RINGKASAN

Logam berat kadmium (Cd) adalah salah satu logam berat berbahaya bagi makhluk hidup dan lingkungan. Akumulasi kadmium di tanah mengakibatkan terganggunya ekosistem tanah dan penyerapan unsur hara oleh tanaman. Pakcoy merupakan tanaman sayuran yang dapat secara langsung terdampak dengan adanya akumulasi Cd hingga mengakibatkan penurunan kuantitas dan kualitas produk. Upaya mengurangi dampak akumulasi Cd dapat dilakukan melalui pemberian bahan pembenah tanah yang mampu memperbaiki sifat sifik, kimia, dan biologi tanah. Asam humat dan biochar merupakan bahan pembenah tanah yang umum digunakan dalam memperbaiki sifat-sifat tanah melalui peningkatan Kemampuan Tukar Kation (KTK) tanah, penyerapan dan pengikatan logam berat di dalam tanah, serta membentuk kondisi lingkungan yang sesuai untuk pertumbuhan bakteri baik tanah. Penelitian ini bertujuan untuk mengetahui pengaruh aplikasi asam humat dan biochar terhadap kandungan Cd tanah dan tanaman serta pengaruhnya terhadap pertumbuhan dan hasil tanaman pakcoy.

Penelitian ini dilaksanakan di *Screen House* Desa Kebanggan, Laboratorium Agroekologi Fakultas Pertanian Universitas Jenderal Soedirman dan Wahana Laboratorium Semarang pada Agustus – Desember 2023. Rancangan percobaan yang digunakan adalah Rancangan Acak Kelompok (RAK) 2 faktorial. Faktor pertama adalah asam humat dengan dosis A1 = 10 kg/ha ≈ 0,0225 g/polibag, A2 = 20 kg/ha ≈ 0,045 g/polibag, dan A3 = 30 kg/ha ≈ 0,0675 g/polibag. Faktor kedua adalah biochar dengan dosis B1 = 5 t/ha ≈ 11,25 g/polibag, B2 = 10 t/ha ≈ 22,5 g/polibag, dan B3 = 15 t/ha ≈ 33,75 g/polibag. Kedua faktor tersebut dikombinasikan menjadi 9 kombinasi perlakuan. Perlakuan diulang 3 kali dengan 3 plot tanaman hingga didapatkan 81 unit percobaan. Variabel yang diamati adalah kandungan Cd tanah dan tanaman, kadar klorofil total, tinggi tanaman, jumlah daun, luas daun, bobot segar, dan jumlah populasi bakteri tanah. Data kualitatif dianalisis deskriptif dan data kuantitatif dianalisis menggunakan sidik ragam dengan taraf kepercayaan 95%. Apabila menunjukkan hasil berbeda nyata maka dilanjutkan dengan uji *Duncan Multiple Range Test* (DMRT) dengan taraf kepercayaan 95%.

Hasil penelitian ini menunjukkan bahwa pengaplikasian asam humat dosis 30 kg/ha menjadi dosis terbaik dalam menurunkan kadar Cd tanah hingga 40,52%. Kombinasi perlakuan asam humat 30 kg/ha dan biochar 15 t/ha menghasilkan kandungan Cd terendah yang diserap tanaman pakcoy, yakni 0,0178 ppm. Biochar dosis 15 t/ha memberikan hasil terbaik pada variabel tinggi tanaman 15,44 cm, luas daun 428,871 cm^2, dan bobot segar tanaman pakcoy 55,49 g. Aplikasi asam humat dan biochar pada variabel kadar klorofil dan jumlah daun menunjukkan hasil yang fluktuatif. Dosis asam humat 30 kg/ha dan biochar 15 t/ha menghasilkan jumlah populasi bakteri tanah terbanyak 11×10^9 CFU/mL. Jumlah populasi bakteri cenderung bertambah seiring meningkatnya dosis asam humat dan biochar.

Kata kunci: kadmium, biochar, asam humat, pakcoy.

SUMMARY

Heavy metal cadmium (Cd) is one of the harmful heavy metals for living beings and the environment. Accumulation of cadmium in soil leads to disruption of soil ecosystem and nutrient absorption by plants. Pakcoy is a vegetable crop that can be directly affected by the accumulation of Cd, resulting in a decrease in product quantity and quality. Efforts to reduce the impact of Cd accumulation can be done through the provision of soil amendments that are able to improve soil specific, chemical and biological properties. Humic acid and biochar are commonly used soil amendments that improve soil properties by increasing soil Cation Exchange Capacity (CEC), absorbing and binding heavy metals in the soil, and forming suitable environmental conditions for the growth of good soil bacteria. This study aims to determine the effect of humic acid and biochar application on soil and plant Cd content and its effect on the growth and yield of pakcoy plants.

This research was conducted at the Screen House of Kebanggan Village, Agroecology Laboratory of Faculty of Agriculture, Jenderal Soedirman University and Wahana Laboratorium Semarang from August to December 2023. The experimental design used was a 2 factorial Randomized Group Design (RAK). The first factor was humic acid with doses of A1 = 10 kg/ha ≈ 0,0225 g/polybag, A2 = 20 kg/ha ≈ 0,045 g/polybag, dan A3 = 30 kg/ha ≈ 0,0675 g/polybag. The second factor was biochar with doses of B1 = 5 t/ha ≈ 11,25 g/polybag, B2 = 10 t/ha ≈ 22,5 g/polybag, dan B3 = 15 t/ha ≈ 33,75 g/polybag. The two factors were combined into 9 treatment combinations. Treatments were repeated 3 times with 3 plant plots to obtain 81 experimental units. Variables observed were soil and plant Cd content, total chlorophyll content, plant height, number of leaves, leaf area, fresh weight, and total soil bacterial population. Qualitative data were analyzed descriptively and quantitative data were analyzed using variance analysis with 95% confidence level. If it shows significantly different results, it is continued with the Duncan Multiple Range Test (DMRT) test with a confidence level of 95%.

The results showed that the application of humic acid at a dose of 30 kg/ha was the best dose in reducing soil Cd levels by 40.52%. The combination of humic acid 30 kg/ha and biochar 15 t/ha produced the lowest Cd content absorbed by pakcoy plants, which was 0.0178 ppm. The biochar dose of 15 t/ha gave the best results in the variable of plant height of 15.44 cm, leaf area of 428.871 cm2, and fresh weight of pakcoy plants of 55.49 g. The combination of humic acid and biochar treatment of 30 kg/ha produced the lowest Cd content absorbed by pakcoy plants. While the application of humic acid and biochar on the variables of chlorophyll content and number of leaves showed fluctuating results. The dose of humic acid 30 kg/ha and biochar 15 t/ha produced the highest soil bacterial population of 11 × 10^9 CFU/mL. The number of bacterial populations tended to increase as the doses of humic acid and biochar used increased.

Keywords: *Cadmium, biochar, humic acid, pakcoy.*