated that these traits have the largest environmental influence. The highest broad sense value was obtained for seed yield/fed. This high value of heritability suggests that selection for high yield must performed on yield *per se* and not their components. In the context, Johnson *et al* (1955) who suggested that heritability along with genetic gain are usually more useful than the heritability value alone in predicting the resultant effect for selecting the best individuals. The present results are in harmony with those obtained by Afiah *et al* (2000) and Sharaan and Ghallab (2005).

The coefficient of phenotypic and genotypic variability may serve or reference point for breeders as they try to detect genotypic differences with respect to these traits and also make the selection of forms with valuable genotypes much more effectively (Guzhov 1984). The estimates of genotypic (G.C.V) and phenotypic (P.C.V) coefficients of variation appeared to be higher for seed yield/pl. and seed yield/fed. than the other traits. However, the remaining studied traits exhibited small differences between genotypic and phenotypic coefficients of variation, revealing that environmental effects were not of great importance on these traits. These results were assured by heritability values in broad sense. These results agreed with those obtained by Afiah *et al* (2000), Ghallab and Sharaan (2002), Ghallab (2003), Cheema and Sadaqat (2005), Wojtowicz (2005) and Sharaan and Ghallab (2005).

Table 4. Variance components (δ^2_{ph} and δ^2_{g}) phenotypic and genotypic coefficient of variability (P.C.V. and G.C.V.), heritability values (H %) and genetic advance under 5% selection intervarsity (ΔG) for yield and some agronomic characters of ten canola genotypes in a salt affected soil.

Characters	δ^2_{ph}			δ^2_{g}			H%			P.C.V			G.C.V			ΔG		
	2005/2006	2006/2007	com	2005/2006	2006/2007	com	2005/2006	2006/2007	com	2005/2006	2006/2007	com	2005/2006	2006/2007	com	2005/2006	2006/2007	com
Days to50%flowering	12.70	13.50	13.50	9.70	11.90	12.50	76.70	88.00	91.50	3.80	3.90	3.90	3.30	3.70	3.80	5.60	6.70	6.90
Days to100%flowering	13.90	11.8	13.90	10.30	10.10	12.30	74.40	85.30	90.50	3.70	3.40	3.70	3.20	3.10	3.50	5.70	6.00	6.90
Plant height (cm)	16.00	31.8	18.10	0.20	15.30	0.00	1.50	48.10	0.00	3.20	5.40	2.50	0.40	3.70	0.00	0.10	5.60	0.00
No. of branches/pl.	0.18	0.15	0.20	0.04	0.00	0.00	20.10	0.00	27.90	11.70	13.80	12.10	5.20	0.00	6.40	0.20	0.00	0.20
Seed yield/pl (g)	9.30	2.50	5.20	7.60	1.60	3.30	82.10	62.90	63.00	20.90	12.60	16.90	18.90	10.0	13.40	5.10	2.00	3.00
Seed yield/ fed (ton)	0.00	0.01	0.01	0.00	0.01	0.00	99.1	98.10	99.30	13.80	16.00	14.60	13.70	15.60	14.60	6.10	6.10	6.10
Oil %	3.84	6.69	5.40	3.84	6.95	3.50	99.80	99.90	94.7	3.70	5.10	4.40	5.10	3.60	13.70	4.03	5.4	3.10

Predicted gains under 5% selection (ΔG) were in the favorable direction and were higher for days to 50 and 100% flowering and seed yield/fed in both seasons as well as their combined. Predicted gains were slightly high for oil% and seed yield/pl. in both seasons and their combined.

From the previous results, a rapid progress may be achieved via selection for of days to 50 and 100% flowering; seed yield/pl., oil% and seed yield/fed traits. A similar conclusion was reported by Ghallab and Sharaan (2002) and Sharaan and Ghallab (2005).

Cluster analysis of quantitative traits is being used, frequently, for categorizing genotypic accessions obtained with the average linkage procedure as illustrated in Table (5) and Fig (1). At level of 90% probability, three groups (G1, G2 and G3) in addition to four ungrouped accessions were formed. The (G1) includes two accessions No1 (N.A $_{1013}$) and No 9 (serw46). The (G1) recorded tallest stems (116.4) and lower seed yield/pl. (11.4) and seed yield/fed (0.39) than (G2) and (G3). The (G2) included two accessions No 3 (N.A.$_{16}$) and No 10 (Pactol) which possessed earlier flowering plants in each 50% and100% (90.4 and 98.25) and high oil% (43.9) with intermediate seed yield/pl. and seed yield/fed. (14.5g and 0.43 ton, respectively). (G3) consisted of two accessions No 7 (Serw4) and No 8 (Serw6)that exhibited highest seed yield/pl. and seed yield/ fed (16.1g and 0.55 ton, respectively). The ungrouped four accessions were No 2 (N.A$_{1012}$), No 4 (N.A$_{2}$), No 5 (N.A288) and No 6 (N.A$_{1011}$).

Table 5. Mean performance of group average cluster of ten canola genotypes evaluated in a salt affected soil during 2005/2006 and 2006/2007 seasons.

Genotype		Days to 50% flowering	Days 100% flowering	Plant height (cm)	No.of branches /pl.	Seed yield/ pl.(g)	Seed yield / fed (ton)	Oil %
G1	1	93.40	101.0	116.70	3.20	11.40	0.39	40.10
	9	93.00	101.5	116.20	3.40	11.40	0.40	42.20
	$\bar{X}$	93.18	101.25	116.45	3.25	11.35	0.39	41.10
G2	3	91.70	99.20	117.90	3.0	15.20	0.40	42.80
	10	89.2	97.40	114.00	3.20	13.80	0.46	45.00
	$\bar{X}$	90.40	98.25	115.93	3.08	14.48	0.43	43.9
G3	7	98.80	107.50	113.40	3.80	18.20	0.57	41.70
	8	97.50	105.70	113.90	3.20	14.00	0.54	44.20
	$\bar{X}$	98.15	106.60	113.60	3.08	16.08	0.55	42.90
Ungrouped genotypes								
	2	96.20	102.30	112.80	4.00	12.50	0.44	41.10
	4	87.70	96.20	108.00	3.00	14.80	0.53	43.80
	5	92.20	99.50	114.40	3.7	11.50	0.40	45.50
	6	95.70	103.70	108.00	3.30	13.00	0.50	39.00

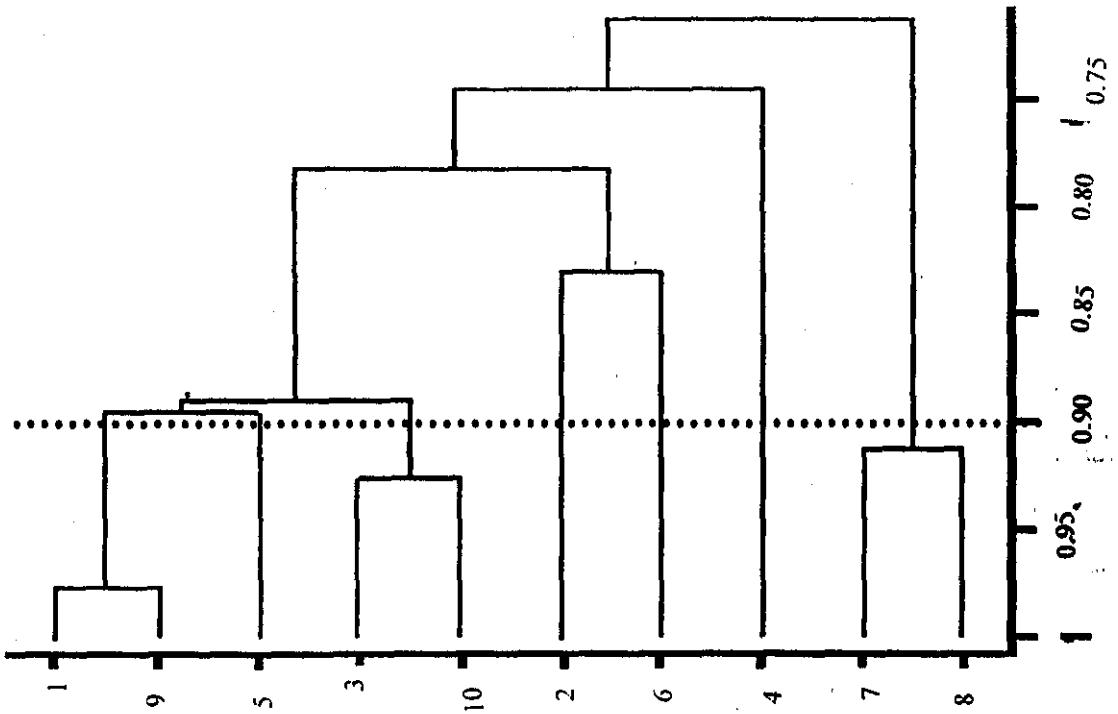

Fig 1. Dendrogram of cluster analysis for ten canola genotypes

It seems that these genotypes were ungrouped to either of formed clusters (G1, G2 and G3) due to their distinctiveness in some features. The accession No2 (N.A1012) recorded highest number of branches/pl. (4.0). Meanwhile, the accession No 4 ($N.A_2$) had earliest flowering with highest seed yield/pl. and seed yield/fed. The clustering pattern of the accessions suggested that genetic diversity may not necessarily related with geographic diversity. Therefore, selection of genotypes for hybridization should be based on genetic diversity rather than geographic diversity (Swain and Dikshit 1997).

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تباين بعض سلالات الكانولا لتحمل الملوحه

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أجريت هذه التجارب خلال موسمى 2006/2005 و2007/2006 بمحطة بحوث العريش و التى تتأثر أرضها بالملوحه لدراسه التباين و تحديد التشابه بين عشرة سلالات من الكانولا لصفات المحصول و مكوناته باستخدام التحليل العنقودى.

و لقد أظهرت النتائج أختلافات عاليه المعنويه بين السلالات لكل الصفات المدروسه سواء فى التحليل المنفصل لكل موسم أو للموسمين معا. أظهرت السلاله سرو 4 أعلى السلالات محصولا سواء للنبات أو الفدان.

كانت التباينات الوراثيه والمظهريه عاليه لكل من الصفات : تزهير50% 100، % من النباتات طول النبات، بينما كانت منخفضه لصفات عددالأفرع/نبات و محصول البذور/فدان.و أظهرت كفاءة التوريث فى معناها الواسع قيم مرتفعه لصفات التزهير 50% و100% من النباتات ومحصول البذور/ فدان و نسبة الزيت سواء فى التحليل المنفصل لكل موسم أو التجميعى للموسمين. وقد أظهرت النتائج أن قيم معامل الاختلاف الوراثى و المظهرى قيم مرتفعه لكل من صفة محصول البذور/نبات و محصول البذور/فدان لكلا الموسمين.

وقد قسم التحليل العنقودى السلالات العشرة الى ثلاث مجموعات رئيسيه على مستوى90%، تتضمن كل مجموعه اسلالتين بينما بقيت أربعه سلالات لم تؤهلها صفاتها إلى الأنتماء لاى من المجاميع الثلاثه.