Pak. J. Bot., 34(2): 151-155, 2002.

STABILITY ANALYSIS OF SEED YIELD IN WINTER TYPE RAPESEED (*BRASSICA NAPUS*) VARIETIES

NAAZAR ALI*, FARZAD JAVIDFAR AND AHMAD ALI ATTARY****

Oilseeds Research Department,
Seed and Plant Improvement Institute (SPII), Karaj-Iran.

Abstract

Twelve winter type rapeseed varieties of *Brassica napus* were evaluated at 10 different locations in mild cold and cold regions of Iran for stability parameters of grain yield. Genotype x Environment interaction was significant indicating the influence of environment on grain yield. The linear component has major contribution towards differences in stability of genotypes. A top yielding genotype SLM-046 was found a stable cultivar for grain yield. Genotypes Regent x Cobra and A.W. are suitable for favourable environments, whereas PF-7045/91 and Eureka are suitable for poor environment. Variety Cobra is unpredictable across the environments.

Introduction

Phenotypic performance of a genotype may not be the same under diverse agro-climatic conditions. This variation is due to Genotype x Environment (GxE) interactions, which reduces the stability of a genotype under diverse environments. Development of a stable cultivar is the major goal of any breeding programme. Many models have been developed to measure the stability parameters and partitioning of variation due to GxE interactions (Finlay & Wilkinson, 1963; Eberhart & Russel, 1966; Shulka, 1972). The model proposed by Eberhart & Russel (1966) is considered more appropriate to interpret the stability statistics and is more commonly used for stability studies in different crops. Yao & Xu (1994) studied adaptability and yield stability of rapeseed varieties and revealed that variety x year interaction was greater than variety x location interaction. They further reported that the yield stability depended on the stability and buffering capacity of the yield components (siliquae/plant, seeds/siliqua and 1000-seed weight) and interactions among them. Hussain *et al.*, (1996) evaluated eleven rapeseed-mustard varieties in three seasons (1989-92) for stability of seed yield. Four varieties viz., M-27, T-9, YST-151 and RSK-7 were found stable over the years. While studying the G x E interaction in relation to combining ability in Indian Mustard, significant variances of both GCA x Environment and SCA x Environment were found for yield components (Ravi *et al.*, 1997). They further reported higher estimates of non-additive x environment interactions indicating that non-additive variance was more prone to environmental variation. Dhillon *et al.*, (1999) also reported significant G x E interaction in Indian Mustard for all the yield components except oil percentage. The characters differed in contribution of linear and non-linear components of G x E interaction. The genotypes PBR-181, PBR-171 and PBR-91 were found stable for seed yield and important yield contributing components. Rashid *et al.*, (2000) indicated that heterogenity of regression was highly significant. Genotypes KS-74 and CV-3 were relatively stable having b value near to one and low deviation from regression. They further reported that regression coefficient is the most useful stability statistics for selection of stable genotypes in mustard.

*Consultant (Rapeseed Improvement),

**Rapeseed Breeder and Head of Oilseeds Research Dept., Seed and Plant Improvement Institute (SPII), Karaj-Iran.

Rapeseed is a new crop in Iran, but its area has increased significantly within the last two years. Iran has diverse climates in different regions. To maximize the rapeseed crop in vast area there is a need to develop/identify stable genotypes, which can be grown under a wide range of environments. Therefore, the objective of the present study was to evaluate and identify the promising genotypes with wider adaptability in different climatic conditions both in mild cold and cold regions of Iran.

Materials and Methods

Twelve rapeseed genotypes (Cobra, Shiralee, SLM-046, Darmor, Yanter, A.W., ACSN-1, Wotan, Ceres, PF-7045,91, Eureka and Regent x Cobra) received from diverse sources were evaluated for seed yield performance at 10 different locations in mild cold and cold regions of Iran during 1999 (Table 1). At each location the experiment was conducted in a randomized complete block design with four replications. Four rows of five-meter length were planted for each genotype with a row spacing of 50 cm. Recommended doses of fertilizer were applied. The experiments were maintained according to the recommended cultural practices. After maturity yield data were recorded from the two middle rows of the plot and converted into tons/ha.

Analysis of variance for each location and pooled analysis over locations were computed assuming replications and location effects as random and the genotypes were considered as fix variable (Steel & Torrie, 1980). Seed yield stability parameters were computed following Eberhart & Russel Model (1966). The mean of each variety was regressed on the environmental index. Regression coefficients and deviations from regression were calculated and used as parameters for evaluating the yield stability over environments. A genotype, which has high mean yield, regression coefficient (b) close to unity and deviation from regression (Sd^2) near to zero, is defined as a stable cultivar.

Results and Discussion

Seed yield differences among varieties were significant at all the locations except at Arak and Hamadan, where the differences were non-significant (Table 1). Highest average seed yields of 3.305 and 3.304 t/ha were obtained at Broujerd and Hamadan locations, respectively closely followed by Khoy (3.2 t/ha), Karaj (3.18 t/ha) and Sandaj (3.16 t/ha). Tabrez and Zarghan were the lowest yielding locations with an average seed yield of 1.41 and 1.49 t/ha, respectively. The highest seed yield of 4.15 t/ha was obtained by SLM-046 at Khoy followed by Cobra (3.98 t/ha) at Kermanshah. The highest yielding variety SLM-046 was also highest at Sandaj (3.64 t/ha) and Mashad (3.07 t/ha) locations, whereas it was the second highest at Kermanshah (3.54 t/ha) and Tabrez (1.89 t/ha). Cobra, which was the highest yielding variety at Kermanshah produced the lowest seed yield at Karaj, Hamadan and Zarghan.

Pooled analysis of variance revealed significant GxE interaction indicating the influence of environments on the yield performance of genotypes. Environment linear variance was highly significant which indicates the genetic control of genotypic response to environments (Table 2). Ravi *et al.*, (1997), Dhillon *et al.*, (1999) and Kirishnanand *et al.*, (1997) also reported significant G x E interactions for yield and yield components in Indian Mustard and Indian Rapeseed, respectively. Analysis further revealed that the stability of genotypes differed due to linear regression, as the deviations from regression were non-significant. Similar findings have been reported by Khan *et al.*, (1988) in sorghum, Ahmad *et al.*, (1996) in wheat and Ali *et al.*, (2001) in groundnut.

Table 1. Mean yield (t /ha) of rapeseed genotypes at different locations.

Genotype	Karaj	Kermanshah	Broujerd	Khoy	Sandaj	Hamadan	Arak	Tabriz	Zarghan	Mashad	Mean
Cobra	2.457	3.982	3.399	3.558	3.390	2.425	2.904	0.948	0.621	2.500	2.618
Shiralee	3.922	2.821	3.363	2.833	3.324	3.638	2.421	1.577	1.748	2.300	2.795
SLM-046	3.545	3.541	3.178	4.155	3.642	3.365	2.462	1.893	1.648	3.075	3.050
Darmor	2.737	3.215	3.074	3.115	2.886	2.817	2.679	0.804	1.392	1.825	2.454
Yanter	2.770	3.163	2.940	2.843	2.624	3.572	2.946	1.131	1.259	1.540	2.479
A.W	3.510	3.211	3.477	3.425	3.186	3.374	2.513	1.233	1.541	2.600	2.807
ACSN-1	2.820	2.137	3.392	2.208	2.691	3.638	1.779	1.443	1.595	2.250	2.395
Wotan	2.980	3.464	3.570	3.270	3.348	3.563	2.804	1.547	1.574	2.200	2.832
Ceres	2.955	2.806	3.445	3.920	3.519	3.337	2.887	2.043	1.697	1.850	2.846
PF-7045,91	3.667	2.340	3.645	2.570	2.787	3.302	2.458	1.546	1.672	2.250	2.624
Eureka	3.615	1.942	3.000	2.670	2.934	2.832	2.379	1.068	1.500	2.350	2.429
Regent x Cobra	3.185	3.173	3.175	3.832	3.607	3.786	2.867	1.697	1.653	1.925	2.890
LSD (5 %)	0.609	0.490	0.326	0.449	0.538	N.S	N.S	0.551	0.253	0.765	0.342

Table 2. Pooled analysis of variance for stability of seed yield in twelve rapeseed genotypes.

Source of variation	DF	Sum of Squares	Mean Squares
Genotypes (G)	11	5.030	0.458**
Environment (E)	9	233.477	25.942**
Environment + (G X E)	108	73.110	0.677**
Environment (Linear)	1	58.371	58.371**
G X E (Linear)	11	0.843	0.077
Pooled Deviation	96	13.896	0.145
Cobra	8	3.280	0.410*
Shiralee	8	0.856	0.107
SLM-046	8	1.272	0.159
Darmor	8	0.616	0.077
Yanter	8	1.104	0.138
A.W.	8	0.224	0.028
ACSN-1	8	1.792	0.224
Wotan	8	0.296	0.037
Ceres	8	1.120	0.140
PF-7045,91	8	1.256	0.157
Eureka	8	1.376	0.172
Regent x Cobra	8	0.704	0.088
Pooled error	**360**	**70.922**	**0.197**

* = P<0.05 ** = P< 0.01

Table 3. Stability parameters for 12 rapeseed genotypes.

Genotype	Mean yield (t / ha)	Variance	C.V. (%)	bi	S^2 d	R^2
Cobra	2.618	1.2095	42.00	1.25**	0.4102*	0.70
Shiralee	2.795	0.6167	28.10	0.98**	0.1074	0.85
SLM-046	3.050	0.6471	26.37	0.97**	0.1585	0.78
Darmor	2.454	0.6773	33.53	1.06**	0.0772	0.90
Yanter	2.479	0.7243	34.33	1.06**	0.1382	0.83
A.W	2.807	0.6848	29.48	1.11**	0.0284	0.96
ACSN-1	2.395	0.5395	30.66	0.79**	0.2244	0.63
Wotan	2.832	0.6214	27.83	1.04**	0.0368	0.95
Ceres	2.846	0.5754	26.65	0.91**	0.1401	0.78
PF-7045,91	2.624	0.5484	28.23	0.87**	0.1566	0.75
Eureka	2.429	0.5744	31.20	0.88**	0.1723	0,73
Regent x Cobra	2.890	0.7042	29.04	1.08**	0.0884	0.89

According to Eberhart & Russel (1966) model a genotype is considered stable over different environments if it has high performance, unit slope and deviation from regression (Sd^2) near to zero. The stability parameters in Table 3 indicated that the regression coefficients ranged from 0.79 (ACSN-1) to 1.25 (Cobra). Varieties Shiralee, SLM-046 and Wotan have slope near to unity, non-significant deviation from regression and above average yield responses indicating that these genotypes are stable cultivars over the locations under study. Two other genotypes Regent x Cobra and A.W. has also showed above average yield performance, but the regression coefficient are greater than unity indicating that these genotypes are suitable for favourable environments. Genotypes PF-7045, 91 and Eureka has slope less than unity (bi<1) and below average performance indicating that these genotypes are suitable for poor environments. Variety Cobra has the highest value of regression coefficient (b=1.25) and significant deviation from regression (0.412) indicating that it is not suitable for varying environments. Rashid *et al.*, (2000), Dhillon *et al.*, (1999) and Wani (1992) also reported similar results while studying stability of yield and yield components in Indian Mustard.

From these results it is concluded that the top yielding variety SLM-046 is a stable cultivar with wider adaptability under varying environments in mild cold and cold regions of Iran whereas, the second highest yielding variety (Regent x Cobra) is suitable only for favourable environments. Variety Cobra was unpredictable across the environments due to significant deviation from regression.

References

Ahmad, J., M.H. Choudhery, S. Salahuddin and M.A. Ali. 1996. Stability for grain yield in wheat. *Pak. J. Bot.*, 28: 61-65.

Ali, N., S.N. Malik, M.Y. Mirza and G.R. Hazara. 2001. Stability analysis for pod yield in groundnut (*Arachis hypogaea* L.). *Pak. J. Bot.*, 33: 191-196.

Dhillon, S.S., K. Singh and K.S. Brar. 1999. Stability analysis of elite strains in Indian Mustard. *Proc. 10th International Rapeseed Congress*, 26-29 September, 1999 at Canberra, Australia.

Eberhart, S.A. and W.A. Russell. 1966. Stability parameters for comparing varieties. *Crop Sci.*, 6: 36-40.

Finlay, K.W. and G.N. Wilkinson. 1963. The analysis of adaptation in a plant breeding programme. *Aust. Jour. Agric. Res.*, 14: 742-754.

Hussain, S.M., B.K. Sarma and V. Mahajan. 1996. Stability analysis of seed yield in rapeseed-mustard under Nagaland conditions. *Jour. of Hill Res.*, 9: 161-162.

Khan, M.I., N.A. Khan and A.S. Khan. 1988. Evaluation of different sorghum genotypes for stability in yield performance. *Pak. J. Agri. Res.*, 10 : 237-243.

Krishnanand, B. Ram and R. Bhajan. 1997. Phenotypic stability for yield and yield contributing characters in Indian rapeseed (*Brassica campestris* var. Yellow sarsoon). *Indian J. Oilseed Res.*, 14: 93-95.

Rashid, A., G.R. Hazara and N. Javed. 2000. Genotypic x environmental interaction and stability analysis in mustard (*B. juncea*). Proc. 3rd International Crop Sciences Congress, 17-22 August 2000, Hamburg, Germany, Poster No. 104 (Section 4-C).

Ravi, K., S.P. Sinhamahapatra and M. Subrata. 1997. Genotype x environment interaction in relation to combining ability in Indian Mustard. *Indian J. Genetics & Plant Breeding*, 57: 274-279.

Shulka, G.K. 1972. Some statistical aspects of partitioning genotype-environment components of variability. *Heredity*, 29: 237-245.

Steel, R.G.D. and J.H. Torrie. 1980. *Principles and procedures of statistics*, 2nd Ed. McGraw Hill Book Co., Inc. New York.

Yao, J.B.and C.K. Xu. 1994. A study on adaptation and yield stability of rapeseed varieties in Huainan region. *Oil Crops of China* 16: 21-24 [Ch. 5 ref.] Institute of Agricultural Sciences of Taihu Prefecture, Jiangsu, China.

Wani, S.A. 1992. Genotype x environment interaction for yield and its components in Indian mustard. *Adv. Plant Sci.*, 5: 421-425.

(Received for publication 14 July 2001)