

BIODIVERSITY OF KHEJRI IN ARID REGION OF RAJASTHAN: I-SCREENING OF KHEJRI FOR CULINARY VALUE

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ABSTRACT : A survey was conducted in 14 districts in arid region of Rajasthan during 1995-1997 to select some superior genotypes of khejri (*Prosopis cineraria* (L) Druce) based on their pod characters which is utilised as a vegetable. A wide range of variability with respect to pod length, thickness, number and weight of seed, pod appearance, tenderness and nutritional value was observed. A weighted score was allotted for desired culinary characters of pods and nine genotypes of khejri i.e. tree no. 1,2,3,13, 14, 20, 21, 26 and 29 have been identified for vegetable purpose. The selected genotypes should be multiplied by vegetative means for preservation of desired genetic purity. It was also advocated that remaining genotypes, though not fit for culinary value but this biodiversity of khejri in arid ecosystem must be conserved either *in situ* or *ex situ* which can be utilised as parent materials for any future breeding programme.

Key words : Biodiversity; Culinary value; Khejri; Pod characters; Weighted scoring.

The *khejri* (*Prosopis cineraria* (L) Druce) belongs to subfamily Mimosoidae of Leguminosae family. The tree is found extensively in arid and semi arid parts of Rajasthan, Haryana, Gujarat, Punjab, Delhi and southern states and is thus called by various names such as Janti and Chonksa (Delhi), Jind, Jhand and Jand (Punjab and Haryana), Bani (Karnataka), Vanni (Tamil Nadu), Sumri (Gujarat), Kandi (Sindh) and Shami (Sanskrit). *Khejri* can tolerate adverse edaphoclimatic conditions as is evident from its coppicing and growth pattern, i.e. new foilage, flowering and fruiting emerge during the most dry period from March to June. Its extensive and deep root system penetrates even the stratified *kankar* layer (Lahiri 1955) commonly found in the arid region. Owing to deep root system, monolayered canopy and atmospheric nitrogen fixing capability, the tree has favourable effect on companion crops and can thus be an integral component of cropping systems in arid ecosystem. All arid land forms except hills and saline depression receiving an annual rainfall of 150-500 mm have good population of *khejri* trees. Optimum density of its trees is, however, confined in areas having 350-

400 mm rainfall.

Khejri plants have long been used by mankind in various ways. Its nutritive green leaves containing 11.9-18.0, 13-22, 43.5, 6-8, 2.9, 2.1 and 04 per cent crude protein, crude fibre, nitrogen free extract, ash, ether extract, calcium and phosphorus, respectively with a high calorific value (Bhimya *et al.*, 1964; Mathur, 1976, Bhandari *et al.*, 1979) are considered to be good fodder for animals. Twigs and branch wood of lopped trees are a source of fuel for the rural population. Unlopped trees produce pods (*sangri*). When immature, these pods are used as vegetable and preparation of pickles. The immature pods are dried and used as vegetable even after dehydration. The ripe sweet and edible pods (*khokha*) are used to prepare flour. Duhan *et al.* (1992) recorded 18, 56, 26, 2, 0.4, 0.4 and 0.2 per cent crude protein, carbohydrates, crude fibre, fat, phosphorus, calcium and iron, respectively, in immature pods, while ripe pods contain 9-14 per cent crude protein and 6-16 per cent sugar (Arya *et al.*, 1991) Other parts of the tree such as bark, flowers etc. are also used for medicinal and other purposes.

Being a cross pollinated species, high degree of variability in vegetative and pod characters has been observed. Therefore, an attempt was made to select elite trees with high productivity and pod quality attributes (for vegetable purpose) from this rich biodiversity. In view of this, an intensive survey was conducted to locate the trees producing tender, long and round pods having good taste with lower tannin and fibre content and more number of small and tender seeds.

MATERIALS AND METHODS

An exploration programme was undertaken during March-April, 1995 in the Thar desert. The survey was conducted throughout the 5 agroclimatic zones of Rajasthan covering Bikaner, Ganganagar, Hanumangarh, Churu, Jhunjhunu, Sikar, Jaipur, Dausa, Jodhpur, Pali, Nagaur, Barmer, Jaisalmer and Ajmer districts. More intensive survey was conducted in areas around Bikaner (Fig. 1) having high population of *khejri*. Thirty promising trees with respect to horticultural traits were identified. Pods of these trees at similar maturity stage were collected for detailed observations on different horticultural traits. The average values for each of the three years were

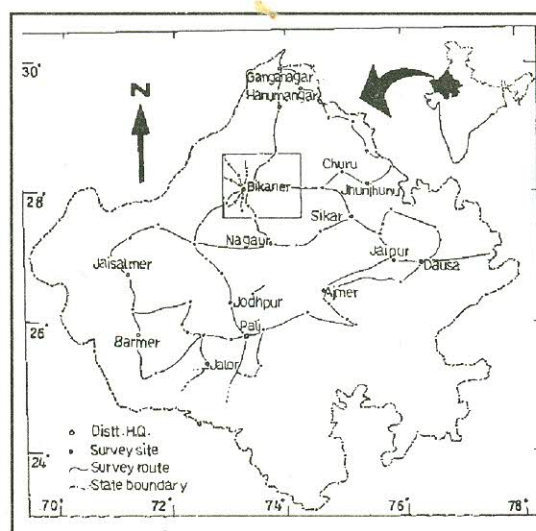


Fig. 1. Survey routes and survey sites for identifying pod variability in khejri

computed and then these were pooled. The nutrient content of pods were analysed by standard method. Quality scoring of pods from each tree was done by a panel of judges on 9 point hedonic scale (Amerine *et al.*, 1965). The method of rating was based on the scores allotted for various characters as given in Table 1.

In order to select elite trees having superior productivity and quality of pods for vegetable

Table 1. Scores allotted for various characters for rating of *khejri* pods (sangri) from selected trees.

Score	Pod length (cm)	Circumference (cm)	Appearance	Tenderness	Taste	Seed Pod ⁻¹	Weight seed ⁻¹ (mg)
9	≥ 25.0	≥ 0.5	Gr, Gl, R	Te, Fl	Sweet	≥ 20.0	10
8	22.0-24.9	0.51-0.69	Lg, Gl, R	Te, Lf	Less sweet	18.0-19.9	20
7	20.0-21.9	0.70-0.89	Gr, S, R	St, Fl	Slightly sweet	15.0-17.9	30
6	18.0-19.9	0.80-1.09	Lg, S, R	St, Lf	Flat	13.0-14.9	40
5	15.0-17.9	1.10-1.29	Gr, Gl, F	Te, Mf	Slightly acrid	10.0-12.9	50
4	13.0-14.9	1.30-1.49	Lg, Gl, F	St, Mf	Less acrid	7.0-9.9	60
3	10.0-12.9	1.50-1.69	Gr, Tr, Ro	Te, Fi	Acrid	5.0-6.9	70
2	7.0-9.9	1.70-1.89	Lg, Tr, Ro	St, Fi	Highly acrid	3.0-4.9	80
1	≥ 6.9	≥ 1.90	Gr, C, Lo	H, Mf	Bitter	≥ 2.9	90

N.B. : C-Curled; F-Flat; Fi-Fibrous; Gl-Glabrous; Gr-Green; H-Hard; Lf-Less fibrous; Lg-Light green; Lo-Lobed; Mf-Medium fibrous; R-Round; Ro-Rough; S-Smooth; St-Semitender; Te-Tender; Tr-Tinged.

purpose, weightage was given as follows on the characters in accordance with their importance i.e. 40, 30, 20 and 10 per cent for taste and tannin content, tenderness and fibre content, pod length and shape and seed content, respectively. The data were analysed statistically to see the extent of variability.

RESULTS AND DISCUSSION

Variation in pod characteristics: Immature *khejri* pods were harvested from selected trees from different sites and data on pods characteristics

were recorded to identify promising genotypes for vegetable purpose. It is obvious from the data presented in table 2 that there were significant variations on different pods characters, hence mean, standard deviation, standard error of mean and coefficient of variation were also computed. The length of such pod in the selected trees varied from 7.7 cm in No. 14 to 23.3 cm in No. 10. The thickness (circumference) of pod also varied in these types. The minimum thickness (0.20cm) was recorded in No. 5 followed by No. 19(0.26cm) while the maximum value (0.51cm) was recorded in No. 29. The maximum number of seed (22.8)

Table 2. Variation in Characters of immature pods (*sangri*) of *khejri* (pooled data -1995-97)

Tree	Pod length (cm)	Thickness (cm)	No. of seed pod ⁻¹	Weight of seed (mg)	Appearance	Tenderness	Taste
1	20.1	0.34	19.8	30	Gr,Gl,R	Te, Fl	Flat
2	22.8	0.39	17.1	30	Gr,Gl,F	Te, Fl	Sweet
3	23.2	0.37	19.3	40	Lg,Gl, R	Te,Fl	Sweet
4	23.1	0.40	20.0	40	Gr,Gl,F	St,Lg	Less sweet
5	13.5	0.20	16.0	30	Gr,Gl,F	Te,Fl	Slightly sweet
6	17.4	0.34	19.9	20	Lg, S	Te,Fi	Slightly sweet
7	17.0	0.36	15.9	40	Gr,Gl,F	Te,Fi	Slightly sweet
8	13.5	0.35	12.6	30	Gr,C, Lo	H,Mf	Less sweet
9	13.4	0.39	12.5	30	Lg, S, R	St,Lg	Less sweet
10	23.3	0.35	18.5	30	Gr,Gl,F	Te,Mf	Flat
11	16.1	0.45	13.7	40	Lg,Gr,R	Te,Kg	Less sweet
12	14.8	0.35	19.0	30	Gr,Tr, Ro	Te,Fi	Acrid
13	21.9	0.42	18.6	50	Lg, Gl, R	Te,Lg	Sweet
14	7.7	0.44	5.3	50	Gr,C,Lo	Te,Fl	Sweet
15	15.1	0.34	11.5	30	Lg,Gl,F	Te,Fl	Slightly sweet
16	16.9	0.36	12.5	20	Gr,Gl,F	St,Lg	Slightly sweet
17	18.2	0.40	19.0	30	Lg,Gl,F	Te,Fl	Acrid
18	15.6	0.39	12.2	40	Lg,Tr,Ro	Te,Lg	Slightly sweet
19	15.6	0.26	15.0	20	Gr,Tr,Ro	Te, Fl	Flat
20	20.3	0.38	14.5	30	Gr,Gl,F	Te, Fl	Slightly sweet
21	22.3	0.45	22.8	50	Gr,Gl,R	Te,Lf	Less sweet
22	18.2	0.42	18.2	50	Lg,Gl,R	Te,Fl	Flat
23	18.3	0.47	15.1	50	Lg,Gl,F	Te,Lg	Slightly sweet
24	14.2	0.44	17.1	30	Lg,Gl,F	St,Fi	Slightly sweet
25	13.2	0.40	16.8	30	Gr,C,Lo	Te,Lf	Acrid
26	14.8	0.35	20.1	30	Gr,C,Lo	Te,Fl	Less sweet
27	16.5	0.38	15.1	20	Gr,Tr,Ro	Te,Fl	Slightly sweet
28	19.7	0.41	19.9	40	Lg,Gl,F	St,Fl	Flat
29	18.9	0.51	14.7	50	Lg,Gl,R	Te,Fl	Sweet
30	15.8	0.42	16.3	30	Gr,Tr,Ro	Te,Lf	Slightly sweet
Mean	17.4	0.38	16.3	35	-	-	-
SD	3.7	0.06	3.6	10	-	-	-
SEm±	0.7	0.01	0.7	2	-	-	-
CV(%)	21.3	15.63	21.9	28	-	-	-

was recorded in tree No. 21 followed No. 4 (20.0) and No. 26 (21.1). The minimum weight of individual seed (20mg) was recorded in genotypes 6, 16, 19 and 27. Similar variations in pod length, width, seed length and seed width were also reported by Kaul *et al.*, (1991) in *khejri* trees found in Shekhawati region of Rajasthan.

Appearance and tenderness of pods also varied at different stages of development and in different trees. Taste of pods varied from acrid (No. 17 and 25) to sweet (No. 2, 3, 13, 14, 29). *Khejri* seeds are rich in protein. Therefore pods with larger number of small and tender seeds were considered superior. The genotypes also varied in number of seeds per pod and average weight of individual seed. The size of pods and their weight are mainly yield attributing characters while appearance, tenderness, taste, seed content and nutritional value are quality characters of pods. Therefore, during weightage scoring both parameters were taken into consideration in selection of elite trees.

Mineral contents of pods : Determination of nutrient content of immature pods is essential to know nutritional quality of food but there were no clear trends in the nutrient content of pods. Data given in Table 3 reveal that mineral contents differ significantly among these types. The nitrogen content varied from 2.1 to 3.2 per cent with a mean value of 2.4 per cent. Accordingly, crude protein varied from 13.13 to 20.00 per cent with mean value of 15.01 per cent. The phosphorus content differed significantly and ranged from 0.21 to 0.27 per cent with a mean value of 0.24 per cent. The potassium content varied from 0.50 to 0.90 per cent. The Ca and Mg contents ranged from 3.20 to 4.00 per cent and 0.65 to 0.90 per cent, respectively.

Weighted scoring : The data on important pod characters having horticultural significance have been presented in Table 4 after giving due weightage as decided before the survey was

Table 3. Mineral content of immature pods of *khejri*

Tree	Protein (%)	N (%)	P (%)	K (%)	Ca (%)	Mg (%)
1	15.63	2.5	0.22	0.50	3.20	0.90
2	16.25	2.6	0.22	0.60	4.00	0.85
3	13.13	2.1	0.22	0.55	4.10	0.85
4	15.63	2.5	0.23	0.60	3.80	0.85
5	20.00	3.2	0.26	0.85	4.00	0.85
6	18.13	2.9	0.23	0.65	3.65	0.80
7	18.75	3.0	0.26	0.65	3.20	0.75
8	14.38	2.3	0.25	0.65	3.25	0.75
9	13.13	2.1	0.25	0.80	4.00	0.85
10	16.63	2.5	0.25	0.80	3.90	0.80
11	14.38	2.3	0.27	0.35	3.90	0.80
12	13.13	2.1	0.23	0.85	3.90	0.85
13	13.13	2.1	0.24	0.63	3.50	0.85
14	14.38	2.3	0.23	0.65	3.60	0.80
15	15.63	2.5	0.26	0.90	3.20	0.75
16	15.63	2.5	0.21	0.90	3.30	0.70
17	13.13	2.1	0.24	0.90	3.40	0.75
18	14.38	2.3	0.25	0.85	3.40	0.75
19	17.50	2.8	0.26	0.80	3.60	0.75
20	14.38	2.3	0.26	0.85	3.65	0.80
21	15.63	2.5	0.23	0.85	3.50	0.80
22	14.38	2.3	0.21	0.90	3.50	0.80
23	15.00	2.4	0.21	0.90	3.50	0.80
24	13.75	2.2	0.21	0.90	3.50	0.80
25	15.00	2.4	0.21	0.65	3.50	0.75
26	13.75	2.2	0.23	0.60	3.60	0.70
27	14.38	2.3	0.21	0.67	4.00	0.67
28	15.63	2.5	0.26	0.65	4.10	0.65
29	13.13	2.1	0.25	0.65	3.80	0.70
30	15.00	2.4	0.23	0.65	3.65	0.60
Mean	15.01	2.4	0.24	0.74	3.64	0.78
CD	3.10	0.49	0.029	0.21	0.81	0.24

(p=0.05)

undertaken. It is apparent from the data that tree Nos. 2, 3, 13, 21 and 29 are promising as they scored more than eighty per cent. Tree No. 1, 14, 20, 26 scoring more than seventy five per cent are also considered valuable. There were certain trees which obtained good scores but due to poor quality attributes they were not considered as elite tree for vegetable purpose.

It is obvious from the data (Table 3) that the protein content was highest in tree No. 5 (20.0), P in tree No. 11 (0.27), K in tree No. 15, 16, 17, 22, 23 and 24 (0.90) Ca in tree No. 3 and 28 (4.10)

Table 4. Weighted scores for desired traits of khejri pods

Trees	Pod and length and appearance	Tender-ness	Taste	Seed content	Total Score
1	16.7	27	24	7.5	75.2
2	14.7	27	36	7.0	84.7
3	16.7	24	36	7.0	83.7
4	16.7	18	32	7.5	74.2
5	12.0	27	28	7.0	74.0
6	13.3	9	28	8.0	58.3
7	12.7	9	28	6.5	56.2
8	9.3	3	32	6.0	50.3
9	12.7	18	32	6.0	68.7
10	14.7	24	24	7.5	70.2
11	14.7	15	32	6.0	67.7
12	10.7	9	12	7.5	39.2
13	16.0	24	36	6.5	82.5
14	8.0	27	36	4.0	75.0
15	12.0	27	28	6.0	73.0
16	12.7	18	28	6.5	65.2
17	12.7	27	12	7.5	59.2
18	10.7	24	28	5.5	68.2
19	11.3	27	24	7.5	69.8
20	14.0	27	28	6.5	75.5
21	17.3	24	32	7.0	80.3
22	15.3	27	24	6.5	72.8
23	12.7	24	28	6.0	70.7
24	11.3	6	28	7.0	52.3
25	9.3	24	12	7.0	52.3
26	9.3	27	32	8.0	76.3
27	11.3	27	28	7.5	73.8
28	12.7	18	24	7.0	61.7
29	14.7	27	36	5.5	83.2
30	11.3	24	28	7.0	70.3
Mean	12.9	21	28	6.7	68.8
SD	2.5	7	7	0.9	11.0
Sem±	0.5	1	1	0.2	2.0
CV(%)	19.1	34	24	12.7	16.0

and Mg in tree No. 1 (0.90) but during weighted scoring these tree were not selected except tree No. 1 and 3. This indicated that characters like yield and taste have been given more weightage than those of nutrient content. Therefore, such trees with

high nutrient content in immature pods, though not suitable for vegetable purpose can be utilised as parent material in any future breeding programme.

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