

# Plant Growth Promotion **by** Rhizobacteria for Sustainable Agriculture

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**PLANT GROWTH PROMOTION BY RHIZOBACTERIA  
FOR SUSTAINABLE AGRICULTURE**

(Proceedings of First Asian PGPR Congress held at Acharya NG Ranga Agricultural University, Hyderabad, India June 21-24, 2009)

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## Forward

*Dr. J. W. Kloepper*

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Good morning. It's a great pleasure for me to greet all of you here attending the 1<sup>st</sup> Asian PGPR congress for sustainable agriculture. Some of you in attendance here were present at the International PGPR workshop in Calicut in 2003. However, for the majority of you, this is, likely your 1<sup>st</sup> International congress centered on the theme of PGPR. Therefore, I would like to explain briefly the significance of this area. The concept of PGPR encompasses bacteria that function as biofungicides and biofertilizers. Worldwide R & D with PGPR has continually grown since the 1970s when the term PGPR was first introduced. Research with PGPR ranges from discovery of new strains and confirmation in field studies to basic molecular characterization of the strains. Hence, the study of PGPR is one area of science where both basic and applied research are essential to reach our goal of implementing the science in everyday life and regarding implementation, every year, the use of PGPR in agriculture worldwide is increasing. As you will see during this congress, there are different models for extending the theories of PGPR to farmers depending on the social, political and regulatory policies of each country. As PGPR use was, we learned more about their current opportunities and challenges. Opportunities include alternating applications of PGPR biofungicides with chemical fungicides to manage fungicide resistance and to reduce the number of fungicide treatments per year. PGPR biofertilizers are showing promise in integrated nutrient management strategies with a goal of reducing run-off of unused fertilizers and the environmental damage that results. Throughout the world, there is a growing number of so called dead zones in oceans and seas that result from run-off of agricultural fertilizers into rivers and ultimately oceans. I very much believe that the goal of reducing fertilizer use will be to the 21<sup>st</sup> century what (while) reducing fertilizer use was to the 20<sup>th</sup> century. I am very much pleased that Dr. M. S. Reddy and the other organizers of this congress have developed a PGPR meeting specifically aimed at Asia. While the core underlying science of plant microbial interactions is global, applications in agriculture are somewhat region specific. For example, here in North America, we have no agriculture system similar to plantation crops. Hence, logically, the opportunities and challenges for using

PGPR in a plantation crop system need to be addressed in the Asian region. Also, Asia has been a leader in studies of PGPR as biofertilizer which is I mentioned as a growing area of interest worldwide. I would specially like to welcome all the students and young investigators to this congress. Every year, the study of PGPR is enriched by a new crop of investigators who launch their careers working on PGPR. We all need to encourage the students and new investigators to persevere in this critically important field of science. Finally, allow me to say that I am very impressed with the organization of this congress. The entire organizing, planning and funding teams have done a simply outstanding job. I wish you all a very successful congress.

Thank You!

***J. W. Kloepper***



## Preface

Distinguished guests, ladies and gentlemen, it is indeed an honor for us to be here with you in the presence of our honorable host, Dr. Raghava Reddy, the Honorable Minister of Agriculture, Mr. Raghu Veera Reddy, Asian PGPR board members and the many other scientists and entrepreneurs who have come to participate in this Congress. It is our privilege to welcome all of you. To me, this is a very special and a spectacular way of coming to our mother land, particularly Hyderabad, Andhra Pradesh to speak to you about PGPR technology.

The initial idea of having the First Asian PGPR Congress in Hyderabad was sparked by Dr. Y. R. Sarma, when he visited me in Auburn, Alabama, USA, seven months ago. We wanted to have an outlet where we could have alternative workshops and congresses that could be more accessible to people in this region of the world, given that it is difficult for many people interested in PGPR research to attend every International Conference. From those ideas we arrive at this Congress in Hyderabad. The creation of biotechnologies, bio-businesses, biotechnopreneurs, bio-farmers, bio-students and bio-billionaires is the theme of this “ASIAN PGPR CONGRESS FOR SUSTAINABLE AGRICULTURE”.

What is PGPR? Why Asian PGPR? Let's take a moment to discuss PGPR and its importance. Plant growth promoting rhizobacteria (PGPR) are root associated bacteria representing many different genera and species that colonize the rhizosphere, rhizoplane and improve plant growth when artificially introduced onto seeds, seedpieces, roots, or into soil. PGPR improve plant growth by one or more mechanisms: direct stimulation of plant growth; enhancement of nutrient uptake; suppression of plant pathogens; and/or induction of resistance in host plants against pathogens.

The first PGPR Workshop was held in Canada in 1987 and since then the workshop has been held every three years at various locations around the world: Switzerland (1990), Australia (1994), Japan (1997), Argentina (2000), India (2003) and The Netherlands (2006). The 8th International PGPR Workshop was held very recently in the Portland, Oregon, USA (2009).

In 2003, the PGPR workshop held in India achieved considerable recognition and was attended by more than 300 delegates. Since then, PGPR research has increased exponentially and has resulted in continued boosting of new companies in a growing industry for the production of PGPR related products in India.

Asian PGPR Congress for Sustainable Agriculture aims to assemble any professional who want to gain and share their knowledge on PGPR under one roof and to present their views on the following themes:

- Status of PGPR research
- PGPR applications in crops
- Biofertilizers and PGPR in integrated nutrient management
- Mechanisms, signaling, plant responses, bioactive metabolites
- Plant pathogen - PGPR interactions
- Farmers – academia - industry interaction
- Biogeography, genomics, bioinformatics
- Rhizosphere interactions, climate change and new technologies
- Round table discussion on research – industry - policy interfacing
- Commercialization, regulatory issues, trade barriers in PGPR
- Human resource development and transfer of technology

Today, many economically important agricultural, horticultural and ornamental crop plants are attacked by various soil borne and foliar diseases, resulting in billions of dollars in crop losses. Currently, the most widely used disease management strategy is the use of chemical fungicides. However, the use of these fungicides has encountered problems, such as development of resistance by pathogen to fungicides and rapid degradation of the chemicals. Other factors leading to increased interest in alternatives include the increasing cost of soil fumigation, lack of suitable replacements for methyl bromide and public concerns over exposure to fungicides. Both the agriculture and agri-food sector are now expected to move toward environmentally sustainable development, while maintaining productivity. These concerns and expectations have led to renewed interest on the use of “biologically based pest management strategies”. One approach to such biologically based strategies is the use of naturally occurring and environmentally safe products such as PGPR.

It has long been known that many microorganisms in the soil root ecosystem are attracted by nutrients exuded by plant roots. This soil-root ecozone is called rhizosphere. Many bacteria from the rhizosphere can influence plant growth and plant health positively, and we refer to them as PGPR. The beneficial effect of these bacteria have been variously attributed to their ability to produce various compounds including phytohormones, organic acids and siderophores, fixation of atmospheric

nitrogen, phosphate solubilization, antibiotics that suppress deleterious rhizobacteria or to some other unidentified mechanisms.

Worldwide, PGPR technology is being considered as the latest pursuit for expertise in knowledge intensive sectors. Currently, the global agriculture biotech industry is valued at an estimated US\$ 45 billion and is expected to grow at 25% annually. Indian Ag biotechnology industry is currently valued at US\$ 2.5 billion. Much of the credit for growth of the Indian Ag biotechnology industry goes to the government that created a separate department for biotechnology under the Ministry of Science and Technology. Our state governments are also equal contributors towards making India an emerging hub of Ag biotechnology. Today, we have the benefit of having both Central and State Governments partnering with us for this congress. I see similar capabilities in all participating Asian countries and we all inherently have the strengths, excellent networks of research laboratories, rich biodiversity, well-developed seed industries and most importantly highly skilled and trained pool of scientific manpower. Today, Asian countries are slowly but steadily preparing themselves for an emerging Ag biotechnology revolution. The success in this sector, however, depends on a number of enabling factors like facilitating venture capital funding, technology absorption and strengthening of links between the industry, academic and government institutions, not only within each country but amongst all Asian countries and our International partners.

The green revolution of agriculture brought an enormous increase in food production. It not only made the world self sufficient in food but also gave the world's scientists and farmers an immense amount of self-respect. Though the green revolution did increase food production, the productivity levels have remained low and increase was achieved at a cost of intensive use of water, fertilizer and other inputs which have caused problems of soil salinity, ground water pollution, nutrient imbalances, emergence of new pest and diseases and environmental degradation. To feed the ever increasing population globally and in Asia more and more food now has to be produced from less and less land, water and other natural resources. It is therefore apparent that we have to do things differently and doing more of what we did yesterday will not take us forward. With the advent of PGPR technology and its use on crops, we can achieve higher productivity, better quality, improved nutrition, improved storage properties, increased pests and disease resistance and achieve higher prices for farmers in the global market place. PGPR technology has the immense potential of eradicating rural poverty and fueling Asia's GDP growth. By exploiting our knowledge of PGPR technology we have the opportunity to make Asia the global center of bioresearch.

The PGPR industry is a relatively new venture, just coming out of its infancy. Its potential is being tested, realized and used. The public

awareness and acceptance of PGPR will accelerate the process. Currently these are being supplemented by private individual entrepreneurs for developing PGPR products for local needs as well as for the export market. Technologies are flowing into the country due to the changed economic scenario. With continued support we can soon become global players in PGPR technology.

I hope I have been able to impart upon you the great enthusiasm I feel about the future through the use of PGPR. We must bring about a massive collective global effort dedicated to funding new research in PGPR's. I encourage all of you here to bolster the spirit in your colleagues and yourselves as you now enable Asia to become a world leader in the application of PGPR technology to the betterment of our agriculture. I am confident that by working together we can overcome the obstacles and seize the opportunities in the PGPR technologies in the new millennium. I am taking this opportunity to call upon all stakeholders from the wide range of Asian countries to join hands and use PGPR to make our world a better place to live. Join me and let us see the future we can create with PGPR through this Congress.

My best wishes to all of you.

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*Section - I*  
**Invited Lectures**

