RINGKASAN DISERTASI

Slamet Santosa. T631008009. **PERAN *PLANT GROWTH PROMOTING RHIZOBACTERIA* (PGPR) PADA PENINGKATAN PRODUKTIVITAS TANAMAN PADI IR 64 BERBASIS PERTANIAN RAMAH LINGKUNGAN.** Disertasi, Surakarta: Program Doktor Ilmu Lingkungan, Universitas Sebelas Maret. Promotor: Prof. Dr. rer. nat. Sajidan, M.Si, ko-Promotor: (1) Prof. Drs. Suranto, M.Sc., Ph.D, (2) Prof. Dr. Ir. Edi Purwanto, M.Sc.

Sistem pertanian anorganik masih banyak digunakan para petani di Indonesia. Penggunaan pupuk kimia atau pupuk buatan pabrikan memiliki dampak buruk bagi keberlangsungan system pertanian. Penggunaan pupuk kimia sintetik dapat mengakibatkan penurunan porositas tanah, ketersediaan oksigen, dan keberadaan bakteri dalam tanah. Mengingat hal tersebut, perlu adanya perubahan dalam system pertanian anorganik menjadi organik.

Sistem pertanian organik menggunakan *biofertilizer* yang berfungsi untuk meningkatkan kesuburan tanah. *Rhizobacter* merupakan mikroba pemupukan tanah yang dapat meningkatkan efisiensi pemupukan, kesuburan, dan kualitas tanah. *Rhizobakteri* menghasilkan promotor pertumbuhan yang dapat meningkatkan pertumbuhan tanaman sering disebut pertumbuhan tanaman rhizobakteri (PGPR). Karakterisasi populasi PGPR asli untuk sawah organik sangat penting dilakukan untuk menemukan *strain* yang dapat digunakan untuk meningkatkan pertumbuhan dan keberlanjutan sawah organik. Penelitian ini bertujuan untuk menemukan *strain* rhizobacteria isolat lokal padapertanian organik dan anorganik yang mempunyai potensi enzim dan protein hormone yang menyebabkan kesuburan tanah berdasarkan data Bank Genom atau NCBI; mengukur rasio pertumbuhan dan produksi pertanian padi berdasar indicator rhizobakteria, BOD, COD, DO, TSS, Pb, Cr VI, pH, rasio C/N, N, P, K. dan menganalisis kultur social petani padi IR 64.

Prosedur penelitian dimulai dengan mengambil data kondisi tanah serta air pada pertanian organik dan anorganik, selanjutnya isolasi PGPR dari rhizosphere, isolasi DNA, amplifikasi PCR dan sequencing; pengukuran pertumbuhan dan produksi dari pertanian organic dan anorganik berdasarkan indikator rhizobakteria, BOD, COD, DO, TSS, Pb, Cr VI, pH, rasio C/N, N, P, K. dan analisis kultur social petani pada pertanian organic dan anorganik meliputi: umur, Pendidikan, matapencaharian dan lama usaha tani.

Hasil penelitian kondisi kimiawi tanah menunjukkan kandungan C-organik pada sawah organik memiliki kadar 1.90%. yang tinggi dibandingkan dengan sawah anorganik 1.40%, dengan jumlah Kandungan N pada sawah organik 0,37% dan sawah anorganik persentase 0,24%. C/N rasio untuk organik 15 dan anorganik 12; Kandungan P pada sawah organik memiliki kadar 11.64 ppm lebih tinggi dibandingkan dengan P pada sawah anorganik10.81 ppm. Rata-rata K tertukar 0.28 untuk organik dan 0.23 untuk anorganik. pH organik sebesar 6,58. Dan anorganik 6.26. Hasil data kondisi air diketahui bahwa kadar COD, BOB dan DO lebih tinggi pada pertanian organik, sedangkan TSS, Pb dan Cr VI untuk organik dan anorganik sama. Hasil isolasi DNA dapat dikelompokkan menjadi tujuh genus karena kedekatannya yang sangat tinggi, yaitu, *Stenotrophomonas sp., Acinetobacter sp., Serratia sp., Pseudomonas sp.,*

Exiguobacterium sp. Brevundimonas sp. dan *Bacillus sp*. Hasil produksi padi IR 64 pada sawah organik sebanyak 7-8,5 ton/ha paling, sedangkan pada sawah anorganik 6–7 ton/ha. Hasil penelitian ditemukan *Rhizobacter* pada sawah organik yang lebih banyak dibanding pada sawah anorganik; ditemukan 9 *rhizobacter* yang sudah di ACC number dengan Blast.ncbi.nlm.nih.gov/ Blast.cgi; ditemukan hasil produksi yang lebih tinggi pada sawah organik; berdasarkan hasil analisis 16s RNA isolat lokal diperoleh isolat PGPR *Pseudomonas sp* strain SSR1, *Brevundimonas sp* strain SSR2, *Stenotrophomonas sp* strain SSR3, *Bacillus sp* strain SSR4 *dan Bacillus sp* strain SSR5, , *Stenotrophomonas sp* strain SSR6, *Exiguobacterium sp* strain SSR7, *Serratia sp* strain SSR8, *Bacillus sp* strain SSR9, dan *Acinetobacter sp* strain SSR10. diperoleh sequence yang berbeda antara DNA isolat terpilih dengan bakteri marker. Tingkat pendidikan menentukan keberhasilan pertanian dikarenakan pola pikir pertanian yang maju, dan sudah mengetahui dampak polusi dari pupuk dan insektisida. Kelompok umur mempunyai pengaruh karena yang sudah tua dan lama menjadi petani mempunyai pengalaman bertani yang lebih bagus. Nilai kebaharuan *(novelty)* disertasi ini yaitu: pertama ditemukan strain bakteri perakaran padi pada pertanian organik dan anorganik yang telah diuji secara molekuler dan bioinformatika dan sudah dipublikasikan di NCBI (http://ncbi.nlm.nih.gov.). Kedua ditemukan strain Rhizospher yang memproduksi enzim dan bioaktif seperti IAA *like hormone* yang berfungsi meningkatkan kesuburan tanah sehingga dapat meningkatkan pertumbuhan dan produktivitas tanaman padi IR 64.

Kata Kunci: *Plant Growth Promoting Rhizobacteria* (PGPR),16S rRNA, Padi IR 64, Pertanian Organik.

DISSERTATION SUMMARY

Slamet Santosa. T631008009. **ROLE OF PLANT GROWTH PROMOTING RHIZOBACTERIA (PGPR) IN PRODUCTIVITY IMPROVEMENT OF IR 64 PADI PLANTS BASED ON ENVIRONMENTAL FRIENDLY AGRICULTURE.** Dissertation, Surakarta: Doctoral Program in Environmental Sciences, Sebelas Maret University. Promoter: Prof. Dr.rer.nat. Sajidan, M.Si, Co-Promoter: (1) Prof. Drs. Suranto, M.Sc., Ph.D, (2) Prof. Dr. Ir. Edi Purwanto, M.Sc.

Inorganic farming systems are still widely used by farmers in Indonesia. The use of chemical fertilizers or man-made fertilizers has a negative impact detrimental effect on the sustainability of the agricultural system. The use of chemical fertilizers can result in a decrease in soil porosity, oxygen availability, and the presence of bacteria in the soil. Given this, there needs to be a change in the inorganic farming system to become organic.

Organic farming systems use biofertilizers which function to increase soil fertility. Rhizobacter is a soil microbial fertilizer that can improve fertilizer efficiency, fertility, and soil quality. Rhizobacteria produce growth promoters that can increase plant growth often called rhizobacterial plant growth (PGPR). The characterization of the original PGPR population for organic rice fields is very important to find strains that can be used to increase the growth and sustainability of organic rice fields. This study aims to find local isolate rhizobacteria strains in organic and inorganic agriculture that have the potential of enzymes and protein hormones which cause soil fertility based on Bank Genome or NCBI data; measuring the ratio of growth and production of rice farming based on indicators of rhizobacteria, BOD, COD, DO, TSS, Pb, Cr VI, pH, C / N, N, P, K. ratio and analyzing the social culture of IR 64 rice farmers.

The research procedure was started by taking data on soil and water conditions in organic and inorganic agriculture, then isolating PGPR from rhizosphere, DNA isolation, PCR amplification and sequencing; measurement of growth and production of organic and inorganic agriculture based on indicators of rhizobacteria, BOD, COD, DO, TSS, Pb, Cr VI, pH, C / N, N, P, K. ratio and analysis of farmers' social culture in organic and inorganic agriculture including : age, education, livelihood and length of farming.

The results of the research on the chemical conditions of the soil indicate that the C-organic content in organic rice fields has a level of 1.90%. which is high compared to 1.40% inorganic rice fields, with N content in organic rice fields 0.37% and inorganic rice fields with a percentage of 0.24%. C / N ratio for organic 15 and inorganic 12; The P content of organic rice has a level of 11.64 ppm higher compared to P in 10.81 ppm inorganic paddy fields. The average K is exchanged for 0.28 for organic and 0.23 for inorganic. Organic pH of 6.58. And inorganic 6.26. The results of the water condition data show that the levels of COD, BOB and DO are higher in organic farming, while TSS, Pb and Cr VI are the same for organic and inorganic. The results of DNA isolation can be grouped into seven genera because of their very high proximity, namely, *Stenotrophomonas* sp., *Acinetobacter* sp., *Serratia* sp., *Pseudomonas* sp., *Exiguobacterium* sp. *Brevundimonas* sp. and *Bacillus* sp. IR 64 rice production in

organic fields is 7-8.5 tons / ha at the most, whereas in inorganic rice fields is 6-7 tons / ha. The results of the study found more Rhizobacter in organic rice fields than in inorganic rice fields; 9 rhizobacter found in the ACC number with Blast.ncbi.nlm.nih.gov/ Blast.cgi; found higher yields in organic rice fields; based on analysis of 16s RNA local isolates obtained PGPR isolates *Pseudomonas* sp SSR1 strains, *Brevundimonas* sp SSR2 strains, *Stenotrophomonas* sp SSR3 strains, *Bacillus* sp strains SSR4 and *Bacillus* sp strains SSR5, *Stenotrophomonas* sp strains SSR6, *Exiguobacterium* sp strains SSR7, *Serratia* sp strains SSR8 , *Bacillus* sp strain SSR9, and *Acinetobacter* sp strain SSR10. obtained different sequences between selected isolate DNA with marker bacteria. The level of education determines the success of agriculture due to the advanced mindset of agriculture, and already knows the pollution effects of fertilizers and insecticides. Age groups have an influence because those who are old and old become farmers have better farming experience, He novelty value of this dissertation is: first found rice root bacterial strains in organic and inorganic agriculture that have been tested molecularly and bioinformatics and have been published at NCBI (http://ncbi.nlm.nih.gov.). The two found Rhizospher strains that produce enzymes and bioactives such as IAA like hormone which functions to increase soil fertility so that it can increase the growth and productivity of IR 64 rice plants. He novelty value of this dissertation is: first found rice root bacterial strains in organic and inorganic agriculture that have been tested molecularly and bioinformatics and have been published at NCBI (http://ncbi.nlm.nih.gov.). The two found Rhizospher strains that produce enzymes and bioactives such as IAA like hormone which functions to increase soil fertility so that it can increase the growth and productivity of IR 64 rice plants.

Keywords: Plant Growth Promoting Rhizobacteria (PGPR), 16S rRNA, Rice IR 64, Organic Rice Fields.