Field Performance of Six Chinese Jujube Cultivars Introduced and Tested in Northern Italy

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Abstract

In 1995, six cultivars of Chinese jujube (*Ziziphus jujuba* Mill.) which were thought to be potentially interesting for their diffusion in Italy were introduced and tested at the Experimental Institute for Fruit Growing of Verona Province, Italy. They were 'Buluosuzao', 'Dabaizao', 'Dongzao', 'Hupingzao', 'Meimizao' and 'Zanhuangdazao'. After several years of observations the results are very promising. The cultivars introduced produce very big fruit, two or three times the weight of fruit of common Italian cultivars, and the results have generally confirmed the valuable features found in China. The main factors limiting the spread of these cultivars are that the fruit appear to be susceptible to cracking due to rain, and in general it is difficult to determine harvest time. Harvesting starts with 'Meimizao' in the middle of September and ends in the third week of October with 'Dongzao'. Harvesting generally requires two to four consecutive harvests and the fruits are not homogeneous in size and shape in some cultivars, particularly in 'Dabaizao'. Generally they have excellent quality for fresh consumption, high content of soluble solids, crisp flesh and are very tasty. These initial results of cultivation in North Italian environment are encouraging, demonstrating the potential of the wide genetic heritage of this Chinese species. It is therefore considered that these six cultivars, possibly together with other Chinese genotypes, are worthy of further testing in Italy and also in Europe in different local environments, soils and climates for a diffusion that values the following distinctive features: the absence of very small thorns, rapid tree development, early and high yields, big fruit size, harvesting and consumption over an extended period, and high-value organoleptic fruit qualities. These plants appear to have no serious diseases, insects or pests in Italy, so they can easily be introduced for integrated or organic fruit production. Taking in consideration these results, the cultivation of some Chinese jujube cultivars should be extended, both for garden and commercial plantings.

INTRODUCTION

China is the center of origin of various fruit species including Chinese jujube (*Ziziphus jujuba* Mill.). Several authors believe that the jujube cultivated by the Chinese evolved from a wild-type and that the site of origin is in the middle regions of the lower Yellow River. The domestication of the jujube started about 7,000 years ago and by 2000-3000 years ago it was already widespread in northern China (Qu and Wang, 1993; Peng et al., 1991; Yan and Ferguson, 1993; Meyer and Chambers, 1998; Liu, 2006; Liu and Wang, 2009, Liu and Zhao, 2009). The first reference to cultivar descriptions dates from the year 600 BC, when 11 cultivars of jujube were named; in subsequent centuries this number increased significantly: 72 cultivars in 1300, and so on, until a recent publication of 1993, which provided an analytical overview of 700 cultivars (Qu and Wang, 1993). The very wide genetic variability of this species therefore provides plants and fruit with quite varied characteristics, mostly unknown outside of China (with the exception of Korea and parts of the former Soviet Union).

Today, China is the world’s largest producer of jujube (Cossio, 1995) and in the rest of the world the jujube is not very widespread and there are very few cultivars. The availability of large-fruited types is mostly linked to sporadic imports and the introduction
of genetic material by “amateurs” or nurserymen. Traditionally, fruit industries outside China have shown very little interest in jujube although it is recognized for its ornamental value. One of the factors limiting the expansion of cultivation is the unavailability of genotypes that are readily adaptable to different growing conditions or with better quality fruit.

The knowledge of the genetic variability available in China offers the possibility of some development of this species: many Chinese cultivars show strong resistance to cold and drought, produce fruit of high nutritional value (especially in the content of vitamin C that can reach 400-500 mg/100 g fresh weight), easy-preservation through drying (in China it is ranked among the most important dried fruits), and processed into various products. There is large variability in resistance to diseases and pests, vigor and bearing of the tree, ripening time, and fruit shape, size and quality.

In Italy, Chinese jujube cultivation started at the time of the Romans (towards the end of the empire of Augustus), and today, although various aspects of cultivation have been solved (Scortichini, 1987; Paglietta, 1991; Bellini et al., 2000), the main problem remains the scarcity of valuable genetic material. A project (EC Project GENRES 29) on the conservation, evaluation, use and collection of minor fruit germplasm, which includes the jujube, showed a very limited number of accessions in Europe (Bellini et al., 2000).

In Italy, thanks to the initiative of some growers, only a few years ago a couple of large-fruited cultivars are available in the market: these have a taste that differs from that of the typical Italian jujube. The first cultivar is ‘Li’ with the shape of a “barrel”, weighing about 30 g, and the second is ‘Lang’, a pear-shaped fruit of about 20 g, both ripen gradually from the beginning to the end of September (Bertolami, 1997). These two cultivars did not have, however, success in the Italian market, which still prefers the fruit of homegrown cultivars.

The success of any new jujube introductions will be determined by characters such as improved size, flavor and juiciness. Therefore it was considered useful to introduce some different Chinese cultivars and assess the potential interest. The preliminary results have already been reported in a local symposium some years ago and are now integrated and updated.

MATeRialS ANd MeThOdS

In 1995 plant material was chosen, among the hundreds of Chinese cultivars, on the basis of the popularity and fruit quality taking into account the descriptions of the cultivars available at that time (Tian et al., 1992; Qu and Wang, 1993).

Six Chinese jujube cultivars producing large fruit were grafted in the nursery on wild common rootstock, and grown at the Experimental Institute for Fruit Growing of Verona Province. They were: ‘Buluosuzao’, ‘Dabaizao’, ‘Dongzao’, ‘Hupingzao’, ‘Meimizao’ and ‘Zanhuangdazao’.

The training system adopted was free, mostly spindle, with a planting density of 1,250 plants per hectare. The site of the trial, Verona, is in the North-East of Italy, the latitude is 45°21'N, the altitude 54 m, relative humidity 78%, average annual rainfall 803 mm, average annual temperature 12.7°C. The soil of the site is rich in stones, typical of the high plain of Verona and suitable for growing peaches, with a thin topsoil. The cultural practices included microjet-irrigation, weeding along the row, mulching grass among the roads, no fertilizing and no sprays for plant protection.

The first fruiting occurred in the second growing season. Later two plants of each cultivar were transferred to another experimental farm in Valpolicella, and other plants were grafted in a farm close to Verona, where we have continued to conduct observations.

The most significant data recorded on the plants of the six cultivars observed in the two localities in the last three years are reported in Table 1.
RESULTS AND DISCUSSION

‘Buluosuzao’ (Fig. 1)

The tree has medium vigor with a spreading habit and a canopy of average density, although sometime was noted a tendency to denude the lateral branches; the leaves are small and thorns almost absent (very small, < 5 mm, falling during the season). Medium to good productivity with fruits which ripen gradually starting between the end of September and the beginning of October. Susceptible to cracking. The fruit is of good size, weighing about 20 g, uniform, regular in shape, slightly ovate, similar to a barrel (size: about 4 x 3 cm). The taste is very good, balanced sweet-sour (soluble solids > 25 °Brix).

‘Dabaizao’ (Fig. 2)

The plant is vigorous and has an upright habit, with spreading growth, with several lateral shoots; thornless, except for few small thorns – about 5 mm – in vigorous new shoots. The leaves are very large. Average productivity with not uniform maturation, uneven shape and fruit size. Harvest in late September and early October. With good productivity but alternate bearing. Irregular, broudt ovate fruits (like a small apple) and susceptible to splitting. ‘Dabaizao’ is the cultivar with larger fruit, but not uniform size. The average weight is 30 g with some up to 40 g (size: 4.5 x 3.8 cm). The flavor is good (soluble solids 20-25 °Brix).

‘Dongzao’ (Fig. 3)

Vigorous plant, with dense, strong branches, upright bearing, which becomes spreading especially with high loads of fruits; fully thornless, with small leaves. Very productive cultivar with even fruit ripening, in a late period, the second half of October. Fruits of medium size, around 10-12 g (size: 2.9 x 2.8 cm), very uniform, very regular in shape, rounded. Flavor is very good (soluble solids 20 °Brix).

‘Hupingzao’ (Fig. 4)

The plant is medium vigorous and upright on average, with many lateral shoots, thornless with fairly large leaves. The productivity is very good and the harvest time is between half September and early October. The fruits are elongated cylindrical, pear-shaped (size: 4.6 x 3.0 cm) and with skin very susceptible to cracking. The fruit weight is high (approximately 20 g), and the fruit is relatively homogeneous and with good taste (soluble solids 23 °Brix).

‘Meimidzao’ (Fig. 5)

Small plant with upright growth habit, with several shoots evenly placed around the central axis, without thorns or with only occasional hint of tiny spines, less than 5 mm in length. Very productive and very early ripening time, around the first and second week of September. Susceptible to cracking. The fruit is in a characteristic elongated shape, similar to an olive and skin colour is reddish-brown. The fruit size is good, about 10 g (size: 3.4 x 2.1 cm), less than that of the other Chinese cultivars, but larger than that of ordinary Italian jujube. The taste is very good with a good equilibrium between sweet and acidity (soluble solids 23 °Brix).

‘Zanhuangdazao’ (Fig. 6)

This cultivar is widely cultivated in China for both the size and the quality of fruits owing to it being triploid (Wang et al., 2009). The tree has medium vigor and upright growth habit, characterized by a few lateral branches, completely thornless. Excellent productivity, medium-sized large fruits, about 18 g (size: 3.9 x 2.8 cm) fairly homogeneous, slightly elongated and pear-shaped. The fruit ripen gradually starting from the last week of September to early October. The fruit flavor is very good (soluble solids 20 °Brix). Very susceptible to cracking in wet weather.
CONCLUSIONS

The six cultivars tested have been shown to produce big fruit having a weight two or three times greater than that observed in the cultivars commonly grown in Italy, which have a size of about 2.5 x 2 cm, an average weight of 5 g, and a pronounced sweet sour taste (it can reach 30 °Brix). Generally they confirmed the valuable esthetic and organoleptic characteristics found in China. Nevertheless some aspects appear to be critical for their diffusion such as susceptibility of fruit to split after rain, and in general very uneven ripening with a wide variation in fruit size (the latter only in some cultivars, notably ‘Dabaizao’).

The results obtained in Verona area, showed that the most promising cultivars for commercial distribution for fresh-market are: ‘Meimizao’ for early ripening, ‘Buluosuzao’ for the general fruit quality, ‘Dongzao’ for late harvest. ‘Dabaizao’, even though some fruit are very large, has too much variation in fruit size, so can be suggested only for home gardening, even if it has some thorns. About the pear-shaped cultivars ‘Hupingzao’ and ‘Zanhuangdazao’, although widely used in China for many purposes (fresh-eating, processing dried fruits and candied fruits, alcoholic fruits) do not seem interesting because of a marked susceptibility to rain cracking.

With regard to the fresh market potential it is difficult to predict the size of marketing development; surely this fruit needs to be publicized and promoted on the market, through actions that will make it known and appreciated. These fruits could also be sold in the organic food market, because, for now, do not need pesticide treatments. Moreover it is possible that they can be consumed by the increasing Chinese and Asiatic population, which has recently been established in Italy. It should also be pointed out that the diffusion of this species in certain countries, especially in developing rural and marginal areas, could represent a significant improvement in the supply of fruit food of relevant importance, suitable to occupy areas with poor exploitation (particularly dry or cold) with interesting possibilities for cultivation in intercropping – for example – with cereal such as seen in some areas of China.

These results refer to a limited number of plants and sites of cultivation so they have only limited overall value, but they are very encouraging in demonstrating the value of the wide gene pool of this Chinese species.

It is therefore considered that these six cultivars, possibly together with other genotypes, are worth further testing in different Italian and European micro-environments, soil and climate for diffusion able to enhance positive distinctive features such as the high resistance to drought, the absence of thorns, early fruit bearing, extended window of harvest and consumption, valuable organoleptic qualities for fresh-eating and big fruit size.

Literature Cited
### Table 1. Main characteristics of six jujube cultivars grown at Verona, Italy.

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Buluosuzao</th>
<th>Dabaizao</th>
<th>Dongzao</th>
<th>Hupingzao</th>
<th>Meimizao</th>
<th>Zanhuangdazao</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ripening period</td>
<td>end of September</td>
<td>early October</td>
<td>second half of October</td>
<td>half of September</td>
<td>first week of September</td>
<td>end of September</td>
</tr>
<tr>
<td>Average fruit weight (g)</td>
<td>20</td>
<td>30</td>
<td>11</td>
<td>20</td>
<td>10</td>
<td>18</td>
</tr>
<tr>
<td>Fruit size (cm)</td>
<td>4 x 3</td>
<td>4.5 x 3.8</td>
<td>2.9 x 2.8</td>
<td>4.6 x 3.0</td>
<td>3.4 x 2.1</td>
<td>3.9 x 2.8</td>
</tr>
<tr>
<td>Brix</td>
<td>25°</td>
<td>22.05°</td>
<td>20°</td>
<td>23°</td>
<td>23°</td>
<td>20°</td>
</tr>
<tr>
<td>Fruit shape</td>
<td>similar to a barrel</td>
<td>like a small apple</td>
<td>rounded, similar to a cherry</td>
<td>pear shape</td>
<td>olive shape</td>
<td>column shape nearly obovate</td>
</tr>
<tr>
<td>Fruit uniformity</td>
<td>good</td>
<td>low</td>
<td>very good</td>
<td>medium</td>
<td>good</td>
<td>medium</td>
</tr>
</tbody>
</table>
Fig. 1. Fruits of ‘Buluosuzao’.

Fig. 2. Fruits of ‘Dabaizao’.

Fig. 3. Fruits of ‘Dongzao’.
Fig. 4. Fruits of ‘Hupingzao’.

Fig. 5. Fruits of ‘Meimizao’.

Fig. 6. Fruits of ‘Zanhuangdazao’.