Indian Forester, 140 (4) : 435-436, 2014
http://www.indianforester.co.in

ISSN No. 0019-4816 (Print)
ISSN No. 2321-094X (Online)

(IV)

A RARE AND ENDANGERED ROOT PARASITE: *BALANOPHORA INVOLUCRATA* HOOK. F. & THOMPSON

Study area

An exploration survey was conduced to find out the presence of Balanophora involucrata was conducted in Kedarnath Wildlife Sanctuary (KWS), one of the largest protected area in the Western Himalaya (975 km^2) with several extensive alpine meadows and dense evergreen broadleaved (*Quercus semecarpifolia*), conifer (*Abies spectabilis*), deciduous (*Betula utilis*) forests and *Rhododendron campanulatum* krummholtz;(Adhikari *et al.*, 2009). These forests and alpine meadows harbour a rich array of flora and fauna including rare endemic plants, of which as many as 15 species of vascular plants are listed in Red Data Book of Indian plants (Rao *et al.*, 2003) occurring in KWS. The Sanctuary was extensively surveyed at and around timberline ecotone during 2007-2010, covering all the seasons.

The plant

Balanophoraceae, a family of obligate root parasites comprising of 17 genera in the world is one of the interesting group of plants and are known to parasitize at least 74 species in 35 families (Mabberley, 1987). The genus *Balanophora* represents *ca.* 19 species worldwide (Ke *et al.*, 2003) and 4 species are reported from Indian Himalayan region, *viz. B. involucrata*, *B. polyandra*, *B. dioica* and *B. harlandii*. The distribution of *Balanophora involucrata* is from Pakistan to Western China and in India from Jammu and Kashmir to Sikkim. *Balanophora* forms underground tuberous structure, haustorium attached to the host plants and only emerge aboveground during reproduction. Unlike typical flowers of dicots that have differentiated sepals and petals, the flowers of Balanophoraceae are highly reduced and the remnant floral organs are sometimes difficult to interpret the ontological origins.

Due to the extreme reduction of morphological features, the phylogeny of Balanophoraceae has been controversial. Cronquist (1981) viewed the sandalwood as the ancestral group for Balanophoraceae and recent molecular phylogenetic analyses point towards Santalales (Nickrent *et al.*, 2005) and also has been recovered using B-class floral homeotic genes (Su and Hu, 2008). About 1% of angiosperm species have evolved to extract resources from other plants in the form of root parasite (Press and Graves, 1995). Balanophoraceae is one of the oldest groups of angiosperms which survived through late triassic period (Cornet, 1989). Extreme modification and reduction in floral morphology presents an obstacle to determine the evolutionary relationships and appropriate position in the classification of these parasitic species. This is ecologically distinct group of species to establish and compete among their host plants and surrounding vegetation. The host-parasite interactions have special interest for the ecologists and physiologists. Over the last three decades, there has been a major shift in the study of adaptive patterns and processes towards the role of host-parasite interactions, informed by concepts from evolutionary ecology and phylogenetic relationships (Nickrent *et al.,* 2005; Takhtajan, 1997; Thorne, 1992).

Owing to its achlorophyllus nature, it is very difficult to locate the plant in the field. The main plant of *B. involucrata is* erect, glabrous, fleshy, dioecious, achlorophyllous, holoparasitic herb (Photo 1 a, b and c) that produces swollen tuberous haustorial roots (Ke et al., 2003). The leaves are verticillate and connate into a sheath like whorl and their unisexual flowers represent the ultimate in reduction among angiosperms. The rhizomes are usually branched and smooth with small scaly warts containing sticky wax, balanophorin (Ke *et al.*, 2003). Peduncles emerged from the root-stocks, form an irregular toothed or lobed ring and sheathed halfway up by an involucre of 2-4 partially connate scales at its base. The aboveground parts constitute the inflorescence,

Photo I. Various developmental stages of *Balanophora involucrata*
(a), initiation of inflorescence (b) mature aboveground part and (c) flowering stage

which is remarkably fungoid in appearance, brown, pink or purplish, bearing numerous flowers which are among the smallest known (Cornet, 1989). Male flowers with the tube of perianth surrounding the base sunk in the cavities of the head, usually trimerous. However, the female flowers are naked, numerous, interspersed with sub-globulate to clavate bracts.

Species distribution

In western Himalaya the species is considered as endangered (Ved *et al.,* 2003) and reported earlier only from Ghangharia on way to Valley of Flowers NP (Naithani, 1984). During the current survey *B. involucrata* was recorded from two localities, Tungnath (30°30'13"N and 79°13'29"E) and Patyuri (30°37'42" N & 79°08'29" E) in KWS with small populations, 3-8 individuals in each group (I.D. Rai, WII-11450). Out of four groups, three were in the *Betula utilis* and one in *Quercus semecarpifolia* forests between 3250-3400m amsl within and under canopy of *R. campanulatum*, as the species does not require light and mostly grows under shady and dense canopy. The dead remains of the previous year's shoot were also seen.

Medicinal uses

It is medicinally used in piles and rheumatism (Khare, 2007). Some pastoral communities in the temperate zone of Kashmir Himalaya using this species as a substitute of tea and commonly known as 'Mastaani Booti' in the region (Sharma, 2009). It is used as folk medicine in the Yunnan province of China as tonic and haemostatic (Xi-kui *et al*., 1998), bleeding, cough, hemorrhoid's gall, whitlow and extract to reduce the blood sugar, however, *Triterpene* esters and *Balanophorin* are also extracted.

Conservation status

Some species of *Balanophora* are already listed under Appendix II of the CITES (Kipgen and Singh, 2010). Even after declaring as Sanctuary, KWS is subjected to excessive anthropogenic pressure due to intensive grazing, tourism activities, soil erosion and landslides, which have cumulative adverse effect on the natural regeneration of forests species, thereby indicating very poor conservation status of the species. For the conservation of such rare taxa and botanical curios of the sanctuary, it is extremely desirable to protect such an important area.

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