



KERAGAMAN GENETIK DAN REGENERASI *DIPTEROCARPUS GRACILIS* DI CAGAR ALAM KECUBUNG ULOLANANG

INTISARI

Dipterocarpus gracilis Blume adalah salah satu spesies *Dipterocarpus* asli di Pulau Jawa, Indonesia yang memiliki nilai komersial sebagai hasil hutan kayu (kayu) dan bukan kayu (oleoresin). Spesies ini telah dianggap rentan menurut kriteria Daftar Merah Spesies Terancam Punah oleh IUCN. Penelitian ini bertujuan untuk mempelajari keragaman genetik, dinamika regenerasi bibit sebagai populasi regenerasi alami *D. gracilis* Blume di Cagar Alam Kecubung Ulolanang, Kecamatan Batang, Provinsi Jawa Tengah, Indonesia serta untuk mengetahui pengaruh naungan dan pemupukan terhadap sifat fisiologisnya.

Populasi *D. gracilis* di cagar alam ini tersebar di empat zona. Berdasarkan tiga enzim yang digunakan (*esterase*, *acid phosphate* dan *peroxidase*) diperoleh nilai rata-rata heterozigositas teramati dari semua zona lebih rendah ($H_o=0,078$) daripada heterozigositas harapan ($H_e= 0,203$). Nilai N_m diperoleh sebesar 0,746 dan Indeks fiksasi (F_{IS}) menunjukkan nilai sebesar 0,6778 yang menunjukkan bahwa semua populasi memiliki kecenderungan mengalami penurunan heterozigositas yang mengarah pada perkawinan kerabat sebagai akibat dari populasi yang kecil dan terisolasi. Setelah 10 bulan pengamatan, tingkat kelangsungan hidup tertinggi *D. gracilis* di alam pada CO 21%-25% (44%), dan tingkat kelangsungan hidup terendah diamati pada CO <15-20% (20%). Laju pertumbuhan relatif tinggi (RGR H) dan laju pertumbuhan relatif diameter (RGR D) tertinggi ditemukan pada CO 21-25% ($1,03 \pm 0,03$ cm dan $1,87 \pm 0,03$ mm). CO < 15% menunjukkan RGR H dan RGR D terendah ($0,6 \pm 0,02$ cm dan $1,39 \pm 0,02$ mm). Bulan kering adalah periode kritis bagi kelangsungan hidup semai *D. gracilis*. Penurunan persentase naungan dan peningkatan dosis pemupukan NPK signifikan meningkatkan laju fotosintesis dan kandungan klorofil. Pemberian pupuk tidak memengaruhi konduktansi stomata dan laju transpirasi serta tidak ada interaksi diantar kedua perlakuan. RGR H pada semai meningkat seiring dengan penurunan persentase naungan, namun tidak dipengaruhi oleh pemberian pupuk. Rerata RGR H pada naungan 30% dan 60% masing-masing adalah 0,943 cm dan 0,671 cm. Pemberian pupuk 1 g/semai lebih tinggi namun pemberian pupuk NPK tidak berpengaruh terhadap RGR H dan RGR D. Konduktansi stomata pada naungan 60% signifikan lebih tinggi dibandingkan di bawah naungan 30%. Tidak ada perbedaan yang signifikan dari perlakuan pemberian pupuk pada konduktansi stomata. Biomassa paling banyak terdistribusi pada batang, daun kemudian akar.

Keragaman genetik *D. gracilis* berkurang ketika pohon dewasa berkurang dan kapasitas regenerasi *D. gracilis* yang buruk yang menyiratkan bahwa kegagalan dalam pembentukan bibit dari waktu ke waktu akan mengubah demografi pohon *D. gracilis*. Oleh karena populasi ini memiliki nilai esensial di Pulau Jawa dan harus menjadi prioritas evaluasi dalam konservasi *in-situ* dan *ex-situ* sumber daya genetik.

Kata kunci: *Dipterocarpus gracilis*, keragaman genetik, kegagalan permudaan, perlakuan naungan, perlakuan dosis NPK



GENETIC DIVERSITY AND REGENERATION OF DIPTEROCARPUS GRACILIS IN THE KECUBUNG ULOLANANG NATURE RESERVE

ABSTRACT

Dipterocarpus gracilis Blume is one of the native *Dipterocarpus* species in Java Island, Indonesia. It has commercial value as timber (wood) and non-timber forest products (oleoresin). This species has been considered vulnerable following the Red List of Threatened Species criteria by IUCN. We aimed to study the genetic diversity, and regeneration dynamics of seedlings as the natural regenerating population of *Dipterocarpus gracilis* Blume in The Kecubung Uloanang Nature Conservation Reserve, Batang Subdistrict, Central Java Province, Indonesia and to determine the effect of shade and fertilizer to physiological traits of *D. gracilis*.

The *D. gracilis* population in this area is distributed in four zones. We observed a total of 137 juvenile seedlings representing all the zones. Isozyme markers detected the genetic diversity of *D. gracilis* by peroxidase (POD), esterase (EST), and acid phosphatase (ACP) enzymes. The mean heterozygosity observed in all the zones was lower ($H_o=0,078$) than the heterozygosity expected ($H_e=0,203$). Decreased genetic diversity due to genetic drift and indication of inbreeding (Nm value 0,746). The fixation index (F_{IS}) showed a positive value of 0,6778 which indicated that all populations had a tendency to experience a decrease in heterozygosity leading to marriage as a result of a small and limited population. F_{ST} has a positive value (0,251) indicating very high genetic differentiation within the zone. After 10 months of observation, the highest survival rate was found in CO > 21%-25% (44%), and the lowest survival rate was observed in CO < 15%-20% (20%). The highest relative growth rate of height (RGR H) and the relative growth rate of diameter (RGR D) were found in CO 21%-25% (1.03 ± 0.03 cm and 1.87 ± 0.03 mm). CO < 15% showed the lowest RGR H and RGR D (0.6 ± 0.02 cm and 1.39 ± 0.02 mm). The RGR H and D showed a significant CO 21%-25% increase compared with other canopy classes. Pearson's correlation between RGR D and CO was 0.466 ($p > 0.05$). Dry months were a critical period for seedling survival. Increasing light intensity significantly. Our through decreasing the percentage of shade and increasing the dose of NPK fertilization. increased the rate of photosynthesis even though seedling conditions decreased stomatal conductance and transpiration rates. A decrease in stomatal conductance correlates strongly with a decrease in the rate of transpiration. Decreasing light intensity by increasing the percentage of shade causes an increase in chlorophyll content. Meanwhile, fertilizer application did not affect stomatal conductance and transpiration rate and there was no interaction between the two treatments. The RGR H in the seedlings increased as the shade percentage decreased, but was not affected by fertilizer application. The mean RGR H at 30% and 60% shade were 0,943 cm and 0,671 cm, respectively. The application of 1 g/seedling fertilizer was higher but the application of NPK fertilizer did not affect RGR H and RGR D. Stomatal conductance at 60% shade was significantly higher than the conductance of the seedlings under 30% shade. There was no significant difference between the application of fertilizers to stomatal conductance. Biomass as a result of photosynthesis is mostly distributed in stems, leaves, and then roots.

We conclude that the genetic diversity of *D. gracilis* decreases when mature trees are reduced and the poor regeneration capacity of *D. gracilis*, implying that failure in a seedling establishment over time would alter the tree demographics of *D. gracilis*. This population has essential values in Java Island and should be a priority evaluation in the in-situ and ex-situ conservation of genetic resources.

Keywords: *Dipterocarpus gracilis*, genetic diversity, regeneration failure, shading treatment, NPK fertilizer treatment