BREEDING ACTIVITIES ON POMEGRANATE AT THE CREA- FRUIT TREE RESEARCH CENTER (CREA-FRU) ROME, ITALY

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Abstract

Pomegranate (*Punica granatum* L.) cultivation has considerably increased worldwide during recent years, mainly in reaction to the rising consumers' awareness on the numerous nutraceutical benefits of this fruit. To satisfy also future demands, enhanced research was carried out at the CREA-FRU in Rome, Italy, both concerning rationalization of cultivation systems and to breed and select new varieties. With regard to innovation in orchard management, CREA-FRU selected the first non-suckering *Punica granatum* rootstock, with application for plant breeder's rights in Europe as Pjered One, which can easily be propagated by hardwood cuttings, shows an optimum grafting compatibility with the main commercial cultivars and demonstrates a wide pedoclimatic adaptability.
Concerning selection and breeding for fruit quality aspects, we identified nine advanced selections which differ from present varieties in terms of agronomical and organoleptic characteristics, thus allowing to enrich the varietal assortment in terms of adaptation to modern orchard management practices, tolerance to biotic and abiotic stresses, and satisfaction of consumers' rising demands for high quality of the fruits.

Introduction

Pomegranate, native to Persia and probably adjacent areas, is one of the oldest edible fruits. It was cultivated in ancient Egypt and subsequently spread all over the Mediterranean Basin. Further to recent commercial plantations, high numbers of scattered trees on the border of or within other fruit orchards are reported to be still existing in many Mediterranean countries where the fruits are very popular especially on local markets. Considering the excellent adaptability of the species for cultivation in arid zones and the fact that pomegranate fruit is increasingly recognized for its nutritional and medicinal value, its cultivation is gradually increasing in several countries of the western world.
In spite of this trend, what remains to be resolved are several problems in this species, related both to the variety assortment and tree management (shrubby growth habit, high suckering tendency).

Materials and methods

The work was carried out with the objective to evaluate the phenotypical, agronomical and pomological performance of accessions of *Punica granatum* of different geographic origin, in order to identify genotypes of potential interest for use as rootstocks, fruiting varieties (Preka e Cherubini, 2011; Preka et al., 2014) or progenitors in breeding.
Specific objectives were the identification of non-suckering genotypes for use as rootstocks, while for fruit producing types, we concentrated on high organoleptic qualities such as high sugar/acidity ratio, high juice content, soft pink or red arils, as well as new fruit shape and colour, early ripening, long shelf life, positive post-harvest performance and low sensibility to fruit cracking.
Concerning plant habit, genotypes showing an evenly spreading canopy with strong branches and thornless twigs were preferred.
The observed plants are present in the pomegranate collection of the CREA-FRU (Fig. 1) and represent two different geographic origins, the Mediterranean Basin and the Near East, with basic differences in fruit colour and sweetness (rather pale skin and arils but high sugar content in Mediterranean types, bright or dark red skin and arils but high acidity in the Oriental types).
Considering the organoleptic differences between the two geographic types, a preliminary study was carried out on populations deriving from Mediterranean and Oriental progenitors. This study paid particular attention to the content of total soluble solids and titratable acidity, whose ratio (Sweet Index) expresses the sensorial perception of taste by the consumer.
Observations were carried out on the most interesting genotypes for at least three consecutive years (2012-2014) and comprised tree vigour and habit, suckering activity, earliness of fruit set, flowering and ripening time, as well as size and colour of fruits and arils, juice yield, sweetness, acidity and the sugar/acidity ratio. All observations followed the procedures defined by UPOV.

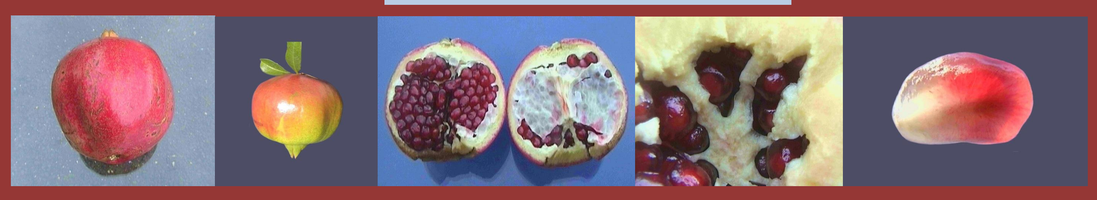
Fig. 1: Partial view over the experimentasl pomegranate fields of the CREA-FRU

Results and Discussion

The different research lines have resulted in the individuation of a number of interesting genotypes.
Concerning rootstocks, the most important discovery was a non-suckering plant (Fig. 2) in 2007 which, during subsequent years, was tested as rootstock with the major commercial varieties. The rootstock showed highly satisfactory grafting compatibility with these varieties, as well as positive agronomical performance, inducing high vigor and good anchorage in the soil. The absence of suckers also allows for innovative training systems (ypsilon, narrow hedgerow, pergola). Propagation is easily done via hardwood cuttings, but also *in vitro*. In December 2015, an application for a European Community Plant Variety Right for this new rootstock selection was filed, under the name "Pjered One "
The preliminary examination of organoleptic characteristics of the Mediterranean and Oriental type pomegranates clearly shows higher levels of tritratable acidity in the Oriental type (medium + 83,7%) with respect to the Mediterranean types, while sweetness is more or less the same (Fig. 3 and Fig. 4). Consequently, Mediterranean type pomegranates show a higher Sweet Index (Fig. 5).
In both types, variability in the soluble solids content (SSC) is small (Coefficient of Variation 0,064 ÷0,095), whereas it is much higher for acids: the Coefficients of Variation are 0,88 in the Mediterranean and 0,6 in the Oriental types. This genetic diversity clearly offers the possibility to conduct future breeding activity aimed at enhanced organoleptic quality of the fruits.
Concerning new selections for fruit production, so far we identified nine genotypes (Fig. 6) with interesting agronomical and pomological characteristics (Table 1) from within the vast number of observed plants. Generally speaking, the Mediterranean type selections have scarcely coloured fruits and low acidity, the Oriental genotypes show intensively coloured fruits but high levels of acidity.
In both groups, the Coefficient of Variation (CV) resulted high for plant vigour and habitus (32%), the medium size of fruits (32%) and the weight of the peel (37%). Less variability was observed for fruit height and width (14%) and the weight of arils (17%).

Fig. 2 : Rootstock Pjered One

Mediterranean type: details



Oriental type: details

Preliminary investigation on organoleptic quality of Mediterranean and Oriental type pomegranates

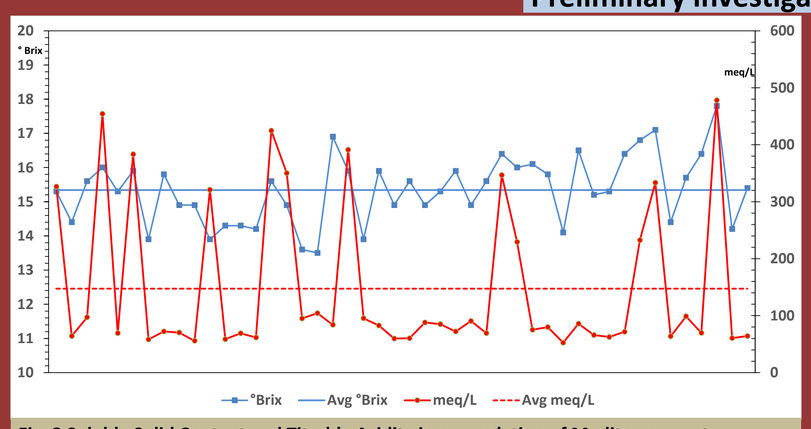


Fig. 3 Soluble Solid Content and Titrable Acidity in a population of Mediterranean types

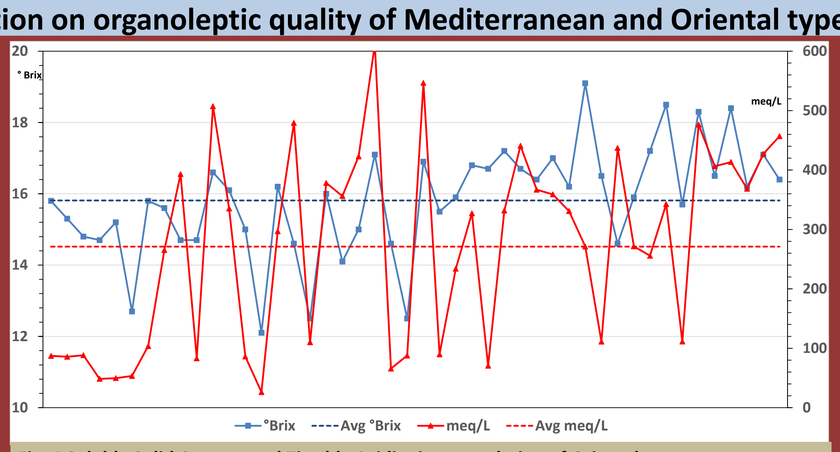


Fig. 4 Soluble Solid Content and Titrable Acidity in a population of Oriental types

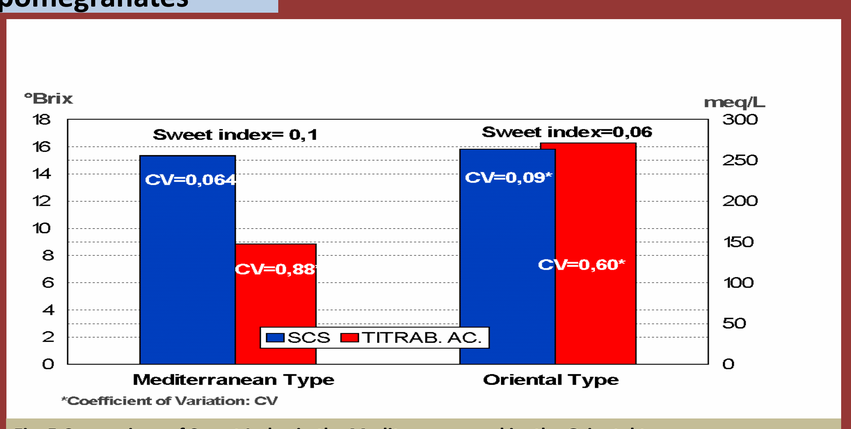
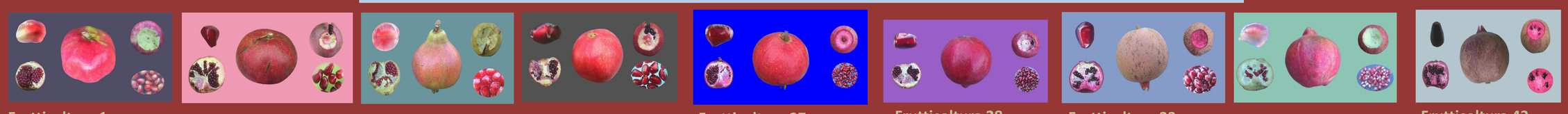


Fig. 5 Comparison of Sweet Index in the Mediteranean and in the Oriental types

Fig. 6: Promising new selections obtained from within the Mediterranean and Oriental types



Tab. 1: Main characteristics of the nine most promising selections

Selection name	Origin	Average fruit weight (g)	Yield (t/ha)	Maturity period		Average peel weight (g)	Average aril weight (g)	Ratio aril/fruit weight (%)	Ratio juice/aril weight (%)	Ratio juice/fruit weight (%)	Soluble solids (°Brix)	Total acidity (meq/L)	Sweet index (°Brix/ [meq/l]
Frutticoltura 1	Mediterranean	496,8	350	10 Oct.	5 Nov.	249,6	0,51	49,8	79,0	39,3	14,2	108,2	0,131
Frutticoltura 2	Near East	597,4	325	15 Oct.	5 Nov.	395,2	0,28	33,9	83,9	28,8	15,8	87,2	0,181
Frutticoltura 11	Mediterranean	489,9	310	25 Oct.	15 Nov.	301,4	0,34	38,5	89,4	34,4	14,1	96,2	0,147
Frutticoltura 17	Near East	310,4	300	30 Oct.	10 Nov.	164,0	0,34	47,2	86,4	40,8	16,1	335,3	0,048
Frutticoltura 27	Near East	394,4	315	20 Oct.	15 Nov.	273,4	0,24	30,7	70,4	21,6	15,0	430,0	0,035
Frutticoltura 28	Near East	591,6	305	20 Oct.	10 Nov.	407,4	0,28	31,1	78,6	24,5	17,1	611,2	0,028
Frutticoltura 33	Near East	601,2	320	25 Oct.	15 Nov.	391,2	0,36	34,9	88,6	30,9	17,0	546,8	0,010
Frutticoltura 36	Mediterranean	588,2	320	5 Nov.	25 Nov.	429,0	0,64	27,0	85,5	23,1	14,4	282,5	0,051
Frutticoltura 43	Near East	383,0	305	1 Nov.	20 Nov.	247,4	0,32	30,2	79,1	23,2	16,2	330,9	0,049

Conclusions

The results obtained so far are highly significant, especially concerning the selection and presentation of the first non-suckering rootstock, which might drastically influence on future orchard management in pomegranate plantations.
Concerning the new selections for fresh consumption, we identified material with innovative characteristics, especially in the edible parts. In addition, the selections show a higher adaptability to environmental cultivation conditions in Central Italy.

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