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ORIGINAL ARTICLE

Investigation the Important Traits of Spring Safflower Varieties through Multivariate Statistical Methods

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ABSTRACT
Due to the growing demand for edible oils, oilseed crop development is very important. Safflower (Carthamus tinctorius L) is a native of Iran oil seed. This crop is compatible with the environmental conditions in the country as well; this is especially true in areas exposed to non-biological stresses such as drought and salinity. Since the recognition of stress-resistant varieties and grouping them is important for correct planning in plant breeding programs, this study was conducted in order to grouping safflower varieties in three irrigation regimes of stress (six and five irrigation, respectively) and free stress (seven times irrigation) conditions. This research was in split- plot form with completely random block designs about 26 varieties of safflower which were assessed twice. In factor analysis, we selected 3 factors with special values more than 1 including 64/98 % data initial variance. Cluster analysis was conducted by Ward and it made 7 separate clusters of safflower varieties according to studied traits. The 6th cluster was composed of shortest variety, N51016, with shorter growing and producing time. The number of the grain per boll, 1000 grain weight, oil percentage and the plant yield were more than mean values in this variety. According to the results, N51016 was the best variety regarding the important and needed traits. Zargan local IV and Mianeh local I were the most sensitive varieties in both water and drought stress conditions regarding stress tolerance index (STI) and the most tolerant varieties to this condition was N51016. Finally N51016 was known as the most tolerant variety against water stress in 26 safflower varieties. Also it had the most bush yield. The results of cluster analysis showed adequate genetic variety for studied traits and we can use it in modifying and improving if spring safflowers genotypes.
Key words: *safflower, drought stress, factor analysis, clusters analysis.*

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INTRODUCTION

The major portion of the oil supply is from external sources and regarding the growth of population and per capita consumption of oil in the country, increasing the area under cultivation and production of oilseeds is of utmost importance. Safflower is a versatile traditional plant and is cultivated as a pigment from long ago [23]. But nowadays is cultivated more as an oilseed crop that contains 25-45% oil and 12-24% proteins. Based on genotype, safflower has two different kinds of oil with different quality. Some genotypes with high linoleic acid oils have cooking or industrial usage and can be used in the production of soft margarine. Some genotypes oil is consisted of very high oleic acid and is the same as olive oil and thus they show a very high nutrient quality [23]. Safflower is compatible with the environmental conditions in the country as well; this is especially true in areas exposed to non-biological stresses such as drought and salinity. Because of the high adaptability to stress, relative resistance to drought, cold and salinity and low fertilizer requirement is planted in most countries [2,9]. Survey conducted on some oilseed crops (soybean, canola, safflower and sunflower) showed more capacity and more effective crop roots of safflower to penetrate the soil and water extraction from lower soil [15]. Conducted experiments have shown that to obtain good performance, 400 mm water and for maximum yield, 600 mm water is needed [9]. Sondge et.al [21] showed that the timing of irrigation based on principles of phonological development is more beneficial than timing based on evaporation and transpiration. According to Zaman [26] the most critical period for safflower irrigation is aggregation and flowering. Haby et.al [11] announced that in safflower like other agricultural crops, the effect of water stress on grain yield and plant life in the early reproductive growth stages is more than the others. The survey that Chinese Academy of Science conducted on 2625 populations from 28 countries verified that the height of the bush

in the foot changed in the range of the 13 to 251 cm and the tallest bush was from Iran and the shortest one from India (12). Yazdi Samadi and Abde Mishani [24] studied 1858 Iranian and foreign lines in irrigation free condition in Karaj announced that the plant height is so changeable and its changing range is from 20 to 90 cm. Also they found out that Iranian lines are the shortest samples.

Mojtahedi [16] investigated safflower foreign varieties in Ahvaz research station and introduced Nebraska 10 as the superior variety with 1618 kg yield. Ehdaei [8] mentioned Nebraska 10 as the best one regarding oil content and Oroomieh local regarding the grain protein with 23/36%. Bratulean [5] in his studies in Romania showed that the best genotype performance had 5 tons per hectare which indicates the safflower high potential in seed production. Bergman [4] in his recent researches mentioned to safflower two new varieties: Montala and Morlin with 81/6% oleic acid and 83% linoleic acid respectively. Ashri et al, Kasato et.al, Patil, Yoslow et al. [3,6,19, and 22] studies showed that the boll number is the most important component in the safflower. Also Paramsoarpa, patil, Jonson et al, and Korleto et al [7, 13, 17 and 18] researches cleared that there is a negative and significant correlation between the grain shell rate and oil content in the safflower. Several studies on the use of multivariate statistical methods in crop have been done in order to safflower correction in the country and other parts of the world. Kang Digming [14] identified by multivariate statistical procedures on 30 safflower varieties those 6 main components: the first effective branch, stem diameter, seed size, 1000 grain weight, the grain oil and the angle of the branch explains about 78% of the total variance. Akbariyn [1] divided the different varieties of safflower in 4 groups related to flowence and a group related to Gelacus and a group related to Dentatous based on cluster analysis. Poolignano and Alba [20] divided their studied varieties of safflower in 5 groups with different countries on the basis of cluster analysis and canonical function determination. The change basis of this grouping was the bush height, the days to flowering and 1000 grain weight. Yazdi Samadi and Abde Mishani [24] investigated 168 lines and varieties of inner and outer safflower and announced that the under investigate varieties are in the 5 main groups: American, Iranshahr, Marand, Oroomieh, Mogan, Fars, Isfahan and Jiroft. Also they concluded that the similarity between above mentioned crops is from the same genetic basis. Godrati [10] mentions to 10 main components for 88% explanation of existed diversity in the studied varieties.

The purpose of this research is to find the way of different traits relationship with the grain yield in the selection and presentation of data and also grouping them based on similarity and dissimilarity in planning is the another object of this study.

MATERIALS AND METHODS

This experiment was conducted in Azerbaijan-e-Shargi Agricultural and investigation centre as spring, in 1379. The area is located at an altitude of 1350 meters above sea level. In this study 26 spring varieties of safflower were investigated in split- plot form with completely random block designs: . ،MIAEL.1 ، MARAND L.1 ،MIANE L.2 ،MARAND L.2 ،MARAND L.3 ،LANGARMAHAN L. ،ZARGHAN L.2 ،ZARGHAN L.3 ، ZARGHAN L.4 ،ZARAND.KERMAN 1 ،ZARAND.KERMAN 2 ،KORDESTAN 2 ،ESFAHAN L. ،BROOJERD L. ، NISHABOOR L. ،N974051 ،N51016 ،V-51-242 ،NEBRASKA825 ،A-1 ،TOMJIC ،N.5 ،3151 ،24-1 و D51-361.

The preparing of the ground was done as: plow, disc, ta bulation and stack atmosphere in spring and winter. All operations were performed in a mechanical way to deal with weeds and for a farm pest; the spraying was done three times. So that the first time was with Thrips, the second with Desis and the third one was with DinoKarp spraying pesticides. During the harvesting, in a3 irrigation level, seven times, a2: six times and a1, five times irrigation had been done.

In factor analysis, the data of two repetitions have been used by dividing to the main components and after determination of special values, the factors with the most variance was selected.

In order to grouping of the varieties, we used cluster analysis with Ward, SPSS and SAS.

RESULT AND DISCUSSION

Factor analysis

In this analysis, two replicate data was used with the dividing to the main components and after determination of special values, the factors with the most variance was selected.

In factor analysis, the mail factors dividing conducted in order to find temporary factorial coefficients. Regarding this method, the special values were more than one selection and finally there were 3 factors which explain 64/98% of the initial data changes.

As you see in tables1 and 2, the joint coefficients of the most traits are high and these results show that the needed factors are appropriate and they could explain the traits changes very well.

The first factor explains 35/94% of the initial variables which were named as: the number of the days to 100% flowering, the number of the days to 50% flowering, the number of the days to 50% buds, the number of the days to stalk appearance, 1000 grain weight and the bush height. The second factor

explains 16/04% of initial data changes, the number of the boll per bush, the number of the grain per boll, oil content and the plant performance have high factorial coefficients. The third factor explains 12/99% of the initial data changes and has high relationship with the number of the grain per boll and the plant yield. The forth to eleventh factors explain 8/49, 7/51, 6/43, 5/98, 3/12, 1/78, 1/46 and 0/25 data changes respectively. Two traits in this factor have high and positive correlation with each other and can have very important role in the selection of varieties with favored features.

Table1. The results of Factor Analysis

Component	Special values	Variance %	Cumulative percentage of variance
1	3.954	35.94	35.94
2	1.765	16.04	51.99
3	1.429	12.99	64.98
4	0.934	8.49	73.47
5	0.826	7.51	80.98
6	0.707	6.43	87.41
7	0.658	5.98	93.39
8	0.343	3.12	96.51
9	0.196	1.78	98.29
10	0.161	1.46	99.76
11	0.027	0.25	100

Table2. Subscribe coefficients of studied traits in factor analysis

Trait	First factor	Second factor	Third factor	Share degree
Number of days to 100% flowering	0.908	0.051	0.044	0.828
Number of days to 50% flowering	0.588	0.198	-0.051	0.387
Number of days to 50% budding	0.868	-0.140	0.031	0.774
Number of days to germination	-0.399	0.190	-0.020	0.196
Number of days to stalk appearance	0.797	-0.189	-0.011	0.671
1000 grain weight	-0.670	0.025	-0.073	0.455
Number of bolls per bush	0.306	0.872	-0.099	0.863
Number of grain per boll	-0.062	-0.414	0.872	0.936
Bush height	0.765	0.218	0.255	0.697
Oil percentage	-0.220	0.649	0.066	0.474
Plant yield	-0.238	0.480	0.760	0.865

Cluster Analysis

Genetic diversity of the crop has been the subject of worldwide researches (20). We did cluster analysis in order to investigate varieties genetic diversity regarding studied traits. Based on genotype and phenotype diversity, different varieties of safflower divided in separate groups. The same and proximate genotypes placed in a same cluster (figure 1).

Cluster No.1: Bonab local, Marand local I, Marand local II, Mianeh local I
Cluster No.2: Zargan local II, Zargan local IV, and Neishaboor local
Cluster No.3: Mianeh local II, Isfahan local, 3151 and Marand local III
Cluster No.4: Langar Mahan local, 24-1, V-51-242, Zargan local III, Zarand Kerman I, Zarand Kerman II, N974051, Kordestan II, Booroojerd local, D51-361 and N.5
Cluster No.5: TOMJIC
Cluster No.6: N51016
Cluster No.7: Nebraska and A-1

In table 3 you can see the mean of each cluster's safflower varieties and mean deviation of the overall clusters for studied traits. In first cluster, there are varieties with more grains per boll. The second cluster composed of 3 varieties and the mean boll number was more than entire mean. The third cluster varieties had shorter growing period, longer producing period and superior boll number per bush, grain number per boll, oil percentage and the plant performance. The 11 varieties of fourth cluster showed longer growing period and shorter producing period, relatively dwarf and more 1000 grain weight more than entire mean. The fifth cluster composed of dwarf TOMJIC with longer growing period and shorter production; this variety had more mean value of boll number per bush, oil content and plant performance compared studied varieties. The sixth cluster composed of the most dwarf one: N51016 with shorter

growing and production period. It had grain number per boll, 1000 grain weight, oil content and plant performance more than the entire mean value. Moreover, the number of grain per boll and the plant performance in this cluster assessed more than the others. Cluster no.7 composed of 2 dwarf verities with shorter growing and producing period and more boll number per bush, 1000 grain weight, oil content and plant performance. The most 1000 grain weight belonged to this cluster. We can consider the cluster no.6 as the best cluster regarding important and needed traits.

Table3. Clusters mean and deviation from entire mean for safflower studied traits

cluster No	Cluster 1		Cluster2		Cluster3		Cluster4		Cluster5		Cluster6		Cluster7	
trait	mean	Deviation from total mean	mean	Deviation from total mean	mean	Deviation from total mean	mean	Deviation from total mean	mean	Deviation from total mean	mean	Deviation from total mean	mean	Deviation from total mean
Germination days	9.25	-0.08	9.17	-0.16	9.63	0.30	9/14	-0.19	9.17	-0.16	9.83	0/50	10.09	0.76
Stalk days	32.54	1.4	34.22	3.08	30.96	-0.18	30.39	-0.75	30.27	-0.87	29.33	-1.81	29.59	-1.55
50%budding days	63.42	3.2	65.83	5.61	59.88	-0.34	58.49	-1.73	58.83	-1.39	57	-3.22	57.09	-3.13
50%flowering days	80.13	2.26	85.11	7.24	79.58	1.71	76.08	-1.79	74.33	-3.54	72.22	-5.65	73.50	-4.37
100% f days	84.42	1.4	90.56	7.54	84.33	1.31	81.53	-1.49	80.83	-2.19	77.33	-5.69	78.5	-4.52
Bush height	77.62	7.18	78.89	8.45	75.96	5.52	67.15	-3.29	68.17	-2.27	56.67	-13.77	58.50	-11.94
Boll per bush	12.53	-2.66	18.37	3.18	17.03	1.84	14.77	-0.42	17.30	2.11	9.67	-5.52	16.05	0.84
Grain per boll	39.29	6.57	27.74	-4.98	33.05	0.33	31.84	-0.88	32.23	-0.49	49.47	16.75	23.13	-9.59
1000grain weight	32.39	-3.2	30.63	-4.96	32.15	-3.44	36.01	0.42	34.78	-0.81	43.42	7.83	50.49	14.9
Oil percentage	26.79	-2.38	29.58	0.41	29..55	0.38	29.05	-0.12	35.37	6.2	29.29	0.12	29.89	0.72
Plant yield	15.78	-1.12	15.25	-1.65	17.95	1.05	16.07	-0.20	19.27	2.37	20.57	3.67	17.57	0.67

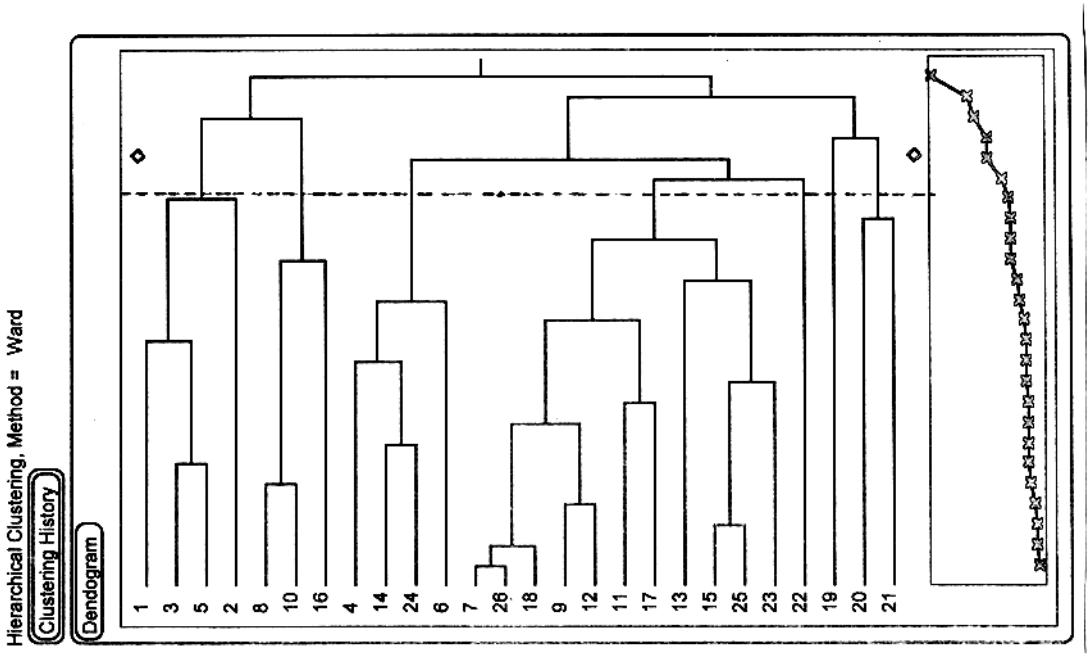

Figure1. 26 safflower varieties cluster analysis dendrogram

REFERENCES

1. Akbaryin, H. (1992). Biometrical studies on Carthamus species distributed in the south-east Anatolia university. Turky Botanic (16)287-297.
2. Alyari, H., Shekari, F.,and F., . (2000). Oilseed crops. Tabriz Amidi Publications.
3. Ashri, A. D., E. Zimmer, A. urie, A. Chaner. (1976). Evaluation of the world collection of Safflower for yield and yield components and their relationship. Crop. Sci. 14: 799-802.
4. Bergman, J. W. (1997). Safflower genetic improvment for yield and other traits. IV International Safflower Conf. Italy. 215-218.
5. Bratulean, C. (1993). Progress of safflower breeding in Romania. Third International Safflower Conf. China. P. 15-30.
6. Cassato, E. P. Ventricelli, A. Corleto. (1997). Response of hybrid and open pollinated safflower to increasing doses of nitrogen fertility. IV International safflower Conf. Italy. 98-103.
7. Corleto, A. E. Cazzato, P. Ventricelli. (1997). Performance of hybrid and open pollinated safflower in two different mediteranean environments in procceding of the Fourth International Safflower Conf. Bari. Italy. 276-278.
8. Ehdaei, B., . (1971). To investigate spring safflower. Annual report of oilseed researches department. Seed and Plant Improvement Institute, Karaj.
9. Foorozan, K., . (1999). Safflower, Oilseed Firm Publications, Tehran.
10. Godrati, G. (1997). To investigate genetic and cytogenetic diversity of Iran spring safflowers. Master thesis in the field of plant breeding, Tarbiat Modarres University.
11. Haby, V. A., A. L. Black, J. W. Bergman, and R. A. Larson. (1982). Nitrogen fertilizer requirements of irrigated safflower in the northern great plains. Agron, J. 74: 331-335.
12. Han, Yun Zhou, Yang Jianguo Zangli, Li Dajue, and Wang Zhaoma. (1993). In characterization and evaluation of safflower germplasm. Institute of Botany, Chinese Academy of Sciences.
13. Johnson, R. C. V., L. Barldley, P. B. Ghorpade and J. W. Bergman. (1997). Regeneration and evaluation of the "US" safflower germplasm collection. IV International Safflower Conf. Italy, 215-218.
14. Kang Digming, J. (1993). Principal component of agricultural properties of 30 safflower cultivar. Third International Safflower Conf. China. 250-272.
15. Merrill, S. D., D. L. Tanaka, J. M. Krupinsky and R. E. Ries. (2001). Safflower root growth and water use in omparison with other crops. Vth international safflower conference, Williston, N. D., U. S. A. 227-231.
16. Mojtahedi, A, . (1971). To investigate safflower inner and outer varieties, Annual report of oilseed researches department. Seed and Plant Improvement Institute, Karaj.
17. Parameswarappa, K. G. (1984). Genetic analysis of oil yield and other quantitative characters in safflower. J. Agric. Sci. 17:83.
18. Patil, F. B. (1985). Correlation of some yield components in safflower j. Mahrashtra. Agric. Univ. 10 (1): 82.
19. Patil, B. R. and M. P. Deshmukh. (1997). Studies on selection indices in safflower. Third International Safflower Conf. China. 265-269.
20. Polignano, G. and R. ALBA. 1995. Phenotypic stability analysis of safflower varieties over six years. Agricultural Mediterranea, Bari Italy. (11) 21-30.

21. Sondge, V. D., R. P. Rodge., and S. J. Quadri. (1987). Irrigation decisions in safflower under constraint conditions. Journal of Maharashtra Agricultural Universities, 12: 1, 19-22.
22. Uslu, N., A. Akin, M. Basri. (1997). Weed and row spacing effects on some agronomic characters of spring planted in proceeding fourty international Safflower Conf. Italy. pp. 128-132.
23. Weiss, E. A. (2000).Oil Seed Crops. Blackwell Science Ltd., Oxford, London.
24. Yasdi Samadi, B. and C. Abd-Mishani. 1989. Cluster analysis in safflower Second international Safflower Conf. India. pp. 1119-1125.
25. Yazdi, Samadi. B., and Abde Mishani S., .(1991). Breeding crop. Tehran University Publication Center.
26. Zaman,. A. (1986). Safflower water management in drought affected region of west Bengal. Seeds end Farms, 12: 8, 6-9.

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