Available online at www.scholarsresearchlibrary.com

Scholars Research Library

Annals of Biological Research, 2012, 3 (6):3089-3092
(http://scholarsresearchlibrary.com/archive.html)

ISSN 0976-1233
CODEN (USA): ABRNBW

Studying Genetic Diversity and SelectingCastor bean's most Possible Genotype Based on DroughtTolerance Indices

Moharam Ehtesham Zade[1] and Mahmoud Pooryousef Myandoab[2]

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

ABSTRACT

In order to investigate the genetic diversity and select the best drought tolerance index of the most feasible genotype of castor (Ricinuscommunis), 12 genotypes were evaluated in a split plot design with totally random block of tree repetitions under two levels of irrigation (stressed and stress free) at the research farm of 'Uromiyeh *Agricultural Research Center' in 2009 farming year.To evaluate drought tolerant genotypes on the basis of yield performance in stressed (Ys) and non-stressed (Yp) environments, quantitative measures of drought tolerancesuch asmean productivity (MP), stress tolerance (TOL), geometric mean productivity (GMP), harmonic mean(HM), stress susceptibility index (SSI) and stress tolerance index(STI) were computed. In this respect and based on the correlation results of different indices and the reactions of genotypes in the two environments we observed that the STI, HARM, MP and GMP indices have the most correlation with the performance under the two conditions. The highest amounts of STI, HM,GMP and MP were related to the genotype 80-12-1 in both stressed and non-stressed conditions. Based on these four indices and the above reactions in both conditions the genotype 80-12-1 was selected as the drought tolerant genotype. Cluster analysis located tolerant genotype 80-12-1 in one group and the other genotypes in another group as susceptible genotypes.*

KEYWORDS: Cluster analysis, Drought tolerant indices, Castor

INTRODUCTION

Caster bean, *Ricinus communis* is in the *Euphorbiacea* family. This family is made of many vegetables that are mostly indigenous to tropical areas. The Ricinus has a unique type named Ricinus communis that includes types that have different shapes. The word drought is a climatology term meaning the lack or shortage of rainfall in a quite long time [1]. Droughtaffects yield and the quality of the plant. Reduction of turgescencepressure is the first effect of drought stress that affects the growth of cells and their final size. Probably the reduction of growth rate, stem's longitudinal growth, leaf growth and also the reduction of the size of pores are among the most sensible processes caused by drought stress. There are different indices for the evaluation of the reaction of genotypes in different environmental conditions and determining the resistance and sensitivity. Levitt proposed a quantitative method for drought resistance. Based on his method the seed growth of drought condition was compared to the seed growth of an ideal moisture condition [2]. Fischer and Maurer[3] proposed stress susceptibility index (SSI).In this index, the lesser amount ofSSI represents less changes of genotype performance in stressed conditions compared to desirable conditions and finally results in high resistanceof that genotype. Fernandez [4] and kristian [5]proposed another index named geometric mean productivity (GMP).

High amount of TOL shows genotype susceptibility to stress. Low amounts of TOL areneeded in order to reach high performance under moisture stress condition of genotype selection[6]. The most suitable index is the one that is of positive and significant correlation under irrigated conditions[7-8].

MATERIALS AND METHODS

This study was carried out in the farming year of 2009 in the research station of Uromiyehlocated 25 kilometers outside the city with latitude of 45̊ and 10' and longitude of 37̊ and 44'. It was done onthe basis of split plot in the form of completely accidental blocks in 3replicates. Major factor included 2 irrigated (a2) and dry (a1) treatments andminor factor included 12 castor genotypes of equal valence. Each experiment unit contained 3 cultivation rows with a5m length. There were 72 plots in this plan and each plot had the surface area of 22 square meters. 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. With any twice irrigation of the irrigated parts, the stressed part was irrigated once.

Dry resistance indices were calculatedthrough plant performance in irrigated cultivation (Yp) and low irrigation (Ys) 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. Susceptibility Index (SSI)

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

In this formula SI is the stress intensity, y_S is mean performance of all of the genotypes under stressed conditions and$y_P$is mean performance of all of the genotypes under stress free conditions.

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):

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

For statistical analyses and graphs these software were used: SPSS, EXCEL, MSTAT-C and MINITAB

RESULTS AND DISCUSSION

1- Determining the best drought resistance index

Through correlation analysis of the performances in stress free environment and stressed environments and the quantitative indices of drought resistance the best indices can be selected[9]. The most suitable index is the one that can be performed in both stressed and stress free environments with positive and significant correlation [9-10]. According to correlation results from various indices and genotype performance of stressed and stress free environments, it can be observed that GMP, MP, HARM and STI indices are of mentioned characteristics (Table 1). These indices of genotype performance of both stressed (0.934, 0.723, 0.992 and 0.901) and stress free (0.790, 0.968, 0.616 and 0.808) environments show positive and significant correlationwith possibility level of 1%. So, genotype of the highest amount is the most resistant one. These results were in accordance with the results of Zabet et al [11]on vetch and results of Farshadfar et al [12]on pea. In relation with other indices TOL has the most significant and positive correlation in stress free environment (r=0.935) and positive but insignificant correlation 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 correlation to performance in stress free conditions (r=0.207) and negative and significant correlation to performance in stressed conditions (r=-0.697). Lesser amounts of this index are dryness resistant genotypes so, genotypes of high performance in stressed and low performance in stress free environments will be chosen on the basis of SSI. These results were in accordance with the results of NurmandMoayed [13], and Samizade [14].

Table1- Correlation coefficients between drought resistence indices and performance in stressed and stress free environment

indices	TOL	MP	SSI	STI	HM	GMP	YS	YP
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****	

**, ** 1% and 5% respectively in significance of probability.*

2- Determining drought resistant genotypes using the best indices

Table 2shows the resultsrelated to the resistance 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 were in accordance with the results obtained fromKaregar et al [15] studyon soya and results of NurmandMoayed et al (2001) on wheat. Based on this table, the highest performance in stressed and stress free environments is related to genotype (1-12-80) 10 with Yp=2201kg and Ys=650.4kg in hectare and genotype (31-80) 9 with Yp=1472kg and Ys=335.4kg in hectare is the next one. The lowest performance is related to genotype (17-80) 2 with 960kg in hectare in stress free 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 was TOL which defined the difference between performances in both conditions. It could be concluded that the most susceptible genotype was 1-12-80TOL=1550 and the most resistant one was 17-80 TOL=682.5.

The second investigated index was 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 was GMP. Genotype (1-12-80) 10 GMP=1192 was the most resistant and genotype (25-80)8 GMP=401.9 was the most susceptible one.

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

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

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

Cluster Analysis

Investigated genotypes were classified through Ward and Euclidean distance methods on the basis ofqualitative indices of drought tolerance. Genotypes were divided into 2 groups on the basis ofDendrogram 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. In general, it can be concluded that the genotypes of the second group can be introduced as drought resistant genotypes in dry farming.

Table 2- the quantitative indices of drought resistance and performance in stressed and stress free environments in castor bean genotypes.

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

REFERENCES

[1] Jamshid Moghaddam, M., Pakniyyat, H., Farshadfar.A. (**2009**). Studying significant changes of agricultural characteristics and selection for dryness resistant of Cicerarietinum L. paper summary of the seventh congress of agriculture and plant modification of Iran. Karaj. P.226.

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

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

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

[5] Kristin, A. S., Serna, F.I. perz, B.C. Enrigues, J. A. A. Gallegos, P. R. Vallego, N. Wassini, and J. D. Kelley. **2000**. Impriving Cimmon bean performance under drought stress. *Crop Sci*. 37: 43-50.

[6] Naderi, A., MajidiHarvan, A., HashemiDezfuli, A., Rezaee, A., Nurmuhammadi, G. (**2007**). Analyzing efficiency of evaluating indices related to plant tolerance to environmental stresses and introducing a new index. *Plant and seed Research publication*. Vo.21(4), p. 390-402.

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

[8] Ma'rufi, A. (**2009**). Identification of chromosome place of dryness resistant in wheat. M. A. Thesis. Kermanshah Agriculture University. 115 pages.

[9] Safaee.H. (**2006**). Evaluation of quantitative and qualitative characteristics of domestic bulks of lentil (Lens culinaris L.) of Fars Province. *The magazine of sapling and seeds*. Vo.7, No.3, p.49-57.

[10] Blum, A., B. Sinmena, and O□ zir. **1980**. An evaluation of seed and seedling drought tolerance screeing in weat. *Euphytica* 29: 727- 736.

[11] Zabet, M., Hoseynzadeh, A., Ahmadi, A., Khialparast, F. (**2007**). Study of dryness stress effects on various characteristics and identification of the best dryness resistant index of vetch. *Iran Agriculture magazine*. Vo.34, No.4, p.889-898

[12] Farshadfar, A., Zamani, R., Matlabi, M., Emamjome, A. (**2001**). Selecting in order to reach a dryness resistant in pea lines. *Iran Agriculture magazine*. Vo 32 (1), p.65-77.

[13] NurmandMoayed, F., Rostami, M., Ghannahda, M. (**2001**).Evaluating dryness resistant indices of bread wheat. *Iran Agriculture magazine*, V.32, No.4, p.795-805

[14] Samizadeh Lahichi, H. (**2006**). Studying phenotype and genotype variety of qualitative and quantitative characteristics and their correlation to white pea. M. A. Thesis. Islamic Azad University of Karaj. 98 pages

[15] 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. *Iran Agriculture magazine.* Vo.35, No.1, p.129-142.