It is evident that the current method of soil fertility estimation, which assumes a soil mass of 2.0 million kg ha$^{-1}$, did not have any effect on SOC as the impact of coarse fragments was not considered. SOC increased with coarse content when soil mass was estimated based on BD values; presence of coarse fragments in the root zone increased the BD values and thus soil mass and SOC. In the third situation where SOC was derived only for fine earth, SOC decreased with increase in coarse fragment content; reduction in the effective soil volume with increase in coarse fragment content appears to reduce SOC. Estimating SOC only from the fine earth part of soil appears to be realistic than the other situations. This is because volume of active fine earth available for SOC retention decreases with increase in coarse fragment content. In other words, the presence of coarse fragments in the bulk soil has a dilution effect on the SOC$^{1,2}$. This analogy holds good for estimation of all nutrients in soil. Thus, the present method of soil fertility assessment that assumes a soil mass of 2 million kg ha$^{-1}$, or based on the actual BD values, would lead to overestimates. Therefore, volumetric assessment of fine earth may be important in soil fertility assessment, especially for degraded soils.

Quantifying the proportional volume of fine earth, especially for a degraded land, could have the following implications:

- To make afforestation programmes successful in physically degraded lands, consideration of the volume of soil effectively available in the root zone would be more meaningful in terms of water and nutrient availability.
- In SOC stock assessments, quantification of proportional volume of fine soil in the bulk and then expressing it for the entire soil volume would be appropriate for realistic estimations.
- High productivity in a gravelly soil compared to a normal agricultural soil with the same level of nutrient application could be attributed to high fertilization effect. However, the risk of nutrient loss due to poor nutrient retention may mask the initial fertilization effect.

Thus, it is appropriate to make soil fertility assessments based on the proportional volume of fine earth (effective soil volume) than the conventional method.


ACKNOWLEDGEMENTS. We thank Y. B. Srinivasan, Scientist, IWST, Bangalore, for his encouragement to put a decade-old thought into this paper. His comments (with suggestions) and valuable evenings spent on this paper are duly acknowledged. Discussions during GVP Reddy’s thesis work have made us bring out this concept paper. Discussions with Dr K. M. Nair, NBSS & LUP, Bangalore are duly acknowledged by the first author.

M. S. Nagaraja is in the Krishi Vigyan Kendra, Kandali, Hassan 573 217, India; C. A. Srinivasamurthy* is in the Department of Soil Science and Agricultural Chemistry, Agricultural College, GKVK Campus, Bangalore 560 065, India.
*e-mail: casmurthy@yahoo.com

Save these rare ornamental trees

R. K. Roy

India is bestowed with a variety of agroclimatic conditions ranging from tropical–subtropical to subtemperate–temperate. Ten biogeographic zones of India enthrall botanists with the diversity and endemism of flora$^1$. Consequently, our country is one of the 12 mega biodiversity rich centres of the world besides housing two of the 25 recognized biodiversity hotspots$^3$. There are 47,000 plant species in India including 18,000 angiosperms which form a major part of the flora$^3$. Nevertheless, 30% of the angiosperms and 18% of the total flora are endemic to India$^3$. According to the IUCN report (2007), 45 tree species from India have been included in the Red List of Threatened Plant Species, and declared as ‘critically endangered’ facing high risk of extinction while 247 tree species have been declared ‘threatened’$^5$. Therefore, proper conservation measures for the unique floristic wealth of India are necessary.

During the colonial era, new botanical gardens and agri-horticultural societies were established. Besides, diverse kinds of people visited India for different purposes. The westerners were greatly attracted to the botanical wealth of our country. This eventually created a gateway for introduction of many new plant species particularly trees. However, no record exists regarding introduction of ornamental trees except mention in some old publications. Though Botanical Survey of India is closely monitoring Indian flora and furnishing status reports in the form of Red Data Book regularly, a closer look is required at these introduced ornamental trees and their centre of introductions. The old botanical gardens and agri-horticultural societies of India were instrumental for these valuable introductions and made significant
contributions towards enrichment of the floristic wealth of India.

The author extensively surveyed old historical gardens (botanical and horticultural) of India and traced out consulted some old literature. It was felt that the following introduced ornamental trees need immediate attention from botanical conservationists and horticulturists for formulating ex situ conservation measures. These are extremely rare and in some cases only one individual is surviving.

**Napoleon’s button** (*Napoleona heudelotii* Beauv.)

Family: Lecythidaceae; Nativity: Central Africa.

The tree was first noticed by A.P. Beauvois, a Frenchman, during his trip to central Africa (around 1800) and the genus was named after the French Emperor Napoleon. Subsequently, two other botanists Heudelot and de Jussieu confirmed the existence of the genus by collecting specimens and describing the same (Figure 1). The species name *heudelotii* is after ‘Heudelot’ who died after collection of the specimen. This is a medium height tree with simple leaves of dark green colour (15×5 cm). It produces single flowers from the leaf axil, about 5.0–7.5 cm across, resembling a shallow cup with lobes in crown shape, curious construction, reddish in colour.

The route of introduction of this tree to India is not exactly known but it is presumed that the tree was transported from France to the United Kingdom and subsequently brought to India by the British. Currently, a single specimen of this tree is existing in the Agri-Horticultural Society’s Garden at Alipore Road, Kolkata and must be termed as ‘extremely rare’. The Society established in 1820 by William Carey was credited for introduction of a lot of new ornamentals as well as agricultural crops in India.

**Orchid tree** (*Monodora grandiflora* Benth.)

Family: Anonaceae; Nativity: Central Africa.

This evergreen medium sized tree is native to the central African forests and reached Europe from Jamaica, Trinidad in the eighteenth century (Figure 2). This was also probably introduced to Calcutta from Europe³. The generic name refers uniqueness of the single flower which is pendant on a 15–20 cm long peduncle. The flowers are orchid-like, gorgeous consisting of six petals (12–15×7–10 cm) in two whors with outer petals curved inward, central part creamy, outer spotted with yellow-red dots; inner petals small, colourless⁴.

A few specimens can be seen in the Agri-Horticultural Society’s Garden. No other garden in India has this species. Very difficult to multiply, as there is no seed setting and vegetative multiplication is also not possible.

**Queen amherstia** (*Amherstia nobilis* Wall.)

Family: Caesalpiniaceae; Nativity: Myanmar (Burma).

The tree is considered as the ‘queen of the flowering trees’ and ‘tree of heaven’, since the flowers are very gorgeous and appealing (Figure 3). The flowers hang in a graceful raceme which is about 40–50 cm long, holding 20–25 individual vermillion-yellow flowers, unfolding from base to terminal. Coupled with trusses of new leaves, the flowers look very attractive⁵. First noticed in 1826 in Burma (Myanmar) by Nathaniel Wallich, the Danish discoverer who was also Director of Calcutta Botanical Gardens, the monotypic genus was named after Countess Amherst (British Governor of Burma) and her daughter, Lady Sarah. Subsequently, the tree drew a lot of attention from all over the world and created a huge interest. First attempt to introduce *Amherstia* to Europe dates back to 1845. The Duke of Devonshire collected a specimen from Burma but was unsuccessful in growing it in a new climate. However, in 1849, *Amherstia* flowered for the first time in England and the spray was sent to Queen Victoria¹,¹².

The tree was introduced in the then Royal Botanical Gardens, Calcutta by Nathaniel Wallis and from there it spread to different royal residences and gardens of Calcutta. Few trees still exist in the botanical gardens at Shibpur, Howrah; besides one in Agri-Horticultural Society’s Garden. Perhaps, the genus is endemic to Bengal. The tree does not set seeds in the climate of Bengal which is a major bottleneck for its propagation. The species could not be multiplied by air-layering also leading to its rarity.

**Tipu tree** (*Tipuana tipu*) (Benth.) Hubb. & Rehd.

Family: Fabaceae; Nativity: South America (Bolivia).

A tall, evergreen tree, commonly known as ‘Pride of Bolivia’ and ‘rose wood’ (Figure 4). ‘Tipa’ is a vernacular name of this tree in Bolivia and accordingly the first botanical name was *Tipuana tipa*.
exist in the Lalbagh Botanical Garden, Bangalore but are not present in eastern and north Indian gardens and parks. This botanical garden was credited with the introduction of many new ornamentals in India. The tree was perhaps directly introduced here. Multiplication has been a problem due to non-seed formation which has restricted its propagation.

An attempt is made here to highlight the need for strategic \textit{ex situ} conservation methods of these plant species. These trees do not bear seeds limiting easy scope for multiplication. Vegetative propagation by air-layering has also remained unsuccessful pushing these species further into rarity. A suitable alternative method of multiplication for increasing their population is an immediate requirement. Once multiplied, exchange of plantlets with other gardens is recommended for their \textit{ex situ} conservation. The responsibility lies with the custodians of these gardens as well as policy makers to save these rare ornamental trees from future extinction.

given by botanist Lillo. However, it was described and renamed by Hubbard and Rehder as \textit{Tippuna tipu}\textsuperscript{13}. This is a beautiful tree, mainly grown for its golden yellow pea-like flowers (2 cm in diameter), borne on long panicle and bright green foliage.

Details of introduction of this tree in India are not exactly known. A few trees

Figure 4. \textit{Tippuna tipu} in Lalbagh Botanical Garden, Bangalore.


\begin{center}
\textbf{R. K. Roy is in the National Botanical Research Institute, Rana Pratap Marg, Lucknow 226 001, India. e-mail: raynbi@rediffmail.com}
\end{center}