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CHAPTER 1

Habitat Specific Ecological Constrains in Medicinal Plant Species *Blepharis sindica* T. Anders

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Abstract

Blepharis sindica T. Anders (Acanthaceae) is a threatened and important medicinal plant of Indian arid zone. Sand dune slopes with heavy eolian shifting are most preferred habitat for this species. Serotiny habit with excellent seed output and germplasm protection mechanisms are hope of this species to thrive well. The extra ordinary adaption features like highly hygroscopic seed coat coverings and precise imbibition needs are life threatening issues that operate under high moisture environment while seedling are struggling to establish. Both spatial and temporal features are major constrains for this medicinal plant species to colonize at sandy habitats of Indian arid zone.

Keywords: Habitat, ecology, sand dunes, serotiny, adaptabilities, moisture

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Introduction

Human dependency on medicinal plants is much ancient practice than the human civilization itself. Initially; it formed the bulk of folk, tribal or ethano-medicine systems, practiced in India and other parts of the world including China, the Middle East, Africa and South America. Progressively this indigenous knowledge was formulated, documented and eventually passed into the organized system of medicine, *viz.* Ayurveda, Unani, Siddha or some other systems outside the India too. With technical advances of phyto-chemistry and pharmacology, a number of active principles of medicinal plants were isolated and standardized as valuable drugs in modern medicine.

In India, the contribution made during the last decades as diverse information on medicinal plants can be placed under codified, empirical and scientific knowledge groups dealing with organized medicine systems (Ayurveda, Unani and Sidha), ethano-medicine or folk medicine (oral information passing through generations) and active phyto-principles based modern medicine, respectively.

Present time increasing interest in plant based drugs has accelerated medicinal plants/parts demand leading to their over exploitation, unsustainable harvesting and finally to complete loss of several important plant species in nature. The habitat destruction due to increased human activities (human settlements, agricultural and other developmental programs), illegal trade of rare and endangered medicinal plants and lack of restoration practices for degraded forests have further accelerated extinction of several species, particularly medicinal. India is a home of versatile plant diversity residing in different agro-climatic zones of varied topography and attitudinal variations like high mountain ranges, coast lines, plains and deserts. Indian desert- the Thar; is unique and richest among all desert ecosystems spreading in different parts over global surface. Prevailed as well as on-going ecological interactions within its biotic and abiotic components are determining the future of Thar desert ecosystem in western Rajasthan.

It is estimated that about one fourth of the total plants of the Indian Thar desert is useful for the welfare of human beings and domestic animals for food, fuel, fodder, medicine and other requirement (Saxena, 1994, Sen, 1982). Long-time availability of medicinal plants from natural climates need to calculate and understand adequate information about particular biodiversity region. As per current census, several important plant species of Indian arid zone are facing high risk of extinction and are included threatened vegetation of Thar arid zone like *Commiphora wightii, Tribulus rajasthanensis, Calligonum polygonoides, Ephedra foliata, Leptadenia reticulata, Tecomella undulata, Blepharis sindica, Peganum harmala, Sarcostoma vinimale, Butea monosperma,* etc. Continuous exploitation of these plants from natural areas and absence of scientific developmental approaches; many plant species have become vulnerable to extinction. Inadequate knowledge about the usable plant parts, lack of eco-friendly feeling, deficiency in plant product harvesting knowledge and several factors of plant itself *i.e*. slow growth rate, habitat limitations, decrease in reproduction efficiency, disturbances in particular bio-geochemical cycling etc. promote the silent depletion of much valuable medicinal plants of the area with a remarkable speed. Lack of regeneration and unscrupulous collection by unskilled persons too increasing the threats to medicinal flora of Indian arid zone (Kasera *et al.*, 2002).

For better human health, it is prerequisite to not only sustain the relevant plants but also to ensure their multiplication in nature. For handling above lines, the study of the medicinal plants in present scenario is necessary, including positions left behind in particulars ecosystem, measurement of growth promoting/inhibiting factors, new arising and pre-existing threats, determination of suitab00le *in-situ* and *ex-situ* conservation approaches are strongly recommended.

Blepharis sindica T. Anders, locally known as Billi Khojio, Bhangara, Unt-Katalo is an aphrodisiac plant species of family Acanthaceae. Its compressed seeds with densely clothed hygroscopic hairs are used in preparation of herbal medicines (Bhandari, 1990; Singh *et al*., 1996). Its roots are used for urinary discharge and dysmenorrhoea. Powdered plant is applied locally on infections of the genitals and on burns (Khare, 2001). Seeds contain flavonoides (apigenin, blepharin, prunine-6″-O-coumarate, and terniflorin), steroid (β-sitosterol) and triterpinoide-oleanolic acid (Ahmad *et al*., 1984).

Biology and Phenology

B. sindica is a small, dichotomously branched, lignified woody annual herb growing on dune slopes or near crop fencings. Dried plants of previous year along with attached spikes turn black and remain scattered in the field giving the distinguishable appearance to the species. Lignified plant axis as well as seed loaded spikes make the plant enough heavy to resist blown by wind currents and the dried plants remain open to buried under eolian depositions. The first rainfall initiates the life, as after a slight soaking, the capsules spread out seeds by an explosive mechanism. Epigeal germination gives rise to seedlings having dark green, massive and heart shaped cotyledons. Stem bears ash coloured, terete and finally pubescent branches in dichotomous manner (Fig.01). Leaves are sessile in a whorl of 4, unequal, 2.5-9 x 0.2-0.7 cm, linear and acute; usually with a few, spinous teeth near the base. Margins recurved, midrib whitish green and prominent beneath.

Flowers develop in strobilate, spiny spikes; 2-13 cm long, in the fork of the branches, solitary at upper nodes or in cluster of 5-27 at lower nodes on a very short, woody peduncle. Bracts quadrifarious, 1.5-2.5 x 0.8-1.5 cm, lowest smaller and sterile, densely hairy on both surfaces, ovate, accuminate, spinous-pointed, 5-nerved, pubsecent spines, bracteoles 2, linear lanceolate, 1.5 cm long, midnerved strong, raticulately veined, hairy and ciliate. Calyx divided to base, softly haired on both surfaces, outer segment largest, ovate, 15 x 6 mm, shortly accuminate, 7-nerved, the mid nerves parallel and continued beyond, the opposite calyx segments smaller, not produced into apical teeth, lateral segments 8 mm long, ovate, acute, 1-nerved. Corolla 1.5 cm long, one lipped, the lip 3-lobed, mid lobe quadrate, slightly larger than the lateral lobes which are rounded at apex, tube 4 mm long, brown, constricted below the limb. Stamens 4, didynamous, filaments thick, rigid, anther cells unequal, larger cell with bearded margin. Fruit 8 x 4.5 mm capsule, ellipsoid, compressed, narrowed at both ends, glabrous, shining. Seeds 4 mm long, compressed, densely clothed with thick hygroscopic hairs.

Fig 01: (Photos a-q). *Blepharis sindica*: Dried plants of previous year buried under eolian deposition during summer (a), young seedlings with dark green, heart-shaped and massive cotyledons (b), seedlings in close association (c), characteristic vegetative growth by dichotomously branching pattern (d), plant in association with *Borreria articularis* and *Cyperus iria* at dune (e), quadra-angular and spiny spikes in a dense cluster at basal nodes (f), single bract bearing marginal spines (g), one-lipped, purple tinged corolla with quadra-angular mid lobe (h), didynamous stamens (i), unequal anther lobes (j), larger anther lobe with extended connective at apex (k), oval pollen grains (l), flattened stigmatic surface lodged with pollen mass (m), dried plant with bright brown spikes at nodes (n), immature and mature glabrous, shining and ellipsoid capsules (o), single seed sheathed by hygroscopic hairs (p), and an *in-vitro* seedling exposing the typical seed coat (q).

In *B. sindica*, the seeds remain enclosed within hard capsule coverings till the slight absorption of moisture from surroundings to disperse seeds by means of explosive mechanism. The vegetative growth was observed from July to October and flowering during September to November, which leads to the fruit formation in October-November and finally seed maturation by November-December (Fig. 02).

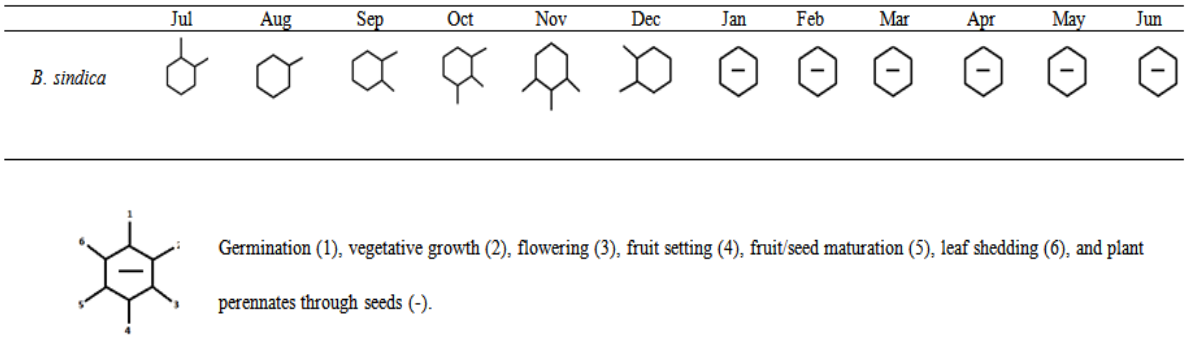

Fig. 2: Phenograms for *B. sindica* vegetation in Indian arid zone.

Habitat and Constrains

B. sindica plants is a desert plant species that thrive well at sand dunes (especially east-south facing slopes) and cropping free field margins/fencings (Lal *et al*., 2014). Serotinous holding of germplasm within attached spikes, efficacy of seed release during initial rains and seedling establishment are the most vital strategies that limit the size of local patchy populations of this species (Narita and Wada, 1998; Bhatt, *et al*., 2017). Seed release abilities, eolian sand burial load on dried plants, high predation probabilities of dispersed seeds and excessive moisture availabilities during seedling establishment are the previously reported threats working for the population decline in this species (Mathur, 2014, Lal, *et al.*, 2020). To withstand against the existing ecological stresses, *B. sindica* plants might use their body parts in a precise adaptive way (Lal, 2025).

In desert habitats like Indian arid zone, seed germination efforts tend to be highly dependent on micro-environment conditions over space and time. Germination is most likely to occur at a time when seedlings may have a greater chance to survive. Germination strategies also strongly influence reproductive output (Narita and Wada, 1998), which is the most important component of life history in arid ephemerals. The adaptive features as seed size, shape, seed output and reserve food amounts collectively adjust the reproductive efficiency for a plant species in a particular habitat (Sen, 1982). Seed germination is a key element affecting population dynamics and control the distribution and abundance of particular species in an area. Among external factors; water, oxygen, temperature, light and acute soil conditions are most important to affect seed germination and seedling establishment (Valverde *et al*., 2005).

Conclusions

As generation long adaptabilities, *B. sindica* plants are highly adjusted to micro-habitat conditions of sandy dunes and seem to be dependent on eolian sand characteristics. Serotiny habit of the species is the most important aspect for perpetuation efficiency. Highly efficient seed protection mechanisms and imbibition opportunities of freshly dispersed seeds are life managing for the species. Population growth restrictions in terms of space and time invariably controlled during very beginning of young seedlings over dune surfaces under precipitation amounts. As the moisture amounts exceeds, the habitat specific adaptabilities of the species turn life threatening to collapse young seedlings. Besides seedlings; growing plants too adversely affected by high moisture in surrounding. *B. sindica* is a highly adapted arid zone medicinal plant species but aridity love of this species pushes it to complete failure of seedling establishment at naturally preferred sand dune habitats.

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