Growth of tongkat ali (*Eurycoma longifolia*) on a sandy beach ridges soil in Malaysia

Wan Rasidah K.[A], Rosazlin A.[B] and Rozita A.[A]

[A]Soil Management Branch, Forest Research Institute Malaysia, 52109 Kepong, Selangor, Malaysia, Email rashidah@frim.gov.my
[B]Department of Soil Management, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia, Email rosazlin@yahoo.com

Abstract
Soils of sandy dunes or beach ridges interspersed swales (BRIS) are common in the coastal parts of the east coast in Peninsular Malaysia. The soils have low productivity due to many physical and chemical limitations. A planting trial of tongkat ali (*Eurycoma longifolia*), a medicinal plant sought after for its commercial value, was carried out on a BRIS soil in Setiu, Terengganu. Three levels of nitrogen with basal phosphorus (P) and potassium (K) were applied with and without organic mulch. Results showed significant positive effects of fertilizer input on plant height and root biomass yield, and fertilizer use efficiency improved with organic mulch. The optimum rate of fertilizer on this soil required by tongkat ali was 75 kg N/ha as urea with basal applications of P and K preferably in the form of organic mulch.

Key Words
BRIS soil, *Eurycoma longifolia*, fertilization, organic mulch, root biomass.

Introduction

One of the most sought after herbal plants for commercial exploitation in Malaysia is tongkat ali, scientifically known as *Eurycoma longifolia*. The medicinal properties of tongkat ali have been known for centuries (Ang *et al*. 2003; Kuo *et al*. 2004). Every part of the plant, especially the roots, is used for among others as an afterbirth tonic, reducing fevers, curing mouth ulcers and to treat intestinal worms. The roots contain quassinoids which are effective for eliminating malarial parasites. Despite these therapeutic properties, however, tongkat ali is more highly regarded for its purported aphrodisiac properties (Ang *et al*. 2003). This has led to the excessive gathering of the plant from its natural habitat by over-enthusiastic collectors.

It is common that in the virgin forests, tongkat ali grows tall reaching the forest canopy but flowering is infrequent. Thus regeneration of new plants is slow. As the demand for tongkat ali roots increase, the plant is becoming extinct and is scarcely available on the forest fringe. One has to go deep into the forest area to find wild tongkat ali. Domestication and commercial planting of this plant are very timely to support the local market demand.

Soils of beach ridges interspersed swales (BRIS) dominate large parts of the coastal areas of the east coast of Peninsular Malaysia. The soils have > 98% sand, with many associated limitations such as excessive drainage, high surface soil temperature, low moisture and low nutrient content. One way to green the site is to utilize the land for agroforestry planting, and tongkat ali is one of the medicinal plants selected for interplanting between forest trees. Thus, a fertilizer response experiment was carried out to assess application of different levels of urea on the root growth of tongkat ali and to study the effect of incorporating a mulch mat on the efficiency of applied urea.

Methods

Study site
The experiment was conducted in Setiu, Terengganu on a BRIS soil. The area was flat land formerly occupied by coastal shrubs and was cleared off before planting. The texture of the soil was highly sandy with more than 98% sand. Nutrient content was poor with average of 0.07% N, 0.86 µg/g P (Bray and Kurtz no. 2 method) and 0.05 $cmol^+$ / kg exchangeable K in the top 5 cm layer soil; and 0.03%, 0.31 µg/g and 0.02 $cmol^+$ / kg of N, P and K respectively for the 5-15 cm soil layer. During the dry period, the high air and surface soil temperatures can cause leaf scorching and wilting of the plant (Amir 1999).

Experimental layout
Seven treatments including the control were established to evaluate the effects of fertilizer and a combination

of mulch mat with fertilizer on the growth and root biomass yield of tongkat ali. The mulch mat, which was produced from oil palm empty fruit bunches fibres, was obtained from the nearby factory. Details of the treatments are depicted in Table 1. Treatment with mulch mat alone was not established as the number of mulch mat available was insufficient and the experiment focused more on testing the efficiency of urea granular fertilizer. Fertilizers were applied at 6-monthly intervals, with the first application was 2 weeks after planting. A mixture of mineral soil and palm fibres was added into each planting hole to improve water holding capacity for initial plant establishment. Planting stock of uniform size was obtained from the Kesedar site office in Kuala Krai, Kelantan. The experimental layout was a complete randomized block design with four replicates and 18 measured plants in each plot. Height growth measurement was recorded at 3-monthly intervals. When the stand was 2 years old, three representative plants of average growth from each plot were destructively sampled to measure their biomass yield. All data collected were analysed statistically based on Analysis of Variance and Duncan's Multiple Range Test.

Table 1. Fertilizer treatments for young tongkat ali plants on BRIS soil in Setiu, Terengganu, Peninsular Malaysia.

Treatment	Fertilizer rate
T1	Control
T2	50 kg/ha urea (+P, K)*
T3	75 kg/ha urea (+P, K)*
T4	100 kg/ha urea (+P, K)*
T5	50 kg/ha urea + EFB mulch mat (initial)
T6	75 kg/ha urea + EFB mulch mat (initial)
T7	100 kg/ha urea + EFB mulch mat (initial)

* P and K rates were at equivalent amount as available in mulch mat

Results

Growth of tongkat ali seedlings on BRIS soil were rather slow compared to that reported for other sites (Then 2008), but still differences were obvious between different rates of fertilizer application (Figure 1). At 2 months after planting, growth was the same regardless of the treatments. Differences in growth were only obvious after 5 months but the lowest was recorded with treatment T7 where the highest rate of urea was applied in combination with organic mulch mat. No significant differences were observed between fertilized and non fertilized plants. At stand age of 9-month-old, a similar trend was recorded with control treatment as good as fertilized plants. However, mulching showed significant improvement in plant height growth, and application of 50 kg/ha urea-N gave the highest height increment. The mulching effect was more obvious at one-year, when treatment T5 gave the highest height increment. The overall data showed that with mulching, 50 kg N/ha is sufficient whereas without mulching, tongkat ali requires more than 100 kg N/ha for one year growth period. Urea fertilizer has been proven to perform better with organic input (Ram *et al*. 2003, Vanlauwe *et al*. 2001).

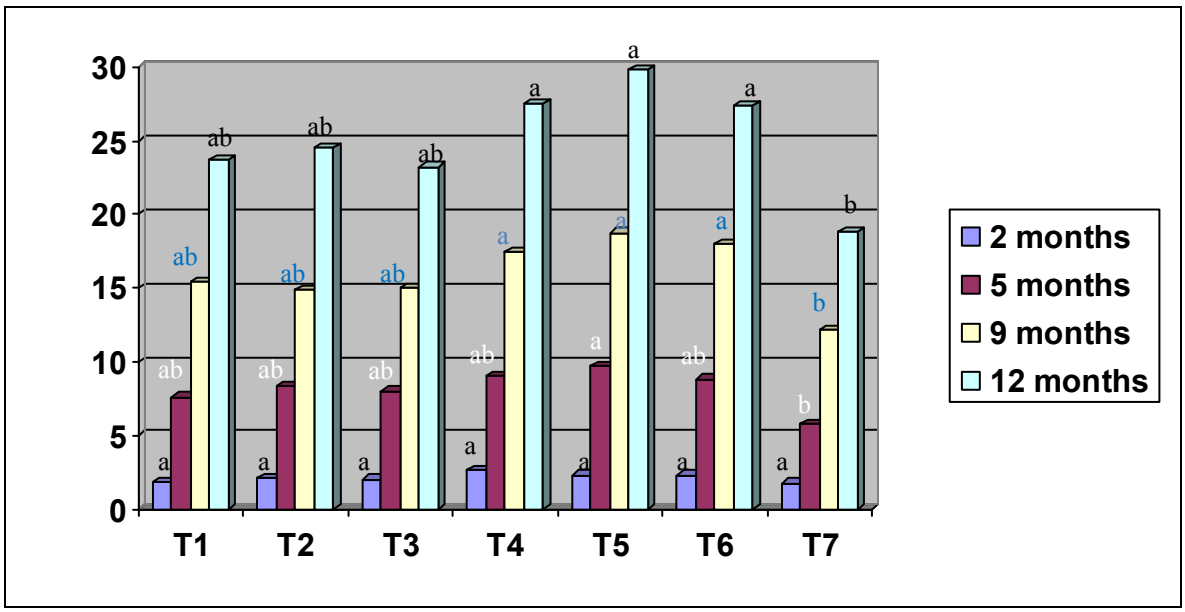

Figure 1. Cumulative height growth increment (cm) of tongkat ali plants in Setiu, Terengganu, Peninsular Malaysia. Means with the same letter across the treatments within the age group are not significantly different at P<0.05.

Root biomass data do not conform well with height data. Figure 2 shows that highest root biomass yield was obtained with application of 75 kg N/ha in combination with organic mulch mat. The second highest was achieved with the same amount of N in combination with inorganic P and K sources. It seems that the optimum rate of fertilizer for root biomass production of tongkat ali on BRIS soil was 75 kg N/ha with balance P and K input, preferably using organic mulch. Application of 80 kg N/ha as urea was found to be optimum for tobacco planted on BRIS soil (Wan Azman *et al*. 1994). Wan Asma *et al*. (2000) also observed significant increament in biomass yield of serai wangi (*Cymbopogon nardus*), a medicinal shrub planted for its essential oils, when mulched with oil palm empty fruit bunch fibres.

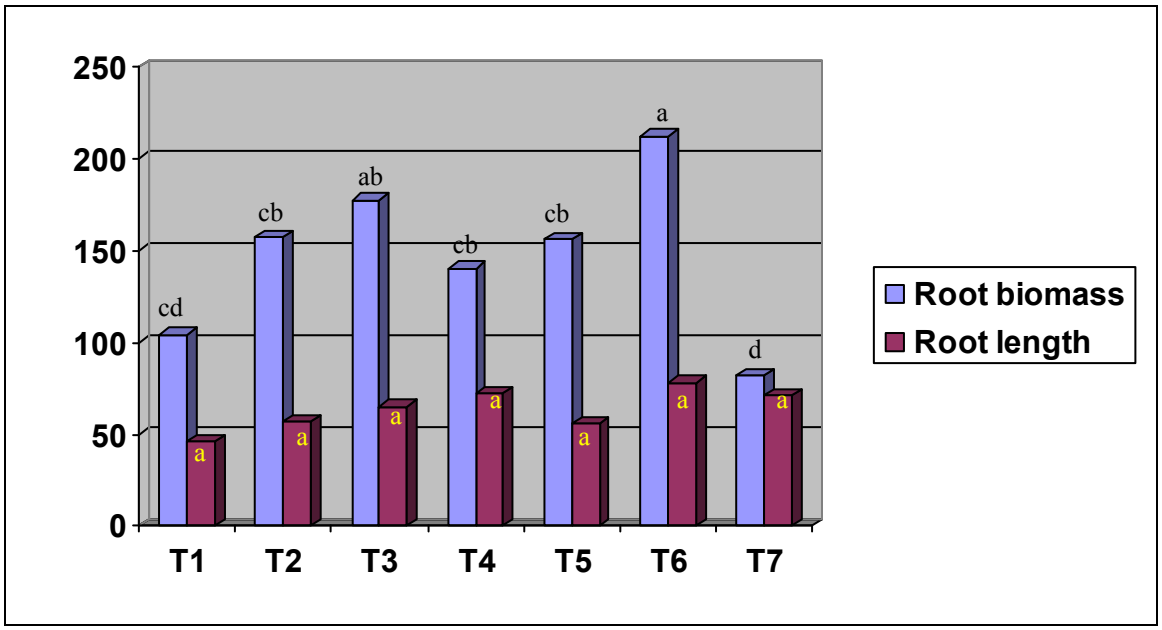

Figure 2. Root dry biomass yield (g) and length of tap root (cm) of 2-year-old tongkat ali plants as affected by fertilizer and organic mulch application in Setiu, Terengganu, Peninsular Malaysia. Means with the same letter across the treatments within the same variable are not significantly different at P<0.05.

There was no significant difference between treatments in tap root length. Root form influences harvesting activity, with shorter roots of bigger diameter easier to pull out.

Conclusion

Tongkat ali can be cultivated on BRIS soil but its growth was slower than on better textures soils. Even

though this soil is excessively drained, application of fertilizer N source as urea significantly improved growth of tongkat ali and fertilizer efficiency was further improved when applied together with organic mulch. Root harvesting was much easier on the sandy soil.

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