World Agroforestry

Food and Agriculture Organization of the United Nations

The International Treaty on Plant Genetic Resources for Food and Agriculture

Key descriptors for *Ziziphus mauritiana* (jujube)

INTERNATIONAL YEAR OF FRUITS AND VEGETABLES 2021

Key descriptors for

Ziziphus mauritiana

(jujube)

World Agroforestry (ICRAF) is a centre of science and development excellence that harnesses the benefits of trees for people and the environment.

Leveraging the world's largest repository of agroforestry science and information, we develop knowledge practices, from farmers' fields to the global sphere, to ensure food security and environmental sustainability.

ICRAF is the only institution that does globally significant agroforestry research in and for all of the developing tropics. Knowledge produced by ICRAF enables governments, development agencies and farmers to utilize the power of trees to make farming and livelihoods more environmentally, socially and economically sustainable at scales.

We are guided by the broad development challenges pursued by CGIAR, a global research partnership for a food-secure future, which include poverty reduction, increasing food and nutritional security and improved natural resource systems and environmental services. ICRAF's work also addresses many of the issues being tackled by the Sustainable Development Goals (SDGs), specifically those that aim to eradicate hunger, reduce poverty, provide affordable and clean energy, protect life on land, and combat climate change.

ICRAF's Vision is an equitable world where all people have viable livelihoods supported by healthy and productive landscapes.

The Centre's mission is to harness the multiple benefits trees provide for agriculture, livelihoods, resilience, and the future of our planet, from farmers' fields through to continental scales.

The objectives of the FAO International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) are the conservation and sustainable use of all plant genetic resources for food and agriculture (PGRFA) and the fair and equitable sharing of the benefits arising out of their use, in harmony with the Convention on Biological Diversity (CBD), for sustainable agriculture and food security.

The ITPGRFA text stresses the importance of in situ conservation and the need to collect and make publicly available related information. Particularly Article 5d which states that Contracting Parties shall *"Promote in situ conservation of wild crop relatives and wild plants for food production, including in protected areas, by supporting, inter alia, the efforts of indigenous and local communities"*.

Since 2015, the ITPGRFA has intensified its support to national institutions on the documentation and exchange of PGRFA data in the context of its Article 17 and the development of the Global Information System on PGRFA.

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Cover Photo: *Ziziphus mauritiana* (jujube) fruits

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PREFACE

The 'Key descriptors for *Ziziphus mauritiana* (jujube)' consists of an initial minimum set of characterization and evaluation descriptors for this species. This strategic set aims at facilitating access to and utilization of this African indigenous fruit tree. It does not exclude the addition of other descriptors later.

This work has been done jointly with the World Agroforestry (ICRAF) and the FAO International Treaty on Plant Genetic Resources for Food and Agriculture. The list was based on a preliminary List developed by World Agroforestry. In addition, internet searches were carried out looking for the most updated information on relevant characteristics and traits. The original List was subsequently integrated with evaluation traits. Special attention was given to the inclusion of descriptors relevant to nutritional components and biotic stresses of particular importance in the context of emerging adverse weather events which are expected to intensify under current and future climate challenges. Those included in this Key set have been chosen because of their global impact since they have wide geographic occurrence and cause significant economic damage.

The key set of access and utilization descriptors was defined through an online survey, in which 20 experts from 14 different organizations/universities from ten countries participated. Survey results were subsequently validated in consultation with a Core Advisory Group (see 'Contributors') led by Joyce Chege from ICRAF.

The strategic set of data standards is designed to facilitate access to and utilization of plant genetic resources for food and agriculture information. Together with passport information (Alercia *et al.* 2015, 2018), descriptors are critical to the effective sharing of characterization and evaluation data and to the efficient use of plant genetic resources for food and agriculture.

INTRODUCTION

Ziziphus mauritiana, commonly known as jujube, ber or Indian jujube, is an important multipurpose fruit tree of the hot and dry lowland tropical and subtropical Asia and Africa. It belongs to the family Rhamnaceae.

Jujube is native to Central and South Asia, and natural populations elsewhere have been attributed to ancient introductions. It is widely distributed in arid and semi-arid regions of the world, where it is found in cultivation or naturalized. Jujube has spread through cultivation and natural dispersal to over 100 countries in Africa, Australia, the Americas, and many Indian and Pacific Ocean Islands.

Jujube occurs naturally in dry deciduous and scrub forest in lowland areas. It thrives in extremely dry habitats, even yielding fruit under low rainfall and high temperatures. The tree grows on a wide range of soils, tolerates temperature extremes, and low and erratic rainfall. It withstands seasonal waterlogging and tolerates drought and high alkaline soils.

Jujube is an important fruit in the dry areas of Asia and sub-Saharan Africa contributing to food security and household income. Improved cultivars are planted for commercial fruit production. The fruit is a good source of vitamin C, sugars, and minerals including iron. Fruits are consumed fresh or processed into beverages, preserved by drying or candying. Fruits, seeds, leaves, bark and roots have medicinal applications. Leaves provide excellent fodder. The wood is used for making household implements and provides fuelwood and charcoal.

Jujube is an important component of dryland agroforestry systems where it is planted for fruit production, soil improvement, and live fencing.

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Particular thanks go to Francisco Lopez, from the International Treaty of FAO for his valuable advice during the publication process.

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KEY SET OF CHARACTERIZATION AND EVALUATION DESCRIPTORS FOR *ZIZIPHUS MAURITIANA* (JUJUBE)

This is an initial, minimum set of Characterization and Evaluation descriptors for jujube, that is useful in assisting researchers to utilize accessions more easily. This is not intended to be an exhaustive descriptor list, but rather a key list of descriptors and traits that are relevant to describing, categorizing, and especially utilizing germplasm of indigenous fruit trees.

- Ideally, observations should be made on trees of the same age, unless otherwise stated.

- For fruit descriptors, record the average measurement, or predominant shape of 25 ripe fruits randomly selected.

CHARACTERIZATION

1. Tree growth habit

1 Erect
2 Semi erect
3 Spreading
4 Drooping

2. Tree height [m]

Measured from ground level to the top of natural occurring trees.

3. Branch thorniness

0 Absent
1 Present

4. Leaf shape

Record the predominant shape using 10 leaves randomly selected.

1 Ovate
2 Oblong
3 Elliptic
4 Oval
5 Cordate
6 Obovate
99 Other (specify in the Notes descriptor)

5. Fruit weight [g FW]

Record the average fresh weight of 25 fruits randomly selected.

6. Fruit shape
Record the predominant shape using 25 mature fruits randomly selected.

1 Oblong
2 Oval
3 Ovate
4 Round
4 Ovoid
5 Obovate
99 Other (specify in the Notes descriptor)

7. Fruit length [cm]
Measured from the base to the tip of the fruit. Record the average length of 25 mature fruits randomly selected at the longest point.

8. Fruit width [cm]
Record the average diameter of 25 mature fruits randomly selected at the widest point.

9. Fruit taste

1 Sweet
2 Bitter
3 Apple-like
4 Acid

10. Fruit flesh colour

1 Pink
2 Yellow
99 Other (specify in the Notes descriptor)

11. Flesh texture

3 Soft
5 Intermediate
7 Hard

12. Stone shape
Record the predominant shape of 25 stones (nuts) randomly selected.

1 Round
2 Ovate
3 Oblong
4 Oval
5 Spindle
6 Club
99 Other (specify in the Notes descriptor)

13. Stone length [mm]

14. Stone width [mm]

15. 100-Kernel (seed) weight [g]

EVALUATION

16. Yield per tree [kg]

17. Number of mature fruits
Record the average number of mature fruits per tree.

18. Fruit seasonality
3 Early
5 Intermediate
7 Late

19. Ascorbic acid content (Vitamin C) [mg/100g FW]

20. Iron content [mg]

21. Calcium content [mg]

22. Phosphorus content [mg]

Biotic stresses

	Causal organism	Common name
23.	***Oidium* sp.**	**Powdery mildew**
24.	***Carpomyia vesuviana***	**Fruit fly**
25.	***Alternaria chartarum***	**Fruit rot**
26.	***Isariopsis indica* var. *zizyphi***	**Black leaf spot**
27.	***Phakopsora zizyphi-vulgaris***	**Leaf rust**
28.	***Zonocerus variegatus***	

29. NOTES

Specify any additional information here.

BIBLIOGRAPHY

Abdel-Sattar, M., Almutairi, K.F., Al-Saif, A.M. & Ahmed, A.K. 2021. Fruit properties during the harvest period of eleven Indian jujube (*Ziziphus mauritiana* Lamk.) cultivars. Saudi Journal of Biological Sciences, 28(6): 3424–3432.

Alercia, A. 2011. Bioversity International. Key characterization and evaluation descriptors: Methodologies for the assessment of 22 crops. Bioversity Technical Bulletin Series. Bioversity International, Rome, Italy. pp. 602. (also available at https://cgspace.cgiar.org/handle/10568/74491).

Alercia, A., Diulgheroff, S. & Mackay, M. 2015. Source/contributor: FAO (Food and Agriculture Organization of the United Nations), Bioversity International. In: FAO/Bioversity Multi-Crop Passport Descriptors (MCPD V.2.1). (also available at https://cgspace.cgiar.org/handle/10568/69166).

Alercia, A., López, F.M., Sackville Hamilton, N.R. & Marsella, M., 2018. Digital Object Identifiers for food crops - Descriptors and guidelines of the Global Information System. Rome, FAO. (also available at: http://www.fao.org/3/I8840EN/i8840en.pdf).

Alercia, A., López, F., Marsella, M., & Cerutti, A.L. 2021. Descriptors for Crop Wild Relatives conserved *in situ* (CWRI v.1). Rome, FAO on behalf of the International Treaty on Plant Genetic Resources for Food and Agriculture. (also available at https://doi.org/10.4060/cb3256en).

Arndt, S.K., Clifford, S.C. & Popp, M. 2001. *Ziziphus* - a Multipurpose Fruit Tree for Arid Regions. In: Breckle SW., Veste M., Wucherer W. (eds) Sustainable Land Use in Deserts, pp. 388–399. Springer, Berlin, Heidelberg. (also available at https://doi.org/10.1007/978-3-642-59560-8_41).

Bal, J.S. 1992. Identification of ber (*Ziziphus mauritiana* Lamk.) cultivars through vegetative and fruit characters. Acta Horticulturae, 317: 245–253.

Depommier, D. 1988. *Ziziphus mauritiana*: cultivation and use in Kapsiki country, northern Cameroon. Bois et Forêts des Tropiques, 218: 57–62.

Ghosh, S.N. and Mathew, B. (2002). Performance of nine ber (*Ziziphus mauritiana* Lamk.) cultivars on topworking in the semi-arid region of West Bengal. J. Appl. Hort. 4(1): 49–51.

Kaarira, S. 1998. The market potential of *Ziziphus mauritiana* Lamk. in Malawi. In International Workshop on *Ziziphus mauritiana* Lamk., Harare, Zimbabwe, 13–16 July.

Memon, A.A., Memon, N., Luthria, D.L., Pitafi, A.A. & Bhanger, M.I. 2012. Phenolic compounds and seed oil composition of *Ziziphus mauritiana* L. fruit. Polish Journal of Food and Nutrition sciences, 62(1).

Morton, J.F. 1987. Indian jujube. Fruits of warm climates, pp. 272–275. Florida Flair Books, Miami.

Muchuweti, M., Zenda, G., Ndhlala, A.R. & Kasiyamhuru, A. 2005. Sugars, organic acid, and phenolic compounds of *Ziziphus mauritiana* Fruit. European Food Research and Technology, 221: 570–574. (also available at https://doi.org/10.1007/s00217-005-1204-6).

Naseem, S., Muhammad J.J., Summar, A.N. & Faisal, S.A. 2018. Exploitation of diversity in domesticated and wild ber (*Ziziphus mauritiana* Lam.) germplasm for conservation and breeding in Pakistan. Scientia Horticulturae, 249: 228–239.

Pareek, S. 2021. Nutritional composition of jujube fruit. Emirates Journal of Food and Agriculture, 25(6): 463–470.

Rashwan, A.K., Karim, N., Shishir, M.R.I., Bao, T., Lu, Y. & Chen, W. 2020. Jujube fruit: A potential nutritious fruit. Journal of Functional Foods, 75.

Raut, V.U. & Diware, D.V. 2005. Effect of pruning time and severity on growth and development of ber (*Ziziphus mauritiana* Lamk.). Journal of Soils and Crops, 15(1): 60–63.

Razi, M.F.D., Anwar, R., Basra, S.M.A., Khan, M.M. & Khan, I.A. 2013. Morphological characterization of leaves and fruit of jujube (*Ziziphus mauritiana* Lamk.) Germplasm in Faisalabad, Pakistan. Pak. J. Agri. Sci., Vol. 50(2): 211–216.

Saran, P.L., Godara, A.K. & Sehrawat, S.K. 2006. Characterization of her (*Ziziphus mauritiana* Lamk.) genotypes. Haryana Journal of Horticultural Sciences, 35(3/4): 215–218.

Sharma, J.R., Bhatia, S.K., Gupta, R.B., Surender, S. & Gehlot R. 2008. Influence of nutrients and growth regulators on yield and quality of ber (*Ziziphus mauritiana* Lamk.) fruits cv. Umran. Haryana Journal of Horticultural Sciences, 37(3/4): 217–219.

Sharma, S., Sharma, R.K., Siddiqui, S., Goyal, R.K., Sharma, J.R. & Kumar S. 2008. Physico-chemical changes during growth and development of ber (*Ziziphus mauritiana* Lamk.). Haryana Journal of Horticultural Sciences, 37(1/2): 57–59.2016.

Singh, A.K., Sharma R. K., Singh, N.K., Bansal, K.C., Koundal, K.R. & Mohapatra, T. 2006. Genetic diversity in ber (*Ziziphus* spp.) revealed by AFLP markers. The Journal of Horticultural Science and Biotechnology 81: 205–210.

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