

RINGKASAN

Biofertilizer adalah pupuk organik dengan kandungan mikroba fungsional yang dapat meminimalisir penggunaan pupuk kimia. Fokus pengembangan dan inovasi produk hayati di PT Petrokimia Gresik adalah melakukan eksplorasi mikroba untuk memperoleh isolat bakteri dengan kemampuan menambat nitrogen bebas (N_2) dan memiliki karakteristik lainnya sebagai pelarut fosfat, kalium, dan memiliki aktivitas selulolitik sehingga berpotensi sebagai agensia *biofertilizer*. PT Petrokimia Gresik memiliki koleksi isolat bakteri dari sampel molase brix 80%, tanah persawahan, dan tanah gambut di Pulau Jawa, yaitu BBONA 0001, BBONB 0001, BASUA, dan BGAM 0101 yang belum teridentifikasi dan diuji kemampuannya dalam menambat nitrogen. Tujuan penelitian ini adalah untuk mengetahui kemampuan isolat bakteri koleksi PT Petrokimia Gresik tersebut dalam menambat nitrogen dengan variasi waktu inkubasi, menguji potensi lainnya sebagai agensia *biofertilizer*, dan karakterisasi fenetik isolat penambat nitrogen terpilih.

Penelitian ini dilakukan dengan metode eksperimental menggunakan Rancangan Acak Lengkap (RAL) pola faktorial menggunakan dua faktor. Faktor pertama adalah isolat bakteri koleksi (I) dan faktor kedua adalah waktu inkubasi (T). Variabel bebas pada penelitian ini adalah isolat bakteri dan waktu inkubasi, sedangkan sebagai variabel terikat adalah kemampuan bakteri dalam menambat nitrogen. Parameter utama yang diukur yaitu kadar N total dan parameter pendukung terdiri atas pH medium, hasil uji kualitatif penambatan nitrogen pada medium selektif NFB, indeks pelarutan fosfat, indeks pelarutan kalium, aktivitas selulolitik, dan hasil karakterisasi fenetik bakteri. Data kuantitatif diuji dengan menggunakan analisis *Two Way ANOVA* dengan taraf kesalahan 5% dan diuji lanjut menggunakan *Post Hoc DMRT (Duncan Multiple Range Test)*, sedangkan data kualitatif berupa data karakteristik fenetik bakteri dianalisis secara deskriptif komparatif dengan menggunakan *Bergey's Manual of Determinative Bacteriology 9th Edition* untuk mengetahui identitas isolat.

Hasil penelitian menunjukkan isolat BBONA 0001, BBONB 0001, BASUA, dan BGAM 0101 mampu menambat nitrogen. Jenis isolat, variasi waktu inkubasi, dan interaksi keduanya memiliki pengaruh signifikan terhadap kadar N total. Isolat BASUA menjadi isolat dengan penambatan nitrogen tertinggi dengan rerata kadar N total 80,81 ppm. Waktu inkubasi 10 hari menjadi waktu inkubasi paling optimal dengan rerata kadar N total 64,72 ppm. Interaksi isolat BASUA dan waktu inkubasi 10 hari menghasilkan rerata kadar N total tertinggi yaitu 96,90 ppm. Isolat BBONA 0001, BBONB 0001, BASUA, dan BGAM 0101 berpotensi sebagai agensia hayati *biofertilizer*. Berdasarkan karakteristik fenetik diketahui isolat BBONA 0001 adalah spesies dari genus *Bacillus*, BBONB 0001 spesies dari genus *Azotobacter*, BASUA spesies dari genus *Bacillus*, dan BGAM 0101 spesies dari genus *Pseudomonas*.

Kata kunci: *Biofertilizer, Kadar N Total, Penambatan Nitrogen, Petrokimia Gresik, Waktu Inkubasi*

SUMMARY

Biofertilizers are organic fertilizers containing functional microbes that can reduce the need for chemical fertilizers. The focus of product development and innovation at PT Petrokimia Gresik is microbial exploration to obtain bacterial isolates capable of fixing atmospheric nitrogen (N_2) and possessing additional characteristics such as phosphate and potassium solubilization as well as cellulolytic activity, making them potential agents for biofertilizer applications. PT Petrokimia Gresik has collected bacterial isolates from various sources including 80% brix molasses, rice paddy soil, and peat soil across the island of Java. These isolates—BBONA 0001, BBONB 0001, BASUA, and BGAM 0101—have not been identified and evaluated for their nitrogen-fixing capabilities. The objective of this study is to determine the nitrogen-fixing ability of PT Petrokimia Gresik's bacterial isolates under different incubation periods and to assess their additional potential as biofertilizer agents. The selected isolates were then phenetics characterized to identify their taxonomy as nitrogen-fixing bacteria.

The research was conducted experimentally using a Completely Randomized Design (CRD) in a factorial arrangement involving two factors: the bacterial isolates (Factor I) and the incubation time (Factor T). The independent variables in this study were the bacterial isolates and incubation duration, while the dependent variable was the bacteria's nitrogen-fixing capacity. The primary parameter measured was total nitrogen content. Supporting parameters included medium pH, qualitative nitrogen fixation tests on selective NFB medium, potassium and phosphate solubilization indexes, cellulolytic activity, and phenetic bacterial characterization results. The quantitative data were analysed using Two-Way ANOVA with 5% significance level, followed by post hoc analysis using Duncan's Multiple Range Test (DMRT), while the qualitative data, such as phenetic characteristics, were analysed descriptively and comparatively using *Bergey's Manual of Determinative Bacteriology* (9th Edition) to determine the identity of the isolates.

The results indicated that all isolates—BBONA 0001, BBONB 0001, BASUA, and BGAM 0101—were capable of nitrogen fixation. The type of isolate, incubation duration, and their interaction had a significant effect on nitrogen levels. BASUA isolate showed the highest nitrogen fixation capability, with an average nitrogen content of 80.81 ppm. The optimal incubation period was 10 days, yielding an average nitrogen content of 64.72 ppm. The interaction of BASUA and 10 days of incubation produced the highest nitrogen content, at 96.90 ppm. All four isolates demonstrated potential as biofertilizer agents. Phenetic characterization revealed that isolate BBONA 0001 was identified as a member of the genus *Bacillus*, BBONB 0001 as a member of the genus *Azotobacter*, BASUA as belonging to the genus *Bacillus*, and BGAM 0101 as affiliated with the genus *Pseudomonas*.

Keywords: *Biofertilizer, Incubation Time, Nitrogen Fixation, Petrokimia Gresik, Total Nitrogen*