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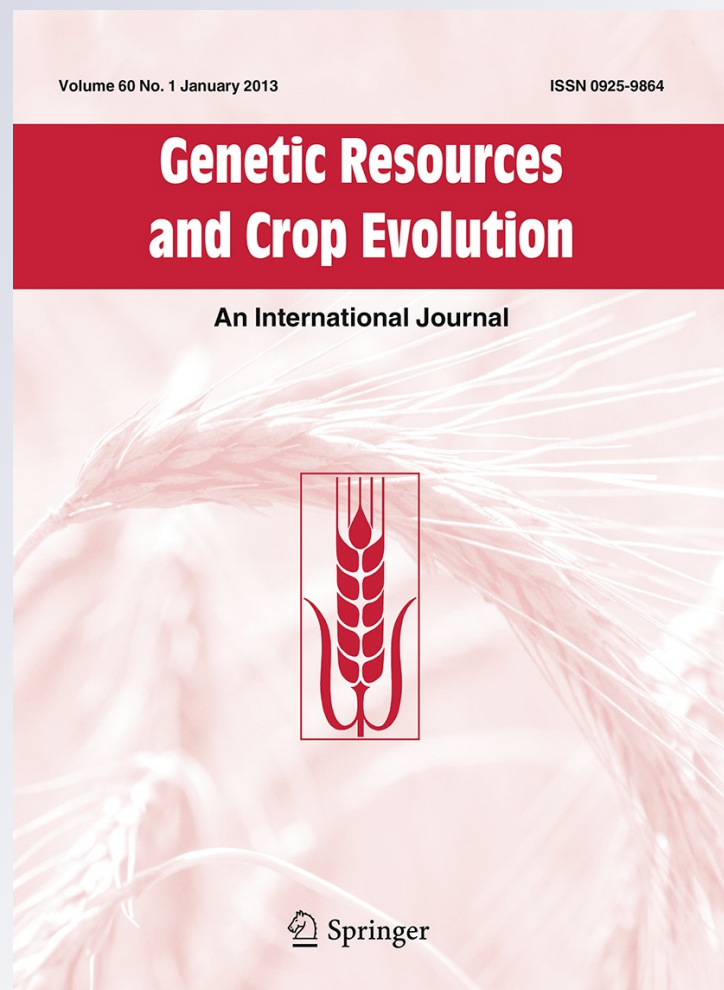
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## *Capparis decidua* (Forsk.) Edgew.: an underutilized multipurpose shrub of hot arid region—distribution, diversity and utilization

H. R. Mahla · V. S. Rathore · Dheeraj Singh · J. P. Singh

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**Abstract** *Capparis decidua* (Forsk.) Edgew. commonly known as “Kair”, is an important shrub widely distributed in arid and semi-arid regions. The species has been used for making pickle and vegetables and number of other uses that include medicine, fuel wood and fodder. It is tolerant to temperature, salt and drought stresses and helps in arresting wind erosion and improving soil fertility. This paper is an attempt to provide scientific information pertaining to distribution, morphology, propagation, phenological characteristics, diversity and uses of the species for stimulating interest to promote its domestication and commercialization.

**Keywords** *Capparis decidua* · Distribution · Diversity

### Introduction

*Capparis decidua* (Forsk.) Edgew. is a shrub of family Capparaceae. The family comprises ~30 genera and 600 species, which occurs mainly in tropical and warm temperate regions (Vyas et al. 2009). Around 26 species are reported from the India (Heywood 1978). *C. decidua* occurs in arid and semi-arid regions of India (Bhandari 1990). It is tolerant to drought, salt and heat stresses (Gupta et al. 1989). It provides food (pickle and vegetable), fodder, fuel wood and timber, thus plays an important role in the rural economy of arid regions (Kumar et al. 2005). Besides economic significance, the species has important ecological roles i.e. provides vegetation cover, improves soil, prevents soil erosion and promotes biodiversity (Shankarnayan et al. 1987). It is also used as hedge (Hammer 2001). Relatively little scientific attention has been given to this species, which hinders its development and sustainable utilization. It can become a perspective species for arid and semi-arid lands with appreciable development potential. The paper is an attempt to summarize information on distribution, morphology, phenology, morphological diversity, nutritional aspects and uses of *C. decidua* to stimulate interest in this species. Information has been gathered from meagre published literature and inhabitants of north-western Rajasthan, India. The diversity for morphological characters are measured from area receiving rainfall  $<200 \text{ mm year}^{-1}$  (Jaisalmer and Barmer Districts of Rajasthan) of north western Rajasthan during

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survey. The seedling characteristics were measured at Central Arid Zone Research Institute (CAZRI), Regional Research Station (RRS), Jaisalmer.

### Distribution and ecology

*Capparis decidua* is an important shrub species of desert and arid regions of the Indian subcontinent, Africa and Saudi Arabia. It is distributed in tropical and subtropical regions of Chad, Egypt, Ethiopia, India, Arabia, Pakistan, Iran, Jordan, Mauritania, Niger, Nigeria, Senegal, Somalia, South Africa, Sudan and Egypt. In India it occurs in Gujarat, western Rajasthan, Uttar Pradesh, Madhya Pradesh, Haryana, Punjab and parts of Tamil Nadu, Karnataka and Andhra Pradesh (Singh and Singh 2011). It is a hardy species and provides vegetative cover in dry, hot, sandy desert areas where little else grows (Von Maydell 1986). It grows preferably in dry, arid and exposed habitats like wastelands, ditches, drying ponds, cultivated lands, road sides and surrounding plains of hills due to its excellent adaptations for arid environment to survive under prolonged drought condition (Pandey and Rokad 1992). Its common habitat is Pediment plain in the dry region. It occurs in rangelands, barren fields, farm boundaries and wasteland in Rajasthan. It covers ~3,540 km<sup>2</sup> pediment plains in Bikaner and Jodhpur districts of Rajasthan, India (Chandra et al. 1994). Its density in different landforms in Thar Desert of Rajasthan varies from 9 to 170 plant ha<sup>-1</sup> (Singh et al. 2005). It grows in association with *Acacia senegal* (L.) Willd. (Mimosaceae), *Calotropis procera* (Ait.) R. Br. (Asclepiadaceae), *Grewia tenax* (Forsk.) Fiori (Tiliaceae), *Maytenus emarginata* (Willd.) Ding-Hou (Celastraceae), *Ziziphus nummularia* (Burm. f.) Wt. et Arn. (Rhamnaceae), *Salvadora oleoides* Decne (Salvadoraceae), *Prosopis cineraria* (L.) Druce (Mimosaceae) etc.

### Botanical description

*Capparis decidua* is a shrub of dense tufts, 4–5 m high but occasionally it occurs as a small tree. It possesses many green vine-like apparently leafless branches, hanging in bundles. Branches and twigs are glossy dark green and bark turns whitish grey with age. Small, light brown spines occur in pairs on the twigs at

each node. Leaves are very minute (2 mm long) and emerge on young shoots. Leaves have very short life and plant looks leafless most of the time.

Flowers are pink, red-veined, emerge in small groups along the leafless shoots at the axils of the spines. Fruit is small many-seeded ovoid or sub-globulose, slightly mucronate and becomes blackish when dry (Satyanarayanan et al. 2008). The seeds are 2–5 mm diameter, and are embedded in the pulp. Large size fruits have many (>30) small seeds while smaller fruits have 1–2 large sized seeds. The root is deep and extensive and penetrates up to four meter deep. Initially a single tap root develops and afterwards many secondary roots emerge from main/primary tap root.

### Flowering, pollination and fruiting

Flowering starts during February and continues up to November. It flowers in three seasons: February–March (*Ambe Bahar*), July–August (*Mrig Bahar*) and October–November (*Hast Bahar*). Flower appears both on new as well as old shoots. One year old shoot produces maximum flowers. The flower is large, highly conspicuous, colored, and has large stamens of different sizes. Stamen bends downwards. Large colored flowers, long stamens, along with asynchronous flowering and foliation at the time of flowering are conducive for pollination by insects. It blooms during March–June, which is food scarcity period for insects in the region. Therefore, this species attracts number of insects which are considered beneficial for pollination within the plant as well as among the plants of vicinity.

Floral bud initiates around mid-February and takes 14–15 days for development. Bud is greenish white at initiation and become dark brownish red with ting of greenish white at maturity. The size of flower bud increases gradually throughout the period of development (Shekhawat 1999). It exhibits significant yearly variation in flowering pattern among the plants as well as within the same plant. The February–March flowering gives better fruit yields (>10 kg fruits plant<sup>-1</sup>). Fruit yield varies from 2 to 20 kg plant<sup>-1</sup> depending on genetic potential, age, and flowering season (Singh and Singh 2011).

Significant intra-population phenological variation indicates high degree of homeostasis of species. It

produces leaves, flowers and fruits twice or thrice in a year. Summer months are peak flowering time and maximum mature fruits are available just before onset of monsoon. This is an important adaptation for continuity of the species. Flowering at 1–2 months before the onset of rainy season ensures availability of seeds for germination at the time of rainfall. The plant can afford this behaviour because of its ability to draw moisture from deeper soil layers (Singh et al. 2005).

## Diversity

Various studies have confirmed the genetic diversity of *C. decidua* in natural population (Abdel-Mawgood et al. 2005; Singh et al. 2007; Vyas et al. 2009) but its systematic utilization in genetic improvement programme is very limited. Therefore, an attempt was made to collect diverse germplasm from different habitats viz. rocky, gravelly, sand dunes, natural rangelands and cultivated fields of arid regions receiving rainfall <200 mm year (Jaisalmer and Barmer districts) of Rajasthan (Table 1) during summer 2011 for systematic evaluation and *ex-situ* conservation.

Natural population exhibits marked diversity with respect to plant types, spine, canopy (spread and compactness), flowering (time of flowering, colour of flower), and fruiting (size and colour of fruits) characters. Two distinct plant types were observed, shrub with large canopy spread (Fig. 1a–c), and small tree form having more than 5 m height (Fig. 1b). Flower are light red to scarlet red, and occasionally few plants has yellow flowers (Fig. 1d, f–h). Size and colour of mature fruits varied considerably (Fig. 1i–k). Collected accessions (forty-five) exhibits wide range of variability for fruit diameter, fruit weight, number of seeds per fruit, test weight and canopy characteristics (Table 2).

## Propagation

*Capparis decidua* is mainly propagated by seeds and root suckers under natural conditions (Chundawat 2005; Malik et al. 2010). Plant raised by root suckers showed limited success. Few sprouts that produced shoots and survived up to 1 year in nursery failed to survive in the field beyond 2 months. It appears that the suckers survive in nature by remaining dependent

on mother plant for prolonged period and their early separation during collections has been lethal (Singh et al. 2005).

Germination and seedling growth behaviour of 45 accessions of *C. decidua* was studied at CAZRI, RRS, Jaisalmer. Germination and seedling growth showed significant variations among accessions. The seeds of collected 45 accessions were sown in ploy bags on 25th August 2011. The planting medium consisted soil mixed with FYM in 3: 1 ratio. The germination starts at 10th day after sowing (DAS) and continued up to 27th day, however 50 % germination was recorded after 19th day of seeding. The germination had range 41.6–93.4 % and average germination was 72.4 %. The survival varied from 44.2 to 76.8 %. The seedling attains 20.0 cm height after 5 months. The survival after 1 year of planting varied from 36.1 to 64.3 %. The average root shoot ratio among different accessions was found 0.70 after 5 months of sowing (Table 3). The higher root: shoot ratio is an important character which indicates suitability of accessions to survive under moisture deficit conditions. The accessions with high root: shoot ratios have better chances of survival and perform under moisture deficit condition compared to accessions with lower root: shoot ratio.

## Harvesting and post-harvest handling

Hand picking is a common practice of fruit harvesting (Fig. 2a), it ensures picking of only tender fruit and hence there is no need for their further grading. Harvesting with twigs is also in vogue but it adversely affects the plant vigour and subsequent fruiting.

*Capparis decidua* starts fruiting at the age of 5–6 years. Green tender fruit at small pea stage are suitable for pickling and vegetable purposes. Fruits should be harvested after 7–10 days of fruit setting with 5–8 mm diameter during March–April to fetch better price in the market (Meghwal 2002). Fruits having mature seeds are not preferred for consumption. The fruit of second flowering available during September–October not harvested as the fruit yield as well as quality during rainy/post rainy season is supposed to be inferior quality.

The unripe fruits are generally not used as such due to acrid taste. These fruit can be converted into a variety of by-products after processing. The tender

**Table 1** Locations of sites of germplasm collections (45 accessions)

Collection number	Village/District/State	Latitude (°N)	Longitude (°E)	Altitude (m a.s.l.)	Habitat	Plant type	Collection number	Village/District/State	Latitude (°N)	Longitude (°E)	Altitude (m a.s.l.)	Habitat	Plant type
CAZJK—1	Dhani/JSL/RAJ	26.41	71.11	203.1	PS	T	CAZJK— 24	Madasar/JSL/RAJ	26.45	71.30	296.1	WL	S
CAZJK—2	Army Area/JSL/RAJ	26.45	71.08	206.4	RS	S	CAZJK— 25	Sankra/JSL/RAJ	26.45	71.32	299.4	WL	S
CAZJK—3	RRS Farm/JSL/RAJ	26.44	71.09	201.6	RL	T	CAZJK— 26	Sankra/JSL/RAJ	26.45	71.32	295.8	CL	S
CAZJK—4	Farm/JSL/RAJ	26.44	71.09	200.7	RL	T	CAZJK— 27	Chauk/JSL/RAJ	26.46	71.38	279.6	CL	S
CAZJK—5	Farm/JSL/RAJ	26.44	71.09	201.6	RL	S	CAZJK— 28	Chauk/JSL/RAJ	26.49	71.41	265.8	WL	S
CAZJK—6	Lanella/JSL/RAJ	27.04	70.49	182.4	NHS	S	CAZJK— 29	Pokran/JSL/RAJ	26.55	71.52	255.0	CL	S
CAZJK—7	Mokal/JSL/RAJ	27.06	70.46	174.9	GL	S	CAZJK— 30	Chacha/JSL/RAJ	26.57	71.46	252.6	RS	S
CAZJK—8	Mokal/JSL/RAJ	27.07	70.45	218.1	WL	S	CAZJK— 31	Chaud/JSL/RAJ	26.45	71.08	261.6	WL	T
CAZJK—9	Mokal/JSL/RAJ	27.07	70.45	215.1	WL	S	CAZJK— 32	Chaud/JSL/RAJ	26.44	71.09	257.4	GL	S
CAZJK—10	Mokal/JSL/RAJ	27.09	70.44	217.5	WL	S	CAZJK— 33	Chaud/JSL/RAJ	26.45	71.08	260.1	RL	S
CAZJK—11	Sonu/JSL/RAJ	27.12	70.41	239.1	WL	S	CAZJK— 34	Amarpura/JSL/RAJ	26.39	71.12	292.8	WL	S
CAZJK—12	Sonu/JSL/RAJ	27.16	70.37	218.1	WL	T	CAZJK— 35	Sangad/JSL/RAJ	26.33	71.10	286.5	SD	S
CAZJK—13	Bhadasar/JSL/RAJ	27.03	70.46	164.7	GL	S	CAZJK— 36	Bariada/BAR/RAJ	26.24	71.13	268.8	CL	S
CAZJK—14	Chaitral/JSL/RAJ	27.03	70.46	172.8	F	T	CAZJK— 37	Nimbasar/BAR/RAJ	26.09	71.16	220.5	CL	S
CAZJK—15	Chaitral/JSL/RAJ	27.01	70.45	170.4	WL	S	CAZJK— 38	Nimbasar/BAR/RAJ	26.09	71.16	231.6	NHS	S
CAZJK—16	Bhagu Gaon/JSL/RAJ	26.54	71.09	210.3	GL	S	CAZJK— 39	Nimbasir/BAR/RAJ	26.08	71.17	231.0	WL	S
CAZJK—17	Bhagu Gaon/JSL/RAJ	26.54	71.08	209.1	RL	S	CAZJK— 40	Nimbasar/BAR/RAJ	26.07	71.19	230.4	DL	S

**Table 1** continued

Collection number	Village/District/State	Latitude (°N)	Longitude (°E)	Altitude (m a.s.l.)	Habitat	Plant type	Collection number	Village/District/State	Latitude (°N)	Longitude (°E)	Altitude (m a.s.l.)	Habitat	Plant type
CAZJK—18	Aakal/JSL/RAJ	26.54	71.09	206.7	GL	S	CAZJK—41	Bhadka/BAR/RAJ	26.08	71.17	222.6	SD	S
CAZJK—19	Aakal/JSL/RAJ	26.53	71.07	211.8	WL	S	CAZJK—42	Bothia/BAR/RAJ	25.58	71.22	194.4	RL	S
CAZJK—20	Aakal/JSL/RAJ	26.53	71.07	209.7	WL	S	CAZJK—43	Bothia/BAR/RAJ	25.58	71.21	195.0	RL	S
CAZJK—21	Devikot/JSL/RAJ	26.46	71.07	261.6	GL	S	CAZJK—44	Fatehgarh/JSL/RAJ	26.29	71.12	275.7	WL	T
CAZJK—22	Sanwta/JSL/RAJ	26.42	71.18	280.2	WL	S	CAZJK—45	Fatehgarh/JSL/RAJ	26.31	71.10	267.9	WL	S
CAZJK—23	Rasla/JSL/RAJ	26.42	71.19	282.3	WL	T							

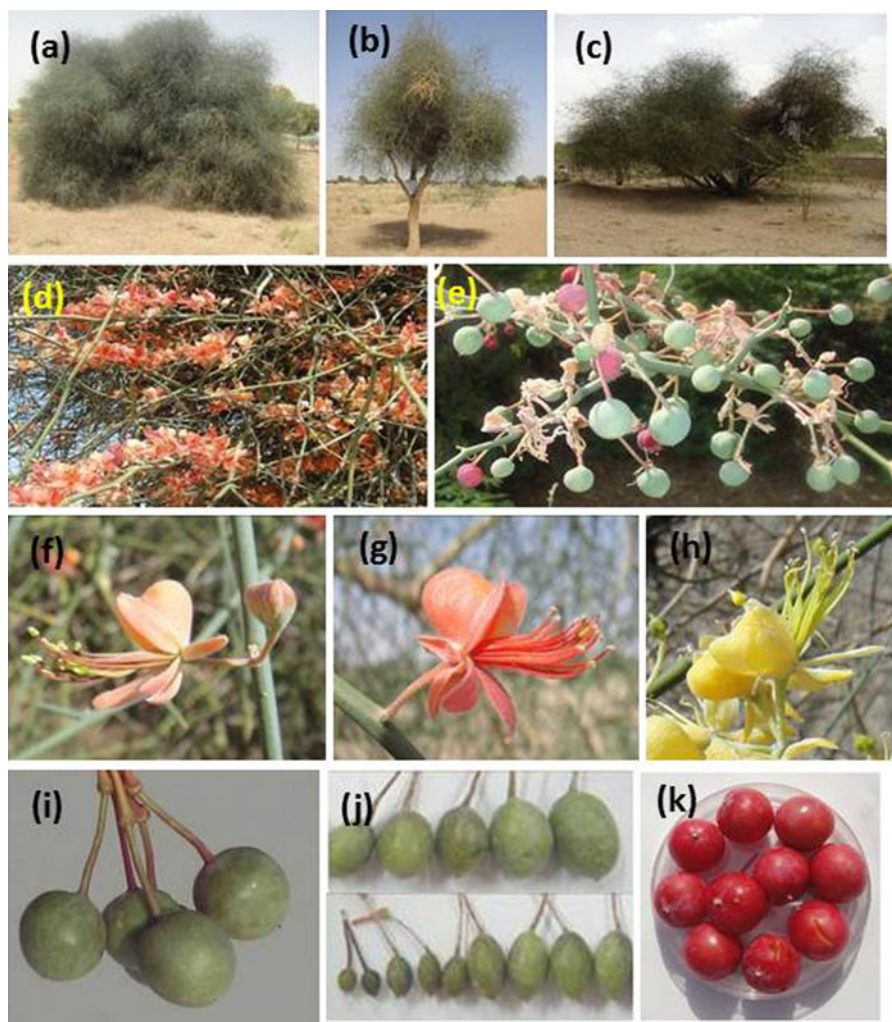
Where, JSL Jaishmer, RAJ Rajasthan, BAR Barmer, PS pond site, RS road side, RL rangeland, NHS near human settlement, GL grassland, WL wasteland, F forest, CL cultivated land, SD sand dune, T tree, S shrub

fruits are picked along with stalk, and stalk is removed manually (Fig. 2b–c). One kg of fruits is mixed with 250 g curd and 50 g salt and water in earthen pot. The pot is kept in open place after closing the lid. Water is drained at 4 days interval and the process is repeated 3–4 times till the fruits give flat and salty taste. The processed fruits can be utilized directly for preparation of pickles and/or as vegetable or can be dehydrated for off-season utilization (Goyal and Sharma 2009). Based on size, three relative grades of processed fruits i.e. big, medium and small size of *C. decidua* are available in the market. The smaller fruits are more tender and of better quality than bigger fruits. The processed dried fruits can be stored for a year without any deterioration in the quality at room temperature. The recovery is about one-fourth i.e. 1 kg of fresh immature fruit yields about 200–250 g of processed dried fruit (Fig. 2d).

For pickle making the processed fruits are dried for some time to drain excess water. Thereafter, dried fruits are mixed with spices mainly red chilli (*Cap-sicum annum* L.), turmeric (*Curcuma longa* L.) powder, clove (*Syzygium aromaticum* (L.) Merrill et Perry), nigella (*Nigella sativa* L.), cumin (*Cuminum cyminum* L.), fennel (*Foeniculum vulgare* Mill.), aniseed (*Pimpinella anisum* L.), fenugreek (*Trigonella foenum-graecum* L. and rai (*Brassica nigra* Koch) etc. in a definite proportion (Bala 1998). The mixture is kept for 1 day after adding common salt (Sodium chloride) and next day mustard (*Brassica juncea* (L.) Czern. et Coss. (Brassicaceae) oil is heated and after cooling the oil is poured in the vessel containing mixture up to brim. The mixture is kept in sun for few days and after 2 weeks pickle is ready for consumption (Fig. 2e).

### Yield and economics

A mature plant (6–8 year old) yields about 3–4 kg of green tender fruits. However, there is high variation in fruit yield, for instance old plants of tree shaped yields as high as 12–15 kg fruits plant<sup>-1</sup>. Pareek (1998) estimates 10–20 kg plant<sup>-1</sup> fruit yield. Fruit production increases as the plant gets older. The systematic plantation of species at 5 m × 5 m having ~400 plants can give ~1,600 kg of green fruit (@ 4 kg plant<sup>-1</sup>) from an area of one hectare. The green tender fruits fetches good price in local market even at road



**Fig. 1** *C. decidua* (a) Shrub type (b) small tree type (c) shrub with strong main branch type (d) flowering stage (e) Fruiting stage (f) light pink flower (g) dark pink flower (h) yellow flower

(i) immature green fruit (j) variability in fruit size and shape (k) mature red fruit. (Color figure online)

**Table 2** Diversity in plant and fruit characteristics of *Capparis decidua*

SN	Character (s)	Mean	Range	SD	Coefficient of variation
1	Fruit diam. (mm)	15.94	11.42–22.63	2.61	16.37
2	Fruit weight (g)	3.19	1.18–7.23	1.44	45.22
3	Seeds per fruit (no.)	12.75	5.20–27.80	5.38	42.17
4	1,000—seed weight (g)	21.29	14.59–26.92	2.34	11.01
5	Height of plant (cm)	364.4	134.3–804.2	203.33	55.8
6	North–south spread (cm)	318.7	97.8–786.0	139.90	43.9
7	East–west spread (cm)	298.9	92.5–694.1	124.94	41.8
8	Mean crown spread (cm)	305.6	100.1–476.3	121.63	39.8



**Table 3** Germination and seedling growth diversity in *C. decidua* accessions

SN	Character (s)	Mean	Range	SD	Coefficient of variation
1	Germination (%)	72.4	41.6–93.4	15.87	21.92
2	Survival (%)	60.2	44.2–76.8	11.74	19.50
3	Root length (cm)	13.69	8.13–17.52	2.64	19.30
4	Shoot length (cm)	19.88	12.33–28.25	3.42	17.22
5	Root: shoot ratio	0.70	0.40–0.98	0.14	19.49

**Fig. 2** Pickle preparation (a) picking of immature fruits (b) grading (c) removing the stalk attached with fruits (d) drying of processed fruits (e) pickle

side sale (@ Rs. 35–40 per kg). If processed, these 1,600 kg green fruits can give ~320 kg dried fruit. At the prevailing market price (Rs. 250–300 kg<sup>-1</sup>) of dried fruit it can give an income of ~ Rs. 80,000–96,000 ha<sup>-1</sup>. Since, picking in *C. decidua* fruits is very difficult due to small spines, compact canopy and very small size of tender fruit. An adult person can pick only 10–12 kg fruits day<sup>-1</sup>.

Scientific efforts towards developing genetically superior strains and standardization of suitable cultivation practices may increase the yield, and thereby increase income from the plantation in arid regions where arable cropping is not much remunerative. Timber and fuel wood provide additional income besides fruit and ecological benefits.

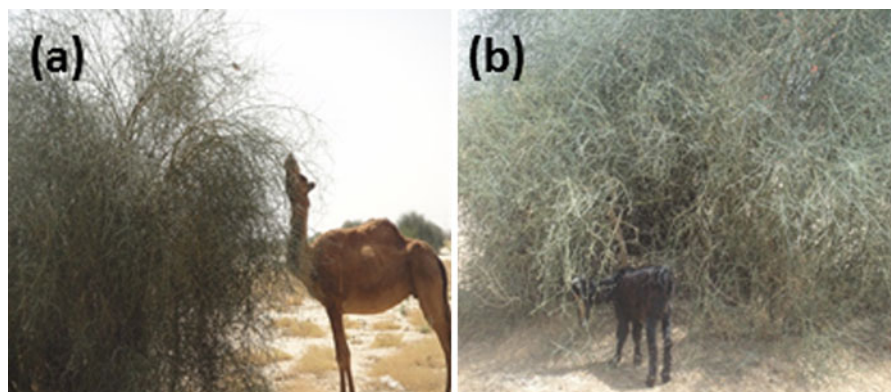
## Uses

### Food

The flower buds and immature green fruits of *C. decidua* are pickled, cooked and consumed as vegetables (Harsh and Tewari 1998; Pareek et al. 1998). The mature fruits are consumed fresh by local inhabitants. Ripe fruit contains 55 % pulp of the total fruit weight, 8.6 % protein, 1.8 % total sugars, 1.1 % reducing sugars, 0.057 % P, 1.026 % K, 0.055 % Ca, 0.055 % Mg and 7.81 mg per 100 g ascorbic acid. Thus, this fruit is rich in protein and mineral matter (Khera and Singh 1975). The immature fruits are in great demand in the different regions of India. Unripe fruit is pickled and has good commercial value. The fresh or dehydrated fruits are used extensively as vegetables and pickles. They are also cooked as vegetables with the fruits of *Prosopis cineraria* and seeds of *Acacia senegal*. Young green fruit is an important ingredient of the famous “Panchkoot” mixtures of dry vegetables of Rajasthan. The air-dried processed and immature fruits are delicious and highly priced.

**Table 4** Medicinal uses of plant parts of *C. decidua*

Plant part	System of medicine	Use	Reference
Leaves	Unani	Appetizer, helps in cardiac troubles	Kirtikar and Basu (1993), Chopra et al. (1999)
Fruit	Ayurveda	Astringent to the bowels, destroys foul breath, biliousness and urinary purulent discharge and helps to cure of cardiac trouble	Singh et al. (2005)
Bark	Ayurveda	Analgesic, diaphoretic, laxative, anthelmintic and good for cough, asthma, ulcers and boils, vomiting, piles and inflammations	Singh et al. (2005)

**Fig. 3** *C. decidua* as a source of browse (a) camel (b) goat

Among locally available fruits and vegetables of the arid zone of Rajasthan *C. decidua* is the richest source of beta-carotene in fresh and various processed states like blanched, dried and roasted (Chaturvedi and Nagar 2001). Unripe fruits contain 14.88 % crude protein, 7.43 % ether extract, 12.32 % crude fibre, 0.12 % ascorbic acid, 0.05 % carotene, 0.09 % Ca, 0.18 % P, 0.04 % Fe, 0.02 % Zn, 0.01 % Cu and 0.02 % Mn (Chouhan et al. 1986). Its seeds contains 1.7 % sugar, 8.6 % protein and 20 % oil (Rai and Rai 1987). The oil had 68.6 % unsaturated fatty acids and 31.4 % of saturated acids (Rai and Shekhawat 2000).

#### Medicinal

*C. decidua* is an important constituents of traditional medicine systems. Its leaves, fruits and bark are used to cure many diseases and ailments (Table 4). It contains number of alkaloids, terpenoids, glycosides and some fatty acids. Ethanol extract of aerial parts exhibits anti-inflammatory and analgesic activity (Ageel et al. 1985).

#### Fodder

In many part of the arid region shrubs are an important source of fodder (Rathore et al. 2011). Young branches of *C. decidua* is relished by camels and goat (Fig. 3a–b) particularly during post winter season, when little else is available in desartic conditions (Khan 2005). It gives  $\sim 1.10$  kg fodder shrub<sup>-1</sup> year<sup>-1</sup> (Narain et al. 2005). Its green or dried leaves are used as diet supplement for goat, sheep, camel and other animals during scarcity period of grass (IBPGR 1984).

#### Fuel wood and timber

It is used as firewood and for preparing charcoal. The wood of *C. decidua* has good fuel wood characteristics like calorific value, density, silica, carbon, ash-biomass ratio, moisture, volatile matter and fuel wood index (Jain, 1994). The wood is very hard and used to make water pipes and water troughs. Its timber is hard, heavy and termite resistant. The wood's strength and durability is suitable for making small beams, rafts,

knees of boats, tool handles, cartwheels, axles, and even combs. It also serves as material for making huts and fences.

### Ecological significance

*Capparis decidua* can be used in landscape gardening, afforestation and reforestation in semi- desert and desert areas; and it prevents soil erosion (Bangarwa 2008). It reduces wind erosion and alkalinity and improves soil fertility (increase of organic carbon and available N, P and K). It is best species for shelterbelts to check the movement of sand, and has an important role in sand dune stabilization for the Thar Desert of India (Pandey and Rokad 1992).

### Conclusion

Wild plant genetic resources are especially important under harsh climatic conditions where crop failures are very common, that often results in poor nutrition or starvation of the local population (Gebauer et al. 2007). In spite of the obvious interest of local people in indigenous species used for food, additional income, livestock feed, folk medicine, energy and for their role in soil conservation, their potentialities are neither exploited nor fully appreciated for their contribution to livelihoods (Pandey and Arora 2004). *C. decidua* due to rich nutritional profile and medicinal properties thus deserves special emphasis on conservation and improvement for exploring its untapped potential value in arid and semi-arid regions of India and iso-climatic regions of the world. If proper selection is made from available variability, *C. decidua* can make an excellent crop for extreme arid zone of India where a few species can survive and can be domesticated (Chundawat 1990).

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