

RINGKASAN

Populasi mikroorganisme tanah dipengaruhi oleh praktik budidaya yang diterapkan serta tingkat pencemaran logam berat di lahan pertanian. Pencemaran logam berat, seperti timbal (Pb), yang berasal dari aktivitas industri dan pertanian yang tidak ramah lingkungan, dapat berdampak negatif tidak hanya pada mikroorganisme tanah, tetapi juga pada manusia melalui konsumsi tanaman yang terkontaminasi. Bioremediasi menggunakan bakteri indigenus menjadi salah satu upaya yang dapat dilakukan untuk menurunkan konsentrasi Pb di lahan pertanian. Penelitian ini bertujuan untuk mengetahui perbedaan populasi bakteri rizosfer padi sawah budidaya organik dan konvensional serta memperoleh bakteri resisten dan potensial menurunkan konsentrasi Pb pada skala laboratorium.

Penelitian ini berlangsung dari Agustus 2024 hingga Januari 2025 di Laboratorium Agroekologi, Fakultas Pertanian, Universitas Jenderal Soedirman. Sampel tanah organik diperoleh dari Desa Ajibarang Kulon, sementara sampel tanah konvensional berasal dari Desa Tinggarjaya. Tahapan penelitian mencakup pengambilan sampel, pengukuran pH tanah, isolasi bakteri, karakterisasi makroskopis dan mikroskopis bakteri, uji resistensi, uji bioremediasi, serta pengamatan pertumbuhan bakteri pada media cair tanpa cemaran dan yang mengandung Pb 25 ppm.

Hasil penelitian menunjukkan bahwa populasi bakteri rizosfer padi sawah konvensional lebih tinggi yakni mencapai $3,3 \times 10^6$ CFU/g, dibandingkan dengan budidaya organik $1,2 \times 10^5$ CFU/g. Dari hasil isolasi di dua desa, diperoleh sepuluh isolat dominan, yaitu O1, O2, O3, O4, O5, K1, K2, K3, K4, dan K5, yang memiliki karakter makroskopis beragam. Uji resistensi pada media NA dengan konsentrasi Pb 0-100 ppm menunjukkan bahwa isolat O5 dan K2 memiliki tingkat resistensi tertinggi. Pengamatan karakter mikroskopis mengungkapkan bahwa isolat O1, O3, O5, K1, K2, K3, K4, dan K5 termasuk bakteri gram positif dan mampu membentuk endospora. Isolat K2 memiliki bentuk bulat, sedangkan tujuh isolat lainnya berbentuk batang. Uji bioremediasi menunjukkan bahwa isolat O5 memiliki kemampuan reduksi Pb tertinggi dengan total reduksi mencapai 87,86%. Isolat O5 beregenerasi dalam 58 menit, sedangkan isolat K2 dalam 1 jam 49 menit. Bakteri rizosfer padi budidaya organik dan konvensional berpotensi dijadikan sebagai agen bioremediasi Pb.

Kata kunci: Pb, padi budidaya organik, padi budidaya konvensional, bioremediasi

SUMMARY

Soil microorganism populations are affected by applied cultivation practices as well as the level of heavy metal pollution in agricultural land. Heavy metal pollution, such as lead (Pb), derived from industrial and agricultural activities that are not environmentally friendly, can negatively impact not only soil microorganisms, but also humans through the consumption of contaminated plants. Bioremediation using indigenous bacteria is one of the efforts that can be made to reduce Pb concentration in agricultural land. This study aims to determine the difference in the population of rhizosphere bacteria in organic and conventional rice fields and obtain resistant bacteria and have the potential to reduce Pb levels on a laboratory scale.

This research took place from August 2024 to January 2025 at the Agroecology Laboratory, Faculty of Agriculture, Jenderal Soedirman University. Organic soil samples were obtained from Ajibarang Kulon Village, while conventional soil samples came from Tinggarjaya Village. The research stages include sampling, soil pH measurement, bacterial isolation, macroscopic and microscopic characterization of bacteria, resistance test, bioremediation test, and observation of bacterial growth on uncontaminated liquid media and containing Pb 25 ppm.

The results showed that the rhizosphere bacterial population of conventional rice fields was higher, reaching 3.3×10^6 CFU/g, compared to organic cultivation of 1.2×10^5 CFU/g. From the results of isolation in two villages, ten dominant isolates were obtained, namely O1, O2, O3, O4, O5, K1, K2, K3, K4, and K5, which have diverse macroscopic characteristics. Resistance tests on NA media with Pb levels of 0-100 ppm showed that O5 and K2 isolates had the highest levels of resistance. Observation of microscopic characters reveals that O1, O3, O5, K1, K2, K3, K4, and K5 isolates belong to gram-positive bacteria and are capable of forming endospores. K2 isolates have a coccus shape, while the other seven isolates are bacilli. Bioremediation tests showed that O5 isolate had the highest Pb reduction ability with a total reduction of 87.86%. O5 isolate regenerates in 58 minutes, while K2 isolate in 1 hour and 49 minutes. Organic and conventionally cultivated rice rhizosphere bacteria have the potential to be used as Pb bioremediation agents.

Keywords: Pb, organic cultivated rice, conventional cultivated rice, bioremediation