

# The Group of "Environmental Microbiology"- CIBNOR

## Productivity: Final 2011

(Numbers in parenthesis near journal's name are the *impact factor, 2010*)

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### Summary

- Original publications in peer-reviewed journals	
Published and "in press" -	12
- Submitted papers -	2
- Publications in books -	6
- Publications in websites -	5
- Invited presentations in conferences	12
- Voluntary presentations in conferences	1
- Review of manuscripts for international and national journals and funding agencies	101
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- Total productivity (without conferences, reviews and websites) for 2011:	20

- **Average "Impact Factor" of all published papers in 2011: 2.558**

### PUBLISHED AND "IN PRESS" PUBLICATIONS

#### *PUBLICATIONS IN INTERNATIONAL PEER-REVIEWED JOURNALS*

1. Perez-Garcia, O., Escalante, F.M.E., de-Bashan L.E., and Bashan, Y. 2011. Heterotrophic cultures of microalgae: Metabolism and potential products. **Water Research** 45: 11-36 (4.546)
2. Bacilio, M., Vazquez, P., and Bashan, Y. 2011. Water versus spacing: A possible growth preference among young individuals of the giant cardon cactus of the Baja California Peninsula. **Environmental and Experimental Botany** 70: 29-36 (2.699)
3. Perez-Garcia, O., Bashan, Y., and Puente M.E. 2011. Organic carbon supplementation of sterilized municipal wastewater is essential for heterotrophic growth and removing ammonium by the microalga *Chlorella vulgaris*. **Journal of Phycology** 47: 190-199. (2.239)
4. Vovides, A.G., Bashan, Y., López-Portillo, J.A., and Guevara R. 2011. Nitrogen fixation in preserved, reforested, naturally regenerated and impaired mangroves as an indicator of functional restoration in mangroves in an arid region of Mexico. **Restoration Ecology** 19: 236-244 (1.972)
5. Vovides, A.G., López-Portillo, J., and Bashan, Y. 2011. N<sub>2</sub>-fixation along a gradient of long-term disturbance in tropical mangroves bordering the gulf of Mexico. **Biology and Fertility of Soils** 47:567-576 (2.156)

6. Lopez, B.R., Bashan, Y., and Bacilio, M., 2011. Endophytic bacteria of *Mammillaria fraileana*, an endemic rock-colonizing cactus of the Southern Sonoran Desert. **Archives of Microbiology** 193: 527-541 (1.754)
7. Bashan Y., Trejo, A., and de-Bashan, L.E., 2011. Development of two culture media for mass cultivation of *Azospirillum* spp. and for production of inoculants to enhance plant growth. **Biology and Fertility of Soils** 47: 963-969 (2.156)
8. de-Bashan, L.E., Schmid, M., Rothballer, M., Hartmann, A., and Bashan Y., 2011. Cell-cell interaction in the eukaryote-prokaryote model using the microalgae *Chlorella vulgaris* and the bacterium *Azospirillum brasilense* immobilized in polymer beads. **Journal of Phycology** 47:1350-1359 (2.239)
9. Trejo, A., de-Bashan, L.E., Hartmann, A., Hernandez, J.-P., Rothballer, M., Schmid, M., and Bashan Y. 2012. Recycling waste debris of immobilized microalgae and plant growth-promoting bacteria from wastewater treatment as a resource to improve fertility of eroded desert soil. **Environmental and Experimental Botany** 75: 65-73 (2.699).
10. Covarrubias, S.A., de-Bashan, L.E., Moreno, M., and Bashan, Y. 2011. Alginate beads provide a beneficial physical barrier against native microorganisms in wastewater treated with immobilized bacteria and microalgae. **Applied Microbiology and Biotechnology** (in press) doi: 10.1007/s00253-011-3585-8 (3.28)
11. de-Bashan, L.E., Hernandez, J.-P., and Bashan, Y., 2011. The potential contribution of plant growth-promoting bacteria to reduce environmental degradation - A comprehensive evaluation. **Applied Soil Ecology**. (in press) doi:10.1016/j.apsoil.2011.09.003 (2.399)
12. Bashan, Y., Salazar, B.G., Moreno, M., Lopez, B.R., and Linderman, R.G. 2011. Restoration of eroded soil in the Sonoran Desert with native leguminous trees using plant growth-promoting microorganisms and limited amounts of compost and water. **Journal of Environmental Management** (accepted)(2.596)

### **PUBLICATIONS IN INTERNATIONAL BOOKS**

1. Bashan, Y. 2011. Reality and challenges in microbial ecology of tropical soils - Forward. In: **Microbial Ecology of Tropical Soils**. (eds.) Ferreira de Araújo A.S. and Figueiredo M.d.V.B., Nova Science Publishers, New York, USA. pp.vii-viii.
2. Kim, Y.-C., Glick, B.R., Bashan, Y., and Ryu, C.-M. 2012. Promotion of plant drought tolerance by microbes. In: **Plant responses to drought stress: from morphological to molecular features**. Aroca, R (ed). Springer Verlag, Heidelberg, Berlin, Germany (Commissioned and written).

### **PUBLICATIONS IN NATIONAL BOOKS (Mexico)**

3. Holguin, G, Vazquez, P., Sánchez, J., López de Los Santos, Y., Flores-Mireles A. L., Melgarejo, L. M., Venegas, J., Galindo, T., Dávila-Lule, A., Polanía, J. y Ruiz, M. (2011) Microbiología del manglar. En: Félix Pico, E. F., Serviere Zaragoza, E., Riosmena Rodriguez, R., León de la Luz, J. L. (Eds.) In: **Los Manglares de la península de Baja California**. Published by: Centro Interdisciplinario de Ciencias Marinas, Centro de Investigaciones Biológicas del Noroeste, S.C y Universidad Autónoma de Baja California Sur. México. P 129-151. (*in Spanish*)
4. de-Bashan, L.E., and Bashan, Y. 2011. Microorganismos utilizados en la recuperación de suelos erosionados y ecosistemas degradados en México. In: **Biodiversidad Microbiana de México**. (Eds): Álvarez Sánchez J., Rodríguez Guzmán, P. and Alarcón, A. Chapter 24. Published by: SAGARPA, Mexico City, Mexico, (*in Spanish*) (accepted)
5. de-Bashan, L. E., Moreno, M., Lopez, B.R., Hernandez, J.-P., Bacilio, M., Leyva, L.A., Vazquez, P. and Bashan, Y. 2011. Los mas pequeños y los mas grandes: ¿Qué los microorganismos ayudan a las plantas del desierto? In: **¿Qué se mueve en el desierto?: la palpitante vida del matorral**. (Eds): de la Luz, J.L. and Blazquez, C. Published by: CONABIO, Mexico City, Mexico, (*in Spanish*) (accepted)

### **PUBLICATION IN CONFERENCE'S BOOK**

6. de-Bashan, L.E., Hernandez, J.-P. and Bashan, Y. 2011. Plant growth-promoting bacteria as a component for environmental improvement. In: **Proceedings of the International workshop on rhizosphere, biodiversity and sustainable agriculture**. Garcia de Salomone, I.E. (Ed), Published by: Asociacion Argentina de Microbiologia, Buenos Aires, Argentina. (*in Spanish*) (accepted).

### **Websites**

1. Bashan, Y., Bashan, N., and Hernandez J.P. 2011. In memoriam; Dr. Gina Holguin (1957-2007). In: <http://www.bashanfoundation.org/gmaweb/gina/maingina.html>. 160+ pages.
2. Bashan, Y., and Hernandez J.P. 2011. In memoriam; Dr. Wolfgang Zimmer (1958-2002). In: <http://www.bashanfoundation.org/zimmer/zimmerweb.html>. 100+ pages.
3. Bashan, Y., and Hernandez J.P. 2011. In memoriam; Dr. Jesus Caballero-Mellado (1953-2010). In: <http://www.bashanfoundation.org/caballero/caballeropub.html>. 150+ pages.
4. Bashan, Y., and Hernandez J.P. 2011. In memoriam; Dr. Jose Luis Ochoa (1951-2007). In: <http://www.bashanfoundation.org/ochoa/ochoapub.html> (under construction)
5. Bashan, Y., and Hernandez J.P. 2011. In memoriam; Dr. Horst Vierheilig (1960-2011). In: <http://www.bashanfoundation.org/horst/horstpub.htm> (under construction)

## ***SUBMITTED PUBLICATIONS***

### ***PUBLICATIONS IN SCIENTIFIC INTERNATIONAL REVIEWED JOURNALS***

1. Lopez, B.R., Tinoco, C., Bacilio, M., Mendoza, A., and Bashan, Y., 2011. Endophytic bacteria of the rock-dwelling cactus *Mammillaria fraileana* affect plant growth and mobilization of elements from rocks. **Environmental and Experimental Botany** (2.699)
2. Bashan, Y., Moreno, M., Salazar, B.G., and Alvarez, L. 2011. Restoration and recovery of hurricane-damaged arid mangroves using the knickpoint-retreat effect and tides as dredging tools - a case study. **Journal of Environmental Management** (2.596)

### ***PRESENTATIONS IN CONFERENCES: 13***

1. Bashan, Y., and de-Bashan, L.E. 2011. Plant growth-promoting bacteria in an IPM program. In: 9<sup>th</sup> Soil Health Symposium of the USDA Natural Resource Conservation Service. April 13, 2011, Indio, California, USA (**Invited lecture**)
2. Bashan, Y., de-Bashan, L.E., Hernandez, J.-P., Hernandez, S.A., Cruz, I. and Moreno, M. 2011. Bioencapsulation of microorganisms for environmental purposes. South-America workshop on bioencapsulation, April 25-27, 2011, Valdivia, Chile. (**Invited lecture**)
3. Lopez, B.R., Tinoco, C., Bacilio, M., Bashan, Y. 2011. Aplicaciones de las bacterias endófitas. Special videoconference in: Universidad del Bosque, Facultad de Biología, May 11, 2011. Bogota, Colombia. (**Invited lecture**)
4. Bashan, Y., de-Bashan, L.E., Hernandez, J.-P., Hernandez, S.A., Cruz, I. and Moreno, M. 2011. Bioencapsulation of microorganisms for environmental purposes. Seminar of the Academy of Biotechnology of the Northwestern Center for Biological Research, May 12, 2011, La Paz, Baja California, Sur, Mexico (**Invited lecture**)
5. Bashan, Y., Lopez, B. R., Moreno, M. and de-Bashan, L.E. 2011. Utilización de microorganismos del desierto para restauración del desierto. In: Institutional seminar, Institute of Ecology, May 25, 2011, Xalapa, Veracruz, Mexico (**Invited lecture**).
6. Bashan, Y., Lopez, B. R., Moreno, M. and de-Bashan, L.E. 2011. Utilización de microorganismos del desierto para restauración del desierto. In: Jornadas de Investigación en Microbiología Agrícola: Homenaje a Dr. Jesus Caballero Mellado. University of Puebla, May 27, 2011, Puebla, Mexico. (**Invited lecture**)
7. Cruz I., Hernandez J.-P., de-Bashan L.E. and Bashan Y. 2011. Removal of nutrients from domestic wastewater in autotrophic and heterotrophic 50-L bioreactors using the microalgae *Chlorella vulgaris* and the bacterium *Azospirillum brasilense* jointly immobilized in alginate beads. In: The 4th Congress of the International Society for Applied Phycology, June 19th - 24th, 2011, Halifax, Canada.

8. Bashan, Y., Lopez, B. R., de-Bashan, L. E., Moreno, M., Hernandez, J.-P., Bacilio, M. and Vazquez, P. 2011. Restoration of degraded ecosystems using plant growth promoting bacteria. In: Institutional seminar; Korea Research Institute of Bioscience and Biotechnology (KRIBB). October 5, 2011, Daejeon, Korea (**Invited lecture**).
9. de-Bashan L.E., Hernandez, J.-P., Choix, F.J. and Bashan, Y. 2011. Joint immobilization of plant growth-promoting bacteria and green microalgae in alginate beads as an experimental model for studying plant-bacterium interactions. In: Institutional seminar; Korea Research Institute of Bioscience and Biotechnology (KRIBB). October 5, 2011, Daejeon, Korea (**Invited lecture**).
10. Bashan, Y., Lopez, B. R., de-Bashan, L. E., Moreno, M., Hernandez, J.-P., Bacilio, M. and Vazquez, P. 2011. Bioremediation of eroded desert soils using plant growth-promoting bacteria. In: International Symposium on Agroforestry Biotechnology to Combat Desertification, October 7-8, 2011, Changwon City, Korea. p 16. (**Invited lecture**)
11. de-Bashan, L.E., Trejo, A., Hernandez, J.-P., Hartmann, A., Rothballer, M., Schmid, M., Bashan, Y. 2011. Enhancing fertility of eroded desert soil by using recycled wastewater debris containing plant growth-promoting bacteria and microalgae. In: International Symposium on Agroforestry Biotechnology to Combat Desertification, October 7-8, 2011, Changwon City, Korea. p 19. (**Invited lecture**)
12. Lopez, B. R., Bashan, Y., de-Bashan, L.E., Bacilio, M., Moreno, M. 2011. Associative bacteria of cacti and their application as inoculants for revegetation of the desert. In: 2nd Symposium Microorganisms and their biotechnological potential on farming and agricultural production and 2nd Meeting on microbial genetic resources, SUBNARGEM, Northwest Node. October, 13–14, 2011, University of Baja California, Mexicali, Mexico. p. 10. (**Invited lecture**)
13. Bacilio, M. 2011. La dieta como parte del estilo de vida, en la salud y la enfermedad. Special seminar for the 36th anniversary of CIBNOR, October 27, 2011, La Paz, Mexico. (**Key-note lecture**).

## DOMESTIC OUTREACH AND COMMUNITY SERVICES

1. **Strategic line of research of CIBNOR.** Plant growth-promoting bacteria to solve environmental problems in the desert. (Prof. Yoav Bashan, Dr. Luz de-Bashan, and Dr. Macario Bacilio) (P.C. 6.0)
2. **Radio interview.** Bacterias y fertilizantes. Programa de Radio: Panorama Informativo. Radio Station: Promomedios California, La Paz, Mexico. 19.11. 2011 (M.Sc. Juan Pablo Hernandez).
3. **Invited lecture by a non governmental organization promoting organic urban gardening.** Bacterias y fertilizantes. In Jardin Comunitario, La Paz, Mexico. 19.11. 2011 (M.Sc. Juan Pablo Hernandez).

### SCIENTIFIC RECOGNITION AND INTERNATIONAL SERVICES

1. 2011- Invited to serve as member of the **Steering Committee** of **"The Bioencapsulation Research Group"**. An international scientific organization with headquarters in Nantes, France (Dr. Luz E. de-Bashan).
2. 2011- **Institutional recognition of project**. The project "Cellular mechanisms controlling the combined growth of microalgae and microalgae growth-promoting bacteria and their contribution to eliminate nutrients (N and P) from wastewater" was recognized by the Director General of CIBNOR as exemplary, and was selected to be presented to the national evaluation committee of the federal government of Mexico as a "success case" of basic research in Mexico (7.3.2011).
3. 2011- **Guest editor of scientific journal: Applied Soil Ecology**. "Microbes & Sustainability", Special issue (Prof. Yoav Bashan, Joint position (on an equal basis) with Prof. Joseph Kloepper and Dr. Jay Garland, USA).
4. **Review of manuscripts for national and International Journals and funding agencies:**

**Total: 101**

Reviewer	Journal, or funding agency	Country	Number of manuscripts
Yoav Bashan	Water Research	The Netherlands	2
	Bioresource Technology	The Netherlands	2
	Journal of Biotechnology	The Netherlands	1
	Applied Soil Ecology	The Netherlands	11*
	European Journal of Soil Biology	The Netherlands	3
	Environmental and Experimental Botany	The Netherlands	1
	Journal of Environmental Management	The Netherlands	3
	Journal of Arid Environment	The Netherlands	1
	Biochemical Engineering Journal	The Netherlands	2
	Process Biochemistry	The Netherlands	1
	Plant Cell and Environment	USA	1
	Desalinization and Water Treatment	USA	2
	Applied and Environmental Microbiology	USA	1
	Biology and Fertility of Soils	Germany	6
	Applied Microbiology and Biotechnology	Germany	2
	FEMS Microbiology Letters	Germany	1
	FEMS Microbiology Ecology	Germany	1
	Journal of Applied Phycology	Germany	3
	Annals of Microbiology	Germany	2
	Plant and Soil	Germany	5
	Archive of Microbiology	Germany	1
	Acta Physiologiae Plantarum	Germany	1
	Journal of Plant Interactions	UK	2
Forest Systems	Spain	1	

	Australian Journal of Botany	Australia	1
	Functional Plant Biology	Australia	2
	International Journal of Tropical Biology and Conservation	Costa Rica	1
	Brazilian Journal of Microbiology	Brazil	1
	Chinese Journal of Oceanology and Limnology	P.R. China	1
	Agrociencia	Mexico	1
	Biodiversidad Microbiana de México	Mexico	1
	CONACYT-investigacion basica	Mexico	1
	Swedish University of Agricultural Sciences-promotion for professorship	Sweden	1
	Czech Science Foundation, grant proposal	Czech Republic.	1
Luz de-Bashan	Biology and Fertility of Soils	Germany	7
	Plant and Soil	Germany	1
	Journal of Environmental Management	The Netherlands	2
	Water Research	The Netherlands	2
	Bioresource Technology	The Netherlands	2
	Applied Soil Ecology	The Netherlands	6
	European Journal of Soil Biology	The Netherlands	3
	Desalinization and Water Treatment	USA	1
	Polish Journal of Environmental Studies	Poland	1
	Journal of Microencapsulation	UK	1
	CONACYT-investigacion basica	Mexico	5
Blanca Lopez	European Journal of Soil Biology	The Netherlands	1
Juan-Pablo Hernandez	CONACYT-investigacion basica	Mexico	2

\* Nine manuscripts as editor

#### EXTERNAL RESEARCH PROJECTS (total:\$6,487,000)(527,000 U\$S) (12.3 pesos=1 USD).

Physiological and genetic mechanisms in the establishment and maintenance of mutualisms of plants with different partners.

Funding: \$4,380,000.00; Financed by CONACYT-investigacion basica

Duration: Four years (2011-2014).

PI: Dr. Yoav Bashan

Co-PI: Dr. Luz Estela de-Bashan and Dr. Martin Heil (CINVESTAV, Irapuato)

Co-researcher: M.Sc Juan Pablo Hernández.

Escalamiento de una novedosa tecnologia para el tratamiento terciario de aguas residuales combinado con la recuperacion de suelos erosionados de zonas aridas, utilizando microalgas y bacterias coinmovilizadas.

Funding: \$1,800,000.00; Financed by SEMARNAT-CONACYT

Duration: Four years (2008-2011).

PI: Dr. Yoav Bashan

Co-PI: Dr. Luz Estela de-Bashan

Co-researcher: M.Sc Juan Pablo Hernández.

Influence of biochar and compost in the phytoremediation of oil contaminated soil  
 Funding: \$ 307,000. Financed by UC-Mexus  
 Duration: 18 months (July 2011- December 2012)  
 PI: Dr. Macario Bacilio  
 Co-PI: Dr. David Crowley. (UC Riverside, USA)

### *PERSONAL AND COLLABORATIONS IN 2011*

#### Researchers (full time)

1. Dr. Luz Gonzalez de-Bashan
2. Prof. Yoav Bashan
3. Dr. Macario Bacilio

#### Staff, research (full time)

4. M.Sc Juan-Pablo Hernández
5. Mar. Biol. Patricia Vazquez
6. M.Sc. Manuel Moreno
7. M.Sc. Sergio Hernandez (To July 2010)

#### Post-Doctoral fellow (full time)

8. Dr. Blanca Romero-Lopez

#### Sabbatical year scientist (full time)

8. Dr. Alberto Mendoza, Center of Genetic Biotechnology, Reynosa, Mexico

#### Graduate students (Research)

9. **M.Sc Sergio Hernandez – Graduated March 3, 2011** (CIBNOR, La Paz, Mexico). (With Dr. Luz de-Bashan and Prof. Yoav Bashan)
10. **Dr. Alejandra Vovides. – Graduated May 25, 2011** (Instituto de Ecología, Xalapa, Mexico). (With Dr. Jorge Lopez-Portillo and Prof. Yoav Bashan).
11. M.Sc. Luis Leyva. **D.Sc.** Student since 2009 (CIBNOR, La Paz, Mexico). (With Prof. Yoav Bashan and Dr. Luz de-Bashan).
12. M.Sc. Francisco Choix. **D.Sc.** Student, since 2010. (CIBNOR, La Paz, Mexico). (With Prof. Yoav Bashan and Dr. Luz de-Bashan).
13. Eng. Ivonne Cruz. **M.Sc** student since 2010. (CIBNOR, La Paz, Mexico). (With Prof. Yoav Bashan).
14. Eng. Beatriz Meza. **M.Sc** student since 2010. (CIBNOR, La Paz, Mexico). (With Dr. Luz de-Bashan).
15. Eng. Cinthya Chavez. **M.Sc** student since 2010. (CIBNOR, La Paz, Mexico). (With Prof. Yoav Bashan).
16. M.Sc. Oskar Palacios, 2011. **D.Sc.** (CIBNOR) La Paz, Mexico. (With Prof. Yoav Bashan and Dr. Luz de-Bashan).
17. Eng. Emmanuel Vidaña. 2011. **M.Sc.** (CIBNOR), La Paz, Mexico. (With Prof. Yoav Bashan).
18. Biol. Edgar Amavizca. 2011. **M.Sc.** (CIBNOR), La Paz, Mexico. (With Dr. Luz de-Bashan).

#### Group's administrator

Eng. Cristina Galaviz



## INTERNATIONAL AND NATIONAL COLLABORATIONS IN 2011 (in: projects, publications and supervising graduate students)

1. **Prof. Hani Antoun**. Laval University, Quebec (Canada). Water Bioremediation and phosphate solubilization.
2. **Dr. Humberto Suzan**. University of Queretaro (Mexico). Ecology the Iron wood tree.
3. **Dr. S.R. Prabhu**, International Bio Recovery Corporation (Canada). Inoculant information from developing countries.
4. **Dr. Robert Linderman**- Plant Health LLC. Corvallis, Oregon (USA). Reforestation of desert eroded lands.
5. **Dr. Jorge Lopez-Portillo and Dr. Roger Guevara**, Institute of Ecology, Xalapa (Mexico). Nitrogen fixation in mangroves.
6. **Dra. Concepcion Lara**- CIBNOR (Mexico). Heterotrophic growth of microalgae.
7. **Dra. Gracia Gomez** –CIBNOR (Mexico). Genetic manipulation of microalgae.
8. **Prof. Anton Hartmann, Dr. Michael Schmid and Dr. Michael Rothballer**. German Research Center for Environmental Health, München, (Germany). FISH and transcriptomic analyses of plant-bacteria interactions.
9. **Dr. Martin Heil**, CINVESTAV (Guanajuato, Mexico). Mutualism between microalgae and bacteria.
10. **Dr. Michael Cohen** –Sonoma State University, California (USA). Enzymatic and molecular mechanisms of fatty acids in microalgae.
11. **Dr. Alberto Mendoza**- IPN Reynosa, Tamaulipas (Mexico). Enzymatic and molecular mechanisms of fatty acids in microalgae.
12. **Dr. Chris Rensing**- University of Arizona, Tucson (USA). Enzymatic and molecular mechanisms of fatty acids in microalgae.
13. **Dr. Felipe Ascencio** (CIBNOR), La Paz, Mexico. Enzymatic and molecular mechanisms of fatty acids in microalgae.
14. **Dr. Jesus Cordova and Dr. Yolanda Gonzalez**, University of Guadalajara (Mexico). Ethanol production from microalgae.
15. **Dr. Gustavo Hernandez-Carmona**, IPN-CICIMAR, La Paz, (Mexico). Scaling up wastewater treatment.
16. **Prof. Joseph Kloepper and M.Sc. John McInroy**, Auburn University, Auburn (USA). FISH techniques for detection of PGPB (not active in 2011).
17. **Dr. Beatriz Baca**, Autonomous University of Puebla (Mexico). Indole-3-acetic acid regulation in *Azospirillum*.
18. **Dr. Cecilia Creus**, University of Mar de Plata, Balcarce (Argentina). Signal molecules in *Azospirillum*.
19. **Dr. Gabriela Almedo**, CINVESTAV (Guanajuato, Mexico). Mutualism between microalgae and bacteria.
20. **Dr. Claudio Penna and Dr. Rosana Messa**, Stoller Co., Brazil/Argentina. Synthetic inoculants for plant growth-promoting bacteria.
21. **Dr. David Crowley**. University of California-Riverside (USA). Phytoremediation using compost.
22. **Prof. Ann Hirsh**, University of California-Los Angeles (USA). Microorganisms of the desert.
23. **Dr. Choong-Min Ryu**. Korean Institute of Bioscience and Biotechnology, Daejeon, (Korea). Volatile in *Azospirillum*.
24. **Dr. S. Y. Park**. Korean Institute of Bioscience and Biotechnology, Daejeon, (Korea). Molecular biology of desert bacilli.