



Short communication

Performance of cactus pear at two geographical locations in Indian arid zone

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ABSTRACT

Twenty cactus pear (*Opuntia ficus-indica* Mill.) genotypes were introduced in India to assess its suitability and performance at two geographical locations *i.e.*, Jodhpur, Rajasthan (26°18'N:73°04'E, 216 m MSL) and Kutch-Bhuj, Gujarat (23°21'N:69°77'E, 15 m MSL) for survival and growth. The cladodes were planted in the potting mixture of soil and compost (6:1) with initial moisture regulated at 7-9% to prevent rotting. The rooted plants were transplanted in the field at 2 × 3 m spacing. Mortality due to bacterial rot ranged from 50 to 100 per cent at Jodhpur. The highest plant survival in the field after one year of planting was recorded in genotypes RojaxRojax-4-Pianta-25 and ARL spineless (50%) followed by 33.33% each in genotypes Bianco Macomer, Roja Castel Sardo, Gymnocarpe and clone No. 1270. Absolute mortality occurred in varieties Roja San Cono, Clone No.1287, Giall × Giall, Trunzara Red San Cono, A. Giant, Lyria and Militeo White. In contrast, better survival per cent (20-90%) was observed at Bhuj in different accessions. However, the performance and survival in pots under shade net house was almost 100% at both the locations but the growth was better at Bhuj as compared to Jodhpur. The establishment and growth of cactus pear was affected at Jodhpur due to high temperature coupled with low relative humidity (27.81-58.39%, 10 years mean). The coastal areas of Kutch-Bhuj have comparatively higher relative humidity (44-76%) favoured better growth of cactus. Based on this study, it can be inferred that Kutch-Bhuj region is comparatively better location for growing cactus pear.

Key words: *Opuntia ficus-indica*, pear, plant survival, high temperature, field establishment.

The Indian hot arid zone covers an area of 31.70 m.ha spread across seven states with major chunk in Rajasthan and Gujarat. These areas have extremes of temperature (often >45°C in peak summer and sub zero in winter), high wind velocity, light sandy soil, low uncertain and erratic annual rainfall (100-400 mm), with very high frequency of drought. The edible cactus pear could be considered a new hope for wasteland development (Singh and Peter, 7). This can be potential alternate crop especially to meet the fodder requirement of large animal population, an integral component in arid farming system. The cultivation and commercial exploitation of cactus pear for various purposes has been done in many countries (Pimienta *et al.*, 6; Barbera *et al.*, 1). In view of above, it has been introduced in India under various collaborative programmes from time to time. The most recent one was made during 2010-11 when 43 accessions were brought to CAZRI from Tunisia and Italy in collaboration with ICARDA. We present here the details of their performance at two locations in India.

Nineteen introduced cactus pear germplasm were first multiplied in the pots under shade net. The potting mixture was prepared by mixing the sandy soil and compost manures in 5:1 ratio. Partially moist (7-9%

moisture) potting mixture was filled in pots. About one year old cladodes were planted in the pots after 15th of February, 2011. No irrigation was given till 15 days of planting to avoid rotting of cladodes from the base. These cladodes were grown in the pots till October, 2011, which produced 2-3 new cladodes each. These plants were carefully transplanted in the field on 15th November, 2001 with entire soil of the pot undisturbed at the spacing of 2 m × 3 m with flat surface facing east-west side in Randomized Block Design with three replications having three plants per replication at two geographical locations, *i.e.* Jodhpur ((26°18'N:73°04'E, 216 amsl) and Kutch-Bhuj (23°21'N:69°77'E, 15 amsl) for evaluation in terms of growth and survival. Light irrigation was given after one week of planting by avoiding direct contact of water with the stems. The mean monthly weather data with respect to temperature, relative humidity, and rainfall and Sun shine hours were recorded at both the locations with the help of automatic weather station (Fig. 1 & 2). Periodical data were recorded on transplant success, incidence of rotting, number of new leaves produced etc. The uninfected aerial part of the rotten plants were separated and planted in the pots for rooting and multiplication for gap filling. Visible impact of high temperature, low atmospheric humidity and damage to plants by vertebrate pest were also recorded.

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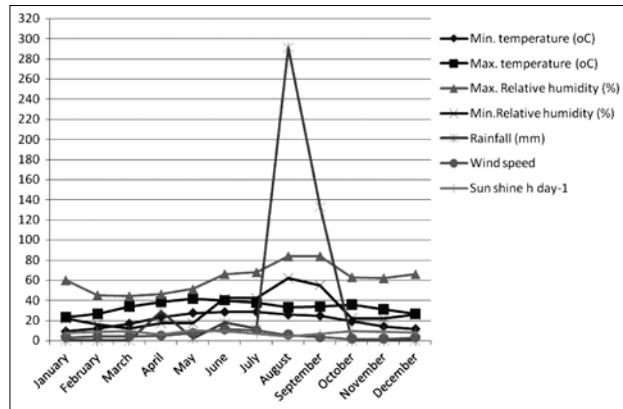


Fig. 1. Mean monthly weather conditions at Jodhpur.

The field establishment of cacti were affected due to rotting at the basal part which ranged from 0 to 100 per cent in different accessions. The rotten plants were replaced with fresh plants raised in pots during March 2012. The mean survival of all the germplasm accession taken together was 74.88% and only 24.12% were lost due rotting during three months. The mean survival in June was highest (100%) in

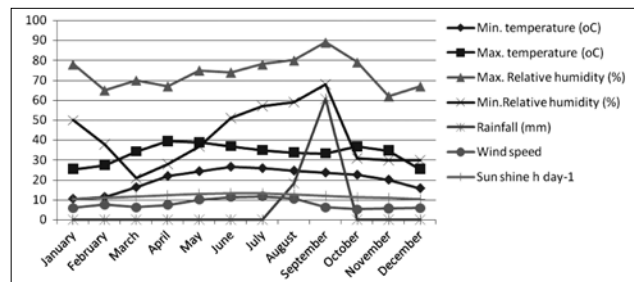


Fig. 2. Mean monthly weather conditions at Bhuj.

variety Roja × Roja-4 Pianta- 25, clone No. 1308 and accession from Botanical Garden, CAZRI, while clone No. 1270, Clone No. 1271, varieties Roja San Cono, ARL Spineless, Bianco Macomer and A. Giant showed 80-88 % survival. The remaining varieties had survival ranging between 40-80 per cent with lowest value in case of Trunzara Red San Cono (Table 1). The observations on post rainy season (22.8.12) survival indicated further loss of plants due to rotting with mean survival of 46.13 per cent. The genotype Lyria was lost completely during this period. The highest survival in the field after one year of planting

Table 1. Per cent survival (mean) of cacti genotypes at different time intervals post planting at Jodhpur.

Genotype	No. planted	Survival (%) in mid March	No. after gap filling in March	Survival (%) mid June	Survival (%) mid August	Survival (%) mid December	Mean No. of new cladodes/ yr
Clone No.1270	9	11.11	9	88.88	55.55	33.33	4.5
Clone No.1308	9	33.33	9	100.00	55.55	11.11	4.0
Clone No.1271	9	33.33	9	88.88	44.44	11.11	3.6
Clone No.1287	9	22.22	9	44.44	33.33	0.00	4.2
Roja San Cono	9	66.66	8	87.5	62.50	0.00	3.5
ARL Spineless	5	40.00	6	83.33	50.00	50.00	5.5
Cristallina	9	55.55	8	62.5	12.50	25.00	4.2
Red San Cono	3	55.55	9	77.77	66.66	22.22	2.5
Seedless Santa Margherita Balice	8	12.50	9	77.77	55.55	22.22	3.6
Bianco Macomer	6	83.33	6	83.33	66.66	33.33	4.5
Roja Castel Sardo	6	50.00	6	66.66	50.00	33.33	3.6
Gymnocarpe	4	50.00	6	66.66	16.66	33.33	5.5
Roja × Roja-4, Pianta 25	4	100.00	6	100.00	66.66	50.00	6.6
Giall × Giall	6	0.00	4	75.00	75.00	0.00	2.5
Trunzara Red San Cono	2	100.00	5	40.00	40.00	0.00	2.5
A. Giant	8	0.00	5	80.00	20.00	0.00	3.2
Militello White	1	0.00	2	50.00	50.00	0.00	3.2
Lyria	4	25.00	2	50.00	0.00	0.00	2.5
BG	9	44.44	9	100.00	55.55	11.11	9.6
Total/ Mean	120	41.21	118	74.88	46.13	17.68	4.17

was recorded in Roja × Roja-4-Pianta-25 and ARL spineless (50%) followed by 33.33% each in genotype Bianco Macomer, Roja Castel Sardo, Gymnocarpe and clone No. 1270. Absolute mortality occurred in varieties Roja San Cono, Clone No.1287, Giall × Giall, Trunzara Red San Cono, A. Giant, Lyria and Militelo White. The number of cladodes developed after 12 month of planting was maximum (9.60) in the old accession from botanical garden, CAZRI, Jodhpur while others it ranged between 2.5 to 6.6 (Table 1.) Pathological examination of the rotten part revealed that rotting was due to bacteria. The isolated samples were cultured on nutrient agar medium and pure cultures were obtained by streaking on to the petri-plates containing NA medium. It was then multiplied on NA Broth medium for DNA isolation using Bacterial Genomic mini kit.16s rRNA gene and subjected to DNA sequencing. The sequences resulted in molecular identification of pathogen as *Enterobacter cloacae*. Accordingly, to save cladodes from this bacterial infection these were treated with fixed copper formulation/streptomycin before planting. Even this treatment was also not effective to prevent rotting. During peak summer months when the atmospheric humidity was lowest and high temperature was at peak, the cladodes were found to shrivel (Fig. 3). Peacocks, parrots, squirrels and rats eat upon young cladodes too as they are rich in carbohydrates.

Twenty genotypes including two local genotypes from Bhuj was planted in pots under shed net house and in field. Significantly higher survival per cent was recorded both in pots and field as compared to its performance at Jodhpur. The survival per cent of all the accessions in pots was more than 95 percent after 180 days of planting except the variety Militelo White (0%), Clone No. 1308 (36.0%), Clone No. 1270 (45.5%) and Clone No. 1271 (66.7%). Similarly in open field also the survival of more than 60 per cent was recorded in most of accessions. However, in Clone No. 1271 it was only 20 per cent (Table 2).

The climatic factors that controls the growth and distribution of *Opuntia-ficus-indica* are rainfall, atmospheric humidity, temperature, nature of soils and drainage thereof (Monjauze and Houerou, 4). The mean monthly weather conditions at Jodhpur and Kutch-Bhuj in India where the performance trial was conducted indicate that at both the locations temperature remains much higher (av. 33.4°C at Jodhpur with a range 9.3-41.6°C) than optimum required (<30°C) during most part of the year, i.e. from March to October. Comparatively better climatic conditions with respect to maximum temperature (mean 25.38, range 25.52-39.36°C and minimum RH (30-68%) prevailed in coastal areas of Bhuj led



Fig. 3. Shrivelling in cactus pear due to high temperature.

Table 2. Plant survival of different cactus pear genotypes at Kutch-Bhuj, Gujarat.

Genotype	Survival (%) after 180 days	
	Pot	Field
Clone No. 1270	45.5 (22)*	50 (10)
Clone No. 1271	66.7 (27)	20 (10)
Clone No. 1308	36.0 (25)	60 (10)
CAZRI Kukma 1	95 (20)	90 (10)
CAZRI, Botanical Garden	95 (20)	75 (15)
Clone No. 1287	100 (6)	-
Roso San Cono	100 (1)	-
Giall × Giall	100 (1)	-
Trunzara Red San Cono	100 (1)	-
Piantra-25	100 (2)	-
ARL Spinless	100 (1)	-
Red San Cono	100 (2)	-
Militelo White	0.0 (1)	-
Cristallina	100 (1)	-
Rosa Castle Sardo	100 (1)	-
Bianco Macomer	100 (6)	-
Seedless Santa Margherita Belice	100 (1)	-
Gymnocarpe	100 (2)	-
CAZRI Kukma 2	100 (1)	-
CAZRI Kukma 3	100 (4)	-

*No. planted

to better performance in terms of survival and growth. The climatic requirement of the species indicate that it tolerates dryness and is very resistant to high temperatures, however, its photosynthetic productivity can diminish enormously if 30°C or more is exceeded even when the water supply is sufficient; temperatures higher than 30°C cause reductions of up to 70% of photosynthetic activity; while temperatures lower than 0°C, even for 4 h, produced irreversible damage to the cladode tissue and the fruit (Inglese, 2). Similarly, atmospheric humidity plays significant roles in deciding the ecological region for satisfactory growth of cactus pear. Empirical observations seems to demonstrate that *Opuntia ficus-indica* is eliminated from areas where the average R.H. remains below 40% for more than one month consecutively (Monjauze and Houerou, 4; Peyre de Fabregues, 5). For that reason cacti can not grow in the Sahel where the average annual R.H. is ca 38% ca 24 HPa and mean saturation deficit (SD) nor do they grow in Sudanian zone with R.H. of 52% and SD of 17 Hpa; but they normally develop in eastern and southern Africa with annual R.H. of 60-65% and SD of ca 11 HPa (Le Houerou *et al.*, 3). Satisfactory growth of cacti in Indian arid zone has been observed during February to March. The growth is much suppressed during May to July due to high temperature. The temperature remains favourable during August-September but that being the peak monsoon season in the region of study lead to water stagnation in the root zone result in rotting especially during the year of planting or till the collar region become woody. Satisfactory period of growth can be considered during October-November when both temperature and humidity conditions are most favourable. The growth is again checked during December-January due to low temperature. The mean survival diminished from 74.88% in pre monsoon to about 17% in post monsoon period. There was heavy rainfall in 2012 on the standing plants of cacti during August-September, 2012 leading to water stagnation for some time, which led to rotting and mortality.

Compared to Jodhpur, the performance of cacti was better in Bhuj both in terms of better field establishment and growth due to lower summer temperature and higher relative humidity. Thus, in

view of these findings, Bhuj can be considered better location for large scale performance trial on different varieties of cacti.

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