

Distribution of the Population of Tongkat Ali (*Eurycoma Spp.*) in Malaysia Based on Data Taken from Herbarium Records

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Abstract

Eurycoma spp., also known locally as Tongkat Ali is considered the most popular medicinal plant in Malaysia. The tremendous attention put to it by the public for its medicinal properties has led to its non-selective harvesting at a very alarming rate. Concerted efforts by a number of institutions in the country have been initiated to manage, conserve and recommend a sustainable way of utilizing them. A program to study the genetic diversity of *Eurycoma* species population, its distribution throughout country and to conserve its genetic resources *in situ* as well as *ex situ* has been carried out. As the first step, a preliminary study was conducted to get an idea the kinds of species occurring in the country, its general distribution, preferred habitat, and to look for various observable variations between and within species. Data used in this study was obtained from sixty eight herbarium records, dated back as far as 1930, which were kept in herbarium units located at the various local universities and research institutions within Malaysia. The results indicate that there are two species of *Eurycoma* found in Malaysia namely *E. longifolia* and *E. apiculata* with very little difference to differentiate between them except that *apiculata* has slightly bigger leaf size. *Eurycoma* spp. is called by six different local names. Specimens of *Eurycoma longifolia* and *E. apiculata* kept in the herbariums were mainly collected from zone 1, 2 and 3. The climatical descriptions of each zone are presented thus giving some indications of its preferred habitat and the locations where the diversity of the species are at the highest. The majority of the *apiculata* specimens were collected from hilly areas deep in the forest thus is in agreement with the previous findings which stated that *apiculata* is a mountain species. Flora Map[®] software was used to predict the areas of possible adaptation of *E. Longifolia* in Malaysia and the map showing the probability distribution is presented. The map can assist in future germplasm collection and conservation.

Keywords: *Eurycoma* spp.; Medicinal plant; Genetic resources; Conservation

Introduction

Plant genetic resources collection and conservation using random basic sampling strategy, a strategy devised under situation where little or no information is available on the target population, normally needs more money, time and personnel to undertake. Therefore information on the kinds of species, the amount of genetic variation in target population and its distribution in the target areas is therefore very useful in developing sampling strategy and collecting routes which can ensure a more efficient utilization of time, manpower and financial resources.

Eurycoma longifolia, one of the two recorded species of *Eurycoma*, commonly known locally as Tongkat Ali, is considered the most popular medicinal plant in Malaysia. It is widely acclaimed for its energy boosting and aphrodisiac properties. In fact at the cellular level, *E. longifolia* was found to increase the level of cGMP, a secondary messenger which produces smooth muscle relaxation in the corpus cavernosum thus allowing inflow of blood and eventually penile erection, the same mechanism of action found with Viagra. But unlike Viagra, *E. longifolia* also increases the levels of cAMP, a secondary messenger that augments body metabolism by enhancing glycogenolysis, gluconeogenesis and glycolysis thus explaining the energy boosting effects of *E. longifolia* derived products [1]. The findings were further supported by Zanolis et al. [2] who observed an increasing sexual activity of rats treated with Tongkat Ali extract. The tremendous attention given to this plant by the public for its medicinal and nutraceutical properties has led to its non-selective harvesting at a very alarming rate. Efforts by a number of institutions in the country have been made to manage, conserve and recommend a sustainable way of utilizing the species. Malaysian Agriculture Research and Development Institute (MARDI) for instance have implemented a project that looked closely at the genetic diversity

of *E. longifolia* population, its distribution throughout the country and to conserve them *in situ* as well as *ex situ*. The ultimate objective of the project was to ensure maximum genetic diversity that exists within the current population was kept, managed and utilised for the present and future needs. The activities of the project included collecting genetic resources, study on its genetic diversity particularly on traits of commercial importance, set up and suggest most appropriate and efficient methods of conservation, and recommend ways that the species can be utilised commercially with minimum genetic erosion.

Materials and Methods

To provide the necessary background data on which the proposed *Eurycoma* species collection expeditions would be based, a herbarium survey was conducted. Three major Malaysian herbaria located each at Universiti Kebangsaan Malaysia (UKM), Forest Research Institute of Malaysia (FRIM) and Mardi were visited and specimens of *Eurycoma* species were examined.

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Within each of the herbaria, where records are available, the following data were recorded:

1. Herbaria Number
2. Source (name of the herbaria)
3. Family, genus, species and sub-species
4. Local name
5. Date of collection and the collector's or donor's name
6. Availability of flower or fruits
7. Location, longitude, latitude and altitude
8. Soil type and slope
9. Habitat

10. Variations/characters observed and described by the Collector
 Altogether, a total of 65 herbarium records were examined. None of the specimens was collected from East Malaysia (Sabah and Sarawak). The data recorded from each record was sorted out and analysed for information on number of species, its occurrence and general distribution, preferred habitat, and observable variations if any. Flora MapR software was used to map the probability distributions of each species throughout the country.

Results and Discussion

Species occurrence, habitat and distribution

Based on the herbarium data, only two species of *Eurycoma* (Tongkat Ali) were recorded in Malaysia. The two species were *Eurycoma longifolia* and *Eurycoma apiculata*. Seventy two percent of the herbarium specimens examined were of *E. longifolia* and the rests were *E. apiculata*. However since all specimens were only collected from West Malaysia, the same cannot be said for Sabah and Sarawak, the two Malaysian states located in the Borneo region.

Burkill et al. [3] stated that *E. apiculata* is a mountain species. Our observation on the specimens showed that more than 80 percent of the *E. apiculata* specimens were collected from the hilly areas compared to slightly more than 30 percent for the *E. longifolia*. However the specimen records also showed that *E. apiculata* can also thrive at lower elevation.

Climatically, Peninsular Malaysia is divided into seven climatic zones [4]. Seventy nine percents of the *E. apiculata* specimens kept in the herbaria were collected from zone 2. Zone 2 covers parts of Perak, Selangor, Negeri Sembilan and Malacca. It is characterized by the more equal seasonal distribution of rainfall and frequent short dry period. It has relatively high rainfall especially near mountain. Meanwhile, more than eighty percent of the *E. longifolia* specimens were collected from zone 1, 2, and 5, with almost equal number for each zone. Zone 1 covers northwest including states of Perlis, Penang, Kedah, and Northwestern Perak. The zone has clear and regular dry seasons. Zone 5 covers central interior including parts of Negeri Sembilan state and a major part of Pahang. The zone has the tendency towards two dry seasons of equal intensity, local variations in rainfall, and larger diurnal ranges in temperature.

The proportion of the two species over a 60-yr period is presented in Figure 1. It was obvious from the chart presented that *E. apiculata* was only recorded at the beginning of year 1966. From 1930 to 1965, no *E. apiculata* specimen was collected and recorded. The number of

E. apiculata specimens collected again decreased significantly from the year 1986 onward. Putting this information together with observations made by the author during his many trips to the forest to collect genetic resources of *Eurycoma* species, it was obvious that erosion occurred in *E. apiculata* and was rather alarming. So far only one accession out of the 35 accessions of Tongkat Ali collected by the author from many parts of the country has characteristics resembling *E. apiculata*. On the other hand, increasing trend was observed in the number of herbarium specimens collected for *E. longifolia* over the 60-year period indicating the wider distribution of the specie.

Probability distributions of each species based on herbarium records are presented in Figures 2a and 2b. The chance of finding *E. apiculata* is expected to be better if search is made in the interior parts of Perak and Selangor near the main range, and in the vicinity of Gunung Ledang in the central part of Johor (Figure 2a). *E. longifolia* is rather widespread in its distribution. Higher number of *E. longifolia* plants is expected to be found in the interior part of Kelantan, south eastern part of Pahang near Endau-Rompin areas, in most forested area of Johor especially in the north eastern part of Pahang.

Observable variations

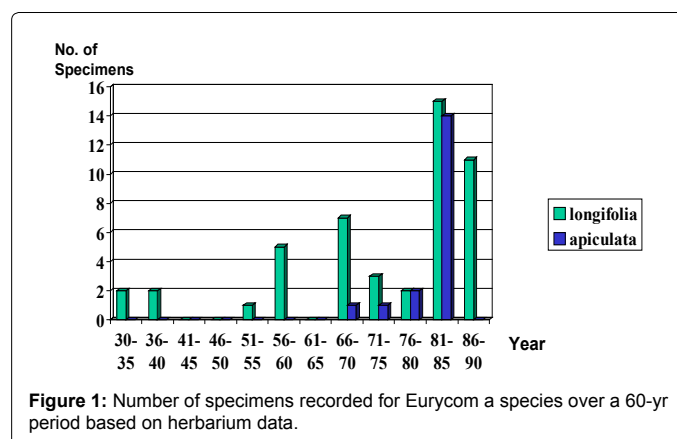


Figure 1: Number of specimens recorded for Eurycoma species over a 60-yr period based on herbarium data.

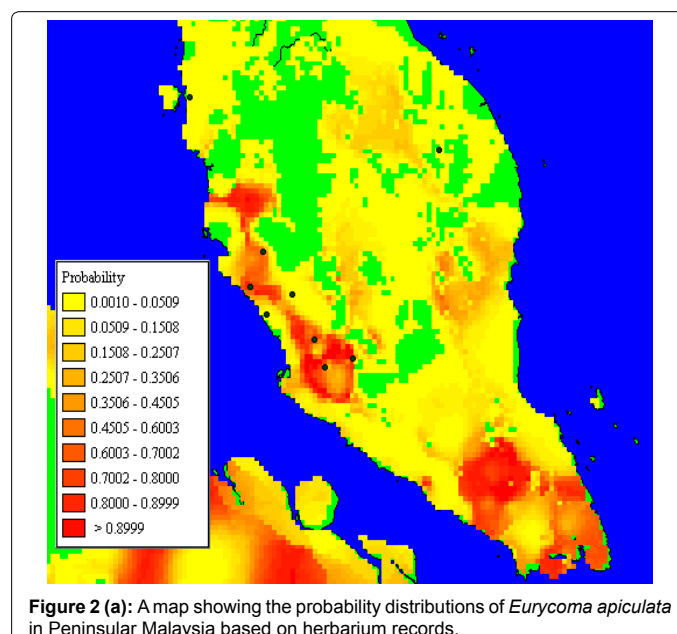


Figure 2 (a): A map showing the probability distributions of *Eurycoma apiculata* in Peninsular Malaysia based on herbarium records.

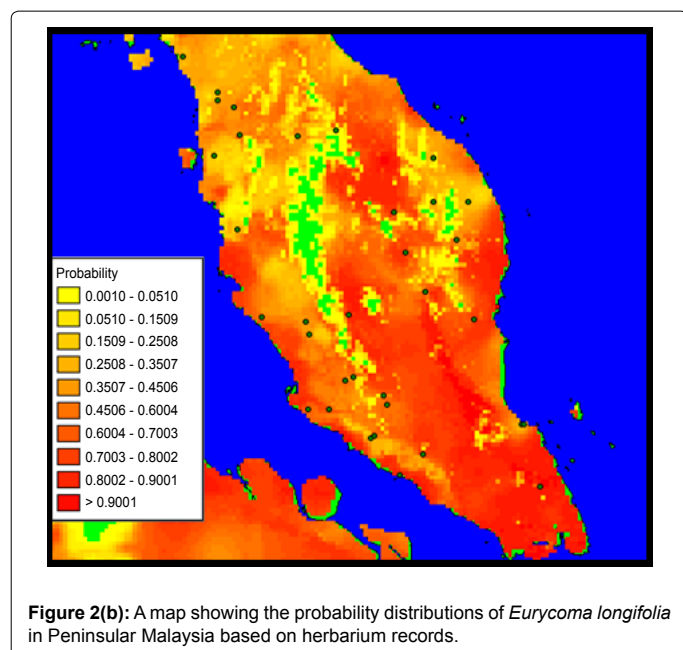


Figure 2(b): A map showing the probability distributions of *Eurycoma longifolia* in Peninsular Malaysia based on herbarium records.



Picture 1: Leaf characteristics of *E. Longifolia* and *E. Apiculata*.

When the specimens were observed for traits that might show variations, it was hard to differentiate between the two species except that *E. apiculata* has bigger and slightly angular shaped leaflets with slightly round tip (Picture 1). In many plant species, leaf shape is normally genetically controlled with very little or no effects of environment. Within species variations were even harder to notice

from the herbarium specimens except for leaf size, a trait which in many plant species is highly influenced by environment. Records on fruits and flowers accompanying specimens were very rare. Out of the 65 records observed in the study, only six specimens contain records of flower description and three specimen records provide description on fruits. This can only imply that Tongkat Ali rarely produce flowers and fruits in the jungle. It may take years from seed dispersal or “sowing” before the plant start to flower. There is no data available on its flowering frequency.

Conclusion

In collection and conservation of germplasm, the onus is always on the collector to obtain the richest collection for a given expenditure of effort. Whatever strategy adopted should be able to optimize the use of available resources which in many cases are limited. This study showed that by sorting and analysing records of herbarium specimens, basic information related to the kind of species and its probable distributions, preferred habitat and observable variations between and within the species can be gathered. The information can be used to plan collecting routes as well as in developing sampling strategy. For *Eurycoma*, the two species to be targeted are *E. longifolia* and *E. apiculata*. Among the two, *E. longifolia* should be given priority. To ensure maximum chances of capturing all the available alleles that exist in the populations, more plant or seed samples should be collected from the forests in the eastern part of Perak, interior part of Selangor especially in the Hulu Langat and Ponsoon areas, central to North eastern part of Johor including south eastern part of Pahang particularly in the vicinity of Gunung Kelang moving towards Endau Rompin areas, the interior part of Kelantan near Pahang-Kelantan border, and in the interior parts Terengganu near Gunung Tebu and Setiu areas. To maximize the chance of finding plants with fruits, collection should be done in June or July.

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