

## **KEANEKARAGAMAN JENIS *Azospirillum* PENAMBAT NITROGEN PADA LAHAN PASIR BESI**

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### **INTISARI**

Penelitian mengenai keanekaragaman jenis *Azospirillum* penambat nitrogen pada lahan pasir besi telah dilakukan. Penelitian ini bertujuan untuk menganalisis keanekaragaman jenis *Azospirillum* penambat nitrogen pada lahan pasir besi dengan pendekatan sistematika polifasik, menseleksi kemampuan isolat *Azospirillum* asal rizosfer tumbuhan dan tanah pasir besi dalam menambat nitrogen, menguji pengaruh berbagai konsentrasi besi terhadap kemampuan *Azospirillum* dalam penambatan nitrogen, dan menguji kemampuan isolat *Azospirillum* penambat nitrogen terpilih dalam pelarutan fosfat dan pembentukan IAA. Karakteristik tanah pasir besi merupakan lingkungan ekstrim yang memiliki kesuburan rendah ditunjukkan dengan variasi suhu cukup tinggi (29 – 39 °C), kandungan air rendah (3,22–6,14%), rasio C/N rendah (5,57), dan kandungan besi tinggi (10,02 – 14,99 %). Bakteri *Azospirillum* diisolasi dari rizosfer 15 jenis tumbuhan (*D. ischaemum*; *S. littorius*, *C. gigantea*, *Cp. mucunoides*, *P. serratifolia*, *S. chamaelea*, *Pandanus* sp., *Cr. pumila*, *T. cordifolia*, *H. ovalifolium*, *M. chamaelea*, *R. scabra*, *A. maritima*, *Al. monilifer*, *I. pres-caprae*) dan tanah pasir besi menggunakan medium Caceres. Keanekaragaman jenis *Azospirillum* pada lahan pasir besi bervariasi dengan jumlah isolat pada rizosfer (87 isolat) ditemukan lebih banyak dibandingkan pada tanah pasir besi (31 isolat). Kepadatan populasi *Azospirillum* pada rizosfer juga lebih tinggi daripada tanah pasir besi yaitu berturut-turut berkisar antara 0,04 – 8,0 x 10<sup>7</sup> CFU g<sup>-1</sup> dan 0,01 – 6,0 x 10<sup>5</sup> CFU g<sup>-1</sup>. Penambatan nitrogen oleh isolat *Azospirillum* ditunjukkan dengan konsentrasi nitrogen berkisar antara 5,73 – 94,54 µg mL<sup>-1</sup>. Isolat *Azospirillum* sp. KR66 yang diisolasi dari rizosfer *S. chamaelea* menunjukkan kemampuan tertinggi (94,54 µg mL<sup>-1</sup>). Aktivitas penambatan nitrogen isolat tersebut lebih tinggi daripada kemampuan penambatan nitrogen tiga strain acuan (*A. lipoferum* DSM 1840<sup>T</sup>, *A. brasilense* DSM 1690<sup>T</sup>, dan *A. halopraeferens* DSM 3675<sup>T</sup>). Semakin tinggi konsentrasi besi terutama di atas 25 µM, kemampuan *Azospirillum* spp. dalam menambat nitrogen semakin menurun. Isolat *Azospirillum* penambat nitrogen asal rizosfer dan tanah pasir besi mampu melarutkan kalsium fosfat, besi fosfat, dan aluminium fosfat dengan kisaran nilai E masing-masing berkisar antara 100,76 – 140,74; 118,52 – 140,60; dan 100 – 119,40. Isolat *Azospirillum* sp. KP11 dan *Azospirillum* sp. HR11 menunjukkan kemampuan yang tinggi dalam pelarutan fosfat. Isolat *Azospirillum* penambat nitrogen asal rizosfer dan tanah pasir besi juga mampu menghasilkan IAA berkisar antara 32,20 – 58,84 µg mL<sup>-1</sup>;



dan kemampuan tertinggi ditunjukkan oleh *Azospirillum* sp. HR11. Berdasarkan kemampuan penambatan nitrogen, pelarutan fosfat, dan produksi IAA, isolat *Azospirillum* spp. terpilih berpotensi sebagai rizobakteri penginduksi pertumbuhan tanaman. Identitas keempat isolat *Azospirillum* terpilih, yaitu *Azospirillum* sp. KP11, *Azospirillum* sp. KP35, *Azospirillum* sp. HR11, dan *Azospirillum* sp. KR66 diduga kuat sebagai spesies baru anggota genus *Azospirillum* berdasarkan metode pendekatan sistematika polifasik.

Kata kunci: *Azospirillum*, penambatan nitrogen, pelarutan fosfat, IAA, polifasik.

## SPECIES DIVERSITY OF NITROGEN FIXING *Azospirillum* ON IRON SAND LAND

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### ABSTRACT

A study regarding species diversity of nitrogen fixing *Azospirillum* on iron sand land has been conducted. The objectives of this study were to analyze species diversity of nitrogen fixing *Azospirillum* on iron-sandy land using systematical polyphasic approach, select *Azospirillum* isolates originated from plant rhizospheres and iron-sandy soils based on its ability to fix nitrogen, assay the effect of various concentrations of iron on the ability of *Azospirillum* isolates to fix nitrogen, and assay the selected nitrogen fixing *Azospirillum* isolates in phosphate solubilization and IAA production. Iron sand land characteristically is extreme environment which has low fertility with high temperature variation (29 – 39 °C), low water content (3.22–6.14 %), low C/N ratio (5.57), and high iron content (10,02 – 14,99 %). Bacterium of *Azospirillum* was isolated from 15 plant species (*D. ischaemum*; *S. littorius*, *C. gigantea*, *Cp. mucunoides*, *P. serratifolia*, *S. chamaelea*, *Pandanus* sp., *Cr. Pumila*, *T. cordifolia*, *H. ovalifolium*, *M.chamaelea*, *R. scabra*, *A. maritima*, *Al. monilifer*, *I. pres-caprae*) and iron sand soils using a Caceres medium. Species diversity of *Azospirillum* in iron sand land varied with numbers of isolate in plant rhizospheres (87 isolates) were found higher than in iron sand soils (31 isolates). Population density of *Azospirillum* in the rhizospheres was also higher than in iron sand soils in amount of  $0.04 - 8.0 \times 10^7$  CFU g<sup>-1</sup> and  $0.01 - 6.0 \times 10^5$  CFU g<sup>-1</sup>. Fixation of atmospheric nitrogen by *Azospirillum* isolates was shown with concentrations of nitrogen ranging from 5.73 – 94.54 µg mL<sup>-1</sup>. *Azospirillum* sp. KR66 isolated from *S.chamaelea* rhizosphere showed the highest ability (94.54 µg mL<sup>-1</sup>). Nitrogen fixing activity of those isolate was higher than fixation ability of the three reference strains (*A.lipoferum* DSM 1840<sup>T</sup>, *A.brasilense* DSM 1690<sup>T</sup>, and *A. halopraeferens* DSM 3675<sup>T</sup>). At iron concentration especially that is over 25 µM, the ability of *Azospirillum* in fixing nitrogen was lower. Nitrogen fixing *Azospirillum* which originated from either plant rhizospheres or iron sand soils was capable of solubilizing calcium phosphate, iron phosphate and aluminum phosphate with E values ranging from 100.76 – 140.74, 118.52 – 140.60, and 100 – 119.40, respectively. Isolates of *Azospirillum* sp. KP11 and *Azospirillum* sp. HR11 demonstrated higher ability in solubilizing phosphates. Nitrogen-fixing *Azospirillum* isolated from plant rhizospheres and iron sand soils were also capable of producing IAA with concentrations ranging from 32.20 – 58.84 µg mL<sup>-1</sup>; and the highest ability was shown by *Azospirillum* sp. HR11 isolate. Based on the ability of nitrogen fixation, phosphates solubilization, and IAA production,



selected isolates of *Azospirillum* sp. were potential as plant growth promoting rhizobacteria. Identity of the four selected *Azospirillum* isolates i.e. *Azospirillum* sp. KP11, *Azospirillum* sp. KP35, *Azospirillum* sp. HR11, and *Azospirillum* sp. KR66 were very likely to be a new species belong to *Azospirillum* genus based on polyphasic systematic approach method.

Key words: *Azospirillum*, nitrogen fixation, phosphate solubilization, IAA, polyphasic.