POTENSI AKTINOBAKTERIA FILOSFER INDIGENOS SEBAGAI AGENS BIOKONTROL PENYAKIT HAWAR DAUN BAKTERI (*Pantoea ananatis*) DAN RESPON FISIOLOGIS PERTAHANAN TANAMAN BAWANG MERAH

TESIS

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ABSTRAK

Penyakit hawar daun bakteri pada tanaman bawang merah disebabkan oleh *Pantoea ananatis* yang dapat menyebabkan kehilangan hasil berkisar 78,04-83,64%. Alternatif pengendalian penyakit hawar daun bakteri yang ramah lingkungan dan berkelanjutan yaitu dengan memanfaatkan mikroorganisme aktinobakteria filosfer indigenos. Penelitian bertujuan untuk: 1). Memperoleh isolat aktinobakteria filosfer indigenos yang berpotensi sebagai agens biokontrol penyakit hawar daun bakteri, meningkatkan pertumbuhan tanaman, dan produksi bawang merah; 2). Mengetahui aktivitas enzim pertahanan tanaman bawang merah yang diintroduksi dengan aktinobakteria filosfer indigenos dan diinokulasi *P. ananatis,* dan mengetahui kemampuannya menghasilkan senyawa biokontrol serta biofertilizer; 3). Mengetahui keragaman spesies akinobakteria filosfer indigenos yang berpotensi sebagai agens biokontrol dan biofertilizer. Penelitian dilakukan secara eksperimen, yang disusun dengan Rancangan Acak Lengkap, terdiri dari 3 tahap yaitu: 1). Kemampuan aktinobakteria filosfer indigenos mengendalikan penyakit hawar daun bakteri, meningkatkan pertumbuhan tanaman, dan produksi bawang merah, terdiri dari 22 perlakuan isolat aktinobakteria filosfer indigenos, 3 ulangan, 3 unit percobaan. 2). Aktivitas enzim pertahanan tanaman bawang merah yang diintroduksi aktinobakteria filosfer indigenos dan diinokulasi *P. ananatis* secara *in planta,* serta karakterisasi aktinobakteria filosfer indigenos sebagai agens biokontrol dan biofertilizer secara *in vitro*, terdiri dari 12 perlakuan, dan 3). Identifikasi molekuler 5 isolat aktinobakteria filosfer indigenos yang berpotensi sebagai agens biokontrol dan biofertilizer. Parameter yang diamati yaitu: Perkembangan penyakit hawar daun bakteri, pertumbuhan tanaman, serta produksi bawang merah, 2). Aktivitas enzim pertahanan tanaman, produksi senyawa biokontrol, dan biofertilizer, dan 3). Analisis hasil sekuensing dan filogenetik antar spesies. Hasil penelitian yang diperoleh yaitu: 1). *Streptomyces bullii* strain NLLP2H, *Actinomycetes bacterium* strain NLLA3F, *Streptomyces seoulensis* strain NBSP3A, *Streptomyces xiangtanensis* strain NBSP3F, dan *Kitasatospora kepongensis* strain NBSP2H mampu berperan sebagai agens biokontrol penyakit hawar daun bakteri dengan indeks penekanan penyakit yaitu 77,15-87,00%, meningkatkan tinggi tanaman yaitu 41,55-45,77 cm, jumlah daun yaitu 48,66-74,55 helai, bobot segar umbi yaitu 111,24-150,55 g, dan bobot kering umbi bawang merah yaitu 109,48-147,24 g. 2). Kelima isolat tersebut mampu meningkatkan aktivitas enzim POX pada akar dengan persentase peningkatan yaitu 50,00-115,63% dan daun yaitu 36,00-80,56%, enzim PPO pada akar yaitu 16,00-216,00% dan daun yaitu 56,00-136,00%, serta enzim PAL pada akar yaitu 13,93-22,73%, dan daun yaitu 8,74-13,73%, dan mampu menekan pertumbuhan bakteri *P. ananatis* secara *in vitro* dengan diameter zona hambat yaitu 16,00-17,50 mm, menghasilkan enzim protease dengan diameter yaitu 1,03-1,22 mm, enzim amilase yaitu 1,01-2,05 mm, dan menghasilkan hidrogen sianida (HCN). Isolat tersebut mampu memfiksasi nitrogen, melarutkan fosfat dengan diameter yaitu 1,14-1,38 mm, dan *Indole Acetic Acid* (IAA) dengan konsentrasi yaitu 83,46-308,51 *ppm*.

Kata kunci: Aktivitas enzim pertahanan, biofertilizer, enzim *peroxidase*, *Kitasatospora kepongensis, Streptomyces xiangtanensis.*

POTENTIAL OF INDIGENOUS PHYLLOSPHERE ACTINOBACTERIA AS BIOCONTROL AGENTS BACTERIAL LEAF BLIGHT DISEASE (*Pantoea ananatis*) AND PHYSIOLOGICAL DEFENSE RESPONSES OF SHALLOT

ABSTRACT

Bacterial leaf blight disease in shallots caused by *Pantoea ananatis* can result in yield losses ranging from 78.04 to 83.64%. Environmentally friendly and sustainable alternatives for controlling bacterial leaf blight can be achieved by utilizing indigenous phyllosphere actinobacteria. The objectives of this research were: 1) to obtain indigenous phyllosphere actinobacterial isolates with potential as biocontrol agents of bacterial leaf blight disease, plant growth promoters, and yield enhancers of shallots; 2) to determine the physiological responses of shallot plants introduced with indigenous phyllosphere actinobacteria and inoculated with *P. ananatis*, as well as their ability to produce biocontrol and biofertilizer compounds; and 3) to determine the diversity of indigenous phyllosphere actinobacterial species with potential as biocontrol and biofertilizer agents. The study was conducted experimentally using a Completely Randomized Design, consisting of three stages: 1) the ability of indigenous phyllosphere actinobacteria to control bacterial leaf blight disease, promote plant growth, and increase shallot yield, consisting of 22 actinobacterial isolates with three replications and three experimental units; 2) the activity of defense enzymes in shallot plants introduced with indigenous phyllosphere actinobacteria and inoculated with *P. ananatis* under in planta conditions, as well as the characterization of indigenous phyllosphere actinobacteria as biocontrol and biofertilizer agents under in vitro conditions, consisting of 12 treatments with four replications; and 3) molecular identification of five indigenous phyllosphere actinobacterial isolates with potential as biocontrol and biofertilizer agents. The parameters observed were: the development of bacterial leaf blight disease, plant growth, and shallot yield; the activity of defense-related enzymes, the production of biocontrol and biofertilizer compounds; and sequencing and phylogenetic analysis. The results of the study showed that *Streptomyces bullii* strain NLLP2H, *Actinomycetes bacterium* strain NLLA3F, *Streptomyces seoulensis* strain NBSP3A, *Streptomyces xiangtanensis* strain NBSP3F, and *Kitasatospora kepongensis* strain NBSP2H were able to act as biocontrol agents of bacterial leaf blight disease with disease suppression indices ranging from 77.15 to 87.00%, to increase plant height ranging from 41.55 to 45.77 cm, number of leaves ranging from 48.66 to 74.55, fresh bulb weight ranging from 111.24 to 150.55 g, and dry bulb weight of shallots ranging from 109.48 to 147.24 g. These five isolates were able to increase peroxidase (POX) enzyme activity in roots ranging from 50.00 to 115.63% and in leaves ranging from 36.00 to 80.56%, polyphenol oxidase (PPO) enzyme activity in roots ranging from 16.00 to 216.00% and in leaves ranging from 56.00 to 136.00%, and phenylalanine ammonia lyase (PAL) enzyme activity in roots ranging from 13.93 to 22.73% and in leaves ranging from 8.74 to 13.73%. They were also able to suppress the growth of *P. ananatis* in vitro with inhibition zone diameters ranging from 16.00 to 17.50 mm, to produce protease enzymes with diameters ranging from 1.03 to 1.22 mm, amylase enzymes ranging from 1.01 to 2.05 mm, and to produce hydrogen cyanide (HCN). These isolates were also able to fix nitrogen, solubilize phosphate ranging from 1.14 to 1.38 mm, and produce indole-3-acetic acid (IAA) ranging from 83.46 to 308.51 ppm.

Keywords: Defense enzyme activity, biofertilizer, peroxidase, *Kitasatospora kepongensis*, *Streptomyces xiangtanensis*.