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Physiological Responses of *Avicennia marina* var. *acutissima* and *Bruguiera parviflora* under Simulated Rise in Sea Level

(Respon Fisiologi *Avicennia marina* var. *acutissima* dan *Bruguiera parviflora* di Bawah Simulasi Kenaikan Aras Air Laut)

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ABSTRACT

Climate change components such as increased in atmospheric carbon dioxide (CO_2) and rising sea levels are likely to affect mangrove ecosystems. Healthy mature propagules of A. marina *var. acutissima and* B. parviflora *were subjected to two tidal treatments; shallow and deep; for six months. Shallow treatment mimicked the current tidal fluctuations and deep treatment simulated future tidal conditions under rise in sea level. Deep treatment decreased A_{max} of both species and significant two way interactions between tidal treatments and species were observed. A_{400} was significantly reduced in the deep treatment in* B. parviflora *but not in* A. marina. *Carbon dioxide compensation point was not affected by the tidal treatments but varied significantly between both species. The ratio A_{400}/A_{max} was significantly lower in the shallow treatment in* B. parviflora *indicating higher carbon sink potential at moderate tidal flooding whereas A_{400}/A_{max} of* A. marina *was less variable between tidal treatments. Chlorophyll conductance was insensitive to tidal flooding but was significantly higher in* B. parviflora *than in* A. marina. *Carbon sequestration of* B. parviflora *was substantially reduced in the deep treatment while the difference between tidal treatments was much less in* A. marina. *These results indicated that these two species responded differently under tidal flooding where* A. marina *was less sensitive to tidal. Thus,* A. marina *is better adapted to the projected climate change than* B. parviflora.

Keywords: Climate change; inundation; mangroves; seedling growth; water logging

ABSTRAK

Unsur-unsur perubahan iklim seperti kenaikan karbon dioksida atmosfera dan aras air laut sememangnya mempengaruhi ekosistem hutan paya bakau. Dalam kajian ini, propagul Avicennia marina var. acutissima *dan* Bruguiera parviflora *didedahkan kepada 2 perlakuan air pasang; dalam dan cetek; selama 6 bulan. Perlakuan cetek mewakili keadaan semasa sementara perlakuan dalam mewakili keadaan kenaikan aras air laut pada masa hadapan. Perlakuan dalam mengurangkan nilai A_{max} untuk kedua-dua spesis. Nilai A_{400} menurun dengan bererti bagi* B. parviflor*a tetapi tidak* A. *marina untuk perlakuan dalam. Titik imbangan karbon dioksida tidak dipengaruhi oleh perlakuan air pasang tetapi menunujukkan perbezaan bererti antara kedua-dua spesies. Nisbah A_{400}/A_{max} adalah rendah pada perlakuan cetek* B. parviflora *yang menandakan potensi sinki karbon yang lebih tinggi manakala nisbah A_{400}/A_{max} bagi* A. marina *kurang menunujukkan variasi. Konduktans klorofil tidak sensitif terhadap air pasang namun B. parviflora menunjukkan nilai lebih tinggi berbanding* A. marina. *Sekuestrasi karbon* B. parviflora *menurun pada perlakuan dalam tetapi tidak begitu ketara pada* A. marina. *Kesemua keputusan menunjukkan* A. marina *lebih toleren terhadap kenaikan aras air laut berbanding* B. parviflora.

Kata kunci: Kebanjiran; kegenangan air; paya bakau; pertumbuhan biji benih; perubahan iklim

INTRODUCTION

Two major climate change components that are likely to affect mangrove communities are the increased in atmospheric carbon dioxide (CO_2) and rising sea levels (Krauss et al. 2008). Increased in atmospheric CO_2 could enhanced the growth rates via increased net assimilation rates and increased leaf area ratio and through increased water use efficiency (Ball et al. 1997). Likewise increased in atmospheric CO_2 concentrations determine the stomatal regulation of water loss (Morison 1998). However, the extent to which individual species respond to increased CO_2 depends on other growth limiting factors such as nutrient availability and the presence of stress factors such as salinity and flooding (Ball et al. 1997; McKee & Rooth 2008).

Mangroves are exposed to various levels of tidal inundations depending on the geomorphological characteristics of the shoreline (Woodroffe & Grindrod 1991). Rise in sea level is likely to prolong tidal inundation and cause intense soil anoxia (Pezeshki 2001). Under experimental cultures, soil flooding can reduce oxygen concentrations of the soil by as much as 28% after 6 h of flooding and as much as 72% after 20 h (Skelton & Allaway 1996). Intense soil anoxia triggers various physiological