SYNCHRONIZED FLOWERING AND MASTING BEHAVIOR OF *STROBILANTHES* (NELU)

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Horton Plains gives a unique and rare opportunity for thousands of local and foreign tourists including nature lovers after 12 years with a cover of white, pink and purple carpet of Nelu flowers during September-December, 2013. Nelu flowers normally bloom once in 12-14 years and before the flowering observed in this year, full bloom of flowers was observed in 2001. Further, there are records of Nelu flower bloomings in 1881, 1893 and 1905. Therefore, the Horton plains will be lucky to adorn again with this Nelu flower carpet in year 2024.

Image 01: Bloom of Nelu invite nature lovers to visit the Horton Plains and enjoy the beauty of the flowers after 12 years, in 2013. (Photo: YRF Annual trip in 2013.11.14)

Nelu, which is also known as Nilu or Nilla in sinhala, belongs to the genus *Strobilanthes* and to the family Acanthaceae. There are around 130 *Strobilanthes* species throughout the world. However it occurs mainly in the Asian region. There are 31 species of *Strobilanthes* in Sri Lanka and of them, 26 are endemic.

The flowering of *Strobilanthes* marks the death of the mother plant. It means that flowering and fruiting only occurs once in the life span of this plant. Those type of plants are known as monocarpic or semelparous plants. According to the life cycle, plants can be divided as annuals, biannuals and perennials. An annual plant completes its life cycles (germination, flowering and seeds production) within a year, a biannual plant takes two years and a perennial plant lives for more than two years. Most annual and biannual plants flower once and die. Based on the flowering pattern, perennial plants can be further divided into two as monocarpic and polycarpic (iteroparous). However, polycarpic plants flower and set seeds many times during its lifetime while monocarpic plants flower only once and die. Some species of Bamboos, *Strobilanthes*, *Agava* and *Lobelia* are some of the examples for monocarpic plants found in Sri Lanka.

Group behavior of flowering of the individual plants of the same species at the same time period in a certain geographical area is known as 'synchronized flowering' (McDonald and Kwong, 2005). This phenomenon causes the production of a large mass of seeds in an area at a particular time period and it is called as mast seeding or masting. Masting, in the strict sense of the term, occurs only in monocarpic species. That synchrony occurs over long distances and involves almost every tree or occurs as a wave pattern. As synchronized flowering or masting is generally defined for one specific species, harmonized flowering in more than three species (*S. dianadra, S. calycina, S. hookeri, S. pulcherrima, S. viscosa,* etc.) in Horton plain at this time is a wonder.

Long pre-reproductive period is necessary to accumulate enough resources to produce a large number of flowers and seeds at the short masting period. It gains an evolutionary advantage of longer reproductive cycles which result in higher fitness compared to annually reproducing plants

Image 02: Harmonized flowering of *Strobilanthes* in Horton Plains in 2013. (A) *S. pulcherrima,* (B) *S. calycina* and (C) *S. viscosa.*

(Tsvuura *et al.*, 2011). Death of plants after reproduction signifies expending all the resources in reproduction. Death of the parent plants increases the available resources (space, light requirement, nutrition etc.) for survival of the offspring.

Tsvuura (2011) has encapsulated three hypotheses that have been forwarded to describe the evolutionary significance of synchronized flowering and masting.

1. The outcrossing hypothesis suggests that a large visual display associated with synchronous flowering increases the chances of cross-pollination. Cross pollination allows diversity within the species, as the genetic information of different plants are combined. Therefore, it benefits the parent plant by producing high quality seeds and off springs with high vigour.
2. The predator satiation hypothesis proposes that synchronous reproduction in long-lived species produces more seeds than that can be consumed by seed predators during masting years, and starves the seed predators in non-seeding years. Predator satiation is an anti-predator adaptation in circumstances where prey occurs in high population densities. Masting reduces the probability of an individual organism being predated.
3. A third hypothesis is that interspecific competition may have driven the evolution of reproductive synchrony in monocarpic species. The dominance of monocarpic species in the community is maintained by synchronized mass reproduction and seedling establishment, which excludes seedlings of other species beneath the parent plants. As the parent plants die, their seedlings are released from competition.

There is a question on how masting trees manage to coordinate the same cycle over a large area. However, no clear evidence to reveal that how plants pass signals to synchronize the flowering through long distance. Three mechanisms are germane to discuss the mechanism of synchronization of activities among plants or animals: chemical, reproductive and environmental. A Recently, completed studies have revealed that chemical and reproductive mechanisms are not enough

Image 03: Synchronize flowering of *Strobilanthes Kunthiana* in Western Ghats, India. It blooms once in 12 years. *(http://floralbasket.blogspot.com)*

to explain the synchrony of masting in observed distances. Geographically wide-ranging climate conditions cause trees to mast in synchrony (Isagi *et al.*, 1997; Schauber *et al.*, 2002). There is evidence to say that temperature may be a key parameter. The scientist consider that the periodic fluctuations of temperatures (perhaps caused by the cyclic El Nino phenomenon) operate in synchronization with masting over the same geographic area (Schauber *et al.*, 2002). However, the mechanism of this interesting behaviour is still to be known.

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