



**UNIVERSITI PUTRA MALAYSIA**

**SEED GERMINATION OF SELECTED *HEVEA BRASILIENSIS* (WILD. EX A.JUSS.) MÜLL.ARG. (LATEX TIMBER CLONE) AND INFLUENCE OF FERTILIZER AND WATER DEFICIT ON SEEDLING PERFORMANCE**

**MOHD SHAFAR JEFRI BIN MOKHATAR**

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**By**

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**Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia,  
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**Chairman: Associate Professor Wan Mohamed Noordin Wan Daud, DSc**

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The increasing demand for high quality rubber planting material has resulted in the need for selection of clones with high quality and proper management practices. Hence, this study has been carried out with the objective to evaluate seeds germination and seedling performance towards fertilizer and water deficit. Initially, germination test was carried out with 50 seeds of six clones namely PB 260 (control), RRIM 901, RRIM 2001, RRIM 2005, RRIM 2006 and RRIM 2026. Germination percentage was determined after two weeks. After germination, seedlings were transplanted into polythene bags and growth performances were evaluated for three months. In the second study, the response of seedlings towards single fertilizer was evaluated. Locally produced urea, Agrenas was compare with imported ammonium sulphate with a treatment rate of 10 g N from Agrenas per plant (T1), 20 g N from Agrenas per plant (T2), and 10 g N from  $(\text{NH}_4)_2\text{SO}_4$  per plant (T3) and zero N per plant (T4). Another study on fertilizer was conducted to evaluate current fertilizer recommendation using compound fertilizer, RISDA 1. Four different rates of RISDA 1(10.7: 16.6: 9.5: 2.4) compound fertilizer were used;

T1 (0 g per plant) act as control, T2 (50%, 18.75 g per plant), T3 (100%, 37.5 g per plant) and T4 (150%, 56.25 g per plant) with T3 (100%) being the rate recommended by the Rubber Industry and Smallholders Development Authority. In order to evaluate rubber tree to water stress condition, a study was carried out under rain shelter. Two new latex timber clones from Malaysian Rubber Board (MRB), RRIM 2001 and RRIM 3001 were used in this study. Five levels of treatment were used; plants watered for every two days, five days, 10 days, 15 days and everyday which acted as control. The results showed that clone PB 260 had the highest germination percentage with 72%, while seeds from clone RRIM 2005 were the lowest (48.57%). Although germination percentage was second highest, seeds from clone RRIM 2001 had the best growth performance as shown by seedling height, girth and root dry weight. This study suggested seeds from clone RRIM 2001 were the most suitable seeds to be used for rootstocks production. In the second study, it was found that urea performed as well as ammonium sulphate at the equivalent of 10 g N per plant as reflected by leaf dry weight, leaf N content, height and girth increment measurements. Most leaves of the plants in T2 were scorched and some had abscised from the plant. All treatments, except T2, showed that the girth and height increased steadily over time. Through this study, it was found that urea performed equally well when compared to ammonium sulphate at the equivalent of 10 g N per plant. However, in terms of cost per unit nitrogen, urea is much cheaper.

For another study on fertilizer, results showed that the maximum value of plant height and girth was from T4 (RISDA 150%) with the mean of 62.11 cm and 4.41 cm, respectively. The P content were not significantly different among the treatments while the K and Mg content were highest in T4 (150%) and significantly different from other treatments. Compared to nutrient critical values, T4 met the

nutrient sufficiency range for rubber. The nutrient use efficiency shows decreasing efficiency with increasing rates of fertilizer. From this study, it can be concluded that the current recommended fertilizer rate were insufficient, and precise fertilizer application should be considered to optimize fertilizer use efficiency. For water deficit study, fundamental changes of plant growth and physiological responses showed that treatment with sufficient water for clone RRIM 2001 (T1) had higher values than other treatments. Photosynthesis rate was highest in well watered (T6) with mean  $11.26 \mu\text{mol m}^{-2}\text{s}^{-1}$ , while T4, T5 and T9 were lowest with the mean  $0.00 \mu\text{mol m}^{-2}\text{s}^{-1}$ . Stomata conductance showed significant difference between T6 with  $0.16 \mu\text{mol m}^{-2}\text{s}^{-1}$  compared to under stress treatments with  $0.00 \mu\text{mol m}^{-2}\text{s}^{-1}$ . The results also showed root length increase with the increase of water stress. There was treatment failure to adapt to water stress at treatments withholding water for 15 days followed by treatments of 10 days and five days respectively. From this study, it can be concluded that *Hevea brasiliensis* cannot withstand water stress at nursery stage. From all these studies, it can be concluded that seed germination percentage and seedling performance was influenced by the genotype. Over dosage of fertilizer would be detrimental to the seedlings and insufficient nutrient would results in visual deficiency symptoms and affect the growth performance. Rubber seedling also cannot withstand water stress and need proper water management if planted on dry areas.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

**PERCAMBAHAN BENIH *HEVEA BRASILIENSIS* (WILLD. EX A.JUSS.)  
MÜLL.ARG. (KLON LATEKS BALAK) TERPILIH DAN PENGARUH  
BAJA DAN KEKURANGAN AIR KE ATAS PRESTASI ANAK BENIH**

Oleh

**MOHD SHAFAR JEFRI BIN MOKHATAR**

Disember 2012

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Fakulti: Pertanian**

Peningkatan permintaan terhadap bahan tanaman berkualiti tinggi telah menyebabkan wujud keperluan untuk pemilihan klon-klon yang berkualiti tinggi dan amalan pengurusan yang betul. Oleh itu, kajian ini telah dijalankan dengan objektif untuk menilai percambahan biji benih dan prestasi benih terhadap baja dan kekurangan air. Pada mulanya, ujian percambahan telah dijalankan dengan menggunakan 50 biji dari enam klon iaitu PB 260 (kawalan), RRIM 901, RRIM 2001, RRIM 2005, RRIM 2006 dan RRIM 2026. Peratus percambahan ditentukan selepas dua minggu. Selepas percambahan, anak benih telah dipindahkan ke dalam beg politena dan pertumbuhan telah dinilai selama tiga bulan. Dalam kajian kedua, tindakbalas benih terhadap baja tunggal telah dinilai. Urea yang dihasilkan tempatan, Agrenas dibandingkan dengan ammonium sulfat yang diimport dengan kadar rawatan 10 g N dari Agrenas bagi setiap tumbuhan (T1), 20 g N dari Agrenas sepokok (T2), dan 10 g N (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub> sepokok (T3) dan sifar N sepokok (T4). Satu lagi kajian mengenai baja telah dijalankan untuk menilai cadangan pembajaan semasa menggunakan baja sebatian, RISDA 1. Empat kadar yang berbeza RISDA 1 (10.7: 16.6: 9.5: 2.4) baja kompaun telah digunakan; T1 (0 g/pokok) bertindak

sebagai kawalan, T2 18.75 g/pokok), T3 (37.5 g/pokok) dan T4 (56.25 g/pokok) dengan T3 (37.5 g) adalah kadar yang disyorkan oleh Lembaga Pembangunan Pekebun Kecil dan Industri Getah. Dalam usaha untuk menilai pokok getah kepada keadaan kekurangan air, satu kajian telah dijalankan di bawah lindungan hujan. Dua klon baru lateks balak dari Lembaga Getah Malaysia (LGM), RRIM 2001 dan RRIM 3001 telah digunakan dalam kajian ini. Lima tahap rawatan telah digunakan; tumbuhan disiram untuk setiap dua hari, lima hari, 10 hari, 15 hari dan setiap hari yang bertindak sebagai kawalan. Keputusan menunjukkan klon PB 260 mempunyai peratusan percambahan tertinggi dengan 72%, manakala benih daripada klon RRIM 2005 adalah yang terendah (48.57%). Walaupun peratusan percambahan adalah kedua tertinggi, benih dari klon RRIM 2001 mempunyai prestasi pertumbuhan yang terbaik seperti yang ditunjukkan oleh lilitan, ketinggian, dan berat kering akar. Kajian ini mencadangkan benih dari klon RRIM 2001 adalah benih yang paling sesuai untuk digunakan untuk pengeluaran pokok penanti. Dalam kajian kedua, telah didapati bahawa urea memberi tindakbalas yang sama dengan ammonium sulfat pada kadar bersamaan 10 g N setiap pokok seperti keputusan yang diperolehi dari berat kering daun, kandungan N dalam daun, ketinggian dan ukuran lilitan. Kebanyakan daun dari T2 telah terbakar dan ada yang luruh. Semua rawatan, kecuali T2, menunjukkan bahawa lilitan dan ketinggian semakin meningkat dari masa ke semasa. Melalui kajian ini, didapati bahawa tindakbalas urea adalah sama berbanding dengan ammonium sulfat pada kadar 10 N g per pokok. Walau bagaimanapun, dari segi kos per unit nitrogen, urea adalah jauh lebih murah. Bagi kajian baja yang lain, keputusan menunjukkan bahawa nilai maksimum ketinggian tumbuhan dan lilitan adalah dari T4 (56.25 g/pokok) dengan purata 62.11 cm dan 4.41 cm. Kandungan P tidak berbeza secara ketara antara rawatan manakala

kandungan K dan Mg tertinggi pada T4 (56.25 g/pokok) dan jauh berbeza daripada rawatan lain. Berbanding nilai kritikal nutrien, T4 menunjukkan nutrien yang mencukupi. Kecekapan penggunaan nutrien menunjukkan penurunan kecekapan dengan peningkatan kadar baja. Dari kajian ini, kesimpulan boleh dibuat bahawa kadar baja yang disyorkan semasa tidak mencukupi, dan pembajaan yang tepat perlu dipertimbangkan untuk mengoptimumkan kecekapan penggunaan baja. Untuk kajian defisit air, perubahan asas pertumbuhan tumbuhan dan tindak balas fisiologi menunjukkan bahawa rawatan dengan air yang mencukupi untuk klon RRIM 2001 (T1) mempunyai nilai yang lebih tinggi berbanding rawatan lain. Kadar fotosintesis adalah yang tertinggi dalam baik disiram (T6) dengan min  $11.26 \mu\text{mol}^{-2}\text{s}^{-1}$ , manakala T4, T5 dan T9 adalah terendah dengan min  $0.00 \mu\text{mol m}^{-2}\text{s}^{-1}$ . Stomata konduktans menunjukkan perbezaan yang signifikan antara T6 dengan  $0.16 \mu\text{mol m}^{-2}\text{s}^{-1}$  berbanding di bawah rawatan tekanan dengan  $0.00 \mu\text{mol m}^{-2}\text{s}^{-1}$ . Keputusan juga menunjukkan peningkatan akar panjang dengan peningkatan tekanan air. Terdapat kegagalan rawatan untuk menyesuaikan diri dengan tekanan air pada rawatan yang menahan air selama 15 hari diikuti oleh rawatan masing-masing 10 hari dan lima hari. Daripada kajian ini, kesimpulannya adalah *Hevea brasiliensis* tidak boleh menahan tekanan air pada peringkat nurseri. Daripada semua kajian ini, ia boleh membuat kesimpulan bahawa peratus percambahan biji benih dan benih prestasi telah dipengaruhi oleh genetik. Lebihan baja akan memudaratkan benih dan kekurangan nutrien akan menunjukkan gejala kekurangan visual dan menjejaskan prestasi pertumbuhan. Anak benih getah juga tidak boleh menahan tekanan air dan memerlukan pengurusan air yang betul jika ditanam di kawasan kering.



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I certify that a Thesis Examination Committee has met on (x) to conduct the final examination of Mohd Shafar Jefri Bin Mokhtar on his Master of Science thesis entitled “Seed Germination of Selected *Hevea Brasiliensis* (Latex Timber Clone) and The Influence of Fertilizer and Water Deficit On Seedling Performance” in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U. (A) 106] 15<sup>th</sup> March 1998. The Committee recommends that the student be awarded the Master of Science.

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## DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or at any other institution.

---

**MOHD SHAFAR JEFRI BIN MOKHATAR**

Date: 6 December 2012



I certify that a Thesis Examination Committee has met on 6 December 2012 to conduct the final examination of Mohd Shafar Jefri Bin Mokhtar on his Master of Science thesis entitled “Seed Germination of Selected *Hevea brasiliensis* (Willd. Ex A.Juss.) Müell. arg. (Latex Timber Clone) and Influence of Fertilizer and Water Deficit on Seedling Performance” in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U. (A) 106] 15<sup>th</sup> March 1998. The Committee recommends that the student be awarded the Master of Science.

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