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PRODUCTIVITY, QUALITY AND PHENOTYPIC STABILITY OF TWENTY EIGHT RAPESEED GENOTYPES GROWN IN FOUR LOCATIONS

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ABSTRACT

Twenty eight canola (Brassica napus) genotypes of different geographical origins and a wide genetic diversity were evaluated across eight environments, Shandaweel ,Malawy , El-Gemmeiaza and Sakha Research Stations in two successive winter seasons 2007/2008and 2008 / 2009. Combined analysis over all environments showed highly significant differences among genotypes (G), environments (E) and G x E. The average of genotypes over all environments for oil content ranged from 42.18—47.19% and seed yield ranged from 0.953 to 1.220 ton /fedan. Malawy location gave the lowest oil % in the two seasons . The lowest seed oil was observed for line 23 (42.18%) Malawy location also gave the lowest seed yield / fedan in the first season .Analysis of variance showed significant and highly significant differences among genotypes, environments and the genotypes x environments interaction for most of the studied traits . The stability parameters indicated that seven genotypes No: (2,5,6,14,18,21 and 28) were more stable in seed oil content ,while twelve genotypes No: 2,4,7,13,14,15,18,20,21,22,23 and 24were more stable for seed yield / fed. Analysis of seed yield and oil % using the stability parameters (bi and (DS^2d), showed significant difference for the main effect of genotype and genotype x environments(linear) interactions and non –significant difference for (S^2d) deviation mean squares from regression.

Key words: ***Canola, Brassica napus, Genotypic stability ,Phenotypic stability ,G x E Interaction.***

INTRODUCTION

Oil seed rape *(Brassica napus* L.) is one of the most important vegetable oil crops in the world. It is now the third important source of edible vegetable oils. It is a promising oil crop in Egypt that can help in solving the local problem of oil production gap. Moreover, it can be grown in the new reclaimed lands as a winter crop.

Information about phenotypic stability is useful for selecting crop varieties for cultivation as well as for breeding programmes. The phenotypic performance of a genotype is not necessarily the same under diverse agro – ecological conditions. Some genotypes perform well in some environments but did not in others. Genotype x environment (G x E) interaction was fully explained by Hebert *et al* (1995).

The expression of seed oil content , oil and seed yield as the most important canola quantitative traits, is greatly influenced not only by genotype but also by environment and interaction of genotype x environment (Habekotte 1997) The stability of genotypic values under diverse environments was the regression coefficient (b-values) and deviation from regression (stability indices),provide information permitting more effective comparisons of different genotypes for yield and adaptation across the varied locations . Many researchers like Ali *et al (2001) Khan et al (*1998*)* Mirza *et al (*2002*)* Ahmad *et al (*1996*)* described the importance of genotype x environment interaction in stability analysis.

The genotypes included in the present study were introduced from different sources of agro- ecological regions in order to increase area and production of canola in Egypt .As stated by Zobel *et al (1988*) the breeding programes should comprise assessment of new genotypes in a wide range of environments. Results obtained from such analyses are very important for developing and recommending best lines or cultivars for production in a specific area as a selection criterion for further genetic improvements.

The main objective of the present investigation was to study the performance and stability parameters of seed yield /fed and percentage of oil in canola genotypes tested under eight environments.

MATERIALS AND METHODS

The materials for the present study comprised twenty eight genotypes of *Brassica napus* L. The origin of these genotypes is shown in Table(1) The experiments of the present study were carried out during seasons 2007/2008 and 2008/2009. The experiments were sown in four locations, Sakha, El-Gemmeiza , Malawy and Shandaweel research stations in the two seasons. Twenty eight genotypes were sown in field plots in a randomized complete block design with three replications. Each experimental plot consisted of four rows ,4m long and 60 cm width and spacing between plants within rows was kept at 20 cm . Thinning was done leaving one plant /hill .Normal cultural practices were applied at each site as recommended. Seed yield/ fed and seed oil content % was recorded.

The analysis of variance was carried out for each experiment separately. The combined analysis for the eight trials was carried out after estimation of the homogeneity test of error. The model of stability parameters as proposed by Eberhart and Russell (1966), was used to describe the performance of a variety over a series of environments. The data for each cultivar was collected on a plot basis. Stability and adaptability estimation were performed using combination of two parameters, regression coefficient (bi) and deviation mean squares (S^2d). The results were interpreted, according to Backer and Leon (1988)..Simple correlation coefficients were computed between oil content % and seed yield fed. Besides, association between stability parameters themselves,were also computed.

Table 1. Pedigree and origin of the twenty eight *Brassica napus* genotypes.

No	N.A	Pedigree	Origin
1	1	Gorczanski	Poland
2	3	Gorczanski	Poland
3	5	Skrzeszowicki	Poland
4	6	Warszawski	Poland
5	11	Diamantlembkes winter rape	Toshoslofici
6	15	Esterhizy	Toshoslofica
7	44	Rapal winter rape	Toshoslofica
8	67	Ogul	England
9	69	Cresuo pprecoce	England
10	73	Erglu	England
11	74	Papoka	West Graninia
12	90	Mides	England
13	93	Mides	England
14	94	Mides	England
15	95	Mides	England
16	98	Briofolder	England
17	99	Rapso	England
18	102	Skrireskig	England
19	150	Torch	France
20	157	Niklas	Sweden
21	159	Cresor	Sweden
22	172	Ocrober	FAO
23	249	Witite flower	FAO
24	250	Awass A23	FAO
25	252	Regtria	FAO
26	259	Regina	FAO
27	Srew	Srew	Local cv
28	Pactol	Pactol	France

RESULTS AND DISCUSSION

Analysis of variance

Results in Table (2) indicated significant differences among genotypes and environments for the two studied traits. The genotypes x environments interaction was also significant, indicating change in the performance of a genotype from one environment to another. The results reflect the importance of G x E interactions to determine the most stable high yielding genotype over locations and the proper genotype for a given location.

Table 2. Analysis of variances (mean squares) for twenty eight genotypes over eight environments for the studied traits .

SOV	Df	Seed oil content %	Seed yield ton /fed
Environmental (E)	7	1.4464*	6.5797*
R/E	16	0.1406	0.3070*
Genotype (G)	27	42.7269*	0.0994*
G x E	189	0.9478*	0.0661*
Error	432	0.1311	0.0247
Total	671		

*Significant at 0.05 levels of probability .

Mean performance

The average of seed yield (ton /fed) overall genotypes, are presented in Table (3). The results showed different response of genotypes to seasons and locations. The over all mean of seed yield (ton /fed) ranged from 1.344 ton for line 24 to 1.070 ten/ fed for line 9 in the first season, while the second season it ranged from 1.253 to o.835 across in most stable genotype was line 7. It gave 1.22 ton /fed as an average of four diverse location that represent upper and lower Egypt.

The average percentage of oil in the twenty eight canola genotypes over the eight environments are presented in Table (4). The results showed different responses of the twenty eight genotypes to season and location, The over all mean of oil percentage ranged from 42.37 to 47.10 in the first season ,while in the second season it ranged from 42.71 to 47.28 in the four locations. Line 2 introduced from Poland was the most promising for oil content across locations and environments.

Stability Analysis

Results of stability analysis according to Eberhat and Russell (1966) presented in Table (5) indicated significant differences among genotypes for the two studied traits. On that context, the significance of the G x E variance gives adequacy to calculate bi for each genotype.

It is obvious from the table that the G X E interactions was significant. Consequently, the regression coefficient (bi) and deviation from regression (S^2d) pooled over the eight environments were calculated for each genotype according to the model used. Besides, the three parameters that describe each genotype (i.e, mean performance over the range of environments used in this experiments ($\bar{x}$), the linear response of each genotype (bi) and the deviation mean square from the regression line) are shown in Table (6) .

Table 3. Mean of seed yield ton /fed for twenty eight genotypes based on eight environments

Environment / Genotypes	2007-2008				Mean	2008-2009				Mean	Grand mean
	Shandaweel	Malawi	Sakha	El-Gemmeiza		Shandaweel	Malawi	Sakha	El-Gemmeiza		
1	1.086	1.019	1.153	1.251	1.121	0.716	1.089	1.252	1.231	1.072	1.100
2	1.179	1.322	1.221	1.566	1.322	0.666	0.994	1.233	1.527	1.105	1.213
3	1.107	0.984	0.922	1.598	1.15	0.439	0.996	1.233	1.561	1.057	1.105
4	1.165	1.068	1.244	1.707	1.296	0.662	1.015	1.135	1.610	1.111	1.201
5	1.083	1.326	0.906	1,626	1.235	0.719	1.062	0.984	1.682	1.094	1.173
6	1.101	0.813	1.119	1.328	1.090	0.558	0.918	1.283	1.615	1.224	1.092
7	1.048	1.085	1.359	1.374	1.217	0.772	1.239	1.314	1.571	1.040	1.220
8	0.950	0.756	1.164	1.470	1.085	0.949	0.746	1.186	1.278	0.850	1.062
9	1.006	0.970	0.885	1.420	1.070	0.329	0.807	0.964	1.240	0.835	0.953
1o	0.977	0.990	1.283	1.698	1.237	0.619	0.809	1.260	1.194	0.9715	1.104
11	1.048	0.964	1.224	1.251	1.120	0.712	0.902	1.303	1.378	1.074	1.098
12	1.283	1.159	1.332	1.191	1.241	0.586	0.628	1.277	1.042	0.883	1.062
13	1.165	0.778	1.260	1.438	1.160	0.770	1.291	1.268	1.682	1.253	1.207
14	0.994	0.869	1.334	1.517	1.179	0.550	1.175	1.244	1.049	1.005	1.091
15	1.010	0.929	1.253	1.651	1.211	0.809	1.101	1.252	1,469	1.158	1.184
16	1.127	0.978	1.182	1.546	1.208	0,421	0.786	1.192	1.624	0.953	1.107
17	1.041	1.247	1.079	1.410	1.194	0.553	0.911	1.108	1.516	1.022	1.108
18	1.051	1.289	1.032	1.638	1.252	0.597	0.885	1.064	1.364	0.978	1.115
19	1.101	1.095	1.258	1.707	1.290	0.381	1.081	1.223	1.811	1.124	1.207
20	1.057	0.998	1.130	1.371	1.139	0.695	1.048	1.074	1.621	1.1095	1.124
21	1.011	1.278	1.067	1.625	1.245	0.874	0.786	1.083	1.537	1.07	1.158
22	1.093	1.049	1.183	1.558	1.221	0.431	0.788	1.213	1.655	1.022	1.121
23	1.095	1.095	1.351	1.477	1.254	0.562	0.945	1.275	1.387	1.042	1.148
24	1.354	1.373	0.885	1.765	1.344	0.371	0.873	1.003	1.645	0.973	1.159
25	1.163	1.021	1.042	1.414	1.160	0,604	0.864	1.108	1.503	1.0198	1.090
26	1.068	1.032	1.126	1.383	1.152	0.574	0.893	1.194	1.142	0.951	1.051
27	1.062	1.250	0.908	1.512	1.183	0.509	0.842	1.068	1.473	0.973	1.078
28	1.006	1.114	0.926	1.430	1.119	0.655	0.780	0.994	1.067	0.874	0.996
Mean for environments	1.087	1.066	1.137	1.497	1.197	0.610	0.938	1.171	1.445	1.041	

GLSD0.05=0.21,ELSD0.05=0.115,GXELSD0.05=0.06

Table 4. Mean of seed oil percentage for twenty eight genotypes on eight environments

Environment Genotypes	2007—2008				Mean across location s	2008-2009				Mean across location s	Geneeral mean
	Shandawee	Mallwy	Sakha	El-Gemmeiza		Shandaweel	Mallw	Sakha	EL-Gammeiza		
1	44.22	44.07	44.24	44.34	44.22	44.03	44.18	40.55	43.99	43.99	43.70
2	47.12	47.06	47.07	47.15	47.10	47.27	47.33	47.37	47.16	47.28	47.19
3	44.60	44.49	44.52	44.26	44.47	45.78	45.83	45.86	45.65	45.78	45.12
4	46.35	46.29	46.31	46.38	46.33	47.42	47.31	47.24	47.26	47.31	46.82
5	46.49	46.43	46.48	46.49	46.47	46.23	46.01	46.14	45.96	46.09	46.28
6	44.77	44.78	44.79	46.77	44.78	45.32	44.98	45.06	45.07	45.11	44.94
7	44.85	44.81	44.76	44.70	44.78	44.84	44.93	44.93	44.83	44.88	44.83
8	45.10	45.10	45.11	45.16	45.12	47.49	46.96	47.26	47.03	47.19	46.15
9	44.10	44.09	44,08	44.13	44.10	43.75	43.69	43.74	43.58	43.68	43.89
10	42.43	44.46	42.45	42.13	42.37	43.74	43.70	43.76	43.66	43.72	43.04
11	45.78	45.73	45.76	45.83	45.78	46.84	46.89	46.89	46.83	46.86	46.32
12	42.67	42.63	42.64	42.64	42.65	42.75	42.67	42.69	42.71	42.71	42.68
13	43.58	43.52	43.61	43.58	43.57	43.64	43.64	43.70	43.57	43.64	43.61
14	45.19	45.19	45.21	45.14	45.18	45.45	45.21	45.29	45.41	45.34	45.26
15	44.39	44.45	44.48	44.52	44.46	44.57	44.61	44.59	44.53	44.57	44.52
16	45.32	45.38	45.35	45.34	45.35	45.38	45.51	45.47	45.45	45.45	45.40
17	43.51	43.5	43.53	43.57	43.53	43.61	43.55	43.57	43.55	43.57	43.55
18	45.28	45.30	45.31	45.26	45.78	45.77	45.40	45.42	45.29	45.47	45.38
19	43..25	43.31	43.34	43.42	43.33	42.70	42.75	42.74	42.75	42.74	43.03
20	45.75	45.75	45.77	45.72	45.75	46.73	46.73	46.76	46.74	46.74	46.25
21	44.75	44.76	44.78	44.73	44.76	44.52	44.42	44.34	44.36	44.41	44.58
22	42.69	42.65	42.68	42.69	42.68	42.76	42.86	42.85	42.84	42.83	42.75
23	42.06	42.04	42.01	42.23	42.09	42.31	42.26	42.29	42.27	42.28	42.18
24	43.16	43.18	43.22	43.36	43.23	44.45	44.49	44.58	44.58	44.52	43.88
25	43.69	43.76	43.66	43.68	43.69	4450	44.21	43.96	44.03	44.17	43.94
26	42.82	42.73	42.71	42.84	42.78	44.35	44.27	44.29	44.25	44.29	43.53
27	46.34	46.39	46.03	46.37	46.8	43.38	43.23	43.25	43.26	43.28	44.78
28	44.44	44.43	44.45	44.58	44.47	44.21	44.25	44.21	44.20	44.23	44.35
Mean	44.45	44.44	44.44	44.47	44.45	44.78	44.71	44.60	44.67	44.69	44.54

G.LSD0.05=0.09,ELSD0.05=0.17,GxELSD0.05=0

Table 5. Analysis of variances for twenty eight genotypes over eight environments for the two studied traits .

SOV	d f	MS for oil	MS for seed
Total	223	2.010*	0.092*
Genotypes(G)	27	14.260*	o.o33
Env x G	196	0.328*	0.0996*
Env(linear)	1	3.905*	15.352*
G x Env (linear)	27	1.5072*	0.034
Pooled deviation	168	0.1108	0.0193*
1	6	1.8699	0.0073
2	6	0.0064	0.0052
3	6	0.0963	0.0113
4	6	0.01899	0.0050
5	6	0.0205	0.0386
6	6	0.0056	0.0215
7	6	0.0044	0.0177
8	6	0.1561	0.0353
9	6	0.0154	0.0063
10	6	0.0968	0.0274
11	6	0.0504	0.0119
12	6	0.00020	0.0606
13	6	0.0026	0.0422
14	6	0.0046	0.0161
15	6	0.0125	0.0161
16	6	0.0024	0.0045
17	6	0.0002	0.0096
18	6	0.0137	0.0170
19	6	0.0186	0.0085
20	6	0.0427	0.0126
21	6	0.0172	0.0275
22	6	0.0028	0.0039
23	6	0.0050	0.0095
24	6	0.0903	0.0487
25	6	0.0042	0.0049
26	6	0.0809	0.0085
27	6	0.4654	0.0161
28	6	0.00772	0.0158
Pooled error	448	0.0438	0.0116

*** significant at 0.05 level of probability.**

Table6. Stability parameters of twenty eight genotypes over eight environments.

No.		Average	bi+_SE	S^2d	Average	bi+_SE	S^2d
1		43.703	1.269±3.760	0.486	**1.100**	0.567±0.116	0.038
2		47.193	0.671±0.2192	0.171**	1.213	1.005±0.097	0.066**
3		45.124	4.726±0.853	0.062	1.105	1.284±0.144	0.002
4		46.820	3.709±0.379	0.065	1.201	1.164±0.096	0.069**
5		46.280	1.309±0.394	0.059**	1.173	1.038+_0.265	0.000
6		44.943	1.385±0.205	0.186**	1.092	1.072±0.198	0.050
7		44.830	0.333±0.182	0.216	1.220	0,761±0.179	0.034**
8		46.153	7.666±1.086	0.103	1.062	0.671±0.253	0.093
9		43.892	1.459±0.342	0.083	0.953	1.114±0.107	0.049
10		43.043	4.872±0.856	0.062	1.104	1.050±0.223	0.071
11		46.319	3.962±0.618	0.011	1.098	0.735±0.147	0.002
12		42.676	0.282±0.039	1.130	1.062	0.669±0.332	0.147
13		43.605	0.232±0.139	0.296	1.207	0.871±0.278	0.110**
14		45.262	0.666±0.186	0.211**	1.091	0.792±0.292	0.120**
15		44.517	0.449±0.125	0.333	1.184	0.911±0.171	0.026**
16		45.400	0.339±0.133	0.311	1.107	1.376±0.902	0.079
17		43.549	0.220±0.042	1.031	1.108	1.021±0.132	0.015
18		5.380	0.932±0.322	0.093**	1.115	1.045±0.176	0.031**
19		43.032	2.150±0.375	0.067	1.207	1.532±0.125	0.024
20		46.245	3.588±0.568	0.002	1.124	0.901±0.152	0.007**
21		44.584	1.094±0.361	0.074**	1.158	0.922±0.224	0.071**
22		42.752	0.513±0.146	0.271	1.121	1.389±0.084	0.009**
23		42.183	0.771±0.194	0.201	1.148	1.007±0.132	0.008**
24		43.877	4.637±0.826	0.056	1.159	1.478±0.298	0.125**
25		43.936	2.140±0.179	0.221	1.090	0.998±0.095	0.070
26		43.533	5.581±0.783	0.048	1.051	0.794±0.125	0.024
27		44.780	10.753±1.876	0.225	1.078	1.119±0.171	0.026
28		44.346	0.888±0.241	0.149**	0.996	0.715±0.169	0.025
Mean		44.89			**1.119**	**1.000**	**0.060**

Stability parameters for percentage of seed oil content indicated that all genotypes were stable except genotypes No. 1,3,4.7, 8,9,10,11,12,13,15, 16, 17, 19, 20,22,23,24,25, 26 and 27 , exhibited insignificant stability parameters from unity and from zero for regression coefficient (bi) and deviation from regression (S^2d) respectively. As for the genotypes No,15, 2 2and 23, they were considered specially adapted to unfavorable environments because, the regression coefficient of these genotypes were significantly less than one , whereas the genotypes No 15,22, and 23 performed consistently and did better in favorable environments.

Seed yield /fed. with respect to the stability parameters for seed yield/ fed data in Table(6) indicated that all genotypes were stable except No ,3,5,6,8,,9,11,12,16,17,19,25,26,27 and 28.They exhibited insignificant bi value . The genotypes No ,1,5,8, 10,11,12,17,25 and 25 were considered specially adapted to unfavorable environments because ,the regression coefficients of these genotypes were significantly less than one, whereas the genotypes No, 1, 8, 11,12 ,25 and 26, performed consistent and did better in favorable environments. Similar results have been reported by Mirza *et al* (2002). Highly significant environmental (linear) also showed that the response of genotypes to change in the environment was under genetic control. Similar conclusion were also reported byAli *et al* (2001) and Mirza *et al* (2002). As the deviation from regression is also significant, it is obvious that differences in genotypic stability were due to both linear as well as non- linear components. This finding is not in line with that of *Ali et al (2001)*..As explained by Eberhart and Russell (1966), linear (bi) and non significant (S^2d) should be considered while identifying the phenotypic stability of a line . They also emphasized that an ideal line, should have high mean performance, b- value near to unity and S^2d as small as possible.

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الإنتاج و الجودة والثبات المظهري لعدد ثمانية وعشرون تركيبا وراثيا من الكانولا المنزرعة فى أربعة مواقع

رجب محمد فهمي ،علي ناصف عبد العال، رضا السيد احمد السيد ، محمد مرسي عوض

قسم بحوث المحاصيل الزيتية. معهد بحوث المحاصيل الحقلية مركز البحوث الزراعية

الهدف من هذا البحث هو تقدير ثوابت التأقلم أو الثبات الوراثي لثمانية وعشرون تركيبا وراثيا من الكانولا التابعة للنوع *Brassica napus* وقد اختبرت هذه السلالات في أربع محطات بحوث وهي سخا الجميزة شندويل وملوي لمدة موسمين متتاليين ٢٠٠٧-٢٠٠٨، ٢٠٠٨-٢٠٠٩ ، وقدرت ثوابت التأقلم بطريقة إبراهارت وراسل لسنة ١٩٦٦ لصفتي محصول البذور والزيت وفي ما يلي أهم النتائج المتحصل عليها:

١- كان التباين الراجع للتفاعل البيئي والوراثي لصفتي محصول الزيت والبذور الفدان معنويا.

٢- أمكن تحديد أحسن التراكيب الوراثية في قدرتها على الثبات في محصولي البذور و الزيت على أساس ثوابت التأقلم وهي أن يكون لكل منهما متوسط محصولي مرتفع ومعامل إنحدار أقرب ما يكون للوحدة وأن يكون متوسط مجموع مربعات الانحراف عن خط الانحدار لكل تركيب وراثي أقل ما يمكن أو لا يختلف عن الصفر معنويا وكانت اكثر التراكيب الوراثية الثابتة بصفة الزيت هي سلالة رقم ٢، ٥، ٦، ١٤، ١٨، ٢١، ٢٨ و التراكيب الوراثية لصفة محصول بذور الفدان هي السلالات ٢، ٤، ٧، ١٣، ١٤، ١٥، ١٨، ٢٠، ٢١، ٢٢، ٢٣، ٢٤ ثم لصفتي الزيت والمحصول معا هما ٢، ١٤، ٢١.

ويوصي البحث بأنه يمكن استخدام هذه التراكيب الوراثية مباشرة في تحسين محصول الزيت وهي السلالات التالية: ٢، ٥، ٦، ١٤، ١٨ وكذلك بالنسبة محصول الفدان السلالات التالية : ٢، ٤، ٧، ١٣، ١٤، ١٥، ١٨، ٢٠، ٢١، ٢٢ ثم لصفتي الزيت والمحصول معا وهما ٢، ١٤، ٢١ من التراكيب الوراثية لما لها من قدرة تأقلمية واسعة تحت ظروف بيئات متباينة وكذلك يمكن استنباط سلالات لها نفس الصفات المرغوبة وهذه يمكن استغلالها فيما بعد لإنتاج أصناف تتصف بالتأقلم الوراثي على نطاق بيئي متباين.