

Thornless cactus: An Emerging Solution for Green Fodder Scarcity in Dry Regions of India under changing climate scenario

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Introduction

Livestock production is the inevitable pillar of Indian agriculture, contributing 4.11% to national GDP and a major source of employment and livelihood for more than 70% population in rural areas. Its contribution towards the agriculture sector has been unwaveringly increasing for decades. The large cultivatable parts of India comprise drylands and rainfed farming, which has played a unique role in agricultural production. The rainfed zones contribute around 60% of the country's net cultivated area and have annual rainfall from 500-1500 mm. Arid and semi-arid regions are characterized by highly variable, low and erratic rainfall, highly evapotranspiration, frequent drought occurrence, and poor fertile soils, limiting fodder production and threatening the sustainability of livestock-based systems in these areas. As a result, the shortage of fodder availability (35 % green fodder and 11 % dry forage) increases year by year, affecting milk and animal productivity.



Performance of Opuntia in arid regions

For a regular supply of succulent green fodder, round the year major challenge in the rainfed and arid region of the country. Which acts as an important factor behind the poor productivity of the animals in these poor resource areas. Under such conditions, the spineless cactus as non-conventional fodder becomes the most emerging solution for dairy farmers in these areas. The spineless cactus (*Opuntia ficus indica*), commonly known as prickly pear, nagphani or danda thohar, could become a potential fodder crop in dry regions due to the high survival rate and propagation capacity and production potential even the resource-poor condition and changing climate scenario of India.

Characteristics for aptness under poor resources

Due to the high input requirements of conventional fodder crops and natural growing pastures, farmers could not grow these crops in poor resource conditions. Cactus is highly succulents (85% water) and has a high biomass potential crop that provides 180 tonnes/ha/year of water stored in their cladodes and produce more than 20 tonnes of dry matter/ ha/year. It is a cost-effective supplementation for livestock water as well as nutrition. Its succulent and drought-tolerant behaviour enables the animals to survive for a long time without water in water deficit areas. Primarily, it can provide year-round fodder availability either in fresh forage or as stored feeding. Recently, farmers are adopting the crop in rainfed and dry regions is because of:-

- ✓ More efficient in converting water to dry matter than other crops even under high-stress conditions.
- ✓ Remain succulent and provide fodder round the years.
- ✓ Reduce the long-term degradation of the ecologically fragile environment.
- ✓ The remarkable characteristic of this plant (CAM plants) is high water use efficiency, which has about 3-times higher than for highly productive C₄ plants (such as maize or sugarcane) and 5-times higher than C₃ plants (such as alfalfa, cotton, or wheat) under similar environmental conditions.

Cactus as animal feed

The livestock sector faces many challenges, including climate change and fodder scarcity. A potential option for improving fodder availability in dry areas is adapting underexploited perennial crops. The perennial crops have lower input requirements and provide forage throughout the year. Generally, cactus is considered the future forage crop in the dryland

region because it produces higher dry matter under limited water situations due to its specialized photosynthetic mechanism called *Crassulacean Acid Metabolism* (CAM). The mechanism can be well adapted to extreme climatic conditions. It can provide fodder, especially under lean periods (March-June and November-December) when scarce green fodder.

Chemical composition of the cactus fodder

Although cactus is not a balanced feed but considered a cheap energy source, the cladodes have low crude protein content and should be mixed with protein sources for feeding. For use as fodder, cacti need supplementation with protein sources and fibrous feed like straws from cereals for optimum animal performance.

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	29 µg/100 gm
Ascorbic acid	13 µg/100 gm

(Source: NDDB)

Agro-practice fo cactus production

Cactus has enormous potential to augment forage production especially in drought-prone and degraded land areas. Because it is easy to grow with less care and maintenance under different climatic vagaries.

- **Soil:** Cactus thrives best on well-drained, shallow to medium-deep with sandy and sandy loam soils and gravely or stony lands. A rotting problem developed if waterlogging stagnated. Before planting field should be well prepared with a chisel plough before planting

up to a depth of 60-80 cm for good drainage. The plant can survive in adverse soil conditions of pH up to 8.5-9.0.

- **Climate:** Cactus prefer warm summer and cool, dry winter and grow in deserts of up to 50 and 60°C. The optimum temperature for cactus production ranges between 20° and 35°C, although some species can tolerate higher temperatures. It grows in zones with 200 to 450 mm annual precipitation, and conditions like an absence of frost, hail, and strong winds are suitable for cultivation.
- **Planting time and method:** In a nursery, planting is done in September-October and February-March. To avoid rotting problems, transplanting should be done before the onset of the rainy season. Planting is generally done with leaves known as cladodes. Traditionally it is propagated through the cutting of cladodes. The planting of cladodes with a row-to-row distance of 100 cm and plant to a plant of 40 cm. Cladodes collected from the plants are dried under shade for 8-15 days. To prevent the cladodes from rotting problems, the cladodes should be planted on ridges (30 cm high) in the north-south direction of the field. The Thumb rule keeps one-third of the cladode under the soil and two-thirds above the soil surface in an erect position for better survival and germination.



Boundaries plantation of Cactus

- **Cladode treatment:** To prevent the plant from various bacterial and fungal diseases, fresh cladodes should be essentially treated with a copper-based fungicide such as copper oxychloride (50% WP) or copper hydroxide (77% WP) @ 5 grams per litre of water.
- **Fertilizer management:** Apply well-decomposed FYM @ 10-15 ton/ha in the field 20-25 days before planting. For maximization of yield potential, typical fertilizations required for cactus is 60-100 kg nitrogen, 30-40 kg phosphorus, 30 kg potash and 10 kg Zinc sulphate per

ha. Before planting, mix the 30 kg nitrogen and the rest of the fertilizers and apply them to the soil. Apply 20 kg nitrogen as a top dressing in equal doses quarterly during the year.

- **Irrigation management:** After covering the roots of plants with soil, irrigate the cladodes for better root establishment. Irrigation of the plant with control water systems. Apply light irrigation to crop as per need and soil moisture availability. Drain excess water from the fields as it cannot tolerate waterlogging.

- **Harvesting, feeding and digestibility:**

For cactus harvesting, the cut and carry method is preferred overgrazing. It should not be allowed to be grazed directly by animals, as it is highly destructive and decreases plant longevity. When feeding to animals, it should be cut into small pieces, and two simple rules should be followed:

- (i) Although, cactus is an unbalanced diet source that should be fed in conjunction with fibrous foodstuffs (straw, hay, shrubs, etc.) and supplemented with an appropriate and inexpensive protein source such as leguminous crop.
- (ii) Cactus is rich in soluble carbohydrates and Ca but poor in Phosphorus. Therefore, it is recommended to
 - ✓ add molasses to the ration to avoid decreasing rumen cellulolytic activity.
 - ✓ reduce the grain quantity in the diet
 - ✓ before feeding the cactus, fed the animals with fibrous feeds (straw, hay).

Cactus is highly palatable, digestible and in-vitro digestibility values were found 67% for organic matter, 62% for dry matter, 72% for protein and 43% for crude fibre. An extra benefit of cactus cladodes feeding over traditional fodder crops is that overutilizing cladodes will not produce acidosis in ruminants because of its high mucilage content, which improves insalivation forestall an extraordinary reduction in rumen pH.

- **Varieties:** Several thornless varieties of *Opuntia ficus indica* are available for multipurpose use as fodder and forage. Recommended available cultivars of thornless cactus in India are No. 1270, No. 1271, No. 1280, Yellow San Cono, White Rocca Pal and Texas 1308.
- **Yield:** Under the recommended agro-practices, its yield varies from 80-100 t/ha of cladodes as animal feed. It is suggested to harvest cladodes at their full size and maturity for optimum yield and nutrition because they contain the lowest water and maximum nutrient content.

Summary

In addition to soil fertility and climate constraints, providing the optimum quantity of forage in dryland remains a constant challenge. The adoption of thornless cactus has incredible breadth in producing a copious amount of fodder to improve livestock productivity in arid and semi-arid regions. With proper care and maintenance, farmers have good opportunities to foster cactus-based livestock production systems, promote human livelihood security, and reduce the pressure on cultivated land. We can use field boundary plantation and alley-cropping practices with cereal, legume and pasture crops. The cactus field boundaries plantation also acts as a vegetative hedge to protect the field crops.



Boundary plantation of thornless Opuntia