



Figure 1. Schematic diagram of limnological processes taking place in Kandy lake during high and low water levels.

A. granulata and *P. simplex*) re-established themselves with several minor species such as non-nitrogen fixing cyanobacteria, *Merismopedia punctata*. Although *M. aeruginosa* appeared throughout the following years, it did not form a bloom as in the previous year.

The most likely limnological interpretation for the sudden emergence of *M. aeruginosa* is as follows. The lowering of the water level during the dry spell of 1999 may have resulted in greater access for *M. aeruginosa* to utilize phosphorous mobilized in the anoxic deeper layer, as shown in Figure 1. It is known that *Microcystis* shows good buoyancy; it comes to the surface and drifts along the wind

direction. The schematic model shown in Figure 1 and the available limnological information clearly demonstrate that the biomass regulation or prevention of emergence of *Microcystis* biomass in Kandy lake is a combination of both top-down and bottom-up approaches¹¹. Multiple techniques may also be relevant in the case of restoration, since the urban lakes are different from other man-made water bodies¹. Nevertheless, sound knowledge of hydrology, limnological processes and dynamics of the water body and the human activities taking place in the watershed plays a key role in restoration and management.

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***Cadra cautella* Walker (Lepidoptera: Crambidae: Phycitinae) – a pest on *Parkia timoriana* (DC.) Merr. in Manipur**

Among the numerous less familiar food used by the local communities in north-east India is a tree legume, commonly known as tree beans (*Parkia timoriana*) or yongchak by the locals in Manipur. The tree bean, *P. timoriana* (DC.) Merr. syn. *P. roxburghii* G. Don belongs to the family Leguminosae and sub-family Mimosoideae¹. It is one of the most

common multipurpose trees in Manipur having high commercial value, and is commonly grown in the backyard of houses, *jhums* and forests throughout Northeast India². It flowers during the months of September–October and the onset of fruiting starts from November onwards. The pod is available from November till April, and is consumed in

all its developmental stages starting from the green, tender pods to the matured, black seeds, fresh or cleaned and sun-dried for future use during the off-season. The associating pungent smell in the seeds is due to the presence of thiazolidine-4-carboxylic acid (TCA, thioproline), a cyclic sulphur-containing amino acid³. Thioproline is known to be



Figure 1. *a*, Pupation inside infested seed; *b*, Adult moth; *c*, Larva infesting inflorescence head and *d*, Infested pod head.

anti-carcinogenic and inhibits the formation of squamous cell carcinomas in the fore-stomach of rats^{4,5}. A number of workers have reported the biochemical and nutritional values of the plant, including various medicinal uses⁶⁻¹².

During the months of June–July 2000, heavy infestation of caterpillars of *Cadra cautella* was observed on stored tree-bean seeds in properly sealed paper bags at Imphal (782 m above sea level), Manipur. These seeds were stored in April, after proper drying. Literature survey revealed few reports of pest infestation on *Parkia* spp. The pod-boring larvae of the pyralid moth, *Mussidia pectinicornella*

Hamps. and tortricid moth, *Argyroplote illepida* Btlr. infest the ripening seeds of *P. speciosa*, while *M. nigrivenella* Ragonot is a natural pest on *P. biglobosa*¹³⁻¹⁵. However, there is no record of *C. cautella* infesting tree beans.

The larvae of *C. cautella* feed voraciously on the green kernels. The larvae are elongated caterpillars, about 2 cm, grayish-white with numerous dark setae interspersed along the body. They are mobile and make webs as they tunnel through the food, and excrete yellowish-brown excreta near the point of entrance. The duration of larval stages was between 45 and 60 days. The larvae start feeding from the surface of the kernels and continue inside. In the case of heavy infestation, the whole kernel from the inside was consumed, while the outer skin of the seed had tiny holes through which the larva entered. Each seed bore only one larva. It caused considerable amount of damage in the infested seed, rendering it unfit for consumption. Pupation occurred inside the crevices of the infested seeds and the paper bags (Figure 1*a*).

The pupa is reddish-brown, immobile, produces large webs and is enclosed in a cocoon. The adult moth appears after two weeks of pupation. Adult moths are mottled grey, fawn-coloured with a fringe on the back of each hind wing (Figure 1*b*). They do not feed. They fly in the early morning and late afternoon. They are short-lived, surviving for approximately twelve days. Adults spread infestation through eggs laid in the bags and on seed surfaces. Immature dropping of inflorescence and pod heads during the months of October to February were found to be associated with larval infestation. The dissection of these heads revealed the larvae making extensive damage inside (Figure 1*c* and *d*).

Thus it was observed that *C. cautella* infested the plant, both in the field and on storage. All the stages in the life cycle of the insect were observed on *P. timoriana*.

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