RINGKASAN

Penggunaan pupuk dan pestisida sintetik pada lahan pertanian secara berlebihan dalam jangka waktu lama dapat menyebabkan pencemaran lingkungan. Pencemaran Pb di lahan pertanian, khususnya lahan sawah, tidak hanya terbatas pada tanah, tetapi juga dapat ditemukan pada jaringan tanaman seperti akar, batang, daun, hingga biji gabah. Produk pertanian yang tercemar logam berat seperti Pb sangat berbahaya jika dikonsumsi oleh masyarakat. Upaya untuk mencegah dan mengurangi pencemaran akibat Pb pada produk pertanian dapat dilakukan dengan bioremediasi menggunakan bakteri *indigenous* yang resisten terhadap Pb. Penelitian ini bertujuan untuk mengetahui kadar cemaran Pb pada tanah, dan mendapatkan bakteri potensial yang mampu meremediasi Pb.

Penelitian ini dilaksanakan pada bulan Agustus 2024 – Februari 2025 di Laboratorium Agroekologi, Fakultas Pertanian, Universitas Jenderal Soedirman. Sampel tanah diambil dari tiga lokasi yang ada di Kabupaten Banyumas, yaitu Desa Karangkedawung, Kecamatan Sokaraja, Desa Pekunden, Kecamatan Banyumas, dan Desa Kebasen, Kecamatan Kebasen. Tahapan penelitian ini meliputi persiapan penelitian, pengambilan sampel tanah, pengenceran sampel tanah, perhitungan populasi dan pengamatan morfologi koloni bakteri, pemurnian bakteri, pewarnaan gram dan endospora, uji resistensi isolat bakteri, uji remediasi, uji populasi bakteri hasil uji potensi remediasi, dan uji kurva pertumbuhan bakteri.

Hasil analisis tanah pada ketiga lokasi didapatkan kadar cemaran Pb paling tinggi yaitu 25,09 ppm dari sampel tanah di Desa Pekunden, diikuti Desa Kebasen dengan kadar cemaran timbal yaitu 23,05 ppm, dan kadar cemaran paling rendah di Desa Karangkedawung yaitu 19,57 ppm. Dari ketiga didapatkan enam isolat potensial, yaitu KDW 1, KDW 5, PKD 1, PKD 5, KBS 2, dan KBS 3. Karakteristik morfologi koloni bakteri secara umum memiliki bentuk bulat, ukuran kecil, elevasi rata, dan tepi utuh. Hasil pewarnaan gram keenam isolat merupakan bakteri gram positif dan terdapat tiga isolat yang mampu menghasilkan endospora. Isolat KDW 1, PKD 5, dan KBS 2 memiliki kemampuan resistensi tinggi terhadap Pb hingga 100 ppm. Uji remediasi pada medium NB (*Nutrient Broth*) yang diperkaya 25 ppm timbal menunjukkan bahwa isolat PKD 5 memiliki total reduksi paling tinggi yaitu 23,29 ppm, dengan presentasi penurunan Pb 91,3%. Hasil analisis uji remediasi bakteri yang memiliki kemampuan remediasi tinggi juga memiliki jumlah populasi paling banyak, yaitu isolat PKD 5. Kurva pertumbuhan isolat bakteri menunjukkan isolat KDW 1 memiliki waktu regenerasi tercepat, yaitu 42 menit 36 detik.

Kesimpulan dari penelitian ini adalah pada ketiga lokasi terdapat cemaran Pb dengan kadar cemaran masih dalam batas aman (dibawah 100 ppm) dan didapatkan tiga isolat yang memiliki kemampuan remediasi Pb hingga 91,3%.

Kata kunci: bakteri, timbal, isolasi, resistensi, remediasi.

SUMMARY

The excessive use of synthetic fertilizers and pesticides on agricultural land over a long period can lead to environmental pollution. Lead (Pb) contamination in agricultural areas, particularly in paddy fields, is not only limited to soil but can also be found in plant tissues such as roots, stems, leaves, and even rice grains. Agricultural products contaminated with heavy metals such as Pb pose serious health risks if consumed by the public. Efforts to prevent and reduce Pb contamination in agricultural products can be carried out through bioremediation using indigenous bacteria that are resistant to Pb. This study aimed to determine the level of Pb contamination in soil and to isolate potential bacteria capable of remediating Pb.

This research was conducted from August 2024 to February 2025 at the Agroecology Laboratory, Faculty of Agriculture, Jenderal Soedirman University. Soil samples were collected from three locations in Banyumas Regency, namely Karangkedawung Village (Sokaraja Subdistrict), Pekunden Village (Banyumas Subdistrict), and Kebasen Village (Kebasen Subdistrict). The stages of this research included research preparation, soil sampling, soil dilution, bacterial population counting and colony morphology observation, bacterial purification, Gram and endospore staining, bacterial isolate resistance testing, remediation testing, bacterial population analysis after remediation potential testing, and bacterial growth curve analysis.

The soil analysis results from the three locations showed that the highest Pb contamination level was found in the soil sample from Pekunden Village (25.09 ppm), followed by Kebasen Village (23.05 ppm), and the lowest in Karangkedawung Village (19.57 ppm). Six potential bacterial isolates were obtained from these locations, namely KDW 1, KDW 5, PKD 1, PKD 5, KBS 2, and KBS 3. In general, the morphological characteristics of the bacterial colonies showed round shape, small size, flat elevation, and entire margins. Gram staining results indicated that all six isolates were Gram-positive bacteria, with three isolates capable of producing endospores. Isolates KDW 1, PKD 5, and KBS 2 exhibited high Pb resistance, up to 100 ppm. Remediation testing using Nutrient Broth (NB) medium enriched with 25 ppm Pb showed that isolate PKD 5 had the highest reduction capability, with a total Pb reduction of 23.29 ppm, equivalent to a 91.3% decrease. The bacterial population analysis also showed that isolates with high remediation ability, particularly PKD 5, had the highest bacterial count. The bacterial growth curve analysis showed that isolate KDW 1 had the fastest regeneration time, recorded at 42 minutes and 36 seconds.

In conclusion, Pb contamination was detected in all three locations, with contamination levels still within safe limits (below 100 ppm), and three bacterial isolates demonstrated Pb remediation capabilities of up to 91.3%.

Keywords: bacteria, lead, isolation, resistance, remediation.