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Review on Some Features of the Chinese Jujube (*Ziziphus jujuba* Mill.)

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REVIEW

Abstract
The Chinese jujube (*Ziziphus jujuba* Mill.), originating from China, with a history of over 4000 years, is one of the major fruit crops cultivated in China and on important areas in Central Asia, India, Iran, the Middle East etc. The high resistances to drought, salty soils and similar climate to that of China recommend this fruit tree as a valuable crop, especially in the context of climate changes and extended desertification. Chinese jujube has a high tolerance to pests and disease, being suitable for organic farming. The lack of divulgative papers on jujube true nutritional, medicinal and economic value, makes it still unknown for the great part of Romanian and European consumers, intensive advertising campaign is needed. The aim of this review is to highlight the requirements of the Chinese jujube (*Ziziphus jujuba* Mill.) in regards to the soil, water, climate as well as its high nutritional and medicinal values.

Keywords: climate changes; fruits; nutraceutical properties; resistance to drought.

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INTRODUCTION

Jujube (*Ziziphus jujuba* Mill.) is recognized as the most important *Ziziphus* species for fruit production in the buckthorn family *Rhamnaceae*. Jujube is indigenous to China with a history of over 4000 years and is widely distributed in Southern Europe, Southern and eastern Asia and Australia (Gao et al., 2013). Being one of the characteristic fruit resources originated from China, Chinese jujube has been introduced directly or indirectly to more than 20 countries and regions including South Korea, Japan, India, Mongolia, Russia, Britain, Germany, France, Italy, the United States, Canada and Australia (Wang et al., 2009). It bears fruits that are edible and delicious, has various shapes and sizes and great nutritional and medicinal value but has not been exploited commercially on the proper scale (Golmohammad, 2013). Different parts of *Ziziphus jujuba* possess multiple medicinal properties (Hasan et al., 2014).

Gaius Plinius Secundus (AD 23-79), better known as Pliny the Elder, mentioned in his *Historia Naturalis* that Counsellor of the Roman Emperor Octavian Augustus, introduced the Chinese jujube from Syria to Italy and from there it was distributed to other Mediterranean countries (Stănică, 2019).

In Romania, the only region where the Chinese jujube exists in semi-spontaneous status is Dobrogea area, located between the Danube River and the Black Sea. It is important to mention that, the Chinese jujube populations founded in Romania are located in the neighbourhood of antique sites with Greek, Roman and Byzantine ruins. Probably those old civilizations had an important role in the introduction of the Chinese jujube in the area from the Mediterranean basin (Stănică, 2008).

Since 1996, researches regarding propagation, cultivation technology and genetic improvement of Chinese jujube genotypes was carried out at the Faculty of Horticulture within USAMV Bucharest. Small collections of jujube genotypes can also be found at ICDP Mărăcineni and USAMV Iași, Faculty of Horticulture (Stănică and Braniște, 2011).

After the introduction of several Chinese jujube varieties at the Faculty of Horticulture in București, mainly from Shanxi Province, jujube fruits were analysed from the pomological and biochemical point of view. It was presented and underlined the high content of jujube fruits in essential nutritional factors and its high value for the human health (Stănică et al., 2020)

MATERIALS AND METHODS

This review represents a research on the needs and some features of *Ziziphus jujuba* Mill. crop toward the environment and its elements, if it were to start large scale commercial farming, pharmaceutical and gastronomic industry in our country. Most research is made from the online environment of various works, scientific articles (International Society for Horticulture Science, Google scholar and others), books and pomology sites from aboard and our country, about the requirements of *Ziziphus* in relation to the soil, air, water, as well as its high nutritional and medicinal values.

Chinese jujube soil and water requirements

Due to their characteristics as a drought-adapted fruit tree with multipurpose uses, *Ziziphus* species are promising plants for arid regions, marginal and low fertility soils especially in developing countries (Arndt *et. al*, 2001).

Currently, most fruit production in semi-arid regions is based on species such as peach, apricot, almond etc., which require relatively intense management and high irrigation for successful fruit set-up and development. Compared to other common fruit tree species *Ziziphus* sp., have special physiological and morphological characteristics that create their ability to adapt to drought. *Ziziphus jujuba* trees usually develop deep and extensive roots that ensure its ability to exploit deep water sources, thus maintaining a sufficient amount of water and providing nutrients for long periods when the top layers of the soil dry out (Arndt *et. al*, 2001).

During moderate water limitation, stomatal control of water loss maintains plant water status as the soil dries. Results from glasshouse experiments confirmed the high sensitivity of stomatal closure in *Ziziphus* during drought, with significant reductions in conductance occurring before any change in leaf water potential could be detected. When water stress became more severe, osmotic adjustment occurred. Active accumulation of solutes in the cell sap contributed to turgor maintenance, this being a prerequisite for continued growth during drought. As a consequence of osmotic adjustment in *Ziziphus*, many metabolic functions can continue even under severe drought stress. When water is severely limited, *Ziziphus* trees are able to selectively shed their mesophytic leaves. Leaf loss in water-stressed plants can be regarded as a beneficial adaptation that reduces water loss and in the short-term prolongs survival (Arndt *et. al*, 2001).

Chinese jujubes grow in areas in China with annual rainfall between 87-2000 mm. The tree is reported to survive drought because its vertical root system reaches a depth of 13 m (Yan and Ferguson, 1993) and is able to grow in slightly acidic soil with a pH ranging from 4.9-7 (Du, 2009).

Chinese jujube temperature and climate requirements

The Chinese jujube grows best in climates with a long, hot and dry summer after adequate rain at the beginning of the season and cool temperatures during the vegetative dormancy. The tree is adapted to temperate subtropical and warm areas (Crawford et al., 2013).

Table 1. Natural growing conditions of Chinese jujube in China

Annual average temperature (°C)	5-22
Average temperature of flower season (°C)	≥ 22-24
Minimum temperature (°C)	≥ -38.2
Frost-free period (d)	≥ 100
Annual rainfall (mm)	87-2000
Annual sunshine (h)	≥ 1100
Soil depth (cm)	≥ 30
Soil pH	4.5-8.4
Soil NaCl (%)	≤ 0.15
Soil Na_2CO_3 (%)	≤ 0.3
Soil Na_2SO_4 (%)	≤ 0.5

Source: Crawford et al., 2013

Commercial cultivation of jujube requires an average annual temperature of 5.5-22.0°C and can tolerate winter temperatures down to -38°C when inactive. The cold hour requirement of Chinese jujube depends on the cultivar and can vary between 775-1735 hours ≤ 7.2°C (Crawford et al., 2013). Chinese jujube is fairly adaptable, but should be grown in full sun as it is shade intolerant (Lim, 2013).

Chinese jujube pathogens and pests

Jujube leaves proved to have an insecticide action against one of the major pests in the world, *Helicoverpa armigera*, by inhibiting the digestive and mitochondrial enzymes which lead to retarding growth of the larvae. They have similar effect against *Tribolium confusum* (Varghese and Patil, 2005). All around the world, except its native environment, jujube seems to be very resistant to pests and no major damage had been registered until now (Ciceoi et al., 2017).

During the last 20 years, since we first introduced the jujube tree in the experimental fields of University of Agronomic Science and Veterinary Medicine Bucharest, no pests were observed in the field, except *Ceratitis capitata* fly, starting with 2013 and no chemical applications were needed (Ciceoi et al., 2017).

In the origin land, the jujube plant may be affected by *Agrobacterium tumefaciens, Gloesporium sp., Botrytis cinerea, Phakospora ziziphi-vulgari* (Stănică and Braniste, 2011). In China, witch's broom and fruit splitting are the two most dominant diseases. Witch's broom is caused by a phytoplasm, '*Candidatus Phytoplasma ziziphi*', and cannot be cured once it infects trees (Jung et al., 2003). Resistance sources were found in several genotypes and recently the resistant variety 'Xingguang' (Ji S-SV-ZJ-027-2005), selected from naturally 'Junzao' bud mutations, was released at Hebei Agricultural University. It is an excellent mid-ripening cultivar for dehydration. It's early bearing, productive and highly resistant to Jujube Witches' Broom disease (Zhao et al., 2009; Liu, 2018). Some leafhoppers were reported as vectors for this disease (Yao and Zhao, 2016).

Fruit splitting is a serious problem in some environments, caused not by a pathogen but by excessive moisture. If it rains often around fruit maturation time, fruit cracking most likely happens, and the severity varies with the cultivar. In some severe years, fruit splitting can cause huge damage for growers (Guo and Shan, 2010). Recently by fruit breeding, cracking resistant varieties as 'Yujiao' (Rain Beauty) and 'Yushuai' (Rain Man) have been released by Prof. Liu Mengjun team at Hebei Agricultural University in China (Liu, 2018).

In terms of insect problems, peach moth is the number one issue in China (Yao and Zhao, 2016). Song in 2019 said there are many types of pests and diseases that damage jujube trees. According to the survey results of jujube pests along the Huangzao area, 21 species of Coleoptera pests accounted for 32.8%, 17 species of Lepidopteran pests, accounting for 26.6% of the total number of pests, 15 species of Homoptera, accounting for 23.4% of the total, half 9 species of the order, accounting for 14.1% of the total, and the remaining 2, accounting for 3.1%. In recent years, the occurrence of pests and diseases has been increasing year by year. The difficulty of prevention and control, as well as their costs is increased (Song, 2019).

Jujube fruits nutritional value

Compared with other edible fruits, one jujube fruit per day would meet the diet requirements for the vitamin C and B complex for an adult man, as recommended by FAO/WHO (Pareek, 2013). Jujubes are an excellent source of many nutrients and phytochemicals and can contribute to a healthy diet. Jujubes has in its composition 81–83% moisture, vitamins (A, B complex, carotene, thiamine, riboflavin, and especially ascorbic acid), sugars (22%; galactose, fructose, and glucose), organic acid (citric, malonic, and malic acids), minerals (Ca, K, and Fe), fatty acids [oil content of 0.76–1.8%; oleic acid (71.7%), and linoleic acid (15%)], amino acids (0.8%; L-Asn, L-Pro, L-Arg, L-Ala, 4-Abu, L-Glu, p-Ser, L-Asp, and L-Ser), carbohydrates (17%), fiber (1.3%), and polyphenols (Li et al., 2007; Muchuweti et al., 2005; Pareek, 2013; Wang et al., 2010).

Research conducted by Liu et al*.* (2020) shows that jujube fruits are rich in the phenolic compounds catechin and rutin while leaves are rich in rutin and apigenin-7-glucoside. Alpha-tocopherol and beta carotene contents of jujube fruits are very low when compared with other fruits which possess these components. The total lipid content of jujube fruit is very low. The predominant fatty acids in the four jujube selections that were studied are oleic acid, linoleic acid, palmitic acid and palmitoleic acid (Liu et al., 2020). Palmitic acid is the main saturated fatty acid. Unsaturated fatty acids range from 68.54% to 72.44% of the total fat in jujube fruit (Liu et al., 2020).

The fruit is particularly rich in nutrients, and its contents of sugar, vitamin C and B, cyclic nucleotide, proline, triterpenic acid, potassium, iron, and zinc are the highest among many fruits (Hu, 2011). Stănică in 1997 noted the very high content of fruit in ascorbic acid (vitamin C), depending on the variety, values of 330-880 mg ascorbic acid/100 g are present. The content in vitamin P exceeds 1,000 mg/100 g the same the B vitamins.

The content in microelements is also high: Fe 0.355%, Ca 0.246%, Mg 0.057%, Zn 5.044 ppm, Mn 3.85 ppm, Cu 2.334 ppm. The fruits contain up to 500 nmol / g of dry matter, 3-5 adenosine monophosphate (10 times more than any plant analyzed so far) and in addition, large amounts of oleanolic and ursolic acid (Stănică, 1997).

In Romania, at the Faculty of Horticulture within USAMV Bucharest chemical analyzes were performed on Romanian jujube local population fruits (Jurilovca 1, Jurilovca 2, Ostrov) and some Chinese and Korean varieties, by

Stănică in 2016. The highest content in soluble solids was found at the R2P4 selection (39.60%) most of the genotypes having content higher than 30% (Table 2). R2P4 selection was interesting also for its high resistance to cracking. Fruit content in minerals had values between 0.16% (R2P7 selection) and 3.38% (Feng Mi Guan Zao), the fact showing a big variation taking into consideration also the average content in minerals (1.78%). Only three new selections had a higher mineral content respecting the average: R2P3, R2P4 and R2P5. All the genotypes showed a high content in ascorbic acid with an average of 306.1 mg/100 g fresh weight. The highest value of ascorbic acid content of 1020.0 mg/100 g fresh weight was registered by R1P11 selection. Fruit acidity, expressed in percentage of malic acid, varied between 0.16% (Cheng Tuo Zao) and R1P7 selection (Stănică, 2016).

Table 2. Chemical characteristics of Chinese date fruits grown in Romania

Genotype	Soluble Solids (%)	Minerals (%)	Ascorbic acid (mg/100g f.w.)	Acidity (%)
R1P7 Selection	28.99	0.25	450.0	0.82
R1P8 Selection	23.73	0.50	343.4	0.32
R1P9 Selection	30.65	0.32	290.4	0.30
R1P10 Selection	25.67	0.20	520.0	0.43
R1P11 Selection	32.75	2.82	1.020.0	0.52
R2P2 Selection	28.58	0.20	237.6	0.24
R2P3 Selection	35.60	2.10	264.0	0.39
R2P4 Selection	39.60	2.54	290.4	0.35
R2P5 Selection	29.20	2.08	343.2	0.36
R2P7 Selection	28.40	0.16	281.6	0.36
R2P8 Selection	25.70	1.65	110.0	0.43
R3P5 Selection	22.71	0.82	620.0	0.33
R3P10 Selection	28.85	0.96	240.0	0.44
Da Gua Zao	30.80	2.56	193.6	0.27
Xuan Cheng Jian Zao	34.30	3.03	334.4	0.41
Da Bai Ling Zao	31.70	2.35	202.4	0.35
Da Ma Ya Zao	33.80	2.70	264.0	0.32
Long Zao	30.80	0.76	334.4	0.38
Cheng Tuo Zao	30.40	0.75	290.4	0.16
Tai Li Hong Zao	29.10	3.22	334.3	0.28
Feng Mi Guan Zao	35.60	3.38	237.6	0.28
Hongan	32.40	1.76	246.4	0.26
Average	30.42	1.59	306.1	0.36

Source: Stănică, 2016

Chinese jujube medicinal value

Cyclic Adenosine Mono-Phosphate (cAMP) was the original 'second messenger' to be discovered. Its formation is promoted by adenylyl cyclase activation after ligation of G protein–coupled receptors by ligands including hormones, autocoids, prostaglandins, and pharmacologic agents. Increases in intracellular cAMP generally suppress innate immune functions, including inflammatory mediator generation and the phagocytosis and killing of microbes (Serezani et al., 2008).

Water extracts of 180 different plants were tested for cyclic AMP activity by a competitive binding assay. Out of these only the fruit of *Ziziphus jujuba* was positive. The active substance was eluted by methods known to isolate cyclic AMP. After incubation with cyclic nucleotidespecific phosphodiesterase (EC 3.1.4.17) at 37°C for 60 minutes, more than 98% of the activity disappeared and 5'-AMP was detected by TLC. These results suggest that the isolated substance is cyclic AMP (Cyong and Hanabusa, 1980). Cyclic AMP levels in matured dry fruit of *Z. jujuba* range from 100 to 600 nmol/g (dry weight) and in matured fresh fruit 100 to 150 nmol/g (fresh weigh) as measured by both competitive binding assay and radioimmunoassay. Moreover, both methods usually gave the same value on a given sample (Cyong and Hanabusa, 1980).

The fruits and seeds of *Ziziphus jujuba* are widely used in Chinese and Korean traditional medicine, they are used for antifungal, antibacterial, antiulcer, anti-inflammatory and sedatives. It is thought that seeds can alleviate stress and can serve as antiseptic, antifertility/contraception, hypotensive and antinephritic, cardiotonic, antioxidant, immunostimulant, and wound healing properties (Mahajan and Chopda, 2009). Two consecutive clinical trials have found that the *Ziziphus jujuba* fruits are helpful for chronic constipation and proved to be effective against neonatal jaundice (Hasan et al., 2014). There are reports of the positive effects of the jujube fruit on the treatment of burns and wounds (Goyal et al., 2011). It is also known as the fruit of life (Koohi-Hosseinabad et al., 2015). In a study, the intestinal conditions of hamsters were improved using the water-soluble carbohydrate concentrate of jujube fruit, which contained glucose, fructose, pectin polysaccharide and hemicellulose. This effect can be attributed to a decrease in the exposure of intestinal mucosa to harmful substances such as ammonia, which is toxic (Ghobadi et al., 2019).

The anticancer effects of jujube fruit have been reported by many researchers. For instance, there are reports of the contribution of jujube extract to the reduced cell viability through the concentration-dependent alteration of apoptosis and differential cell cycle arrest in HepG2 cells. Jujube also exerts selective anti-tumor effects via inhibiting cell growth and inducing apoptosis (Ghobadi et al., 2019). The *in vitro* cytotoxicities of the triterpenoic acids extracted from *Z. jujuba* were tested against tumour cell lines. The lupanetype triterpenes showed high cytotoxic activities. The cytotoxic activities of 3Op coumaroyl-alphitolic acids were found to be better than those of noncoumaroic triterpenenoids. These results suggest that the coumaroyl moiety at the C3 position of the lupane type triterpene may play an important role in enhancing cytotoxic activity (Lee et al., 2003).

Jujube fruit, kernel, leaf, wood core and branches are used as chinese herbal medicines with high medicinal value (Liping, 2019).

Chinese jujube economic value

Traditionally, jujube varieties are divided in two groups with different mesocarp textures: dry (coarse texture) and fresh (crisp texture). Dry textured jujube represents approx. 80% of total production. China is the leading producer with 2 million hectares yielding 4.32 million tonnes annually (Liu et al., 2013). A great majority of the rural population in arid regions meet their daily household requirements through biomass or biomass-based products such as food, fuel (firewood, cowdung, crop wastes), fodder, fertilizer (organic manure, forest litter, leaf mulch), building materials (poles, thatch) and medical herbs. *Ziziphus* species meet many of these needs and they can be used for a variety of purposes in arid regions (Arndt, 2001).

In Kuwait, Sudhersan (2016) observed that *Z. mauritiana, Z. jujuba, Z. spinachristi, Z. xylopyrus,* and *Z. numularia* are found to be tolerant towards the harsh climatic conditions. They performed well during the summer months. Initial planting needed regular irrigation and protection for the establishment. Once established in the field, all the five species of *Ziziphus* survived under the harsh climatic conditions. All these species can be utilized for the desertification control and famine reduction (Sudhersan et al., 2016).

The wood itself is valuable. Strong, durable, and smooth, it is used for the manufacture of musical instruments, artwork, carts, ships, and miscellaneous items (Outlaw et al., 2002).

In the last 30 years, various new products, such as jujube juice, jujube powder, jujube slices, jujube tea, jujube beer, jujube essence, and jujube pigment, have been developed (Liu*, 2004*). The fruit has been used, in myriad recipes, and for the production of wine and vinegar (Outlaw et al., 2002). There are many traditional processed jujube products, such as candied jujube, smoked jujube, stoneless sugared jujube, jujube liquor, liquor-saturated jujube, jujube jam, jujube paste, and so on (Liu et al., 2020). Jujube (*Ziziphus jujuba* Mill.) honey is one of the most valuable honey varieties from China with unique characteristics (Ying et al., 2019). Honey has been reported to show a significant antibacterial activity against a wide range of bacteria (Molan, 2009).

CONCLUSIONS

Due to the similar climate to that of China jujube production areas, new orchards can be set up in most regions of our country without any problems.

Despite the fact that it is a plant with a high tolerance to drought, high salinity and spring frosts, can be adapted to organic farming, capitalize affected areas under the desertification process, there are no yet specialized nurseries in Romania to produce planting material.

The lack of divulgative papers on jujube true nutritional, medicinal and economic value, makes it still unknown for the great part of Romanian and European consumers.

As demand for healthful foods increases, it will not be difficult for the public to accept this new fruit, but an intelligent and intensive advertising campaign is needed.

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Conflicts of Interest
The authors declare that they do not have any conflict of interest

REFERENCES

1. Arndt SK, Clifford SC, Popp M (2001). *Ziziphus* - a Multipurpose Fruit Tree for Arid Regions. In: Breckle SW, Veste M, Wucherer W (eds) Sustainable Land Use in Deserts. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-642-59560-8_41.
2. Ciceoi R, Dobrin I, Mardare E, Dicianu E, Stănică F (2017). Emerging Pests of *Ziziphus jujuba* Crop in Romania. Scientific Papers. Series B, Horticulture. LXI: 143-153.
3. Crawford R, Shan FC, McCarthy A (2013). Chinese Jujube: a Developing Industry in Australia. Acta Hortic; 993, 29-36. DOI: 10.17660/ActaHortic.2013.993.3 https://doi.org/10.17660/ActaHortic. 2013.993.3.
4. Cyong JC, Hanabusa K (1980). Cyclic adenosine monophosphate in fruits of Zizyphus jujuba. Phytochemistry; 19(12): 2747–2748. DOI:10.1016/s0031-9422(00)83955-2.
5. Du JJ (2009). The determination of chilling requirement and changes of carbohydrate during dormancy for Chinese jujube. Acta Hort; 840: 369-374.
6. Ghobadi A, Amini-Behbahani F, Yousefi A, Taghavi-Shirazi M, Behnoud N (2019). Medicinal and Nutritional Properties of *Ziziphus jujuba* Mill. in Traditional Persian Medicine and Modern Phytotherapy.
7. Golmohammad F (2013). Medicinal plant of Jujube (*Ziziphus jujuba*) and its indigenous knowledge and economic importance in desert regions in east of Iran: situation and problems. Tech J Engin & App Sci; 3(6): 493-505.
8. Goyal R, Sharma PL, Singh M. (2011). Possible attenuation of nitric oxide expression in anti-inflammatory effect of Ziziphus jujuba in rat. J Nat Med; 65(3-4): 514-518. DOI:10.1007/s11418-011-0531-0.
9. Guo Y, Shan G (2010). The Chinese Jujube. Shanghai, China: Shanghai Sci. and Techn. Publishers.
10. Han Gang (2019), Key technology for dried jujube cultivation, Seminar on Jujube Industrial Technology of Romania at Yangling, China.
11. Hasan N, Sorkhy M, AlBattah F (2014). Ziziphus Jujube of the Middle East, Food and Medicine. Unique Journal of Ayurvedic and Herbal Medicine.
12. Hu F (2011) Study on Four Main Functional Components of Chinese Jujube. Hebei Agricultural University, Baoding.
13. Jung HY, Sawayanagi T, Kakizawa S, Nishigawa H, Wei W, Oshima K, Miyata S, Ugaki M, Hibi T, Namba S (2003). *Candidatus phytoplasma ziziphi*, a novel phytoplasma taxon associated with jujube witches'- broom disease. Int. J. Syst. Evol. Microbiol; 53: 1037–1041, http://dx.doi.org/10.1099/ijs.0.02393-0. PubMed.
14. Koohi-Hosseinabadi O, Andisheh-Tadbir A, Bahadori P, Sepehrimanesh M, Mardani M, Tanideh N. (2015). Comparison of the therapeutic effects of the dietary and topical forms of *Zizyphus jujuba* extract on oral mucositis induced by 5-fluorouracil: A golden hamster model. J Clin Exp Dent; 7(2): e304-309. DOI:10.4317/jced.52198.
15. Lee S, Min B, Lee C-G, Kim K-S, Kho H (2003). Cytotoxic Triterpenoids from the Fruits of *Zizyphus jujuba*. Planta medica; 69. DOI:1051-4.10.1055/s-2003-45155.
16. Li J-W, Fan L-P, Ding S-D, Ding X-L (2007). Nutritional composition of five cultivars of Chinese jujube. Food Chemistry; 103(2): 454–460. DOI:10.1016/j.foodchem.2006.08.016.
17. Lim TK (2013). Edible Medicinal and Non-Medicinal Plants. Vol. 5 – Fruits; 578. DOI:10.1007/978-94-007-5653-3_30, © Springer Science+Business Media Dordrecht.
18. Liping K (2019). Techonology of Jujube Preservation and processing, Seminar on Jujube Industrial Technology of Romania at Yangling, China.
19. Liu MJ (2004). Technical Manual for Quality Production in Chinese Jujube, China Agriculture Press.
20. Liu MJ (2010). Jujube Witches's Broom Disease, China Agriculture Press.
21. Liu MJ (2018). Personal results in Chinese jujube research. Reception speech at Doctor Honoris Causa Ceremony. USAMV București.
22. Liu MJ, Liu P, Liu GN (2013). Advances of research on germplasm resources of Chinese jujube. Acta Hortic; 993:15–20. 10.17660/ActaHortic.2013.993.1.
23. Liu MJ, Wang J, Wang L, Liu P, Zhao J, Zhao Z, Yao S, Stănică F, Liu Z, Wang L, Ao C, Dai L, Li X, Zhao X, Jia C (2020). The historical and current research progress on jujube - a superfruit for the future. Horticulture research; 7: 119. https://doi.org/10.1038/s41438-020-00346-5.

24. Mahajan RT, Chopda MZ (2009). Phyto-pharmacology of *Ziziphus jujuba* Mill - A plant review. Pharmacognosy Reviews; 3(6): 320-329.
25. Miklavčič Višnjevec A, Baruca Arbeiter A, Hladnik M (2019). An Integrated Characterization of Jujube (*Ziziphus jujuba* Mill.) Grown in the North Adriatic Region. Food Technol Biotechnol; 57(1):17-28. DOI:10.17113/ftb.57.01.19.5910
26. Molan PC (2009). Honey: Antimicrobial actions and role in disease management. In Ahmad I& Aqil F (Eds.), New Strategies Combating Bacterial Infection, pp. 229-253. Weinheim: Wiley VCH.
27. Muchuweti M, Zenda G, Ndhlala AR (2005). Sugars, organic acid and phenolic compounds of *Ziziphus mauritiana* Fruit. Eur Food Res Technol; 221: 570–574. https://doi.org/10.1007/s00217-005-1204-6.
28. Outlaw WH, Zhang S, Riddle KA, Womble AK, Anderson LC, Outlaw WM, Thistle AB (2002). The jujube (*Ziziphus jujuba* Mill.), a multipurpose plant. Economic Botany; 56(2): 198-200. DOI:10.1663/ 00130001(2002)056[0198:tjzjma]2.0.co;2.
29. Pareek S (2013). Nutritional compotistion of jujube fruit. Emirates Journal of food and Agriculture, 25: 463-470. https://doi.org/10.9755/ejfa.v25i6.15552.
30. Serezani CH, Ballinger MN, Aronoff DM, Peters-Golden M (2008). Cyclic AMP: master regulator of innate immune cell function. American journal of respiratory cell and molecular biology; 39(2): 127-32. DOI:10.1165/rcmb.2008-0091TR.
31. Song XP (2019). Jujube tree main pest control, Seminar on Jujube Industrial Technology of Romania at Yangling, China.
32. Stănică F (1997). Chinese jujube (*Ziziphus jujuba* Mill.), fruit-tree species for southern Romania, UASVM Bucharest, Faculty of Horticulture.
33. Stănică F (2009). Characterization of Two Romanian Local Biotypes of *Ziziphus jujuba*. Acta Horticulturae; 840: 259–262. DOI:10.17660/actahortic.2009.840.34.
34. Stănică F, Braniște N (2011), Guide for fruit-tree growers, Bucharest; Ceres.
35. Stănică F, Dicianu DE, Butcaru AC, Iliescu LM (2018). Preliminary Results about Romanian Consumers Preferences on Jujube Fruits. 4th International Jujube Symposium, 16 August 2018, XXX International Horticultural Congress – IHC 2018, Istanbul, Turkey, Acta Horticulturae (in press).
36. Stănică F (2016). Chinese Dates (Jujubes): A New Promising Fruit Plant for Romania, In book: Chinese Dates a traditional functional food. Liu D, Ye X, Jiang Y. (Eds) CRC Press. Taylor&Francis Group. ISBN: 978-1-4987-0358-1. pp 387. (pp.363-373) DOI: 10.1201/b20025-24.
37. Stănică F (2019). Twenty Years of Jujube (Ziziphus Jujuba Mill.) Research in Romania. Scientific Papers. Series B, Horticulture, Vol. LXIII(2), Print ISSN 2285-5653, 17-24.
38. Sudhersan C, Jibi S, Ashkanani, J (2016). Ziziphus: a highly potential multipurpose woody perennial for desert environmental rehabilitation. Acta Horticulturae; 1116: 9–14. DOI:10.17660/actahortic. 2016.1116.2.
39. Varghese J, Patil MB (2005). Successive use of proteinase inhibitor of Zizyphus jujuba leaves for effective inhibition of Helicoverpa armigera gut enzymes and larval growth. Biosciences Biotechnology Research Asia; 3: 367-370.
40. Wang YK, Li DK, Sui CL, Zhao AL, Du XM (2009). Conservation, Characterization, Evaluation and Utilization of Chinese Jujube Germplasm Resources. Acta Horticulturae; 840: 235–240. DOI:10.17660/ actahortic.2009.840.29.
41. Wang BN, Cao W, Gao H, Fan MT, Zheng JB (2010). Simultaneous determination of six phenolic compounds in jujube by LC-ECD. Chromatographia; 71: 703–707.
42. Yan GJ, Ferguson AR (1993). The Chinese date or Chinese jujube. Horticulture in New Zealand; 4(2): 13-18.
43. Yao S, Zhao ZH (2016). Jujube (Ziziphus jujuba) in the United States: challenges and opportunities Acta Hortic; 1116. ISHS 2016. DOI 10.17660/ActaHortic.2016.1116.4 XXIX IHC – Proc. III Int. Jujube Symp. Eds.: Mengjun Liu et al.
44. Zhang Y, Wang Y, Zhao H, Zhang G, Peng D, Cao W (2019). Journal of Agricultural and Food Chemistry, Characterization of Novel Protein Component as Marker for Floral Origin of Jujube (*Ziziphus jujuba* Mill.) Honey; 67(44): 12255-12263 DOI: 10.1021/acs.jafc.9b05190.
45. Zhao J, Liu MJ, Liu XY, Zhao ZH (2009). Identification of resistant cultivar for jujube witches' broom disease and development of management strategies. Acta Horticulturae; 840: 409-412. DOI:10.17660/ ActaHortic.2009.840.57.