J. Basic. Appl. Sci. Res., 2(3)2733-2436, 2012
© 2012, TextRoad Publication
ISSN 2090-4304
Journal of Basic and Applied Scientific Research
www.textroad.com

Evaluation of Drought Resistance Indices in Castor Bean (*Ricinuscommunis*)

Mahmoud PooryousefMyandoab*[1] ,ShaghayeghSharifiTopragh Ghaleh[2] And NavidHosseini Mansoub[2]

[1]Department of Agronomy, Mahabad Branch, Islamic Azad University, Mahabad, Iran
[2]Mahabad Branch, Islamic Azad University, Mahabad, Iran

ABSTRACT

In order to evaluating drought resistance indices in castor bean (*Ricinuscommunis*) 12 genotypes were evaluated in a split plot design with tree replications under two levels of irrigation (with stress and without stress) at research farm of " Agricultural reseach center of Urmia " in spring \ 2009.To evaluate drought tolerant genotypes on the basis of yield performance in stressed (Ys) and non-stressed (Yp) environments, quantitative measures of drought tolerance*i.e* mean productivity (MP), stress tolerance (TOL), geometric mean productivity (GMP), harmonic mean(HARM), stress susceptibility index (SSI) and stress tolerance index(STI) were computed and studied in RCBD design. Results indicated significant differences among all genotypes with respect to drought indices and yield performance in both environments. The highest amounts of STI, HARM, GMP and MP were related to the genotype 80-12-1 in both stressed and non-stressed conditions. Correlation analysis between yield and indices revealed that STI, HARM,GMP, and MP are the beast indices for screening of drought tolerant genotypes. Accordingly, genotype 80-12-1 was selected as drought tolerant genotype. Biplot multivariate technique located the genotype 80-12-1 near the vectors related t STI, HARM, GMP and Mp. Cluster analysis located tolerant genotype 80-12-1 in one group and susceptible genotypes 80-4, 80-25 in another group as well.

KEYWORDS: Castor bean, Drought tolerant indices, Cluster analysis, Biplot.

INTRODUCTION

Oil seeds are the significant part of tropical agriculture. They are easily prepared and a nutrient for human and animal. Most of oil seeds have industrial usages. Iran spends 1 million dollars on importing vegetable oil and oil seeds annually. Less than 10% of demands are supplied with internal productions [1].Dryness is a meteorological expression which means lacking or shortage of rain or snow falling for a long time [2]. Dryness occurs when a mixture of physical and environmental factors cause plant stress and seed production decreases [3], [4]. Dryness tolerance depends on moisture of soil and means that a particular soil's performance capability can be more than another one's genotype performance [5].

Various factors are represented in order to evaluate genotype reactions under different environmental conditions, resistance and susceptibility. Proposed quantitative evaluation includes comparing performance under dryness condition to performance under desirable moisture condition in order to study dryness resistance by Levitt [6].Fisher and Murd[7]proposed stress susceptibility index (SSI). In this index, the lesser amount of SSI represents less changes of genotype performance in stressed, desirable conditions and finally high resistance of that genotype. It was introduced tolerance index (TOL) and mean productivity index (MP). Fernandez [8] proposed another index in the title of geometric mean productivity (GMP).

High amount of TOL shows genotype susceptibility to stress. Low amounts of TOL is demanded in order to reach high performance under moisture stress condition of genotype selection [9]. The most suitable index is the one that is of positive and significant solidarity under irrigated conditions [4,10-11].

MATERIALS AND METHODS

This study was carried out on the basis of split plat plan in the form of completely accidental blocks in 3 replicates in research site of Urumia located in latitude of 45̊ and 10' and longitude of 37̊ and 44'. Major factor included 2 irrigated (a_2) and dry (a_1) treatments. Minor factor included 12 castor genotypes of equal valence. Each experiment unit contained 3 cultivation rows in the length of 5m. There were 72 plots of $22m^2$. The first irrigation was performed immediately after cultivation and the next ones were done when needed (every 7-10 days) through leakage method. Stress was imposed on dry treatment plots after germination stage. For twice irrigation of irrigated part, stressed part was irrigated once.

***Corresponding Author:** Mahmoud PooryousefMyandoab, Department of Agronomy, Mahabad Branch, Islamic Azad University, Mahabad, Iran.

Dry resistance indices are calculatedthrough plant performance in irrigated cultivation (Y_p) and low irrigation (Y_s) in order to measure the amount of castor resistance in dryness.

1. Tolerance index (TOL) and mean productivity (MP):

$$TOL = Y_P - Y_S$$

$$MP = \frac{(Y_S - Y_P)}{2}$$

2. Stress susceptibility index (SSI):

$$SSI = \frac{[1 - (Y_S/Y_P)}{SI} \qquad SI = 1 - \left(\frac{y_S}{y_P}\right)$$

In this formula, SI is stress intensity, y_s is mean performance of whole the genotypes of stress environment, y_p is mean performance of whole the genotypes of unstressed environments.

3. Geometric mean productivity index (GMP) and stress tolerance index (STI):

$$GMP = \sqrt{(Y_S \times Y_P)}$$

$$STI = \frac{(Y_P \times Y_S)}{(Yp)^2}$$

4. Harmonic mean (HM):

$$HM = \frac{2 \times (Y_P \times Y_S)}{(Y_P + Y)}$$

SPSS, EXCEL, MSTAT-C and MINITAB systems are utilized for statistical analyses and drawing graphs.

RESULTS AND DISCUSSION

Genotypes show significant differences (P<1)% from all quantitative indices of dryness resistance and performance in stressed and unstressed environments' point. This represents the existence of genetic variation and selection possibility of dryness tolerance. The existence of genetic variation among different genotypes is verified in pea (dryness tolerance index) [10].

Table1. Variance analysis of quantitative indices related to dryness resistance and performance in stressed and unstressed conditions in castor

Table1. Quantitative indices of dryness resistance and performance in stressed and unstressed environments' point in castor bean (*Ricinuscommunis*)

* and ** respectively represent significance of 1 and 5 percentages

Change resources	Freedom degree	Y_P	Y_S	GMP	HM	STI	SSI	MP	TOL
genotypes	11	/32** 347764	48608/76**	124104/19**	105107/27**	21446/16**	0/014**	149039/50**	196588/14*
replica	2	198948/67	320/68	16317/12	3636/61	2423/80	0/005	53558/52	184304/64
Error	22	67452/80	9356/21	14870/40	17208/87	1463/11	0/010	18564/37	79360/53
Index Changes	23/12	27/91	19/84	32/23	19/91	27/56	35/51	12/09	16/93

Identification the Best Indices of Dryness Resistance

The best indices can be selected through analyzing solidarity between performance in stressed and unstressed environments and qualitative indices of dryness tolerance. The most suitable index is the one that can be performed in both stressed and unstressed environments with positive and significant solidarity [4,10-11]. According to solidarity results from various indices and genotype performance of stressed and unstressed environments, it can be observed that GMP, MP, HARM and STI indices are of mentioned characteristics. These indices of genotype performance of both stressed (0.934, 0.723, 0.992 and 0.901) and unstressed (0.790, 0.968, 0.616 and 0.808) environments show positive and significant solidarity in possibility level of 1%. The genotype of the highest amount is the most resistant one. These results accord to the results of [12] over vetch and results of [13] over pea. TOL has the most significant and positive solidarity in unstressed environment (r=0.935) and positive but insignificant solidarity in stressed environments (r=0/194). Genotypes of lesser amounts are identified as tolerant genotypes therefore, selecting genotypes on the basis of this index will opt genotypes of lesser performance. SSI index has positive and insignificant solidarity to performance in unstressed conditions (r=0.207) and negative and significant solidarity to performance in stresses conditions (r=0.697). Lesser amounts of this index are dryness resistant genotypes so, genotypes of high performance in stressed and low performance in unstressed environments will be chosen on the basis of SSI. These results accord to results of [14-15].

Table3.7. Solidarity coefficients between dryness resistant indices and performance in stressed and unstressed environments

Identifying Dryness Resistant Genotypes via Utilizing the Best Indices

Table 3 represents the result of studying resistant of castor genotypes. It can be concluded that STI, GMP, MP and HARM indices are the best ones and the selection based on them can identify resistant genotypes. These results accord to the results of [16] over soya and results of [14] over wheat. According to this table, the highest performance in stressed and unstressed environments is related to genotype (1-12-80) 10 with Y_p=2201kg and Y_s=650.4kg in hectare and genotype (31-80) 9 with Y_p=1472kg and Y_s=335.4kg in hectare is in the next position. The least performance is related to genotype (17-80) 2 with 960kg in hectare in unstressed environments and genotype (25-80) 8 with 173.2kg in hectare in stressed environments.

This research studied 6 various indices of resistance identification. Imposed stress in this experiment was SI=0.92.

The first investigated index is TOL which defines the difference between performances in both conditions. It could be concluded that the most susceptible genotype is sort 1-12-80TOL=1550 and the most resistant one is 17-80 TOL=682.5.

The second investigated index is MP. The higher the genotype amount, the more desirable is the genotype. Genotype (1-12-80) 10 MP=1426 is the most resistant and genotype (25-80) 8 MP=573.7 is the most susceptible one.

The third index is GMP. Genotypes (1-12-80) 10 GMP=1192 is the most resistant and genotype (25-80) 8 GMP=401.9 is the most susceptible one.

The fourth index is SSI. Genotype (18-80) 5 SSI=0.95 is the most susceptible and genotype (29-80) 1 SSI=0.73 is the most resistant one.

The fifth index is STI. Genotype (1-12-80) 10 STI=363.1 is the most resistant and genotype (4-80) 7 STI=51.86 and genotype (25-80) 8 STI=42.48 are the most susceptible ones.

The sixth index is HARM. Genotype (1-12-80) 10 HM=998.9 is the most resistant and genotype (25-80) 8 HM=401.9 is the most susceptible one.

Cluster Analysis

Investigated genotypes were classified through Ward and Euclidean distance methods on the basis of qualitative indices of dryness tolerance (fig.1). Genotypes were divided into 2 groups on the basis of Dendrogram cutting. The first cluster include 80-29, 80.17, 80-11-1, 80-7, 80-18, 80-16-1, 804, 80-25, 80-31, 80-22 and 80-23 and the second cluster include 80-12-1. On the whole, it can be concluded that the second genotypes can be introduced as dryness resistant genotypes in dry farming.

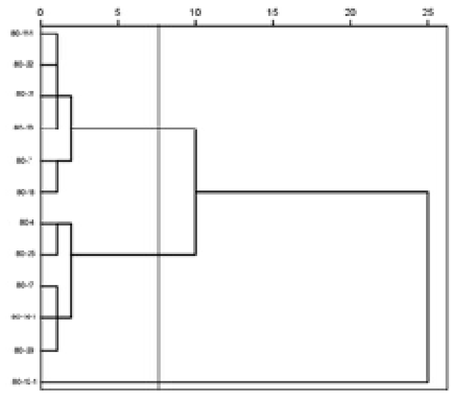

Figure.1. Existed Dendrogram related to cluster analysis of castor genotypes through Ward and Euclidean distance on the basis of quantitative indices of dryness resistant.

Table 2. Results of performance in stressed and unstressed environments and qualitative indices of dryness tolerance

* and ** respectively represent significance of 1 and 5 percentages.

Change resources	TOL	MP	SSI	STI	HM	GMP	Y_S	Y_P
TOL								
MP	0/818**							
SSI	0/529**	-0/036						
STI	0/558**	0/921**	-0/335*					
HM	0/298	0/792**	-0/613**	0/939**				
GMP	0/524**	0/917**	-0/409*	0/981**	0/969**			
Y_S	0/194	0/723**	-0/697**	0/901**	0/992**	0/934**		
Y_P	0/935**	0/968**	0/207	0/808**	0/616**	0/790**	0/528**	

Table3.Result of studying resistant of castor genotypes

genotypes	Y_P	Y_S	GMP	HM	STI	SSI	MP	TOL
80-29	1122 cd	366/8 b	641/4 bc	552/6 b	106/1 bc	0/73 f	744/7 cd	755/7cd
80-17	960/6 d	287/1 bcd	515/3 de	428/8 bcd	68/41 de	0/77 def	619/4 e	682/5 d
80-11-1	1424 b	280 bcd	630/3 bc	467/3 bc	106/51 bc	0/86 bcd	852/6 bc	1144 b
80-7	1382 b	223/2 cde	537/9 cde	347/7 cde	78/03 cde	0/90 ab	802/5 bcd	1159 b
80-18	1408 b	174/7 e	485/5 ef	305/5 e	62/82 de	0/95 a	791/2 bcd	1233 b
80-16-1	1054 d	302/3 bc	547/4 cde	451/8 bc	77/42 cde	0/74 ef	678/3 de	751/9 cd
80-4	1019 d	195/2 de	440/7 ef	323/3 de	51/86 e	0/78 abc	606/9 e	823/4 cd
80-25	974/1 d	173/2 e	401/9 f	287/6 e	42/48 e	0/88 abc	573/7 e	800/8 cd
80-31	1472 b	335/4 b	699/7 b	543/4 b	131/4 b	0/83 bcde	903/9 b	1137 b
80-12-1	2201 a	650/4 a	1192 a	998/9 a	363/1 a	0/75 ef	1426 a	1550 a
80-22	1394 b	309/0 bc	647/2 bc	498/2 bc	107/0 bc	0/83 bcde	851/4 bc	1085 b
80-23	1301 bc	312/1 bc	611/4 bcd	479/5 bc	97/41 bcd	0/79 cdef	806/4 bc	988/6 bc

REFERENCES

[1]Ahmadi, J., ZeynaliKhanghah, H. (2000). Studying dryness resistant indices and utilizing bi-plot method in corn hybrids. Agricultural science magazine: Iran.

[2] JamshidMoghaddam, M., Pakniyyat, H., Farshadfar.A. (2002).Studying significant changes of agricultural characteristics and selection for dryness resistant of Cicerarietinum L.: Karaj. Iran.

[3] Ehdaee, B. (1993). Selection for dryness resistant of wheat. The 1st agricultural and breeding conference: Iran.

[4] Ma'rufi, A. (1998). Identification of chromosome place of dryness resistant in wheat. M. A. Thesis. Agriculture University of Kermanshah.

[5]Kuchaki, A., Alizadeh, A. (1986). Principle of agriculture in dry regions.AstaneQodseRazavi Press.

[6] Levitt. J. 1972. Responses of plant to environment stress. Academic press. New York. 120 pp.

[7] Fischer, R.A., and R. Maurer. 1988. Drought stress n the water cultivars: I. Grain yield responses. Aust. J. Agric. Res. 29: 897- 912.

[8] Fernamdes, G. C. 1992. Effective selection criteria for assessing plant stress tolerance In Preceding of aSymposium. Taiwan, 13- 18.Aug. pp. 257 – 270.

[9] Naderi, A., MajidiHarvan, A., HashemiDezfuli, A., Rezaee, A., Nurmuhammadi, G. (1998). Analyzing efficiency of evaluating indices related to plant tolerance to environmental stresses and introducing a new index. Research paper of Nahal and Bazr.

[10] Emamjome, A. (1998). Detecting genetic distance by RAPD-PCR and evaluating dryness resistance indices and utilizing bi-plot method in corn hybrids. Agriculture magazine: Iran.

[11] Blum, A. 1988. Plant breeding for stress environment.CRG press. Boca Rutom, pp. 38-78.

[12] Zabet, M., Hoseynzadeh, A., Ahmadi, A., Khialparast, F. (2003). Study of dryness stress effects on various characteristics and identification of the best dryness resistant index of vetch. Agriculture magazine: Iran.

[13] Farshadfar, A., Zamani, R., Matlabi, M., Emamjome, A. (2001). Selecting in order to reach a dryness resistant in pea lines. Agriculture magazine: Iran.

[14] NurmandMoayed, F., Rostami, M., Ghannahda, M. (2001).Evaluating dryness resistant indices of bread wheat. Agriculture magazine: Iran.

[15] Samizadeh, H. (1996). Studying phenotype and genotype variety of qualitative and quantitative characteristics and their solidarity to white pea. M. A. Thesis. Islamic Azad University of Karaj.

[16] Kargar, S., Ghannadha, R., Bozorgipur, R., Khaje Ahmad Attari, R., Babaeepur, J. (2004). Evaluating tolerance indices of dryness stress in a number of soya genotypes under limited irrigation conditions. Agriculture science magazine: Iran.