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ORIGINAL ARTICLE

Introduce Some Grapevine Cultivars (*Vitis vinifera*) Tolerated To Drought Stress

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ABSTRACT
Identification and using of grapevine (Vitis vinifera) with tolerance to the drought stress is one of the most importance aims in grape breeding programs in Qazvin province. Indirect selection of drought tolerance among varieties on the base of morphological characteristics with update the drought stress tolerance were identified and selected. For this object, a design in RCBD, and 4 replications in grapevine varieties of Qazvin province were done. The studied characteristics were: relative capacity of leaf water, leaf diameter, leaf area index, leaf hair and ripening time. Data were analyzed that genotypes with morphological phenotypes to drought tolerance were Chafteh, Molae and Syah angoor. Then from those genotypes cutting were obtained and planted in nursery for 2 years. Plants were planted in experimental field in RCBD. In the next year those genotypes treated with 4 drought stress treatment. Drought stress treatments were irrigation to end of May, June, July and August. Data from this stage were analyzed with SPSS software and sensitivity index to the drought stress were calculated. Chafteh was known as the best tolerable genotype to the drought stress in Qazvin province.
Key words: *Grape genotype, drought stress, morphological selection, susceptibility index*

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INTRODUCTION

The main part of food of the world's people produces in the regions that have limited rainfall in growth seasons and or crop plant use from the humidity of stored soil water. Therefore there is no amazing that plant breeding to the drought stress tolerance for these regions is the most importance object. For this case in crop plants or orchards, such as grapevine, identification, and selection and using of tolerated plant to the drought stress to prevention of yield reduction is importance and essential object in plant breeding programs.

Patakas et al measured water amount, leaves osmotic and potential turgidity of Roditis grapevine variety by using cychrometric method. They observed that Symplastic water amount reduced to 78% in young leaves and 62% in old leaves in drought stress duration [7]. Zyl et al had done a research in water treatments of grapevine. They found that in Chenin variety, maximum rooting was in 300 to 400 millimeter deep of soil surface and there was 90% of root accumulation lower than 900 millimeter deep of soil surface. Maximum water needing was in flowering and berry growth stage [12].

Meriaux irrigated the Grenache grapevine variety with 200 liters water and drought stress was done in 6 stages of growth. Data analysis of leaf number, weight and sugar of berries indicated that 73% of stems and leaves formed in the initial growth stages [5]. TSS (total soluble solid) reduced by drought stress and berries became small. These results obtained in drought stress effect test on osmotic pressure of Hesling and Silvaner grapevine variety [3]. Schultz et al used growth of internodes, leaves and tendrils of Kishmishi variety as selection index to drought stress tolerance in grapevine. They observed that growth of internodes, leaves and tendrils was abnormal or stopped in drought stress [11]. Ricciar et al investigated the reaction of the canopy temperature on grapevine genotypes with and without drought stress conditions. Results indicated that there is significance difference between with and without drought stress conditions in canopy temperature but there was no significance difference between genotypes [10].

In pot experiments with 4 genotypes under soil moisture regimes of 70 and 35% of field capacity, moisture stress reduced photosynthetic rate, specific leaf weight, leaf area and dry matter accumulation

in the leaves. There were intervarietal differences in adaptation to drought stress, with the photosynthetic apparatus being especially sensitive in Muskat Gamburgskii [*Hamburg Muscat*], whereas Traminer, Pinot and Moldova were more resistant [6].

Barabal measured leaves electrical response of grapevine in before and after drought stress. Leaf electrical conductivity has direct relation with leaf moisture and that is resulted tolerance to the drought stress. Kishmish variety was resistance to the drought stress and its electrical response reduced from 71.9% (in normal conditions) to 30% (in drought stress conditions) despite Aleatico variety was susceptible to the drought stress and its electrical response reduced from 87.1% (in normal conditions) to 9.9% (in drought stress conditions) [2].

Pooni (2000) investigated the sensitivity of grape clusters to water deficit in different growth stages of berries as leading water use management. He observed that water of grape clusters come back to the stem by phloem in drought stress time. Immature berries were more susceptible than mature berries and for this reason, yield decreased and clusters became undesirable [9].

Pellegrino *et al* investigated the correlated characters with drought tolerance in grapevine. They, after this study, divided these characters in three groups .The first group were potential leaf water stomata conductivity as that most important characters. The second group was canopy temperature, leaf light reflection, leaf chlorophyll amount, trunk diameter and moving rate of elaborate sap. The vegetative characters were in the third group and have low importance [8].

Leboni et al investigated organogenesis of principal steam of two grapevine cultivars with drought stress in field and glasshouse condition in north of France. They found a little correlation between all of growth stages and soil moisture. There are no significance differences between two cultivars in all characters. Number of leaf was very susceptible to the soil water decrease and rate of new leaves appearance to the steam growth decreased very slowly. These reactions correlated with amount of usable carbon, photosynthetic reaction and total soluble solid in young leaves. Extremely reduction of leaf area in drought stress observed in each two cultivars. This phenomenon is the importance factor in drought tolerance selection [4].

Objects of this investigation are:

1) Initial investigation of local grapevine genotypes of Qazvin province to the drought stress tolerance.

2) Identification of tolerated grapevine genotypes to the drought stress condition.

MATERIALS AND METHODS

a) First stage

This experiment started in spring of 2003 with screen of drought tolerance grapevine genotypes in Qazvin grapevine collection on the base of morphological characters. At first, the genotypes those have adapted characters to the drought tolerance were selected [1]. For this purpose, an experiment in RCBD with 4 replications performed. From each genotype, 8 plants (two plants in each plot) selected and measured the date of fruit reaching, leaf diameter (with micrometer), relative capacity of leaf water, leaf area index, and leaf hair. For measurement of relative capacity of leaf water performed in below approach:

1) To take four leaves from each variety and measurement of their weight (b).
2) To place leaves in distillated water for 24 hours.
3) Measurement of leaves weight in the second time (a).
4) To calculate relative capacity of leaf water (LWCR) with below formula:

$$LWCR = \frac{a-b}{a} \times 100$$

After variance and cluster (by Squared Euclidean Distance) analysis, means of genotypes compared with DMRT at α=5% or 1% and the best tolerated genotypes to the drought stress selected by morphological markers, then cutting toke them.

b) **Second stage**

After rooting of cutting in nursery for two years, they were planted on the form of factorial RCBD with four replication and three plants in each plot. The lateral plant as border effect did not take notes. Factor A was drought tolerant genotypes from the first stage test and factor B was treatments in the four stages of drought stress (irrigation until the end of May, June, July and August). To break off irrigation at the end of August is the local custom and as a control test was used. Each plant irrigated once per 30 day with pressured system in 8 liter per hours for 10 hours. After the end of growing season, dry matter of each

genotype was measured. Sensitivity index was calculated with the following formulae for selecting the most tolerant genotype to drought stress [1]:

$$D = 1 - \frac{X}{Xp} \qquad S = \frac{1 - \frac{Y}{Yp}}{D}$$

Y: Dry matter of each cultivar under drought stress conditions.
Y_P: Dry matter of each cultivar in normal conditions.
D: Severity of drought stress.
X: Average dry matter of all cultivars under drought stress conditions.
X_P: Average dry matter of all cultivars under normal conditions.
S: Sensitivity index

RESULTS AND DISCUSSION

a) First test (preliminary screening of genotypes)

Based on the analysis of variance, more variation among the grapevine genotypes of Qazvin in relative capacity of leaf water was seen that this variation in α=1% (table 1) was significance. Eight groups of genotypes obtained in compared means of relative capacity of leaf water (table 2) that Mollaee, Chafteh, Syah Angoor, Shast-e-aroos and Yagooti were located in group A and were higher than other genotypes. Also in variance analysis of leaf area index, more significance variation was observed between genotypes (table 1). After comparison of the genotypes for this trait, nine groups were obtained (table 2). With attention to this point that leaf area index has reverse relation with amount of tolerance to drought stress, Mollaee, Chafteh, Syah Angoor, Shast-e-aroos, Sahebi, Mish pestan, Shahani and Talaee were located in group A and they had lower leaf area index among other genotypes . The results of variance analysis of leaf diameter showed significance difference among genotypes in α=5% (table 1). With compare means of this trait, 4 groups were obtained (table2). With attention to this point that leaf diameter has direct relation with amount of tolerance to drought stress, Chafteh, Mollaee, Karelooee, Shool Angoor, Sahebi, Syah Angoor, Asgari, Gohari, Fakhri, Shahani Peykani and Bidaneh haven't significance difference together and were located in group A. Other genotypes were located in other groups and were lower than group A. These results were seen in research of Schultz et al [11]. Other characters such as date of fruit reaching and leaf hair with leaf diameter, relative capacity of leaf water and leaf area index were used together in cluster analysis to grouping of genotypes for determination of morphological tolerated genotypes to drought stress. After cluster analysis, 4 groups were obtained (figure 1).

Just as was seen in compare mean table and cluster analysis figure, some genotypes were located in higher groups. These genotypes are Chafteh, Syah angoor and Mollaee that located in the third group of cluster analysis.

B) The second stage of test (drought stress treatment)

In variance analysis of drought stress treatments (irrigation until the end of May, June, July and August) and dry mater production, F test for both factors were significance in α=1% and α=5% (Table 3). In compare means of different drought stress, irrigation until the end of May produced minimum dry mater and located in an independently group. While there are no significance difference between irrigation until the end of June and July and located in after group. Dry mater production in irrigation until the end of August was in maximum amount and has significance difference with other drought stress treatments (table 4). In compare means of tree genotypes, two groups were obtained that Mollaee and Syah angoor were located together in a group and class B while Chafteh was higher than other genotypes and located in class A (Table 5). In investigation of sensitivity index values (S) for three higher genotypes, Chafteh has the lowest index (table 6). In the other hand this genotype is more tolerance than the other cultivars to the drought stress. As already noted, researchers of plant breeding use some different traits for screening genotypes to drought stress tolerance that each of these characters evaluates genotypes from especial dimension that will depend on the purpose of research. So these results were seen in Poni [1], Pellegrino et al [8] and Patakac et al [7]. On the other side, drought stress tolerance in plant depends to more characters. These characters have direct or indirect relation with drought stress tolerance. Therefore in plant selection to drought stress tolerance should be use average characters [1]. For this reason, cluster analysis was used to dividing facility and genotypes selection to drought stress tolerance. This method didn't see in other paper of researcher. Other strengths of this study is using stress Sensitivity index because this method was used very low by researcher in horticultural plant because of the difficult using. Using of this technique makes introduction a tolerable variety to drought stress from most of characters point while most of researchers were used only one or two characters [10, 11, 9]. The results of analysis and discussion of measured traits in the first stage of test and drought stress treatment in the second stage of test suggests that Chafteh is superior than the other Qazvin grapevine genotypes to drought

stress tolerance. This variety in comparing with other genotypes has more leaf diameter, upper Relative capacity of leaf water, lower Leaf area index and relative superior in other characters point of drought stress tolerance.

Table 1: Mean square of variance analysis investigated characters in grapes cultivars of Qazvin province.

S.O.V	D.F.	Relative capacity of leaf water	Leaf area index	Leaf diameter
Replication	3	n. s. 0.0148	n. s. 402.327	0.00105 n. s.
Variety	22	** 0.173	** 6360.531	* 0.002679
Error	66	0.024	415.718	0.001447

ns, *, and **: non significance, significance in 5% probability and significance in 1% probability

Table 2: Mean comparison of investigated characters in grapes cultivars of Qazvin province by DMRT.

Cultivar	Relative capacity of leaf water	Leaf area index	Leaf diameter
Talaee	0.39 defg*	75.645 a	0.1975 cd
Mollaee 1	0.69 ab	85 ab	0.2525 abcd
Sahroodi	0.46 bcde	86.25 ab	0.2475 abcd
Yazandaee	0.12 gh	77.275 ab	0.2 cd
Shahani 3	0.17 fgh	ab 92.21	0.2175 abcd
Syah angoor	0.71 a	ab 97.25	0.2525 abcd
Shast-e-aroos	0.61 abcd	abc 100.19	0.21 bcd
Chafteh	0.81 a	abc 100.25	0.2825 a
Sahebi	0.26 efgh	abc 100.44	0.2525 abcd
Mish pestan	0.16 fgh	abc 102.28	0.2 cd
Mollaee 2	0.66 ab	abc 102.89	0.2675 ab
Yagooti	0.64 abc	bcd 111.94	0.19 d
Shool angoor	0.27 efgh	bcde 116.64	0.2525 abcd
Asgari	0.21 efgh	cdef 132.25	0.2425 abcd
Shahani peykani	0.24 efgh	def 141.1	0.2175 abcd
Karelooee 2	0.275 efgh	ef 146.8	0.2525 abcd
Bidaneh 1	0.1 h	fg 150.37	0.22 abcd
Fakhri	0.29 efgh	fg 151.25	0.225 abcd
Karelooee 1	0.34 efgh	fg 159.48	0.2527 abc
Bidaneh 2	0.23 efgh	fg 164.5	0.225 abcd
Ahmadi	0.42 cde	gh 181.48	0.21bcd
Mesghali	0.43 efgh	hi 202.25	0.2125 bcd
Gohari	0.35 efgh	h 221.63	0.225 abcd

*Means with similar letters in each column are not significance

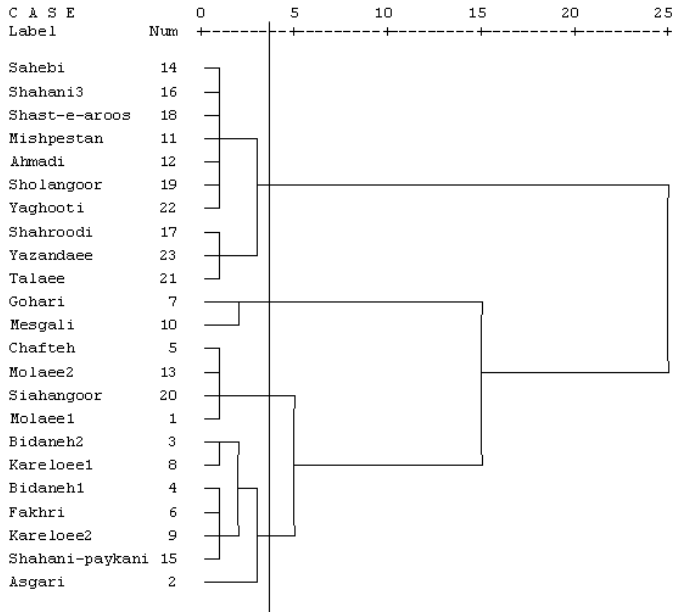

Fig.1.Dandrogram of grouping grapevine genotypes in Qazvin province on the basis of traits related to drought tolerance.

Table 3: Variance analysis of dry mater

S.O.V.	D.F.	S.S.	M.S.	F
Replication	3	14781.879	4927.239	1.491 n.s.
) A (Cultivar	2	273995.7	136997.85	41.446**
) B (Drought Stress	3	238164.3	793880.1	240.175**
A×B	6	88109.189	14684.866	4.443**
Error	33	0.09548	0.001447	

Table 4: Mean comparison of dray mate in different drought stress by DMRT.

Drought stress	Groups
Irrigation until end of May	1176.8 c
Irrigation until end of June	1289.9 b
Irrigation until end of July	1519 b
Irrigation until end of August	1759.4 a

Table 5: Mean comparison of data for dray material after drought stress in selected cultivars from the first stage of experiment by DMRT.

Cultivar	Groups
Chafteh	1543.8 a
Mollaee	1382.05 b
Syah angoor	1385.2 b

Table 5: Sensitivity index to the different drought stress treatments.

Cultivar	Irrigation to 21 May	Irrigation to 21 Jun	Irrigation to 22 Jul	Mean
Syah angoor	1.01	1.003	1.014	1.009
Mollaee	1.24	1.03	1.22	1.163
Chafteh	0.97	0.83	0.87	0.86

SUGGESTIONS

Chafteh as a tolerable grapevine variety to drought stress for direct planting or grafting with commercial cultivars in semidry lands that have insufficiency water to irrigation was suggested. Also noted that this variety has no favorable market product, but can be as valuable germplasm for using in grapevine breeding programs to drought stress tolerance.

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