RINGKASAN

Nitrogen merupakan unsur esensial karena komponen utama klorofil, asam amino, protein, dan DNA, sehingga vital untuk pertumbuhan tanaman (Marschner, 2012). Pemenuhan kebutuhan N dengan pupuk kimia sintetik dalam jangka panjang berdampak pada penurunan kualitas tanah. Pupuk hayati menjadi salah satu alternatif yang dapat digunakan untuk memenuhi kebutuhan nitrogen pada tanaman dengan memanfaatkan kemampuan fiksasi N_2 atmosfer oleh bakteri. Bakteri penambat N (BPN) dapat dieksplorasi dari area perakaran tanaman salah satunya dari rizosfer tanaman singkong yang berpotensi untuk diaplikasikan pada tanaman lain yang berbeda famili seperti tanaman pakcoy (*Brassica rapa* L.). Pakcoy merupakan jenis sayuran yang banyak diminati masyarakat namun tidak diimbangi dengan produksi yang ada, sehingga produksinya perlu ditingkatkan. Hal tersebut disebabkan oleh berkurangnya lahan produktif seiring dengan peningkatann jumlah penduduk. Sistem hidroponik dengan irigasi tetes sederhana menjadi solusi untuk budidaya pakcoy pada lahan terbatas. Pemanfaatan BPN diharapkan mampu meningkatkan pertumbuhan tanaman dan mengurangi penggunaan pupuk anorganik. Oleh karena itu, penelitian ini bertujuan untuk mengeksplorasi BPN dari rizosfer singkong guna mendorong pertumbuhan pakcoy melalui isolasi dan karakterisasi bakteri serta mengkaji efektivitasnya dalam mendukung pertanian berkelanjutan.

Penelitian dilaksanakan dari bulan Mei 2024 hingga Desember 2024, ekplorasi bakteri penambat N dilakukan di Laboratorium Agroekologi dan uji biologis isolat bakteri penambat N dilakukan di *greenhouse* Fakultas Pertanian, Universitas Jenderal Soedirman. Pengambilan sampel tanah untuk isolasi dari rizosfer tanaman singkong desa Notog, Kecamatan Patikraja, Kabupaten Banyumas. Rancangan percobaan yang digunakan yaitu variasi pemberian 3 isolat bakteri tunggal dalam bentuk suspensi bakteri dan larutan nutrisi hidroponik meliputi larutan nutrisi hidroponik 100% N + 10 mL suspensi bakteri, larutan nutrisi hidroponik 50% N + 10 mL suspensi bakteri, dan larutan nutrisi hidroponik 0% N + 10 mL suspensi bakteri. Variabel yang diamati berupa karakteristik morfologi, kemampuan menambat N, dan uji hipersensitif bakteri yang disajikan secara deskripsi kualitatif serta respon pertumbuhan vegetatif tanaman pakcoy meliputi tinggi tanaman, jumlah daun, bobot segar biomassa, bobot kering biomassa, dan kandungan klorofil daun dengan Rancangan Acak Kelompok (RAK) Non Faktorial menggunakan 10 perlakuan yang dianalisis dengan analisis ragam (ANOVA) dengan taraf kepercayaan 95%, apabila berpengaruh nyata maka akan dilanjutkan dengan Uji Jarak Berganda Duncan (DMRT) pada taraf kepercayaan 95% .

Hasil karakterisasi diperoleh sepuluh isolat dominan yang memiliki persamaan karakter morfologi koloni yaitu elevasi tetapi terdapat perbedaan bentuk, ukuran, warna dan tepi. Karakter morfologi sel bakteri didominasi oleh Gram positif berbentuk batang. Golongan Gram negatif mampu menghasilkan endospora. Kesepuluh isolat dominan memiliki kemampuan memfiksasi N serta tidak bersifat patogen berdasarkan uji hipersensitif. Sepuluh isolat dominan

diperoleh, dengan tiga isolat bakteri unggulan, yaitu KNS_2 dan KNS_8 dengan kemampuan fiksasi N dan melarutkan fosfat, serta KNS_2 dan KNS_{10} dengan kemampuan fiksasi N dan menghasilkan ZPT IAA. Hasil uji aplikasi tiga isolat dengan variasi dosis pupuk nitrogen (100%, 50%, dan 0%) pada tanaman pakcoy, menemukan bahwa pemupukan N 50% + 10 mL suspensi bakteri KNS_2, KNS_8, dan KNS_{10} mampu meningkatkan bobot segar pak coy, masing-masing 58,8%, 31,6% dan 33,77% dibanding perlakuan yang diberi pupuk N 100% tanpa isolat. Bahkan Pemberian ke 3 isolat BPN pada pengurangan pupuk nitrogen hingga 100%, masih cenderung meningkatkan bobot segar pakcoy sebesar 26,3%, 6,3% dan 23,4% dibanding kontrolnya (N dosis 100%).

Kata kunci: Penambat nitrogen, rizosfer singkong, pakcoy

SUMMARY

Nitrogen is an essential element as it is a major component of chlorophyll, amino acids, proteins, and DNA, making it vital for plant growth (Marschner, 2012). The long-term application of synthetic chemical fertilizers to meet nitrogen needs negatively affects soil quality. Biofertilizers serve as an alternative for supplying nitrogen by utilizing nitrogen-fixing bacteria capable of atmospheric N_2 fixation. These nitrogen-fixing bacteria (NFB) can be explored from plant root zones, including the rhizosphere of cassava, which holds potential for application in other plant species from different families, such as pakcoy (Brassica rapa L.*). Pakcoy is a highly popular vegetable; however, its production does not meet market demand, necessitating efforts to increase yields. The decline in productive land due to population growth contributes to this issue. A simple hydroponic drip irrigation system provides a solution for cultivating pakcoy in limited space. Utilizing NFB is expected to enhance plant growth and reduce the reliance on inorganic fertilizers. Therefore, this research aims to explore NFB from cassava rhizosphere to promote pakcoy growth through bacterial isolation and characterization, as well as to evaluate its effectiveness in supporting sustainable agriculture.*

The research was conducted from May 2024 to December 2024. The exploration of nitrogen-fixing bacteria was carried out at the Agroecology Laboratory, while biological tests of the bacterial isolates were performed in the greenhouse of the Faculty of Agriculture, Universitas Jenderal Soedirman. Soil samples for bacterial isolation were taken from the cassava rhizosphere in Notog Village, Patikraja District, Banyumas Regency. The experimental design included the application of three single bacterial isolates in the form of bacterial suspensions and hydroponic nutrient solutions, which consisted of: hydroponic nutrient solution with 100% nitrogen + 10 mL bacterial suspension, hydroponic nutrient solution with 50% nitrogen + 10 mL bacterial suspension, and hydroponic nutrient solution with 0% nitrogen + 10 mL bacterial suspension. Observed variables included bacterial morphological characteristics, nitrogen-fixing ability, and hypersensitivity tests, which were presented descriptively. Additionally, vegetative growth responses of pakcoy were measured, including plant height, leaf count, fresh biomass weight, dry biomass weight, and leaf chlorophyll content, using a Non-Factorial Randomized Block Design (RBD) with 10 treatments. The results were analyzed using analysis of variance (ANOVA) with a 95% confidence level. If significant differences were found, further analysis was conducted using Duncan's Multiple Range Test (DMRT) at a 95% confidence level.

Characterization results identified ten dominant bacterial isolates with similar colony morphological characteristics, such as elevation, but differing in shape, size, color, and edge structure. The bacterial cell morphology was predominantly Gram-positive rod-shaped bacteria, while Gram-negative bacteria were able to produce endospores. All ten dominant isolates demonstrated nitrogen-fixing capability and were non-pathogenic based on hypersensitivity tests. Ten dominant bacterial isolates were obtained, with three superior isolates: KNS_2 and

KNS_8, which possess nitrogen fixation and phosphate-solubilizing capabilities, while KNS_2 and KNS10, which has nitrogen fixation ability and produces the plant growth hormone indole-3-acetic acid (IAA). The application of these three isolates with varying nitrogen fertilizer doses (100%, 50%, and 0%) on pakcoy revealed that a nitrogen fertilization of 50% combined with a 10 mL suspension of KNS_2, KNS_8, and KNS_{10} increased fresh weight by 58,8%, 31,6%, and 33,77%, respectively, compared to the treatment with 100% nitrogen fertilization without bacterial isolates. Furthermore, the application of these three NFB isolates, even with a 100% reduction in nitrogen fertilizer, still tended to increase the fresh weight of pak choi by 26,3%, 6,3%, and 23,4%, compared to the control treatment (100% nitrogen dose).

Keyword: nitrogen-fixing, cassava rhizosphere, pakcoy