

Indigenous ornamental flora for arid landscapes

The indigenous arid flora can tolerate harsh climatic condition and remains in presentable form during intense summer heat (50°C temperature) and during severe winter frost (-2°C), which makes them highly apposite for arid landscape with round the year acceptability. While most of the exotic ornamentals cannot tolerate extremities of climatic vagaries and showed high mortality and remains in presentable form only during short periods of milder climate or under indoor condition. The native flora of the desert are also crucial for maintaining the biodiversity of the arid eco-systems. Apart from the food and fodder utilization, these desert flora could also serve the purpose of ornamental gardening. Having peculiar characteristics obtained through leaf, stem or other modifications, they are highly suitable as specimen plants in the garden landscapes. The arid flora of the desert eco-system has the additional benefit of less water requirement rendering low maintenance and care compared to other ornamental species of other regions. However, some exotic flora such as bottle brush, bougainvillea, *Euphorbia milii*, *Lantana camera* and *Jatropha gossypifolia* etc. were introduced from other regions and showed high adaptability to arid climatic condition. In this way, the indigenous arid flora have special significance in landscaping of arid region as these are ecologically adaptable and economically viable.

THE harsh climate of arid regions supports a surprisingly large number of hardy, drought-resistant plant species. A major pie of the harsh landscape is located in the northwestern part of the country considered as the great Thar Desert of India. These arid regions are bestowed with a wide range of flora that has been adapted to the desert conditions of sandy soil, scarce water and high solar intensity. Some flora have subterranean root systems that tap deep into low ground water levels, others have smaller or no leaves, and spiky thorns to save on water loss through transpiration. Some species, particularly grasses,

and small herbaceous plants are ephemerals in that they live in short seasonal cycles; they germinate in the first rains in July and die out by the time the soil dries up by December, leaving behind seeds that will bloom again next year. The indigenous arid flora of the desert remains crucial for the survival of the nomadic pastoral and agricultural communities, providing them with food,



Khejri 'Thar Shoba' trees with lush green foliage



Date ornamental



Rohira (*Tecomella undulata*)

fodder, fuel, traditional medicines and a host of other derivatives. The desert flora could be broadly classified into trees, shrubs, climbers and grasses.

TREES

Desert trees are the native plants of the arid ecosystem adapted to the harsh weather and soil conditions over the centuries. They rarely grow as big as those of humid and semiarid ecosystems, but provide shelter to a range of desert fauna and even food and fodder for the desert inhabitants. Lack of nutrients, too much exposure to hostile nature, and low humidity, contribute to smaller stature more suitable for arid regions. Most of them grow in the outermost area of the deserts, where there is more water available. Some of the desert trees have ornamental appearance and have the potential to be used in the ornamental landscapes as avenue plants or as an element of 'focal point'. Some of the desert trees highly suitable for ornamental landscaping include Khejri, Rohira, Kumath, Pilu, Neem, Shisham, Lasoda and Bael etc.

Khejri (*Prosopis cineraria*)

Also known as Jammi, Shami, Khejri Tree, Jand, or Ghaf, is a species of flowering tree in the pea family, Fabaceae. It is native to arid

portions of Western Asia and the Indian Subcontinent. In India, it is declared as state tree of two states *i.e.* Rajasthan and Telangana. The tree is found in extremely arid conditions, with rainfall as low as 150 mm annually; but is indicative of the presence of a deep water table. As with some other *Prosopis* spp., *P. cineraria* has demonstrated a tolerance of highly alkaline and saline environments. During the harsh summers, the khejri plants show up lush green appearance, thus making it highly suitable for arid landscaping with very low water requirement and maintenance. ICAR-Central Institute for Arid Horticulture, Bikaner has developed a dual purpose variety of khejri "Thar Shobha" which is thornless, dwarf and suitable for vegetable pod and fodder. It has extremely ornamental fine textured foliage particularly during severe summer (April to June). It is highly responsive to pruning and can be easily maintained as leafless condition during winter when sun light is required, which make it most apposite specimen tree, screening tree for kitchen garden or as avenue tree under water deficit condition of hot arid region. It is propagated by patch budding on seedling rootstock.

Pilu/ Jaal (*Salvodara persica*)

Popularly known as meswak tree, as the chewing sticks are used for oral hygiene, religious and social purposes. It is native to India, Africa and the Middle East; belonging to the family salvodoraceae. The pilu tree is a salt-tolerant shrub or small tree, living in arid zones. It is a large, well-branched evergreen shrub or small tree having soft whitish yellow wood. The bark is of old stems rugose, branches are numerous, drooping, glabrous, terete, finely striate, shining, and almost white. Fruits are small, globose, smooth and becomes red when ripe. It is suitable as a focal element in the arid landscape or as an avenue tree. It remains green during extreme summer and provides shelters for birds and animals. It is propagated by seed.



Neem



Datepalm



Lasora



Khejri

Arid trees for avenue plantation



Bael tree with golden yellow foliage during leaf shading

Indian date (*Phoenix sylvestris*)

It is widely cultivated as a fruit crop in the arid regions of the world as well as India. In other regions, it is mostly grown as an ornamental plant and used in the urban landscaping. It has the special advantage of tolerance to extreme temperatures and saline water conditions. Date palm is also grown an ornamental tree along road side and in front of buildings. The major advantage with the date palm trees is that they possess shallow root system and facilitate transplantation of huge, aged plants creating grand looking landscapes overnight. It is quite popular as an avenue plant in the urban landscapes of international airports, and hotels. It is propagated by suckers, seed and tissue culture.

Rohira (*Tecomella undulata*)

The tree species is popular as Desert teak/ Marwar teak and is found locally in the Thar Desert regions of India and Pakistan. It is a slow growing, deciduous or nearly evergreen tree of arid and semi-arid regions. It occurs on



Nerium as a flowering shrub

flat and undulating areas including gentle hill slopes and sometimes also in ravines. It is well adapted to drained loamy to sandy loam soil having pH 6.5-8.0. The species thrives very well on stabilized sand dunes, which experience extreme low and high temperatures. It grows in areas of scanty rainfall (annual 150-500 mm) and high temperature (35°C to 48°C). It can withstand extreme low temperature (0°C to -2°C) during winter and high temperature (48°C to 50°C) in summers. The tree is a strong light demander. It is drought, frost, fire and wind hardy. At the time of flowering (December–February) it produces beautiful showy flowers in yellow, orange and red colours. This is best suited as an avenue tree in the arid landscapes. It is propagated by seed.

Neem (*Azadirachta indica*)

The neem is a tough evergreen tree, that offers leafy appeal, honey-scented blossoms, year round shade and perhaps the key to a future of soft pesticides. It is native to India and is ideal for revegetating barren landscapes. Its rapid growth, deep root system, and ideal CO₂ balance make it the “air conditioner” of choice. Because of its fast-growing biomass and ability to provide stable wind protection, it can quickly regenerate leached soils and turn them into fertile land. Being tall and leafy with dense



Hop bush



Henna

Arid flora amenable for garden hedging

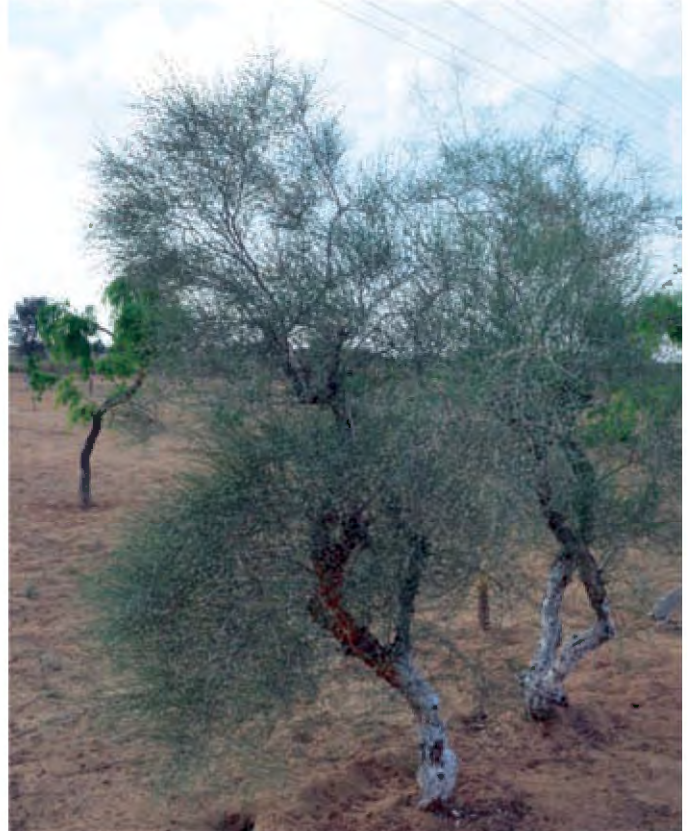


Ker (*Capparis decidua*)

crown, it could be well placed as a garden centerpiece or as an avenue plant. More than just a specimen plant, the neem tree provides a lot and demands only a little in a garden. It offers shade in a hot area with little rainfall and is extremely drought-resistant. It thrives in almost any well-draining soil, including deep sand, in sun or partial shade and in an outdoor garden or container indoors. Additionally, this tree improves soil fertility, neutralizes acidic soil and increases soil's water-holding capacity. It can be pruned and maintained as leafless during winter when sunlight is required. It is multiplied by seed and cutting. Now-a-days due to high demand of organic produce it is commercially used for making neem cake and neem oil.

Lasora (*Cordia spp.*)

It is a medium-sized broad-leaved deciduous tree and the fruits are popularly known as Assyrian plum/ Gonda. Though originated in China, it is found grown primarily in the Asia and other tropical regions all over the world. It flourishes well in the sandy soil of arid region. The fruits are edible and hence are used in the preparation of preserves, pickles and many other ayurvedic preparations. The wood being moderately hard, yields good quality



Phog as protective fence

timber. It is generally used for making ornamental furniture, house posts, beams, scantlings, planks, dugout canoes, boats, tea boxes, cart shafts, axles, yokes, well-curbs, agricultural implements, combs, gun stocks, naves, spokes, *etc.* Have the potential to be used as an avenue plant.

Shisham (*Dalbergia sissoo*)

Most popular as north Indian Rosewood, shisham is a hardy, deciduous, fast-growing species with light crown. Leaves are leathery, alternate, and pinnately compound while flowers are whitish to pink, fragrant, and nearly sessile, blooming in dense clusters. Pods are oblong, flat, thin, strap-like. It is best known internationally as a premier timber species of the rosewood genus. However, Shisham is also an important fuel wood, shade, and shelter plant. With its multiple products, tolerance of light frosts and long dry seasons, this species deserves greater consideration for tree farming, reforestation and agro forestry applications. After teak, it is the most important cultivated timber tree in India, planted on roadsides, and as a shade tree for tea plantations. It is pruning responsive, can be maintained as leafless during winter and multiplied



Hingota

by seed and cutting.

Bael (*Aegle marmelos*)

It is considered as one of the sacred trees of Hindus and used for worship of lord Shiva and native to Indian sub-continent. It is known as Bengal quince, golden apple, and Japanese bitter orange or stone apple. It is highly drought tolerant and have very deep root system with slow growth in initial years. Bael is grown as shade tree and have ornamental fruits. Fruits have high medicinal value, rich in Vitamin B and marmelosin content and used for making preserve, juice and powder making. It is propagated by seed and patch budding. This could be used as an avenue tree or shade plant.



Rangoon creeper



Jasminum grandiflorum

SHRUBS

Shrubs are an integral component of any ecosystem and are important from both ecological and economical point of view. In arid regions shrubs have distinct significance, as these are hardy, have high adaptability to arid environment. Shrubs are the source of food, fuel, fodder, fibre, gum, dye, and other products in these biomass deficient areas. The shrub as a vegetation form is hardier than the tree is proved beyond doubt by the presence of shrubs beyond the tree limit. Since ages, the shrubs of the arid eco-system have been the lifeline for the survival of human and livestock in the region. Some of these herbs could serve the purpose of ornamental gardening if placed in a right position. Indian arid zone is endowed with unique resources of such ornamental shrubs which have the wide scope for utilization in the ornamental gardening as hedge, topiary, border plants, biofence, etc.



Bui (*Aerva javanica*) as a potential dry flower



Kheemp (*Leptadenia pyrothecnica*) as a potential hedge/live fence

Nerium (*Nerium oleander*)

It is a shrub or small tree in the dogbane family Apocynaceae, toxic in all its parts. It is the only species currently classified in the genus *Nerium*. Oleander is a vigorous grower in warm subtropical regions, where it is extensively used as an ornamental plant in parks, along roadsides and in private gardens. It is most commonly grown in its natural shrub form, but can be trained into a small tree with a single trunk. Hardy versions like white, red and pink oleander will tolerate occasional light frost down to -10°C , though the leaves may be damaged. The toxicity of oleander renders it deer-resistant and its large size makes for a good windbreak – as such it is frequently planted as a hedge along buildings. The plant is tolerant of poor soils, intense heat, salt spray, and sustained drought – although it will flower and grow more vigorously with regular water. The flowers are showy, profuse, and often fragrant, which makes them very attractive in many contexts. It is propagated easily by seed and stem cutting.

Henna (*Lawsonia inermis*)

Henna is a heavily-scented, much-branched, slender, evergreen shrub or small tree. The plant is often cultivated in tropical and subtropical areas both for its use as a dye plant and also as an ornamental, being appreciated especially for the strong, pleasant fragrance of its flowers, which is reminiscent of tea rose (*Rosa chinensis*). Mass flowering was recorded twice a year, where 75% of the canopy was covered with flowers. Flowers are attractive, scented and bloomed in the morning and last for two days. It attracts butterflies, bees and birds. Tree architecture is attractive and the plant can fit into a small space. Because of its dense habit of growth, and amenability to pruning, the plant is particularly useful as a hedge. It is traditionally planted as a windbreak in vineyards. It is propagated

by seed and stem cutting.

Hop bush (*Dodonaea viscosa*)

This is a native desert shrub which has attractive, lush green foliage and growth habit similar to oleander. They can be used as an attractive green hedge and/or screening. They don't have colorful flowers; but their bright green foliage is their strong point. Hop bush can be allowed to grow into their natural shape or pruned into a formal hedge. This shrub does best in soil with good drainage. It has an upright growth habit that requires plenty of sunlight to reach its full height. The hop bush has an excellent, natural shape and seldom requires pruning. Pruning is required only to reduce its size or to remove dead or damaged foliage in the spring. Water deeply once a month in the summer, and rely on rainfall in the winter. It is propagated by seed.

Karonda (*Carissa carandas*)

It is a species of flowering shrub from the dogbane family Apocynaceae. It is a hardy, drought-tolerant plant that thrives well in a wide range of soils. It is an evergreen shrub or short statured plant with dichotomous branching. Mostly it is found grown wildly in various parts of India. It is well suited to arid climate and grow well at higher temperatures. Being a thorny shrub, it is popular as a live fence for the orchards, and gardens. Few cultivars have attractive red colored fruits rendering them to be used as a focal element in the gardening or even trained as a bonsai plant. The berry-sized fruits that are commonly used as a condiment in Indian pickles and spices. When ripe the fruits are rich in anthocyanins making them a good source for extraction of natural food colorants. It is propagated by seed.



Thhor

Ker (*Capparis decidua*)

It is an important

indigenous shrub found growing in natural wild landscape, along farm boundaries, orans, gochars (local grasslands) and wastelands, widely distributed in arid and semi-arid tracts of India. Its natural habitat is pediment plains all over the dry regions. It is an important constituent of desert ecosystems and plays a significant role in the rural economy of peoples of the northwest arid regions of the Indian sub-continent. The natives of the Thar Desert recognized the importance of this shrub long ago. It is an extremely hardy species and provides vegetative cover in hot, sandy desert areas where little else grows. The shrub has a mass of slender, leafless branches, the small caducous leaves being found only on young shoots. Red conspicuous flowers appear in March-April, giving a grand appearance to the plant. Fruits are used for pickling in western India. It could be well used as a live fence/ hedge in the landscape due to thorny nature. It is propagated by seed.

Phog (*Calligonum polygonoides*)

It is a small shrub with scattered distribution all over the arid and semi-arid regions of India. It commonly grows on dry sandy soils and on sand dunes. It is very hardy and being capable of growing under adverse conditions of soil and moisture. It is frost hardy. It produces root suckers and is easily propagated by cutting and layering. The plant is much branched, rigid shrub. Branches trete pale and glabrous. It generally exhibit leaf fall during winters. Leaves when present alternate, stipulate, linear and subulate; stipules short and membranous, cup shaped, obliquely truncate and produced upward at one side. The plant gives the appearance of *Casuarina* from a distance. Hence, it could be well placed in ornamental garden as a hedge plant and foliage can be used as filler and base material for bouquet making.

Hingota (*Balanites aegyptiaca*)

Balanites aegyptiaca is an arid species, classified either as a member of the Zygophyllaceae or the Balanitaceae. It is a small shrub found growing naturally in Thar Desert particularly khejri tree. It can be used as protective fence owing to spine. It has whitish leathery leaves.

Young leaves and tender shoots are used as a vegetable, which is boiled, pounded, then fried or fat added to prepare it. It is propagated by seed.

CLIMBERS/ CREEPERS

Creepers are the ornamental plants which have the potential to be used over pergolas, or trained into a particular shape made of wired mesh/ network. The climbers/creepers used in this arid regions are generally evergreen and flowers round the year. The most commonly used climbers are Rangoon creeper, Climber bougainvillea, *Ipomoea* spp., etc.

Rangoon creeper (*Combretum indicum*)

Popular as Chinese honeysuckle, is a vine with red flower clusters and native to tropical Asia. It is the most common climber used in the home gardens of urban landscapes. It is not uncommon to see the creeper rooted only in a small hole in cemented ground, but the vine thriving and climbing high. Clusters of fragrant white pendulous trumpets open white then change to pink, red and finally a deep maroon. It is a vigorous twining climber blooming profusely throughout summer that can reach as much as 70 feet in tropical climates. This plant needs support for growing and is very useful in covering fences, supports, and walls. The fragrant white flowers grow in pendent racemes, quickly changing to pink then red, making a spectacular show. The growth rate is generally fast, and the plant does not make heavy fertilizer demands. Rangoon creeper does like medium to bright light. Under good conditions it will be necessary to prune the plant to keep it in bounds. Rangoon creeper is found in thickets or secondary forests of the Philippines, India and Malaysia. It has since been cultivated widely in the gardens as an easy to grow plant.

Chameli/ Royal Jasmine (*Jasminum grandiflorum*)

Jasminum grandiflorum subsp. *grandiflorum* is the subspecies of the jasmine native to south Asia having naturalized populations distributed all over. It is basically a climbing shrub bearing flowers with unique

Adaptations in the arid ornamentals

For survivability in the harsh arid climatic conditions, viz. low rainfall, intense sunlight and dry winds; the arid flora have developed numerous xerophytic adaptations. One of the simplest adjustment is to have a shorter lifecycle, which is found in the desert ephemerals that germinate during the first rains of July and die out by the time the soil dries up by December, leaving behind seeds that will bloom in the following year. The native plant species of the arid region have adaptations that enable them to reproduce, grow and survive in the most inhospitable edaphoclimatic conditions. Some plants have evolved special root systems, while others have unique leaf characteristics that allow them to withstand prolonged periods of drought. Many woody species simply lose their leaves when soil moisture conditions become too dry. In general, the flora of arid ecosystem exhibits xeromorphological leaf structures, physiological control of transpiration and metabolism, moisture and nutrient storage organs, and thorns. Generally plants lose water vapour through leaves in the form of transpiration. To reduce the surface area of leaves, arid ornamentals have adaptations such as fewer branches, smaller leaves and thorns/spines. Few arid species such as kair (*Capparis decidua*) has new leaves for less than a month around March and usually exists as an untidy thicket of leafless twigs. Some plants have fine hair on the surface of leaves to break the airflow or a wax coating on the leaf surface to reflect sunlight. Both these adaptations can be seen in *Cactus* species, *Calotropis procera*. Succulents like cactus are able to store water in its tissues. Thhor (*Euphorbia caducifolia*) is the most visible cactus of this region that grows in a widening circle, providing, within its stalks, a protected, shady microhabitat for other plants. Species such as the khejri tree (*Prosopis cineraria*) and the kair shrub (*Capparis decidua*) have a deep root system to tap into groundwater reserves.



CIAH Garden



Junagarh Fort Landscape

sweet fragrance. The flowers grow from the tips of the stems in clusters of three to nine blooms. You should notice a strong, pleasant fragrance from the small white flowers typically blooming in Sept-Oct. especially in the arid regions. The scent of the Jasmine (spanish) is considered quite lovely. Commercially the plant is grown to produce perfume. In India, its leaves are widely used as an Ayurvedic herbal medicine and its flowers are used to adorn the coiffure of women.

EPHEMERALS AND HERBACEOUS ANNUALS

Arid ephemerals are the ornamental species which complete their lifecycle in a particular season, disperse their seeds and regrow with the onset of favourable conditions. They include flowering annuals and other ephemeral grass species with ornamental appearance. In addition to the mentioned species, all the winter annuals could be successfully grown in the arid regions during the winter seasons.

Bui (*Aerva javanica*)

It is also known as desert cotton or snow bush. It is a perennial semi-shrubby plant growing in tropical and subtropical dry areas. It is both erect and spreading, grows up to a height of 1.5 m high, and is covered with densely matted hairs on stems and leaves. It is muchbranched, with vigorous round stems that are woody at the base, and a dark stout taproot. It has numerous leaves, ovate to lance shaped, alternate and white to grey. The flowers are small and whitish and arranged in dense, woolly at branch-ends panicles. This herb is deep rooted, and is used as soil binder in desert reclamation. The dried woolly flower twigs have the potential to be used as such or after dyeing in the dry flower arrangements.

Broom brush/Kheemp (*Leptadenia pyrotechnica*)

This is a type of desert grass found in the desert parts of Rajasthan. This plant has wiry stems and leaves which grows upto two and half meters. This produce tiny star shaped flowers and thin elongated pods which are often used as vegetable by the desert dwellers. This plant is the best soil binder and the dried stems are often used for thatching purposes. It is very hardy in nature and the dried stems/leaves have the potential to be used in the dry flower industry.

CACTI AND SUCCULENTS

These are the group of plants that store water in their stems, roots and leaves. They are highly adaptive for this arid climates due to their inbuilt xerophytic adaptations. There are about 60 different plant families within this group. These plants have evolved in some of the toughest growing conditions on earth, and are actually at their best when grown in hot sun and poor soil. Cacti and succulents lend themselves to all sorts of garden uses: in stone walls, between patio pavers, in rock gardens, and even for creating green roofs. But one of the easiest ways to grow them is in containers, specifically small dishes or troughs made from stone, terracotta, concrete or hypertufa. Very few species are ind igenous to our country viz. as Milk Hedge (*Euphorbia caducifolia*) while most of them currently in use are being introduced from other arid regions viz. *Adeniums*, *Agave*, *Furkriya*, *Yucca*, *Nolina* spp., *Sansevaria*, Jade plant, *Pedalanthus*, *Bryophyllum*, *Euphorbia milii* etc.

Leafless spurge/Milk Hedge (*Euphorbia caducifolia*)

It is a great looking, sparsely spiny columnar branching Euphorbia. It is very similar to *Euphorbia nivulia* (Leafy Milk Hedge). It differs chiefly in being a many stemmed, cactus-like, shrub forming dense, dendride thickets with numerous branches arising from the very base and at the top. It is the major species in rocky desert areas of western and central India and Pakistan. It grows in stony ground on barren coastal plains and in the hilly tracts of the Indian desert on well-drained limestone soils as well on sandy soil, and therefore the substrate varies from slightly alkaline to slightly acidic. The plant is used in parks and gardens for ornamentals and also for protective hedges, due to the fragility of its branches together with the well known skin irritancy of its latex. It can also be kept as an indoor ornamental plant. The leaves of this species are boiled and eaten as a vegetable by the local population, after throwing the cooking water. It is used for the treatment of cough or application on the blisters, warts and pustules and applied to cuts and wounds for speedy healing. Pakistan young branches are burned and smoke inhaled to treat asthma. It is propagated by cuttings.

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