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Studies on table grape germplasm grown in Northern Greece I. Maturity time, bunch characteristics and yield

by

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S u m m a r y : 41 local and introduced table grape cultivars of the Greek Gene Bank in Thessaloniki were evaluated and documented with regard to 10 important morphological and viticultural characteristics, e.g. maturity time, bunch form and crop yield from 1991 to 1993. The data indicate great variation within the grape germplasm in all characters and stress the importance of the genetic material as a donor of valuable genes for further grapevine improvement. Among the earliest cultivars is the Greek newbred Attiki (harvest time: end of July), while the local traditional Sideritis was shown to be the latest maturing cultivar (end of October). Principal Component Analysis (PCA) showed 3 factors representing 69.6 % of the total variation. PC_1, explaining 40.6 % of the total variance, is highly correlated with time of maturity and crop yield. PC_2, may be considered as the bunch size factor. The assessed cultivars were classified by cluster analysis into distinct groups, 2 of which contained all early and most of the late season cultivars.

K e y w o r d s : table grape, cultivar, evaluation, maturity, germplasm, gene bank, Greece.

Introduction

The importance of plant genetic resources and the need for their conservation and utilization have been increasingly emphasized in the last years. Their vital significance for the maintenance of the biodiversity, genetic improvement and protection against genetic erosion has been worldwide recognized (LESTER *et al.* 1986). Important initiations to document global genetic grape diversity have been carried out in certain countries, particularly in Germany (DETTWEILER-MÜNCH 1990). Germplasm characterization and evaluation is a priority task for gene banks and a prerequisite for a successful breeding program. It enables the identification of sources of precious genes and the assessment of the importance and potential of the collections (BACHMANN 1989; ZAMANIS *et al.* 1993).

Within the breeding programs performed in Greece by the Athens Vine Institute (MICHOS 1992) the earliness of production is a crucial characteristic in the extremely competitive European table grape market, significantly affecting the income of the grape growers.

Maturity time is reported to be a multigenically controlled characteristic with a high contribution of maternal factors (FANIZZA and RADDI 1973; CORODEA and NEAGU 1978; OPREA 1978; CANCELLIER *et al.* 1990). Bunch weight is moderately influenced by the environment. Its heritability coefficient (h^2) was estimated from $h^2 = 0.35$ (AVRAMOV *et al.* 1978) to $h^2 = 0.50$-0.59 (GOLODRIGA and TROCHINE 1978). With regard to vine yield, the same researchers found a very low heritability coefficient ranging from $h^2 = 0.13$ to $h^2 = 0.27$-0.38, respectively. This is due to the fact that this quantitative characteristic with multigenic control is highly influenced by environmental and cultural conditions. The number of bunches per shoot is primarily genetically controlled ($h^2 = 0.49$-0.63) (GOLODRIGA and TROCHINE 1978) and regulated by a number of dominant genes.

In 1991 an ampelografic and viticultural evaluation of *Vitis vinifera* germplasm was initiated by the Greek Gene Bank. In a preliminary phase the genetic improvement program will be based on promising parents. Priority will be given to characters which are important for the Greek table grape industry, e.g. time of maturity, seedlessness, berry size and structure, sugar and acid content, adaptation and productivity.

In this investigation we studied the variability of table grape cultivars grown under the ecological conditions of Northern Greece with respect to time of maturity, bunch characteristics and crop yield.

Material and methods

The most important 41 table grape cultivars of the Greek Gene Bank collection were studied from 1991 to 1993. 23 of these cultivars were local Greek cultivars and 18 introduced from other countries but grown in Greece for a long time. The vineyard collection was established in the period 1985-1987. The traditional germplasm was collected and identified by several collecting expeditions in all parts of Greece. All examined cultivars are grafted to

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the rootstock 110 R and trained to a bilateral Royat cordon trellis system (2.0 m x 1.5 m). Each cultivar is represented by 10 vines. All cultivars were subjected to standard pruning, fertilization and spraying.

The grapevine collection is situated at 40° 33' N, 20° 57' E, altitude 9 m above sea level. The soil is a well drained sandy loam (SL), poor in organic matter (1.2 %) and 7.1 - 7.3 pH. The average air temperature of the years 1980-1993 is 15.1 °C and the mean annual precipitation is 388 mm.

The maturity time is defined as the time from bud break (>75 % buds opened, OIV 301) to physiological maturity of grapes. The bud fertility (productivity) index is defined as the number of bunches per shoot (OIV 201). The yield per vine refers to the average value of a 3-year period (1991-1993). The cultivars were characterized according to the Descriptors List for *Vitis vinifera* L.and *Vitis* species (IBPGR 1983; O.I.V. 1983). Bunch character scores appearing in the Table represent means of measurements at 50 bunches per cultivar in 3 consecutive years. Principal Component and Cluster analysis (SPSS/PC package) were used to determine the suitability of the descriptors to characterize the variation of the data and to find natural groups among the cultivars studied (ALLEWELDT and DETTWEILER 1989).

Results and discussion

Assessment of maturity time: The cultivars were classified into 4 categories on the basis of their maturation period. Mean values for each cultivar over 3 years were used in the comparative assessment:

Categories of cultivars	Maturation period (days)	Harvest time
early	130-140	End of July
mid season	146-170	August
late season	175-190	Mid/end of September
very late season	197-210	Mid/end of October

Length of the stages from bud break to flowering, from flowering to veraison, from veraison to maturity and the overall period from bud break to maturity, are significantly correlated, with r ranging from 0.46 to 0.94. Also, the length of the periods from flowering to veraison, from veraison to maturity and from bud break to maturity were significantly correlated to crop yield (r = 0.53, 0.60 and 0.62, respectively.).

Factor analysis indicated 3 principal components with eigen values > 1 accounting for 69.6 % of the overall variance. The first and most important principal component (PC_1), accounting for 40.3 % of the total variance, could be characterized as maturity time factor. The maturity time parameters as the length of the periods from bud break to flowering, from flowering to veraison, from veraison to maturity and from bud break to maturity highly contributed to this factor (0.71, 0.87, 0.88 and 0.92, respectively). Plotting the cultivars over the 1st and 2nd principal component grouped the early and the very late season cultivars in separate areas (Fig. 1) The dendrogram produced by cluster analysis also grouped the early and very late maturity cultivars in separate areas (Fig. 2).

As the Greek germplasm is characterized by a great variation in all these characters, breeding for these traits seems promising.

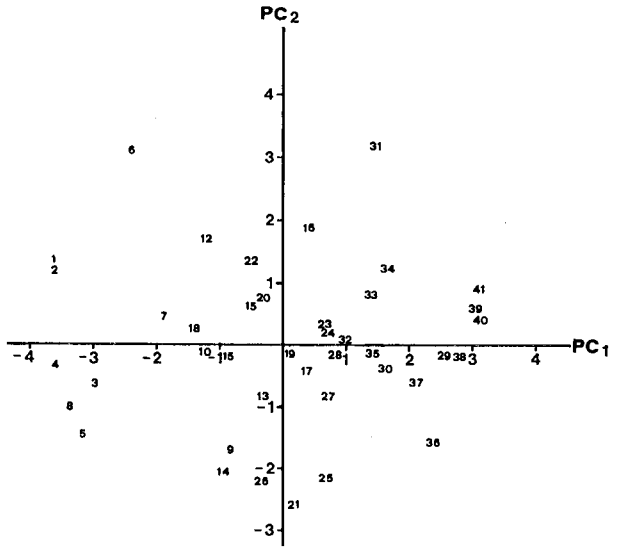

Fig. 1: Projection of cultivars on PC_1 (maturity time factor) and PC_2 (bunch size factor). Early cultivars appear on the negative side of PC_1 axis and very late ones score high on its positive side. Cultivars with large bunches are plotted at the positive part of the PC_2 axis and those with small bunches at its negative part.

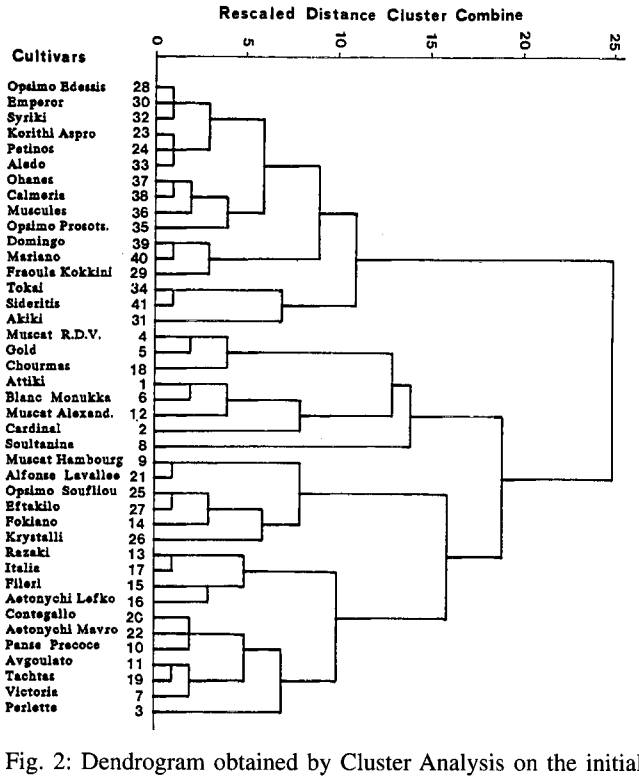

Fig. 2: Dendrogram obtained by Cluster Analysis on the initial data. Early cultivars and very late ones were grouped in distinct clusters.

Table

Categories of cultivars, quantitative characteristics of bunches and yield per vine

Cultivars	Number of days from				Bunch characteristics					
	Bud break - Flowering	Flowering - Veraison	Veraison -Maturity	Bud break -Maturity	Weight g	Length cm	Width cm	Stalk %	Bud Fertility	Yield per Vine g
Early										
1 Attiki	52	50	28	130	485	23,4	17,6	3,50	1,10	5200
2 Cardinal	54	48	30	132	550	24,6	15,6	4,10	1,45	4600
3 Perlette	53	50	32	134	420	21,5	14,8	2,80	0,95	6500
4 Muscat R.D.V.	51	52	35	138	470	17,5	15,4	3,90	0,90	5600
5 Gold	52	52	34	138	420	17,5	15,6	3,30	1,30	5700
6 Blanc Monukka	52	53	35	140	580	25,7	20,5	3,50	1,05	5400
Average	**52.3**	**50.8**	**32.3**	**135.3**	**487.5**	**21.7**	**16.5**	**3.51**	**1.12**	**5500**
Mid season										
7 Victoria	56	52	30	146	600	22,1	17,3	3,30	1,35	6400
8 Soultanina	61	55	38	154	420	22,5	15,7	3,20	1,40	6500
9 Muscat Hambourg	55	58	42	155	545	21,3	14,3	3,30	1,60	6700
10 Panse Precoce	55	54	46	155	395	23,2	17,1	3,00	1,25	6800
11 Avgoulato	57	63	36	156	520	20,1	17,8	3,30	1,35	6900
12 Muscat Alexand.	55	59	46	160	480	23,4	20,8	2,90	1,15	5300
13 Razaki	57	58	45	160	640	23,4	13,1	2,90	1,32	7300
14 Fokiano	58	57	45	160	600	17,4	14,2	3,30	1,50	6300
15 Fileri	55	62	44	161	740	21,5	15,9	3,10	0,94	6600
16 Aetonychi Lefko	59	57	45	161	880	23,7	19,4	2,90	1,20	7100
17 Italia	56	58	52	166	720	23,1	15,4	2,80	1,50	7100
18 Chourmas	59	62	45	166	550	19,2	16,4	4,20	1,20	5500
19 Tachtas	57	62	49	168	580	20,4	17,7	3,50	1,30	7400
20 Contegallo	58	63	49	170	430	22,2	18,7	3,40	0,95	7350
21 Alfonse Lav.	59	60	51	170	460	21,8	13,4	3,20	1,95	7100
22 Aetonychi Mavro	63	62	45	170	520	23,5	18,4	3,50	1,10	6100
Average	**57.5**	**58.8**	**44.2**	**161.1**	**568.7**	**21.8**	**16.6**	**3.30**	**1.32**	**6653**
Late season										
23 Korithi Aspro	58	65	52	175	620	22,9	17,7	3,10	1,30	7300
24 Petinos	59	70	48	177	630	21,9	18,4	3,10	1,40	6900
25 Opsimo Soufliou	59	62	58	179	570	19,7	13,7	2,80	1,35	7500
26 Krystalli	60	62	60	182	320	20,9	13,1	3,00	1,40	5800
27 Eftakilo	62	66	60	184	600	19,9	14,6	3,40	1,20	6800
28 Opsimo Edessis	58	72	55	185	550	21,8	16,7	3,50	1,35	7300
29 Fraoula Kokkini	58	73	57	188	710	23,5	18,9	2,60	1,90	7600
30 Emperor	59	71	60	190	570	21,8	17,2	3,40	1,50	7500
31 Akiki	60	68	62	190	900	23,9	19,7	3,70	0,95	6200
32 Syriki	57	75	58	190	500	21,8	18,1	3,10	1,25	6900
33 Aledo	58	61	51	190	630	22,4	19,4	2,90	1,35	6400
Average	**58.9**	**69.5**	**56.4**	**184.5**	**600**	**21.8**	**17.0**	**3.14**	**1.35**	**6927**
Very late season										
34 Tokai	60	80	57	197	610	23,3	17,9	4,10	1,15	7500
35 Opsimo Prosots.	58	84	57	197	610	18,8	18,9	2,60	1,30	5800
36 Muscules	60	75	67	202	590	19,9	16,4	2,80	1,60	7300
37 Ohanes	61	86	56	203	620	21,8	15,4	3,10	1,35	7100
38 Calmeria	60	87	57	204	630	21,9	17,4	2,80	1,40	7600
39 Domingo	61	88	55	204	680	23,9	18,2	3,00	1,50	7500
40 Mariano	62	88	57	207	680	22,7	19,4	2,70	1,60	7100
41 Sideritis	62	87	61	210	700	22,8	18,7	3,60	1,50	7600
Average	**60.5**	**84.3**	**58.3**	**203**	**640**	**21.8**	**17.7**	**3.08**	**1.42**	**7187**

Cluster characteristics: Bunch weight which increased gradually with the time of maturity ranged from 485 g in the earliest cv. Attiki to 700 g in the latest cv. Sideritis. Cluster weight was significantly correlated (r = 0.39) with the length of the period from flowering to veraison. Cluster length was correlated only with cluster width (r = 0.45). Cultivars with large bunches are plotted at the positive part of PC_2 and those with small bunches at its negative part (Fig. 1). PC_2 may be considered to be the bunch size factor, summarizing the variance attributed to bunch weight, length and width. These parameters were highly contributing (0.83, 0.79, 0.56, resp.) to this component.

Bud fertility index and crop yield per vine: The number of bunches per shoot was slightly increased in the very late season cultivars. The fertility index was found significantly correlated with yield (r = 0.37). Yield per vine is increased significantly from the early cultivars (5400 g) to the very late season cultivars (7228 g) (Table). This demonstrates the difficulty to combine earliness and fruitfulness in table grapes. The best yielding cultivars are Perlette and Gold (early), Tachtas and Contegallo (mid season), Fraoula Kokkini and Opsimo Soufliou (late season), Sideritis and Mariano (very late season) (Table). Compared to Razaki (Dattier de Beyrouth), which is the most adapted cultivar in Greece, all other cultivars had lower yields.

Fertility index and yield contribute highly to the PC_3 factor (r = 0.70 and 0.56 respectively). The percentage of stalk of bunches has a highly negative score (r = -0.78). PC_3 could be considered as a productivity factor. Cultivars with long bunches (very late season) appear on the positive part of the PC_2 axis, those with small bunches (early) on the negative part (Fig. 1).

Conclusions

The results clearly show that there is a wide variation among the 41 accessions with regard to important characteristics which could be effectively used for the genetic improvement, particularly time of maturity, fertility and crop yield. This stresses the importance of evaluating the remaining 233 cultivars of the *Vitis* germplasm of the Greek Gene Bank on quantitative and qualitative characters, such as seedlessness, characteristics of berries , sugar and acid content, etc.

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