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Cultivar and accessions of fig (*Ficus carica* L.) for breba production selected within the autochthonous germplasm of Calabria (South Italy)

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Abstract
Many morphological and qualitative characteristics were evaluated on brebas from 40 autochthonous fig accessions from Calabria in 2019 with the aim to select superior genotypes and create new commercial orchards for breba production.. , An evaluation scale based on weighting fruit characteristics and both local and global consumer preferences was developed to compare overall performance of each studied accession. The results relating to ripening time of the studied 40 accessions showed that it is possible to have a market offer period of 40 days both for accessions that produce fruits with yellow or green skin and for those that produce fruits with purple or black skin. The weighted analysis of the fruit characteristics allowed the best accessions to be identified for each ripening time and type of skin color. This study allowed us to select from the Calabrian fig germplasm the most interesting and appropriate range of varieties for the breba production according to the market needs taking into account the ripening time and the color of the fruit.

Keywords: *Ficus carica*, breba production, fruit quality, varietal selection

INTRODUCTION

In recent years, consumer demand for fresh figs has increased significantly: it is to be found in the beneficial properties of these fruits for human health. Figs are rich in sugars and minerals (Chessa, 1997; Crisosto et al., 2011), but free of sodium, fat and cholesterol (Vinson, 1999; Crisosto et al., 2010; Veberic et al., 2008; Veberic and Mikulic-Petkovsek, 2016). Furthermore, they are sources of fibers, important proteins, vitamins, amino acids and antioxidants (Slavin, 2006; Dueñas et al., 2008; Oliveira et al., 2010; Çaliskan and Polat, 2011; Trad et al., 2014) (Solomon et al., 2006) that can protect human health from various human diseases (Solomon et al., 2006) . In Italy the fig industry has ancient tradition and assumes economic importance in South Italy, particularly in three regions: Campania, Puglia and Calabria. In this last region large part of fig industry is based on the cultivar "Dottato", which is able to produce partenocarpic fruits usually processed as dried figs (Mafrica et al., 2015). The increasing demand on the local, national and European markets of fresh fruits, has made economically sound the sector of the fig market. Among the types of fresh figs, the greatest attention of consumers and, consequently the most interesting prospects for farmers to make a profit, seems to be towards the brebas. Although the production of brebas appears to be less demanding in terms of climate characteristics, the development of a profitable fresh fig industry is very difficult. The development of the breba industry depends on the availability of cultivars producing high crop and top quality fruits (Flaishman et al., 2008), the use of proper horticultural techniques and appropriate postharvest techniques would help to preserve and prolong the life of the fruit, promoting access to new markets (Crisosto et al., 2011; Villalobos et al., 2014). In the last years, several cultivars and accessions from Calabria (South of Italy) are looking promising due to the high quality brebas suitable for fresh consumption. The objective of this study is to evaluate the morphological and

qualitative characteristics of brebas, sampled from trees of cultivar/accessions of the Calabrian fig germplasm.

MATERIAL AND METHODS

During 2019 the brebas of forty authoctonous fig cultivar/accessions previously identified (Costa et al., 2015) were evaluated. Brebas were harvested from adult trees in perfect health grown in commercial and experimental orchards located between 80 and 200 m above sea level. Brebas were harvested at the commercial ripening stage, when the fruits began to show the characteristic colour of the variety and the use of slight finger pressure on these fruits was possible. From each fig cultivar, 30 fruits were randomly selected from the trees. Harvested fruits were immediately transferred into ice boxes and then stored at 3°C. The fruits were then evaluated for pomological properties. There were 3 replicates each consisting of 10 fruits. Fruits were morphological characterised by mean of IPGRI and CIHEAM descriptors (2003) with an additional 20 new characteristics. A total of 56 morphological and qualitative characteristics were evaluated, 26 of which were subjective and 30 of which were objective traits. To compare overall performance of each genotype studied, an evaluation scale was developed based on weighting fruit characteristics considering both local and global consumer preferences (Table 1).

In particular, 9 descriptive characters were used to evaluate the different fig accessions, selected from those considered most important for fresh fig fruits market (Flaishman et al., 2008). The levels of each descriptor character (which take into account the possible variation of the character within the *Ficus carica*) were those proposed by the IPGRI and CIHEAM Descriptor List (2003). As for the weight fruit (whose levels were not present on the abovementioned list) those proposed by Bellini et al (2007) for the breba were used. The value of the points attributed to each character and level was given in accordance with its importance in marketing breba, according to researchers and consumers.

RESULTS AND DISCUSSIONS

Considering the different consumer preference with regard to skin colour of fruits and, consequently, to a possible diversification of market supply, the 40 accessions were divided into 2 groups on the basis of the skin colour: light skin (yellow or green) and dark skin (purple or black). The results of the ripening time showed substantial differences between the accessions: early and late-ripening brebas were identified in both groups. Overall, a very extensive brebas harvest calendar has been obtained from the beginning of the second decade of June to the end of the second decade of July (Figure 1 and 2). This aspect is very important in commercial terms as it can guarantee a market offer of at least 40 days. The fruit weigth, which notoriously represented a very important character for fresh consumption in figs, varied from 23.4 to 127.7 g. There were no substantial differences in the average value of fruit weight (68 g). Similarly to weight, the fruit shape, defined by the ratio between width and length, is another very important requirement for market of fresh fruit, as it affects packaging and transportation (Pereira et al., 2017): the most suitable shape is considered the globose one (Condit, 1941). Most of the studied accessions had an acceptable fruit shape. Although only 18% of the accessions had a typically globose shape (with a width/length ratio between 0.9 and 1.1) in many of the remaining accessions fruits tended to be globose (0.7- 0.9). The vast majority (over 90% of cases) of accessions

produced brebas with necks. The presence of a neck in figs is a very important element as it facilitates picking the fruit from the tree, and is thus associated with easier to harvest (Trad et al., 2012). However, an excessively long neck can negatively affect the packaging and transportation. Overall fruits with dark skin had longer necks than those with light skin. On average, the accessions with a light skin had less ostiole width than those with a dark skin. Only in two accessions (with light and dark skin) ostiole width was greater than 5 mm. The presence of a large number of accessions with fruits characterized by narrow or very narrow ostiole is a very important element for market aspects. In fact, the varieties with very large ostioles (> 5mm) are not popular for the fresh fig market, as they represent an entry point for microorganisms that can damage the fruit after harvesting (Crisosto et al., 2011; Trad et al., 2012). The presence of skin cracks was very limited both in light and dark-skinned accessions. The absence of skin cracks is a very important requirement for the marketing of fresh figs: they are undesirable because can be entry points for mushrooms and also cause a loss of moisture with further reducing of post-harvest life and sale period (Kong et al., 2013). The easy skin peeling is important character for consumer acceptance because consumers tend to peel the figs before eating (Crisosto et al., 2010). The degree of skin peeling was also good: in over 90% of accessions it was particularly easy or of medium difficulty. With regard to the colour of the pulp, white and amber tone prevailed in the accessions with light skin, while pink and red were more frequent in dark skinned ones. Generally fresh figs with pink and red flesh color are preferred by consumers (Çaliskan and Polat, 2012). The total soluble solids (TSS) content varied between 10.5 and 20.7 in light-skinned accessions and between 15.1 and 23.5 in dark-skinned ones with higher mean value in dark-skinned accessions. Light skinned accessions showed instead the highest total acidity (TA). TSS and TA are both related to fruit ripening and influence fig shelf life: fruits with higher TSS and lower TA content are the most sensitive to physical damage and, consequently, their duration is reduced (Pereira et al., 2017). The results of the weighted characterization are shown in figures 3 and 4. The weighted evaluations made possible to establish the best accessions of light or dark skinned fruits for each of the 4 fractions (lasting ten days each) obtained from the harvest calendar. With regard to accessions with light-skinned fruits, "Bifera bianca CS 150", Bifera bianca CS 139","Signorella CS 229" and Unifera bianca CS 166" showed a great potential for breba production due to good quality fruit traits. With regard to the accessions with dark-skinned fruits, the best genotypes were "Bifera nera CS 103", "Bifera nera CS 119", "Bifera nera CS 144", and "Citrulara CS 31". With regard to the latter group of accessions, despite "Bifera nera CS 103" and "Bifera nera CS 144" had not particularly high scores (essentially penalized by the very low weight), the peculiarity of their quite early ripening (second and third decade of June) makes these accessions particularly interesting in commercial terms, because it is a period in which the other black skinned accessions have no ripe fruits.

CONCLUSIONS

The results of this study showed that within the Calabrian fig germplasm there are accessions capable of producing good quality brebas with different ripening time. The learned knowledge will allow fruit growers to choose the most interesting and appropriate range of varieties based on market needs, taking into account the ripening season and fruit colour.

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Table 1 - Weighted classification and relative points system used for the evaluation of the forty autochthonous fig accessions from Calabria

Character	Weighting factor	Classification	Points	Character	Weighting factor	Classification	Points
Fruit size	20	< 20	0	Ease of peeling	10	Easy	10
(g)		20 - 49	4			Medium	6
		50 - 89	6			Difficult	0
		90 - 120	8	Pulp internal colour	6	White	2
		> 120	10			Amber	4
Fruit shape	8	< 0.9	8			Pink	8
(width/length)		09 - 1.1	10			Red	10
		> 1.1	6			Dark red	6

Neck lengh	6	< 5	0	Total soluble solids (%)	10	< 13	2
(mm)		5 – 15	10			13 - 16	4
		> 15	2			16.1 - 20	10
	10	< 1	10			20.1 - 25	8
Ostiole width (mm)		1 – 2.9	8			> 25	6
		3 – 5	6	Acidity (%)	10	< 0.050	0
		> 5	2			0.051 – 0.125	6
Fruit skin cracks	10	None	10			0.126 – 0.225	8
		Scares	6			0.226 – 0.300	10
		Minute	0			>0.300	4
				Total	100		

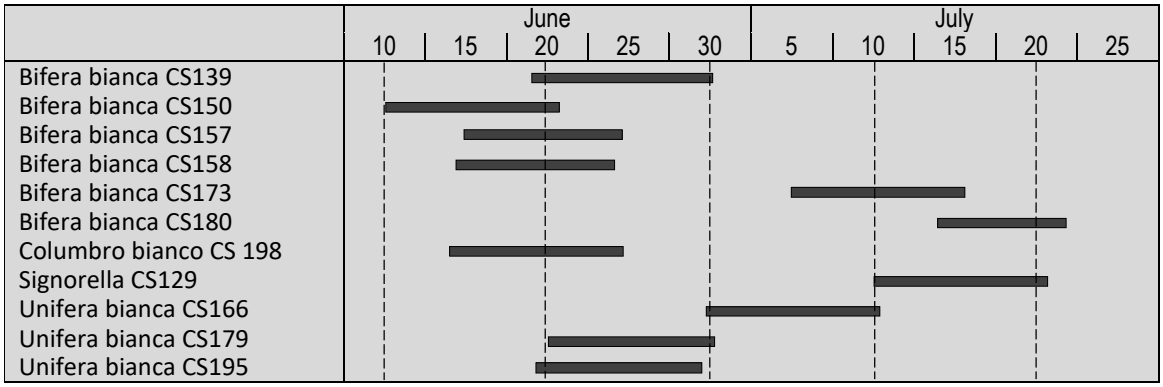

Figure 1 - Ripening time of the brebas from autochthonous fig accessions from Calabria producing fruits with yellow or green skin.

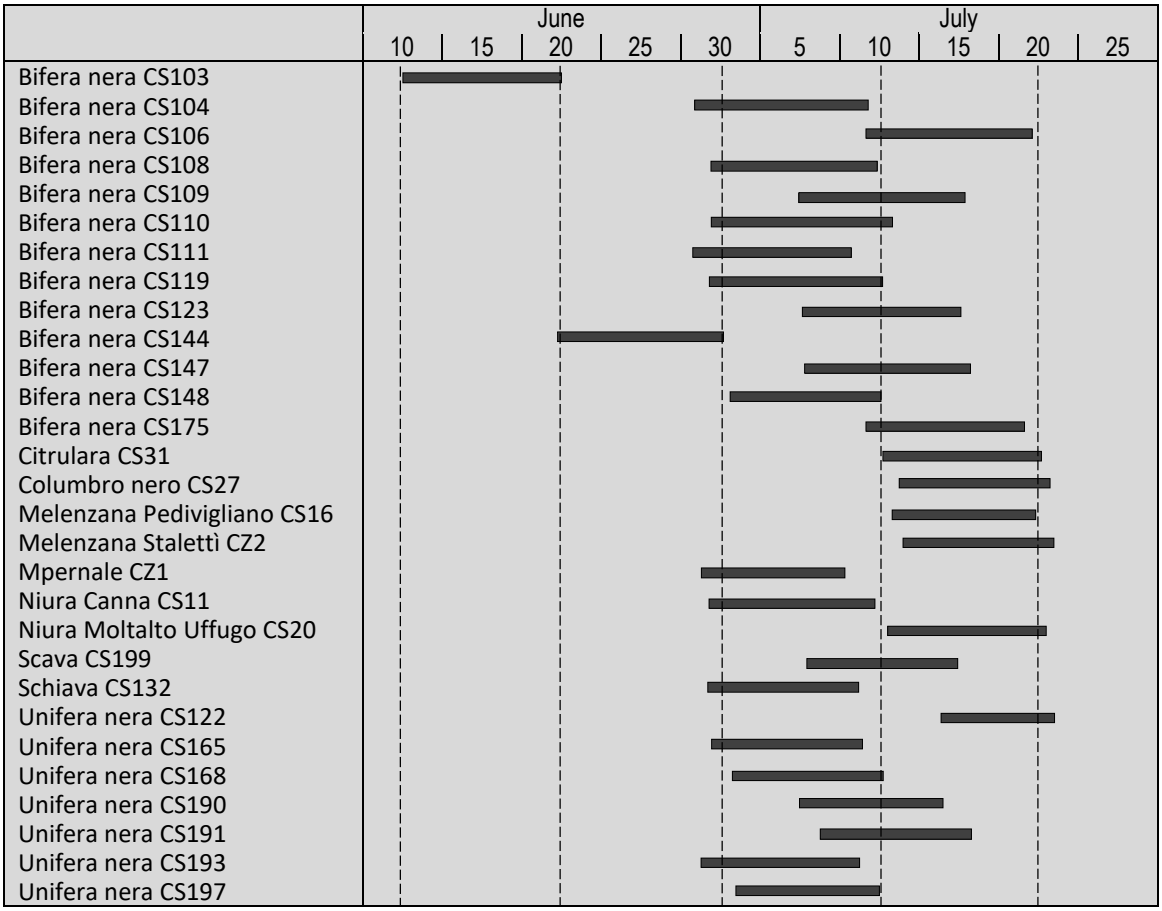

Figure 2 - Ripening time of the brebas from autochthonous fig accessions from Calabria producing fruits with purple or black skin.

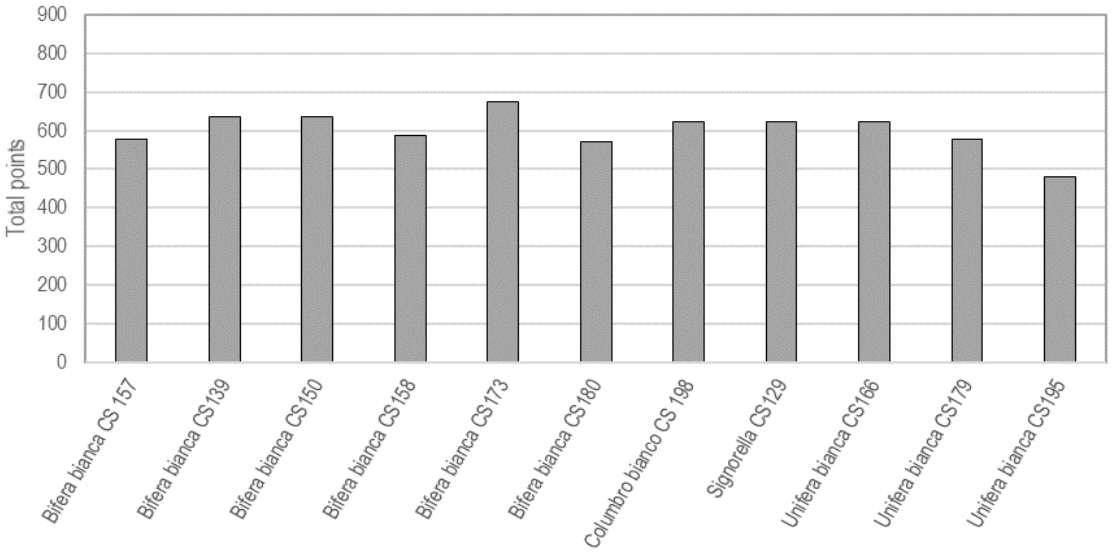

Figure 3 - Results of weighted characterization of autochthonous fig accessions producing fruits with yellow or green skin.

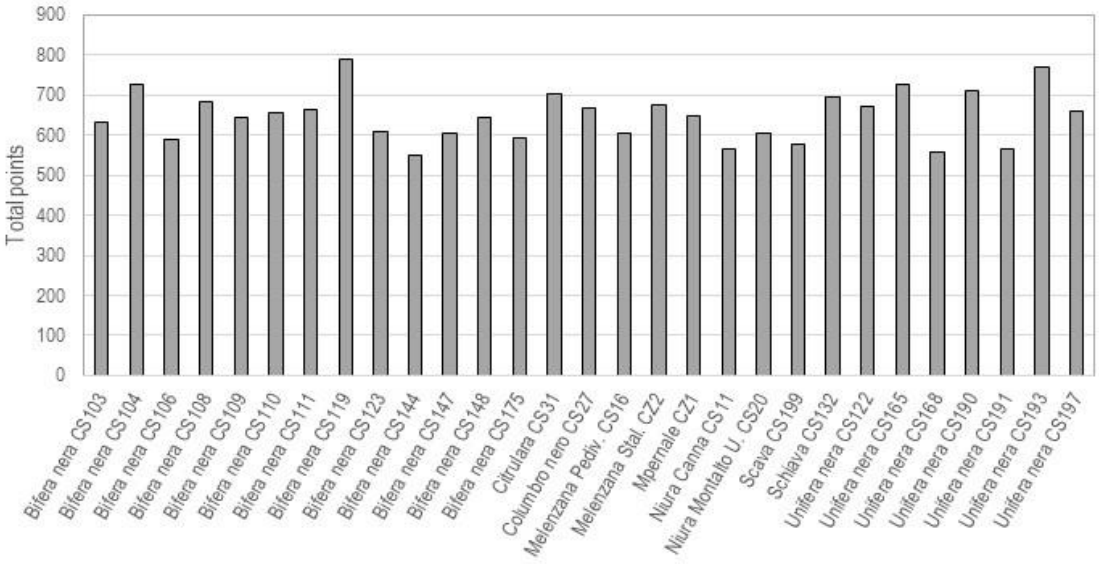

Figure 4 - Results of weighted characterization of autochthonous fig accessions producing fruits with purple or black skin.