

Evaluation indicator of drought stress in different cultivars of sesame

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Abstract

In Order to determined tolearance cultivars and Selection Of hiegh yield variaties, no Cultivar Seseam Weve investijuted in randomized complete block Desingn with three replications in two Separate experiments under optimize irrigation conditions and deficiet irrigation conditions in 2008-2009 year in Agriculture and Nature resource center of zabol. In non Stress experiment in all growth stages and in Stress experiment, irrigntion introupted in flowering and grain filling stages. For evaluation tolearance to drought cultivars, is used index six, compraied stress susceptible index (SSI), mean productivity (MP) geometric mean productivity (GMP), tolerance index (TOL) Stress tolearance Index (STI) and HARM. The resules showed that both nons- stress and stressed. conditions exist diversity that indicator impossibility selection, tolearance cultivars to stress drought. Under non stressed condition the highest seed yield obtained from , line, 1-Sistan 2-TN₂₃₈ 3-Varamin with (2569, 2532, 2466 kg/ha) and under stressed the highest seed yield obtained from, lines, 1-Sistan 2-TN₂₃₈ 3-with (2525, 2440 kg/ha) respectively. In between Index, investighte in this experiment, HARM, STI, GMP and MP indices, dut to, had most positive correlations with seed yield in non-stressed and stressed conditions were determined as best indices for determine and evaluate high yield cultivars in both conditions local varity of Sistan together two cultivar 1-Sistan 2-TN₂₃₈ thereas on, had vate hieghst of indices, STI, MP, GMP and HARM, were determined as cultivars tolerant to drought stress.

Keywords: Tolerance to drought, Stress, Indicator, Yield, Sesame.

Introduction

Iran has an arid and semi-arid climate and very fertile lands for agriculture is the main factor limiting production is their lack of water. Drought-tolerant crops as a useful strategy in situations maximum and efficient use of limited water is considered water Anglysh et English et al.,) 1990). Among the crops of sesame (*Sesame indicum*) to bring desirable drought resistant characteristics suitable for cultivation in semi-arid has the advantage. In Sesame, like other crops, grain filling period is of great importance in determining productivity. Although the grain filling period was influenced by plant genetics, but environmental stresses such as drought can cause yield loss has a great impact on the Frederick et al (Frederick, et al 1991). Thereby reducing the yield stress depends on several factors, including the factors set the stage of plant growth, stress and susceptibility to figure out Nysanka (Nissanka, 1997). Potential yield under stress is not the best measure of drought tolerance, but also performance and stability as criteria to compare the performance of optimum conditions appropriate for the reaction of tension and stress values were have been introduced. Padya Ramirez and colleagues (Padilla-Ramirez et al., 2005) reported that drought stress caused a significant reduction in grain yield, biomass and harvest index. Multiple markers for genotyping reaction to stress are presented. Fischer and Maurer (Fischer and Maurer., 1978) stress susceptibility index (SSI, Stress Susceptibility Index) was introduced. Rzly and Hamblyn (Rosielle and Hamblin., 1981 Ttnsh tolerance index (Tol, Tolerance Index) and the average of yields or productivity (MP, Mean Productivity) were present. Both TOL and SSI are reduced, shows that plants that are more resistant to stress. Select Mp to enhance performance in both environments. Fernandez (Fernandez, 1992) stress tolerance index (STI, Stress Tolerance Index) and the geometric mean yields (GMP, Geometric Mean Productivity) presented. Genotypes that have higher STI rates also have higher yield potential and drought tolerance .Rzals Serena et al (Rosales-Serna et al., 2000) and Schneider and colleagues (Schneider et al., 2004) for evaluation of drought resistance in bean lines index, mean productivity (GMP) and the criteria for selection of RAPD markers reported. Singh (Singh, 1995) the arithmetic average yield in stress and non-stress and yield reduction due to drought stress were selected as benchmarks.

Materials and Methods

In experiment crops 86-1385 Farm Research Center for Agriculture and Natural Resources Zahak located 25 km south of latitude 30 degrees 54 minutes East with the city Zabol, longitude 62 degrees, 42 minutes, 483 meters above sea level and sandy loam soil were investigated. Chemical analysis of soil tests are given in Table 2. The minimum and maximum

annual temperature is 16 ° C and 30. In two separate trials in a randomized complete block design with three replications. They differ only in terms of irrigation schemes. In experiments with conventional optimum irrigation water in the region of 7-5 leaves, stem elongation, flowering, pod and seed filling rate and the stress test for the stress field of flowering to maturity, irrigation completely stopped. Similar tests were normal vegetative stages and irrigation conditions.

Each plot contains four lines long; 4 meter line spacing was 50 cm and the area of 8 square feet. Based on soil test values of 100 kg ha triple superphosphate, 200 kg of potassium sulfate was added to the soil at land preparation. 200 kg urea 50% was added to the soil before planting and flowering stage. Phenological stages of the plants of each variety in each plot being 50% had reached the stage has been taking notes. To determine the number of components selected five plants of each genotype, and measurements were repeated. The marginal effects for grain yield, harvest the lines between the three square acres harvested and turned.

Table1 . Physical and chemical properties of soil (0-30)

Soil Texture		Sand	Clay	Loam	N		P	K	PH	EC (ds.m)
- sand	-lomi	12	29	18	25	27	7/5	0.57		

Genotypes for drought tolerance indices for evaluating the yield obtained using yield and stress conditions were used in the figures.

1 - Tolerance Index (TOL) and mean productivity index (MP): $TOL = YP - YS$

2 - Stress Susceptibility Index: (SSI) $SI = 1 - \overline{YS} / \overline{YP}$ $SSI = 1 - \frac{YS}{YP} / SI$

The formula for the stress intensity, SI or ((Stress Intensity Average yield of all varieties in stressed and non-stressed environments is the average yield of all varieties.

3 - Index, geometric mean productivity (GMP) and stress tolerance index (STI):

$$STI = YP.YS / (\overline{YP}^2) \quad GMP = \sqrt{Yp.Ys}$$

4 - Harmonic Mean (HM or Harmonic Mean) $(HM = 2(YP.YS) / YP + YS)$

After calculating quantitative indices, this index with yield genotypes using statistical software SAS analysis of variance was used to compare the means tested by Duncan at 5% level took place. To analyze the correlation between the index and grain yield in stress and non-stress environments using MINITAB software.

Results and Discussion

Phenological stages, grain yield and its components

A - During the period of vegetative and flowering

Analysis of variance of Tables 2 and 3 shows a significant difference between the varieties of sesame in both yield and irrigation with two stages during the vegetative and flowering period is that it represents the variation between varieties and options for it is drought tolerant. Average number was determined by comparing the figures, Varamin 125 days and the average local figure out problems with 6/109 day maximum and minimum duration of vegetative stress condition. But during the flowering period of 56 days to figure out the most with the least out of Jiroft local 3/38 day local cultivars in

Sistan-related problems (Table 4) during the vegetative and flowering largest irrigation conditions, respectively The local varieties were Jiroft Iranshahr and local varieties (Table 5).

Kurt and colleagues (Korte et al., 1985) reported the occurrence of drought during the vegetative stages of soybean seed yield by reducing the leaf area is reduced. This leads to a reduction in the number of seeds produced per unit area will be. Stress from anthesis to maturity through accelerated senescence of leaves, reduced growth and reduced grain filling period reduced seed weight and seed yield is. (Royo et al., 2000). In this test, a positive correlation between the length of the vegetative period ($r^2 = 0.12$) and flowering ($r^2 = 0.67$) with the yield obtained. The only significant correlation with grain yield during flowering. Faraji (Faraji et al., 2008) showed that the flowering stage of the life cycle of flowering to seed canola and the plant growth rate, grain filling an important factor in determining the aggregate number. The results of the research findings in other species corresponded (Abbate et al., 1997; Bindraban et al., 1998; Vega et al., 2001)

B - Yield

Based on the analysis of variance table (2, 3) no significant difference between the 1% level of sesame varieties in terms of both yield and grain yield was limited.

The highest average yield in stress condition 2/253 grams per square meter to figure out the lowest Sistan and 2/215 g m was chelated to the local varieties. Sistan figure out the tension in the 2/252 grams per square meter and the highest yield of local varieties out of Jiroft with 2/172 grams per square meter had the lowest yield (Tables 4 and 5). Stress occurred at flowering stage in testing conditions, limited water had a significant effect on yield reduction. Similar results by Gan et al (Gan et al 2004) and Fanaei and colleagues (Fanai et al., 2004) based on the reduction of stress at reproductive phase has been reported. Hassanzadeh et al. Drought stress (Hasanzadeh et al., 2005) reported that canola oil reduces stopping irrigation at flowering stage and seed yield, oil yield and its components.

Table 2- Analysis of variance agronomic characteristics of 10 sesame genotypes in non-stress condition

SOR	d.f	PV	PF	Ca/P	S/Ca	1000SW	Y (gr .m2)
Blouk	2	5.2ns	7.23ns	27.73*	5.23ns	0.001ns	196.13*
Tretment	9	59.18**	93.48**	332**	47.94**	1.94**	2361.17**
Error	18	3.2	4.6	14.88	6.56	0.01	11.61
C.V(%)		1.5	4.83	6.86	4.64	4.04	1.45

ns: Non-significant

* and ** : Significant at 5 and 1% probability levels, respectively

Table 3- Analysis of variance agronomic characteristics of 10 sesame genotypes in stress condition

SOR	d.f	PV	PF	Ca/P	S/Ca	1000SW	Y (gr .m2)
Blouk	2	2.03ns	2.43ns	7.03*	2.23ns	0.001ns	380.633*
Tretment	9	72.07**	82.16**	355.70**	80.23**	0.20**	3859.26**
Error	18	7.21	2.39	19.55	11.71	0.002	12.17
C.V(%)		2.43	3.81	10.22	7.26	1.82	1.97

ns: Non-significant

* and ** : Significant at 5% and 1% probability levels, respectively

C- Number of seeds per capsule

The stress test of cultivar Sistan with 55 seeds per capsule, number of seeds per capsule had the highest yield Nyzdashth and the testing of non local Varamin with 35 seeds per capsule minimum number of seeds per capsule revealed (Tables 4 and 5). The number of capsules per plant seems to be more effective role in the sesame seeds. Scientists and colleagues (Daneshmand et al., 2004) reported that pod of main stem and branches of canola at a percentage, pod length and seed weight at the five percent level, there are significant differences among irrigation levels found. The results Hassanzadeh et al (Hasanzadeh et al., 2005) have also been reported.

D - Seed weight

The results of the comparison showed that in both experiments, optimum and limited irrigation highest grain weight in the local variety of Ahvaz and the lowest rate in local cultivars Iranshahr, Jiroft, Fars, Khuzestan, Sistan and Varamin was observed (Tables 4 and 5). Drought tolerance trait is complex, and many factors are involved, the judgment regarding a number of complex traits often associated with conflicting results. Studies on reproductive stages of the crop rapeseed showed that drought stress reduced yield related traits in rapeseed most like number of pods per plant, seed weight and seed yield is reduced and eventually Drkhvryjn (Ma et al., 2006; Ghodrati, 2012).

Table 4. Mean comparison agronomic characteristics of 10 sesame genotypes in non-stress condition.

Treatment	PV	PF	Ca/P	S/Ca	1000SW	Y (gr .m2)
C1	119.6bc	45.6c	42.6f	53cd	5.1a	22.5de
C2	121bc	41de	56d	55.3a	2.6d	222.1e
C3	120bc	50.3b	43.3f	65.3abc	3.2c	232.5c
C4	118.3c	56a	48.3ef	54.6bcd	2.8d	176.7g
C5	122ab	45.6c	57cd	58.6ab	2.6d	230.9cd
C6	119.6bc	44.6cd	57.6cd	59.6a	2.7d	243.6b
C7	113d	38.3e	66.3b	58ab	2.6d	256.9a
C8	120bc	39.3e	63.3be	59ab	3.2c	253.2a
C9	125a	43.6cd	51.3de	47.3e	2.6d	246.6b
C10	109.6e	38.3e	67.3a	50.6de	3.8b	215.5f

Means in each column and for each treatment, followed by similar letter(s) are not significantly different at 5% of probability level, using Duncans Multiple Range Test

Table5. Mean comparison agronomic characteristics of 10 sesame genotypes in stress condition

Treatment	PV	PF	Ca/P	S/Ca	1000SW	Y (gr .m2)
C1	110.6b	43.6b	34.6d	46.6bc	3.1a	157.3e
C2	119.3a	39.3d	29.3d	50.2abc	2.3f	218.6c
C3	111b	45.3b	34d	49abc	2.8c	219.3c
C4	111b	51.3a	35.6d	44.3c	2.7cd	117.2f
C5	107.6b	41.3cd	44c	48bc	2.5e	220.5c
C6	107bc	39.6d	49.3bc	51ab	2.6d	224.3c
C7	108.6b	34.3e	61a	55a	2.4f	252.5a
C8	108b	36e	55ab	47.3bc	2.9b	244b
C9	117.3a	39.6d	35.6d	35.6d	2.5e	219.2c
C10	102.6c	34.6e	44c	53.6ab	3.1a	179d

Means in each column and for each treatment, followed by similar letter(s) are not significantly different at 5% of probability level, using Duncans Multiple Range Test

E - Indicators of drought resistance

Indices based on STI, MP, GMP and HARM figure Sistan-digit performance in both trials were identified. Correlation with yield stress equal to the optimum irrigation ($r^2 = 0.89$) which was significant at the 1% level. Yield in terms of both indices GMP, STI, MP, SSI and HARM positive correlation at 1% level of significance ($r^2 = 0.6$). General indicators of both tests are highly correlated with grain yield as the best indicators are introduced. Because these indicators are able to separate and identify genotypes with high yield in both environments are. Because genotypes are found to have low sensitivity to drought but also have lower performance and overall Ramyrza (Ramireza and Kelly, 1998).

Conclusions

The results showed that water deficit has a negative effect on yield and yield components of different cultivars showed different responses. In this experiment, the results can be stated that the local cultivars in Sistan and TN238 are identified as drought tolerant varieties. It seems that one of the main reasons for the enduring figures in both stress and non-stress conditions, is capable of producing a greater number of capsules. It was the only part of the variation between genotypes was large we can conclude that the number of capsules per plant water deficit is a critical trait. The evaluation indices, indices MP, GMP, HARM and STI as the best indicator for high-yielding cultivars in both stress and non-stress conditions, sesame plants can be used. The relationship between drought resistance indices, which determine the number of digits in the Sistan inland towards the endurance of higher production, which should be of interest and more.

Table 6. Comparison of grain yield of 10 sesame genotypes based on drought tolerance indices.

Cultivar	YP	YS	MP	GMP	HARM	TOL	SSI	STI
Ahvaz local	1082.67	755.33	919	904.26	889.75	327.33	2.62	0.96
Iranshahr local	1066.33	1049.33	1057.83	1057.8	570.76	17	68.51	1
Borazjan local	1116	1053	1084.5	1083.93	1083.36	63	21.17	1
Jeroft local	848.3	562.67	705.5	690.77	676.35	285.67	2.32	0.95
Darab local	1108.67	1058.67	1083.67	1083.32	1082.98	50	28.2	1
Dezfol local	1169.67	1077	1123.33	1122.24	1121.16	92.67	13.77	1
Ssitán local	1233.33	1212.33	1222.83	1222.78	1222.73	21	28.85	1
TN238 number	1215.6	1117.33	1193.5	1193.28	1193.06	44.33	28.85	1
Varamin local	1184	1052.67	1118.33	1116.35	1114.36	131.33	8.42	1
Kalat local	1034.67	859.33	947	942.92	0.85	17.33	5.08	0.99

Table 7. Correlation coefficient between grain yield in stress-non stress condition and drought tolerance indices.

good performance performance of tension average productivity average productivity account harmonic average indicator sensitivity to
tension indicators to tension indicators to tension

good performance	1								
performance of tension	0.89**	1							
average productivity	0.95*	0.98**	1						
average productivity account	0.95**	0.98**	0.99**	1					
harmonic average	0.94**	0.99**	0.99**	0.99**	1				
indicator sensitivity to tension	0.33*	0.57*	0.49*	0.5**	0.5**	1			
indicators to tension	-0.6**	-0.89**	-0.8**	0.81**	-0.82**	-0.68**	1		
indicators to tension 1	0.76**	0.92**	0.89**	0.9**	0.9**	0.45*	0.89**		

ns: Non-significant

* and ** : Significant at 5% and 1% probability levels, respectively

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