

POTENSI SIMBIOSIS CASUARINA – FRANKIA DALAM PENINGKATAN KUALITAS TANAH DI LAHAN PASIR PANTAI

INTISARI

Potensi kontribusi simbiosis cemara udang dengan *Frankia* terhadap tapak belum banyak dipelajari maupun digunakan. Pemanfaatan tumbuhan penambat nitrogen di bidang kehutanan perlu dilakukan, karena semakin banyak kerusakan hutan, yang mengakibatkan terjadinya degradasi kesuburan tanah. Permasalahan yang ada adalah bagaimana karakteristik bintil akar dan jasad simbiotiknya, berapa akumulasi biomasa yang dihasilkan dan bagaimana mekanisme distribusi hara ke lingkungan. Penelitian bertujuan untuk memahami 1) karakteristik bintil akar cemara udang dan isolat *Frankia*, 2) pembentukan bintil akar 3) kapasitas penambatan nitrogen 4) alokasi fotosintat dan cekaman air 5) peran simbiosis di lahan pasir pantai.

Identifikasi karakteristik bintil akar cemara udang mengacu pada Somasegaran (1982). Anatomi bintil akar dipelajari melalui pengamatan penampang melintang. Karakteristik isolat *Frankia* dipelajari dalam media ekstrak tanah padat dan cair (Fred dan Waksman, 1982) yang dimodifikasi. Kapasitas penambatan nitrogen isolat *Frankia* diukur dengan metode *Acetylene Reduction Activity* (ARA). Produksi seresah cemara udang ditampung dalam *litter trap* di bawah penutupan tajuk yang merupakan evaluasi tanaman umur 2,5 tahun, dirancang dengan disain plot nelder (Seebauer, 2008). Profil tanah dibuat di plot pengamatan seresah. Analisis tanah untuk kadar C-organik dengan metode Walkley-Black (Nelson dan Sommers, 1982) dan untuk kadar N-total dengan metode Kjeldahl (Bremner dan Mulvaney, 1982).

Bintil akar cemara udang memiliki ragam bentuk dengan struktur seperti kalus mengelilingi akar dan tidak mudah lepas dari inangnya. Isolat *Frankia* yang berasal dari pertanaman di kawasan pesisir dapat membentuk bintil akar aktif dalam media pasir steril. Kapasitas penambatan nitrogen yang dihasilkan oleh setiap isolat *Frankia* yang berjumlah 14 berkisar antara 0,25-0,88 mmol/g berat kering bintil akar/jam. Penambahan mulsa, bahan organik dan campuran mulsa bahan organik berturut-turut menghasilkan kapasitas penambatan nitrogen 1,835; 1,157; 1,084 mmol/g berat kering bintil akar/jam. Pada tapak rumput teki, rumput grinting dan tapak terbuka berturut-turut 0,06; 0,09; 0,89 mmol/g berat kering bintil akar/jam. Penyiraman setiap hari, 4 dan 8 hari sekali menghasilkan kapasitas penambatan nitrogen tertinggi berturut-turut 2,68; 8,5; 9,24 mmol/g/jam. Pemutusan alokasi fotosintat dengan perlakuan penyiraman masing-masing menghasilkan kapasitas penambatan nitrogen 5,34; 5,42 dan 8,27 mmol/g/jam. Nitrogen tanah di bawah tegakan cemara udang umur 2,5 tahun meningkat 200 – 400% (0,3 – 0,6 ton/ha/th, C-organik 3,6 – 7,2 ton/ha/th. C-organik yang terkandung dalam seresah 1,01 – 1,63 ton/th/ha, sedangkan nitrogen 0,02 – 0,04 ton/th/ha.

Kata kunci: potensi, simbiosis, cemara udang, *Frankia*, lahan pasir

THE POTENTIAL OF SYMBIOTIC FRANKIA WITH CASUARINA EQUISETIFOLIA IN IMPROVING SOIL QUALITY IN SANDY COASTAL AREAS

ABSTRACT

The study on the potential of symbiotic *Frankia* with *Casuarina equisetifolia* in enriching nutrient poor-sites is very scanty. A number of research issues related with these are the characteristics of root nodule and its symbiotic microorganism, the amount of biomass accumulation and the mechanism of nutrient distribution to its surrounding environments. The objectives of this current research are to investigate: 1) the characteristics of root nodule of *Casuarina equisetifolia* var. *incana* and the isolate of *Frankia*, 2) the development of root nodule, 3) the capacity of nitrogen fixation; 4) photosynthate allocation and water stress, 5) symbiotic role in sandy coastal areas.

In the study the characteristics of *C. equisetifolia* root nodule were identified and the anatomy of root nodule is analyzed through the observation of transverse section. The *Frankia* isolate was characterized in a media of solid and liquid ground extract. The nitrogen fixation capacity of *Frankia* isolate was measured using Acetylene Reduction Activity (ARA) method. *C. equisetifolia* litter accumulation was measured using litter traps placed under a 2.5 year old stand laid out in Nelder's design. Soil profiles were made in the litter observation plots. The contents of soil C-organic and total N were measured.

C. equisetifolia root nodule had a variety of forms with callus like structure encircling the root and tightly bound to its host plants. *Frankia* isolate growing in coastal sandy areas was able to form an active root nodule in sterile sandy media. Nitrogen fixation capacity of *Frankia* isolate ranged from 0.25 to 0.88 mmol per gram of dry weight of root nodule per hour. The nitrogen fixation capacities in the plot treated with the addition of organic matter as mulch, organic matter incorporated into soil and the combination of these organic matter applications were 1.835, 1.157, 1.084 mmol per gram of dry weight of root nodule per hour respectively, while those on site grown by *Cyperus* sp, *Spinifex litorius* and open area were 0.06, 0.09 and 0.89 mmol per gram of dry weight of root nodule per hour respectively. The nitrogen fixation capacities in the following watering treatment: every day, every 4 days and every 8 days were 2.68, 8.5 and 9.24 mmol/g/hour respectively. The discontinued supply of photosynthate in the corresponding watering treatment resulted in the nitrogen fixation rate of 5.34, 5.42 and 8.37 mmol/g/hour, respectively. The contents of soil nitrogen under a 2.5 year old stand of *C. equisetifolia* were 200-400% higher than those on open area with an accumulation rate of 0.3 – 0.6 ton/ha/yr. The accumulation rates of soil C-organic, litter production and nitrogen were 3.6 – 7.2 ton/ha/yr, 1.01 – 1.63 ton/ha/yr and 0.02 – 0.04 ton/ha/yr respectively.

Keywords: symbiotic, *Casuarina equisetifolia*, *Frankia*, sandy coastal areas