The selection of the most adaptable line of Carthamus tinctorius L. to the stress of non-irrigation conditions in mild region (Khoramabad, Lorestan)

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Abstract: To perform research project of Carthamus tinctorius L. non-irrigation was selected as the most adaptable one of Carthamus tinctorius L. under non-irrigation conditions in mild-cold regions of 19 lines in the form of completely random blocks in fall 2010 in research stations of Sarab Changayi located in km 5 of Khoram Abad road in three replications. The results showed that there was a significant difference between the numbers for the attributes height, number of grains in the bush, oil percent, the number of grains in the tray and the number of trays in the bush at level 1% and for the attributes of the weight of 1000 grains and grain performance per hectare at level 5%. The results of the comparison of the average attributes of the study showed that line 12 (306599 PI) in attributes of 1000 grains weight, height, the number of grains in the bush, oil percent, the number of grains in the tray, the number of tray in the bush and grain performance per hectare had the highest performance to other lines. Line 4 with 32g had the maximum weight of 1000 grains among the investigated lines. In the division to main components, the main component was named as the number of grains in the bush, the second component as height and the third component as biological performance.

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1. Introduction

Carthamus tinctorius L. is a plant with deep root with thorny leaves and these two attributes created the toleration of dryness and heat (26). Carthamus tinctorius L. is cultivated in arid and hot areas as an oil grain, birds grain, paint of the flowers or medicinal applications (23). In three decades, this plant was used as oil grain and its oil grain is ranging from 20 to 45%. Middle East, namely Iran is one of the variety centers of this plant. Carthamus tinctorius L. is a good plant to be cultivated in Mediterranean weather. Any factor stopping the natural metabolic stages of a plant is considered stress. Dryness stress is one of the most important environmental stresses restricting the performance of cultivation plants. Hashemi Dezfuli in the investigation of the effects of dryness stress on Carthamus tinctorius L. showed that leaf surface, plant height, the number of branches and the number of bolls were reduced due to draught and despite the reduction of dry matter of stem and root was increased to the root to the stem. To modify the dryness-resistant plants, some of the researchers believed in selecting the genotypes in good conditions (non-stress)(13, 29) and some other people emphasized on the selection in stress conditions (16,. 30). Most of the researchers recommended the selection of genotypes in both conditions of stress and non –stress. Sinemna et al. found that the potential of performance in stress conditions was not considered as the best criterion resistant to dryness and the stability of performance in stress and non-stress conditions are good criteria for the reaction of genotypes to humidity stress. The selection of genotypes in stress and non-stress environments caused the congestion of good points and genotypes with high performance. Rosbel and Hamblin called the difference between the performance of a genotype in stress and non-stress conditions as Tolerance (TOL) and introduced as dryness tolerance index. High value of this index showed the relative sensitivity of genotypes to stress, thus low values of TOL are good. The selected genotype based on this index has low relative performance in non-stress conditions but in stress conditions have high performance. Productivity mean index (MP) was provided by these two researchers that is defined as mean sum of the performance of a genotype in stress and non –stress conditions. Fernandez proposed Stress Tolerance Index (STL) as a criterion to select draught tolerant figures. The high value of STI showed high tolerance of stress and high potential performance. The figures with high STI are the genotypes with high stress and non –stress conditions. Another index being proposed by Fernandez is mean productivity geometrics (GMP). This index has high power compared to MP in genotype separation. Stress Susceptibility Index (SSI) was proposed by Fisher and More, low amount of SSI showed the low changes of performance in stress conditions to the non-stress conditions and more stability of genotype. Richard believed that selecting the genotypes in stress and non-stress conditions of dryness caused the congestion of good Alels and the high performance genotypes are selected. Patil et al evaluated seven varieties of Carthamus tinctorius L. in five regions of non – irrigation and 8 varieties in 4 regions of irrigation (without humid stress). There was significant difference in terms of the performance of grain among the genotypes and genotype X of the environment. In this test, good genotypes were defined for each of irrigation and non-irrigation conditions. Abolhasani in the investigation of 15 local lines of Carthamus tinctorius L. in stress and non-stress conditions of draught showed that draught stress had negative influence on the weight of grain and the attributed of the number of grains in boll in stress conditions 71% and in non-stress conditions 70% of the changes of performance of grain in the bush were justified.jamshid Moqadam and Pordad with the review of 15 Iranian and foreign genotypes of Carthamus tinctorius L. under humid stress condition in controlled conditions and stated that in stress conditions of 0.4, 0.8 mega Pascal, the length of the root of genotypes is increased and by reduction of the growth of the stem, had more sensitivity to the root. Most of the Iranian genotypes in sprouting stage had better reaction to foreign genotypes in stress conditions. In humid stress conditions, one of the plant parts that is firstly damaged is plasma membrane as permeability of cell membrane is increased and cause that the existing electrolytes inside the cell infiltrate to outside the cell. One of the most important strategies in the modification of increasing the resistance to dryness is that cell membrane after being faced with water stress, keeps its stability and is not disintegrated. Various tests are applied to measure cell membrane stability (GMS) that can define the resistance to dryness among the plants. In most of the methods, a genotype is faced in two different conditions (dryness stress and control) and it is measured by a specific method (measuring EC), the amount of electrolytes is measured by which genotype is infiltrated in stress and control conditions. By comparing these two types, we can find which genotypes in stress conditions could keep the cell membrane better and fewer electrolytes infiltrated of it. Kuchva and Jorjif in the evaluation of resistance to dryness of climate figures, observed less destruction in resistant figures cell membrane to dryness. Based on the results of the tests, this is raised that free perolin make the membrane stable during dryness stress period. The stability of cell membrane under humid stress was reported as the main component of tolerance to dryness. The damage to cell membrane by the dryness is evaluated via measuring electrolicich of the cells (cell infiltration). Fokar et al reported that reduction of grain weight in each cluster and percent of damage to cell membrane had high negative correlation (r=0.97**). Vinslo and Smirov showed that the genotypes tolerating dryness stress, had less cytoplasm membrane destruction. Kuchva and Jorjiof by dryness stress via PEG6000 solution and submerging the root of two varieties of barley in this solution showed that relative content of the water of the leaves was reduced in stress conditions and by increasing stress stability was decreased. This investigation was done to investigate the resistance to dryness in genotypes of Carthamus tinctorius L. and identification of resistant genotypes by plot and disintegration to main components of the lines resistant to stress with high grain performance and they were in future modification plan.

2. Materials and methods

Initial operation of providing land including sow, disk was prepared and based on the results of soil test, fertilization (phosphor and potash) was done, the test was done as total random blocks with three replications and the lines were cultivated randomly in each block. The cultivation time was 89.9.3 and greening 89.10.5 and investigation time as 4.18 to 90.4.21. During cultivation season, some attributes as the start and ending of flowering, flowering period length, bush height, the number of trays in the bush, the number of grains in the tray were written. After harvesting, the grain performance was determined in the plot and per hectare. It was done by MSTATC, Minitab, Excel software and they were analyzed by the comparison of the averages by Duncan method. The division to main components was applied by Minitab software and score plat method was used to identify and compare resistant lines to non-irrigation conditions stress.

Principle components analysis

The aim of most of the multi-variant statistical methods is summarizing the attributes as by some quantities, the population can be distinguished. This method was proposed by Pearson in 1901 and by Hotling its calculation method was recommended.

In principle components analysis, the first component had the maximum changes and after than the maximum variance was related to the second component and the last component had the least variance. This multi-variant analysis was used to identify the important attributes, the reduction of the volume of data and grouping of the figures and stress-resistant genotypes are used.

3. Results

The results showed that there was significant difference between the figures in attributes of height, the number of grains in the bush, oil percent, the number of grains in the tray and the number of trays in the bush in level 1% and for the attributes of the weight of 1000 grains and grain performance per hectare at level 5%. The results of the comparison of the average of the attributes showed that line 12 (306599PI) in the attributes of the weight of 1000 grains, height, the number of grains in the bush, oil percent, the number of grains in the tray, the number of trays in the bush and grain performance per hectare had maximum performance to other lines. The maximum biologic performance was related to line 7 (253541PI|) and the minimum biological performance was related to line 12 (306599PI). The low biological performance of line 12 showed that the plant to increase the performance required taking high energy to produce the grain and due to this fact, grain performance was with biological performance reduction. Line 12 with the height of 117cm had maximum height and line 19 with 93cm had lowest height. Leaf surface index was related to line 5 with 23cm and at minimum state was for line 12 with 13cm. Lines 2, 4, 7, 11, 12, 14 had the maximum weight of 1000 grains. In principle components analysis the first component 0.463 as the component of the number of grains in the bush, the second component with 0.445 as height component and third component with 0.753 were named biological performance. The results showed that lines 12, 7, 8, 2, 17 with high performance is weak to non-irrigation conditions stress. Liens 15, 19, 13, 6, 3 as with no high performance showed relative resistance against the stress of non-irrigation condition.

The average of squares of the attributes						
Changes resources	Degree of freedom	The number of grain in the bush	OIL (%)	The performance of grain per Hectare (Kg)	The number of grain in the tray	The number of grain in the bush
Block	2	30391	611.46	118710	1375.8	28.077
Treatment	18	12085**	243.16**	71784*	547.1**	11.165**
Error	36	1833	36.88	76805	82.99	1.694
Total	56					
C.V		22.3	6.54	17.39	19.1	11.54
*,** were significant at 5%, 1%						

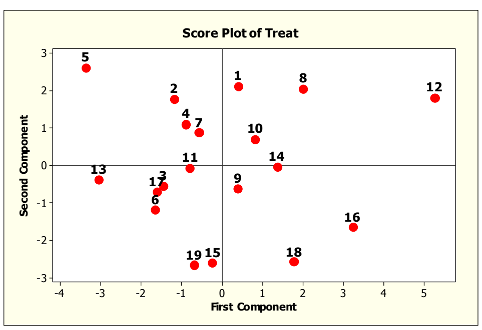
The average of squares of the attributes						
Changes resources	Degree of freedom	The weight of 1000 grains gr	Biological performance gr	Grain performance in plot gr	Height (cm)	LAI (cm)
Block	2	12.754	4728202	24009	36.02	46.89
Treatment	18	10.54*	2117802	14534	158.72**	28.62
Error	36	5.632	2691798	15548	40.68	45.12
Total	56					
C.V		19.41	24.61	14.93	13.87	12.22
*,** were significant at 5%, 1%						

Line	The comparison of the average of the study attributes for 19 lines							
	The weight of 1000 Grains gr		Biological Performance gr		Height (cm)		LAI (cm)	
1	29.67	ab	4316.67	ab	102.67	b	19.18	ab
2	31.67	a	3716.67	b	107	ab	15.35	b
3	28	b	5100	ab	102	b	12.7	cd
4	32	a	3150	bc	108.33	ab	16.39	bc
5	28.67	b	3200	bc	114	ab	22.5	a
6	25.67	b	3433.33	bc	100	b	14.18	c
7	30.33	a	5850	a	112.33	ab	18.94	ab
8	29	ab	3500	bc	110.33	ab	15.92	bc
9	26.67	b	3483.33	bc	106	ab	11.57	cd
10	27	b	3166.67	c	110	ab	17.87	ab
11	31.67	a	4550	ab	101	ab	12.58	c
12	30	a	3300	c	117	a	11.28	cd
13	27	b	4100	b	108.33	ab	18.16	ab
14	28.67	a	3733.33	b	111	ab	10.74	cd
15	26.67	b	5166.67	ab	99.33	b	14.14	cd
16	26.67	b	4683.33	ab	99.33	b	16.4	ab
17	28	ab	5166.67	ab	90.33	b	16.83	ab
18	28.33	ab	5116.67	ab	97	b	13.47	cd
19	27.67	ab	4483.33	ab	92.33	c	16.51	ab

Line	The comparison of the average of the studied attributes									
	The number of grain in bush		Oil percent		Performance of grain per hectare (Kg/h)		The number of grain in tray		The number of tray in bush	
1	211.33	c	29.98	b	929.33	a	44.96	b	6.42	ab
2	138	def	19.57	cd	861.33	ab	29.36	b	4.19	bc
3	120.33	cde	17.07	def	776.67	b	25.6	b	3.66	cde

4	134.33	cde	19.05	cd	695.33	c	28.58	ab	4.08	bc
5	86.67	e	12.29	ef	655	b	18.44	c	2.63	ef
6	106.33	cde	15.08	cde	667.67	c	22.62	cd	3.23	cde
7	161.33	bc	22.88	bcd	767	ab	34.33	b	4.9	b
8	244	b	34.61	ab	823.33	ab	51.91	ab	7.42	ab
9	164.67	bc	23.36	bcd	642	c	35.04	b	5.01	b
10	196.33	c	27.85	b	684.67	c	41.77	ab	5.97	ab
11	135.67	cde	19.24	cd	713	ac	28.87	b	4.12	bc
12	324.67	a	41.05	a	956	a	69.08	a	9.87	a
13	69	d-f	9.79	e	708.67	ac	14.68	cde	2.1	f
14	191.67	c	27.19	b	624.33	b	40.78	ab	5.83	ab
15	141.33	cde	20.05	cd	491.33	c	30.07	b	4.3	bc
16	262.67	b	37.26	ab	464.33	cd	55.89	b	7.98	ab
17	133.33	cde	18.91	cd	809.33	ab	28.37	b	4.05	bc
18	202	c	28.65	b	412.67	de	42.98	ab	6.14	ab
19	131	cde	18.58	cd	464.67	cd	27.87	b	3.98	bc

Principal components analysis of the attributes			
Attributes	First component	Second component	Third component
1000 grains	0.015	0.345	0.356
Biological performance	-0.041	-0.306	0.753
Grain performance in plot	-0.201	0.5	0.172
Height	0.09	0.445	-0.367
LAI	-0.223	0.214	0.266
The number of grains in bush	0.463	0.103	0.101
Oil percent	0.463	0.103	0.101
Grain performance per hectare	-0.201	0.5	0.172
The number of grains in tray	0.463	0.103	0.101
The number of trays in bush	0.463	0.103	0.101



The chart of score plot of the lines to identify and compare the figures resistant to stress

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