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Evaluation of yield and morpho-phenological traits of sesame cultivars under drought stress

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ABSTRACT: In order to evaluate the yield and morpho-phenological traits of sesame cultivars and lines under drought conditions, 16 genotypes were evaluated in two separate experiments, under drought stress of season's end and non-stress conditions in a randomized complete block design with three replications in crop year 2008-2009. The results showed that the cultivars and lines were different in both conditions for yield and morpho-phenological traits. Under drought stress of season's end conditions, the yield of sesame genotypes declined from 853 to 564 kg/ha. The lines of “TS-3” and “Darab 14” in non-stress conditions, had the highest grain yield but in stress conditions cultivars of “Darab14” and “Sistan local”, had the highest grain yield. Although phenological traits of cultivars and lines were not statistically significant in drought stress of season's end, but the change process was decreasingly.

***Keywords*:** Sesame; drought; grain yield

INTRODUCTION

The sesame with scientific name of (*Sesamum indicum* L.) was known as an oilseed plant with medicinal properties. This plant is relatively drought tolerant (Boryma, 2011). Sesame for resistance to water stress and adaptation, is important in many country with low rainfall.

Identification of critical or sensitive step of plant, is important in term of the need water. Mansouri, (2009) reported that the moisture stress have a large impact on the characters of plant height and grain yield. In the irrigation conditions of control, in Karaj, the Moghan-17 cultivar had the highest yield with producing 1310 kg/ha, but in Moghan conditions, the Karaj-1 cultivar had the highest average with 1884 kg/ha. Mansouri and Tabatabai (2008) reported that in local and foreign genotypes there are significant differences in term of the measured traits such as flowering, plant height, treat date, and economic performance. Heydari, (2011) and Golestani and Pakniat (2007) reported that with increase water stress in generative phase, reduced the grain yield and yield components, special grain weight of sesame. In experiment conducted for select and recommend a cultivar or cultivars appropriate for specific conditions in Sistan region.

MATERIALS AND METHODS

In order to evaluate the yield and morpho-phenological traits of sesame cultivars and lines under drought conditions, 16 genotypes were evaluated, in two separate experiments, under drought stress of season's end and non-stress conditions, in randomized block design with three replicates in crop year 2009-2010**.** Each plot consisted of four rows of five meter intervals of 50 cm from each other. Planted was done in early June, and with “plot work”. Irrigation was performed under normal conditions based on growth stages of plant, but in the drought strees of season’s end irrigation was introupted from the flowering to end of season growing. But in the early

stages irrigation was performed similar to normal conditions. Overall, compared to the control (with 4 times irrigation) 2 times less has occurred in stress condition. Based on the soil test results amount of fertilizer utilized was 90 kg/ha pure nitrogen from urea source which is equivalent to 200 kg/ha urea, and 30 kg/ha pure phosphate from triple superphosphate source which is equivalent to 100 kg/ha super phosphate, and also 200 kg/ha sulphate of potash was given to the land. During the growing stage recorded phenologic steps, including days to flowering, and days to physiologic maturity and when 50 % of plants per plot had reached that point. In the maturity time of each plot , depending on cultivar, in physiologic maturity stage , 5 plants from each plot were randomly selected and was measured the traits such as plant height and the capsule length. In time of leaves change color and browning of the capsule to determine the grain yield per plot, harvest was performed considering the marginal effects of the two midline. Statistical analysis included analysis of variance and average comparison was performed using the Mstat-C software.

RESULTS AND DISCUSSION

The results of the analysis of variance showed that in non-stress conditions between the cultivars and lines evaluated in terms of grain yield, plant height, flowering period, and days to maturity physiological there was statistically significant difference (Table 1). However, the analysis of variance showed that in stress conditions, cultivars and lines evaluated in terms of grain yield, plant height , and the capsule lenght, there was a significant difference. But phenological traits of cultivars and lines of sesame under these conditions were not statistically significant.

From the table of comparison average characteristics under non -stress conditions , it can be inferred: The lines of “TS-3”, “Darab-14“ had the highest grain yield with values of 1141 and 1115 kg/ha, that with the lines of “Jiroft local “, “Sistan local”, “TN-238”, “ Darab-2” and Pakistan cultivar were statistically in similar group. The lines of “SG1-86365”, “TN-240”, “SG4-84215” and “SG3-86365” had the lowest grain yield with a means of 724, 733, 786 and 793 kg/ha , respectively. As can be inferred from the comparison mean’s table: The Pakistani and “Jiroft local” lines had maximum height with means of 118 and 119 cm, and the lines of “Sistan Local” and “Safiabad Local” had minimum height with 99 cm, among cultivars and lines were studied . It appears that the genetic difference between the lines are more effective than the environment. In the report of Mansouri, (2010) also in the presented Sesame cultivars, Pakistani and “local Jiroft” cultivars had higher height average than “Darab-1”, “Darab-2” and “Darab-14” cultivars. The “Sistan local” cultivars had highest length of flowering period with a value of 66 day, that were in the same statistical group with the “Safi-Abad Local”, “Darab-14”, “Darab-2”, and Pakistanis Plowhite cultivars. The “SG5-84215” line had most time to physiologic maturity with 124 days, that were in the same statistical group with the “SG4-84215”, “Darab-2”, “Varamin”, “Sistan local”, and “TN-238” lines. (Table 3). In the report of Mansouri and Tabatabai (2008) also same differences are listed. In drought stress conditions, the grain yield declined from 852 to 564 kg/ha. The “Sistan local” line had highest grain yield with 826 kg/ha, and “SG4-82215” line had least grain yield with a value of 376 kg per hectare.

The reducing grain yield components could be the main reason for the decrease in grain yield of sesame cultivars. Relatively small changes “number of pods” and “capsule lentgh” in the local cultivar could be factors affecting on the higher production of its in stress condition. The results obtained were consistent with the results Heydari, (2011) and Golestani and Pakniat (2007).

Westage and Boyer (1998) concluded that water stress during the reproductive processes caused inhibition of photosynthesis and consequently reducing carbohydrate reserves, incomplete grain growth and produce of hollow seeds in capsules. In drought stress conditions , plant height was reduced from 113 to 95 cm. Among cultivars and lines , Pakistanis Plowhite line with a mean of 107 cm, had the highest plant height and “TN-240” and “Haji-Abad” lines had the smallest plant height with 85 and 86 cm, among cultivars and lines were studied .

Tha plant height is trait which is influenced by genetic characteristics more than any other factor. However , environmental conditions such as drought stress will affect plant height (Rastegar, 2005). Reduction plant height under drought stress has also been reported in other studies (Hasan-zadeh, 2009 and Heidari, 2011). In drought stress conditions, the length of capsule reduced from 22.7 to 14.8 mm. “Safiabad”, “Sistan local”, “TS-3”, “Pakistani”, “SG4-84215” and “SG5-84215” lines had the maximum lentgh capsule with 17 and 16 mm, and “Varamin” line had the minimum lentgh capsule with 13 mm, respectively.

Based on the overall results from this study can be concluded that: Cultivars and lines were different in the two environments for performance So that the “TS-3” and “Darab Local” lines had the highest grain yield under “non – stress” conditions and the “Darab-14” and “Sistan local” cultivars had the highest grain yield under drought stress conditions. With regard to the changes in the time of Phonological steges, under water different conditions, it

appears that cultivars and lines can act differently from aspect the efficient use of resources, during their Phonological stages so besides the morphological and phenological characteristics, would be considered physiological and biochemical characteristics of cultivars and lines in stress and non stress conditions.

Table 1. Analysis of variance for grain yield and morpho-phenological traits of Sesame in normal irrigation

changes Sources	df	plant height	length of the capsule	days to flowering	length of the flowering period	days to physiologic maturity	grain yield
Repeat	2	29.021	0.148	2.771	4.296	12.333	28.771
Genotype	14	95.772**	2.578 **ns**	2.354 **ns**	4.847 **	8.572*	53600.778**
Error	28	18.443	0.5252	1.571	0.666	3.422	8741.237
Coefficient of Variation	0.61	4.03	7.01	2.44	1.29	1.52	9.82

* = Significant at 1% level, ** = Significant at 5% level, ns = Non Significant

Table 2. Analysis of variance for grain yield and morpho-phenological traits of Sesame under drought stress of season's end conditions

Changes Sources	df	plant height	length of the capsule	days to flowering	length of the flowering period	days to physiologic maturity	grain yield
Repeat	2	9.000	1.313	0.583	0.521	3.083	21373.188
Genotype	14	117.965**	4.661*	2.943 **ns**	1.743 **ns**	9.076 **ns**	5569.972**
Error	28	28.373	1.757	2.139	1.276	4.706	7677.210
C.V	0.61	5.60	8.91	2.79	1.89	1.83	14.67

* = Significant at 1% level, ** = Significant at 5% level, ns = Non Significant

Table 3. Comparison of mean grain yield and and morpho-phenological traits of Sesame under conditions of stress and non-stress

	grain yield(kg per hectare)		days to physiologic maturity		length of the flowering period		days to begin flowering		length of the capsule		plant height	
	non-stress	stress	non-stress	stress	non-stress	stress	non-stress	stress	non-stress	stress	non-stress	stress
Sistan local	1032ab	826 a	123a	120a	66a	61a	52 a	53a	21.7a	16 abc	99e	101 ab
Safiabad	961bc	644 bc	122ab	118a	64 bc	60a	50 a	53a	22.7a	17 a	99de	91 cdefg
TN-238	1034ab	649 bc	123ab	117a	63 bcd	58a	51 a	53a	22.7a	15 bed	103cde	96 bcde
local Jiroft	1075ab	651 bc	121ab	117a	63 bcd	59a	51 a	52a	21a	15 abcd	119a	95 bcde
Darab-14	1115ab	866 a	121ab	118a	64 b	59a	50 a	52a	23a	15 abcd	106a	102ab
Varamin	969bc	534 bcd	123ab	115a	63 bcde	60a	51 a	53a	23a	13 d	111a	95 bcdef
Darab	1030ab	669 b	123a	118a	64 b	59a	53 a	53a	23a	15 bcd	106a	102 ab
TS-3	1141a	620 bc	122ab	121a	63 bcd	60a	52 a	54a	22.3a	16 ab	105a	99 bcd
Pakistanis Plowhite	1024ab	678 bc	122ab	120a	64 b	60a	52 a	54a	23.3a	16 ab	118a	108 a
SG5- 4215	992abc	546 cde	124a	119a	62 def	60a	52 a	51a	22.7a	16 ab	106a	99 abc
Haji-Abad	845cd	546 bc	121ab	115a	61 f	60a	52 a	52a	22.7a	14 cd	104a	86 fg
TN-240	733d	512 cde	120bc	119a	63 cde	60a	52 a	52a	23.7a	14 cd	102a	85G
SG5-86365	725d	441 de	117c	119a	62 def	60a	50 a	51a	22.7a	14 d	103a	92 cdefG
SG1-86365	972bc	473 de	122ab	120a	62 ef	59a	50 a	52a	20.7a	14 d	107a	92 cdefg
SG3-86365	793d	376 de	123ab	118a	63 bcd	60a	51 a	50a	23.3a	14 d	106a	89 efg
SG4-82215	787d	427 e	121ab	120a	63 bcde	60a	52 a	52a	24.3a	14 cd	107a	90 defg

In each column for each attribute, the means that have Common letters based on least significant difference test at the 5% level, have no significant difference

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