

Tropical Forages

Opuntia ficus-indica

Scientific name

Opuntia ficus-indica (L.) Mill.



Synonyms

Basionym: *Cactus ficus-indica* L.; *Cactus decumanus* Willd.; *Opuntia albicarpa* Scheinvar; *Opuntia amyclaea* Ten.; *Opuntia cordobensis* Speg.; *Opuntia decumana* (Willd.) Haw.; *Opuntia ficus-barbarica* A. Berger; *Opuntia ficus-indica* var. *gymnocarpa* (F.A.C. Weber) Speg.; *Opuntia gymnocarpa* F.A.C. Weber; *Opuntia hispanica* Griffiths; *Opuntia joconostle* F.A.C. Weber ex Diquet; *Opuntia maxima* Mill.; *Opuntia megacantha* Salm-Dyck; *Opuntia paraguayensis* K. Schum.

Family/tribe

Family: *Cactaceae* subfamily: *Opuntioideae* tribe: *Opuntieae*.

Morphological description

A slow-growing, succulent, segmented cactus, up to 5–7 m high with a crown of over 3 m in diameter; with age developing a trunk up to 1 m diameter; superficially spreading root system. Branches (cladodes) are flattened, obovate to oblong, 20–60 cm long × 10–40 cm wide, grey to grey-green; terminal cladodes always bright green, producing flowers and new growth; younger branches arching upwards. Leaves are generally reduced to few spines (to 2.5 cm long) on young cladodes and shed early; some varieties are spineless. Flowers located on the perimeter of the cladodes, conspicuous, yellow or orange, cup-shaped, 6–7 cm long × 5–7 cm wide; petaloids spreading, obovate to oblong-obovate, 2.5–3.5 × 1.5–2 cm, margin entire or erose, apex rounded, truncate, mucronate, or emarginate. The fruit is an oblong berry, 5–10 cm long × 4–9 cm wide, green at first ripening to yellow, orange, red or purple in colour (variety dependent), covered with clusters of minute spines. Number of viable seeds per fruit varies from 177 to 357.

Note: Cultivated *O. ficus-indica* forms are generally spineless, referred to by some as "var. *inermis*" or "forma *Inermis*". However, this is not a stable feature; formation of spines can be environmentally influenced.

Common names

English: Barbary-fig, cactus pear, Indian-fig, Indian-fig prickly-pear, mission cactus, mission prickly-pear, prickly-pear, smooth mountain prickly-pear, smooth prickly-pear, spineless cactus, sweet prickly-pear, tuberous prickly-pear, tuna cactus, yellow prickly pear

Africa: boereturksvy, doringblaar, grootdoringturksvy, kaalblaar, turksvy (Afrikaans); beles (Arabic, Eritrea, Ethiopia); idolofiya (Ndebele);



Spiny form with fruit, Eritrea



Spineless form



Closeup



Flowers located on the perimeter of the cladodes



Flowers cup-shaped, 6–7 cm long, 5–7 cm wide, San Francisco Botanical Garden



Spineless form with fruit



Fruit is an edible oblong berry containing many seeds



Close-up of seeds



Cladodes of spiny form browsed by camel without pre-treatment, Eritrea



Removing spines with fire to feed unarmed cladodes to cattle (Abay 2018)

mudorofia, munanazi (Shona)

Asia: 仙人掌 li guo xian ren zhang (China)

Indian subcontinent: hathlo thor, chorhthlo (Gujarati); haththathoira, nagphana, ■■■■■■■■ ■■■■■■ ■■■■■■■■ naagphnii, nagphani (Hindi); snuhi, vajrakantaka, bahushala (Sanskrit); nagadali, nagakkali, chapati balli (Tamil); nagamulla, nagajemudu (Telugu); nagphani, thuar (Urdu)

Europe: schijfcactus, vijgcactus (Dutch); figuier de Barbarie, figuier d'Inde, raquette (French); Figenkaktus, gelbe/grüne Kaktusfeige, indischer Feigenkaktus (German); fico d'India, pero pungente (Italian); fikonkaktus (Swedish)

Portuguese/Brazil: figo-da-Espanha, figo-da-Índia, figueira-da-Barbária, jamaracá, jurumbeba, orelha-de-onça, palma-de-gado, palma-gigante

Spanish/Spanish America: chumba, chumbera, higuera, nopal de Castilla, nopal pelón, tuna, tuna de Castilla, tuna mansa; nochtli (Mexico)



Cow browsing cactus after spines have been burnt off



Slicing cladodes to suitable size for feeding



Sheep feeding mixed ration with grass and legume



Cattle eating mixture containing cactus.

Distribution

Native:

Probable origin Mexico.

Cultivated/naturalized:

Macaronesia: Cape Verde, Madeira Islands, Canary Islands

Africa: Angola, Eritrea, Ethiopia, Kenya, Libya, Morocco, South Africa, Tunisia

Asia: Saudi Arabia, Yemen, Cyprus, Lebanon, Syria, Turkey, China (s.)

Australasia & Pacific: Australia, Hawaii

Europe: Greece, Italy, France (incl. Corsica), Spain (incl. Balears)

Northern America: USA (Arizona, California); Mexico

Central America & Caribbean: Cuba, Guadeloupe, Hispaniola, Netherlands Antilles, Nicaragua, Puerto Rico, Trinidad and Tobago (Trinidad)

South America: Argentina, Bolivia, Brazil, Ecuador, Paraguay

Uses/applications

Forage

O. ficus-indica is used for feeding various classes of livestock, including dairy cattle. In low rainfall countries it is a valuable source of energy and often water, although protein levels are low. It can provide up to 180 t H₂O/ha/yr stored in its tissue for livestock watering.

Environment

It is used in alley-cropping systems, in contour hedgerows for soil erosion control, and in rows as a windbreak. It can be used for land reclamation by virtue of its ease of establishment on degraded lands, and can improve soil fertility through cycling of nutrients and organic matter accumulation.

Other

O. ficus-indica is the most widespread and most commercially important cactus, and has been/is being widely introduced as a commercial fruit and vegetable (nopalitos) crop, more recently as part of forestry or agroforestry projects in developing countries. The thorny varieties are often used as defensive hedges. It is also one of the cactus hosts for the cochineal insect (*Dactylopius coccus* Homoptera: Dactylopiidae) used in the production of cochineal dyes.

Ecology

O. ficus-indica is native to regions with a sub-tropical to warm temperate climate typically with summer rains and cool and dry winters. It is naturalized and cultivated throughout the arid and semi-arid zones of the tropics and subtropics, including warm-temperate climates.

Soil requirements

Requires well-drained soils (with <15–20% clay content); adapted to a wide pH range; highest potential on fertile soils; able to grow on shallow and rocky substrates due to superficially spreading root system; no tolerance of salinity.

Moisture

Grows in an annual rainfall range of (150–) 250–800 (–1,200) mm with 5–8 dry months. Adaptation to low rainfall is partly due to the CAM (Crassulacean acid metabolism) photosynthetic pathway. Water use efficiency is 3–5 times higher than in C4 and C3 plants.

Temperature

Grows in regions with hot summers (mean maximum temperatures of 35–38 °C in the hottest month) and cool winters (mean minimum temperatures of 7–12 °C in the coldest month); survives <0 °C for brief duration. Nights should be cold.

Light

No shade tolerance.

Reproductive development

Flowering occurs on 1–2 yr-old cladodes. Reproduction is both sexual and vegetative; 10.9–18.5% of apomixis have been reported. For plantations, *O. ficus-indica* is vegetatively propagated (cladodes as propagative material). Plantations are exploitable after 3–4 years and fully grown after 7–10 years; can remain productive for >50 years under rational management.

Defoliation

Management (e.g. in terms of residual photosynthetic area after cutting) is necessary for sustainable production; depending on input level, harvests every 1–4 years possible.

Fire

Fire is used as one of the tools to control stands of *O. ficus-indica* if the species is becoming invasive.

Agronomy

Guidelines for establishment and management of sown forages.

Establishment

O. ficus-indica is, in general, vegetatively established (cladodes as propagative material). For rehabilitation/improvement of native rangeland, recommended density of 1,000–2,000 single or double cladodes per ha, with a spacing of 5–7 m between rows and 1–2 m within rows. For alley cropping, wide rows (e.g. 10–15 m) with the crop in the interspace. Initial weed control necessary.

Fertilizer

In spite of thriving particularly well on good soils, fertilization is applied only in intensively managed plantations, e.g. including fertigation. Exported nutrients (kg/ha/yr), based on 20 t harvested DM/ha/yr, are about 180 kg N, 32 kg P, 516 kg K and 470 kg Ca and must be replaced by fertilization if the system is to be sustainable. Organic fertilizer is reported to be particularly effective. Fertilization with N has been reported to increase CP content.

Compatibility (with other species)

During establishment phase, susceptible to competition by weeds.

Companion species

Legumes: *Gliricidia sepium*, *Leucaena leucocephala* and *Prosopis juliflora* for alley-cropping in Northeast Brazil. Suitable for alley cropping with maize, barley and sorghum.

Pests and diseases

A number of region-dependent fungal and bacterial diseases are reported for *O. ficus-indica*, also phytoplasmas. Their potential threat to forage plantations appears to be only little studied however. Among insects pests, cottony cochineal (*Dactylopius opuntiae* Homoptera: Dactylopiidae) is considered as the most important pest. The cladodes of young plants are susceptible to attack by the cactus moth (*Cactoblastis cactorum* Lepidoptera: Pyralidae), the biological control agent responsible for the near-eradication of the environmental weed *Opuntia* in parts of Australia.

Ability to spread

Dispersal by seed through animals; also via vegetative propagation.

Weed potential

Discussion on the weed potential of *O. ficus-indica* is controversial. The species is considered a landscape transformer as it displaces indigenous species and dependent animals. In some countries (e.g. South Africa and most Australian states) it is listed as a noxious weed, but in other arid and semiarid areas, it is considered a valuable species because of its multi-use potential, provided management is appropriate.

Feeding value

Nutritive value

Nutritive value decreases with age of cladodes; concentrations of fibre and crude protein are reported to be low (CP 3–5%, but properly fertilized >10% is possible); high concentrations of digestible carbohydrates. IVDMD around 75%. Very high water content (80–95%). It is a good source of vitamin A, calcium and magnesium, but is low in sodium, potassium and phosphorus.

Palatability/acceptability

Cladodes of spineless forms are highly palatable to livestock. Spiny forms often require treatment such as burning or a mechanical process to remove or pulverize the spines to make the cladodes more acceptable. Camels are able to ingest cladodes with spines intact.

Toxicity

Low amounts of tannins and saponins, also oxalates, have been reported, without affecting livestock production.

Feedipedia links

<https://www.feedipedia.org/node/120>

<https://www.feedipedia.org/content/cactus-fodder-and-beyond>

Production potential

Dry matter

About 20 t DM ha/yr are frequently reported, but >50 t DM ha/yr have been achieved in intensive cultivation systems (optimum plant density and management including fertilization; northeast Brazil). When rehabilitated with *O. ficus-indica*, native rangeland productivity can increase several-fold (Tunisia).

Animal production

Supplementing low quality forage with fresh *O. ficus-indica* increases the average daily gain of growing ruminants, particularly when N is added. In diets of dairy cows and dairy goats, a considerable portion of concentrates can very economically be substituted by *O. ficus-indica*.

Genetics/breeding

$2n = 22$; cultivated forms may be octoploids ($2n = 88$) or hexaploids ($2n = 66$). Triploids ($2n = 33$), tetraploids ($2n = 44$) and pentaploids ($2n = 55$) have also been identified. There are breeding programs (including hybridization with other *Opuntia* species), part of which also focus on forage production, in Mexico, Brazil, Italy and USA. Main selection criteria for forage types are improved nutritional content, frost tolerance, spineless cladodes, high productivity and quick recovery after pruning, wider adaptability (especially to tropical dry & heat), adaptation to intensive production systems, and pest and disease tolerance.

Seed production

Though establishment of *O. ficus-indica* is mainly by vegetative propagation, seed production is possible; after initial dormancy (scarification necessary), maximum germination occurs after 9 months.

Herbicide effects

Pre-emergence herbicides, Diuron, Tebuthiuron, or a combination of Simazine and Ametryne, are effective for weed control at establishment. To combat *O. ficus-indica* when it becomes invasive, a combination of chemical, mechanical (incl. fire) and biological controls has been suggested.

Strengths

- Very high water use efficiency.
- Multipurpose species.
- High water content (drinking requirements of livestock).
- High DM production potential.

Limitations

- Invasive weed potential.

- Low contents of CP and fibre.
- High water content (transportation costs).
- Supplement to other feedstuff only.

Internet links

<https://www.cabi.org/isc/datasheet/37714>

http://apps.worldagroforestry.org/treedb/AFTPDFS/Opuntia_ficus-indica.PDF

[https://keys.lucidcentral.org/keys/v3/eafrinet/weeds/key/weeds/Media/Html/Opuntia_ficus-indica_\(Sweet_Prickly_Pear\).htm](https://keys.lucidcentral.org/keys/v3/eafrinet/weeds/key/weeds/Media/Html/Opuntia_ficus-indica_(Sweet_Prickly_Pear).htm)

<http://www.fao.org/3/Y2808E/y2808e0e.htm>

Selected references

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Inglese, P., Mondragon, C., Nefzaoui, A., Sáenz, C., Taguchi, M., Makkar, H. and Louhaichi, M. (2017) Crop ecology, cultivation and uses of cactus pear. Food and Agriculture Organization of the United Nations, (FAO), Rome, Italy. hdl.handle.net/20.500.11766/8263

Misra, A.K., Kumar, S., Kumar, T.K., Ahmed, S., Palsaniya, D.R., Ghosh, P.K., Louhaichi, M., Sarker, A., Hassan, S. and Ates, S. (2018) Nutrient intake and utilization in sheep fed opuntia [*Opuntia ficus-indica* (L.) Mill.] in combination with conventional green and dry fodders. *Range Management & Agroforestry* 39 (1):97–102. hdl.handle.net/20.500.11766/8565

Mondragón-Jacobo, C. and Pérez-González, S. (eds). (2001) Cactus (*Opuntia* spp.) as Forage. FAO Plant Production and Protection Paper No. 169. Food and Agriculture Organization of the United Nations (FAO), Rome, Italy. [fao.org/3/Y2808E/y2808e00.htm](http://www.fao.org/3/Y2808E/y2808e00.htm)

Pasiecznik, N. (2007) Datasheet for *Opuntia ficus-indica* (prickly pear). CABI Invasive Species Compendium, Wallingford, Oxon, UK. [cabi.org/isc/datasheet/37714](https://www.cabi.org/isc/datasheet/37714)

Cultivars

'Palma Gigante', 'Palma Redonda', 'Orelha de elefante', 'Mexicana', 'IPA-Clone 20' Released in Brazil

'CPF1', 'CPF2', 'CPF3', 'ANF1', 'ANV1', 'Pabellón' Released in Mexico

'Zukini' Origin unknown; a red-fruited spineless cultivar

'Burbank Spineless', 'Sweet Emerald', 'Sweet Crimson', 'Sweet Purple', 'Sweet Sunset' Released in USA

Much of the selection is based on fruit quality.

Promising accessions

None reported.

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