Grows on open alpine slopes at 3,640-5,140 m.

Specimens examined: Sikkim, without any precise locality, *s.d.*, *G.H. Cave* 431 (Acc. No. 255171-CAL) and *G.H. Cave* 585 (Acc. No. 255170-CAL).

Note: *Stebbinsia umbrella* resembles *Youngia depressa* (Hook. *f* & Thorns.) Babcock & Stebbins in morphological appearance, ligule and pollen characters, but here our identification is confirmed by the presence of neckless cypsela with a truncate apex. Moreover, the cypsela is distinctly ribbed in *Youngia*, but in *Stebbinsia*, it is smooth to slightly striate.

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26. PASSERINE BIRD-POLLINATION IN THE DRY SEASON BLOOMING *BUTEA SUPERBA* ROXB. (FABACEAE) IN THE EASTERN GHATS[1]

A.J. Solomon Raju[2, 3] and S. Purnachandra Rao[2, 4]

[1]Accepted February 07, 2005
[2]Department of Environmental Sciences, Andhra University, Visakhapatnam 530 003, Andhra Pradesh, India.
[3]Email: ajsraju@yahoo.com
[4]Email: sprao999@yahoo.co.in

The genus *Butea*, as the name implies, produces beautiful orange-red or scarlet flowers. There is very little information available on the floral biology and pollinators of *Butea* species. Ali (1932) reported that *B. monosperma* flowers produce a large amount of nectar and that different passerine birds collect this nectar to quench their thirst during the dry season. He also suggested that *B. superba* flowers are structurally similar to *B. monosperma* and would probably also be ornithophilous. But he has not made any observations on the floral characteristics and pollinators of *B. superba*. Therefore, we studied some aspects of the floral biology and pollinators of *B. superba*.

Butea superba is a gigantic woody climbing shrub, occurring in moist localities in the Eastern Ghats forests in the Visakhapatnam and East Godavari districts of Andhra Pradesh. We studied the trees in Lotugedda, Lambasingi and Anantagiri in the Visakhapatnam district and Ramavaram, and in Addateegala in East Godavari district. Floral events – anthesis, anther dehiscence, nectar volume, stigma receptivity and exposure of stamens and stigma were carefully observed according to Dafni (1992), and Solomon Raju and Subba Reddi (1994). Fifty flowers marked on ten different trees were used to observe these events. The flower-visitors included birds, squirrels and monkeys, whose flower-visiting schedules, probing behaviour and role in pollination were observed using binoculars.

B. superba sheds its leaves before the onset of flowering, which occurs during late February-March. The flowers, grouped in threes, are borne on a velvety, dark maroon racemose inflorescence. Their maturation and subsequent anthesis does not show either an acropetal or a basipetal pattern. The flowers are large, 59 mm long, orange-scarlet, bisexual, and zygomorphic. The calyx consists of five sepals, united into a cup-like structure. The corolla has five unequal petals, covered with silky hairs. There are the standard petal, two smaller wing petals and a much curved, beak-shaped keel, formed by the fusion of two petals, which encloses the stamens and stigma. Ten stamens – nine united and one free stamen situated below level of united stamens. Anthers yellow, 3 mm long. Ovary springs up from centre of staminal sheath, style 36 mm long, curved at tip, terminating in a simple greenish-yellow stigma. Curved style and stigma overtop anthers of united bundle of stamens. Ovary unilocular, 4-7 ovules (mostly 4-5).

The flowers open between 0530-0630 hrs. Anther dehiscence is seen thirty minutes after anthesis. Beginning of stigma receptivity is seen one hour after anther dehiscence. Stigma receptivity lasts for 30 hours. A flower produces 30 ± 0.8 µl of nectar. The flowers show signs of withering on the third day, and drop off on the fourth day if not disturbed by flower-visitors.

The flowers were visited by many birds, including passerines – *Acridotheres tristis* (Common Myna), *Chloropsis aurifrons* (Gold-fronted Chloropsis), *Anthus richardi* (Indian Pipit), *Nectarinia zeylonica* (Purple-rumped Sunbird) and *Nectarinia asiatica* (Purple Sunbird), and non-passerines – *Psittacula krameri* (Rose-ringed Parakeet), *Psittacula cyanocephala* (Plum-headed Parakeet), *Loriculus vernalis* (Indian Hanging-Parrot), *Merops orientalis* (Small Bee-eater) and *Dendrocopos nanus* (Brown-capped Pigmy Woodpecker). These birds collected nectar throughout the day, but they showed hectic foraging activity only during the early morning

and late evening hours. While drinking nectar, the passerines, and *Merops orientalis* contacted the stamens and stigma, effecting pollination. The other non-passerines caused damage to sex organs while probing the flowers for nectar. Further, they made punctures or holes at the flower base to drink nectar and also removed flowers to look for more nectar. Both categories of birds were regular visitors to *B. superba* until the flowers were exhausted. They made frequent visits to other trees of the same species in search of more nectar. The Indian Giant Squirrel (*Ratufa indica*), Bonnet Macaque (*Macaca radiata*) and Common Langur (*Presbytis entellus*) were also found to be regular visitors to the flowers of *B. superba*. The squirrel removed the basal part of the keel petals to access the nectar, thereby destroying the flowers. The monkeys plucked the flowers to eat the nectar-bearing part of the corolla. The flower-eating activity of all non-passerine birds, except *M. orientalis*, squirrels and monkeys were found to be detrimental to the reproductive success of *B. superba*.

B. superba flowers show ornithophilous floral characteristics (Faegri and van der Pijl 1979) — anthesis during the day, large, odourless robust flowers, bright orange-scarlet corolla, deep-seated, well-protected nectar and ovary, production of copious amount of nectar and the position of stamens and stigma away from the nectar location. The standard petal curves downwards, facilitating easy probing by birds. The keel petal is beak-shaped, holding the stamens and stigma inside, and overtops the other three petals. Further, the orientation and the arrangement of the flowers on the inflorescence help birds to probe them in quick succession. The leafless state of trees during flowering, makes the flowers more visible, and may help attract bird visitors, even from a long distance.

These bird-flowers attract both passerine and non-passerine birds. The passerine birds and the non-passerine *M. orientalis* effect pollination while probing the flowers for nectar. During probing, the birds cause the release of stamens and stigma from the beak-shaped keel petal and contact them on their beak and forehead. As the birds are far-flying and frequently move between trees of the same species in quest of nectar, they effect both self- and cross-pollination. The other non-passerines are not specialized flower-birds, but use *B. superba* flowers as a liquid source during the dry period, but in the process damage sex organs and also remove a large number of flowers daily, affecting reproductive success. Squirrels and monkeys use the flowers and contribute to a reduced fruit set rate. The hectic flower-feeding activity of non-pollinators on *B. superba* seen in our study appears to be a consequence of reduced or non-availability of their natural food sources due to degraded forest habitats with reduced biodiversity. Nevertheless, *B. superba* flowers serve as potential feeding stations for visiting birds, squirrels and monkeys during the dry season in the Eastern Ghats.

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27. SYNCHRONOUS SENESCENCE IN NEEM TREES IN BIJNOR AND JYOTIBA PHULE NAGAR DISTRICTS OF WESTERN UTTAR PRADESH [1]

Sanjay Kumar[2]

[1]Accepted July 12, 2003

[2]Directorate of Plant Protection, Quarantine and Storage, NH-IV, Faridabad 121001, Haryana, India.
Email:sanjaykdr@yahoo.co.in

Neem (*Azadirachta indica* A. Juss.) is a polycarpic perennial, medium sized, deciduous tree having medicinal as well as insecticidal properties. It is cultivated all over India but thrives best in the drier climate of the north-western parts, where maximum temperatures get as high as 49° C (Anon. 1948). The optimum temperature for its growth, however, is 20-30° C. The Neem tree is described as evergreen because new leaves appear at the tips of branches immediately before



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