# SURVIVAL AND SPROUTING BEHAVIOUR OF SPINELESS CACTUS AS INFLUENCED BY MOISTURE LOSS OF CLADODE IN ARID REGION, INDIA

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**Abstract**
In bio- and edapho-climatic constraints, enhanced human & livestock pressure and wide spread land degradation, *Optuntia ficus-indica* is viewed as a potential source of forage and fruit crop for arid and semi-arid regions of India. Since, planting of cladode in field immediately after detaching it from mother plant has not been so successful; therefore, present study was undertaken to understand the effect of moisture loss of cladode on survival and sprouting behaviour of Cactus pear (spineless cactus) in arid region. Data revealed that moisture loss of cladode influenced significantly the survival and sprouting behaviour of spineless cactus. Out of moisture loss of cladode ranging from 10-60 %, the best performance in term of sprouting, number of new cladode and growth has been observed in cladode treated with 10-20% loss of moisture. The maximum number of sprouting kids (1.66/cladode) and significantly more number/cladode was recorded at the 20 % moisture loss than other treatment. 20% reduced moisture treatment produced maximum kids (46) with cent percent sprouting pads which was at par with 10 % moisture loss, while lowest kids (15) in the 60% reduced moisture treatment with 50 percent sprouting pads. Thus cladode with 10% and 20% reduced moisture was the best treatment for planting in the field since it gave the maximum sprouting kids/pad than other treatment
**Keyword:** Sprouting, Survival, Suberization (moisture loss), Cactus pear, *Opuntia ficus-indica*

## Introduction

The western districts of Rajasthan (Indian Thar area) constitute 62% of the arid zone, which has a distinct rainfall gradient (100-370 mm). Thar region also supports a large livestock population, out-numbering humans population by about 4 times in Jaisalmer district, 3 times in Barmer, 2 times in Bikaner and 1.5 times in Jodhpur districts, as against only one-half in the rest of the country. In present bio- and edapho-climatic constraints, enhanced human & livestock pressure and wide spread land degradation, *Optuntia ficus-indica* is viewed as a source to meet multiple requirements of food, fruit, forage and host of other ecological benefits in arid regions of India. *Optuntia ficus-indica* is a multipurpose plant which is drought tolerant, having built in survival mechanism (CAM plant), easy to establish, produces large biomass thus having potential for improving the livelihood by rangeland and pastureland management, beside soil and water conservation. Cactus hedges, planted according to contour lines play role in erosion control. Soil physical properties and organic matter content are considerably improved under these hedges and immediate adjacent areas, with an improvement in organic matter and nitrogen as compared to non-treated fields. Marginal lands have been cheaply rehabilitated in Tunisia and Algeria by contour planting of cacti [5].

As a part of an Indo-US collaborative research program on *Opuntia* in India initiated by Dr. Peter Felker, Texas, USA, 33 *Opuntia* clones were introduced at the Nimbkar Agricultural Research Institute at Phalton in 1987, 5-different clone of fruit, forage and vegetable clones at Central Soil Salinity Research Institute at Karnal in 1991, 51 additional *Opuntia* clones from Texas A&M University-Kingsville at the National Research Centre for Arid Horticulture at Bikaner in January 1997. Of the 51 clones obtained from Texas A&M University, Kingsville, in January 1997, 48 have survived under Bikaner conditions. Nearly 12-month-old cladodes collected from CSSRI, Karnal and Bikaner, were planted using the upright planting method facing the east-west direction, keeping a distance of 3 m between rows and 1 m between the plants in Agra. Elite cactus material from CSSRI, Karnal, was introduced at National Research Centre for Agroforestry (NRCAF), Jhansi, in 1998.

Cactus pear [*Opuntia ficus-indica* (L.) Mill.], commonly known as prickly pear or tuna, is a new crop in India although it's spiny type, bearing very small fruits (locally called nagphani), is found wild in arid and semi-arid plateau regions. Owing to its xerophytic characteristics and capability for greater conversion of water to dry matter by a specialized photosynthetic mechanism called crassulacean acid metabolism [1,3], it was considered as a potential crop species for the water-scarce arid parts of India and it is already cultivated worldwide for fruit, forage, and vegetable (nopalitos) production. Also, cactus pear has multiple uses *viz*. its tender cladodes are used as fresh green vegetable and salad, mature cladodes or cactus stems are used as nutritive fodder for animals. The fruit, as well as cactus stem are used to prepare value-added products, such as jam, squash, wine, pickle, body lotions, shampoo, creams, etc. It also has several medicinal and industrial uses [8]. Since, planting of cladode in field immediately after detaching it from mother plant has not been so successful, present investigation was therefore to determine optimum seasoning (moisture loss %) of Cactus pear at the time of field planting for best survival in the field condition.

## Materials and Methods

The experimental site is located in CAZRI, Research farm, Jodhpur at an altitude of 241.71 m from MSL, latitude of 26.258 °N and longitude of 72.993 °E. The soil of the region is sandy, poor in water-holding capacity and fertility, having pH 8.3-8.5, EC 0.10-0.15 d $Sm^{-1}$ and 0.08-0.09% organic carbon. In some areas, soil salinity is common. The annual average rainfall is 365 mm, which is erratic and distributed between July and September. The mean monthly maximum temperature ranges from 43.4°C in the month of May during summer to 25.1°C in the month of December during winter, and the minimum monthly mean temperature ranges from 29.6°C to 9.1°C in summer and winter seasons, respectively.

120 Cladodes/pads having similar dimension were separated from different Cactus pear and measured its dimension *viz.* length, width, thickness (Using Vernier Caliper). Then, put them for air drying under shade so as to lose their fresh weight upto 10% (T-1), 20% (T-2), 30% (T-3), 40% (T-4), 50% (T-5) and 60% (T-6) of initial weight and planted them by keeping their 1/3 portion (5 cm) under the soil in the field as alley crop under the tree. Ridge and furrow method was used for planting. The spacing of cladodes was maintained 1x1 m in the alleys of tree. After Cladode lost the desired moisture percent, these were treated with cupper oxychloride (20g in 10 litre water) and streptocycline (1 g in 10 litre water) to prevent from fungal and bacterial attack, because association of the fungus *Phtophthora nicotiana* was observed with Cactus [4]. Light irrigation was given after planting by avoiding direct contact of water with cladode. Observations on their sprouting, survival, establishment and kids health were made at 2-3 days interval. Soil moisture content was assessed by Gravimetric method at 0-15 cm depth of soil.

Data obtained were analyzed using Randomized block design (RBD) for moisture loss treatment of cladode with critical difference (C.D.) at 5 per cent probability level.

## Results and Discussion

The sprouting kids/ cladode were influenced significantly by various moisture % of cladode as per treatment (Table.1). Data revealed that cactus pear with 10% and 20% moisture loss treatment gave more number of sprouted cladode and its survival. While, cladode treated with 50% and 60% gave poor survival and least sprouted cladode which was only half of cent percent sprouted cladode. The maximum

number of sprouting kids (1.66/cladode) and significantly more number/cladode were recorded at the 20 percent moisture loss (T-2) than other treatment, but were at par with 10% and 30% moisture loss treatment. While, 40%, 50% and 60% moisture loss treatments amongst themselves were at par. These findings are in consonance with finding of [2] who reported that 1-2 years old cladodes seasoned at 20-25 °C so as to lose 20 % their fresh weights and planted at the end of rainy season gave best results.

The maximum kids (46) produced were highest in the 20% moisture loss treatment with cent percent sprouting pads, while lowest (15) in the 60% moisture loss treatment with 50 percent sprouting pads. [6] in pots experiment on fifty-one cactus pear clones introduced from Texas A&M University, Kingsville, Texas, USA and found their survival under the hot arid conditions of Bikaner. Their performance was evaluated in pots with respect to sprouting, number of cladodes formed per plant, size of cladodes (cm), weight (g), and yield of cladodes and sprouting occurred in cactus cladode during 24 to 135 days and produced 1 to 6.5 new cladodes per plant in different clones and more cladodes per plant was observed in clones 1376 and 1458.

**Effect of cladode weight on Kids sprouting:**

The cladode dimensions before planting in field were presented in Table.2. The average number of kids produced per pad was influenced by weight of cladode. The more number of kids recorded with the increase in the weight of pad (Fig.1). The maximum kids/pad was produced when the weight of pad is 161-180 g. This observation indicated the mature cladode of weight approximately 161-180 g should be used for field planting to get better sprouting of kids per pad and survival of cactus in field.

**Speed of emergence (Days taken to sprout)**

It revealed that pads with 10% moisture loss treatment have high sprouting potential in initial week after field planting. There was difference in sprouting of cladode and only 10% moisture loss cladode showed high sprouting pattern in harsh condition of summer but as onset of rain and weather amelioration, there was drastic increase of sprouting kids in other treated cladode and 20% moisture loss treatment showed maximum sprouting after onset of rain (Fig.2). [6] recorded that clone 1308 (vegetable type) took the minimum period of 24 days for sprouting while the maximum period of 135 days was taken by clone 1379. However, most of the clones (32) sprouted in 45 to 75 days after planting under the arid conditions of Bikaner. Only four clones sprouted in 24 to 40 days and 11 clones sprouted after over 76 days. Similarly, the cladodes sprouted after 57 to 100 days after planting under the semiarid conditions of Karnal, India [8]. Earlier sprouting at Bikaner seems to be related to the warmer conditions during the month of February. [9] confirm the same finding as fruiting-type clone 1271 took 37 and 80 days in spring and monsoon season respectively, while 23 days were taken for sprouting in clone 1308 after planting in spring season. Cactus performance was evaluated by [7] in different pH soil (pH 8.1, 8.4, 8.7, 9.4, and 10.0) in pots and growth initiation was affected markedly by the pH levels of the medium. He recorded that growth started 54 days after planting at pH 8.1, whereas at pH 10.0, sprouting took about 90 days.

**Sprouting of Kids per pad**

Total number of kids produced per pad was highest in cladode treated with 20% moisture loss followed by 10% moisture loss treatment and it showed the decreasing trend as the moisture loss treatment increased from 30-60%. However, the total number of sprouted pads was also highest with 10% and 20% moisture loss treatment while recorded the decreasing trend as the moisture loss increased from 30-60% as indicated (Fig.3).

Early emergence of kids in pads is suited and good for the ecologically, biologically and economically. Biologically, a mature cladode produced kids/young pads which are leafy in nature in initial stage but as it grow the waxy coating developed on young pads and helps in survival under adverse condition. Climatologically, early emergence of young pads in cladode would help to survive in harsh condition and adverse climatic condition. Economically, early young pad in cactus pear could provide fodder availability in summer season when the scarcity of fodder is common serious problem in arid region of Rajasthan.

**Conclusion**

The mature cladode having weight more than 160 g is best suited for field planting since it gives higher kids per pad after planting. The cladode with 10% and 20% moisture treatment was the best treatment since it gave the maximum sprouting in field after planting and also recorded the maximum kids/pad. Therefore, generally moisture loss or dehydration of not more than 20% of the fresh weight of cladode is suitable for field planting.

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**Table.1. Sprouting pattern of Cladode as influenced by moisture content of pads**

| Treatments (Weight loss) | Sprouting Kids/Pads | Maximum kids produced | Sprouted Cladode | % Survival |
|---|---|---|---|---|
| T-1 (10%) | 1.60 | 43 | 20 | 100 |
| T-2 (20%) | 1.66 | 46 | 20 | 100 |
| T-3 (30%) | 1.51 | 39 | 17 | 85 |
| T-4 (40%) | 1.22 | 24 | 13 | 65 |
| T-5 (50%) | 1.09 | 17 | 10 | 50 |

| | | | | |
|---|---|---|---|---|
| T-6 (60%) | 1.05 | 15 | 10 | 50 |
| **C.D at 5%** | 0.17 | | | |
| | Significant | | | |

**Table.2. Measurement of Cladode dimension parameters before planting in field**

| Treatment (Wight loss) | Avg. Dimension of cladodes | | | Length to Width Ratio | Avg. Weight (g) | Sprouted cladode |
|---|---|---|---|---|---|---|
| | Length (cm) | Width (cm) | Thickness (mm) | | | |
| T-1 (10%) | 27.11 | 8.75 | 8.66 | 3.10 | 122.28 | 20 |
| T-2 (20%) | 27.70 | 8.59 | 6.86 | 3.22 | 107.80 | 20 |
| T-3 (30%) | 28.00 | 8.56 | 8.14 | 3.27 | 115.22 | 17 |
| T-4 (40%) | 26.66 | 8.53 | 7.63 | 3.13 | 106.43 | 13 |
| T-5 (50%) | 26.55 | 8.73 | 7.57 | 3.04 | 101.05 | 10 |
| T-6 (60%) | 25.89 | 8.82 | 7.38 | 2.94 | 97.97 | 10 |

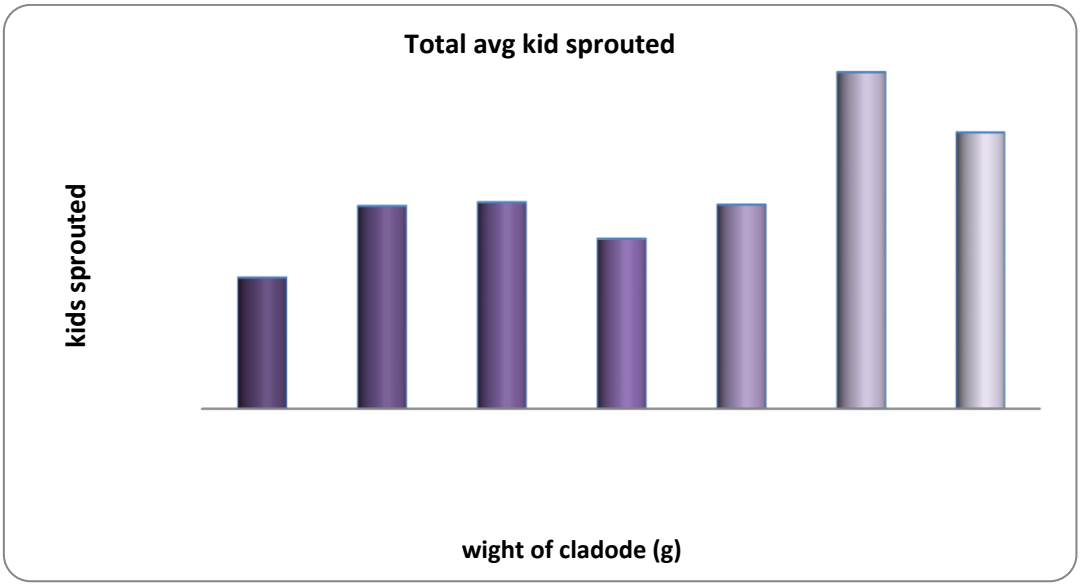


**Fig.1: Kids sprouting as influenced by cladode or pad weight**

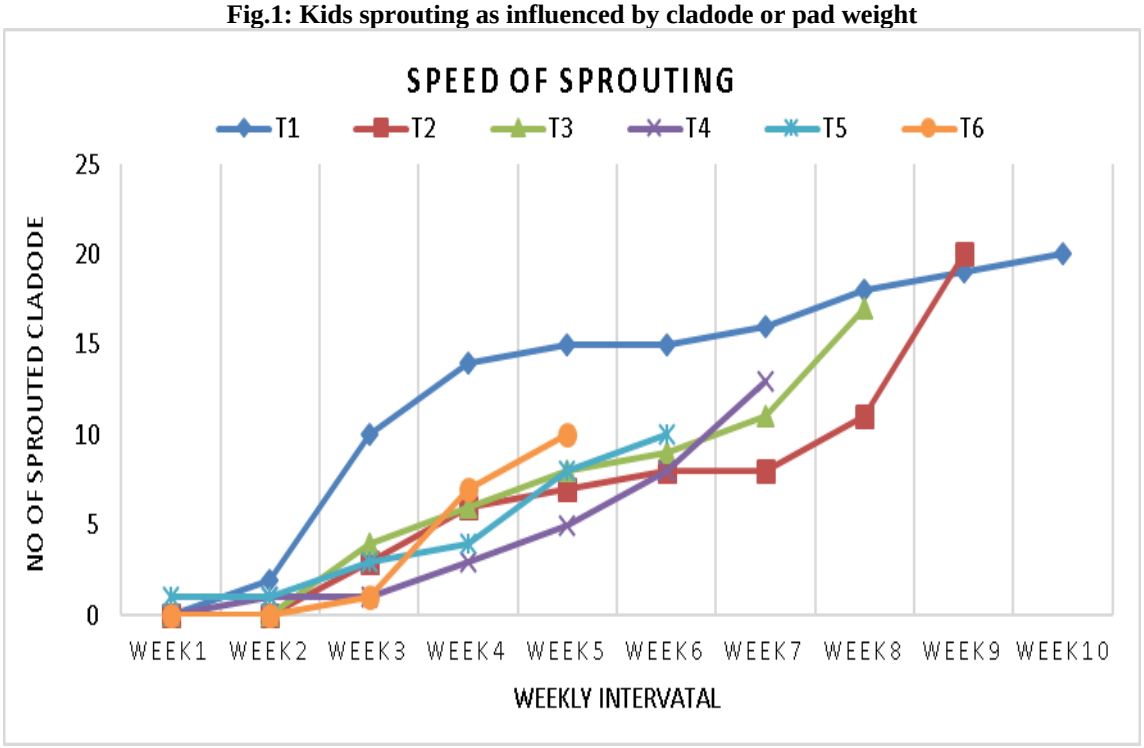


**Fig.2: Speed of Sprouting at weekly interval**

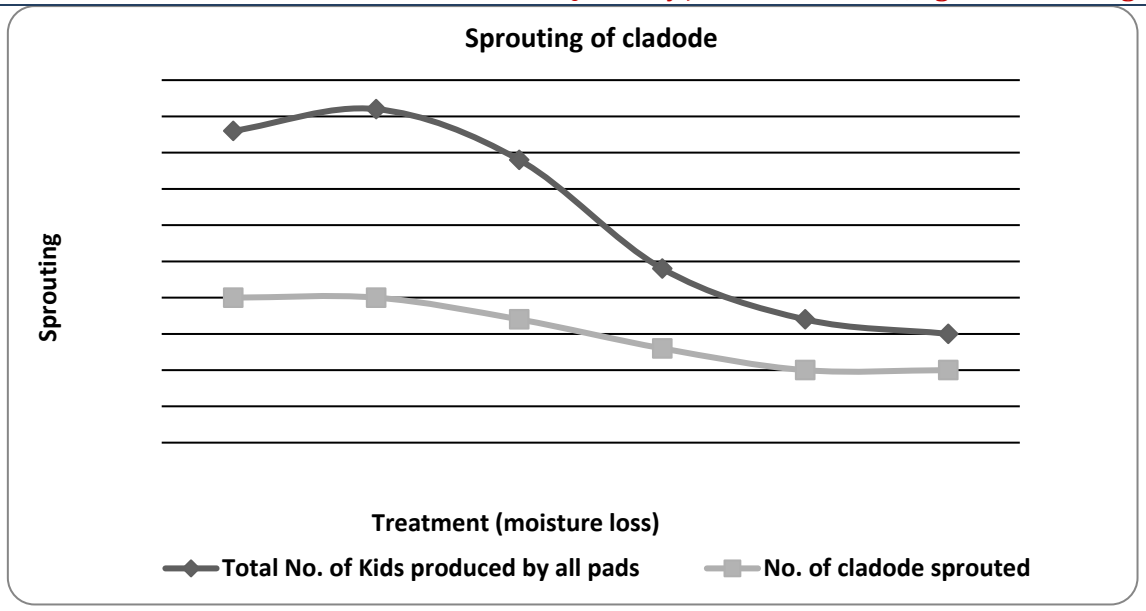


**Fig.3: Sprouting trend of cladode and kids produced/pad**