Abstract

Eucalyptus is one of among the important fast-growing species, and is typically managed on short rotation to sustain economy with the production of timber, pulpwood, charcoal, and fire-wood. In order to sustain the plant material supply with efficient and cost-effective means, macro propagation using cutting is required instead as an alternative to seed-clonal seeds for uniform plant material seedling production. However, information on early root development of E. pellita is still lacking in terms of from these two propagation types, seed and stem cutting of E. pellita seedlings. The objectives of this study were aims to compare the root development of two different propagation seedlings of E. pellita; and to study the effect of different nitrogen concentration levels towards two types of propagation of E. pellita seedlings. The study was conducted using E. pellita seedlings from two types of propagation, namely, seed and stem cuttings, along with three different nitrogen concentrations (0, 50, and 200 kg N ha⁻¹). Shoot biomass, root intensity (RI), total root intensity (TRI), root biomass, root length density (RLD), and specific root length (SRL) were recorded. Most of the root parameters showed a significant difference in stem cutting, as compared to seed cutting. In conclusion, E. pellita seedlings from stem cutting was greater in terms of root distribution compared to propagation by seeds at the nursery stage, and the 50 kg N ha⁻¹ was the best optimal nitrogen concentration level from the considered levels to be applied to the E. pellita seedlings. More research is required for studying the root distribution from these two types of propagation in the real field soil, as different environmental factors may affect the growth performance of E. pellita.

Introduction

Plantation forestry using Eucalyptus spp. in Sabah has began in the 1970s (Harwood & Nambiar, 2014) as part of an effort for forest conservation (Zaiton et al., 2020). Eucalyptus is one of among the important fast-growing species that is typically managed on short rotation to sustain economy with the production of timber, pulpwood, charcoal, and fire-wood (Zaiton et al., 2018; Zhou et al., 2018). Sabah Softwood Berhad (SSB) is the first private forest plantation companies in Sabah that pioneered using fast-growing timber species, where E. deglupta was initially introduced during the early plantation development (Enters et al., 2002). However, it was unsuccessful and was later replaced with other superior species including such as Acacias due to less economic, poor growth performance (Zaiton et al., 2020) and foliar pathogens (Japarudin et al., 2015).

Since almost nearly three decades, A. mangium and hybrids have been the main primary species that planted in Sabah, especially in some forest plantation companies such as Acacia Forest Industries
Sdn Bhd (AFI), Sabah Forest Development Authority (SAFODA) and SSB. However, A. mangium and hybrid performance are affected mainly by serious fungi Ceratocystis disease (Tarigan et al., 2011; Japarudin et al., 2015), wilt (Japarudin et al., 2015), and Ganoderma philippii (Mohammed et al., 2014), which have caused death to about 10 to 20% of the Acacia trees in plantations (Wong., et al. 2015). Therefore, E. pellita is an alternative option for the fast-growing timber production industry. Since 2008, most of forest plantation companies in Sabah and Sarawak have been involved in using Eucalyptus species in plantation (Zaiton et al., 2020).

Eucalyptus pellita F. Muell, or red mahogany, is a medium-to-large tree that can grow up to 40 m in height and over 1 m in diameter (Harwood 1998; Dombro 2010). E. pellita is native to Papua New Guinea and northern Queensland, Australia (Hung et al., 2015; Yahya, 2020; Yew et al., 2015). E. pellita has good growth and a high survival rate because of its wider range of adaptability with sites and favourable stem form (Yahya, 2020). Currently, E. pellita plays an important role in reforestation in countries such as Brazil, Cuba, Indonesia, Malaysia and the Philippines (Hung et al., 2015). Furthermore, E. pellita is used for a variety of products such as fine furniture (Clarke et al., 2009), pulp production in many countries (Eldridge et al., 1993; Poke & Raymond 2006) and high quality writing and printing paper or tissue products (Raymond 2002; Raymond & Schimleck 2002; Schimleck et al., 2006).

In order to sustain the plant material supply with efficient and cost-effective means (Kuppusamy et al., 2019), macro-propagation using cutting is required can be used instead of seed clonal seeds for uniform plant material seedling production. Cutting is the most widely used technique and is cheaper for larger multiplying seedlings of Eucalyptus due to easier handling as compared to the micro-propagation method (Sulichantini et al., 2014).

However, although there exist a lot of many studies previous literatures about E. pellita, there are no or is a limited amount of information about root growth of E. pellita at early development or from these two types from seed and stem cutting of E. pellita seedlings. This is probably due to the difficulty in studying investigation belowground and also due to methodological problems. With such information, it is will be useful for forest plantation companies management in enhancing the understanding on strategies to optimize yield production with the appropriate agronomic or silvicultural approach. In this present study, we used different types of planting material sources from seed and stem cutting of E. pellita and studied their root traits at three different nitrogen concentrations. We hypothesized that, both above and belowground, of E. pellita seedlings from stem cutting were greater than the seedlings from seed propagation. Therefore, the aim of this study were the objectives of this study were formulated as follows: 1) to compare the root