STABILITY OF RAPESEED (*Brassica napus* L.) VARIETIES UNDER RAINFALL CONDITIONS IN NORTHEREN OF IRAQ

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ABSTRACT

Four rapeseed varieties, Paktol, Kebel, Forte and Karat were tested in five environments represented limited and semi-limited dryland area in northern of Iraq, Mosul province (Rashidia during 1999-2000 and 2000-2001, singar during 2000-2001 and Bashiqa site during 2000-2001 and 2001-2002 seasons) in order to determine stability of these varieties for plant height, heading,yield and its components.Significant varietal and environments differences were observed for the traits investigated except no. of seed per pod and 1000 seed weight.GXE interaction effect was highly significant for all traits except 1000 seed weight. Paktol were better adapted to favorite environments for plant height, no. of days to heading and no. of pods per plant and better adapted to a wide of environments and stable for seed yield.

INTRODUCTION

Oil rapeseed (*Brassica napus* L.)is now the second largest oilseed crop in the word providing 13% of the world supply. The world s' commerce is largely supplied by two species, *Brassica napus* and *B. rapa* L. Both species contain both spring and winter form that are distinguished by vernalization requirement (Raymer, 2002). Seeds of these species commonly contain 40% or more oil and produce meals with 35-40% protein. Limited water supply is a major problem for crop production in Mediterranean environments (Blum and Pnuel, 1990). The efficiency with which a crop uses water may reflect crop performance and it provides a means for comparing environments (Perry, 1987) . Different genotypes perform differently in different environments and their growth habit is one of the principle descriptors of this variation (Kretchmer *et al.,* 1979).

To improve the stability of varieties , adaptive traits that affect yield response across environments must be identified as the basis of an effective breeding program. Donald (1968) suggested the importance of having a model (ideotype) as a goal for breeding programs. Fall – seeded rapeseed was studied in five field experiments at Milan in northwest Tennessee during 1986-87 , yields ranged from 2150 kg / ha for 'Viking' to 3140 kg / ha for 'Gorezanski' (Fribourg *et al.,*1990). Research has demonstrated that the diversity of form, usage and adaptability among Brassica species has generated wide interest in crucifers as potential new crops (Williams, 1990) .

Christmas (1996) reported that cultivar performance varied by site indicating that some cultivars may be more tolerant to adverse weather than others.'Touchdown' appears to be the best performer under adverse conditions while 'Liborius' was the poorest performer. In order to project a mean yield for

Virginia farmers, Starner *et al.* (2002) used five best performing entries from 1998-1999 ,1999-2000 and 2000-2001 trials.The result indicated that seed yield means varied from 1951 kg/ha for ARC91023-63L-5 to 3179 kg/ha for UGA96200E with an overall average of 2364 kg/ha .

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The aim of this study was to determine stability of introduced rapeseed varieties for yield and its components and its performance under limited and semi-limited rainfall conditions in northern of Iraq.

MATERIALS AND METHODS

Four rapeseed varieties, Paktol, Kebel, Forte and Karat were sowing in five environments represented limited and semi-limited dryland area in northern of Iraq , Mosul province (Rashidia during 1999-2000 and 2000-2001, singar during 2000-2001 and Bashiqa site during 2000-2001 and 2001-2002 winter growing seasons of a varied rainfall precipitation) using Randomized Complete Block Design with three replications.

The experimental plot comprised 5 rows, each 5 m long and spaced 40 cm apart. The sowing rate was 2 kg /donum.. The precipitated amount of rain and temperature during the three seasons for studied sites showed in table 1 .It is noticed that the amounts of rain during growth season 1999 is very low and under general average, therefore the crop received eight irrigations during growth season in Rashidia.

Table (1): Rainfall and temperature at Rashidia , Singar and Bashiqa over the period   1999-2002 .

Month	Locations						
	Rashidia 99-2000	Rashidia 00-2001	Singar 00-2001	Bashiqa 00-2001	Rashidia 99-2000	Rashidia 00-2001	Bashiqa 00-2001
	Rainfall (mm)				Temperature C°		
					Min. Max.	Min. Max.	Min. Max.
Oct.	10.5	12.4	13.5	15.0	14.7 31.8	13.0 28.4	13.0 29.4
Nov.	8.2	46.7	47.2	55.0	6.6 21.8	6.9 21.4	7.1 22.2
Dec.	28.0	83.7	164.2	114.0	3.3 16.8	5.1 13.9	5.1 14.0
Jan.	52.6	25.9	35.8	35.0	2.4 12.0	3.0 14.1	4.4 13.0
Feb.	23.7	37.9	48.0	37.0	2.3 15.1	4.1 15.8	4.1 15.8
Mar.	31.1	82.5	121.8	107.0	4.0 19.3	9.5 22.2	9.5 22.3
Apr.	22.3	36.2	12.5	32.0	3.7 28.5	10.8 26.2	10.8 25.9
May	0.3	17.6	21.0	15.0	17.3 34.1	15.0 32.3	15.1 32.6
June	0.0	0.001	0.0	0.02	21.2 40.5	21.2 40.6	--- ---
July	0.0	0.001	0.0	0.0	27.4 46.4	25.3 44.1	--- ---
Total	175.7	342.9	464.0	446.0			

At maturity a distance of 50 cm length was chosen at random from middle rows for each plot , and the plants were pulled out and used for yield components study .Data recorded for each plot included plant height (cm), no. of days to heading (when 75% of the plants in a plot had reached heading), no. of pods per plant, no of seeds per pod,
1000 seed weight (g) and seed yield (taken from the middle two rows and converted to kg /donum) .The data were analyzed according to combined variance .For comparison between means,Duncan s'multiple rang test was used (Al-Rawi and Khalafallah,1980) .

Application of safety-first selection indices proposed by Kataoka (1963) and reviewed by Eskridge (1990) were done . This index values (Table 5) were computed from the estimates given in table (2). Variety stability will be based on three different models:

i-The variance of variety across environments (EV) .

ii-Finlay and Wilkinson s' regression coefficient (FW) .

iii-both Finlay and Wilkinson s' regression coefficient and Eberhart and
     Russell s' deviation mean square (ER) .

Table (2) : safety-first selection indices with three definitions of stability .

Stability definition	Index form for variety I	Abbrev.
Variance across environments	$\breve{y}i - z(1-\alpha)Si$	EV
Finaly and Wilkinson s' regression coefficient	$\breve{y}i - z(1-\alpha)[(bi-1)^2 S^2y(1-1/q)]^{1/2}$	FW
Finlay and Wilkinson s' regression coefficient and Eberhart and Russell deviation mean square	$\breve{y}i - z(1-\alpha)[(bi-1)^2 S^2y(1-1/q)+ S^2bi]^{1/2}$	ER

Where:

$\breve{y}i$=overall mean of ith variety ;

$z(1-\alpha) = (1-\alpha)$ percentile from the standard normal distribution ;

S^2i : variance across environments ;

bi :regression coefficient

S^2y : variance of environment means ;

S^2bi: Eberhart and Russell s' deviation mean square from regression .

RESULTS AND DISCUSSION

The combined analysis of variance showed that genotypes were significantly different in all studied characters except no. of seed per pod and 1000 seeds weight (table 3). The highly significant genetic difference among the varieties shows that they must carry genes with different additive effects. The environmental component and the genotype X environment interaction term were highly significant for all characters except 1000 seed weight suggesting different ranking of varieties in individual environment. Environment (linear) effects was significant for all characters except 1000 seed weight indicating that response to environment is under genetic control (Bradshaw, 1973; Khan and Bradshaw ,1976) .Test of pooled deviation vis, pooled error was significant

at 1 % level for plant height, no. of pods / plant and seed yield which shows that deviation from linearity due to unpredictable in the response to environment are important.

The mean performance and stability parameters for studied characters summarized in table 4. Forte variety gave the tallest plants (106.1 cm). Meanwhile Paktol came in second rank (105.8 cm) , on the other hand Kebel variety had the shortest plants , this might be attributed to the genetic constitution of each variety. The average data of the environments showed that Paktol variety gave significantly the highest no. of pods per plant and seed yield .Yields overall environments ranged from low of 197.2 kg / donum for Karat to high of 278.1 kg / donum for Paktol . Varieties varied in heading dates, Kebel is earlier comparing with other varieties, increased about 10 days greater than Karat, which was late in heading. The studied varieties did not differ significantly in no. seeds per pod and 1000 seed weight .It could be concluded that varietal differences among rapeseed varieties may be due to its genetical differences and this results were accordance with those reported by Fribourg *et al.*(1990) ; Christmas (1996) ; Starner *et al.* (2002) .

Table (3): Combined analysis of variance.

SOV	d.f	Mean squares					
		Plant height (cm)	No. days Heading	No. pods Per plant	No. seeds Per pod	1000 seeds wt. (gm)	Seed yield Kg / don.
Genotypes	3	564.2**	306.1**	5643.6**	4.3	0.2	21675.2*
Environments	4	73.4	94.1**	99049.3**	86.6**	1.8**	18146.9*
Gen. X Env.	12	547.2**	8.7**	5695.6*	28.8**	0.2	13942.2*
Env.+Gen.X Env.	16	652.0**	10.1**	9680.0**	14.4**	0.2	4997.3
Env.(Linear)	1	6112.6**	94.5**	98830.5**	87.0**	0.4	18153.9*
Gen. X Env(Lin.)	3	1138.8**	15.9**	12261.6**	35.0**	0.1	5777.1
Pooled divation	12	75.3**	1.6	1605.4**	3.1	0.2	3706.0**
Pooled Error	40	53.2	6.1	786.3	2.9	0.1	635.0

*,** significant at 5% and 1% level, respectively.

Regression of variety mean on environmental mean and the contribution of individual varieties to G X E variance indicated that varieties differed in their genetic potential for responding to a favorable environment. Paktol has (b) values significantly greater than unity for plant height, no. of days to heading and no. of pods per plant which show that this variety was adapted to favorite environment . For seed yield , (b) value not significant higher than unity which indicates that Paktol variety responded well to average environment .This is supported from results reported by Fribourg *et al.*(1990) ; Williams (1990) and Starner *et al.* (2002) .Kebel has (b) values significantly
Less than unity for plant height and no. of days to heading which indicates that this variety responded well to unfavorite environments , and significantly

greater than unity for no. of pods per plant and no. of seed per pods which show adapted to favorite environments .

Safety –first index values shown in table (5). Safety –first selection for stability showed variation in the order of genotype stability for different characters. Paktol exhibited the highest order (1st order) for no. pods per plant and seed yield in the three techniques . Kebel exhibited the highest order for no. seeds per pod in EV and FW and 1000 seed weight in FW and ER techniques .Forte variety gave the highest stability rank for plant height . Forte and Karat gaves the lowest order in stability for no. seeds per pod and 1000 seed weight according to the three stability techniques used respectively and the highest order for no. of days to heading in FW and ER techniques.

Table (4): Mean, variance across environments (S^2i), Finlay and Wilkinson s' regression coefficient(bi) and Eberhart and Russell s' deviation mean square from regression (S^2bi) for genotypes, and variance of environment means (S^2y).

Genotypes	Plant height				No. of days to heading				Pods per plant			
	Mean	S^2i	bi	S^2bi	Mean	S^2i	bi	S^2bi	Mean	S^2i	bi	S^2bi
Paktol	105.8 a	274.4	1.6**	1174.8	107.7 c	6.2	1.4**	0.07	177.50 a	1447.5	1.1**	4069.2
Kebel	99.4 b	139.9	0.6**	169.8	104.1 d	38.0	0.7*	0.25	168.1 ab	1147.2	1.2**	6848.5
Forte	106.1 a	107.4	1.13**	529.3	112.0 b	10.0	1.4**	0.86	134.7 c	3013.3	1.0**	3260.7
Karat	99.7 b	121.7	0.7	340.4	114.2 a	27.4	0.6**	2.33	147.7 bc	1494.9	0.7**	1007.7
S^2y	517.7				7.9				8258.4			

Genotypes	Seeds per pods				1000 seeds wt .				Seed yield			
	Mean	S^2i	bi	S^2bi	Mean	S^2i	bi	S^2bi	Mean	S^2i	bi	S^2bi
Paktol	24.0 a	10	0.2	5.5	3.50 a	0.04	0.1	0.15	278.1 a	8055.4	1.6	5010.7
Kebel	22.9 a	4.5	1.5**	4.2	3.3 a	0.08	0.9	0.19	198.6 b	2063.0	1.2	2585.0
Forte	23.4 a	9.4	2**	3.5	3.2 a	0.05	1.7	0.18	216.6 b	6052.2	0.2	4198.9
Karat	22.8 a	5.7	0.3	1.6	3.2 a	0.05	1.7	0.51	197.2 b	2383.3	1.4	1854.8
S^2y	7.3				0.4				1512.8			

*,** significant at 5% and 1% level, respectively.

Table (5): Values of safety-first selection indices and associated rankings(in parentheses).

Genotypes	Plant height			No. of days heading			Pods per plant		
	EV	FW	ER	EV	FW	ER	EV	FW	ER
Paktol	84.0 (2)	85.7 (4)	46.0 (4)	103.6 (3)	106.1 (3)	106.0 (3)	114.9 (1)	164.0 (1)	123.3 (1)
Kebel	80.0 (4)	86.0 (3)	74.1 (1)	94.0 (4)	102.9 (4)	102.7 (4)	112.4 (2)	141.4 (2)	43.7 (4)
Forte	89.1 (1)	101.5 (1)	68.0 (2)	106.7 (1)	110.4 (2)	109.8 (2)	44.4 (4)	129.4 (3)	83.7 (2)
Karat	81.6 (3)	89.6 (2)	67.7 (3)	105.6 (2)	112.6 (1)	111.2 (1)	84.1 (3)	107.6 (4)	70.2 (3)
Genotypes	Seeds per pods			1000 seeds wt.			Seed yield		
	EV	FW	ER	EV	FW	ER	EV	FW	ER
Paktol	18.8 (3)	19.7 (2)	18.8 (3)	3.2 (1)	2.7 (2)	2.5 (2)	130.5 (1)	243.8 (1)	156.7 (1)
Kebel	19.4 (1)	20.2 (1)	19.0 (2)	2.8 (2)	3.1 (1)	2.6 (1)	123.9 (2)	187.2 (2)	114.2 (3)
Forte	18.4 (4)	18.0 (4)	18.4 (4)	2.8 (3)	2.6 (3)	2.3 (3)	88.6 (4)	170.8 (3)	100.6 (4)
Karat	18.9 (2)	19.0 (3)	19.4 (1)	2.7 (4)	2.5 (4)	1.9 (4)	116.9 (3)	144.3 (4)	122.5 (2)

أستقرارية اصناف من السلجم (*Brassica napus* L.) تحت الظروف المطرية في شمال العراق

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الخلاصة

أستخدم في البحث اربعة أصناف مستوردة من السلجم Paktol ، Kebel ، Forte و Karat. زرعت هذه الاصناف في خمسة بيئات تمثل المناطق الديمية المحدودة وشبه المحدودة الامطار من شمال العراق،محافظة نينوى (موقع الرشيديه خلال موسمي ١٩٩٩- ٢٠٠٠ و٢٠٠٠-٢٠٠١ وموقع سنجار خلال موسم ٢٠٠٠-٢٠٠١ وموقع بعشيقه خلال موسمي ٢٠٠٠ -٢٠٠١و٢٠٠١-٢٠٠٢) لتحديد استقرارية هذه الاصناف في صفات ارتفاع النبات ، التزهير والحاصل ومكوناته . لوحظ اختلافات معنوية بين الاصناف والبيئات لجميع الصفات المدروسة ماعدا عدد البذور في القرنة ووزن ١٠٠٠ بذرة . كان تاثير التداخل الوراثي البيئي عالي المعنوية لجميع الصفات المدروسة ماعدا ووزن ١٠٠٠ بذرة . اعطى الصنف Paktol افضل تاقلم للبيئات الملائمة لصفات ارتفاع النبات وعدد الايام للتزهير وعدد القرنات للنبات ، وكان هذا الصنف مستقر ومتاقلم لمدى واسع من البيئات في حاصل الحبوب .

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