

Edible cactus:

A promising supplementary fodder crop for saline arid regions

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India is blessed with lavished agricultural systems, its large latitudinal sprawl and varied climate have resulted in diverse farming systems. The leading components of dominant farming systems (86%) of the country are crops and dairy animals. Despite sharing 4.11% of total gross value added and 25.6% of total agriculture gross value added, now-a-days the livestock sector is seeking shortage of feed and fodder and low productivity. The area under fodder crops in India is also stagnated from the last 2–3 decades. Further, the fertile land is generally allocated to the food crops and fodder crops are grown on marginal lands. Hence, there is urgent need to enhance the production of quality fodder from existing available land. At the same time, it is essential to explore new alternative fodder crops to supplement the existing fodder production system. Edible cactus is one of the promising nutrient rich fodder crop that can produce very high biomass with minimum input requirement.

Keywords: Fodder, Livestock, *Opuntia*, Saline arid

TRADITIONALLY India is a livestock-rearing country, possesses an economic symbiosis of crop and livestock production. Farming supports approximately 20% of the world's livestock population which contributes substantially to household nutritional security. The livestock population in India has increased by 4.6% from 512 million in 2012 to nearly 536 million in 2019. The returns from livestock especially dairy and mixed farming in small and medium holdings are highly sustainable. To feed this ever increasing livestock population cultivated fodders occupy only 4% of the entire cultivable land of the country. Presently, the country faces 35.6% net deficit of green fodder, 10.5% dry roughages, and 44% concentrate feed ingredients. The option for increasing land area under fodder cultivation is very limited. Hence, it is big challenge to utilize the available meagre land wisely and explore the non-traditional fodder

crops relatively better adapted to the arid environments.

India has nearly 33% of its geographical area in the semi-arid and arid category. A major part of arid and semi-arid region frequently suffers deficit rainfall or droughts, while whatever precipitation received is often concentrated in a short span of time. The degraded lands in arid and semi-arid regions are left for pastures, but their forage productivity is low, unstable and not remunerative. Often this results in acute shortages of fodder during the summer period that can perhaps be partly overcome by exploring potential alternatives that utilize resources more efficiently and thrives well in such an adverse climatic conditions. Edible cactus (*Opuntia ficus-indica*) can be a promising alternative fodder for livestock. It is a xerophytic plant widely cultivated in semi-arid lands of Latin America, Mexico and Mediterranean region and plays a crucial role in subsistence

agriculture. It was introduced in Mexico and the Mediterranean region in the beginning of the 16th century, where its products were popular among natives. By the time its fruits and cladodes have become popular for human consumption and cattle feed (fodder and forage).

Cactus pear can be cultivated in non-traditional areas and can provide a significant amount of forage for livestock. It can generate more dry matter with less irrigation water because of its specialized crassulacean acid metabolism (CAM) photosynthetic mechanism. Hence, cactus pear is beneficial not only because it can endure drought, nevertheless it has higher photosynthate conversion efficiency than C₃ and C₄ plants. In CAM plants biomass production per unit of water consumed is about 3 and 5 times higher than C₄ and C₃ plants, respectively. Albeit under optimum conditions, the different type of plants can produce similar amounts of dry matter per unit area but

under arid and semiarid conditions, CAM plants are relatively better performing than C_3 and C_4 plants. These traits beckon us to explore more production of flat-stemmed *Opuntia* in arid lands for fodder production. It can be regarded as a low-cost, low-input fodder crop for arid environments. Cactus pear also minimizes the water erosion of soil in arid land. Cactus pear is gaining popularity in low fertile and water deficit regions of the world because of its distinct qualities that enables us to cope with the burgeoning effects of climate change and population pressure. Despite its recent introduction in India, it has shown its ability to reduce green fodder shortages. Nonetheless, a thorough understanding of the yield responses to various agronomic management practices in the field conditions will aid in improving crop output (Table 1).

Table 1. Performance of edible cactus in arid and semi-arid region in India

Parameter	Semi-arid region	Arid region
Plant height (cm)	42–54	46–63
Areoles/cladode	0.6–1.6	1.1–1.5
Number of cladode/plant	3.5–4.5	4–5
Length/width ratio	3.1–3.6	1.8–2.8
Survival (%)	87–80	90–100

Cultivation practices

Climatic requirements: Being a drought-hardy plant, prickly pear can be cultivated in the regions with scarce and erratic rainfall and limited irrigation water. On an average 300–600 mm rainfall in summer season is most suitable to meet water requirement of the crop. During winter season temperature below 5°C might adversely affect the cactus production. Hot sunny days are highly desirable for the crop.

Soil: Sandy and sandy loam soils are best for cactus while it can also thrive on heavy textured soils with adequate drainage and stony-sloppy lands at the foot hills. Prolonged water logging is highly unfavourable for crop establishment and the crop can be planted on any type of soils or on slightly alkaline

soils, rich in calcium and potassium.

Seed rate and planting: Cactus can be propagated from either seed or vegetative parts. However, one year-old cladodes are mostly used for planting. The planting should be done using upright method in which 1/3rd part of the cladode is below and 2/3rd above the ground. The moisture content of planting material should be lowered down by keeping it under shade for 4–6 weeks for suberization (hardening). Before planting, the leaves should be treated with fungicide solution to prevent root rot. In rainy season, planting should be done on ridges. Just after planting, irrigate each plant with 8–10 litres of water. Because initially cactus have shallow and spreading root system, therefore, it is essential that the upper 30 cm of soil is in good physical condition. Several thorn less varieties of *Opuntia ficus-indica* are available for multipurpose use as fodder and forage. Recommended available cultivars of thorn less cactus in India are No. 1270, No. 1271, No. 1280, Yellow San Cono, White Rocca Pal and Texas 1308.

Time of planting: Cactus can be planted throughout the year, but the best time for its planting is September–October and February–March.

Spacing: In general, 4 m row to row and 3 m spacing between the plants is optimum for maximum growth. However, spacing depends upon the type of cultivar and the purpose for which the plantation is being raised.

Irrigation: Under adequate rainfall of 500–600 mm cactus usually does not require additional irrigation. In case of sub optimal rainfall, 2–3 irrigations during critical stage of fruit formation should be applied to check fruit cracking and fruit drop. Under severe frost condition, a supplementary irrigation can be applied to reduce the impact of frost.

Fertilizer and manure application: To maintain appreciable amount of crude protein (10%) and dry matter production up to 50 t/ha, a fertilizer dose of 224 kg/ha nitrogen (N) is to be applied in every 2 years. For

better yield, about 5 kg farmyard manure/plant can be added.

Care: Pruning is done to give proper shape to the plants, to reduce competition for light, and it also improve yield, fruit quality and fruit size. It is done after reaping when crop is in dormant stage. Low hanging leaves, damaged and diseased leaves should be removed first. Pruning of fruits is important and to maintain optimum production, 10–15 fruits may be retained on each cladode.

Green fodder yield: The cactus can yield around 40–50 t/ha depending upon agronomic practices.

Edible cactus as a green fodder

The ability of cactus to store moisture in the tissue during drought conditions and produce fodder, fruit and valuable products, as well as its potential to avoid long-term deterioration of ecologically eroded habitats has spotlighted its significance in arid and semi-arid area. Cladodes (1–3 years) are abundant in water (75–90%), carbohydrates (60%), beta-carotene (6.5 mg/kg dry matter basis), have a high Ca: P ratio and are quite palatable. Essential amino acids are around 38% of the total protein content. These are often low in crude protein and fibre content; might also have high oxalates. Nutritional value of spineless cactus cladode is almost similar to some of the other conventional cereal fodders. Use of its cladodes as ruminant forage source reduces the water requirement which is of great significance to the livestock farmers particularly in drought prone areas. If cactus is fed along with leguminous fodder like Berseem hay or *Lathyrus*, it improves dry-matter intake (Per cent body weight of animal), hence the body weight of animal. Feeding cattle calves with cactus supplemented with 1 kg concentrate mixture improve crude protein, crude fibre and total digestible nutrient content. Its consumption as a single feed shouldn't exceed above a particular limit. On fresh matter basis, daily consumption in both cattle and small stock should not exceed 10% of animal body

weight. The cactus should be added equivalent of approximately 1% of the animal live weight in dry roughage, i.e. straw, hay, browse, grazing; or a ration must have a minimum dry-matter content of 25–30%. It can be mixed with other feed depending upon animal requirement and nutritive value of cactus. Before feeding, it should be chopped properly. Therefore, edible spineless cactus could be an alternate source of green fodder for livestock particularly small ruminants with due supplementation of nutrients especially protein. Rajasthan, Haryana, Maharashtra and other semi-arid states have adapted well to the native thorny and less thorny varieties (Table 2).

Table 2. Chemical composition of *Opuntia* spp.

Chemical composition (on dry-matter basis)	
Dry matter (%)	10–11
Crude protein (%)	11.81
Ether extract (%)	1.18
Fibre (%)	8.12
Calcium (%)	6.05
Phosphorus (%)	0.30
Magnesium (%)	3.15
Potassium (%)	1.82
Sodium (%)	0.05
Copper (mg/kg)	6.13
Carotene (µg/100 gm)	29
Ascorbic acid (µg/100 gm)	13

Source: NDDB (National Dairy Development Board)



Research experiments on spineless cactus for saline conditions at ICAR-Central Soil Salinity Research Institute, Karnal, Haryana

Economic benefits and future thrust

The edible cactus is a low input requiring CAM plant that can survive and adapted in wide range of environments. Its capability to produce economic yields in scanty rainfall areas having degraded soils make it a viable option for those areas where no other crops survive. It is a contingent crop for the salty drought prone areas of India. The studies indicated that, its forage quality and its high B:C ratio makes it more likely to sustain the livestock. It is an easy cultivation and low care is another advantage. Since groundwater is declining and agriculture sector is the largest consumer of irrigation water, there is a need to include edible cactus as a fodder crop.

SUMMARY

Edible cactus is a potential fodder crop that can produce biomass in large quantity and a viable

alternative to bridge the gap between the green fodder requirement and production in the areas having poor soils even in water scare region. It has remarkable nutritional quality, viz. dry-matter productivity, high palatability, cations and vitamin-A etc. Cultivation of cactus in those areas where no other fodder crop can be grown can accomplish the fodder requirement of ruminants with low inputs (water, fertilizer, planting material). By the time, cactus is becoming popularized for cultivation in few states of India, still cultivation is limited. Therefore, considering the merits and potential of cactus as well as its low popularity among farmers, there is a great need to amplify the efforts for technology transfer, adoption, diffusion and ultimately popularization.

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