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Preliminary observations on some Sicilian pomegranate (*Punica granatum* L.) varieties

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SUMMARY – The pomological and analytical characteristics of 6 Sicilian pomegranate selections are reported and described in comparison to those presented by a Spanish selection. Overall, the average characteristics of the local selections were somewhat less attractive than those of the Spanish ones, even if with some interesting exception. Nevertheless, a considerable amount of variation has been found among the different local selections, especially as far as No. of arils per fruit, pericarp thickening and titratable acidity are concerned.

Key words: Germplasm evaluation, cultivar, pomological characteristics, analytical characteristics.

RESUME – *"Observations préliminaires sur quelques variétés siciliennes de grenade (*Punica granatum *L.)". Les caractéristiques pomologiques et analytiques de 6 sélections siciliennes de grenades sont rapportées et décrites en comparaison avec celles d'une sélection espagnole. Dans l'ensemble, les caractéristiques moyennes des sélections locales étaient un peu moins attrayantes que celles des sélections espagnoles, quoiqu'avec quelques exceptions intéressantes. Néanmoins, une quantité considérable de variation a été trouvée parmi les différentes sélections locales, spécialement concernant le nombre d'arilles par fruit, l'épaississement du péricarpe et l'acidité titrable.*

Mots-clés : *Evaluation du germoplasme, cultivar, caractéristiques pomologiques, caractéristiques analytiques.*

Introduction

Pomegranate cultivation has a very old tradition in the Mediterranean countries. Native from Middle East (Iran, Caucasus) and spread in the wild from the Balkans throughout the north-east of India, this species finds in the Mediterranean area its most important secondary centre of origin and diversification (Levin, 1994). It was probably during the Roman Empire that pomegranate was introduced into Italy from Northern Africa following the Punic Wars and the destruction of Carthage. (Scortichini, 1990). Its original name used by the Romans was, in fact, *malum punicum,* i.e. Carthage's Apple. Pliny reports that: "but it is the territory near Carthage that claims *malum punicum*, as evidenced by the name, otherwise called *'granatum'* (literally "seed" in Latin)."

Although spread as a minor fruit tree species all over the Italian regions, specially from sea level to a height of 800 m a.s.l. (Pignatti, 1982), pomegranate cultivation has suffered from a great reduction of the acreage during the course of time. Historically, pomegranate cultivation in Sicily was certainly pushed during the Arab domination (827-1040 A.D.). In the period from 14th and 15th century it is mentioned in notarial deeds among the most common fall ripening fruits and the names of different varieties, together with generic "sweet" or "sour" types are also reported (Bresc, undated). Among the latter type a variety named 'Cartasi' (i.e. papery) is often mentioned maybe with reference to the paper consistence of its seed. The most complete survey on pomegranate Sicilian germplasm was performed in the early sixties (Damigella, 1960). In this study four main varieties were diffusely described: 'Dente di cavallo', 'Dente di cavallo tipica', 'Dente di cavallo a coccio duro' and 'Dente di cavallo tardiva', all from the eastern part of Sicily. Therefore, till recently no information was available on the consistence and characteristics of the pomegranate germplasm in other parts of Sicily. This study was carried out on six accessions, all with hard tegumen of the seeds, which have been selected after a preliminary survey in the field among about forty accessions. Most of these were successively discarded due to the high susceptibility to the problem of cracking of fruits.

Materials and methods

Starting from 1988 six pomegranate accessions, (2 accessions from Agrigentum district: 'Ragana' and 'Racalmuto', 2 from Trapani district: 'Profeta' and 'Selinunte', and one from Messina and Ragusa districts, respectively: 'Neirana' and 'Dente di cavallo', together with a Spanish selection ('Roja') proceeding from the region of Murcia, were grown in the same experimental orchard located at Castelvetrano (Trapani district, 37.30°N, at sea level). Nine self-rooted trees per accession, 5×3 m spaced and free shaped, in 3-tree per block were used in this study.

Observations were carried out during three consecutive years on trees at the stages of third to fifth leaf in the field. Fruit characteristics were studied yearly on a sample of ten fruits per accession randomly collected. In the lab fruit longitudinal (L.D.) and transversal (T.D.) (max. and min.) diameters, fruit weight, and pericarp thickening were measured. On 100-aril samples per accession the weight of single aril and single seed, after the removal of the pulp, was determined.

It was therefore possible to calculate a number of carpological parameters such as, for instance, the ratio between pulp and seed, the percentage of seed on the whole fruit and the shape index. The juice from arils was extracted and filtered for compositional analysis (10 ml/accession). Total soluble content (SSC) with a hand refractometer, titratable acidity (percent citric acid – TA), pH and the SSC/TA ratio were determined.

Data were successively unified to obtain a three-year mean for single parameter and the respective standard error (S.E.). In order to assess and describe the overall degree of variability existing among the tested accessions, a cumulative mean and a cumulative coefficient of variation (c.v.) were calculated for each parameter.

Results and discussion

Fruit dimensional characteristics are reported in Tables 1 and 2.

Table 1. Average fruit weight, percent of pulp, pulp/seed ratio and pericarp thickening in different pomegranate accessions (mean ± standard error)

Accession	Fruit weight (g)	S.E.	Pulp (%)	S.E.	Pulp/seed (g/g)	S.E.	Pericarp thickening (cm)	S.E.
Dente di cavallo	392.36	18.1	61.47	1.3	16.84	0.8	0.42	0.02
Neirana	267.99	24.7	55.00	1.4	13.60	0.9	1.84	0.04
Profeta	255.02	16.9	89.51	2.0	21.11	1.7	0.44	0.03
Racalmuto	461.65	34.6	47.78	1.0	15.24	0.6	0.49	0.03
Ragana	314.17	11.2	49.71	1.1	23.56	1.3	2.35	0.04
Roja	381.79	17.8	61.17	1.0	29.16	1.1	0.42	0.03
Selinunte	338.94	19.7	48.57	1.9	22.03	1.2	1.97	0.04
Cumulative mean†	338.35		58.67		18.73		1.25	
c.v.(%)†	21.1		24.8		19.7		65.2	

†Excluding Roja.

Racalmuto had the fruit of highest size, with a mean weight of 120 g more than the cumulative mean weight, and a maximum transversal diameter of about 2 cm wider than that of the least ('Neirana').

The mean dimensional characteristics of the indigenous accessions were generally below the average of the Spanish selection ('Roja').

Table 2. Longitudinal diameter, maximum and minimum width and shape coefficient in fruit of different pomegranate accessions (mean ± standard error)

Accession	Longitudinal diameter (cm)	S.E.	Max. width (cm)	S.E.	Min. width (cm)	S.E.	Shape coefficient (L.D./max. T.D.)	S.E.
Dente di cavallo	8.00	0.1	9.53	0.2	8.86	0.1	0.84	0.01
Neirana	6.95	0.1	8.28	0.2	7.84	0.2	0.84	0.01
Profeta	6.78	0.1	8.34	0.2	7.86	0.2	0.81	0.01
Racalmuto	8.19	0.2	10.19	0.3	9.64	0.3	0.81	0.01
Ragana	7.18	0.1	8.88	0.1	8.54	0.1	0.81	0.01
Roja	8.05	0.1	9.24	0.2	8.82	0.2	0.87	0.01
Selinunte	7.32	0.1	9.14	0.2	8.67	0.2	0.80	0.01
Cumulative mean†	7.40		9.06		8.57		0.82	
c.v.(%)†	7.0		7.3		7.2		1.9	

†Excluding Roja.

The shape index, obtained from the ratio between longitudinal diameter and maximum transversal diameter, indicated a more pronounced flattened shape prevailing among the indigenous accessions in comparison to 'Roja'.

The internal, qualitative characteristics (Tables 1, 3 and 4) presented by the indigenous accessions are somewhat less attractive than those of 'Roja', even if with some exception.

Table 3. Average No. of arils per fruit, 100-aril weight, 100-seed weight and percent of seed weight/fruit weight in different pomegranate accessions (mean ± standard error)

Accession	No. arils per fruit	S.E.	100-aril weight (g)	S.E.	100-seed weight (g)	S.E.	% seed wt./fruit wt.	S.E.
Dente di cavallo	428.01	28.8	60.54	2.1	3.27	0.2	3.75	0.2
Neirana	599.57	51.2	27.22	2.1	1.90	0.1	4.34	0.3
Profeta	358.97	25.0	46.18	1.9	2.22	0.1	4.76	0.2
Racalmuto	761.57	38.4	35.42	1.7	2.23	0.1	3.18	0.1
Ragana	361.46	10.7	44.88	0.9	1.94	0.1	2.31	0.2
Roja	528.51	27.9	46.20	0.8	1.56	0.0	2.14	0.1
Selinunte	423.59	27.7	42.63	0.5	1.95	0.1	2.38	0.2
Cumulative mean†	488.86		42.81		2.25		3.45	
c.v. (%)†	29.8		23.8		21.1		26.7	

†Excluding Roja.

The percentage of pulp on the whole fruit fluctuates considerably among the different Sicilian accessions with a maximum of 89% ('Profeta') and a minimum of 48% ('Racalmuto').

The ratio between the edible part (pulp) and seeds, pericarp thickening, 100-seed weight together with the weight incidence of the seed on the whole fruit were generally better in 'Roja' if compared with the respective cumulative mean values of the indigenous accessions.

However, the 100-seed weight was always particularly low, especially when compared with values of 3-6 grams that have been reported for the Israeli cultivars 'Shami' and 'Mule's Head' and the American 'Wonderful' (Shulman *et al.*, 1984).

Table 4. Titratable acidity (TA), pH, total soluble solids (TSS) and TSS/TA in fruit of different pomegranate accessions (mean ± standard error)

Accession	pH	S.E.	TA (%)	S.E.	TSS	S.E.	TSS/TA	S.E.
Dente di cavallo	4.22	0.1	0.41	0.01	12.93	0.2	32.1	1.2
Neirana	3.87	0.1	0.67	0.01	15.94	0.3	24.2	0.8
Profeta	3.90	0.0	0.48	0.01	14.57	0.3	31.3	1.2
Racalmuto	3.33	0.1	1.95	0.08	15.94	0.2	8.4	0.5
Ragana	4.03	0.0	0.32	0.01	16.31	0.2	53.2	1.6
Roja	3.98	0.0	0.43	0.01	16.88	0.3	39.6	0.9
Selinunte	3.93	0.0	0.34	0.01	16.25	0.3	49.2	1.7
Cumulative mean†	3.88		0.69		15.32		33.1	
c.v. (%)†	7.0		82.8		7.9		45.5	

†Excluding Roja.

Tendency to fruit cracking was low, except in 'Neirana'. Compositional analyses revealed that all the tested accessions can be included, according to Evreinoff (1957), in the group of "sweet cultivars" (TA < 0.9%), with the exception of 'Racalmuto' that resulted "sour" (TA > 1.8%), whereas no "sweet-sour" accession (TA 0.9-1.8%) was found.

All the tested accessions had a TSS higher than the minimum threshold generally required for commercial purpose (12%). Furthermore TSS's values always fell in the range suggested by other authors for the Israel conditions (11-16%) (Ben-Arie *et al.*, 1984).

TSS/TA was particularly high in 'Ragana' as a consequence both of a low TA and of a high TSS, whereas TSS/TA was especially low in 'Racalmuto' as expected by the inclusion of this accession in the group of "sour".

A high amount of variation was found among the indigenous accessions especially for pericarp thickening (c.v. > 65%), number of arils per fruit (c.v. ≅ 30%), TSS/TA and TA. Particularly, this last character was extremely variable (c.v. ≅ 83%) due to the inclusion in the calculation of a "sour" genotype ('Racalmuto') among "sweet" genotypes. In fact, if we do not consider 'Racalmuto', the remaining accession showed a more restricted variation with a TA ranging from a minimum of 0.32% ('Ragana') and a maximum of 0.67% ('Neirana'). On the contrary all the characters related to fruit dimension had the smallest variation (c.v. ≅ 7%). Similarly pH and TSS showed a low variation. All the other considered parameters presented a degree of variation of about 20%.

Conclusions

Although only a small portion of the existing pomegranate indigenous germplasm was considered in this study, the obtained data allowed us to point out the existence of valuable pomological traits among the tested accessions. For most of these characters the observed values can be considered comparable (and sometimes superior) to those presented by other well-known cultivars from other countries (Ben-Arie *et al.*, 1984; Shulman *et al.*, 1984; Al-Khatani, 1992).

The analysis of the between-accession variability testifies the existence of a considerable degree of variation especially as far as characters such as pericarp thickening and number of arils per fruit are concerned. Nevertheless, it should be noted that this interesting source of genetic diversity needs to be better studied and preserved from the risk of extinction for future breeding programmes.

An international ongoing project supported by EU (GENRES 29) on "Conservation, evaluation, and utilisation of minor fruit tree species", which involves for pomegranate Greece, Italy and Spain, and maintains in collections about one hundred accessions, is at the moment the most interesting initiative to pursue this goal.

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