Kheep (*Leptadenia pyrotechnica*): Potential Rangeland Shrub of Western Rajasthan, India

JP Singh*, VS Rathore and RK Beniwal
Central Arid Zone Research Institute, Regional Research Station, Bikaner-334004, Rajasthan, India

Kheep (*Leptadenia pyrotechnica* [Forsk.] Decne) is a widely distributed shrub in western Rajasthan, India. Having xerophytic characters, it is well adapted to harsh edapho-climatic conditions of hot arid region. It is one of most important fibre yielding plants of Thar Desert. It is also traditionally used as food, medicine and thatching purpose by the desert dwellers. As a drought hardy shrub, it plays an important role in arid ecosystem as a greening vegetation in the time of less and erratic rainfall. This paper presents the state of available information on ethnic uses, potential and future research needs of the species.

Key Words: Hot arid regions of India, Fibre, *Leptadenia pyrotechnica*, Kheep, Sand dune, Western Rajasthan

Harsh climatic conditions such as low and erratic rainfall, high evapotranspiration demand, extreme temperature, high wind velocity coupled with poor fertility and water holding capacity of soil resulted in sparse vegetation in hot arid western Rajasthan.The physiognomic aspect of the desert is poor, scanty, xerophytic vegetation, widely dispersed, leaving large barren land. Indian arid zone has 682 species (Bhandari, 1990) of which only 48 species are shrubs. Though, shrubs are less in number of species, they are ecologically most successful biotypes and have maximum share with respect to vegetation cover in the desert environment (Singh *et al.*, 2008). The species like Bordi [*Ziziphus nummularia* (Burm.f.) Wt.], Bawli [*Acacia jacquemontii* Benth.], Lana [*Haloxylon salicornicum* (Moq.) Bunge ex Boiss.], Phog [*Calligonum polygonoides* L.], Kheep [*Leptadenia pyrotechnica* (Forsk.) Decne.], Kair [*Capparis decidua* (Forsk.) Edgew.], Anni [*Clerodendrum phlomidis* L.f.], Aak [*Calotropis procera* (Ait.) R.Br.], Sinia (*Crotalaria burhia* Buch.-Ham.) are the important arid zone shrubs. The halophyte shrubs, *viz.*, Khara lana [*Haloxylon recurvum* (Moq.) Bunge ex Boiss], Lani [*Salsola barysoma* (Roem. and Schult.) Dandy], Luni [*Suaeda fruticosa* (L.) Forsk.], etc. are also the important species of the saline soils in hot arid region.

Leptadenia pyrotechnica (Forsk.) Decne (Family: Asclepiadaceae) locally known as Kheep is one of the important shrubs of natural vegetation of western Rajasthan. It is an erect, much branched, often leafless shrub with watery sap, up to 1.5 m high, sometimes attains a height of 3 m (in protected sites). It occurs on deep, sandy and soils having gravely subsoil in arid region. Natural stands of Kheep (*L. pyrotechnica*) trap the moving sand particles resulting in formation of sand hummocks. In many places, the dunes and interdunal plains are usually barren except for some *L. pyrotechnica,* along with Bui (*Areva pseudotomentosa*) and Sinia (*Crotalaria burhia*). Together with, another Asclepiadaceae species, *Sarcostemma acidum* (Roxb.) Voigt, *L. pyrotechnica* forms a degradation stage of *Calligonum polygonoides* (Mehor-Homji, 1977).

L. pyrotechnica is widely distributed in India, Pakistan, Iran, Israel, Arabia and northern and Sub-Sahalian Africa (Ali, 1983). In India, it is a typical species found on sandy soil throughout western Rajasthan. Being possessing xerophytic characters *L. pyrotechnica* is well adapted to harsh arid conditions of western Rajasthan. Studies on *L. pyrotechnica* in the Egyptian desert shown that it possesses highly effective mechanisms of drought resistance (Migahid *et. al.*, 1972). It has been found to have roots extending to a depth of 11.5 m with lateral extensions to 10 m (Batanouny and Abdel Wahab, 1973).

In the wake of degradation of natural resources and risk associated with arable crops, there is an urgent need of harnessing the potential of this underutilized shrub, which has multiple uses.

Materials and Methods

The information regarding ethnic uses of *L. pyrotechnica* was collected from the Bikaner, Jaisalmer, Churu, Hanumangerh and Sriganganagar districts of North-western Rajasthan during survey attempted to collect the germplasm of arid rangeland shrubs during year 2001-2003. The information was collected from inhabitants of above mentioned districts of hot arid region through

* *Author for Correspondence: E-mail: singh_jpbkn@yahoo.com*

personal interview method. In the present paper, an attempt has been made to pool up the information collected from survey with available information from the diffused literature.

Ethnic Importance

The *L. pyrotechnica* caters various needs of inhabitants of arid region (Table 1). The detailed information regarding its ethnic uses is as under.

Food: The unripe pods known as '*Khipoli*' are used as vegetable by local inhabitants of western Rajasthan and are supposed to be delicious and nutritious. In arid parts of Gujarat (India), its tuberous roots are consumed as vegetable (Tikka and Jaimini, 2005; Vyas, 2005). The leaves and tender shoots of another species *L. reticulata* (Retz.) Wt. & Arn. is also used in some parts of India as a vegetable, especially during times of scarcity. Its follicles (fruits) known as '*Shinguti*' or '*Dodhi*' are also sometimes used.

Fodder: Kheep is browsed by camel and goats in times of drought. Young branches are used as fodder during scarcity period. It is described as one of the important fodder for horses, cattle and camel in the *Sind Gazetteer* (Watt, 1989-93). Inhabitants of surveyed region opined that if Kheep is much browsed by the camel and goats it adversely affect their reproduction in the upcoming years. They also informed that it adversely affected the semen formation in camels and creates reproductive problems in she camel. Skin problem in goat and camel is reported after over browsing of Kheep.

Fibre: Kheep is recognized as one of the important fibre yielding plants since ancient times in the arid region. It is traditionally used for making cordage and ropes. These ropes are used for fastening the firewood bundles. Ropes for *charpoys* (cots) are also prepared, particularly because the green watery latex (juice) present in the stem prevents it fibre from decomposing (Bhandari, 2005). Being fairly resistant against rotting, its rope are used to draw water from wells, particularly in Sindh Provenance of Pakistan, where it frequently blend with fibre of *Periploca aphylla* Decene (Watt, 1889-93).

Medicine: Local inhabitants of arid region from centuries use Kheep as an antihistaminic and expectorant. Bed prepared from its green branches is used to cure fever and sometime sheet of branches is used to cover body to reduce high temperature. In the villages, its juice is used to melt or remove the spines from the body part. Plant juice is mixed with sugar and crushed wheat, and then tied on the affected body part to take out the thorn (Bhandari, 2005). Plant paste is applied over the paralyzed portion of the body for relief. It is applied in paste form to cure boils and blisters. Plant sap is used to cure eczema and skin diseases by Garsia tribe (Singh and Pandey, 1998) in Rajasthan. Kumar *et al.* (2005) reported detailed ethno-medicinal uses for abortion, antidote, typhoid, arthritis, rheumatism, flatulence, tumour and skin irritation in western Rajasthan. Oil extracted from it, known as "*Kubjprasarni* oil" is used in bones disorders and stone cases. As a veterinary herbal, stem decoction is given to cattle after delivery to facilitate the expulsion of 'Jair' (placenta) and also given to cattle for removing fatigue (Takhar, 2004; Bhandari, 2005). Stem is boiled and given orally to sheep to maintain smooth movement of joints (Takhar, 2004).

Table 1. Common uses of *L. pyrotechnica* in arid region

Ethnic Importance	Item/form	References
Food	Unripe pods and roots as vegetable	Tikka and Jaimini, 2005; Vyas, 2005
Fodder	Young/tender shoots	
Fibre	Branches for making cordage and ropes	Bhandari, 2005
Medicine	Plant sap, decoction	Kumar *et al.*, 2005, Takhar, 2004
Fuel wood	Dried stem and roots	–
Biofence	Row of plants on field boundary	
Other uses	Thatching material, brooms	–

Fuel wood : With diminishing availability of common fuel wood species like Phog (*Calligonum polygonoides*) and Khejri (*Prosopis cineraria*) in western Rajasthan, local people started to use Kheep as fuel wood. It is fulfilling the need of fuel wood in the area where the quality wood either not available or costly. It is also much used in *Bhattis* (furnace) for preparing *Mava* (condensed milk) from the milk as substitute wood of Phog (*C. polygonoides*). The local inhabitants of the region were with the impression that large amount of smoke produced during burning of its wood is harmful to human health and caused problems like headache, giddiness and eye problems.

Biofence: Kheep is also used as biofence around the field boundaries. It is supposed to check the soil erosion and also the protection from stray animals. However, its adverse effects on the adjoining rows of crop plants are also reported by some of the farmers. They believe that rain water falling through the Kheep plants adversely

affects the soil quality and thereby crop production. It needs detailed scientific study in this direction.

***Social and religious aspect*:** Dried Branches are used in funeral ceremony for making the *Sidhi* (ladder) for carrying the dead body.

***Other uses*:** Since long, Kheep is extensively used for thatching purpose. In western Rajasthan, it is used for making sidewalls of huts and animal sheds in rural areas. Serving dishes are made for keeping cooked vegetable and other things (Kumar *et al.*, 2005). Brooms are also made from its stems. Camel carts carrying the loads of *L. pyrotechnica* branches are a common feature in the area, which fulfill the local demand for thatching and other purposes.

Exploitation Potential

Fibre: There is growing awareness of utilizing the newer plant resources all over the world for a variety of products. Utilization of indigenous shrubs that constitute a major part of woody vegetation is important to livelihood of the people of arid region. Many such species offer considerable scope for the extraction and use of fibre for cordage, ropes and handicrafts (Singh *et al.*, 2005). Its production potential can be very well utilized in small-scale cottage industries in the area.

Various researchers have dealt quality aspect of *L. pyrotechnica* fibre from India and Pakistan (Jamil, 1970, Jamil *et al.*, 1971; Manavalan *et al.*, 1979; Mojumdar *et al.*, 2001). Jamil (1970) have opined that Kheep fibre is better than most of the bast fibres and can be ranked along with flax and ramie in quality. Mojumdar *et al.*, (2001) reported that owing to high a-cellulose and low lignin contents along with favourable length/breadth ratio of its fibre make it suitable for use in blending with cotton or polyester fibres to produce blended textiles yarns and in pulp and paper industries. Laghari (1983) reported that its fibre accepts silk dyes, but not dyes suitable for cotton or wool. Further, he has been able to prepare ropes, carpets and similar items by spinning the thread on the indigenous handloom. It has also been suggested that Kheep fibre – wool industries may be established on a large scale for this purpose.

During the survey of Northwestern Rajasthan by the authors, it was observed that for making ropes, the branches are spread on the roads before extracting the fibre. This method also vogue in Pakistan (Laghari, 1983) as tyred motor vehicles run over them, thus simulating the stress to which they are subjected when spread on sandy tracts to provide traction for vehicles. Ali (1986) mentioned that this method in separation of fibres has yet to be examined and tried commercially.

Food/green vegetable: The unripe fruits locally known as '*Khipoli*' reported to be rich in nutrients. It contains about 23.18 per cent fibre, 9.83 per cent carbohydrate and 3.13 per cent protein with energy value of 68.4 kcal/ 100 g. It is also fairly good source of minerals e.g., phosphorus, potassium, calcium, sodium, iron and vitamin C having 317 mg, 226 mg, 156 mg, 125 mg, 3.48 mg and 39 mg per 100 g, respectively (Goyal and Choudhary, 2005). They found that Kheep could be used as cheap and readily available ingredient for the diet in the arid region. Thus, nutritionally it is well balanced in term of major and micronutrients and can be included in food basket of local inhabitants having low purchasing power.

Raw material for pharmaceuticals: Effectiveness of alcoholic stem and flower of Kheep against typhoid fever caused by *Salmonella typhi* was reported by Gehlot and Bohra (2000). Furthermore, the presence of various phenolic compounds and alkaloids in *L. pyrotechnica*, adds new dimensions to its pharmaceutical values. A new pentacyclic triterpenoid, named leptadenol, was isolated from a hexane extract of *L. pyrotechnica* collected from Dumba Goth, near Karachi in Pakistan (Noor *et al.*, 1993). Manavalan and Mithal (1980) confirmed presence of triterpenoids, taraxerol and fernenol and b-sitosterol in *L. pyrotechnica.* Resemblance of *L. pyrotechnica* acid phosphatase with human prostatic acid phosphomonoesterase was reported by Dhawan and Singh (1976b). They also reported presence of amino acids (and lysine, arginine, alanine, threonine, methionine, isoleucine and 2-dipeptides) and sugar (raffinose, sucrose, glucose and fructose) in it (Dhawan and Singh, 1976 a). Thus, the use of *L. pyrotechnica* to cure various diseases and disorders in vogue since long back, and there is an urgent need to unfolding the secrets of its medicinal values through modern scientific tools to expand its uses further.

Fodder resource during drought: Sporadic evidences are available about its use as fodder for livestock particularly for camels. Chemical analysis of *L. pyrotechnica* attempted by Dhir *et al.* (1984) and Sharma *et al.* (1984) revealed that it is comparable to other shrubs and trees of arid western Rajasthan with respect to macro and micronutrients contents (Table 2). Abdalla *et al.* (1995) from United Arab Emirates reported 6.94 per cent crude protein content with gross energy of 4.89 kcal/g DM in it. Venkatesh *et al.* (1971) and Venkatesh and Singh (1973)

reported maximum ascorbic acid content 123 mg per 100 g green leaves of Kheep during winter months followed by rainy season (63 mg/ 100 g) and summer (36 mg per 100 g) season. Chromatographic analysis revealed the presence of raffinose and fructose (Dhawan and Singh, 1976a). Detailed investigations are required to evaluate its fodder value and validate the belief of its adverse effect for anti-quality factors in camel and goats.

Material of sand dune stabilization: Shrubs have a key role in resisting soil erosion due to their wider adaptability and ability to withstand biotic pressure, *L. pyrotechnica* showed high potential local raw material using in the checkerboard or parallel hedges as micro wind breaks to halt the movement of sand prior to planting work in sand dune stabilization programme. It has an important role in initial colonization of the bare dunes when its material is used in the checkerboard. The intact ripe fruits with its branches germinate in favorable condition, provide good protection against wind erosion and establish well in adverse conditions. On sand dunes it also does well with indigenous perennial grasses like *Panicum turgidum*. It is one of the potential species used for desert control in Mauritania (Hadjej *et al.*, 1991). In Abu Dhabi, forest areas are being extensively interplanted with fodder shrubs such as *Atriplex, Calligonum comosum* and *Leptadenia pyrotechnica* by the Forest and Agriculture Departments (Khan, 1982).

Suitability as biofence in agricultural fields: As inhabitants believe that the Kheep plants adversely affect the soil quality and thereby crop production. It needs detailed scientific study in this direction. Root and shoot extracts of *L. pytotechnica* exhibit negative effect on germination of arid shrub *Phog* (*Calligonum polygonoides*) and *Sewan* grass (*Lasiurus scindicus*) (Gautam and Bishnoi, 1991).

Conclusions

Western Rajasthan represents a range of diversity in native shrubs, which occur on a wide range of habitats. Some of these species like *L. pyrotechnica* grow in extreme desert conditions and survive in harsh climatic. The diverse material of this indigenous shrub offer a good scope in arid ecosystem to exploit the fiber potential and medicinal value of this shrub along with other ethnic uses. It can supply the raw material even in the times of drought and low rainfall condition. The wastelands and other marginal lands can be utilized for planting this species. This will be particularly useful on those areas where this species make the dominant cover even in times of drought. There is an urgent need to collect and evaluate the diverse germplasm of *L. pyrotechnica* from its natural distribution cover in the hot arid region. Suitable genotypes for different purposes like food, fodder, fibre, and medicinal value can be identified with multidisciplinary team of research organizations.

Table 2. Elements in *Leptadenia pyrotechnica* (Kheep)

Nutrient	Content	Reference
Phosphorus	0.140 %	Dhir *et al.*, 1984
Calcium	2.72 %	do
Magnesium	0.56 mg/100 g	do
Potassium	1.36 %	do
Sodium	0.077 mg/100 g	do
Zinc	22 ppm	Sharma *et al.*, 1984
Manganese	80 ppm	do
Copper	15.5 ppm	do
Iron	131	do

Future Thrust

- Germplasm collection, evaluation and characterization from arid region;
- Standardizing the propagation technique and agro techniques;
- Introduction of suitable genotypes in wasteland development programme and integration in various Alternate Land Use Systems (ALUS) in farming system perspective;
- Designing cost effective technology to extract its fibre and identifying use on commercial scale;
- Identification and characterization of secondary metabolites of pharmaceutical significance;
- Evaluating for anti-quality factors and exploring the possibilities of its use as livestock fodder during drought and scarcity period.

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