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First Asian PGPR Indonesia Chapter International e-Conference

on

Sustainable Agriculture & Eco-Tourism

August 28-30, 2021

Udayana University, Bali, Indonesia

Organized by

Biology Study Program, Faculty of Mathematics and Natural Sciences, Udayana University, Bali, Indonesia
Indonesia Chapter of Asian PGPR Society
Asian PGPR Society for Sustainable Agriculture

Program of Technical Sessions
&
Abstract Book

Zoom Link:

Organizers

Prof. M.S. Reddy
Founder & Chairman, Asian PGPR Society

Dr. Sarjia Antonius
President, Indonesia Chapter of Asian PGPR Society

Dr. Ni Luh Suriani
Organizing Chairman

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Asian PGPR Society
Auburn University USA

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Secretary of Agriculture
Philippines

Dr. Ir. Wayan Koster
Governor
Government of Bali

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Dr. Moh Akhsan, Mohammadiyah Pare-Pare University

DAY 1

Saturday, 28 August 2021
General room

Chairman
Dr. Luh Eswaryanti Kusuma Yuni
Dr. Yan Ramona

Time	Program	Remark
In Bali time	Venue : zoom link	
7.30 – 8.30 AM	Registration	
8.30 – 8.40 AM	Opening ceremony	Carmen & Desy Andya Udayana University
8.40 – 8.45 AM	Indonesia National Anthem	
8.45 – 8. 50 AM	Prayer	
8.50 – 9.00 AM	Welcome to Bali	
9.00 – 9.10 AM	Opening Remarks - Organizing Chairman	Dr. Ni Luh Suriani
09.10—09.20	Invitation - President, Indonesian Chapter, Asian PGPR Society	Dr. Sarjiya Antonius
09.20—09.30	Message - Founder & Chairman, Asian PGPR Society	Prof. M. S. Reddy
09.30 - 09.40	Message - Governor of Bali	Dr Ir. Wayan Koster, M.M.
09.40 - 09.50	Chief Guest - Secretary of Agriculture, Philippines	Dr. Ir. William Dar
09.50—09.55	Inauguration – Rector, Udayana University, Bali	Prof. A.A. Raka Sudewi
09.55 - 10.00	Break	

ROOM 1
DAY 1 **Saturday, August 28, 2021**

Topic : **PGPR, Biofertilizer, Microbial Biostimulations for Suistainable Crop Production, Soil and Plant Health**

Zoom link:
Chairman Room:
1. Dr. Retno Kawuri
2. Dr. A.A. Ketut Darmadi.

No	Time (In Bali Time)	Kind of Speaker	Moderator	Name	Title	Address
1	10.00 AM-10.20 AM	Lead Speaker	**Dr. Retno Kawuri**	Prof. Dewa Ngurah Suprapta	Potential of rhizobacteria as bio-agents for sustainable crop production in Bali (1)	Laboratory of Biopesticide, Faculty of Agriculture, Udayana University, Bali, Indonesia
2	10.20 AM-10.40 AM	Lead Speaker		Prof. Jean W. H. Yong	Understanding the role of biostimulants in photosynthesis, nutrition, and growth of plants (1)	Department of Biosystems and Technology, Swedish University of Agricultural Sciences, Alnarp, Sweden
3	10.40 AM-11.00 AM	Lead Speaker		Dr. Dinesh Singh	Biological control of bacterial wilt of tomato through plant growth-promoting rhizobacteria (1)	Division of Plant Pathology, Indian Agricultural Research Institute, New Delhi -110012, India
4	11.00 AM-11.20 AM	Lead Speaker		Dr. Lalit Kumar	Plight of biofertilizer scientists and entrepreneurs to review world vide biofertilizer regulations (1)	205 Samata Colony, Raipur City, Chhattisgarh, India and Founder
5	11.20 AM-11.40 AM	Lead Speaker		Prof. Rana Pratap Singh	Assessing the multiple strategies to enhance use of plant Growth-promoting microbes for agricultural sustainability (1)	Department of Environmental Science, Babasaheb Bhimrao Ambedkar University Lucknow-226025, India
	11.40 AM-11.50 AM	DISCUSSION				
6	11.50 AM-12.00 AM	Featured Speaker		Prof. Arvind M. Deshmukh	Biofertilizers - an eco-friendly tool in agriculture to improve fertility of	President, Microbiologists Society, India

					soil (1)	
	12.00 AM-01.00 PM	BREAK				
7	01.00 PM-01.10 PM	Featured Speaker	**Dr. Anto Budiharjo**	Mr. Jagadeesh Reddy	Hands on experiences in PGPR based natural farming for 21st Century sustainable agriculture in Chittoor District of Andhra Pradesh, India (1)	Danduvaripalli, Chittoor District, AP., India and Asian PGPR Society for Sustainable Agriculture, Auburn University, USA
8	01.10 PM-01.20 PM	Featured Speaker		Dr. Kumari Sunita	Plant growth-promoting rhizobacteria (PGPR): a potential role in crop improvement and sustainable agriculture (1)	Plant Physiology, Biochemistry and PGPR Lab, Department of Botany, DDU Gorakhpur University, Gorakhpur, U.P., India
9	01.20 PM-01.30 PM	Featured Speaker		Dr. Nagaraja Suryadevara	Evaluation of different indigenous Streptomyces spp. for the biological control of Rhizome rot disease of turmeric (*Curcuma longa* L.) in India (1)	School of Bioscience Faculty of Medicine, Bioscience and Nursing MAHSA University Bandar Saujana Putra, 42610 Jenjarom, Selangor. Malaysia
10	01.30 PM-01.40 PM	Featured Speaker		Dr. Susiana Purwantisari	Evaluation of plant growth-promoting rhizobacteria (PGPR) and *Trichoderma* sp. on growth of potato (1)	Department of Biology, Faculty of Science and Mathematics, Diponegoro University Jl. Prof. Soedarto, S.H, Kampus Undip
11	01.40 PM-01.50 PM			Dr. Ranita Das	Role of PGPR, PGPF and microbial biostimulants for sustainable crop production and soil health (1)	Geolife Agritech India Pvt Ltd. Address: 301, Marathon Max, Oppo. Nirmal Lifestyle, L.B.S Marg, Mulund(W), Mumbai-400080
12	01.50 PM-02.00 PM			Dr. Haseena A.	A comparative study of the PGPR population and its enzymatic activities in the flood and non-flood affected regions of Kerala, India – a case study (1)	Department of Agriculture and Microbiology, Kerala Agricultural University, Vellanikara, Thrissur, Kerala, India
	02.00 PM-02.10 PM	DISCUSSION				
13	02.10 PM-			Dr. Gururaj	Significance of Plant Growth	Department of Plant Pathology,

	02.20 PM			Sunkad	Promoting Microorganisms for the Integrated Management of Plant Diseases (1)	University of Agricultural Sciences, Raichur-584101, India
14	02.20 PM-02.30 PM			Dr. Jafar Nabati	Biofertiliser Containing Plant-growth-promoting Rhizobacteria on Chickpea (*Cicer arietinum* L.) Plant Growth and Yield (1)	Department of Legume Research Center for Plant Sciences, Ferdowsi University of Mashhad, Mashhad, Iran.
15	02.30 PM-02.40 PM			Dr. Shams shaila Islam	Impact of vermicompost as a plant growth-promoting rhizobacteria for sustainable production of boro rice in northern regions of Bangladesh (1)	Department of Agronomy, Faculty of Agriculture, Hajee Mohammad Danesh Science and Technology University, Dinajpur 5200, Bangladesh
16	02.40 PM-02.50 PM			Dr. I Gusti Ayu Lani Triani	Use of plant growth-promoting rhizobacteria in vegetables as an environmentally friendly cultivation (1)	Faculty of Agricultural Technology, Universitas Udayana, Badung, Bali, Indonesia
17	02.50 PM-03.00 PM			Dr. B.L. Geethu	Effect of organic and inorganic fertilizers on growth and fruit yield of bitter gourd (*Momordica charantia*) var: Preethi (1)	Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad, Utter Pradesh, India
18	03.00 PM-03.10 PM			Dr. Anand Dave	Effect of Streptomyces sp. and mycorrhizal strain on plant growth-promotion and protection of pigeon pea wilt caused by *Fusarium udum* Butler (1)	Department of Microbiology and Biotechnology Centre the Maharaja Sayajirao University of Baroda, Sayajigunj, Vadoadara-390002, Gujarat, India
	03.10 PM-03.20 PM	DISCUSSION				
19	03.20 PM-03.30 PM		**Dr. Nagaraja Suryadevara**	Dr. Riyazuddin	Sustainable agriculture approach: chickpea rhizobacteria tolerant to trace elements and silver ions (1)	Department of Plant Biology, Faculty of Science and Informatics, University of Szeged, Kozep fasor 52, H-6726, Hungary
20	03.30 PM-03.40 PM			Dr. S. Mabena	Characterization and activity of plant growth-promoting rhizobacteria in sweet potato production in south Africa (1)	Department of Plant and Soil Sciences, Faculty of Natural and Agricultural Sciences, University of Pretoria, South Africa

21	03.40 PM-03.50 PM			Dr. I. B. G. Darmayasa	Liquid Organic Fertilizer Formulation Based on Potential Microbial Consortium in Growth of Mustard Greens (*Brassica juncea* L.) (1)	Department of Biology, Faculty of Mathematics and Natural Sciences, Udayana University, Denpasar, Bali
22	03.50 PM-04.00 PM			Dr. G. Swapna	Bacterial biostimulants: revitalization of plant and soil health (1)	Lecturer in Botany, DRG Government Degree College, Tadepalligudem, West Godavari District-534101, Andhra Pradesh
23	04.00 PM-04.10 PM			Dr. Puspita Harum Maharani	Influence of plant growth-promoting rhizobacteria (PGPR) on growth and yield of Chili in various growing media (1)	Assessment Institute for Agricultural Technology in South Kalimantan, Panglima Batur Street Banjarbaru, South Kalimantan
24	04.10 PM-04.20 PM			Dr. Erny Yuniarti	Effect of heavy metal-tolerant microorganisms on growth narra seedlings (1)	Soil Research Institute, Indonesian Agency of Agricultural Research and Development, Indonesia
	04.20 PM-04.30 PM	DISCUSSION				

ROOM 2
DAY 1

Saturday, August 28, 2021

Topic 2:

PGPR- Mitigation of Abiotic and Biotic Stresses, Biofungicides, Bioinsecticides, Induced Systemic Resistance

Zoom link :

Chairman Room:

1. Dra. Ni Made Gari,
2. Dra. Ina Narayani,

No	Time (In Bali Time)	Kind of Speaker	Moderator	Name	Title	Address
1	10.00 AM-10.30 AM	Lead Speaker	**Dr. Etty Pratiwi**	Prof. Mui-Yun Wong	Induced systemic resistance and antibiotic production by microbial	Department of Plant Protection, Faculty of Agriculture, Universiti

					biofungicides (2)	Putra Malaysia, Serdang, Selangor, Malaysia
2	10.30 AM-11.00 AM	Lead Speaker		Dr. Lakshmi Prasad Mekala	Enhanced mycorrhiza colonization in presence of Biochar (2)	Sujay Biotech Pvt. Ltd., 19A, 3rd Road, III Phase, Jawahar Autonagar, Vijayawada, India
	11.00 AM-11.10 AM	DISCUSSION				
3	11.10 AM-11.20 AM	Featured Speaker		Dr. Noshin Ilyas	Amelioration of abiotic stresses by soil microbes and amendments (2)	Department of Botany, PMAS Arid Agriculture University Rawalpindi, Pakistan
4	11.20 AM-11.30 AM	Featured Speaker		Dr. William Carrie	Antifungal activity of the tomato endophytic bacteria and evaluation of their bioactive compounds as potent biocontrol agents against major phytopathogneic fungi (2)	Department of Biotechnology, Mizoram University, Aizawl-796004, Mizoram India
5	11.30 AM-11.40 AM	Featured Speaker		Dr. Alka Sagar	Induced mutation in Erwinia sp. PR6 enhanced growth of finger millet var. CO14 under abiotic stress (2)	Department of Microbiology and Biotechnology, Meerut Institute of Engineering and Technology, Meerut, India
6	11.40 AM-11.50 AM			Dr. Zumrotul Hidayah	Increased growth of shallots (*Allium ascalonicum* L.) against fusarium wilt disease with combination of vermicompost and Trichoderma sp.(2)	Universitas Pembangunan Nasional Veteran Yogyakarta, Jalan Padjajaran 104, Condongcatur, Sleman, 55283, Indonesia
	11.50 AM-12.00 AM	DISCUSSION				
	12.00 AM-01.00 PM	BREAK				
7	01.00-01.10 PM		**Prof. Loekas Soesanto**	Dr. Zainal Arifin	Effect of arbuscular mycorrhizae on the growth of *Eucalyptus pellita* seedlings (2)	Sinarmas Forestry Corporate R&D, Jalan Raya Minas – Perawang KM 26, Perawang, Riau 28772, Indonesia
8	01.00 PM-01.20 PM			Dr. Alfi Inayati	Evaluation of Trichoderma species for production of enzymes, antagonistic ability and plant growth-promotion potential (2)	Indonesian Legume and Tuber Crop Research Institute

9	01.20 PM-01.30 PM			Dr. Wayan Alit Artha Wiguna	Sustainable agroindustry and agrotourism in rural areas - case study on chocolate industry of Cau Chocolates of Bali (2)	Cau Chocolates
10	01.30 PM-01.40 PM			Dr. Dian Astriani	Utilization of Soapberry fruit extract as a natural surfactant in Cashew nut shell liquid bioinsecticide formulation for Soybean pest management (2)	Agrotechnology Study Program, Faculty of Agroindustry, Mercu Buana University Yogyakarta, Indonesia
11	01.40 PM-01.50 PM			Prof. I Nyoman Rai	Isolation and identification of indigenous endomycorrhiza in Cocoa plantation and its propagation by giving water stress and different planting media to develop as a biofertilizer (2)	Faculty of Agriculture Udayana University, Denpasar, Bali.
12	01.50 PM-02.00 PM			Dr. Sulastri	The Colonization Assay of Halotolerant Plant Growth-Promoting Bacteria into Agronomic Crops Under Saline Stress (2)	Informatics Department, [Universitas] Center for Agricultural Production Technology, Agency for the Assessment and Application of Technology (BPPT), LAPTIAB-BPPT, Kawasan Puspiptek, Serpong, Tangerang Selatan, Indonesia
	02.00 PM-02.10 PM	DISCUSSION				
13	02.10 PM-02.20 PM		**Dr. Fainmarinat Inabuy**	Dr. Wahyu Astiko	Effect of plant density on intercropping with Maize-Soybean inoculated with mycorrhizae amended with organic fertilizer enhance yield in dryland of north Lombok, Indonesia (2)	Post Graduate University of Mataram Indonesia
14	02.20 PM-02.30 PM			Dr. Wiwik Susanah Rita	Antifungal activity of phenolic compounds from *Samanea saman* Jacq. (Merr) leaves against stem rot disease in dragon fruits caused by *Fusarium solani* (2)	Chemistry Department, Faculty of Mathematics and Natural Sciences, Universitas Udayana, Kuta, Bali, 80361, Indonesia

15	02.30 PM-02.40 PM			Dr. Sopialena (1)	Control of antracnose disease in Tomato (*Solanum lycopersicum*) using endophytic fungi (2)	Agroecotechnology Study Program, Faculty of Agriculture, Mulawarman University, Jalan Pasir Belengkong Gunung Kelua Campus, Mulawarman University, Samarinda, East Kalimantan, Indonesia.
16	02.40 PM-02.50 PM			Dr. Sopialena (2)	Investments in *Metarhizium* sp. and *Trichoderma* sp. in post-mining land on soil fertility, growth and production of tomato plants (*Solanum Lycopersicum* L) (5)	Agroecotechnology Study Program, Faculty of Agriculture, Mulawarman University, Jalan Pasir Belengkong Gunung Kelua Campus, Mulawarman University, Samarinda, East Kalimantan, Indonesia.
17	02.50 PM-03.00 PM			Dr. I Gusti Agung Ayu Putu Swastini	Antibacterial effects of various concentrations of natural ingredients of Snail Mucus (*Achatina fulica*) against inhibition zones of *Fusobacterium nucleatum* causes Periodontitis *in vitro* (2)	Health Polytechnic of Denpasar
18	03.00 PM-03.10 PM			Dr. K. S. Sudirga	Biological Control Crude Leaf Extract of *Ficus septica* to *Colletotrichum gleosporioides* Causes of Anthracnose Disease in *Carica papaya*	Department of Biology, Faculty of Mathematics and Natural Science, University of Udayana, Campus Bukit Jimbaran Bali, Indonesia
19	03.10 PM-03.20 PM			Dr. Ragil S.B. Irianto	Application of Plant Growth Promoting Rhizobacteria and Arbuscular Mycorrhizal Fungi on the Growth of Four Month Old *Acacia mangium* Seedlings in Nursery	Pusat Penelitian dan Pengembangan Hutan, Jl. Gunung Batu No. 5 Bogor, 16610 Indonesia.
20	03.20 PM-03.30 PM			Dr. Rabia Naz	Enhancement of Drought Stress Tolerance in Maize (*Zea mays* L.) by Endophytic Growth Promoting *Bacillus licheniformis* and *Bacillus glycinifermentans*	Dept. of Biosciences, COMSATS University Islamabad, Pakistan

	03.30 PM- 03.40 PM	DISCUSSION

ROOM 3
Day 1
Topic 3:

Saturday, August 28, 2021
Recent Advances in PGPR-Soil and Plant Microbiome, Rhizophere Enginering, Nanotechnology

Zoom Link:

Chairman Room:

1. Dr. Ni Luh Arpiwi
3. Dr. Fainmarinat Inabuy

No	Time (In Bali Time)	Kind of Speaker	Moderator	Name	Title	Address
1	10.00 AM- 10.20 AM	Lead Speaker	**Dr.Ni Luh Arpiwi**	Prof. Tualar Simarmata	Engineering of halotolerant PGPR biodiversity in rhizo-microbiome for alleviating the salinity stress, enhancing nutritional status and rice growth in saline soils (3)	Setiawati Department of Soil Sciences and Land Resources Management, Faculty of Agriculture of Padjadjaran University, Jatinangor 45363. West Java – Indonesia
2	10.20 AM- 10.40 AM	Lead Speaker		Dr. Amrutha V.	Phyto-stimulation of phosphate solubilizing fluorescence Pseudomonas on physiological and growth attributes of chilli (3)	Department of Microbiology, Acharya Nagarjuna University, Guntur 522510, A.P India and
3	10.40 AM- 11.00 AM	Lead Speaker		Dr. Priyanka J. Patel	Selenorhizobacteria Mediated Selenium Biofortification In Mung Bean Under Selenium Deficient Region - A Sustainable Agricultural Approach	Department of Microbiology and Biotechnology, University School of Sciences, Gujarat University, Ahmedabad – 380 009
	11.00 AM- 11.10 AM	DISCUSSION				
4	11.10 AM- 11.20 AM	Featured Speaker		Prof. Chandra Kant Sharma	*Agele marmelos* loaded polymeric nanoparticles evaluation against carbon tetrachloride induced	Faculty of Agriculture, College of Agriculture, Parul University, Limda Vadodara (Gujarat)-391760, India

					toxicity (3)	
5	11.20 AM-11.30 AM	Featured Speaker		Dr. Abhisek Mathur	Nano-particle formulations of metabolites extracted from microbes with PGPR and pesticidal traits in lieu of sustainable and organic practices for agriculture (3)	Prathista Industries Limited, Telangana State, India
6	11.30 AM-11.40 AM	Featured Speaker		Dr. Yuni Sri Rahayu	Optimalization of marginal soils with consortium of hydrocarbon degrading, phosphate-solubilizing bacteria, rhizobium and mycorrhizae in legumes (3)	Biology Department, Faculty of Mathematics and Natural Sciences Universitas Negeri Surabaya
7	11.40 AM-11.50 AM			Dr. Betty Natalie Fitriatin	PGPR activity as a phosphate solubilizing bacteria influenced by different aciditic conditions (3)	Department of Soil Sciences and Land Resouces Management, Agriculture Faculty, Universitas Padjadjaran, Jatinangor, West Java, Indonesia
	11.50 AM-12.00 AM	DISCUSSION				
	12.00 AM-01.00 PM	BREAK				
8	01.00 PM-01.10 PM		**Dr. Yuni Sri Rahayu**	Dr. Desak Ketut Tristiana Sukmadewi	Inoculation of *Aspergillus costaricaensis* and *Staphylococcus pasteuri* Mutants to Increase the Microbes Population and the Availability of Phosphorus and Potassium in soil (3)	Agrotechnology Department, Faculty of Agriculture, Warmadewa University, Terompong street 24, Denpasar 80239, Indonesia
9	01.10 PM-01.20 PM			Dr. Rika Alfianny	Potential of rhizosphere bacterial consortium as PGPR in suppression of root-knot nematode in tomato (3)	School of Life Sciences and Technology, Institut Teknologi Bandung, Indonesia
10	01.20 PM-01.30 PM			Dr. Yanisworo Wijaya Ratih	Decreasing of Cell Viability and Phosphat Solubilizing Activity of the Soil Phosphate Solubilizing Bacteria Caused by Leather Tanning Waste Water Exposure (3)	Soil Science Department of Universitas Pembangunan Nasional Veteran Yogyakarta.

11	01.30 PM-01.40 PM			Dr. Dwi N. Susilowati	Characteristics and potency of culturable bacteria from tidal swamp soils in South Kalimantan and lowland swamp soils in South Sumatra, Indonesia (3)	Indonesian Center for Agricultural Biotechnology and Genetic Resources Research and Development, Jl. Tentara Pelajat 3A Bogor 16111, West Java, Indonesia
12	01.40 PM-01.50 PM			Dr. I Nengah Simpen	Green Nano-Composite of CaO/K-Sulfated TiO2 and Its Potential as Single-Step Reaction Solid Catalyst into Biofuel Production (3)	Department of Chemistry, Faculty of Mathematics and Natural Sciences, Udayana University, Kampus Bukit Jimbaran, Badung-Bali, Indonesia
13	01.50 PM-02.00 PM			Dr. Rahmi	Isolation and analysis of soil fungal population from rhizosphere of rice plants grown under field conditions in Bumirava Morowali Regency (3)	Department of Agrotechnology,Universitas Tadulako,Jl. Sukarno Hatta Km 9.Palu,Sulawesi Tengah,94118,Indonesia
	02.00 PM-02.10 PM	DISCUSSION				
14	02.10 PM-02.20 PM		**Prof. Tualar Simarmata**	Dr. Retno Kawuri	Potential of bacteria as fat and oil biodegradation in environment contaminated with domestic waste (3)	Biology Department, Faculty of Mathematics and Natural Sciences, Udayana University, Kampus Bukit Jimbaran, Bali
15	02.30 PM-02.40 PM			Dr. Zahoor Ahmad Baba	Plant growth-promoting activities of mineral solubilizing microbes isolated from Himalayan agro-ecosystem (3)	Division of Basic Science and Humanities, FoA, SKUAST-K, India
16	02.40 PM-02.50 PM			Dr. Nunna Sai Aparna Devi	Impeccable authentication of bacterial endophytes of rice by re-isolation and DNA fingerprinting method (3)	Department of Agricultural Microbiology, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India
17	02.50 PM-03.00 PM			Dr. IGA Ayu Dharmawati	Utilization of rhizosphere earthworm extracts for sustainable food(3)	Politeknik Kemenkes Denpasar, Bali, Indonesia
18	03.00 PM-03.10 PM			Dr. Darwis Suleman	Isolation and identification of potential bio-inoculants based on phosphate solubilizing molds from	Departement of Soil Science, Faculty of Agriculture, Halu Oleo University,

					different plant rhizospheres (3)	Kendari
	03.10 PM-03.20 PM	DISCUSSION				

ROOM 4
Day 1 Saturday, August 28, 2021
Topic 4: Technology Innovation and Roadmaps for Commercialization of PGPR

Zoom Link:

Chairman Room:

1. Prof. I Ketut Junitha
2. Dr. Made Ria Defiani

No	Time (In Bali Time)	Kind of Speaker	Moderator	Name	Title	Address
1	10.00 AM-10.30 AM	Lead Speaker	**Dr. Made Ria Defiani**	Dr. Arti Raval	Screening of multi-trait phyllosphere bacteria for plant growth-promotion in soils amended with agro-industrial wastes under biotic stress conditions	Department of Microbiology, Arts, Science and Commerce College, Kamrej Crossroads, Surat- 396445 India
2	10.30 AM-11.00 AM	Lead Speaker		Dr. Ting Ho	Hand-on experience with ecological friendly farming in Malaysia	Malaysia
	11.00 AM-11.10 AM	DISCUSSION				
3	11.10 AM-11.20 AM	Featured Speaker		Prof. Hesham Ali El Enshasy	Industrial production of Nitrogen Fixing Bacteria in High Cell Density Culture: Challenges and Platform Design.	Institute of Bioproduct Development (IBD), Universiti Teknologi Malaysia (UTM), Skudai, Johor, Malaysia.
4	11.20 AM-11.30 AM			Dr. Laksmita Prima Santi	Development technology and commercialization of PGPR to improve relationship between	Indonesian Research Institute for Biotechnology and Bioindustry, PT Riset Perkebunan Nusantara, Jl.

					above and below ground biodiversity	Taman Kencana No.1 Bogor ,16128, Indonesia
5	11.30 AM-11.40 AM			Dr. I Putu Wirya Suputra	Molecular and Morphological identification of *Aschersonia* sp. Infected Whitefly on Citrus and Mulberry Plants (4)	Faculty of Agriculture, Udayana University, Indonesia Jl. Panglima Sudirman, Denpasar, Bali, Indonesia
6	11.40 AM-11.50 AM			Dr. Zulqarnain	An overview of transfer and adoption of high technology in permanent food production park program (PFPP) participations in Peninsular Malaysia	Agriculture Technology Department, Faculty of Agriculture, Universiti Putra Malaysia, Serdang,43300, Selangor, Malaysia
	11.50 AM-12.00 AM	DISCUSSION				
	12.00 AM-01.00 PM	BREAK				
7	01.00 PM-01.10 PM		**Dr. I Putu Sudiarta**	Dr. Abhinav Aeron	Plant Growth-Promoting Potential of Commercial Product "Sanjeevni" (An anti-fungal agent)	Department of Biosciences, DAV PG College, Muzaffarnagar, India
8	01.10 PM-01.20 PM			Dr. Mohd Aamir Khan	Microbial formulation technology for the remediation of explosives contaminated soil	Centre for Rural Development & Technology, Indian Institute of Technology Delhi, Hauz Khas, New Delhi 110016
9	01.20 PM-01.30 PM			Dr. Made Pharmawati	Importance of CTAB DNA plant extraction assay for Streptomyces DNA extraction	Biology Department, Faculty of Mathematics and Natural Sciences, Udayana University, Kampus Bukit Jimbaran, Bali
10	01.30 PM-02.00 PM			Dr. Chotimatul Azmi	Effect of seaweed extract amended with endophytic microbes in chili growth	Indonesian Vegetables Research Institute. Jl. Tangkuban Perahu No. 517 Lembang, West Bandung, West Java, Indonesia, 40391, Indonesia
	02.00 PM-02.10 PM	DISCUSSION				

ROOM 5

Day 1 Saturday, August 28, 2021

Topic 5: PGPR in Resilient Agricultural Practces-Challenges in Lab to Land Transfer, Success Stories

Zoom Link:

Chairman Room:

1. Dr. Made Pharmawati
2. Dr. I Ketut Ginantra

No	Time (In Bali Time)	Kind of Speaker	Moderator	Name	Title	Address
1	10.00 AM - 10.30 AM	Lead Speaker	**Dr. Made Pharmawati**	Prof. Pratibha Sharma	Application of microbial consortium against major pests of cumin (5)	Department of Plant Pathology, SKN Agricultural University, Jobner-Jaipur-303328, Rajasthan- India
2	10.30 AM - 11.00 AM	Lead Speaker		Dr. K.V.S.S. Sairam	Prathista ’s 5-G agri-inputs for total crop management (5)	Prathista Industries Limited, Telangana State, India
3	11.00 AM- 11.30 AM	Lead Speaker		Dr. Santa Ram	Genetics of beneficial plant-microbe interactions (5)	Head, Division of Genetics and Plant Breeding (Retd.), Central Coffee Research Institute, India and *Present address: #234, 1-A Main, Bapuji Layout, Bogadi, Mysore 570026, Karnataka, India
	11.30 AM- 11.40 AM	DISCUSSION				
4	11.40 AM - 11.50 AM	Featured Speaker		Dr. Abdul Gafur	Plant growth-promoting microbes (PGPM) in future management of Indonesian estate forests (5)	Sinarmas Forestry Corporate R&D Advisory Board Jalan Raya Minas, Perawang KM 26, Perawang, Riau 28772, Indonesia
5	11.50 AM - 12.00 AM	Featured Speaker		Dr. Popiha Bordoloi	Organic sources of plant nutrient for productivity enhancement of paddy in hill agro-ecosystem of North-eastern India (5)	Subject Matter Specialist, Krishi Vigyan Kendra Ri- Bhoi, ICAR (RC) for NEH Region, Umiam -793103, Meghalaya

	12.00 AM - 01.00 PM	BREAK				
6	01.00 PM - 01.10 PM		**Prof.Riyaz**	Dr. Yuda Purwana Roswanjaya	Production of Beauveria bassiana conidia in solid substrate condition using biphasic system (5)	Centre of Technology for Agricultural Production, Agency for the Assessment and Application of Technology (BPPT), Serpong, South Tangerang, Indonesia
7	01.10 PM- 01.20 PM			Dr. Sagung Ayu Aryawati	Increased productivity and income of farmers through application of ICM technology in rice under rainfed condition (5)	Assessment Institute for Agricultural Technology-Bali, Jl. By Pass Ngurah Rai, Pesanggaran, Denpasar, Bali,
8	01.20 PM - 01.30 PM			Dr. Sagung Ayu Aryawati	Adaptation test of new high yielding rice varieties through integrated crops management (ICM) to support organic agriculture (5)	Assessment Institute for Agricultural Technology-Bali, Jl. By Pass Ngurah Rai, Pesanggaran, Denpasar, Bali, 80222, Indonesia
	01.30 PM - 01.40 PM	DISCUSSION				
9	01.40 PM - 01.50 PM			Dr. Endah Wahyurini	GROWTH AND YIELDS OF THREE TOMATO STRAINS (Lycopersicum esculentum Mill) WITH VARIOUS DOSAGE OF Trichoderma sp. (5)	Agrotechnology, University of Pembangunan Nasional "Veteran" Yogyakarta, Indonesia
10	01.50 PM – 02.00 PM			Dr. Mieke Rochimi Setiawati	Efficacy of halotolerant N-fixing bacterial isolates on biochemical activity, bacterial population and N-uptake in rice seedlings (5)	Soil Science Department, Faculty of Agriculture, Padjadjaran University, Jl. Raya Bandung Sumedang KM. 21, Jatinangor, Sumedang Regency, West Java, 45363, Indonesia
11	02.00 PM - 02.10 PM			Dr. S. Purwaningsih	Evaluation of Azotobacter isolates on growth and yield of rice (Oryza sativa L) under greenhouseconditions (5)	Microbiology Division, Research Center for Biology, Indonesian Institute of Sciences Jl. Raya Jakarta-Bogor KM 46 Cibinong Science Center, Bogor, West Java, Indonesia
	02.10 PM – 02.20 PM	DISCUSSION				

12	02.20 PM - 02.30 PM			Dr. Srie Juli Rachmawatie	Effect of liquid leaf extracts of Moringa (*Moringa oleifera*) and Keong Mas (*Pomacea canaliculata*) on growth of Wangi Mentik Paddy (5)	Student of the UNS Agricultural Sciences Doctoral Program
13	02.30 PM - 02.40 PM			Dr. Boby Vattekkattu Unnikrishnan	Endophytic fungus *Aspergillus costaricensis* mediated growth and yield response in rice (5)	Department of Agricultural Microbiology, College of Agriculture, Kasaragod, Kerala Agricultural University, India
14	02.40 PM - 02.50 PM			Dr. Bambang Supriyanta	Genetic Parameter Estimation Of Some Inodorus Melon Lines (*Cucumis Melo* L.) On Generation S3 With Smart Farming Hidroponic System (5)	Fakultas Pertanian Universitas Pembangunan Nasional Veteran Yogyakarta
	02.50 PM - 03.00 PM	DISCUSSION				

ROOM 6

Day 1 Saturday, August 28, 2021

Topic 6 : PGPR and Evergreen Revolution : Organic Production, Safe Food and Eco-Tourism

Zoom Link:

Chairman Rooom:

1. Dr.Ida Ayu Astarini

2.Ni Kadek Desy Andya Dewi

No	Time (In Bali Time)	Kind of Speaker	Moderator	Name	Title	Address
1	10.00 AM - 10.20 AM	Lead Speaker	**Dr. Ida Ayu Astarini**	Dr. Wayan Koster		Kantor Gubernur Bali
2	10.20 AM - 10.40 AM	Lead Speaker		Dr. Jitendrakumar Patel	Linking organic agriculture with agro eco-tourism - a path to sustainable development (6)	AsiaGreen Biocrops, Kani GIDC.Bardoli.394350, India

3	10.40 AM - 11.00 AM	Lead Speaker		Dr. Lakshmikantha Pothireddy	BIODIVERSITY HOME GARDENS: POTENTIAL SOURCE FOR GLOBAL FOOD SECURITY (6)	2211 Colony Woods Dr, Apex, NC, USA
	11.00 AM – 11.10 AM	DISCUSSION				
4	11.10 AM - 11.20 AM	Featured Speaker		Dr. Raseetha	Valorisation of fruit peels of pomegranate, pineapple and papaya for antioxidant and antimicrobial activity (6)	Faculty of Applied Sciences, Universiti Teknologi MARA, 40450 Shah Alam, Selangor, Malaysia
5	11.20 AM - 11.30 AM	Featured Speaker		Dr. Mulawarman	Evaluation of natural renewable materials to enhance soil microbial populations to control plant pathogens (6)	Plant Protection Department, Agriculture Faculty, Sriwijaya University, Jl. Raya Palembang - Prabumulih Km. 32 Indralaya, OI, Sumatera Selatan 30662
6	11.30 AM – 11.40 AM			Dr. N. W. Bogoriani	Activity of Andong leaf extract (*Cordyline terminalis* Kunth) as an Anti-inflammatory against Oedema of The Soles of Wistar Rats by Carrageenan induction	Depatment of Chemistry, Faculty of Mathematic and Natural Science, University of Udayana. Jl. Kampus Jimbaran Badung , Bali 80362, Indonesia
7	11.40 AM – 11.50 AM			Dr. Dinata	Enhancement of Bali cattle productivity with corn straw amended with molasis containing extracts of leaves of Hibiscus (6)	Assessment Institute for Agricultural Technology Jl. By Pas Ngurah Rai Pesanggaran, Denpasar-Bali
	11.50 AM – 12.00 AM	DISCUSSION				
	12.00 AM - 01.00 PM	BREAK				
8	01.00 PM- 01.10 PM		**Dr. Raseetha**	Dr. Sri Wahjuni	Effect anthiperglycemic of Putri Malu (*Mimosa pudica* L) leaf ethanol extract on pancreas histopathology in hyperglycemic male rat Wistar (6)	Departemen of Chemistry, Faculty of Mathematic and Natural science, Udayana University, Campus Bukit Jimbaran, Bali, Indonesia

9	01.10 PM- 01.20 PM			Dr. Ni Putu Sukanteri	INNOVATION IN THE USE OF ORGANIC INPUT ON RICE IN EFFORTS TO CREATE FOOD SAFETY - Case Study in Tabanan District (6)	Agribusiness Study Program, Faculty of Agriculture and Business, Denpasar Mahasaraswati University
10	01.20 PM - 01.30 PM			Dr. Erna Rusliana M. S.	SYNTHESIS OF BIOFOAM FROM SAGO WASTE AS A BIODEGRADABLE FOOD STORAGE CANDIDATES (6)	Department of Agricultural technology, Universitas Khairun
11	01.30 PM - 01.40 PM			Dr. L. Suriati	EVALUATION OF FRESH CUT QUALITY OF MANGO, MANGOSTEEN AND RAMBUTAN UNDER COLD STORAGE CONDITIONS (6)	Department of Food Science and Technology, Agriculture Faculty, Warmadewa University, Denpasar, Bali, Indonesia
12	01.40 PM - 01.50 PM			Prof. Wirawan	Detection of specific protein in citrus infected by citrus vein phloem degeneration disease (6)	Department of Agricultural Biotechnology, Faculty of Agriculture, Udayana University, Jl. P.B. Sudirman, Denpasar, Bali, Indonesia
	01.50 PM – 02.00 PM	DISCUSSION				
13	02.00 PM - 02.10 PM		**Dr. Abdul Gafur**	Dr. Vaishnavi Palwe and Nutan Rathod	Preliminary Comparative Phytochemical Screening of stem bark and leaves of *Anthocephalus cadamba* evaluating Antibacterial Activity (6)	Preliminary Comparative Phytochemical Screening of stem bark and leaves of *Anthocephalus cadamba* evaluating Antibacterial Activity (6)
14	02.10 PM - 02.20 PM			Dr. M.Gnanachitra	Validating Mutant *Rhizobium* for Volatile Compound Production by GCMS-ATD Analysis Suitable for Blackgram Under Acid Soil Condition	Dept.of Agrl. Microbiology, Tamil Nadu Agricultural University, Coimbatore, India

15	02.20 PM - 02.30 PM			Dr. Agung Wiwiek Indrayani	Optimization of oil, surfactant and cosurfactant ethanol extract of *Curcuma Xanthorriza* rhizome combination with *Andrographis paniculata* stem extract for anti-acne drug (6)	Department of Pharmacology and Therapy, Faculty of Medicine, Udayana University
16	02.30 PM - 02.40 PM			Dr. I Wayan Wijana	Percentage of Carcass, external and internal of crossed village chickens maintained free range by adding levels of Dragon peel fruit extract through drinking water (6)	Poultry Science Laboratory, Faculty of Animal Husbandry, Udayana University, Denpasar
17	02.40 PM - 02.50 PM			Dr. Rahmad	Evaluation of lignocellulolytic fungal consortium for composting sugarcane bagasse, filter cake, and manure (6)	Department of Estate Crops Cultivation, Pangkep State Polytechnic of Agriculture, South Sulawesi, Indonesia
	02.50 PM – 03.00 PM	DISCUSSION				
18	03.00 PM - 03.10 PM			Dr. Luh Putu Kirana Pratiwi	Sustainable agriculture development strategy based on eco-agro-tourism on Subak Sembung in Denpasar City (6)	Agribusiness Study Program, Faculty of Agriculture and Business Mahasaraswati University Denpasar
19	03.10 PM - 03.20 PM			Dr. Marwan Khalis	Evaluation of textile industry wastewater treatment as an effort to control river water pollution in Pringsurat district, Magelang Regency, Central Java (6)	Departement of Environmental Engineering Faculty of Mineral Technology Universitas Pembangunan Nasional Veteran Yogyakarta, Indonesia 55283
20	03.20 PM - 03.30 PM			Dr. I Wayan Sudarma	FERMENTATION OF ROBUSTA COFFEE (*Robusta Coffea*) USING TERMITE CELULASE ENZYM TO IMPROVE QUALITY AND TASTE (6)	Assessment Institute for Agricultural Technology of Bali, By Pass Ngurah Rai, Pesanggaran, South Denpasar, 80222, Bali
	03.30 PM – 03.40 PM	DISCUSSION				

ROOM 1
DAY 2 Sunday, August 29, 2021
Topic 1: PGPR, Biofertilizer, Microbial Biostimulations for Suistainable Crop Production, Soil and Plant Health

Zoom Link:

Chairman Room:

1. Dr. Retno Kawuri
2. Dr. A.A. Ketut Darmadi.

No	Jam	Kind of Speaker	Moderator	Name	Title	Address
1	08.00 AM-08.20 AM	Lead Speaker	**Dr. Retno Kawuri**	Prof. Krishna Sundari Sattiraju	Explorations with Trichoderma beyond biocontrol and plant growth-promotion (1)	Plant and Microbial Biotechnology Group, Biotechnology Department, JIIT, NOIDA, 201307, U. P. India
2	08.20 AM-08.40 AM	Lead Speaker		Dr. R.N. Pandey	Trichoderma spp. in the mitigation of stresses in plants, their commercialization for sustainable agriculture and rural prosperity (1)	Department of Plant Pathology, B. A. College of Agriculture, Anand Agricultural University, Anand -388 110, India and Past President, IPS, & Professor & Head (Retd.)
3	08.40 AM-09.00 AM	Lead Speaker		Dr. KRS Sambasiva Rao	Scope and prospects of organic farming in Northeast India (1)	Mizoram University (A Central University), Aizawl, Mizoram, India
4	09.00 AM-09.20 AM	Lead Speaker		Prof. Sarjiya Antonius	Evaluation of Indole Acetic Acid (IAA) producing and phosphate (P) solubilizing PGPR isolated from Clove (*Syzygium aromaticum L.*) plantations in Bali, Indonesia (1)	Research Center Biology, Indonesia Institute of Science, Cibinong, Indonesia
5	09.20 AM-09.40 AM	Lead Speaker		Dr. Sushil K. Sharma	Acid hydrolysed casein: a key substrate to unravel operation of tryptophan - independent pathway in rhizobacteria for IAA production (1)	ICAR-National Institute of Biotic Stress Management, Raipur - 493 225, Chhattisgarh, India

6	09.40 AM-10.00 AM	Lead Speaker		Dr. Samina Mehnaz	*Pseudomonas aurantiaca* - an overview of its potential as a biofertilizer and biofungicide *(1)*	School of Life Sciences, Forman Christian College (A Chartered University), Ferozepur Road, Lahore, 54600, Pakistan
	10.00 AM–10.10 AM	DISCUSSION				
7	10.10 AM-10.20 AM	Featured Speaker	**Prof. Krishna Sundari Sattirajju**	Dr. Abeer Hashem	Botany and Microbiology Department, College of Science, King Saud University, P.O. Box. 2460 Riyadh 11451, Saudi Arabia	Seed priming with *Bacillus subtilis* (Bera 71) to alleviate chromium toxicity in *Lycopersicon esculentum* Mill. (1)
8	10.20 AM-10.30 AM	Featured Speaker		Dr. Ritu Mawar	Potentials of microbial biostimulants to decipher the basal stem rot in Ganoderma species (1)	Central arid zone research institute, Jodhpur, Rajasthan, India
9	10.30 AM-10.40 AM	Featured Speaker		Prof. Loekas Soesanto	Aplication of Two *Pseudomonas fluorescens* Isolates Secondary Metabolites to Control Bacterial Wilt in Potato (1)	Faculty of Agriculture, Jenderal Soedirman University Jl. dr. Suparno, Karangwangkal, Purwokerto 53123.
10	10.40 AM-10.50 AM	Featured Speaker		Dr. Markus Susanto	Potential of organic waste as a source for plant growth-promoting rhizobacteria (1)	Managing Director, PT. Maggot Indonesia Lestari – Bioconversion & Derivatives Product of Black Soldier Fly Farming.
11	10.50 AM-11.00 AM	Featured Speaker		Dr. Rumella Simarmata	The effect of consortium of plant growth-promoting rhizobacteria (PGPR) in shallots *(Allium cepa* L.) production and soil health (1)	Research Center for Biotechnology, Indonesian Institute of Science, Cibinong, 16911, Indonesia
	11.00 AM-11.10 AM	DISCUSSION				
12	11.10 AM-11.20 AM	Featured Speaker		Dr. Didi Rahmanto	Influence of Liquid organic biofertilizer (LOB®) as PGPR in rice (*Oryza sativa*) and sweet corn (*Zea mays saccarata*) production (1)	Head of Liquid Organic Biofertilizer R&D, Great Giant Pineapple Company (GGPC). Lampung. Indonesia

13	11.20 AM-11.30 AM	Featured Speaker		Dr. Anto Budiharjo	Bioprospecting and bioformulation of *Bacillus Altitudinis*-P10 as an environmentally friendly biopesticide against leaf blight caused by *Xanthomonas oryzae pv. Oryzae (1)*	Biotechnology Study Program, Faculty of Science and Mathematics, Diponegoro University, Jl. Prof. Sudharto SH, Semarang 50275, Indonesia.
14	11.30 AM-11.40 AM			Dr. Syaffiary	Effect of organic fertilizer products on the growth and health of *Acacia crassicarpa* seedlings (1)	PT Fajar Surya Swadaya, Desa Muara Toyu, Kabupaten Penajam Paser Utara, Kalimantan Timur, Indonesia
15	11.40 AM-11.50 AM			Dr. Hendri Bustamam	The efficacy of the organic fertilizer formula of the decomposer microbial and biological agents consortium on the growth and reduction of leek soft rot (1)	Department of Plant Protection, Faculty of Agriculture, University of Bengkulu. Jl. WR Supratman Bengkulu.
16	11.50 AM-12.00 AM			Dr. M. Khais Prayoga	Enriched Azolla extract as liquid biofertilizer to increase the resilient of a rice farming on flooded prone coastal area as a strategy for adapting to climate change (1)	Research Institute for Tea and Cinchona, Bandung, Indonesia
	11.50 AM-12.00 AM	DISCUSSION				
	12.00 AM-01.00 PM	BREAK				
17	01.00 PM-01.10 PM		**Dr. Anto Budiharjo**	Dr. I Putu Sudiarta	Disease and pest management of cabbage using compost, *Trichoderma* sp. and *Bacillus thuringensis* in Pancasari Village, Buleleng Regency, Bali (1)	Faculty of Agriculture, Udayana University, Indonesia Jl. Panglima Sudirman, Denpasar, Bali, Indonesia
18	01.10 PM-01.20 PM			Dr. Reginawati Hindersah	Evaluation of strawberry seedlings in various planting media amended with biofertilizer (1)	Department of Soil Science, Faculty of Agriculture Universitas Padjadjaran, Sumedang, West Java, Indonesia

19	01.20 PM-01.30 PM			Dr. Susila Herlambang	The Effect of Soil Ameliorant Biochar for Roots Growth on Sustainable Agriculture (1)	Departement of soil science Faculty of Agriculture Universitas Pembangunan Nasional Veteran Yogyakarta 55283 Indonesia
20	01.30 PM-01.40 PM			Dr. Dadan N. Ramdani	Indigenous microbials as liquid organic biofertilizers to enhance the rice growth and productivity (1)	Agrotechnology Program Study of Agricultural Faculty – Universitas Majalengka –Majalengka West Java, Indonesia
21	01.40 PM-01.50 PM			Dr. Yulmira Yanti	Evaluation of PGPR strains on growth of tomato and suppression of bacterial wilt caused by Ralstonia (1)	Department of Plant Protection, Faculty of Agriculture, Andalas University, Padang, West Sumatra, Indonesia 25163
22	01.50 PM-02.00 PM			Dr. Fikrinda	Recovering soil quality of elephant grass cultivated suboptimal land by mycorrhizae and organic fertilizer (1)	Department of Soil Science, Universitas Syiah Kuala, Jl. Tgk.. Hasan Krueng Kalee No. 3, Banda Aceh, 23111, Indonesia
23	01.50 PM-02.00 PM			Dr. Tiwit Widowati	Isolation and characterization of plant growth-promoting endophytic bacteria from Celery (*Apium graveolens* L.) (1)	Reseach Center for Biotechnology, Indonesian Institute of Sciences, Jalan Raya Bogor KM 46 Cibinong, Bogor, Indonesia
	02.00 PM-02.10 PM	DISCUSSION				
24	02.10 PM-02.20 PM			Dr. Sylvia J. R. Lekatompessy	Characterization of endophytic bacteria and growth promoting activity in shallots (1)	Research Centre for Biotechnology-LIPI, Cibinong Jl. Raya Bogor Km.46, Bogor Indonesia
25	02.20 PM-02.30 PM			Dr. Haslina	Influence of the ratio of methanol and concentration of methanol with ultrasonic-assisted extraction on the phytochemical content in cornsilk extracts (1)	Faculty of Agricultural Technology, Semarang University, Semarang 50196, Central Java, Indonesia

26	02.30 PM-02.40 PM			Dr. Narendra Kumar	Effect of chemical fertilizers and biofertilizers on growth and yield of Dahlia (Dahlia Variabilis L.) cv. Kenya orange (1)	Department of Horticulture, Naini Agricultural Institute Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, India
27	02.40 PM-02.50 PM			Dr. Etty Handayani	Shoots Induction of Chrysanthemum on Foliar Fertilizer Media Combined with Coconut Water and Plant Puree by In Vitro Culture (1)	Department of Agrotechnology, Faculty of Agriculture
28	02.50 PM-03.00 PM			Dr. Pauliz Budi Hastuti	Effect of empty fruit bunch and rhizobacteria in growth of oil palm Seedlings in a pre-nursery (1)	Department of Agrotechnology, Faculty of Agriculture, Stiper Agricultural Institute, Yogyakarta, Indonesia
29	02.50 PM-03.00 PM			Dr. Made Ria Defiani	Effect of eco-enzyme on germination of mung bean (*Vigna radiata*) (1)	Biology Department, Math and Basic Sience Faculty, Udayana University
	03.00 PM-03.10 PM	DISCUSSION				
30	03.10 PM-03.20 PM		**Dr. Yan Ramona**	Dr. Rahmad Fadli	The effect of vermicompost dosage and plant spacing on growth of sweet corn (*Zea Mays Saccharata* Sturt) (1)	Faculty of Agriculture Mataram University, Jl. Majapahit 62 Mataram, 83115, Indonesia
31	03.20 PM-03.30 PM			Dr. Elly Roosma Ria	PGPR Bamboo Roots to Increase Growth and Yield of Peanuts DM-1 Situraja Variety (1)	Faculty of Agriculture, University of Winaya Mukti, Sumedang, Indonesia
32	03.30 PM-03.40 PM			Dr. Hersanti	Biocontrol of root-knot caused by *Meloidogyne* spp. in tomato by *Bacillus subtilis* and *Lysinibacillus sp.* formulated with graphite and silica nanoparticles (1)	Department of Plant Pests and Diseases, Faculty of Agriculture, Universitas Padjadjaran, Jln. Raya Bandung-Sumedang Km 21, 45363, West Java, Indonesia

33	03.40 PM-03.50 PM			Dr. Mahendra Bairwa	Effect of plant growth regulators and micronutrients in quality of Strawberry (Fragaria X Ananassa Duch.) cv. chandler (1)	Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, U.P. India
34	03.50 PM-04.00 PM			Dr. Sri Suryanti	Effect of plant growth-promoting rhizobacteria, bio-phosphate microorganism and phosphate on growth of oil palm seedlings under drought stress conditions (1)	Faculty of Agriculture, INSTIPER
35	04.00 PM-04.10 PM			Dr. Ema Lindawati	Effect of *Micrococcus* sp. to promote Pineapple rooting	Product & Development Department, Research & Development PT. GGP, Jl. Lintas Timur KM.77, Lampung Tengah, 34165, Indonesia
	04.10 PM-04.20 PM	DISCUSSION				

ROOM 2

DAY 2 : Sunday, August 29, 2021

Topic 2 : PGPR- Mitigation of Abiotic and Biotic Stresses, Biofungicides, Bioinsecticides, Induced Systemic Resistance

Zoom link :

Chairman Room:

1. Dra. Ni Made Gari,
2. Dra. Ina Narayani,

No	Time (In Bali Time)	Kind of Speaker	Moderator	Name	Title	Address
1	08.00 AM-08.30 AM	Lead Speaker	**Dr. Etty Pratiwi**	Dr. Uma Devi Koduru	Mycopesticide Formulation Suitable for Tropical Conditions for use in Crop Pest Management	Department of Botany, Andhra University, Visakhapatnam, 530003, India

					(2)	
2	08.30 AM-09.00 AM	Lead Speaker		Prof. Meenu Saraf	Essential role of phytohormones and osmolytes in balancing abiotic stress in plants (2)	Department of Microbiology and Biotechnology, University School of Sciences, Gujarat University, Ahmedabad – 380 009, India
	09.00 AM-09.10 AM	DISCUSSION				
3	09.10 AM-09.20 AM	Featured Speaker		Dr. Narasimha Rao	Biocontrol efficacy of *Gliocladium virens* and *Trichoderma harzianum* against *Sclerotium rolfsii* Sacc. a causal agent of collar rot of field bean (2)	Department of Plant Pathology, College of Horticulture, Dr. YSRHU, V.R. Gudem
4	09.20 AM-09.30 AM	Featured Speaker		Dr. Shehzad Mehmood	Elucidation of germination potential and growth of wheat seedlings under salinity stress through *Bacillus mycoides* PM35 - A *in vitro* study (2)	Department of Plant Sciences, Quaid-i-Azam University, Islamabad, 45320, Pakistan
5	09.30 AM-09.40 AM	Featured Speaker		Dr. Muh. Akhsan Akib	EXPLORATION AND PROPAGATION OF NATIVE ENDOMYCORRHIZA TOLERANCE TO HEAVY METAL ON VARIOUS ORGANIC CULTURE MEDIA (2)	Universitas Muhammadiyah Parepare, Parepare, Indonesia
6	09.40 AM-09.50 AM			Dr. Ni Made Delly Resiani	Effect of *Trichoderma* sp. against *Alternaria porri* in red onion (2)	Assessment Institute for Agricultural Technology, Bali, Indonesian Agency for Agricultural Research and Development (IAARD), Ministry of Agriculture, Jalan Bypass Ngurah Rai, Pesanggaran, Denpasar, Bali, 80222 (INDONESIA)

7	09.50 AM-10.00 AM			Dr. Ifra Zoomi	PGPR in Mitigation of Abiotic and Biotic stress in plants (2)	Sadasivan Mycopathology Laboratory, Department of Botany, University of Allahabad–211002, UP, India
	10.00 AM-10.10 AM	DISCUSSION				
8	10.10 AM-10.20 AM		**Dr.Noshin Ilyas**	Dr. Meitini Wahyuni Proborini	The role of Arbuscular Mycorrhizal Fungi (AMF) native to Bali in acceleration growth of Cashew (Anacardium occidentale L.) seedlings (2)	Laboratory of Mycology, Department of Biology faculty of Basic Science University of Udayana Bali
9	10.20 AM-10.30 AM			Dr. Sukmawati	Biodiversity and Characterization of Indigenous Arbuscular Mycorrhizal Fungi of on Agricultural Soils in Central Lombok (2)	Faculty of Agriculture Post Graduate Study, Udayana University Bali
10	10.30 AM-10.40 AM			Dr. Arunasri	Effect of *Trichoderma asperellum* GT_4 against stem rot of groundnut caused by *Sclerotium rolfsii* Sacc. (2)	Department of Plant Pathology, S. V. Agricultural College, ANGRAU, Tirupati, A. P. India
11	10.40 AM-10.50 AM			Dr. Bony Cyriac	Plant growth promoting rhizobacteria (PGPR) of the acidic saline soils of Pokkali rice (*Oryza sativa* L.) in Kerala, India (2)	Department of Agricultural Microbiology, College of Agriculture, Kerala Agricultural University, Thrissur, Kerala, India
12	10.50 AM-11.00 AM			Dr. Asmiaty Sahur	Response of Soybean (Glycine max) on biopriming applications with *Trichoderma harzianum* and Streptomyces sp.((2)	Department of Agronomy, Hasanuddin University, Makassar 90245, Indonesia
	11.00 AM-11.10 AM	DISCUSSION				
13	11.10 AM-11.20 AM			Dr. Pranab Dutta	*Trichoderma* spp: a potential bio-fungicide for the management of soil-borne plant pathogens *(2)*	School of Crop Protection, College of Post Graduate Studies in Agricultural Sciences, Central Agricultural University (Imphal), Umiam, Meghalaya-793103, India

14	11.20 AM-11.30 AM			Dr. Ali Tan Kee Zuan	BENEFICIAL CHARACTERISTICS OF SALT-TOLERANT *BACILLUS ARYABHATTAI* IN REDUCING SALINITY EFFECT ON RICE (2)	Department of Land Management, Faculty of Agriculture, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia
15	11.30 AM-11.40 AM			Dr. Henny Hendarjanti	Influence of Arbuscular Mycorrhiza Fungi and Trichoderma spp. to control basal stem rot disease in oil palm (2)	PT. Astra Agro Lestari Tbk. Jl.Pulo Ayang Raya Blok OR/I Pulogadung Industrial Area, East Jakarta 13930
16	11.40 AM-11.50 AM			Dr. Luluk Setyaningsih	The dependence of trembesi (*Samanea saman*) and johar (*Cassia siamea*) seedlings on arbuscular mychorriza fungi in gold mine tailings media(2)	Faculty of Forestry, Nusa Bangsa University, Jl. Baru Km 4, Tanah Sareal, Bogor. Indonesia. 16166
17	11.50 AM-12.00 AM			Anne Nurbaity	Effect of Arbuscular Mycorrhiza and Magnetic Field on P Uptake, Ascorbic Acid Content, and Tomato Yield (*Lycopersicum escullentum*. Mill) Grown on Andisols (2)	Department of Soil Science, Faculty of Agriculture, Universitas Padjadjaran Jl. Raya Jatinangor km. 21 Sumedang 45363
	12.00 AM-01.10 PM	DISCUSSION				

ROOM 3

Day 2 Sunday, August 29, 2021

Topic 3: Recent Advances in PGPR-Soil and Plant Microbiome, Rhizophere Enginering, Nanotechnology

Zoom Link:

Chairman Room:

1. Dr. Ni Luh Arpiwi
2. Dr. Fainmarinat Inabuy

No	Time (In Bali Time)	Kind of Speaker	Moderator	Name	Title	Address
1	08.00 AM-08.30 AM	Lead Speaker	**Dr. Ni Luh Arpiwi**	Prof. H. B. Singh	Recent advances in PGPR: commercialization, regulatory requirements and IPR issues (3)	Department of Biotechnology, GLA University, Mathura-281406, India
2	08.30 AM-09.00 AM	Lead Speaker		Dr. K. R. K. Reddy	Crop microbiomes - modification and optimization for improved crop productivity (3)	Prof. Bir Bahadur centre for crop Microbiome and Nano research, Sri BioAesthetics Pvt.Ltd. Hyderabad, India
7	09.00 AM-09.30 AM	Lead Speaker		Dr. Saxena	Quantification of ecosystem services rendered by soil microorganisms (3)	ICAR. National Bureau of Agriculturally Important Microorganisms, Mau, Uttar Pradesh-275103, India
	09.30 AM-09.40 AM	DISCUSSION				
8	09.40 AM-09.50 AM	Featured Speaker		Dr. Selvasundaram Rajagopal	Enhancing soil and crop health by strategic microbiomes from microbial fermentation collection (3)	Agrinos (American Vanguard Company) India Private Limited., 217, DLF Tower A, Jasola District Centre, New Delhi – 110025, India
9	09.50 AM-10.00 AM	Featured Speaker		Dr. Shamarao Jahagirdar	Recent happenings in exploration of endophytes and biocontrol based green nanoparticles in management of soybean diseases and productivity	Pandit Jawaharlal Nehru College of Agriculture & Research Institute, Karaikal-609 603

					enhancement in India - an overview (3)	
10	10.00 AM-10.10 AM	Featured Speaker		Dr. Etty Pratiwi	Isolation, Screening and Biochemical Characterization of Methane-Utilizing Bacteria from Sediment of Lowland Rice	Indonesian Soil Research Institute, Bogor 16114, Indonesia
11	10.10 AM-10.20 AM		**Dr. Yuni Sri Rahayu**	Dr. Bambang Heri Isnawan	Intermittent Irrigation for Improvement of Rhizobacteria Population Dynamics and Rooting of Some Rice Varieties (Oryza sativa L.) (3)	Department of Agrotechnology, Faculty of Agriculture, Universitas Muhammadiyah Yogyakarta, Yogyakarta, Indonesia.
12	10.20 AM-10.30 AM			Dr. Risky Hadi Wibowo	Selection and characterization of phosphate solubilizing bacteria isolated from chili (*Capsicum Annuum* L.) from plantation of Rejang Lebong district (3)	Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Bengkulu, Kandang Limun, Bengkulu 38112, Indonesia
13	10.30 AM-10.40 AM			Dr. Bowya	Rhizosphere engineering of rice to harness the plant-growth promoting *Pseudomonas chlororaphis* for effective colonization and soil health improvement (3)	Department of Agricultural Microbiology, Thanthai Roever Institute of Agriculture and Rural development, Perambalur- 621 115, Tamil Nadu, India
14	10.40 AM-10.50 AM			Dr. Tri chandra setiawati	Potential of *Bacillus* as Plant Growth Promoting Rhizobacteria (PGPR) to improve P and K nutrient in acid and saline soil (3)	Soil Science Department, Faculty of Agriculture, University of Jember, Kalimantan 37, Jember, East Java, Indonesia, 68121
15	10.50 AM-11.00 AM			Dr. Dissanayake	Use of SELECTED rhizosphere bacteria as bio-inoculants in organic rice cultivation (3)	Sustainable Agriculture Research and Development Centre, Makandura, Gonawila, Sri Lanka
	11.00 AM-11.10 AM	DISCUSSION				

ROOM 5
Day 2 Sunday, August 29, 2021
Topic 5: PGPR in Resilient Agricultural Practces-Challenges in Lab to Land Transfer, Success Stories

Zoom Link:

Chairman Room:

1. Dr. Made Pharmawati
2. Dr. I Ketut Ginantra

No	Time (In Bali Time)	Kind of Speaker	Moderator	Name	Title	Address
1	08.00 AM - 08.30 AM	Lead Speaker	**Prof. Jean W. H. Yong**	Prof. K. Yella Reddy	Climate smart agricultural water management best practices, policy framework and way forward (5)	Dean, ANGRAU and Vice President Hon., ICID, AP., India
2	08.30 AM - 09.00 AM	Lead Speaker		Dr. Suseelendra Desai	Bioinoculants for enhanced farm-productivity and -profitability with emphasis on climate change (5)	Former Head, Division of Crop Sciences, ICAR-Central Research Institute for Dryland Agriculture, Santoshngar, Hyderabad 500059, India
	09.00 AM- 09.10 AM	DISCUSSION				
3	09.10 AM - 09.20 AM	Featured Speaker		Dr. Ravindra Chandra Joshi	Organic home gardens for family food and nutrition security in COVID-19 pandemic: Solomon Islands Experience (5)	Senior Consultant, Philippine Rice Research Institute, Philippines Pacific Islands Coordinator, SAFE-Network, Indonesia Visiting Professor, Central Bicol State University of Agriculture, Philippines
4	09.20 AM - 09.30 AM	Featured Speaker		Dr. Irina Smirnova	Associations of agronomically important microorganisms for increasing the productivity of soybean (5)	LLC “Research and Production Center for Microbiology and Virology"
5	09.30 AM - 09.40 AM			Dr. I Wayan Suardika	SUSTAINABILITY AND POLICY DIRECTION OF SOCIAL FORESTRY MANAGEMENT IN YEH SUMBUL VILLAGE OF JEMBRANA REGENCY (5)	Faculty of Agriculture Udayana University

6	09.40 AM - 09.50 AM			Dr. Serlina Hestiani Oktian	Aboveground carbon stock estimation model with Sentinel-2A Imagery in Bentang Alam Mbeliling of East Nusa Tenggara (5)	Faculty of Forestry, Nusa Bangsa University, Jl. Baru Km 4, Tanah Sareal, Bogor. Indonesia. 16166
7	09.50 AM – 10.00 AM			Dr. Sesha Kiran Kollipara	Status of Gummy stem blight disease of cucurbits in India (5)	College of Horticulture, Venkataramannagudem, Dr. Y. S. R. Horticultural University, Andhra Pradesh, India
8	10.00 AM - 10.10 AM			Dr. Sujatha	Evaluation of decomposed coconut biowaste amended with fungal isolates in growth of cowpea (5)	NAHEP- CAAST, Coconut Mission, College of Agriculture, Padannakkad, Kasaragod 671 314, Kerala Agricultural University, Kerala, India
9	10.10 AM - 10.20 AM			Dr. Sanjay-Swami	Biochar potential for enhancing tomato productivity and soil acidity indices in acid inceptisol of Meghalaya, India (5)	School of Natural Resource Management, College of Post Graduate Studies in Agricultural Sciences, Central Agricultural University, Umiam (Barapani) – 793 103, Meghalaya, India
10	10.20 AM – 10.30 AM			Dr. Triastuti Rahayu	Characterization and efficacy of endophytic bacteria isolated from banana roots in banana and black rice (5)	Research Center for Biotechnology, Universitas Gadjah Mada, Yogyakarta, 55281, Indonesia
	10.30 AM - 10.40 AM	DISCUSSION				
11	10.40 AM - 10.50 AM		**Dr. Kumari Sunita**	Dr. Pujawati Suryatmana	Potential of various organic stimulators to enhance the performance of N-fixing bacteria in soybean (5)	Soil Science and Land Resources Department, Agriculture Faculty Universitas of Padjadjaran, jl. Raya Bandung-Sumedang Km.21, Jatinangor, West Java, Indonesia
12	10.50 AM - 11.00 AM			Dr. Deepika sahu	Effect of NPK and organic manures in growth and yield of flowers in *Dahlia variablis* L. (5)	Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, India

13	11.00 AM – 11.10 AM			Dr. Vishnuvardhan reddy	Genetic variability, heritability and correlation studies in tomato (*Solanum Lycopersicum* L.) (5)	Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, India
14	11.10 AM - 11.20 AM			Dr. Deden D. Eris	Biotechnology Based Replanting for the Improvement and Sustainability of Oil Palm Productivity in Ganoderma Endemic Land (5)	Indonesian Research Institute for Biotechnology and Bioindustry, Jl. Taman Kencana No.1 Bogor 16128
15	11.20 AM - 11.30 AM			Dr. Widhiantini	Performance of Agriculture Sector in Bali (5)	Department of Agribusiness, Faculty of Agriculture Udayana University, Gedung Agrokompleks Sudirman Denpasar Bali, Indonesia
16	11.30 AM – 11.40 AM			Dr. I Wayan Sunanjaya	Utilization of mini air buds from the bottom of Bp308 as a prospective seed to support sustainability and increase farmers income in the Pupuan Robusta Coffee area - Tabanan (6)	Assessment Institute for Agricultural Technology, Bali, Indonesian Agency for Agricultural Research and Development (IAARD), Ministry of Agriculture, Jalan Bypass Ngurah Rai, Pesanggaran, Denpasar, Bali, 80222 (INDONESIA)
	11.40 AM – 11.50 AM	DISCUSSION				

ROOM 6
Day 2 Sunday, August 29, 2021
Topic 6: PGPR and Evergreen Revolution : Organic Production, Safe Food and Eco-Tourism

Zoom Link:

Chairman Rooom:

1. Dr. Ida Ayu Astarini
2. Ni Kadek Desy Andya Dewi

No	Time (In Bali Time)	Kind of Speaker	Moderator	Name	Title	Address
1	08.00 AM - 08.30 AM	Lead Speaker	**Dr.Popiha Bordoloi**	Dr. Hameeda Bee	Probiotics and postbiotics: a new approach to understand and manage plant microbe interactions (6)	Department of Microbiology, UCS, OU, Hyderabad
2	08.30 AM - 09.00 AM	Lead Speaker		Prof. Iin P. Handayani	Ethnobotany for Agritourism and Sustainable Food Resources: Valuing Indigenous Plants (6)	Murray State University, Kentucky, USA
3	09.00 AM - 09.30 AM	Lead Speaker		Dr. Ni Luh Suriani	PGPR and Bali - ecotourism (6)	Udayana University, Mathematics and Natural Sciences Faculty, Biology Study Program, Indonesia
	09.30 AM – 09.40 AM	DISCUSSION				
4	09.40 AM - 09.50 AM			Dr. I Gede Ketut Adiputra	Agroforestry to support Balinese culture and maintain trees protection against air pollution (6)	Department of Biology, Faculty of Information Technology and Sciences, University of Hindu Indonesia Denpasar. Jl. Sangalangit, Tembau, Penatih, Denpasar, Bali, Indonesia
5	09.50 AM - 10.00 AM			Dr. Komang Dean Ananda	Analyzation of Object Operation Area and Natural Tourist Attraction (ADO-ODTWA) spots in the coastal area of Yeh Bakung beach (6)	Agrotechnology Study Program, Faculty of Agriculture and Business, Universitas Mahasaraswati, Denpasar
6	10.00 AM - 10.10 AM			Dr. Herlina Tarigan	Sustainable dry agriculture system in the Citarum upper areas: social, economic and environmental problems (6)	Indonesian Center for Agricultural Socio-Economic and Policy Studies, Jln. Tentara Pelajar No.3B Cimanggu, Bogor, Jawa Barat, Indonesia

7	10.10 AM - 10.20 AM		**Dr. Yulmira Yanti**	Dr. Gusti A.M.K. Dewi	PERFORMANCE AND QUALITY OF JAPANESE QUAIL EGGS TREATED WITH FERMENTED DRAGON FRUIT PEEL (*Hylocereus* SP) JUICE IN DRINKING WATER (6)	Poultry Science Laboratory Faculty of Animal Science, Udayana University, Bali- Indonesia
8	10.20 AM - 10.30 AM			Dr. Ni Made Suaniti	Analysis of Virgin Coconut Oil-Lemongrass compared to standard quercetin by Gas Chromatography Mass Spectrometry (6)	Chemistry Department, University of Udayana, Campus Bukit Jimbaran, Badung 80361 Bali, Indonesia
9	10.30 AM - 10.40 AM			Dr. Vita Meylani	Natamycin treatment for control of *Rhizopus* sp. mold on strawberries (*Fragaria virginiana)* (6)	Department of Biology Education, Faculty of Education and Teacher Training, Universitas Siliwangi
	10.40 AM – 10.50 AM	DISCUSSION				
10	10.50 AM – 11.00 AM			Dr. Ketut Ratnayani	Antioxidant activity and amino acid composition of okara protein hydrolysate (6)	Chemistry Department, Faculty of Mathematic and Natural Sciences, Udayana University, Jimbaran, Bali, Indonesia
11	11.00 AM - 11.10 AM			Dr. I Ketut Widnyana	Isolation of β-carotene in non-polar fraction of Gardenia jasminoides Ellis leaves extract (6)	Staff at Food Analysis Laboratory, Agriculture Technology Faculty, Udayana University, Bali-Indonesia
12	11.10 AM - 11.20 AM			Dr. Adi Parwata	The Potential of Flavonoids Flavonol in Gyrinops versteegii Tea Leaves as a Natural Antioxidants and Antibacterial (6)	Chemistry Department, Faculty of Mathematic and Natural Science, Udayana University, Indonesia
13	11.20 AM - 11.30 AM			Dr. Winny Andalia	Immuno-modulators perspective inspired by probiotic - a review on bovine colostrum (6)	Industrial Department, Tridinanti of University, Jalan Kapten Marzuki No 2446, Palembang, 30129, Indonesia
14	11.30 AM - 11.40 AM			Dr. Purwo Aprianto	The Potential of the Punggualas Area as a Natural Tourism	University Of Palangka Raya

15	11.40 AM – 11.50 AM			Dr. Awadhesh Kumar Pal	PGPR Based Phytohormones Play Critical Physiological Roles in Plant growth and Development Under Extreme Environments	Bihar Agricultural University, Sabour, Bhagalpur-813210, India
	11.50 AM – 12.00 AM	DISCUSSION				

ABSTRACTS - ROOM 1

Potential of Rhizobacteria as Bio-Agents for Sustainable Plant Production System

Dewa Ngurah Suprapta[1] and Ni Luh Suriani[2]
[1]Laboratory of Biopesticide, Faculty of Agriculture, Udayana University, Bali, Indonesia
[2] Biology Study Program, Faculty of Mathematic and Natural Sciences, Udayana University, Bali
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Plant production is important to provide enough food, industrial raw material, medicine, cosmetics, housing, as well as closely related to the culture and ecosystem conservation. Based on this reason, plant production should be managed in a sustainable way to sustain human lives as well as conserve natural resources. Since the green revolution was implemented in 1970's, synthetic chemical fertilizers and pesticides have been used intensively in plant production particularly for food crops production. The crop yield has been successfully increased, however many adverse effects of the miss use of synthetic chemicals in agriculture have been occurred such as human death, water and soil contamination, extinction of several useful animals, development of resistances against pesticides among plant pests etc. To reduce these adverse effects, the use of synthetic chemicals in agriculture should be reduced through the development of alternative bio-agents, which are more friendly to the environment. Indonesia has a huge potential of biodiversity including biodiversity of rhizobacteria that can be explored to produce bio-agents for maintaining plant production system in a sustainable way. Several research activities have been done in our laboratory to develop bio-agents such as bio-pesticides, bio-fertilizers, and bio-stimulants. A total of 1,255 isolates were isolated from rhizospheres of several plants grown in Bali Island Indonesia and tested for their potential as bio-pesticides, biofertilizers, and bio-stimulants in several plants such as rice, chilli pepper, tobacco, soybean and maize. Laboratory tests were conducted to confirm their ability to produce IAA, to fix nitrogen, to produce antifungal substances, and to produce siderophores, while green house as well as field tests were conducted to evaluate their effectiveness under *in vivo* and *in situ* condition. Identification of potential rhizobacteria was conducted based on analysis of 16S rRNA. The ultra-structural observation using scanning electron microscope was also done to evaluate the colonization of rhizobacteria on the plant root and the effects of rhizobacteria to the structures of plant pathogenic fungi. This information would be presented in this conference. In addition, effectiveness of rhizobacteria to promote plant growth and increase the yield under field condition in particular for rice production would also be shared.

Understanding The Role of Biostimulants in Photosynthesis, Nutrition, and Growth of Plants

Jean W. H. Yong[1,2,3]

[1]Department of Biosystems and Technology, Swedish University of Agricultural Sciences, Alnarp, Sweden, [2]ARC Centre for Mine Site Restoration, School of Molecular and Life Sciences, Curtin University, Perth, WA, Australia and [3]School of Biological Sciences, Faculty of Science, University of Western Australia, Perth, WA, Australia
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Applying organic amendments and microbial inoculation as sources of biostimulants (BSs) to plants is a common practice although the precise mechanism(s) in biostimulation is/are unclear. BSs can stimulate growth, altering gas exchange, improving nutrient bioavailability, and producing the desired developmental feature (e.g. flowering) even in small amounts. BSs are derived from a range of materials: living microbial cultures, extracts of microbes, organic materials (composts, vermicomposts, seaweeds, humic and fulvic acids), protein hydrolysates and some industrial by-products. Globally, this widely utilized practice is supported by many studies reporting positive growth effects in many horticultural, agricultural and ecological context. Some benefits reported included enhanced gas exchange characteristics, greater nutrient availability and uptake, leading to favourable growth, activation of natural defenses against diseases, and enhanced stress tolerance (e.g. drought). Many of the observed enhancements in growth and development cannot be solely attributed to the reported benefits of enhanced inorganic mineral nutrition. Selected case studies of cultivation and analyses involving the use of BSs are discussed here for selected species. With the interesting trends observed, we deduced that phytohormones are one of the likely group of BSs responsible for the growth enhancement often observed in tissue cultures and for the whole-plant.

Biological Control of Bacterial Wilt of Tomato Through Plant Growth-Promoting Rhizobacteria

Dinesh Singh

Division of Plant Pathology, Indian Agricultural Research Institute, New Delhi -110012, India

Email: dinesh_iari@rediffmail.com

Tomato (*Solanum lycopersicum* L.) is rich source of vitamins, minerals, anthocyanin, phenols, and amide proteins and called them as protective food and its fruits consist of many phytochemicals such as lycopene (60 - 64%, phytoene, neurosporene and carotenes) and pro-vitamin A and vitamin A. The crop suffers from many bacterial diseases including bacterial wilt caused by *Ralstonia solanacearum* and damages the crop about 2- 60%. This diseases cause epidemics under favourable environmental conditions causing total crop loss, quality of the produce and reduce market value of the produces. For management of the wilt disease, various control measures were applied like cultural practices, use of resistant cultivars, chemical method and biological control. Among them, biological control not only increases crop yield and suppresses diseases but also avoids environmental pollution. To manage these bacterial diseases, biological control through the plant growth-promoting rhizobacteria *Pseudomonas fluorescens, Bacillus subtilis, B. amyloliquefaciens, B. licheniformis, B. cereus, B. subtilis* and *Pantoea* sp. are found to be relatively effective in controlling *R. solanacearum* populations under natural conditions. In case of bio-efficacy of these strains of antagonistic bacteria, minimum wilt intensity (46.0%) in tomato cv. Pusa Ruby was found in treated with *P. fluorescens* DTPF-3 treated soil followed by *B. subtilis* DTBS-5 under glasshouse conditions. To improve efficacy of biocontrol, mix application of bioagents, combine it with resistant genotypes and using botanicals and cultural practices are effectively manage the bacterial diseases particularly wilt disease in tomato crop and also effectively promote the plant growth.

Plight of Biofertilizer Scientists and Entrepreneurs to Review World Vide Biofertilizer Regulations

Lalit Kumar Singhania[1] and [2]M.S. Reddy

205 Samata Colony, Raipur City, Chhattisgarh, India and Founder & Chairman, Asian PGPR Society, Consultant & Entrepreneur, Auburn University, Auburn, AL, USA

lalit1954@gmail.com & prof.m.s.reddy@gmail.com

My talk is based on the fact that in the market driven economy; all research and developments get oriented to what sells? and what pays? and what is in public demand? In-spite of a great advancements in microbiological based research and technology developments in the field of agriculture, it has not yet caught the pace which it deserves. It is also a matter of serious concern; about GHG emission, environmental damage, salinity to soils and other damages caused by excessive or un-controlled use of chemical fertilizers in-spite of available sustainable alternative solutions to reduce its excessive uses by way of microbial intervention. Hence, I wish to draw of your kind attention of the entire Microbiology scientific community as well as biofertilizer producing scientists, entrepreneurs to analyse as why is that the majority of common farmers are reluctant to use the bio-inputs despite the good results presented by the scientists as well as good experience from a few fellow farmers. What are the barriers for the wider adoption to it? Is it the lack of awareness or is it the cost or is it the regulations or is it the spurious material dumped in market which have failed to give good results? It is time to assess why are the young biofertilizer based entrepreneurs are facing hardships in their survival and many of them are not able to run their units viably well? All these issues are more important than further research in labs because the time has ripe to stop getting our health ruined and environment ripped off by excessive use of chemical fertilizers. It is time to take all available knowledge to the fields and to the farmers and ensure its adoption. My humble request to all scientists and entrepreneurs to work hand in hand to impress all Governments to frame a global protocol for microbiological based biofertilizers as well as biostimulants to ensure of their good quality with affordable prices, so that the excessive use of chemical fertilizers could be reduced for safeguarding the environment which will automatically help the entrepreneurs of the biofertilizers and the scientists working in this field.

Scope and Prospects of Organic Farming in Northeast India

K. R. S. Sambasiva Rao

Mizoram University (A Central University), Aizawl, Mizoram, India

Excessive and uncontrolled use of pesticides in production of agricultural commodities arises the need to adopt organic farming as an environment friendly approach of cultivation. Organic farming is in its nascent stage in India and as per Union Ministry of Agriculture and Farmers only 2% of total showed land area is under organic cultivation. Northeast India due to its immense resources has great potential to adopt organic farming. There is an urgent need to promote organic farming in Northeast India by giving proper hands-on training programs to the farmers. It is necessary to focus and give emphasis on hands-on training be providing awareness among farmers about shifting from conventional management to organic management of agricultural land; ensuring the surrounding biodiversity; emphasized on crop rotation, residue management, use of organic manures and biological inputs like PGPMs. Native Plant Growth Promoting Microorganisms (PGPMs) needs to be explored for the development of location specific bio-fertilizers. The location specific bio-fertilizers will provide an additional benefit in maintaining the soil microbial diversity which in turn can enhance the crop productivity. The recent developments in the field of biological inputs and the practices followed in Mizoram, Northeast India will be discussed in detail during the conference.

Biofertilizers - An Eco-friendly Tool in Agriculture to Improve Fertility of Soil

Arvind M. Deshmukh

President, Microbiologists Society, India
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Chemical fertilizers are widely used in developing countries in agriculture. Chemical fertilizers are proved to be damaging human, animal and plant health. They are costly and many times unavailable to the farmers. Biofertilizers or microbial inoculunts are eco-friendly and cheaper. There are many microorganisms in the nature used to improve fertility of soil. There are different types of biofertilizers such as phosphate solubilizer, nitrogen fixers, sulphur, potassium suppliers and organic matter decomposers. Blue green algae, Azotobacter, Rhizobium, Azospirillum, Acetobacter, Frankia, Phosphate solubilizing microorganisms and VAM fungi are used as biofertilizer. Now liquid biofertilizers are also present in the market. We have isolated various actinomycetes from saline soils of Maharashtra and studied their phosphate solubilizing activity. Two efficient actinomycetes were identified by Colonial, morphological and biochemical characters. It was observed that these species significantally enhanced the growth of plants in pot studies.

Hands on Experiences in PGPR Based Natural Farming for 21st Century Sustainable Agriculture in Chittoor District of Andhra Pradesh, India

Jagadeesh Reddy and M. S. Reddy

Danduvaripalli, Chittoor District, AP., India and Asian PGPR Society for Sustainable Agriculture, Auburn University, USA
Jagred2006@gmail.com & prof.m.s.reddy@gmail.com

Natural farming is related to fertility farming, organic farming, sustainable agriculture, agroecology, agroforestry, ecoagriculture and permaculture, but should be distinguished from biodynamic agriculture. The system works along with the natural biodiversity of each farmed area, encouraging the complexity of living organisms both plant and animal that shape each ecosystem to thrive along with food plants. Natural farming is an ecological farming approach with the avoidance of manufactured inputs and equipment. It is related to fertility farming and sustainable agriculture. Essentially, natural farming is to grow crops without fertilizers, pesticides, or herbicides. Observing the conditions of the local ecosystem, and mimic nature rather than heavily relying on outside nutrients and artificial chemicals does the trick. When done properly, natural farming saves up to 90%of water, electricity, and expenditure. It also avoids pollution, prevents loss of biodiversity, and reduces soil erosion and all of this, without sacrificing the output of yield. My presentation is to demonstrate step-by-step on how to turn a farm into a completely natural, chemical-free farm that produces highly nutritional food. Understanding the healthier and beneficial alternatives to chemical fertilizers and other invasive substances on crops of important. There are key differences between natural and organic farming. Natural and organic are chemical or poison free farming methods. Both systems discourage farmers using chemical fertilizers, pesticides in their farming practices. In organic farming, organic fertilizers, and manures like compost, vermicompost, hybrid cow dung manure, etc. are used and added to farmlands from external sources. In natural farming, neither chemical nor organic fertilizers are added to the soil. In natural farming, decomposition of organic matter by PGPR and earthworms is encouraged right on the soil surface itself, which gradually adds nutrition in the soil over the period. Organic farming still requires basic agro practices

like ploughing, mixing of manures, weeding, etc. to be performed. In natural farming there is no ploughing, no fertilizers, and weed removal is manually done. Organic farming is still expensive due to the requirement of specific manures, and it has an ecological impact on surrounding environments; whereas, natural agriculture is an extremely low-cost farming method, completely based on local biodiversity. There are many working models of natural farming all over the world, the SPNF is the most popular model in India. Farming is always my major interest since childhood. Therefore, I joined the family farm with my father who was a chemical farmer. Having seen the deadly effects of pesticides and artificial fertilizers lately, I decided to become a natural farmer following natural farming methods. My strongest desire is to save the soil from these chemicals and pesticides. Over the years I have conducted many workshops all over India and supported many farmers in converting their chemical farms into natural farms. This transformation has attracted the attention of various social media platforms, IAS officers, Doctors, IT employees and people from various professions to come and visit my natural farm and to buy some quality naturally grown chemical free food. Now, many farmers around my village are practicing natural farming under my guidance and I stand as an inspiration to many farmers cooperative groups. Due to my efforts, several Governments and Social Organizations awarded me several awards. I am indebted my mentor, Prof. M. S. Reddy, the Founder and Chairman of Asian PGPR Society for his continued mentorship and support in my day-to-day activities. Balanced, living soils produce healthy crops with minimal disease and insect problems, and support strong livestock. The result is nutritious, good-tasting, health-promoting food, and nontoxic fibre for clothing and other textiles.

Plant Growth-Promoting Rhizobacteria (PGPR): A Potential Role in Crop Improvement and Sustainable Agriculture

Kumari Sunita and M.S. Reddy

Plant Physiology, Biochemistry and PGPR Lab, Department of Botany, DDU Gorakhpur University, Gorakhpur, U.P., India & Asian PGPR Society for Sustainable Agriculture, Auburn University, AL, USA
ksunita78@gmail.com & prof.m.s.reddy@gmail.com

The green revolution of the 20th century enabled unprecedented gains in global food production. The green revolution comprised of two main advances: chemical inputs and improved crop plants. through plant breeding and advanced genetic manipulations. However, gains associated with fertilizer inputs carry high environmental costs. A new revolution in agricultural innovation will be needed to sustain the food, fiber, and fuel needs of a growing global population and a changing climate through the 21st century. A new green revolution, such as PGPR based microbial revolution, needs to be based on fewer intensive inputs with reduced environmental impact. Diverse genera of bacteria have been recognized as PGPRs, some symbiotic (*Rhizobium, Bradyrhizobium, Mesorhizobium*), others non-symbiotic (*Pseudomonas, Bacillus, Klebsiella, Azotobacter, Azospirillum, Azomonas*). These PGPR are now being used worldwide as bio-inoculants to promote plant growth and development under various biotic and abiotic stresses. PGPR shows an important role in the sustainable agriculture industry. The increasing demand for crop production with a significant reduction of synthetic chemical fertilizers and pesticides use is a big challenge nowadays. The use of PGPR has been proven to be an environmentally sound way of increasing crop yields by facilitating plant growth through either a direct or indirect mechanism. The mechanisms of PGPR include regulating hormonal and nutritional balance, inducing resistance against plant pathogens, and solubilizing nutrients for easy uptake by plants. In addition, PGPR show synergistic and antagonistic interactions with microorganisms within the rhizosphere and beyond in bulk soil, which indirectly boosts plant growth rate. The potentiality of PGPR in agriculture is steadily increasing as it offers an attractive way to replace the use of chemical fertilizers, pesticides, and other supplements. Recent progress in our

understanding on the diversity of PGPR in the rhizosphere along with their colonization ability and mechanism of action should facilitate their application as a reliable component in the management of sustainable agricultural system. Marketing and commercialization are other important factors for PGPR based technologies. However, their success is heavily dependent on advancement and improvements in interdisciplinary research, formulation, large-scale production, awareness, and education of farming community for their use. Sustainable approaches are those that are not aimed solely at maximizing short-term production but rather those that consider long-term production gains, safeguard the ecology of agricultural systems, and profitability of farmers. There is an urgent need to promote integrated pest/disease management at a faster rate and it is driven by emphasizing organically produced food, conservation of biodiversity, unpolluted environment, and sustainable agriculture.

Evaluation of Different Indigenous *Streptomyces* spp. for The Biological Control of Rhizome Rot Disease of Turmeric (*Curcuma longa* L.) in India

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Turmeric is utilized as one of the spice materials which comes from rhizomatous turmeric plants (*Curcuma longa* L.). It is very commonly used in almost all Asian foods as curry powder. It is an herbaceous annual plant belongs to the family Zingiberaceae. Curcumin and oleoresin contents are identified as the active principle of turmeric. In India, States of Orissa, Karnataka, Kerala, Maharashtra, Andhra Pradesh, Telangana, Tamil Nadu and West Bengal are the other major producing states of turmeric in India. In the world turmeric trade, India has occupied nearly 60% of the whole global market and is being exported to various European countries in huge amount. Due to its economic importance, it is well explored and studied in Asian, African and European countries. India holds the first position in area which is used for cultivation of turmeric. Rhizome rot disease of turmeric is caused by a fungal pathogen, *Pythium graminicolum* f.sp. *aphanidermatum* which is more prevalent in turmeric growing areas of India. It is a serious problem in certain pockets of southern India and there was a significant reduction in turmeric export since 2010 due to this disease severity. Adequate soil moisture content along with rhizome rot disease severity are the most significant factor affecting rhizome yield. The important turmeric varieties grown in India are, Alleppey Finger (Kerala), Erode and Salem turmeric (Tamil Nadu) Raja pore and Sangli turmeric (Maharashtra) and Nizamabad Bulb (Andhra Pradesh). Actinomycetes, particularly Streptomyces spp. by virtue of their wide distribution in soil system and antibiotic production, may participate activity in establishing the microbiological equilibrium in soil among other beneficial microorganisms. During the establishment of microbiological equilibrium in soil by Streptomyces spp. it has been ascribed to the control the minor pathogens in the rhizosphere soil and/or to increase the soil fertility. An attempt has been made to isolate Streptomyces spp. from various turmeric plantation soils of southern India and to characterize those isolates at species level subsequently to screen the potential strains of Streptomyces spp. for the antagonistic activity against rhizome rot disease of turmeric caused by a fungal pathogen, *Pythium aphanidermatum*. To evaluate the efficacy of bioformulations containing purified Streptomyces strains under field conditions against rhizome rot disease was carried out and to document the finger and mother rhizomes yield potential. Also assessed the curcumin and oleoresin contents in the rhizomes. The results indicated that *S. lydicus*, *S. griseus* and *S. sannanensis* were able to control the rhizome rot disease incidence significantly under field conditions when compared to

Pseudomonas fluorescens and *T. atroviride*. Among biocontrol agents tested against *P. aphanidermatum*, actinomycete strains gave the highest rhizome yield. Also, other attributes such as productivity index along with rhizome quality includes number of primary, secondary and tertiary finger rhizomes significantly followed by fungal and bacterial antagonists which in turn enhanced the curcumin and oleoresin contents in the rhizomes.

Vegetative Growth of Potato Plants in Medium Land by Plant Growth Promoting Rhizobacteria (PGPR) and *Trichoderma* sp. Application

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Potato plants are horticulture plants that has high economic value and relatively stable selling power. However, potato productivity value in Indonesia currently is categorized as low, if compared to potato productivity in other potato producing countries in Asia. One of the reasons is environmental sustainability factor that lead to the extensification of potato farms in the highland can't be done, so that the medium land become an alternative for potato cultivation land exploration. Aside from selecting for good seeds, giving PGPR and *Trichoderma* sp. as biological fertilizer is a strategic effort for increasing potato productivity in medium land. This research aims to know potato plants vegetative growth in medium land by combination of PGPR and *Trichoderma* sp. application local product from farmer in Magelang, Central Java. This research was held at 480 masl in Sawangan Subdistrict, Magelang District, Central Java. This research used Completely Randomized Design with 4 treatments, PO = Control, P1 = Kocor PGPR 20 ml/10 litres of water, P2 = Kocor PGPR 40 ml/10 litres of water, and P5 = Kocor PGPR 20 ml/10 litres of water + *Trichoderma* sp. 80 gram/10 litres of water. The results showed that combination treatment of PGPR and *Trichoderma* sp. provide optimal vegetative growth than PGPR treatment.

Role of PGPR, PGPF and Microbial Biostimulants for Sustainable Crop Production and Soil Health

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Pathogens are not real cause of plant diseases, they only attack to unsuitable varieties or improperly grown crops. Their true role in agriculture is that of censor for pointing out the crops which are imperfectly nourished. Disease resistance seems to be the natural reward of healthy and well-nourished protoplasm, and this is where the role of plant biostimulants become significant. Plant biostimulants are efficient, favouring the good performance of the plant's vital processes, allowing high yields, abiotic stress tolerance and good quality produce. The use of plant biostimulants has gained substantial and significant heed worldwide as an environmentally friendly alternative for

sustainable agricultural production. At present, there is an increasing curiosity in industry and researchers about microbial biostimulants, to improve crop growth and productivity. Significant research has been done to discover the functional roles of plant growth-promoting rhizobacteria (PGPR), macroalgae that promote AMF activity and development and thus boost crop production under both optimal and sub-optimal conditions. The associations between plants and multipurpose plant growth-promoting fungi (PGPF) have been proven extremely to be beneficial to plants. This review describes new knowledge about the interactions between plants and their associated PGPF in determining improved plant growth and induced systemic resistance (ISR) to invading pathogens. The well-known fungal genera Aspergillus, Fusarium, Penicillium, Piriformospora, Phoma, and Trichoderma are the most frequently reported PGPF. But there is one fungus on which not much research has been done. The fungus is called *Neurospora crassa*. Neurospora is actively used in research around the world. It is important in the elucidation of molecular events involved in circadian rhythms, epigenetics and gene silencing, cell polarity, cell fusion, development, as well as many aspects of cell biology and biochemistry. Our Researchers have developed a multidimensional biostimulant which is a perfect blend of *N. crassa* extracts, vitamins, minerals, antioxidants, enzymes and micronutrients. This biostimulant works as a guaranteed yield enhancer, which has proved itself across 6 climatic zones and has been successfully tested in 20 universities across India. Formulated with microbial extracts technology the *N. crassa* could help to enhance all aspects of plant physiology in every crop to the optimum level and also enriches soil health. Performance of this biostimulant is better than any conventional biostimulants. This unique biostimulant is on its way to become a global phenomenon for its magical results in both plant and soil.

A Comparative Study of The PGPR Population and Its Enzymatic Activities in The Flood and Non-Flood Affected Regions of Kerala, India – A Case Study

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The main objective of the study was to isolate and screen PGPR, which can restore soil fertility and rejuvenate soil organic matter based on cellulase, laccase, and dehydrogenase enzymatic activities in the flood-affected areas. A total of 144 plant growth-promoting rhizobacteria (PGPR) isolates (87 nitrogen fixers and 57 phosphate solubilizers) were obtained from the flood and non-flood affected areas of Nelliampathy and Attapadi regions of Palakkad district in Kerala, India. Statistical analysis showed significant variations in the microbial population of all the flood-affected samples in both areas. N- fixers and P-solubilizers showed higher population in the non-flooded soil samples in 7 locations out of the 10 locations analyzed. It was found that 34.48% of N-fixers (30 isolates -13 isolates from flooded and 17 isolates from non-flooded samples) and 14.04% of P-solubilizers (8 isolates - 5 isolates from flood affected and 3 isolates from non-flooded samples) recorded triple enzyme activities (Cellulase, dehydrogenase, laccase). The present study indicated that the promising native N-fixers and P-solubilizers could be exploited for the rejuvenation of the soils in flood-affected areas. However, further studies are underway to use these effective microbes to rejuvenate the organic matter in flood-affected areas.

Significance of Plant Growth Promoting Microorganisms for The Integrated Management of Plant Diseases

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Plant diseases are responsible for the loss of at least 10% of global food production, representing a threat to food security. The prevention of diseases mainly dependent on agro-chemicals especially from the past few decades. Despite the great effectiveness and ease of utilization of chemicals products, their use or misuse has led to hazardous effects to environment. Some microorganisms, the bio-control agents are able to colonize the soil surrounding plant roots, the rhizosphere, making them come under the influence of plant roots. Plant growth promoting rhizobacteria (PGPR) generally refers to a group of soil and rhizosphere free-living bacteria and fungi colonizing roots in a competitive environment and exerting a beneficial effect on plant growth as well as disease management. PGPR play key role not only in transforming nutrients in the soil but also giving protection against plant diseases. The beneficial effect of PGPR on plant growth involves the ability to act as phyto-stimulators or biofertilizers. PGPR could enhance crop yield through nutrient uptake and plant growth regulators. PGPR could also act as bio-control agents by the production of antibiotics and triggering induced local or systemic resistance. The exact mechanism by which PGPR stimulate plant growth is not clearly established, although several hypothesis such as production of phytohormones, suppression of deleterious organisms, HCN and siderophore production, activation of phosphate solubilization, volatile compound production and promotion of the mineral nutrient uptake and plant growth promotion are usually believed to be involved. Sustainable agriculture, based on environmentally-friendly methods, tends to use PGPR as tool that could as a by-product reduce the use of chemicals. There is a great need for eco-friendly management of plant diseases through bio-agents such as PGPR in worldwide.

Biofertiliser Containing Plant-Growth-Promoting Rhizobacteria on Chickpea (*Cicer arietinum* L.) Plant Growth and Yield

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The purpose of this experiment was to apply PGPR and Sulfur to improve soil conditions to morphological and physiological changes of plant and increment of nutrient content. The experimental treatments including: 1- Spa (Pastel sulfur), 2- Spo (Powdered Sulfur), 3- Spa+SOB (Pastel sulfur+Sulfur oxidizing bacteria), 4 Spa+SOB+NFB+PSB+ KSB (Pastel sulfur+ Sulfur oxidizing bacteria+ Free-living nitrogen-fixing, Phosphate solubilizing bacteria, Potassium solubilizing bacteria) , 5- Spow+SOB+NFB+PSB+KSB (Powdered Sulfur+ Sulfur oxidizing bacteria+Free-living nitrogen-fixing, Phosphate solubilizing bacteria, Potassium solubilizing bacteria), 6- Spo+SOB 7 -SOB+NFB+PSB+KSB, 8-NFB+PSB+KSB, 9-SOB and 10-Control. The height of nitrogen fixation nodules and the percentage of active nodules recorded in Spa+SOB+NFB+PSB+KSB and Spow+SOB+NFB+ PSB +KSB. The maximum number of pod per plant, biological yield, and grain yield were obtained at Spow+SOB+NFB+PSB+KSB, increased 73, 43 and 52% respectively compared with control, and the heights plant and 100- weight seed whit Spa+SOB+NFB+PSB+KSB, increased 30, and 35% respectively compared with control. Also, PGPR

treatments' application recorded the highest N, P, and K concentration of grain, plant, and soil compared with Control. In conclusion, application bio fertilization as a substitute for inorganic fertilizers in order to grow plants should not be considered a simple, objective, and short-term benefit, but as an ecological approach to improving environmental conditions and human health.

Impact of Vermicompost as A Plant Growth-Promoting Rhizobacteria for Sustainable Production of Boro Rice in Northern Regions of Bangladesh

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The mission of making strides in agricultural crop yields due to expanded pressure in food production has certainly driven to the indiscriminate use of chemical fertilizers and other agro-chemicals. Plant growth-promoting rhizobacteria (PGPR) are a group of bacteria that enhances plant growth and yield via production of various plant growth promoting substances. Currently, the use of PGPR, which is a biological approach toward the sustainable intensification of agricultural crop production. This research was aimed to study the impact of vermicompost as a PGPR in boro rice production in northern regions of Bangladesh. Our results showed that vermicompost amended research plot comparatively needed less proportion of chemical fertilizers such as urea, TSP, zypsum, and zinc. The yield and net profit of boro rice was significantly much higher in plots used with vermicompost with irrigation. Alternatively, the plots that did not received vermicompost had significant less impact in boro rice yield. As a result, it was shown that vermicompost could reduce the use of chemical fertilizers required for boro rice production. Therefore, application of vermicompost could be successful practice in improving a better soil environment for sustainable production of boro rice production by enhancing water stable aggregates, water holding capacity, and microbial biomass activity of the soil.

Characteristics of Vegetables Using Growth-Promoting Bacteria Applications as an Environmentally Friendly Cultivation Innovation

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This study aims to determine the effect of the application of *Plant Growth Promoting Rhizobacteria (PGPR)* on soil conditions and physical characteristics of Chinese cabbages, tomatoes and carrots produced, then compared with the results of conventional farmers. This study used a factorial randomized block design with 2 factors. The first factor: the duration (length) of soaking the seeds with PGPR solution, namely 0, 10, 20, and 30 minutes, while the second factor: the use of PGPR

concentration at the time of watering the plants in the beds, namely: 0; 1,25; 2,5 and 3,75 cc/L. The results showed that the application of PGPR slightly increased the organic matter and NPK content in the soil, plant height and the number of harvest results (yield) slightly different from the results of conventional farmers. PGPR application had an effect on the texture and brightness level of Chinese cabbages, tomatoes and carrots. The average texture of Chinese cabbage, tomato and carrot from the PGPR application namely 23,46; 22,82; 34,14 kg m/sec2, while the brightness level is 40,19; 34,06; 39,10. The textures of Chinese cabbages, tomatoes and carrots from conventional farmers namely 27,12; 23,03; 31,13 kg m/sec2 and the brightness level is 58,11; 34,16; 43,04. Chinese cabbages, tomatoes and carrots produced by PGPR application had the texture and brightness level that almost the same as those from the result of conventional farmers.

Effect of Organic and Inorganic Fertilizers on Growth and Fruit Yield of Bitter Gourd (*Momordica charantia*) var: Preethi

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The present study was conducted under Allahabad agro-climatic conditions at vegetable research field, Department of Horticulture Vegetable Science during Kharif season of 2017-2018 in var. Preethi of bitter gourd. The experiment was laid-out in a randomized block design with 12 treatments, and each treatment was replicated three times. The treatments consisted of different combinations of organic manures, farmyard manure, poultry manure, vermicompost and inorganic fertilizers. Following experimentation, the growth parameters measured showed that the organic and inorganic nutrients (25% NPK + 2 tonnes of vermicompost +5 tonnes of poultry manure) was considered the best treatment, followed by the recommended dose of fertilizers. The maximum fruit weight was obtained with 25% NPK + 2 tonnes of vermicompost + 5 tonnes of poultry manure. The treatment of 25% NPK + 2 tonnes of vermicompost + 5 tonnes of poultry manure will be an ideal combination treatment to enhance yield and profitability in agro-climatic conditions of Allahabad.

Effect of *Streptomyces* sp. and Mycorrhizal Strain on Plant Growth-Promotion and Protection of Pigeon Pea Wilt Caused by *Fusarium udum* Butler

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The present study was aimed to evaluate the effect of the interaction of autochthonous Streptomyces sp. S-9 and mycorrhizal fungi as “Rhizolive consortium” and the soil-borne *Fusarium udum* on root colonization, plant growth and nutrients accumulation in *Cajanus cajan*. The assays were conducted in a *Cajanus cajan* cultivar “BDN2” inoculated for three months with “Rhizolive consortium” then infected with *F. udum* under greenhouse conditions. Pot experiments of pigeon pea, T-4 (S-9+*Rhizophagus irregularis*(*Glomus intraradices*)) treatment had highest dry weight of root and shoot weight of 22.26 g and 36.26g, respectively, while fresh root and shoot weights were 52.32 g and 59.21 g. This work highlights the importance of microbial interactions in the rhizosphere for crop sustainability and soil quality improvement, by S-9 on *R.irregularis* and pigeon pea symbiosis.

Results of our study showed that *F.udum* inoculation increased accumulation of Proline. Accumulation of H2O2 and MDA (malonaldehyde) increased significantly 72 h following *Fusarium* inoculation. Accumulation of malonaldehyde and generation of reactive oxygen species was a clear indication of membrane damage due to stress within a plant tissue. Co-inoculation of *Streptomyces* sp. and AMF could provide synergic benefits in plant growth.

Sustainable Agriculture Approach: Chickpea Rhizobacteria Tolerant to Trace Elements and Silver Ions

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Sustainable agriculture practices are used to maintain and preserve the long-term soil productivity and natural resources, including diverse and functional microbial populations. Principally plant growth-promoting bacteria (PGPR), are being used as bioinoculants for enhancing plant growth and productivity via promoting metabolites (e.g., phytohormone, siderophore, ACC deaminase (ACCD), and anti-phytopathogens) under abiotic stress conditions. In search of efficient PGPR strains with multiple activities, a total of 148 bacterial isolates were isolated from different rhizosphere soils of chickpea in the vicinity of Nagpur. These isolates were screened and categorized according to the production level of ACCD. They were further tested for tolerance to trace elements. At the concentration of trace elements Cu (100 µg/mL).

Characterization and Activity of Plant Growth-Promoting Rhizobacteria in Sweet Potato Production in South Africa

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Sweet potato (*Ipomoea batatas* L.) is nutritious, drought tolerant with a high yield potential. The average yield of sweet potato produced in South Africa (SA) is not enough to meet the demands of a growing population as a nutritious food and for their income generation. The application of PGPRs has large potential to improve crop production. This study was aimed at characterizing PGPRs associated with sweet potato plants in SA. PGPRs (212 rhizobacteria and 70 endophytic bacteria) associated with sweet potato were isolated from fields located at the Agricultural Research Council

(ARC), SA. The isolates were morphologically characterized and tested for their ability to solubilize phosphate, produce siderophores and increase growth rate of sweet potato seedlings. *In vitro* results showed that 40% of the rhizobacterial isolates produced siderophores and 2% solubilized phosphate. For endophytic bacteria, 34% produced siderophores, and one isolate solubilized phosphate. *In vivo* trials showed that 29 isolates increased the growth of sweet potato seedlings compared to the control. Six isolates were selected based on their growth promotion and are currently being evaluated in a field trial. The improvement in growth of sweet potato will enable farmers to produce higher yields thus will lead to improved food security.

Liquid Organic Fertilizer Formulation Based on Potential Microbial Consortium in Growth of Mustard Greens (*Brassica juncea* L.)

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The use of synthetic fertilizers in agriculture may have negative impacts in the quality of the soil and the organisms in it. The efforts to support the government programs in implementing healthy and sustainable agriculture have been the study of the present investigation. Therefore, the use of microbial-based organic fertilizers has the potential to be one of the efforts to maintain the quality of the soil. This research was aimed to determine the response of mustard greens (*Brassica juncea* L.) which were treated with various concentrations of organic fertilizer formulations made from a consortium of microbes isolated from a culture stock of the Microbiology laboratory of FMIPA UNUD. The research was conducted at the greenhouse of the Biology Education Department, FKIP University of PGRI Mahadewa, Indonesia. In this study we used a randomized block design consisted of fertilizer treatment with active microbial consortium at the concentration of 1% (P1); 2% (P2); 3% (P3); 4% (P4); 5% (P5) and 0% (P0) as a control. The fertilizer application to each plant was with a volume of 100 mL for 4 times. The results showed that the application of fertilizer improved number of leaves, leaf area, wet weight and the green color level of the mustard greens significantly compared to control and the best plant's response was occurred at the application of 5% fertilizer concentration (P5).

Bacterial Biostimulants: Revitalization of Plant and Soil Health

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Rhizobacteria associated with every plant generally regulate the composition and activity of their associated microbial community. The rhizo-microbiome has a significant role in agriculture due to its rich diversity of root exudates and plant cell debris which attracts diverse and distinctive patterns of microbial colonization. Rhizo-microbiome play a significant role in nutrient acquisition and assimilation, soil texture improvement, secreting, modulating hormones, secondary metabolites,

antibiotics, and various signal compounds contributing to the enhancement of plant growth. PGPR are the bacteria that colonize plant roots and promote plant growth. PGPR show their effect in the plant body through confined antagonism to soil borne pathogens or by inducing systemic resistance against pathogens. Antagonistic PGPR secretes stimulants like siderophores, and antibiotics provide pathogen control and enhance plant growth metabolism. When beneficial bacteria and the pathogen remain spatially separated, induced systemic resistance (ISR) in plants resembles pathogen-induced systemic acquired resistance (SAR). Both ISR and SAR contribute healthy and immune plant parts in several plant species. PGPR, especially the genera of Pseudomonas and Bacillus provide antagonistic effects and trigger the resistance through the salicylic acid-dependent SAR pathway or jasmonic acid and ethylene for ISR from the plant. Resistance-inducing and antagonistic PGPR are useful in synthesizing new inoculant combinations with diversified mechanisms of action there by proving themselves as an effective biocontrol agent to revitalize of plant and soil health.

Influence of Plant Growth-Promoting Rhizobacteria (PGPR) on Growth and Yield of Chili in Various Growing Media

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This research was to determine the effect of PGPR in liquid on growth and yield of chili grown in several planting media. This research was carried out at the Agricultural Technology Research and Assessment Installation's screenhouse belongs to South Kalimantan AIAT from June 2020 to February 2021. Chili var. Ciko variety were planted in large polybags and arranged in a Completely Randomized Block with 5 treatments with 5 replications of each treatment. The treatments tested were: M1 (Sand + goat manure + PGPR), M2 (Sand + cow manure + husk charcoal), M3 (Sand + goat manure), M4 (compost block + PGPR) and M5 (compost block + goat manure). The results showed that the application of PGPR had a significant effect on number of leaves, number of productive branches, and diameter of the fruit. However, this PGPR treatment did not significantly affect the height and diameter of chili plants, fresh weight of the shoots, roots, dry weight of the shoots, roots, fruit length and fruit weight.

Effect of Heavy Metal-Tolerant Microorganisms on Growth Narra Seedlings

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The effectiveness of heavy metal-tolerant microorganisms showing plant growth promotion in vitro needs to be proven before their use in soil bioremediation. Three heavy metals (Pb, Cd, and Cu) resistant rhizobacteria from copper (Cu) mined site in Marinduque, Philippines showed plant growth promotion *in vitro*. Inoculant A (CuNFbM 4.1, MGR 333) and B (CuNFbM 4.1, MGR 333, PbSM

2.1) together with compost were applied to narra seedlings (*Ptecarpus indicus* Will) and planted in the Cu-contaminated soil. Lime (2 tons/ha) and recommended doses of fertilizers in soybean (80 kg/ha urea, 300 kg/ha SP-36, 150 kg/ha KCl) served as a positive control to assess the capability of the inoculants and compost to enhance narra growth and its Cu accumulation under greenhouse conditions. All treatments, i.e., Cu contamination, lime with fertilizer, compost and inoculant resulted a significant difference in the stem diameter of 13-week-old narra. Inoculated Narra could thrive in mine-degraded soil containing 445 ppm Cu with and 4% compost. Inoculant B produced the best performance of the plant. ACC deaminase of *Pseudomonas marginalis* PbSM 2.1 might have helped to enhance the plant's growth. The root of the narra accumulated more Cu than the shoot, and Cu accumulation was reduced in trees treated with compost or lime and fertilizer.

Explorations with *Trichoderma* Beyond Biocontrol and Plant Growth-Promotion

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Trichoderma harzianum is popular amongst agronomists, organic farmers and plant biotechnology researchers for its potential as a biocontrol agent. There are commercial formulations of Trichoderma available in a quite good number of research publications and in a handful of patents. Recent research from various groups have hypothesized on its application as to support plant growth. The present discussion is to expand the horizons of Trichoderma research and its potential as an effective bioagent to degrade residual toxicity of pesticides in agriculture soils and to improve soil health. In this study, native isolates of Trichoderma were tested for their tolerance and degrading potential against popular organo-phosphate pesticides includes Monocrotophos, Dimethoate, Malathion, Methyl parathion and phorate isolate registered with high LD_{50} and MIC at concentrations well above 1000 ppm. Isolates were also tested for phosphatase (12 U/ml), esterase's (55 U/ml), and OP hydrolase (29 U/ml) enzymes that bio-transform toxic pesticides into relatively safer compounds by cleaving the P-O, P-F, P-S and P-C bonds found in organophosphorus pesticides. C, N, P exclusion studies revealed preferential mode for utilization of MCP by T103 as P source. FTIR spectral analysis revealed disappearance of the vinyl phosphate bond (1638 cm^{-1}) and N-H bond (3320 cm^{-1}) indicating degradation of MCP by T103. Isolate T103 could degrade 900 ppm of MCP to an extent of 40% (360 ppm) in liquid media, at 5 days of inoculation as confirmed by HPLC analysis. Results of germination assay showed that seed treatment with Trichoderma help in overcoming the adverse effect of pesticide stress compared to untreated seeds. Trichoderma showed better root and shoot growth compared to control with increased root length (37.71%), shoot length (17.8%) and biomass (22.44%). *In Silico* analysis studies involving genes responsible for organophosphate pesticide degradation in Trichoderma indicated TaPON1 like paraoxonases. Docking study with MCP showed that it banded at the active site of a modeled protein. These studies provided a strong evidence that Trichoderma could be used as a bio-remediating agent to decontaminate residual pesticides in agriculture soils and to improve their fertility.

Trichoderma spp. in The Mitigation of Stresses in Plants, Their Commercialization for Sustainable Agriculture and Rural Prosperity

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Bioagents *viz.*, *Trichoderma viride, T. harzianum, T. asperellum,* etc. have been found quite effective for mitigating biotic stresses viz. seed and soil- borne diseases of crops viz. wilt (*Fusarium* spp.), root rot (*M. phaseolina, R. solani*), collar rot (*A. niger*), etc., which may cause huge quantitative and qualitative yield losses in crops. These bioagents also mitigate the abiotic stresses viz. extreme temperatures, drought, salinity, allelopathic effects, oxidative stress, etc. of the plants. These are efficient in colonizing in their habitats, promote plant growth & root development, induce systemic resistance (ISR); besides, managing farm and urban organic wastes by decomposing them with their efficient cell wall degrading enzymes and making the nutrients available for plant growth. The use of bioagents to manage soil and plant health is the present day need for eco-friendly & sustainable crop productivity; reduction of cost of cultivation and remunerative return of agricultural produce; generation of employment through their commercialization, etc. Thus, it is the best sector for improving socio-economic conditions of farmers and nations to become prosperous and self-reliant. Mass production technologies of the bioagents i.e. fermentation, formulations, delivery systems, etc. have been developed. Commercial production of the bioagents has now emerged as a potential sector for employment generation, where millions of skilled persons will be required at different levels by the year 2030 particularly in developing world, where unemployment among the youths are the emerging problem. ICAR, SAU's have introduced ELP's for the students to become entrepreneurs. The KVK's, NIPHM, etc. impart trainings to entrepreneurs/ farmers for establishing bioagents production units. Being a Sun rise sector, the funding agencies viz. RKVY, DBT, DST, NHM, Banks, NFSM, Central & State Govt., etc. need to support farmers, entrepreneurs, NGO's, SHGs, etc. for hands on training in the production process and to establish production units of the bioagents.The funding agencies should also establish 'Bio-resource complex' for production, training and guidance of needy HR. Besides, collaborative research groups should also be established nation-wise as well as globally for innovative outcomes of the product development of the bioagents for the efficient use in the agriculture.

Assessing The Multiple Strategies to Enhance Use of Plant Growth-Promoting Microbes for Agricultural Sustainability

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The use of chemical fertilizers and pesticides etc. has increased cost of cultivation, poisoned the food bowl and degraded agro-ecosystems globally, hence, considered unsustainable for food security in era of anthropocene and climate change. Understanding the coevolution of exophytic and endophytic microbes with plants, microbial regenerative potentials of agro-ecosystems and potentials of inoculation of beneficial soil microbes in the rhizospheric niche are emerging alternatives to sustain the agricultural productivity is cost effective, non-contaminated and more ecological way.We have investigated the potential benefits of bio inoculations of native and exotic soil microbes isolated from different ecosystems in cultivation of tomato, potato, aromatic grasses and wheat crops. The

sustainability of PGPR activities in storage in the lower and room temperature with and without carriers and their stress tolerance capabilities have also been assessed. The survival potential of these microbes in soil and their ecological succession in rhizosheric niche are under investigation. Further we are trying to understand the impacts of exotic biostimulants on plants and consumer's gene regulations vis a vis that of chemical fertilizers.

Evaluation of Indole Acetic Acid (IAA) Producing and Phosphate (P) Solubilizing PGPR Isolated from Clove (*Syzygium aromaticum L.*) Plantations in Bali, Indonesia

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The existence of PGPR on plant roots is beneficial for the plants. Some bacteria can support plant growth or act as agents of biocontrol for plant diseases. Bacteria in the rhizosphere can stimulate the growth of plants through direct or indirect mechanisms. Inorganic synthetic chemical fertilizer was routinely used to increase production of clove plant. This synthetic fertilizer has negative impact on biochemical and physical soil properties. Biofertilizer was needed as alternative for increasing soil fertility. Due to the enormous potential of PGPR in extensive plantations and plant health, in this study, exploration of the PGPR in the rhizosphere of clove plantation as biofertilizer- functioning PGPR was carried-out. Karangasem and Buleleng Islands in Bali Province are clove (*Syzygium aromaticum* L) producing regions. This study aims to explore PGPR in the rhizosphere of the clove trees as potential biofertilizer candidates which may have potency in Indol-3- Acetic Acid (IAA) production and phosphate solubilization. PGPR strains were isolated from the rhizosphere of clove trees and assayed according to qualitative and quantitative methods for IAA and P solubilization. This research includes collecting of various soil samples from rhizosphere of clove plant, purifying, identifying and to evaluate for various growth enhancing traits such as IAA, P solubilization and introducing into Clove plantations for growth enhancement. Among several isolates from clove rhizosphere, two potency isolates TCKI5 and TCBP6 were selected and identified them using various molecular techniques. TCKI5 was identified as *Leclercia adecarboxylata* and TCBP6 as *Burkholderia cepacian.* These two strains when tested for IAA and P solubilization, strain TCK15 produced the highest amount of IAA (19.64 ppm) at 48 hours of incubation and strain TCBP6 has the highest P solubilization capacity (1687.77 ppm) at 7 days of incubation.

Acid Hydrolysed Casein: A Key Substrate to Unravel Operation of Tryptophan - Independent Pathway in Rhizobacteria for IAA Production

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Indole-3-acetic acid (IAA), a plant growth hormone, is produced by most of the rhizobacteria namely *Azospirillum Azotobacter*, *Bacillus*, *Burkholderia*, *Erwinia*, *Enterobacter*, *Flavobacterium*, *Mesorhizobium*, *Pantoea*, *Pseudomonas*, *Rhizobium* and *Serratia* either by tryptophan- dependent

pathways or tryptophan-independent pathway or involving both pathways. IAA production through tryptophan-dependent pathway is widely known, however, operation of tryptophan-independent pathway is least known in bacteria. Enzymatically hydrolysed casein retains most of the amino acids including tryptophan, a precursor of IAA, used for IAA production by tryptophan-dependent pathways. In contrast, acid hydrolyzed casein does not contain tryptophan, cysteine, methionine, purines, pyrimidines, and sugars but it contains other aliphatic and aromatic amino acids. In addition, acid hydrolyzed casein contains glutamic acid and aspartic acid. A simple method was developed showing presence of IAA and the absence of tryptophan in Tris Minimal broth supplemented with acid hydrolysed casein inoculated separately with *Micrococcus aloevera*DCB-20, and some unidentified bacterial strains like TRPV-8, TRSK-71 and TRSK-76 unravelled operation of tryptophan-independent pathway for IAA production. This simple method generated evidence for operation of tryptophan-independent pathway for IAA production will be discussed during the conference.

Pseudomonas aurantiaca - An Overview of Its Potential as A Biofertilizer and Biofungicide

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Pseudomonas aurantiaca, a gram-negative rod shape bacterium, is well known for its ability to promote plant growth and suppress plant pathogens, mainly due to production of metabolites, solubilizes potassium and zinc in soil to make it available to the plants. It is a rare species of Pseudomonas, as till now few strains have been reported and 14 of these have their genome sequenced due to their significant importance in agriculture. Our group has isolated nine strains of this species from sugarcane, cotton, Para grass and cactus. These strains promoted the growth of wheat, rice, corn and tomato under controlled environment and field conditions. Also, these strains inhibited the growth of fungal pathogens including Fusarium spp. and *Colletotricum falcatum* under *in vitro* conditions. Several metabolites have been extracted and characterized from these strains. Among these are phenazine derivatives, bacteriocins, Cyclic lipopeptides, Quorum sensing signals, Pyoverdin, Pyocin, rhizoxin analogue, auxins, HCN, and pyrrolnitrin. A new compound "Lahorenoic Acid" (alkyl-substituted aromatic acid) has been reported by our group. Production of these metabolites vary depending on strain and growth media. Genomes of two strains PBSt2 and ARS38 were published. These bacteria may have great potential to be used as biofertilizer and biofungicide.

Seed Priming with *Bacillus subtilis* (Bera 71) to Alleviate Chromium Toxicity in *Lycopersicon esculentum* Mill.

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The current study evaluated the biological impact of seed priming with formulated *Bacillus subtilis* Bera 71 to alleviate the adverse effects of Chromium (Cr, 150 µM) in tomato. Cr toxicity induced significant alteration in the levels of phenolic compounds (total phenols, flavonoids, anthocyanin, polyphenols), antioxidant enzyme activities (SOD, POD, CAT, and APX), ROS activities (MDA and H_2O_2 contents) and organic acids (fumaric, succinic, citric, malic acid) in tomato seedlings. Seed priming with *B. subtilis* Bera 71 significantly alleviated the adverse impact of Cr-induced toxicity, which was manifested through confirmed by genes expression of such tolerant items. Conclusively, our current research indicated that seed priming with AMF could be adopted as a promising biologically strategy to enhance tomato growth by copping the venomousness effect of Cr.

Potentials of Microbial Biostimulants to Decipher the Basal Stem Rot in Ganoderma Species

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Ganoderma induced mortality in many tree species including *Prosopis cineraria* has become a serious problem in many arid districts of Rajasthan, India. Similarly, basal stem rot (BSR) caused by Ganoderma critically damages the oil palm trees, resulting in poor productivity and substantial economic loss for the palm oil industry in major oil palm growing areas of Andhra Pradesh, India. Efforts have been made during last many years to study predisposing factors and to manage basal stem rot in tree species. Studies have shown that moisture coupled heat stress and mechanical injury are the major predisposing factors for the infection of Ganoderma. Observations have also shown that sometimes an insect Acanthophorous damage the root thereby make easy way for the entry of Ganoderma. Another important observation was that road side plantation of *Acacia tortilis* which has a lateral root system has increased the mortality in *Prosopis cineraria* in agricultural fields. While in case of palms arduous task in dealing with this disease is that diseased trees do not show noticeable symptoms on mature palms until the disease has progressed to the point where the infected trees are no longer responsive to treatment. Use of chemical means of control for treatment of Ganoderma infected trees is not as feasible as apparently infected and other trees may be having fungal infection by the time treatment is applied. Alternative control methods for the effective management may be through microbial biocontrol agents. In recent studies very effective native biocontrol agents viz., *Trichoderma longibrachiatum, T. harzianum* strain AZNF 4, *Aspergillus nidulans, Bacillus tequilensis* and *Streptomyces mexicanus* have been isolated from Indian arid region. In three year of study these biocontrol agents found highly antagonistic against Ganoderma, these novel antagonists proved their aggressiveness against target pathogen viz., *Ganoderma lucidum* and *G. boninense*. In dual culture tests, *B. tequilensis* produced orange color pigmentation only against *Ganoderma* but not against other resident soil fungi. This highlighted specificity of *B. tequilensis* against *Ganoderma*. Interestingly, it has not inhibited growth of another bio-control agent *Trichoderma longibrachiatum*. Its survival at wide temperature range (22-55^{o}C) has also made it well adapted to arid soils. In liquid test, 55 and 30 % reduction in dry mycelial weight of *Ganoderma* was recorded in presence of *B. tequilensis* and its filterate, respectively. Experimentation on effects of *B. tequilensis* on mycelial growth of *Ganoderma* during different periods and on amount of filterate indicated that quantity of antibiotic released and antagonistic activity was dependent on the presence of *Ganoderma* in liquid medium. Similarly *T. longibrachiatum* significantly inhibited the mycelial growth of *G. lucidum* and

G. boninense over control. Highest mycelial growth inhibition (47.6%) was recorded at 96 hrs. followed by 39.8 and 29.3% at 72 and 48 hrs, respectively in *T. longibrachium*. Cell free filtrates of *T. longibrachium, T. harzianum* and *A. nudulans* were found significantly superior in inhibiting the mycelium growth of *G. lucidum* over control. Even a low concentration (3 ml) of *T. longibrachiatum* was more effective in inhibiting *Ganoderma* mycelium compared to other BCAs. Bio-inoculants potential of these antagonists were evaluated at primary as well as secondary stage of oil palm seedling in green house conditions. The results showed that 57.7 % and 54.6 % disease suppression was recorded in T. *longibrachiatum* and *T. harzianum* respectively as compared to untreated seedling. In another study, *prosopis juliflora* compost and onion residue compost amendments as a food substrates favored the growth of these BCAs, which ultimately reduced viability of *Ganoderma* colonized root bits of cowpea. Studies on compatibility between insecticides and BCAs suggested that *T. longibrachiatum, T. harzianum and A. nidulans* can be combined with fipronil at variable concentrations if amended together in the partially infected or as a prophylactic measure in healthy trees. These studies demonstrate that there exists ample opportunity of using native BCAs against *Ganoderma* in managing root rot mortality in *Khejri* in Indian hot arid regions. However, the target area of this management strategy is that niche where *Ganoderma* is more active. If the soil environment is manipulated in favour of biocontrol agents with their food substrates and other nonpathogenic fungi then the suppression of *Ganoderma* is possible. The target pathogen is having poor competitive saprophytic ability and therefore, it is considered a weak parasite. In that view a bio-kit of BCAs has been prepared in talc (10^9 CFU g^{-1} in 200 g) for small-scale distribution to selected farmers. This bio-kit has been used for the management of infected Khejri trees by farmers of many villages. This product requires 100% of MHC to maintain viable counts of BCAs up to a period of 180 days .However, further experimentation is required to improve survival and shell-life of this bio-formulation by combining substrates, which may promote rate of survival.

Effect of Organic Fertilizer Products on The Growth and Health of *Acacia crassicarpa* Seedlings

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Growth and health have been problems in *Acacia crassicarpa* seedlings. Major nursery diseases of *A. crassicarpa* include Xanthomonas leaf blight, Fusarium wilt and leaf spots caused by *Pestalotiopsis* or *Phaeotrichoconis*. Research was initiated to improve the seedling conditions. Effect of two commercial products, a biological organic fertilizer (BOF) and an organic multipurpose fertilizer (OMF), on the growth and health of *A. crassicarpa* seedlings was evaluated. Our results showed that the BOF + current nursery regime (SOP) treatment showed a better germination rate than other treatments. Similarly, the same treatment also showed the best height of *A. crassicarpa* seedlings at 12 weeks after sowing. The incidence of Xanthomonas leaf blight, Fusarium wilt and leaf spot diseases was lower in the plots of OMF and OMF + SOP treatments compared to other treatments. Based on these results, the BOF product could be used to improve the growth of *A. crassicarpa* seedlings, whereas the application of the MOF product could be applied to reduce the incidence of major seedling diseases of *A. crassicarpa* in the nursery.

The Efficacy of The Organic Fertilizer Formula of The Decomposer Microbial and Biological Agents Consortium on The Growth and Reduction of Leek Soft Rot

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The trend of demand for organic leeks (*Allium fistulosum* L.) and its development in the lowlands requires the introduction of organic fertilizers and biological agents to control disease. Soft rot disease caused by Erwinia sp. reduces a yield loss of 12-40%. Soil-borne pathogens are difficult to control. Hence, the application of biological agents may have potential in controlling pathogens. Streptomyces sp. isolate CS1 and *Trichoderma viride* isolates Bio7 have been isolated and tested for antagonistic ability against *Erwinia* sp. For greater efficacy, mixture of organic fertilizers and biological agents were formulated together for single use. The aim of the study was to test the effectiveness of the organic fertilizer formula of the decomposer microbial consortium and biological agents on the growth and reduction of soft rot disease of leeks. The study was designed in a completely randomized block design with five treatments, includes T0 (control), T1 (Fertilizer formula with four microbial decomposers), T2 (Fertilizer formula four microbial decomposers + Streptomyces), T3 (Fertilizer formula 4 microbial decomposers + Trichoderma), T4 (Fertilizer Formula four microbial decomposers + Streptomyces + Trichoderma). Each experiment was repeated five times. The consortium fertilizer formulation was carried out in the following way: the organic matter was fermented with a suspension of *Aspergillus niger*, Saccharomyces sp, Azotobacter sp. and Pseudomonas sp. for four weeks, followed by fermentation with a suspension of Streptomyces sp. isolate CS1 and *T. viride* isolate Bio7 for two weeks. The leek seedlings were planted in a mixture of consortium fertilizer and soil in a ratio of 1:4. Plants were maintained for 8 weeks to observe growth, yield, and decrease in soft rot disease. The results showed that the application of organic fertilizer by a consortium of microbial decomposers and biological agents could increase the growth of leek and reduce the incidence of soft rot disease. The application of organic fertilizer by a consortium of decomposer microbes, Streptomyces and Trichoderma was most effective in increasing the growth of leek plants and reducing the incidence of soft rot disease.

Enriched Azolla Extract as Liquid Biofertilizer to Increase the Resilient of a Rice Farming on Flooded Prone Coastal Area as A Strategy for Adapting to Climate Change

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Rice farming in coastal areas is prone to flooding as a result of climate change. A low-cost adapted strategy is needed to increase the resilience and rice productivity in flood-prone coastal areas by using enriched Azolla extract (EAE) as liquid biofertilizers combined with selected tolerant rice varieties. This study was conducted to determine the effectiveness of EAE to increase yield of different rice

varieties in Pangandaran, West Java from June to October 2020. The research was arranged as a split-plot design and with five replications. The main plot was EAE application (T1 = 3 ton/ha compost and T2 = 3 ton/ha compost + 10 L/ha of EAE) and varieties (V1 = Inpari 43, V2 = Mawar, V3 = Inpari 30, V4 = Inpara 03, V5 = Mendawak) as the sub-plots. Application of EAE 10 L/ha gave a significant effect on improvement of rice grain yield productivity (37.06% higher than positive control). The average grain yield of five varieties under EAE treatment (5.51 ton/ha) is greater than the grain yield of local farmers (3.78 – 4.97 ton/ha). The highest grain yield was obtained by Inpari 43 (5.90 ton/ha) which was not significantly different from Mendawak (4.90 ton/ha). This result concludes that EAE and selected rice varieties (Inpari 43 or Mendawak) can be applied to increase rice yield and the resilience of rice farming on floods prone to a coastal area.

Disease and Pest Management of Cabbage Using Compost, *Trichoderma* sp. and *Bacillus thuringensis* in Pancasari Village, Buleleng Regency, Bali

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The club root disease has been reported as a main disease in cabbage for long time ago. On the other hand *Crocidolomia binotalis* was reported as key pest on cabbage. To control these disease and pest the farmers usually use synthetic chemical pesticide. In contras the utilization of synthetic chemical pesticide if not properly make many negative impacts. To solve the problem the environmentally friendly control is needed, one of them is using biological control, for club rood disease and *C. binotalis* is used *Trichoderma* and *Bacillus thuringensis* (BT), respectively. Based on the phenomena the research in order to know the influence of *Trichoderma* sp. and *Bacillus thuringensis* to control its main disease and pest of cabbage was conducted. The result shows the average number of *C. binotalis* larvae on treatment with BT was low compared with the cabbage without BT in last of observation, the average number of *C. binotalis* larva is 3.41 and 0.44 respectively. On the other hand for the club root disease, the seedlings of cabbage prepared by growing on the *Trichoderma* treated compost media and transplanted on the soil mixed with the compost *Trichoderma* show the best result to control club root disease based on disease severity (4.3%) compared with other treatments especially seedlings of cabbages prepared as farmer's practices and transplanted also as farmer's practices (without *Trichoderma*) the disease severity is 27.77%. The combination of BT and *Trichoderma* was successfully control *C. binotalis* larvae and club root disease based on the low average of larvae, low of disease severity and the high of marketable yield of cabbage.

Evaluation of Strawberry Seedlings in Various Planting Media Amended with Biofertilizer

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The compositions of growing media determine the strawberry seedling quality. Nowadays, coco-peat is widely used as a major component for strawberry's substrate in West Java due to good drainage and high water holding capacity. The disadvantage of coco-peat is low nutrient content. Mixing the coco-peat with manure and biofertilizer will increase their ability to supply nutrient. A pot experiment was conducted to determine the influence of growing media composition with biofertilizer inoculation on the growth and quality of strawberry seedlings at mountainous area. The experiment was setup in Randomized Block Design with 6 treatments and 5 replications. The treatments were substrate composition i.e. coco peat (CP) and chicken manure (CM) in the ratio of 2:1, 2:3, and 3:2; with and without biofertilizer inoculation. The biofertilizer contained nitrogen fixing bacteria and phosphate solubilizing microbes. The results showed that substrate composition changed plant height, shoot and root dry weight, chlorophyll content, as well as Nitrogen and Phosphor uptake by seedling shoot but didn't affect leaves surface area of 6-week old seedlings. The substrates composed of CP and CM in ratio 2:3 and 3:2 enriched with biofertilizer increased plant growth and their Nitrogen and Phosphor uptake.

The Effect of Soil Ameliorant Biochar for Roots Growth on Sustainable Agriculture

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Sustainable agriculture is one of the alternatives to achieve food security by continuously producing agriculture by considering safety, soil health, environment and economic aspects. Shrinkage of agricultural land for agricultural production may slow the development of sustainable agriculture. The research used biochar material which is sourced from organic waste material which functions to temporarily hold soil nutrients in the root area of plants. The purpose of this research is to provide alternative solutions for the expansion of coastal land use by utilizing biochar from organic waste as a soil amendment for agricultural production, especially vegetables. The research method used a two-factor design, the first was the size of the biochar material, which was coarse and fine, the second factor was the dosage of biochar including 10, 15 and 20 tons per hectare. The biochar material uses carbon-rich coconut shell waste.Carbon in the soil is stable and porous. The results showed that the application of coarse-sized biochar at a dose of 15 tonnes per hectare showed lateral root distribution. The development of vegetable roots in the application of fine biochar tends to go down. The use of biochar ameliorant materials by utilizing environmentally friendly organic waste is one of the solutions for sustainable agricultural production.

Indigenous Microbials as Liquid Organic Biofertilizers to Enhance the Rice Growth and Productivity

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Rice growth and development are highly correlated with the microbial biodiversity, soil organic matter and nutrient availability in soils. The beneficial microbes are involved in nutrient cycles and transformation of non-useable essential nutrient to become useable form (available). Moreover, the microbial biofilms on roots (rhizosphere) and phyllosphere act as bio-protectant to improve the root growth or crop health. The research was aimed to investigate the role of indigenous microbial solutions and organic extract as liquid organic biofertilizers (LOB) on the growth and rice yield. The indigenous microbial solution and organic extract (LOB) were obtained from organic wastes (banana weevil, rabbit urine, and golden snail) through the fermentation process for 14 days. The LOB solution contained a high density (10^7-10^9 cfu/mL) of beneficial bacteria and fungi (*Staphylococcus sp., Bacillus sp., Rhizobium sp., Aeromonas sp., Pseudomonas sp., Aspergillus niger, Verticillium sp).* The LOB at 4,8. L. ha^{-1} was applied in combination with the straw compost at the rate of 0, 5, 8 and 10 ton. ha^{-1}. *The* experimental results showed that application LOB and straw compost gave a significant effect on plant height, number of tillers, root length, root volume, number of productive tillers, number of panicles, weight of grain per 1000 grains and weight of grain per clump in rice plants. The highest rice yield of 5 ton. ha^{-1} was obtained with the application of banana weevil, rabbit urine LOB and *5* ton. ha^{-1} of straw compost. This finding shows that indigenous microbial solutions could be used to improve, and LOB could be used to increase the growth and rice productivity. Furtherer research are needed to improve the quality and its contribution as a biofertilizer to enhance rice productivity.

Evaluation of PGPR Strains on Growth of Tomato and Suppression of Bacterial Wilt Caused by *Ralstonia*

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Tomato (*Lycopersicum esculentum* Mill.) is one of the horticultural commodities that is very potential to be developed due to its high economic value and large export potential. Bacterial wilt disease caused by *Ralstonia syzygii* subsp. *indonesiensis* is a vascular disease in Solanaceae that can cause maximum yield loss, which inflicted global concern because of its widespread and attack on many

important crops. This research aimed to identify and characterize the ability of potential indigenous rhizobacterial isolates capable of controlling *R. syzigii* subsp. *indonesiensis* and to promote tomato growth. The PGPR traits characterized were production of hydrogen cyanide, siderophores, biosurfactant, ammonia production and protease activity. The bacterial identification was performed using 16S rRNA. Based on our results, the isolates were identified with some similarities with *Bacillus thuringiensis* strain ATCC 10792 (IR.2.3.5), *B. mycoides* strain ATCC 6462 (IR.1.3.4), *Serratia ficaria* strain DSM 4569 (IR.3.1.4), *Bacillus thuringiensis* strain IAM 12077 (IR.2.2. 1), *Enterobacter oryzendophyticus* strain REICA_082(IR.2.2.7), *Cronobacter dublinensis* subsp. *lausannensis* strain E515 (IR.2.2.5) and *S. rubidaea* strain DSM 4480 (IR.2.2.6). All isolates were characterized with various abilities related to growth promotion and biocontrol activity.

Aplication of *Pseudomonas fluorescens* and Their Secondary Metabolites for Control of Bacterial Wilt in Potato

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This research was aimed to evaluate the effect of secondary metabolites derived from two *Pseudomonas fluorescens* P8 and P60 isolates on induction of potato plant resistance to bacterial wilt (*Ralstonia solanacearum*) and on growth and yield of potato. This research was carried out in the potato field at Serang Village, Karangreja District, Purbalingga Regency with an altitude of 1285 m above sea level, with an average temperature and relative humidity of 22.31 ^{0}C and 84.09%, respectively, in Andosol soils for four months. A completely randomized block design was used with 6 treatments with five replicates. The treatments were control, drenching bactericide (a.i. streptomicin sulphate 20%) 1.5 g/L for 6 times, drenching the secondary metabolites of *P. fluorescens* P8 or *P. fluorescens* P60 3, 6, 9, and 12 times. Variables observed were incubation period, disease incidence, disease intensity, infection rate, plant height, number of tubers, tuber weight per plant, fresh and dry weight of crop, fresh and dry weight of root, number of branches. Phenolic compounds were also analyzed qualitatively. Result of the research showed that application of *P. fluorescens* P8 and *P. fluorescens* P60 secondary metabolites induced resistence of potato plants with increased content of phenolic compounds. Drenching application of the secondary metabolites from *P. fluorescens* P8 or *P. fluorescens* P60 for 12 times delayed the incubation period and supressed the disease intensity and the disease incidence as 9.23, 75, and 53.57%, respectively, and increased plant height, dry weight of crop, fresh weight of root, dry weight of root, number of tubers, tuber weight per plant and as 24.86, 37.67, 19.05, 37.67, 18.39, 10.48, and 18.39%, respectively.

Potential of Organic Waste as A Source for Plant Growth-Promoting Rhizobacteria

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Every day, all countries in the world, including Indonesia, face the problem of waste and trying to find an effective solution to overcome the waste problem. Population growth in each country is positively correlated with increased economic activities but is not followed by new breakthroughs in the waste management system, with a negative impact on the environment. Hundreds of millions and even billions of Rupiah are being spent in a waste recycling business ecosystem. However, most of the recycled waste is inorganic waste, amounting to 20-30%, while the majority of organic waste is only 10-15% used and the remaining 60-75% is dumped in the final disposal site (landfill). The bioconversion process with black soldier fly larvae could be the right solution to overcome the waste problem and contributed to providing alternative solutions at national food needs as raw material for protein source feed in animal feed and organic fertilizer which is rich in nutrients by utilizing waste and by-products that are produced from agro-industry, settlements, food loss/waste from hotels, restaurants, modern/traditional markets, and other domestic waste. Surprisingly with bioconversion process black soldiers fly *(hermetia illucens)* in larvae stage consume all rotten/fermented organic material and multiply their weight to 5000 times. During their fattening process their release enzymes and microbes which was decomposed all substrates and convert will be valuable frass/compost faster and easier than normal composting process with high quality of output that could be utilized as PGPR.

Recovering Soil Quality of Elephant Grass Cultivated Suboptimal Land by Mycorrhizae and Organic Fertilizer

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Improvement of soil quality by bio and organic fertilizer is a sustainable effort to promote plant productivity. Investigation of the effect of arbuscular mycorrhizal fungi with four doses (0, 15, 30, and 45 Mg Ha^{-1}) of manure on the soil quality of elephant grass cultivated suboptimal land, this field study was conducted in a randomized complete block design with three replications. The application of mycorrhizae and manure have improved the soil's physical, chemical, and biological quality. Higher manure doses amended with mycorrhizae increased soil aggregate stability, pH, cation exchange capacity, organic carbon, total nitrogen, available phosphor, and exchangeable potassium. Also found, the highest microbial population with the manure application of 30 Mg Ha^{-1}. Overall, the utilization of mycorrhizae and manure could help to recover the quality of suboptimal land.

The Effect of Consortium of Plant Growth-Promoting Rhizobacteria (PGPR) in Shallots *(Allium cepa* L.) Production and Soil Health

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Shallots (*Allium cepa* L.) is one of the national priority crops which has the potential to be developed in every region because its high economic value. The low productivity of this crop is caused by the excessive use of chemical fertilizers, pesticides, insecticides and herbicides. The use of chemicals for long term with high doses will damage the soil quality. The use of biological fertilizers in plant

cultivation is the ideal effort to improve the quality and productivity of shallot. Biofertilizers can also induce resistance of shallot to biotic and abiotic stresses. However, the isolation and selection of microbes as biological fertilizer agents for shallots is important because the needs and conditions required by each plant at each planting location is different. Therefore, it is necessary to develop microbes as biological fertilizers for shallots. Hence, the current research was carried-out at Research Centre for Biotechnology of LIPI. The bacterial consortium of *Burkholderia* sp., *Bacillus stratosphericus, Sphingobacterium multivorum, B. pumilus, Pseudomonas guariconensis, B. aerius, B. subtilis* were inoculated onto seeds of shallots vr. Bima brebes var and control seeds with chemical fertilizer K and N, were sown in an open-field and followed their growth until harvest. Plant growth development parameters such as soil physical, chemical and molecular profiles (DNA extraction and 16S community sequencing on the Mi-Seq Illumina platform), were investigated. The ethanol extract of shallot bulbs was analyzed with GC-MS. In the first year of our experiment, 199 bacterial isolates were obtained isolated from tissue of shallot plants at 26 and 45 DAP and rhizosphere of shallot plants. All bacterial isolates have been characterized for their activity as a plant growth promoter. A total of 7 bacterial isolates of onion plants has the potential to be used as inoculants of plant growth-promoting agents and which have been applied to onion plantations. Our results showed a positive effect of bacterial application in plant growth, such as plant height by 10-25%, the number of leaves by 20-43%, chlorophyll content up to 49%, the number of bulbs 7-79%, and tuber weight by 15-64% compared to the control. We concluded that the bacterial consortium could improve soil fertility, plant productivity up to 12,95% and also induce the production of metabolic compounds in shallot. At harvest, the bacterial consortium showed an increase in total organic carbon, N-total, organic matter, and available phosphorus, as well as higher concentrations of nutrients compared with control. The molecular profiles showed that community diversity of microbes was positively could create a favourable environment for growth of soil microbes that could support the growth of shallot.

Isolation and Characterization of Plant Growth-Promoting Endophytic Bacteria from Celery (*Apium graveolens* L.)

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Endophytes are non-pathogenic microorganisms that live inside plant tissue. The interaction of endophytes with the host plants promotes plant growth, health and resistance to multiple stresses. The objectives of this study were to isolate and characterize endophyte bacteria from the Celery plant for their plant growth-promoting activities. The isolation of endophyte bacteria was carried out using two methods (spread plate and plant piece methods). A total of 30 endophytes bacteria were isolated using two methods. They have screened *in vitro* for plant growth-promoting (PGP) traits such as production of IAA, ACC-deaminase, nitrogen fixation, phosphate solubilization, amylolytic, proteolytic and cellulolytic activity. This study showed that the spread plate method resulted in isolates more than the plant piece method. Twenty-one isolates exhibited the ability to fix nitrogen, five isolates solubilize phosphate and three isolates produced IAA. The result of the enzymatic activity test showed 14 amylolytic, 18 proteolytic and 12 cellulolytic isolates.

Characterization of Endophytic Bacteria and Growth Promoting Activity in Shallots

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This study was aimed to isolate endophytic bacteria that have nitrogenase activity, produce phytohormones and catalase enzymes isolated from shallots and used as plant growth promoters. Four isolates of endophytic bacteria were tested on shallot growth. The results of PCR amplification of 16S rRNA gene sequence analysis showed that the isolates were *Bacillus pumilus* and *Pseudomonas guariconensis*. Bacterial isolates were tested to determine their nitrogenase activity, production of indole-3-acetic acid (IAA) and for the presence of the catalase enzyme. All isolates were showed nitrogenase activity in NFB media. There was only one endophytic bacteria that showed the ability to produce IAA and two isolates were produced the enzyme catalase. Our study showed a potential of these strains to promote plant growth and increase the resistance of shallot plants.

Influence of The Ratio of Methanol and Concentration of Methanol with Ultrasonic-Assisted Extraction on The Phytochemical Content in Cornsilk Extracts

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Cornsilk was one of the sources of natural antioxidants that have the potential to be used as a raw material for functional food. The study aimed to determine the influence of ratio (material: methanol) and concentration of the Ultrasonic-Assisted Extraction (UAE) method on the phytochemical content in cornsilk extracts. The experimental design used was a factorial Randomized Completely Block Design (RCBD) with 2 factors and 3 replications for each treatment. These two treatments were: A1=methanol (1:4) (w/v), A2=methanol (1:6) (w/v), A3=methanol (1:8) (w/v) and concentration of methanol (60, 70 and 80%). The results showed that the ratio (material: methanol) and concentration of methanol had a significant ($p<0.05$) on the phytochemical content in cornsilk extracts. The best treatment interaction on the A3B3 (1:8 (w/v) and concentration of methanol 80%) on phytochemicals content analysis (total phenol at 2.91 µg GAE/g, total flavonoids at 2.32 µg GAE/g, beta carotene at 1.07 ppm, vitamins C at 12.47 mg, and antioxidant activity at 27.08%). This study implies is that the cornsilk extracts with the UAE method could be developed as a source of bioactive compounds to be converted into value-added products.

Influence of Liquid Organic Biofertilizer (LOB®) as PGPR in Rice (*Oryza sativa*) and Sweet Corn (*Zea mays* Saccarata) Production

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Plant growth-promoting rhizobacteria (PGPR) is the main focus by Great Giant Pineapple Company (GGP) since 2007. GGP evaluated various PGPR in improving pineapple yields and land conditions. GGP management decided to share the beneficial of PGPR products supplied to the local farmers in another different crop. The local farmer uses chemical fertilizers and pesticides continually, hence, causes the soil degradation and lower yields. The substitution of PGPR products could be a solution to reduce the use of chemical fertilizers and pesticides for sustainable agriculture. In this paper, we will present the descriptive analysis to review research results conducted in LOB Department. There were three steps in this review: laboratory steps, the production, distribution, QC steps, and field trials. The laboratory experiment was conducted by descriptive-analytic experimental design. The production, distribution and quality control were monitored. The field experiments were conducted in randomized block design. Our results showed that the PGPR product of GGP in Liquid Organic Biofertilizer (LOB®) contained seven cultures. It consisted of Bacillus, Pseudomonas and Yeast formulated in a mixed culture. The quality of isolates observed every 3-month and showed same morphology and the activity performance compared with ancestor. The production of LOB® started from 2013 using bioreactor with batch fermentation system. During 2013 to 2020, the LOB plant produced about 17.22 million liters with an average of 2.15 million liters per year. The production was sufficient for own plantations needs which is about 98% and remaining 2% for commercialization. The product quality of LOB® is always maintained as per with the government regulations. Application of the LOB® in rice and sweet corn has a potential to reduce the use of chemical fertilizer up to 25% and showed the increase of potential yield to about 16% in rice and 18% in corn.

Bioprospecting and Bioformulation of *Bacillus altitudinis*-P10 as An Environmentally Friendly Biopesticide Against Leaf Blight Caused by *Xanthomonas oryzae Pv. oryzae*

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Xanthomonas oryzae pv. oryzae (Xoo) causes a bacterial leaf blight (BLB) in paddy leaves and damaged rice farming production significantly over the decades. *Bacillus altitudinis* P-10 that was isolated from rhizosphere of paddy grown in organic farm and tested its ability to control the infection of Xoo *in-vitro* and *in-planta* experiments. In vitro analysis using scanning electron microscopy (SEM) displayed the damage of the cell wall structure of Xoo after 24h treatment with the *B. altitudinis* P-10 supernatant. *In-vivo* analysis of the efficiency in different carriers such as kaolin and molasse showed prolonged the shelf-life of *B. altitudinis* P-10. The Kaolin showed the highest viability of cells $8.7x10^8$ CFU compared with molasse $1.1x10^7$ CFU for two months storage. Generally, *B. altitudinis* P-10 in NB medium will survive only for 48 h. In-planta test using paddy plant showed that the severity of leaf blight disease result was also congruent with the viability of cells *B. altitudinis* P-10. The leaves severity in kaolin carrier was the lowest 2,25±0,22, compared with molasse 3,79±0,23 and control 5,45±0,23. The height and number of rice seedlings showed kaolin was the best carrier. Taken together, these results showed the potential use of *B. altitudinis* P-10 as commercial strain for a biocontrol agent against BLB disease with the precise bioformulation technology.

Effect of Chemical Fertilizers and Biofertilizers on Growth and Yield of Dahlia (*Dahlia variabilis* L.) cv. Kenya Orange

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The present investigation was conducted in the Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, (Allahabad) during Rabi season of 2018-2019. The experiment was laid-out in a Randomized Block Design (RBD) with 13 treatments and each treatment was replicated three times. The treatments consisted of different combinations of chemical fertilizers (N, P and K) and biofertilizers (Azotobacter and PSB) and control (without fertilizers and manures). Our results showed that the treatment T_3 (N80+P100+K100+Azotobacter at 2.0 kg/ha) was found significant better compared to other treatment combinations, with highest flower diameter (21.88 cm), flower weight (63.80 gm), flower yield per plant (504.59 gm), flower yield per plot (2.850 kg), flower yield per hectare (11.72 t/ha), vase life in normal tap water (6.53days) followed by T_9 (N100+P80+K100+PSB at 3.0 kg/ha). Treatment T_{10} (N100+P85+K100+PSB at 2.25 kg/ha) was found significant compared to other treatment combination, with highest weight of single tuber (59.23g), numbers of tubers per plant (8.56), tuber yield per plant (47.00 gm), tuber yield per plot (2612.33 gm), yield of tubers per hectare (10.75 t/ha) followed by T_5 (N90+P100+K100+Azotobacter at1.0 kg /ha) compared T0 (control).

Shoots Induction of *Chrysanthemum* on Foliar Fertilizer Media Combined with Coconut Water and Plant Puree by In Vitro Culture

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The purpose of this study was to induce *Chrysanthemum* shoots in an alternative medium of in vitro culture and also to determine the best combination of foliar fertilizer and plant puree that provides the most optimum growth for *Chrysanthemum* shoot induction. The research was conducted using an experimental method with single-factor design 9 treatments with 3 replications and 3 samples. The treatment is various compositions of in vitro culture medium: (1) Murashige and Skoog (MS) + Plant Growth Regulator (PGR), (2) MS+coconut water (CW)+banana puree (BP), (3) MS+CW+potato puree (PP), (4) Green foliar fertilizer (GFF)+CW+PGR, (5) GFF+CW+BP, (6) GFF+CW+ PP, (7) Red foliar fertilizer (RFF)+PGR, (8) RFF+CW+BP, (9) RFF+CW+PP. Plant Growth Regulator used BAP 1 ppm and NAA 1 ppm. The concentration of foliar fertilizer was 3 g/L, coconut water was 150 mL/L, and banana/potato puree was 150 g/L. The results showed that chrysanthemum shoots can be induced and grow well on foliar fertilizer medium combined with coconut water and banana or potato puree. The use of this alternative medium had good potential to substitute the MS medium in the induction of *Chrysanthemum* shoots. The use of green foliar fertilizer+coconut water+potato puree is very good for the enlargement of planlets, while the red foliar fertilizer+coconut water+banana puree is optimum for the multiplication of *Chrysanthemum*.

Effect of Empty Fruit Bunch and Rhizobacteria in Growth of Oil Palm Seedlings in A Pre-Nursery

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Rhizobacteria as a plant growth booster which is commonly called plant growth-promoting rhizobacteria (PGPR) is a specific microbe that can increase the development of roots and plant growth, through the interaction with roots of plants. The purpose of this research was to test palm oil mill by products and PGPR on the growth of oil palm seedlings in a pre-nursery. The research was conducted in a complete randomized design with treatments as factorials. The first factor was the empty palm oil bunches (EFB) consisted of three levels: soil:compost EFB (1:1); soil:ash EFB (1:1) and a soil as control. The second factor was the dose of PGPR in three levels: chemical fertilizer (control); 20 ml and 30 ml. Each combination of treatments was repeated five times. The data of the research results were analyzed using analysis of variance to find out the real difference between the treatment tested with Duncan's multiple range test at 5%. The results showed that there was no interaction between the administration of EFB, PGPR dose in growth of pre-nursery palm oil

seedlings. EFB compost provided good results in growth of oil palm seedlings in pre-nursery. PGPR application at a dose of 20 ml was able to provide good growth in palm head seedlings in pre-nursery.

Effect of Eco-Enzyme on Germination of Mung Bean (*Vigna radiata*)

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Seed germination is the initial stage of plant growth and development. Water is very necessary for the initial process of germination. Currently, ecoenzymes have been applied to plants to support optimal plant growth by reducing the use of synthetic fertilizers. Experiments were carried out in mung bean (*Vigna radiata*) seeds with role of ecoenzymes effect in the germination phase. A factorial completely randomized design (two factors) with three replications was used in mung bean germination. The first factor was the length of soaking of the seeds, at 5 levels of duration 0, 3, 6, 9, 12 hours, and the second factor was the concentration of ecoenzyme at 0, 0.1, 0.2, 0.3, 0.4%. Observations were made at 3 days after sowing. The results showed that the concentration of 0.1% ecoenzyme tended to show growth in the number of sprouts which had formed perfect leaves up to 44% of the total seeds used. Soaking the seeds in 0.3% ecoenzyme for 6 hours was able to enhance growth of leaves almost to 56% of the total sprouts. Ecoenzyme treatment in mung bean showed more vigor sprout growth and longer root growth.

The Effect of Vermicompost Dosage and Plant Spacing on The Response of Growth and Production of Sweet Corn Plants (*Zea mays* Saccharata Sturt).

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Fertilization with vermicompost can increase corn production (Hafsah,2004), and can improve soil stuctue and maintain soil stability (Khrisnawati, 2003). The purpose of this research is to determine the optimum dose of vermicompost and plant spacing to increase the growth and yield of sweet corn plants.This experiment used a Randomized Block Design consisted of two factors, namely 4 levels of vermicompost fertilizer doses and 2 levels of plant spacing, obtained 8 treatment combinations which were repeated 3 times. There were 24 experimental units. Data were analyzed with analysis of variance and Tukey HSD test. The interaction between plant spacing and dose of vermicompost fertilizer had a significant effect on plant height, plant weight and cob weight per bed. The combination of treatment with a spacing of 50 x 40 cm and vermicompost 950 kg/ha gave the best effect on plant height, which was 264.36 cm , the wet weight of 512.4 grams and the dry weight of 239.86 grams. While the combination of treatment with 100 x 20 cm spacing and dose of vermicompost fertilizer gave the best effect on the weight of the cobs per bed, which was 10,472 kg/m2.

PGPR Bamboo Roots to Increase Growth and Yield of Peanuts DM-1 Situraja Variety

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PGPR is a group of beneficial bacteria that actively colonize the rhizosphere that lives and develops well in soils that contain lots of organic matter. Bamboo roots are a source of PGPR that can be used for the growth and development of peanut plants. This experiment aimed to study the effect of using PGPR bamboo roots on the growth and yield of peanut DM-1 Situraja variety to increase the productivity of peanut plants. This experiment started from August 2017 to December 2017 in the experimental garden of the Tanjungsari State Agricultural Development Vocational School (PPN) in Gunung Manik Village, Tanjungsari District, Sumedang Regency. The experimental design was used a Randomized Block Design (RBD) with 6 concentrations of PGPR bamboo roots and 4 replications, namely A = 0 ml L^{-1}, B = 5 ml L^{-1}, C = 10 ml L^{-1} , D = 15 ml L^{-1}, E = 20 ml L^{-1}, and F = 25 ml L^{-1}. The concentration of PGPR bamboo roots about 20 ml L^{-1} affected the growth and yield of peanut DM-1 Situraja variety.

Biocontrol of Root-Knot Caused by *Meloidogyne* spp. in Tomato by *Bacillus subtilis* and *Lysinibacillus* sp. Formulated with Graphite and Silica Nanoparticles

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Graphite is one of the most stable allotropes of carbon, which has been reported suitable to be utilized in a biopesticide formulation as a novel delivery system of biocontrol agents. Addition of silica nanoparticles (silica NPs.) in the formulation is also advantageous, since silica plays an important role in soil and shows beneficial effects in plants include to control pests and resistance to pathogens resistance and plant structural fortification. *Meloidogyne* spp., which causes root-knot in tomato and causes significant tomato yield reduction. In this study, *Bacillus subtilis* and *Lysinibacillus* sp. formulated with graphite and silica NPs. was evaluated to control *Meloidogyne* spp. Under *in vitro* conditions in tomato. The results showed that the formulation of *B. subtilis* and *Lysinibacillus* sp. with graphite and silica NPs. slightly increased the mortality of *Meloidogyne* spp., but did not reduced the number of root galls, slightly reduced the nematode population in roots and significantly reduced its population in the soil. The formulation induced the tomato plant growth.

Effect of Plant Growth Regulators and Micronutrients in Quality of Strawberry (*Fragaria* X *Ananassa* Duch.) cv. Chandler

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Our study was conducted at the Central Research Farm, Department of Horticulture, Sam Higginbottom University of Agriculture, Technology & Science, Prayagraj, U.P. during the years 2015-16 and 2016-2017. The Strawberry (*Fragaria* x *ananassa* Duch.) cv. Chandler was grown with each comprising of treatments replicated three times. Source of variables were NAA (20 ppm); GA_3 (75 ppm); BA (benzyl adenine) (20 ppm); Salicylic acid (50 ppm); Boric acid (0.4%); Zinc sulphate (0.4%) and combination of them with control treatment. The experiment was laid out in a randomized block design. Our results showed application of different treatment of plant growth regulators and micronutrients enhanced the TSS, Ascorbic acid, Sugar content (%), pH of the fruit juice and total acidity (%) and specific gravity were significantly increased at all successive growth stages. Maximum TSS (13.42 and 13.99 brix), Ascorbic acid (42.56 and 42.56 mg/ 100 g), Sugar content (%) (7.02 and 7.20 %), pH of the fruit juice (4.73 and 4.89) and total acidity (%) (0.57 and 0.58%) and specific gravity (1.42 and 1.52) were found in successive years in T_{17} (GA_3 75ppm+ zinc sulphate 0.4% + boric acid 0.4%) and minimum quality were observed in T_1.

Effect of Plant Growth-Promoting Rhizobacteria, Bio-Phosphate Microorganism and Phosphate on Growth of Oil Palm Seedlings Under Drought Stress Conditions

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Drought is a major abiotic stress threatening agricultural production of oil palm. Drought causes disruption of phosphorus absorption by plants. In this study, we evaluated the effect of plant growth-promoting rhizobacteria (PGPR), bio-phosphate microorganism and phosphate on growth of oil palm under drought stress condition at the Tri Dharma Research Station INSTIPER Yogyakarta. The experiment was a factorial and in a completely randomized design with two factors and three replications per treatment during January to May 2020. The first factor was a fertilization treatment includes P1 (PGPR), P2 (bio-phosphate microorganism) and P3 (phosphate). The second factor was a watering intervals included L1 (once-a-day) and L2 (once-in-7 days) to reach to field capacity. Data were recorded at 120 days after planting. The results showed that the PGPR, bio-phosphate microorganism and phosphate had no significant effect in plant height, number of leaves, leaf area, dry weight of plants, volume of root, dry weight of root and shoot, stem diameter, number of stomata and root-shoot ratio. The watering intervals at once-a-day and once-in-7 days had a significant effect in volume of root, dry weight of root and root-shoot ratio. Phosphate fertilization with watering once-in-7 days significantly increased the width of stomata openings.

Effect of *Micrococcus* sp. to promote Pineapple rooting

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Rooting is one of the problems in pineapple growth in Great Giant Pineapple. Roots has major functions of the root system such as resource capture, anchorage, and plant hydraulic. As resource capture, root must be interacting with soil microbes. They play an important role in soil fertility, e.g., the decomposition of organic matter entering the soil, increasing availability of minerals to plants, nitrogen fixation, production of Phyto stimulators, and many more. Indole acetic acid (IAA) as Phyto stimulator produced by microbe could help to promote the root growth. *Micrococcus* sp. one of plant growth-promoting rhizobacteria that could produce IAA. This study was to know the effect of *Micrococcus* sp. and consortium microbe (LOB) to promote pineapple rooting. This research was conducted in poly bag with non-pesticides residue soil, replicated eight times at a of dose 10 ml/L with spray volume of 50 ml/plant. Rooting growth periods in pineapple plant increased at fourteen days after planting and decreased at four months after planting. *Micrococcus* sp. can promote growth of root shoot ratio, main root, root hair and lateral root better than others treatments. Based on root system architecture performance, *Micrococcus* sp. could help to fix it, so the second crop of pineapple production will be better.

ABSTRACTS - ROOM 2

Induced Systemic Resistance and Antibiotic Production by Microbial Biofungicides

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Plant diseases are causing tremendous yield losses in agriculture sector and the impacts of control methods pose another challenge to sustainability in crop protection where pesticide usage is the primary method of control. Improper use of synthetic fungicides adversely affects human health and the environment. A safe and environmental-friendly approach using microbial agents is highly desirable in disease management. Monocot plants such as rice and oil palm are economically important crops in Malaysia requiring sustainable crop protection. Antagonistic microbes confer sustainable crop protection by direct or indirect antagonism of pathogenic microbial strains, competition for space and nutrients, production of antibiotics and activation of plant innate immunity. In rice, *Streptomyces* sp. UPMRS4 induced upregulation of chitinase, glucanase, pathogenesis-related gene (*OsPR1a)* and salicylic-responsive gene (*Oswrky45)* while *Stenotrophomonas maltophilia* UPMKH2 increased the expression of β-1, 3-glucanase and chitinase significantly. In oil palm,

gusA:gfp-tagged *Pseudomonas aeruginosa* UPMP3 demonstrated intense root colonization and application of whole cells or phenazine extracted from *P. aeruginosa* UPMP3 caused induction of chitinase, β-1,3 -glucanase, and peroxidase expressions. *P. aeruginosa* UPMP3 produced antibiotics such as phenazine (PHZ), pyocyanine (PYO) and phenazine-1-carboxylic acid (PCA) *in vitro*. These microbial agents demonstrated potentials to be used as biofungicides as a safe alternative to synthetic fungicides.

Enhanced Mycorrhiza Colonization in Presence of Biochar

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Arbuscular Mycorrhiza (AM) in its association with the plants by the process of symbiotic association, benefits the plants in many ways. AM supports the plants in different phases of the plant in its survival and growth. Absorbing nutrients from the deeper layers of the soil and supply of water and essential nutrients to the plants in nutrient deficient soils is a magnificent character of AM. Thus the presence, survival and colonization of AM with the plants have gained its importance. Application of Biochar notably alleviates the soil organic carbon content, which makes the soil an environment for microorganisms and mycorrhiza to harbor. Accumulation of carbon is higher in the soil. Application of Biochar benefits the soil health by bringing in changes in soil texture, microstructural changes within the soil and also promotes the growth of essential microorganisms that benefits the plants. Biochar prepared by pyrolysis process when applied to soil provides large surface area to volume ratio, which influences the ability of Biochar surface charges to adsorb soil nutrients. Biochar from different sources and processes have its individual beneficial effects in soil in increasing its physico-chemical properties in nutrient and water retention. This also helps in retention of Phosphorus in the soil. Understanding the affinity towards Carbon resource and enhanced colonization of AM in presence of Biochar is the focus in this research.

Amelioration of Abiotic Stresses by Soil Microbes and Amendments

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Soil microbial diversity is a key indicator of soil health and fertility. The main drivers of soil ecosystems include plant and soil type and all factors are governed by environmental conditions. There is a dire need to explore beneficial microbial responses for managing the risks to sustainable agriculture in an environment threatened by climate change. Soil is a limited resource and environmental stresses are decreasing agricultural productivity day by day. The aim of this study was to check the effect of environmental stresses like drought, salinity, and heavy metal on soil microbial biodiversity and testing the efficacy of tolerant plant growth-promoting rhizobacteria alone and in combination with effective soil amendment techniques for improving plants growth under predicted abiotic stresses of climatic change. Experiments were conducted to isolate and characterize stress tolerant rhizobacteria, and to check their stress mitigation potential. Modified plant biomasses like compost, biochar, and bio-organic fertilizer were used as soil amendments. Various morphological, physiological, biochemical, growth and productivity parameters were studied. Microbial strains were isolated from the stressed region. The identification of isolated microbial strains was carried out by physiochemical and 16s rDNA sequencing and phylogenetic analysis. Stress tolerance and different

plant growth-promoting traits of isolated strains were evaluated under normal as well as in stress condition. Inoculation of seeds with PGPR along with compost, biochar and bio-organic fertilizer improved all growth and productivity parameters, increased nutrient status and improved osmolyte production and hence helped the survival and growth under stress conditions. Microorganisms have a variety of evolutionary adaptations and physiological acclimation mechanisms that allow them to survive and remain active in the face of environmental stress. Building our understanding of the interdependence of microorganism communities, environmental stresses and plant responses will be important for understanding climatic effects on soil health and plant growth. Our new understanding of microbial diversity in response to environmental stresses will allow us to cure and conserve our environment and grow more food.

Antifungal Activity of The Tomato Endophytic Bacteria and Evaluation of Their Bioactive Compounds as Potent Biocontrol Agents Against Major Phytopathogneic Fungi

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Phytopathogenic fungi, viruses are known to cause huge losses in fruit and vegetable crop plants. Endophytic bacteria that are antagonistic to most phytopathogenic fungi and their metabolites could act as the effective biocontrol agents. Endophytic bacteria are also becoming popular as the effective biocontrol agents along with plant growth-promoting properties. In this context, endophytic bacteria isolated from the tomato plant were screened for their antifungal potential against important phytopathogenic fungi like *Fusarium graminearum*, *Fusarium oxysporum*, *Fusarium culmorum*, *Fusarium udum*, *Fusarium proliferatum*, *Macrophomina phasoelina* that causes serious diseases in the tomato and other fruit vegetable crop plants. In total, 70 endophytic bacterial strains isolated from different organs of tomato plants sampled from different fields of Mizoram, India were screened against these fungal pathogens using the *in vitro* dual culture assays. The results showed that more than 30% of the isolated endophytic bacteria were found active against at least three different fungal species. Overall, three strains (HST6, HLT9, and D2LTI) were found most active against six pathogenic fungal strains used in screening and were used for further analysis. These strains were identified using 16S rRNA sequence-based phylogenetic analysis and were found to belong to Bacillus sp. The metabolic profiling using organic solvent-based extraction method showed that, these strains produce antifungal compounds. In the initial characterization, it was observed that these are lipopeptide types of compounds. The extracts are prepared and analyzing using TLC. The partially purified compounds were dissolved in methanol and used for antifungal activity. The extract found effective in inhibiting the fungal growth at the lowest concentration (60 - 100 µg/ml). These extracts were also evaluated for tomato leaf bio-protection assay performed for 7 days of incubation. Among the three strains, strains HST6, HLT9 were found to protect spread of fungal pathogen infection on the leaves within 7 days after application of the tomato leaves. The study showed that, both the strains could act as potential biocontrol agents to reduce fungal pathogenic diseases of various crop plants including tomato plants.

Induced Mutation in *Erwinia* sp. PR6 Enhanced Growth of Finger Millet Var. CO14 Under Abiotic Stress

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In the present study, plant growth-promoting rhizobacterium *Erwinia* sp. PR6 was subjected to mutation using ethyl methanesulfonate (EMS) and studied for its effect on seed germination and growth parameters of finger millet var CO14 under abiotic stress. Initially, EMS mutated five potential colonies of *Erwinia* sp. PR6 were screened for their inoculation effect on seed germination and growth parameters of finger millet var. CO14 under control conditions. On the basis of their performance mutated colony EMS-1 was selected for further study. The clones of mutated colony EMS-1 showed enhanced seed germination (48-68%) and growth parameters i.e., elongation of root and shoot length (40-62%) under pH range of 5-9, the highest being at alkaline pH 9. This organism may be further exploited for sustainable production of finger millet var. CO14 under extreme alkaline pH condition.

Increased Growth of Shallots (*Allium ascalonicum* L.) Against Fusarium Wilt Disease with Combination of Vermicompost And *Trichoderma* Sp.

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Fusarium wilt disease in shallot plants could restrain plant growth and productivity. Chemical control of Fusarium wilt disease was known to be unsatisfactory because, the pathogen is in the soil. Biological control is expected to overcome these problems and increase plant growth. This study aims to determine the effect of applying vermicompost and *Trichoderma* sp. against the growth and resistance of shallots to Fusarium wilt disease. The study was conducted in a Complete Randomized Block Design (CRBD) with five replications. The treatments tested were: P1, positive control (*Fusarium oxysporum*), P2, negative control (without *F. oxysporum* inoculation), P3, *F. oxysporum* + *Trichoderma* sp. 40g per polybag, P4, *F. oxysporum* + vermicompost 20g per polybag, and P5, *F. oxysporum* + vermicompost 20g per polybag + *Trichoderma* sp. 40 g per polybag. Our results showed that the addition of vermicompost 20g per polybag and *Trichoderma* sp. 40 g per polybag in the soil increased plant heigh even though the soil had been invested with *F. oxysporum*. The intensity and incidence of fusarium wilt disease were lower in the treatment added by *Trichoderma* sp. at 40g per polybag compared to control.

Effect of Arbuscular Mycorrhizae on The Growth of *Eucalyptus pellita* Seedlings

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Nursery productivity is one key component in plantation forest sustainability. Seedling quality contributes significantly to plantation health. Fertilization regimes and pest and disease control are very critical. The use of chemical fertilizers and pesticides has posed concerns related to environmental issues. It would therefore be more desirable to manage nursery in an environmentally friendly manner but with comparable productivity. The utilization of plant growth promoting microbes (PGPM) is seen as one option to this effort. It has been demonstrated elsewhere that arbuscular mycorrhizae (AM) can improve growth and health of host plants. In this experiment, the effect of two different AM products on the growth and health of *Eucalyptus pellita* seedlings in reduced fertilizer regimes was investigated. Results showed that in *E. pellita*, the AM products have not been able to compensate reduced fertilizer regimes (both to 50 % and 25 %) in term of seedling height and diameter. Further research is required to elucidate possible reduction of fertilizer and/or pesticide use through application of the AM products.

Evaluation of *Trichoderma* Species for Production of Enzymes, Antagonistic Ability and Plant Growth-Promotion Potential

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Trichoderma virens and *T. asperellum* have been widely known for its potential as biocontrol agents. Microbial consortium from effective strains could improve the biocontrol efficacy, increase its dependability and consistency under various environmental conditions. Three different strains of *T. virens, T. asperrelum,* and their consortium have been evaluated for their potency on production of various enzymes which are important for antagonistic capability and plant growth-promotion. In vitro study showed that different species showed different growth rates, however, the growth restriction did not occur among them indicating the compatibility among strains and interspecies. Single isolate from strain Tv1 and Ta2 showed the highest cellulase production, 0.91 µg/ml and 0.91 µg/ml, respectively. Likewise, the consortium of the two strains (Tv1 and Ta2) also produced the highest cellulase compared to other combinations, which was 50% more compared to single stain. *T. asperellum* strains showed higher capability in chitinase production compared to *T. virens*, however, the combination of Tv3 and Ta1 strains showed significant increase in the chitinase production compared to singe isolate. Phosphate solubilizing activity also increased in Trichoderma consortium indicating the synergistic effect from two Trichoderma strains tested. Therefore, it is important to select compatible strains for use in consortium to enhance Trichoderma's ability as biocontrol agent and growth promoter.

Sustainable Agroindustry and Agrotourism in Rural Areas - Case Study on Chocolate Industry of Cau Chocolates of Bali

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Cau chocolates is a chocolate brand produced by Cau Coklat Internasional Ltd, a chocolate processing industry since 2017, located at Cau sub village, village of Tua, district of Marga, Tabanan, Bali, Indonesia. Currently, the chocolate company has three organic certificates include Indonesia (SNI), America (USDA) and Europe (EU). Other local and domestic markets for Cau Chocolates, also exported to several countries, such as Singapore, Malaysia, USA, and Emirates Arab. The cocoa beans, which are used as raw material for chocolate, were produced by cocoa farmers in Bali, organized under farmer cooperative. The cocoa beans were purchased by Cau Coklat International Ltd., through a mutually beneficial cooperation model by concept of "Need Each Other and Growth Together (NEO-GT)". Cau Coklat International Ltd., also develops agrotourism based on chocolate, packaged in various tour packages, such as be Balinese (introducing Balinese daily life and traditional chocolate processing), chocolate tour and making chocolate. Through these two main businesses: chocolate production and agrotourism, Cau Coklat International is able to employ a large number of workers from rural areas, good income for the farmers, so that it will develop in a sustainable issue.

Utilization of Soapberry Fruit Extract as a Natural Surfactant in Cashew Nut Shell Liquid Bioinsecticide Formulation for Soybean Pest Management

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Soybean is one of the commodities which demand continues to increase from year to year. One of the main obstacles in increasing soybean production is the presence of pests. The purpose of this study was to determine the concentration of soapberry fruit extract as natural surfactant in cashew nut shell liquid (CNSL) formulations that was most effective in controlling pests and to produce the best growth and yield of soybean. This study was used as a Randomized Complete Block Design (RCBD) with single factor that was concentration of soapberry extract. The treatments of the research were consisted of application of CNSL formulation with 4%, 3%, 2%, 0% soapberry extract, application of CNSL formulation with detergent 1 g/liter, synthetic pesticides (Fastac 1-2 liters/ha) and without pesticides as a control. The results of the reaserch showed that insecticide applications had efficacy against grasshoper and pod-sucking bug in soybean cultivation, where the CNSL with 3 and 4% soapberry, and the CNSL with detergent, relatively had efficacy as good as synthetic insecticide. All of the applications of CNSL formulations and synthetic insecticide did not cause differences in soybean growth. However, application of CNSL formulation with 4% soapberry was able to increase soybean yield as high as the application of synthetic insecticide, and did not significantly different from CNSL formulation with detergent.

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Isolation and Identification of Indigenous Endomycorrhiza in Cocoa Plantation and its Propagation by Giving Water Stress and Different Planting Media to Develop as a Biofertilizer

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Cocoa is a plantation crop that has potential to increase state income. Increasing the productivity and quality of cocoa can be achieved by using biofertilizer produced from indigenous endomycorrhiza. The aim of this research was to obtain indigenous endomycorrhiza isolates and their propagation with different planting media and water stress to develop as a biofertilizer. The research was conducted from January-May, 2021. Spores of indigenous endomycorrhiza was taken from root rhizosphere of cocoa plantation from Bali. Isolation and identification was conducted at laboratory, while propagation of the spores was conducted at greenhouse. The research used in propagating of spores was a completely randomized design with two factors and four replications. The first factor was planting medium, consisted of four levels (soil only, soil with sand, soil with compost, and sand with compost) and the second factor was water stress consisted of three levels (100%, 70%, and 40% field capacity). The results of isolation and identification showed that there were three genera of indigenous endomycorrhiza spores found, *i.e.* Glomus, Gigaspora and Acaulospora. The percentage of root colonization rate was very high and each sample point had a 100% colonization rate. The treatment combination of soil and sand growing media and soil water content of 40% field capacity gave the highest increase in spores number.

The Colonization Assay of Halotolerant Plant Growth-Promoting Bacteria Into Agronomic Crops Under Saline Stress

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The ability of bacterial strain to colonize the inoculated plants play a role in the successful application of plant growth promoting bacteria in agricultural practices. Nevertheless, the sustainability of the bacterial inoculant to further colonize the roots and inner tissues of the plant is not always clearly recognized. The main purpose of this study was to determine the efficacy of 15 indigenous halotolerant plant growth-promoting bacteria (PGPB) to colonize three selected agronomic crops by seed inoculation method. We have evaluated 15 gfp-tagged halotolerant bacterial isolates on their ability to colonize rice, maize, and soybean seedlings using normal Hoagland's media and Hoagland's media amended with 100 mM NaCl. We used the quantitative dilution plating method and fluorescent microscopy to determine the colonization degree of gfp-tagged halotolerant PGPB isolates in the rhizoplane zone as well as in the inner tissue of rice, maize, and soybean seedlings at 21 days after

germination. All halotolerant PGPB isolates showed better colonization on the rhizoplane zone of all tested seedlings. Isolates E194-3, D183-4, and E101-1 showed the highest colonization in rice, maize, and soybean seedlings respectively at both normal and 100 mM NaCl amended Hoagland's media. We concluded that the efficacy of halotolerant PGPB isolates to colonize the agronomic crops was varied between bacterial isolates, plant species, plant tissues, and NaCl concentration.

Effect of Plant Density on Intercropping with Maize-Soybean Inoculated With Mycorrhizae Amended With Organic Fertilizer Enhance Yield in Dryland of North Lombok, Indonesia

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Mycorrhizae and organic fertilizer play key roles in nutrient acquisition and assimilation, improved soil texture, and secreting hormones to enhancement of plant growth. The aim of this research to determine the effect of plant density on the intercropping maize soybean inoculated with mycorrhizae and the addition of organic fertilizers to the yield of maize and soybean in the dryland North Lombok. The experimental design used was a randomized block design with the treatment of five intercropping patterns i.e., P1 = 2 rows of maize: 2 rows of soybeans, P2 = 3 rows of maize: 2 rows of soybeans, P3 = 3 rows of maize: 3 rows of soybeans, P4 = 4 rows of maize: 2 rows of soybeans, P5 = 4 rows of maize: 3 rows of soybeans. Data were analysed using analysis of two-way ANOVA and Tukey's HSD (Honestly Significant Difference) means-tested at a 5% level of significance. The results showed that the intercropping density of 3 rows of maize: 3 rows of soybean maintain a high yield and could increase the number of spores and percentage of mycorrhizal infections compared to other intercropping treatments. The results showed that intercropping patterns of 3 rows of maize and 3 rows of soybean with the addition of 15 tons of cattle manure per hectare and AMF inoculation can increase yield and mycorrhizal development.

Antifungal Activity of Phenolic Compounds from *Samanea saman* Jacq. (Merr) Leaves Against Stem Rot Disease in Dragon Fruits Caused by *Fusarium solani*

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Fusarium solani is a pathogen causing stem rot disease on dragon fruits. Phenolic compounds are believed to inhibit the growth of the disease. This study aims to determine the total phenolic contents of *Samanea saman* leaves extract, to identify the phenolic compounds, and to evaluate its antifungal activity against *F. solani*. Extraction was done by maceration methods with ethanol 96%, followed by fractionation. Determination of total phenolic content was done by UV-Vis Spectroscopy. Purification was performed by chromatographic technique. Identification of isolate was conducted by

phytochemical test and spectroscopy technique. Antifungal assay was carried out by well diffusion agar. The total phenolic content of the acetone extract was 6589 mg GAE/100g extract. The extract strongly inhibited the growth of the fungal pathogen with the inhibitory zone of 25.50 mm. The active isolate very strongly inhibited the growth of the fungal pathogen with the inhibitory zone of 35.50 mm. The phytochemical test and UV-vis spectroscopy analysis showed that the isolate was hydrolyzed tannin which absorbs the ultraviolet light with a wavelength of 264.90 nm. While the infrared spectroscopy analysis showed that the functional groups of tannin are OH (phenol); -CH aliphatic, -C=O, -C=C aromatic, and -CO.

Control of Antracnose Disease in Tomato (*Solanum lycopersicum*) Using Endophytic Fungi

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Anthracnose is a disease in tomato plants that caused direct economic losses for farmers. This disease caused by a fungus *Colletotrichum coccodes* with symptoms of small blackish spots on the tomato. Then the fruit is shriveled, dry and rot. Biological control using endophytic fungi is one of the safest and environmentally friendly controls. Endophytic fungi are fungi found in living plant tissue, capable of living by forming colonies in the tissue without harming the host and causing no symptoms of the disease. This study aimed to determine the types of endophytic fungi in tomato and to determine endophytic fungi as control of anthracnose disease. The research was conducted by taking plant samples in Lempake Villlage, north Samarinda District, and then tested for antagonists between endophytic fungi found in tomato against pathogens that caused anthracnose disease. The results obtained four genera of endophytic fungi in tomato plants, namely: *Aspergilus flavus*, *Aspergillus niger*, *Trichoderma* sp., and *Rhizopus* sp. Antagonist test showed that *Aspergillus flavus* fungus suppressed 33,17%; *Aspergillus niger* fungus suppressed 36,43% and *Rhizopus* sp. fungus suppressed 38,37% against pathogenic fungi that caused anthracnose disease. *Trichoderma* sp. fungus has the highest ability to control anthracnose disease.

Investments in *Metarhizium* sp. and *Trichoderma* sp. In Post-Mining Land on Soil Fertility, Growth and Production of Tomato Plants (*Solanum lycopersicum* L.)

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Soil conditions in coal mining areas in general are soils in poor nutrient conditions, so that additional nutrients are needed and microbial investment is needed to improve the quality of aeration in the soil

and increase the availability of nutrients for plants. This study used the fungus *Metarhizium* sp. and *Trichoderma* sp. in order to see the ability of each fungus to increase the growth and yield of tomato plants and to see the ability of these fungi to increase soil fertility in post-coal mining soil. This study used post-coal mining soil and the data were compiled using a completely randomized design with four replications. The factors used were *Metarhizium* sp. and *Trichoderma* sp. with each dose of 0 g, 3 g, and 5 g in each treatment. Growth parameters such as plant height, number of branches, number of flowers and fruit production were evaluated. The data were analyzed using variance with the Least Significant Difference (BNT) test with a level of 5%. The results showed an increase in soil fertility by increasing soil pH, C-Organic, Nitrogen, Phosphorus and Potassium. Investments in *Metharizium* sp and *Trichoderma* sp. were able to increase soil fertility, growth and production of tomato plants.

Antibacterial Effects of Various Concentrations of Natural Ingredients of Snail Mucus (*Achatina fulica*) Against Inhibition Zones of *Fusobacterium nucleatum* Causes Periodontitis In Vitro

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Periodontitis is a disease that invades the subgingival area, thereby triggering an inflammatory response of the periodontal tissue. The purpose of this study was to calculate the inhibition of snail mucus against *Fusobacterium nucleatum* with a concentration of 12.5%, 25%, 50%, and 100%. This study was conducted under laboratory conditions at the Oral Biology Laboratory, Faculty of Dentistry, Airlangga University. Plant germ stock with sterile osse in BHI broth media incubated for 48 hours and observed the turbidity of the germs and then standardized with mc farland standard 0.5. Plant germs in Hilton Muller agar media as a spreading technique and treated the test sample on sterile paper disk at 0.01 ml with a sterile micropipette, then pasted it on the surface of the media and incubated for 48 hours and observed and measured the diameter of the clear zone. Our results showed that the average inhibition in the control group was 25.65 mm, and the snail mucus group was 12.5%, 0 mm, 25%, 12.40 mm, 50%, 16.70 mm and 100% 19.60 mm. There was a significant difference in the diameter of the inhibitory power between the treatment groups. The conclusion of the antibacterial effect of natural ingredients of snail mucus from the 25% treatment showed strong criteria, and the greatest inhibitory power was the concentration of 100%.

Biological Control Crude Leaf Extract of *Ficus septica to Colletotrichum gleosporioides* Causes of Anthracnose Disease in *Carica papaya*

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Fig (*Ficus septica*) is a wild plant with a wide distribution and leaf extract of *F. septica* contains bioactive compounds, that have antifungal properties including alkaloid and phenolic compounds and both are also antioxidants. *Colletothricum gleosporioides* is one of the pathogenic fungi in cultivated plants that can cause disease in plants called anthracnose. Papaya (*Carica papaya*) is one

of the cultivated plants that often shows symptoms of anthracnose disease caused by *Colletothricum gleosporioides*. This study aimed to determine the inhibitory of *F. septica* leaf extract to control the growth of *C. gleosporioides* which causes anthracnose on *C. papaya*. This research was conducted by measuring the antifungal activity of *F. septica* leaf extract against the *C. gleosporioides* through the well diffusion method. The concentration of the extract used in this study was determined by measuring the MIC value of the extract, the concentration of the extract used was 0.5%, 1%, 2%, 3%, 4%, 5% (b/v) and as a control methanol and synthetic fungicides were used. The results showed that the MIC value of *F. septica* leaf extract on the growth of the *C. gleosporioides* was 0.4% with an inhibition zone of 2.3 mm. Meanwhile, the inhibition zones formed from the treatment of *F. septica* leaf extracts were: 2.5 mm; 3.4 mm; 7.6 mm; 9.7mm; 12.7mm; 13.5 mm and 0 mm (negative control), 30 mm (positive control) resfectively. Based on the analysis of variance (Anova) conducted that all treatments were significantly different ($P \leq 0.5$) with negative control and among the treatments, 4% extract was the most effective *in vitro*. We conclude that crude leaf extract of *F. septica* contains bioactive compounds with the antifungal substances which can be safely used as an alternative measure to control anthracnose disease of *Carica papaya*.

Application of Plant Growth Promoting Rhizobacteria and Arbuscular Mycorrhizal Fungi on the Growth of Four-Month-Old *Acacia mangium* Seedlings in Nursery

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Acacia mangium is one of the indeginus tree species in West Papua and generally planted in Industrial Plantation Forest programs in Indonesia. The advantages of this species are fast growing species, good quality of wood, and the ability to tolerate various types of soil and the environment. The area for planting Acacia mangium Industrial Plantation Forests is generally carried out outside Java, where the soil conditions are marginal. Using Arbuscular Mycorrhizal Fungi (AMF) and Plant Growth Promoting Bacteria (PGPR) is an alternative solution that can be applied. The purpose of this study was to determine the effect of AMF and PGPR consortium on the growth of Acacia mangium seedlings in the nursery. This study consisted of sixteen treatments, there are combination between AMF and several doses of PGPR. The results showed that the treatment of FMA100 + PGPR100, FMA 0 + PGPR 100, FMA 100 + PGPR 50, FMA0 + PGPR50 significantly increased the height, diameter of the seedlings and the values were 168, 117, 92, 54, 32, 25 %; 100,78, 58, 40, 34, 30 % compared to the control.

Enhancement of Drought Stress Tolerance in Maize (*Zea mays* L.) by Endophytic Growth Promoting *Bacillus licheniformis* and *Bacillus glycinifermentans*

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Maize productivity in Pakistan is decreasing at an alarming rate due to various biotic and abiotic stresses for instance drought, salt and extreme temperatures. Of these stresses, drought is causing the most significant diminution in maize growth and productivity. In this study, a pot experiment was conducted under axenic conditions to determine the direct effects of PGPBs on maize growth and to study the physiological and biochemical attributes and changes in activities of antioxidants. Two PGPB strains (*Bacillus licheniformis* and *Bacillus glycinifermentans*) were applied as seed coating treatment alone and in consortium under control and drought stress conditions. Application of *B. licheniformis* and *B. glycinifermentans* was helpful to reduce the detrimental effects of drought stress and improved the morpho-physiological growth and biochemical attributes of the maize crop. Among all the treatments, *B. glycinifermentans* showed the enhanced maize growth and exhibited maximum increase in RWC, TSS, TCC, proline, protein contents and CAT activity that was followed by the consortium application which exhibited the maximum increase in APX, SOD, POD activities, carotenoid content, RMP and shoot length under drought stress compared to uninoculated plants. This study suggests that *B. licheniformis* and *B. glycinifermentans* alleviates oxidative damage in maize plants grown under water deficit conditions by improving plant growth and activating antioxidant defense system, thereby improving the membrane stability in plant cells.

Mycopesticide Formulation Suitable for Tropical Conditions for use in Crop Pest Management

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Mycopesticide formulations based on the entomopathogenic fungus *Beauveria bassiana* (Bals.) Vuillemin are available under different brand names the world over. The ones available in India are either oil or powder formulations. All the brands of this mycopesticide formulation available in India were tested for spore germination. None were found to have the conidia of B. bassiana. Instead, copious growth of *Aspergillus* and other black moulds was observed from the cultures set up from the commercial oil and powder formulations of *B. bassiana*. This we inferred was due to the short life span of the *B. bassiana* spores under the high temperatures in the tropical climate and contamination of the formulations with saprophytic fungi. We, therefore, developed a formulation of *B. bassiana* conidia with a UV protectant, lubricant, thermo protectant, anti-saprophytic agent, diluent and disintegrant compressed in a tablet form. The tabletted formulation has more than 95% conidia viable for 24 months when stored at ordinary room temperatures (25 to 38 C Day and 16 to 26 C night). About 50% conidia were viable in this tablet formulation up to 24 months. No contamination with opportunistic saprophytic fungi was observed in the tablet formulation. The tablet formulation disperses rapidly in water, and the viscosity of the resultant solution was such that it could be sprayed using the standard spraying equipment. The formulation has been patented in India and the US. Thus, a biopesticide based on this wide host range entomopathogenic fungus with a long shelf-life in tropical environments has been made available.

Essential Role of Phytohormones and Osmolytes in Balancing Abiotic Stress in Plants

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With the rapid increase in human population, we face the challenge of optimising crop production. Also, industrialization and extensive usage of chemical fertilizers are responsible for introducing abiotic stresses in agricultural croplands. Drought and salinity result in low crop yield and global food security. High salinity finally results in the cessation of plant growth and a reduction in crop productivity. New eco-friendly approaches are required to improve plant biomass production. Plant Growth-Promoting (PGP) bacteria may be exploited as efficient biotechnological tools to improve plant growth in various stressful environments. Their implementation can be a profitable alternative for the crop system because of their powerful role in plant growth regulation and salt stress management. Phytohormones are involved in the framing the plant fitness, enhancing the seed germination rate, increases root proliferation that directly enhances plant growth and development. Phytohormones are known to regulate the plant growth under environmental stress. PGPR are well documented for the production of plant growth hormones such as auxins(IAA), cytokinins Several mechanisms for PGP mediated abiotic stress tolerance in plants includes chanPhytohormones biosynthesis at higher NaCl concentration(20%w/v) by selected halotolerant isolates was one of the direct mechanism for salt tolerance in plants assisted with such PGPRs.Osmotic solutes accumulation and antioxidant enzyme activities regulated in halotolerant PGPR was the indirect mechanism of salt tolerance in plants. In this study, all, the three isolates RM1, RM2 and RM3 were found positive for phytohormones production (IAA, Cytokinin, and Gibberellic Acid), osmolyte accumulation and antioxidant enzyme activities at higher salt concentration which proved our hypothesis true. *Rhizobium* and *Bacillus* genera were well documented in several past reports for their phytohormones, osmolytes and antioxidant enzymes activities. *Rheinheimera* sp. a novel rhizobacteria was reported for the first time for such metabolites secretion that supports plant for proper growth and development under salt stress conditions. By induction of antioxidant defense system, compatible solutes accumulation may act as an essential armour for mitigating the salinity stress in plants. This displayed the novel salt tolerance characteristics of *Rheinheimera* sp. These halo-tolerant PGPR may act as a defensive system for plant growth especially to glycophytes and yield enhancement under saline environments when brings into agricultural practices. ges in vegetative growth parameter, proline accumulation, relative water content, auxin production activity, ACC deaminase activity, EPS production, antioxidant defense, accumulation of osmolytes etc. Here, we describe the significance of plant-microbe interactions, highlighting the role of salt tolerant PGPR isolated from Little Rann of Kachchh, Gujarat, India in relieving saline environmental stress by induction of various metabolites which have been tested in pot and fields trial studies.

Biocontrol Efficacy of *Gliocladium virens a*nd *Trichoderma harzianum* Against *Sclerotium rolfsii* Sacc. a Causal Agent of Collar Rot of Field Bean

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Soilborne plant pathogens are of a major concern in agriculture which significantly reduces the crop yield. They can survive for many years in the absence of a host plant by forming persistent resting structures such as microsclerotia, sclerotia, chlamydospores and oospores. They are difficult to detect, predict, diagnose for successful disease management. Chemical control of soilborne plant pathogens imposes threats not only for soil fauna and flora but also potentially dangerous to humans as well as other animals. Biological methods in management of soilborne plant pathogens are more effective. *In vitro* study was conducted to assess the mechanisms of biocontrol by fungal antagonistic microorganisms against *Sclerotium rolfsii* in field bean. The evidence in supporting the mechanisms were metabolites produced by these organisms via a zone of inhibition with of interactions such as coiling of hyphae around the pathogen, penetration, and lysis of hyphae. Among the antagonists tested, *Gliocladium virens* and *Trichoderma harzianum* showed a strong antagonism by overgrew on mycelium and suppressed the growth of mycelium and production of sclerotia. Microscopic observation showed that vacuolation, coagulation of cytoplasm and aggregation of pathogen hyphae. Our results suggests that biological control of pathogens is an important factor in disease control in agriculture.

Elucidation of Germination Potential and Growth of Wheat Seedlings Under Salinity Stress Through *Bacillus mycoides* PM35 - A *In Vitro* Study

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Plant growth-promoting rhizobacteria (PGPR) are a set of microorganisms playing substantial role in plant growth improvement under abiotic and biotic stress conditions. The wheat crop encounters the combined effect of biotic and abiotic stresses during its growth period. The present research was conducted to ameliorate salinity stress through salt stress tolerant rhizobacterial strain *Bacillus mycoides* PM35 *in vitro*. The strain PM35 was isolated from potato rhizosphere and screened for different plant growth promoting traits comprising nitrogen fixation, potassium, and zinc solubilization, indole acetic acid, siderophore, and ammonia production along with extracellular enzyme activities (protease, catalase, amylase, pectinase, cellulase, chitinase, and ACC deaminase enzyme). The strain PM35 showed significant tolerance at 1 M salt stress (NaCl). Upon inoculation to wheat seedling under 1 M salt stress in germination wheat seedlings the results depicted the ability of strain PM35 to augment salt stress tolerance in wheat seedling. Growth parameters and photosynthetic parameters of wheat seedlings were significantly improved with inoculation of PM35. This study indicates that plant growth-promoting biological agent such as strain PM35 could be exploited as a biotechnological candidate against stress conditions in agriculture sectors in near future.

Exploration and Propagation of Native Endomycorrhiza Tolerance to Heavy Metal on Various Organic Culture Media

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Endomycorrhizal fungi that are able to adapt and are resistant to environments contaminated with heavy metals, and the use of medium carrier spora for endomycorrhizal have received special attention from phyto-rhizoremediation researchers and have become the basis for this study. The aim of this study was to explore endomycorrhizal fungi from areas contaminated with heavy metals and to determine a good combination of organic culture media to increase the abundance of endomycorrhizal spores. This research was conducted in two stages, such as rhizosphere sampling of *Polypodium glycyrrhiza*, Sumasang sp (local name) and *Spathoglottis plicata* at coordinates 2^{O}31'57,6 "S and 121^{O}22'50,7" E. Rhizosfer *Chromolaena odorata*, *Melastama affine*, and *Nephrolepis exaltata* at coordinates 2^{O}31'53,5 "S and 121^{O}22'35,4" E, Sorowako, Indonesia; and continued to isolate and identify endomycorrhizal spores at the Microbiology Laboratory, Makassar Environmental and Forestry Research and Development Center, Indonesia in 2019; while other stages in 2020 are utilizing organic culture media as spore carrier media with a combination treatment of organic culture media with a combination of rice husk charcoal, sand, zeolite; rice husk charcoal, sand, sawdust; rice husk charcoal, sand, cocopeat; rice husk charcoal, sand, paddy soil; rice husk charcoal, sand, cold larvae. The results of the first phase of research showed that three endomycorrhizal genera were found were able to adapt and resist in areas contaminated with Hg, Cd, Ni, Pb, As, Cr, Zn, Mn, Fe, Cu, and Co, namely 44.44% to 75.86 % Acaulospora sp; 9.52% to 44.44% Gigaspora sp, and 3.38% to 19.05% Glomus sp, while in the second stage it was found that the combination of rice husk charcoal, sand, cocopeat; and a combination of rice husk charcoal, sand, paddy soil gave the best results for the growth and development of Gigaspora spores. The combination of rice husk charcoal, sand, and cocopeat can be recommended as an effective, efficient, and inexpensive spore carrier medium, but should be used after it has decomposing into compost.

Effect of *Trichoderma* sp. Against *Alternaria porri* in Red Onion

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Shallots are one of the horticultural commodities with high potential, therefore its cultivation is attempted in all seasons, both in the dry season and in the rainy season. Trichoderma sp. is an alternative environmentally friendly control that could be implemented. The research was conducted in Subak Biaung, Pemanis Kaje Village, Penebel District, Tabanan Regency, Bali Province. The results showed that the test treatment had a significant effect in the observed parameters. Trichoderma sp. In Bawan Merah variety showed significant interactions with trotol attacks at 21, 28, 35 and 42 days after planting (DAT). The highest trotol attack 21 hst was shown in the combination treatment T1V1 (15.61%), but not significantly different from the treatment T0V1 (13.66%); T2V1 (14.39%); T3V1 (13.53%) and T1V3 (13.19%). The lowest trotol attack 42 hst was shown in the combination treatment T2V2 (11.55%) which was not significantly different from the T0V2 (11.88%); T1V2 (13.79%); T3V2 (11.64%); T0V3 (12.89%); T1V3 (14.77%); T2V3 (12.62%) and T3V3 (12.42%). The combination treatment of T2V2 (11.55%) was able to suppress trotol attack on plants aged 42 days after planting by 40.25% compared to the combination treatment of T1V1 (19.33%). MS

application. Trichoderma sp. and shallot varieties showed significant interactions on the average maximum number of leaves per clump, number of bulbs per clump, tuber diameter per clump, wet weight of bulbs per clump, wet weight of bulbs per ha, dry weight of bulbs per clump and dry weight of bulbs per hectare. (t/ha). The highest dry tuber weight per hectare was shown in the combination treatment T0V2 (14.10 tons) which was not significantly different from the combination treatment T1V2 (13.15 tons); T2V2 (13.89 tons); T3V2 (13.42 tons); T0V3 (13.40 tons); T1V3 (12.26 tons); T2V3 (13.37 tons); and T3V3 (12.98 tons). Based on the results of the regression analysis, it was found that the correlation between the dose regression analysis of MS Trichoderma sp and the yield of dried shallots per hectare showed a quadratic relationship with the regression line equation $Y = -1.642x^2 + 10.94x - 4.5318$, with a coefficient of determination (R^2) = 99 ,98%. It was concluded that the dose of MS Trichoderma sp. of 46.6 ml/liter of water is the optimum dose to the yield of dried shallot tubers per hectare with a yield of 17.081 tonnes per hectare

PGPR in Mitigation of Abiotic and Biotic Stresses in Plants

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Abiotic and biotic stresses results in deleterious effect on plant health and also reduce the productivity across the globe. Therefore, there is a need to develop new management practices which is eco-friendly and cost effective to reduce the intensity of the losses produced due to abiotic and biotic stress in plant growth. Microorganisms are important component of soil diversity. Among soil microorganisms, plant growth-promoting rhizobacteria (PGPR) plays an important role in providing resistance toward various abiotic and biotic stresses. PGPR improves the plant growth by upgrading soil nutrients through phosphate solubilization, nitrogen fixation, production of metal chelators and improves the production of growth-promoting hormones in plants. Inoculation of rhizosphere region of plant with potential stress tolerant PGPR is expected to improve the plant growth and productivity under stress conditions.

The Role of Arbuscular Mycorrhizal Fungi (AMF) Native to Bali in Acceleration Growth of Cashew (*Anacardium occidentale* L.) Seedlings

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The Arbuscular Mycorrhizal Fungi (AMF) native to Bali strategically could be applied as an effort to overcome the problem of agriculture in arid region such as at north-east and north-west of Bali areas. Many studies at marginal areas have been reported the significant role of AMF on boosting the growth rate, productivity and resistance to plant diseases nevertheless. Therefore, it is a strategy to

conduct our research in Bali native AMF for the accelerate growth of cashew seedlings. The aim of this study was to formulate combination of Glomus, Gigaspora and Acaulospora spores and test to accelerate the growth of cashew seedlings. The experiment was conducted in the greenhouse of Biology Department of Udayana University. The results showed that there was a positive effect on the growth of *A. occidentale* seedling (leaves number, roots biomass and plant height) when added 75 of AMF spores. But there was no significant effect in the growth of *A. occidentale* seedlings when added 90 number of AMF spores. This finding indicated that 75 spores of AMF will be the optimum number to influence the growth of cashew seedlings.

Biodiversity and Characterization of Indigenous Arbuscular Mycorrhizal Fungi of on Agricultural Soils in Central Lombok

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Mychorrizal fungi plays a significant role in increasing the nutrients and water supply to support the plant growth and development on dryland ecosystem. This research was conducted to investigate the biodiversity and characterize of arbuscular mycorrhizal fungi (AMF) on rhizosphere of agricultural soils in central Lombok. From the results of the preliminary survey, it was determined that the soil sampling for Indigenous FMA exploration was carried out in the dry land of central Lombok, precisely in Pujut sub-district. Exploration was carried out on the rhizosphere of legume and corn plants in Sukadana Village, Kuta Village, Mertak Village and Lengser Village by considering environmental factors such as pH, temperature and soil moisture. Isolation and identification of AMF spores was carried out at the Microbiology Laboratory of the University of Mataram, NTB based on its morphology. Research results revealed that the obtained genus of AMF was Glomus., Gigaspora., and Acaulospora in rhizosphre of green beans, Peanut, Long beans, Corn, and Soyname the crops. The abundant of spore density was dominated by *Glomus* sp. (62,2%), followed *Gigaspora* sp. (31,1%), and *Acaulospora* sp. (6,67%). Further bioassay is required to investigate the ability of this AMF as biofertilizers in improving the nutrient availability and crop productivity.

Effect of *Trichoderma asperellum* GT_4 Against Stem Rot of Groundnut Caused by *Sclerotium rolfsii* Sacc.

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Trichoderma asperellum is a promising biofungicide in tropical countries like India where the temperatures will be more than 37^0C especially during *kharif* season in which groundnut is grown. These high temperatures will predispose major soil borne diseases such as stem rot in groundnut caused by *S. rolfsii* which causes 60-70% loss in yield. The present investigation on bioweaponry of *T. asperellum* GT_4 isolated from rhizosphere of groundnut proved that it combats the stem rot pathogen by mycoparasitism, lysis, antibiosis, competition by siderophores, synergism with combination of hexaconazole 4% and zineb 68% (Avtar 72 WP), non- chemical modified panchagavya, neem cake along with plant growth promotion. Our studies showed that *T. asperellum*

GT_4 inhibited mycelial growth of *S. rolfsii* to 78.43% and production of sclerotia to 100%. Microscopic studies showed that mycoparasitism due to coiled hyphae, lysis, hyphal breaking, vacuolation, antibiosis at the zone of inhibition and dark pigmentation supported production of antibiotics. Production of oxalic acid (1.34 mg/ml) by *S. rolfsii* was observed in culture filtrates when grown in potato dextrose broth in presence of *T. asperellum* GT_4 when compared to control (4.80 mg/ml). Production of siderophores was also observed in *T. asperellum* GT_4 on potato dextrose agar amended with modified Chrome Azurol. Hydroxamate and carboxylate type of siderophores were detected in culture filtrates of *T. asperellum* GT_4 grown in Grimm Allen medium. Soil mycostatisis by *T. asperellum* GT_4 against sclerotia of *S. rolfsii* to 100% at depths of 5,10 and 20 cm. Synergistic efficacy of *T. asperellum* GT_4 with combination of hexaconazole 4% + zineb 68% WP, neem cake and non-chemical modified panchagavya was recorded in both pot and field studies. Seed treatment with hexaconazole 4% + zineb 68% (Avtar 72 WP) at 0.01% + Seed treatment with *T. asperellum* GT_4 at 10 g/kg + soil application of neem cake at 500 kg/ha was found to be the best treatment as recorded least percent disease incidence (mean PDI of 12.42% and 10.31%) of stem rot of groundnut in 2018 and 2019, respectively, whereas seed treatment with modified panchagavya (10 dilution) + soil application of *T. asperellum* GT_4 recorded PDI of 12.42% and 13.14% in 2018 and 2019, respectively. This biofungicide was proved to be a plant growth-promoting with increased plant height (60.18 cm and 54.67 cm), root length (12.53 cm and 11.27 cm), dry pod yield (3269 kg/ha and 3056 kg/ha) and dry haulm yield (6633 kg/ha and 6140 kg/ha), respectively.

Plant Growth Promoting Rhizobacteria (PGPR) of The Acidic Saline Soils of Pokkali Rice (*Oryza sativa* L.) in Kerala, India

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Pokkali lands represent the lowlands, often below sea level, in coastal areas of Ernakulam district in Kerala, India. A study was conducted on PGPR screening at 10 locations in each of the three rice-growing regions of Pokkali (Vytilla, Varapuzha and Kadamakudy) in Ernakulam District, Kerala, India for plant growth promoting traits. The highest population of N fixers, P-solubilizers, and *Bacillus* sp were $4x10^3$, $4.66x10^{3,}$ and $16.67x10^3$ CFU g^{-1} respectively. However, fluorescent pseudomonads and K-solubilisers were not present in the soil. A total of 25 predominant isolates were obtained and 17 isolates belonged to *Bacillus* sp. and remaining four isolates each were N-fixers and P-solubilizers. Among the N-fixers, all the four isolates showed excellent growth (++++). IAA production was maximum for $KadN_1$ isolate (31.27µg ml^{-1}). K-solubilisation was 28.57% and 25% in the case of $KadN_1$ and $KadN_{2,}$ respectively. Isolates $KadN_1$ and $KadN_2$ showed moderate (orange, ++) ammonia production. P solubilization activity and siderophore production were absent. In the case of P-solubilizers, $VytP_1$ isolate showed a maximum P solubilization efficiency of 175%. All the isolates showed excellent/good growth on Jensen's N free agar media except $KadP_1$. IAA production was maximum for $KadP_1$ (8.14µg ml^{-1}). Isolates $VarP_1$ and $VarP_2$ recorded poor (yellow, +) ammonia production. K solubilization activity and siderophore production were absent. However, all the *Bacillus* sp. showed excellent/good growth on Jensen's N free agar media. IAA production was maximum for $KadBa_1$ (22.59µg ml^{-1}). Isolate $KadBa_1$ showed good (red, +++) ammonia production, 5 isolates showed moderate (orange, ++) and remaining 11 isolates showed poor (yellow, +) ammonia production. P and K solubilization and siderophore production were absent for all isolates. This study indicated that the nitrogen fixer and *Bacillus* sp. from the Kadamakudy location and P-solubilizer from Vytilla location of Pokkali rice could be a potential saline tolerant PGPR for low lying areas of Pokkali soils. However, further study is in progress to identify saline tolerant PGPR for increasing the growth and yield of Pokkali rice and pot and field conditions.

Response of Soybean (*Glycine max*) on Biopriming Applications with *Trichoderma harzianum* and *Streptomyces* sp.

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Soybean seeds are prone to decrease physiological quality because they have a high protein content of 43.90%. One way to overcome this is by conducting a biopriming process. Biopriming is one of the priming treatments by giving biological agents that can improve the quality of seed germination. This study aimed to improve the quality of seed germination and vigor with a combination of biological agents in the form of *Trichoderma harzianum* and *Streptomyces* sp. This study uses a factorial Separate Plot Design consisting of main plots and subplots. Therefore, the main plot is the long immersion treatment consisting of 4 levels: 3 hours, 6 hours, 12 hours, and 24 hours. Plots are microbial treatments consisting of three criteria, namely, without microbes, *T. harzianum*, and *Streptomyces* sp. The interaction between immersion length treatment and several types of microbes significantly gave the best results on normal sprouts, abnormal sprouts, number of productive branches, number of pods per plant, root length, density of upper leaf stomata, density of lower leaf stomata, width of upper leaf stomata opening, and broad opening of the lower leaf stomata. In the single factor soaking time, soaking 6 hours, gives the optimal number of nodules. In single-factor microbial type, *Streptomyces* sp. gave optimal germination and the number of seeds per plant. All treatments for both immersion duration and various types of microbes that are effectively used are 12 hours immersion and Streptomyces.

Trichoderma spp.: a Potential Bio-Fungicide for The Management of Soil-Borne Plant Pathogens

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During last decade, species of *Trichoderma* have emerged as most powerful bioprotectant for management of wide variety of plant diseases. This is truer in the context of the fact that there is considerable public pressure and pressure from environmental scientists to reduce emphasis on chemical-based protectants and use protectants of biological origin (bioprotectatnt). *Trichoderma* has long been considered as one of the most promising agents for the management due to its broad-spectrum action against a number of plant diseases caused by fungi, bacteria and even nematode and occupied the top position among the bioprotectants developed for plant disease and pest's management. *Trichoderma* strains exert strong aggressiveness against phytopathogens either indirectly by competing for nutrients and space, modifying the environmental conditions, or promoting plant growth and plant defensive mechanisms and antibiosis or directly by mechanisms such as mycoparasitism. *Trichoderma* added directly to rhizosphere or as seed treatment protects plant against numerous classes of pathogens, e.g. those that produce aerial infections, including fungal, bacterial, nematodes and viral pathogens. This reveals induction of resistance mechanisms similar to the hypersensitive response (HR), systemic acquired resistance (SAR) and induced systemic resistance (ISR) in plants. Native strains of *Trichoderma species* were isolated from vegetable and tea

growing areas of Assam, Meghalaya and West Bengal, India. *In vitro* and *in vivo* assays showed effective results against six (6) soil borne fungal plant pathogens viz., *Rhizoctonia solani*, *Sclerotinia sclerotiorum*, *Sclerotium rolfsii*, *Fusarium oxysporum*, *Colletotrichum capsici* as well as root-knot nematode viz., *Meloidogyne incognita* causing diseases in vegetables, paddy, tea, turmeric etc. Mode of action of *Trichoderma* spp was studied against all the pathogen and found that *Trichoderma* suppress the growth of the pathogens by competition, coiling, lysis, antibiosis etc. *Trichoderma* species showed compatible reaction with other biocontrol agents like *Beauveria bassiana, Metarhizium anisopliae, Verticillium leccanni, Bacillus subtilis, Pseudomonas fluorescens, Purpurocilliium lilacinus,* and this study helps to develop a consortial bioformulation with multiple functions. Inter and inter generic protoplast fusion was tried for *Trichoderma* spp and *Metarhizium anisopliae* and successful to produce cybrid and hybrid cell with the ability to suppress the growth of pathogen and activate the defence mechanism against insect pest. *Trichoderma* also found compatible with some commonly used organic and inorganic plant health materials. Our *Trichoderma* based liquid biopesticides (*Org-Trichojal* and *Um-Tricho*) supplemental with osmoticants, adjuvants, sticker, spreader, UV protectants, with a shelf life of 480 days have been proved successful in a large number of field, vegetable, fruit and flowering crops for the management of diseases with plant growth promoter. Farmers, extension personnel's and tea garden managers etc were trained on technical aspects of the bioformulations and its field use. Our liquid biopesticide is *Org-Trichojal* commercialized and widely adapted the market of Northeastern states of India. The low cost technology has opened up a new vista for plant disease management and is likely to be a boon for seed industries who would like to provide protection to seeds as well as plants against a large number of seed, soil- borne and foliar diseases.

Beneficial Characteristics of Salt-Tolerant *Bacillus aryabhattai* in Reducing Salinity Effect on Rice

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Most of the rice cultivation in Malaysia is in a coastal saline region which is exposed to a saline condition that reduces the potential yield of the crop. The effect of salinity on rice can be reduced by utilizing beneficial microbes such as salt-tolerant plant growth-promoting rhizobacteria (PGPR). In this study, a potential salt-tolerant PGPR were isolated from a coastal salt-affected rice field and identified under the state of Kedah in Malaysia. This promising bacterial isolate was evaluated for the production of salt-tolerant properties against a different level of NaCl (0M, 0.5M, 1M, 1.5M and 2M) under laboratory conditions. The results showed that the ability of this isolate to survive under the toxic effect of salinity of up to 2M of NaCl although with a decrease in population. This bacterial isolate absorbs the highest amount of sodium (13.49g) at 1.5M of NaCl, probably due to its higher production of exopolysaccharides (22.79 g/L) and flocculation yield (20.67g/L). Following the 16s rRNA sequencing, this isolate was identified as *Bacillus aryabhattai*. Subsequently, inoculation of this bacterial strain to three rice varieties (BRRI dhan67, Putra-1 and MR297) with different susceptibility against salinity at the seedling stage showed an increase in dry matter production by 49%, 50% and 51%, respectively. Besides, inoculation also caused a decrease in the plant electrolyte leakage by 55%, compared to the uninoculated control. Due to these promising preliminary results, the salt tolerant PGPR *B. aryabhattai* could be used to ameliorate the adverse salinity effect in rice cultivation in the coastal saline areas.

The Preventive Application with Biological Agents : Arbuscular Mychorriza Fungi (AMF) and *Trichoderma* spp. Effectively Control Basal Stem Rot Disease in Oil Palm Plantation

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The preventive action strategy of biological agents plays an important role in the management of major diseases in oil palm plantations. In this study Arbuscular Mycorrhiza Fungi (AMF) and Trichoderma spp. were investigated for their potential to control of basal stem rot disease. AMF colonization on the roots has observed in three-month-old seedlings - AMF treated since the beginning of planting. AMF colonization increased about 85.99% in TBM-1 (1 year immature plant) with AMF treatment of 25 gram in the main nursery. The colonization of AMF was increasing 86.00 - 97.33% in TBM-2 (2-year immature plant). All the treatment were initiated with the application of 30 grams of *Trichoderma* spp. at the beginning of prenursery planting. There was a strong correlation between root colonization and the number of spores in the root rhizosphere I TBM-2 (2-year immature plant). However, AMF inoculation significantly affect root colonization and spore number response ($p>0.05$). This study shown that application of 25 grams AMF both in the pre-nursery and in the main nursery is effective in controlling attacks of basal stem rot disease through early prevention strategies.

The Dependence of Trembesi (*Samanea saman*) and Johar (*Cassia siamea*) Seedlings on Arbuscular Mychorriza Fungi in Gold Mine Tailings Media

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Tailing is one of the wastes resulting from mining activities in the amalgamation of ore from the ground, with extreme characters such as a sand-dominated texture, high content of heavy metal Pb, very low availability of carbon and macronutrients. The application of AMF is expected to increase the ability of forest plant seedlings to grow and develop in tailings media. The research was conducted in a greenhouse using trembesi and johar seedlings inoculated with AMF inoculum, *Glomus manihotis*, *G. etunicatum*, and mix incolan (Mycofer) and planted in tailings media from the Pongkosr gold mine for 8 weeks. Trembesi and johar seedlings have been colonized by AMF in tailing media. The growth of height, diameter and biomass of trembesi and johar seedlings significantly ($p<0.05$) increased with AMF inoculation and showed a significant dependence (MIE) in the presence of AMF in the tailing's media. This shows that AMF really needs to be applied to revegetation activities in tailings media.

Effect of Arbuscular Mycorrhiza and Magnetic Field on P Uptake, Ascorbic Acid Content, and Tomato Yield (*Lycopersicum escullentum*. Mill) Grown on Andisols

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Andisol are productive soils but have a low availability of phosphorus (P), that decrease tomato yield. Application of Arbuscular Mycorrhizal Fungi (AMF) and magnetic fields into plant can promote quantity and quality of plant yield. The interaction of AMF and magnetic field is expected increase soil nutrient availability and promote plant growth. The aim of the experiment was to determine effect of AMF and magnetic field on P uptake, ascorbic acid content, and tomato yield. The experiment used factorial randomized block design consisted of two factors: AMF (*Glomus* sp., *Gigaspora* sp., and *both combination*) and magnetic field (0 and 0.2 mT). There was interaction between AMF and magnetic field on P uptake, ascorbic acid content, and tomato yield on Andisols soil. But there were main effects of *Glomus* sp. AMF and magnetic field on the increase ascorbic acid content, 43.56% and 11.92% compared to control, but there was no effect on both treatment on P uptake and fruit diameter. Application of magnetic field showed increase in plant yield up to 6.19% compared to control. This study showed that the application of AMF and magnetic field have potential to increase ascorbic acid content also plant yield also plant yield.

ABSTRACTS - ROOM 3

Engineering of Halotolerant PGPR biodiversity in Rhizo-microbiome for Alleviating the Salinity Stress, Enhancing Nutritional Status and Rice Growth in Saline Soils

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Salinity stress is the major constrain for rice growth in saline soils. Rhizo-microbiome is an excellence habitat and shelter to highly diversified of microbial community with specific functions and act like a gut to plant genome as ascribed to microbial communities in the human gut. It plays a significant role in regulating the nutrient availability and improving soils or plant health. Moreover, rhizo-microbiome as a part of soil food web or energy flow are highly depend on the abundance of beneficial microbes like PGPR (plant growth-promoting rhizobacteria), rhizo-deposits released by the plant and the soil organic matter supply as fuel or ameliorant. This research is summarized and presented the promising results of integrated engineering of rhizo-micbiome for alleviating the salinity effect of rice growth. The promising halotolerant PGPR isolates that produce relative high of growth factor (gibberellic acid, IAA) and organic acids were characterized and identified as *Bacillus cereus, Delftia tsuruhatensis, Pseudomonas stutzeri, Klebsiella pneumoniae*, Azotobacter sp, and Azospirillum sp,. Subsequently, the selected PGPR isolates were formulated as consortia of inoculant in form of powder organic based carrier. In addition, the enriched ameliorant (30% of rice husk

biochar, 30% of compost, 20% of dolomite and 20% of guano) were formulated to improve the soil properties. The inoculation of HT PGPR isolates was able to improve the seedling growth. The bioassay of selected formulated halotolerant PGPR inoculant as microbial fertlizers or biofertilizers and organic based ameliorant combined with adapted or salt tolerant rice variety were able to improve the biodiversity of beneficial microbes, and improved the growth and yield of rice significantly. Based on our results, we conclude that application of 1000-1500 g ha^{-1} of HT PGPR inoculant and 2–3-ton ha-1 of ameliorant could be used to alleviate salinity stress, improve the nutrient uptake and improve the rice growth in saline ecosystem.

Phyto-Stimulation of Phosphate Solubilizing Fluorescence Pseudomonas on Physiological and Growth Attributes of Chilli

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Plant growth-promoting rhizobacteria (PGPR) are known for its significant role in agriculture systems, but a little is known about their effect on high energy reactions of photosynthesis and transpiration. Therefore, *Pseudomonas plecoglossicida* AVP1, a phosphate solubilizing rhizobacteria (PSRB) isolated from chilli (*Capsicum annum L*) was used to evaluate its phyto-stimulation efficacy on physiological attributes like leaf temperature (**T**), internal carbon dioxide concentration (**Ci**), transpiration (**E**), stomatal conductance (**gs**) and photosynthetic rate (**A**) along with growth attributes such as growth of root, stem, leaf and fresh biomass in chilli. *P. plecoglossicida* AVP1 strain showed significantly high levels of phosphate solubilisation (845 ppm), IAA (66±0.49 µg/ml) and Ammonia production (55 ± 0.67 µg/ml) and maximum acid phosphatase activity (0.176 IU/ml) at pH 3.0 and pH 3.4 after the optimization of growth conditions. The strain AVPI also increased the fresh weight (109.82%), root length (16%) and shoot length (56.44%) at 4 and 8 weeks of growth compared to untreated control. Physiological attributes were analyzed using ADC Bio-scientific Le pro-system (33292). The 8-weeks-old untreated seedlings showed 0.55 µmol m^{-2} s^{-1} of **E**, 230.5 ppm of **Ci,** 0.027 µmol m^{-2} s^{-1} of **gs** and 2.01 µmol m^{-2} s^{-1} and seedlings treated with AVP1 strain increased the **gs** and **A** by 100% and 93.73%, whereas **E** and **Ci** production was not significant among treatments. Our results suggests that *P. plecoglossicida* AVP1 stimulate the stomatal conductance (**gs**), a regulator of gas exchange of CO2 and water and allowed the plant to increase CO2 uptake and assimilation thereby, subsequently enhanced the photosynthesis (**A**). We hypothesized that these attributes increased plant growth of chilli.

Selenorhizobacteria Mediated Selenium Biofortification in Mung Bean Under Selenium Deficient Region – A Sustainable Agricultural Approach

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Biofortification is receiving more devotion to enhance Phyto-availability of micronutrients such as Fe, Zn and Se, in the major food crops. Isolation of selenorhizobacteria were done on nutrient agar plate supplemented with Na_2SeO_3. Among them, best strain MPJ12 was selected on the basis of its PGPR attributes such as siderophore production, phosphate production, ammonia production etc., and was further applied for Mung bean pot study with selenium deficient soil. MPJ12 strain was identified as *Bacillus mycoides* by 16S rRNA sequencing method and submitted to NCBI under accession no. MG694542. Pot studies indicate there was increase in the vegetative parameters like root and shoot length. *Bacillus mycoides* capable to enhance selenium content 0.99ppm in mung bean seed as well as in leaves, root and shoot of mung bean. Use of selenorhizobacterial microbes that endorse plant growth is becoming an effective sustainable agricultural approach to substitute synthetic fertilizers, pesticides, and supplements under selenium deficient region.

Agele marmelos Loaded Polymeric Nanoparticles Evaluation Against Carbon Tetrachloride Induced Toxicity

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The purpose of this work was to formulate, characterize *Aegle marmelos* loaded polymeric nanoparticles (AM-PNPs) as well as to assess their hepatoprotective properties afterwards the administration orally. AMPNPs were synthesized by single emulsion method in addition were assessed for size particles, SEM, entrapment efficacy, drug release in *in vitro* condition and pharmacokinetic study. Hepatoprotective action was assessed afterwards oral administration of designated AM-PNPs in tetrachloromethane (Ccl_4)-intoxicated rats. Prospective *in vivo* acute hepatotoxicity also evaluated. Selected AM-PNPs enclosed 25, 50, 75 and 100 mg *Aegle marmelos* and 100 mg PLGA. Morphology of the selected AM-PNPs discovered spherical as well as evenly disseminated nanoparticles. FTIR readings recommended the existence of AM-PNPs in an amorphous condition as well as lack of chemical interface. The hepatoprotective assessment of the designated AM-PNPs in CCl_4-intoxicated rats shown noteworthy enhancement in the actions of diverse biochemical considerations ($P \leq 0.01$) compared with standard drug silymarin. Histopathological examinations recommended that the designated AM-PNPs produced improved hepatoprotective outcome in CCl_4-intoxicated rats compared to the silymarin. The achieved outcomes recommended that the designated AM-PNPs were harmless and potentially presented the improvement in the pharmacological hepatoprotective effects of *Aegle marmelos*.

Nano-Particle Formulations of Metabolites Extracted from Microbes with PGPR and Pesticidal Traits in Lieu of Sustainable and Organic Practices for Agriculture

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Microorganisms play a vital role in maintaining soil fertility and plant health. They can act as biofertilizers for crops and increase the resistance to biotic and abiotic stresses. The microbes residing in the soil are beneficial for the growth of crops are known as plant growth-promoting rhizobacteria (PGPR). These are effective growth modulators for the crop as they secrete novel metabolites and

growth molecules that enable the crop to sustain in adverse and stress conditions. These molecules also induce systemic resistance and anti-pathogenic effect against the soil borne infections. Several substances produced by antagonistic rhizobacteria have been related to pathogen control and indirect promotion of growth in many plants. Nanoparticles are 100 mm or less, synthesized by a biogenic enzymatic process. Microorganisms such as bacteria, actinomycetes, and fungi play an important role in the treatment of toxic metal through reduction of metal ions and are considered as potential nano factories. These microbes and their secondary metabolites are being used for the preparation of biogenic nanoparticles. These are very cost effective and are significant in terms of application potential. *Beauveria bassiana* produces wide range of metabolites which invades the pathogen's virulence and infectivity potential. The present study was thus focused to isolate the secondary metabolites of *B. bassiana* by solvent extraction with crude metabolites with silver ions to produce *B. bassiana* fused silver nanoparticles. These were found to have significant antifungal activity against the common fungal plant pathogens, insects, and pests in brinjal, okra and tea crops. The present study will lead to develop some novel nano-antifungal and pesticidal agents for combating the infections against prevalent insects and pests. Silica is absorbed by plants as silicic acid, with cereals and grasses containing the highest concentrations (0.2-2.0%). Most soils contain significant quantities of silica, but with continuous cropping, particularly with crops that accumulate significant quantities of silica, can reduce plant available levels of Si to the point that supplemental Si fertilization is required. There appears to be a need for Si amendments in temperate as well as tropical crop production systems. Si fertilizers are applied to crops in several countries for increased productivity and sustainable production. High silica uptake has been shown to improve drought resistance, increase resistance to fungi and other pathogens, and increase plant growth rate and yield. However, its essentiality as a micronutrient for higher plants is difficult to prove, partly because many positive effects of Si are most apparent in cases of abiotic stresses. Silica amendments have also been shown to correct soil toxicities resulting from high levels of soluble Mn^{2+}, Fe^{2+}, and Al^{3+}. The technology we have developed is the combination of chemical and microbial technology for the synthesis and production of agricultural chemical and utilization of the same by using Si solubilizing bacterial consortia. Production of silica nano composites with potassium silicate and silica as the substrates. The nano silica composites thus can be utilized as important molecules for enhancing agricultural productivity. The synthesis of silica nanoparticles by bacteria in the present investigation demonstrates the versatility of the microbial consortia. The nano silica composite produced was further screened for growth promotion activity in brinjal crop in terms of enhanced height, leaves, shoot and branches. The nano-silica formulation was also found appropriate against white flies. Our results showed significant growth in crops treated with biologically derived silica nanocomposites-based formulation.

PGPR Activity as A Phosphate Solubilizing Bacteria Influenced by Different Aciditic Conditions

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Soil P availability is influenced by the level of soil acidity. The problem of P availability in acidic soils due to the low available P. Efforts to increase the availability of P in acidic soils by the application of P solubilizing bacteria. The activities of PGPR as P solubilizing bacteria includes dissolved P and organic acid production The purpose of this study is to study the effect of acidity on organic acid production of phosphate solubilizing bacteria and dissolved P. For this purpose,

experiments were carried-out in the Laboratory of Soil Biology, Department of Soil and Land Resources, Faculty of Agriculture, Universitas Padjadjaran. For this study, the treatments consisted of two isolates of PGPR Burkholderia sp. strain WK 11 and isolate of Burkholderia sp. strain MQ-14W which were isolated from acidic soil-ecosystem. The level of acidity were pH 4.5, normal (pH 7), and 10.5. The results showed that the acidity of affected dissolved P and organic acid production of phosphate solubilizing bacteria. The organic acid (lactic, citric, oxalic and tartaratic acid) produced by PSB and dissolved P were higher at pH 4.5 than at pH 7 and pH 10.5.

Inoculation of *Aspergillus costaricaensis* and *Staphylococcus pasteuri* Mutants to Increase the Microbes Population and the Availability of Phosphorus and Potassium in soil

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The population of microbes and the ability of microbes to provide nutrients for plants is one of the important factors that determine the quality of biofertilizers. The purpose of this study was to determine the effect of the mutant inoculation of *Aspergillus costaricaensis* (*A. costaricaensis*) and *Staphylococcus pasteuri* (*S. pasteuri*) on the microbes population and the availability of phosphorus (P) and potassium (K) nutrients in the soil planted with maize. This research was conducted in a greenhouse with 10 fertilizer combination treatments with inoculation of *A. costaricaensis* and *S. pasteuri* (wild type and mutant). Soil microbes population on Pikovskaya medium showed the highest population in the treatment with *A. costaricaensis* mutant inoculation (6.69 x 10^6 CFU/g). The microbes population in Alexandrov medium showed the highest population in the treatment with *S. pasteuri* mutant inoculation (6.03 x10^6 CFU/g). The available P showed the highest P in treatments using 100% fertilizer dose (SP-36 and feldspar), but these results were not significantly different from the treatment of *S. pasteuri* mutant inoculated with 50% fertilizer dose (SP-36 and feldspar). Exchangeable potassium showed the highest result in treatment with inoculation of *S. pasteuri* mutant.

Potential of Rhizosphere Bacterial Consortium as PGPR in Suppression of Root-Knot Nematode in Tomato

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Root-knot caused by Meloidogyne spp., is a significant disease in tomato plants in Indonesia, causing yield loss up to 46.2%. The use of rhizosphere bacterial consortium as PGPR (Plant Growth Promoting Rhizobacteria) potentially is one of the control methods for Meloidogyne spp. and has the capability by certain means of direct and indirect mechanisms to improve plant growth of tomato. The aim of this study was to find out the rhizosphere bacterial consortium are able to control root-knot nematode and to improve growth of tomato plants. The study was conducted at the Indonesian Vegetable Research Institute, Lembang. This study was designed using a Randomized Block Design consisting of ten treatments and repeated ten times. The results showed that treatment of Ratna cultivar and Permata cultivar treated with Bacillus toyonens + Ochrobactrum sp + Bacillus cereus

consortia showed higher growth and yield, also lower nematode incidence compared to control and other treatments. Overall, our results showed that consortia isolates toyonens + Ochrobactrum Bacillus sp + *Bacillus cereus* was potential to be developed as biological control agent to suppress root-knot disease, so that the consortium isolates will have the potential to be developed as PGPR for tomato.

Decreasing of Cell Viability and Phosphate Solubilizing Activity of The Soil Phosphate Solubilizing Bacteria Caused by Leather Tanning Wastewater Exposure

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The leather tannery waste water causes pollution to the environment because it has BOD, COD, and chromium values above the threshold. This study aims to determine the effect of the leather tannery waste water on the viability of the soil phosphate solubilizing bacteria community and the ability of selected bacterial isolates to dissolve phosphate. The viability of bacterial community was determined based on their growth on the soil exposed to the waste at waste concentrations of 30, 60, and 100%, under field capacity moisture conditions, while the ability of the isolates to dissolve phosphate was observed using liquid liquid Pikovskaya's medium which was added with the waste so that the concentration reached 30%, 60%, and 100%. The bacterial isolates were used, were named RP-1 and RP-2, was obtained from the soil around the tannery which was contaminated to leather tanning waste. The parameters which were analysis were cells number and soluble phosphate. Cells number determined by pourplate methode using Nutrient Agar medium and soluble phoshate was analyzed by P chlorostannous reduced molybdophosphoric acid blue method. The result show that the waste exposure at 30% has reduced the viability of the soil phosphate solubilizing bacterial community and phosphat solubilization activity of the isolate. However, RP-1 isolate survived until the waste concentration reached 100%, whereas RP-2 isolate has showed a growth decreasing at the waste concentration 60%.

Characteristics and Potency of Culturable Bacteria from Tidal Swamp Soils in South Kalimantan and Lowland Swamp Soils in South Sumatra, Indonesia

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Tidal and lowland swamps are land resources that have the potential to be used as agricultural land. However, to manage their sustainably, it needs technological improvements to increase productivity such as the diversity of indigenous microbes of bacteria and fungi. This research was conducted to explore the information on culturable bacterial diversity and their potency in the tidal swamp soils of South Kalimantan and lowland swamp soils of South Sumatra for adaptive microbial germplasm. Our

current research was conducted in Microbiology lab at the Indonesian Center for Agricultural Biotechnology and Genetic Resources Research and Development. Two samples were isolated from tidal swamp soils at Jerapat Baru Village, Tamban, Barito Kuala District, South Kalimantan Province and lowland swamp soils at Tapus Village, Pampangan, Ogan Komering Ilir District, South Sumatra Province. Serial dilution methods and molecular identification were used to assess the diversity of bacterial species. Production of IAA, siderophores, and ACC Deaminase were evaluated. A total of 11 species comprising *Lysinibacillus xylanilyticus* 26_1, *Bacillus cereus* 26_2, *B. cereus* 26_3, *B. subtilis* 27_1, *B. siamensis* 27_2, *Brevibacillus halotolerans* 27_3, *Peanibacillus alvei* 27_4, *Lysinibacillus xylanilyticus* 27_5, *B. nitratireducens* 27_6, *B. cereus* 27_7, and *B. cereus* 27_8 was chacterized from two samples collected from these areas. The most abundant group was Firmicutes. The dominant species in both tidal and lowland swamp soils were *B. cereus* and *L. xylanilyticus*, while common species was *B.* cereus. Potential analysis showed that all bacterial isolates were able to produce IAA, siderophores, and ACC Deaminase. The bacterial diversity was higher in South Sumatra than that of South Kalimantan. The differences were observed in percentage occurrence of bacterial species between two type of swamp lands. The reason may be that the soil pH condition, quality of litters, different micro-environments and other characteristics in those areas. Soil pH in South Sumatera (pH 5.0) is higher than South Kalimantan (pH 3.0), hence, it may have provided more resources for bacterial growth.

Green Nano-Composite of CaO/K-Sulfated TiO_2 and Its Potential as Single-Step Reaction Solid Catalyst into Biofuel Production

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Catalyst enhanced the reaction rate to produce biofuel (biodiesel) in esterification-transesterification methods. Synthesis of solid catalyst of green nano-CaO as a support modified by KOH solution and sulfated TiO_2 and its utilization for conversion of waste frying oil (WFO) into biodiesel in a single-step esterification-transesterification reactions has been studied. The green nano-composite of CaO/K-sulfated TiO_2 was synthesized by physical mixing and hydrothermal method with nano-CaO prepared from eggshell. The obtained solid catalyst was characterized by crystallite size, surface basicity-acidity, functional groups, and surface morphology and tested its potential for conversion of WFO into biodiesel. The results showed that the characteristics of green-CaO was nano-particles (93.13 nm) and its size decreased after modified with KOH (46.43 nm) and sulfated TiO_2 (62.10 nm) as well as the CaO/K-sulfated TiO_2 was the optimum surface acidity-basicity. The catalyst performance test for conversion were obtained that the optimum conditions at catalyst concentration to oil of 5%, methanol/oil molar ratio of 9:1, and reaction time of 60 minutes reached biodiesel mass yield of 94.17% higher than CaO/K (67.88%) and CaO (60.21%). The GC-MS analysis of biodiesel showed WFO has been successfully converted into fatty acid methyl esters. The synthesized solid catalyst has the potential to be used into biodiesel production in a single-step esterification-transesterification reactions.

Isolation and Analysis of Soil Fungal Population from Rhizosphere of Rice Plants Grown Under Field Conditions in Bumirava Morowali Regency

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This study was aimed to isolate and analyze the population level of soil fungi in several types of rice fields in Bumiraya Morowali Regency. Sampling by explorative descriptive method and determination of observation points was determined by purposive sampling. Fungi were isolated from the rhizosphere of rice plants by a multilevel dilution and Total Plate Count (TPC) method. The characteristics of colonies of soil fungi obtained were in various forms: round, oblong, irregular, and shaped like flowers. The colors of the colonies were yellow, white, and brown. The highest clear zone diameter in the colony SR1 (12 mm).The results of soil pH chemical analysis, C/N ratio and moisture content were obtained as follows: neutral soil safety (pH) was found in types STH1 (6.62) and STH 2 (6.86), criteria C /N highest ratio in sr2 type SR2 (66.53) and SR1 (50.56) and the highest moisture content was in SR2 type (59.86%).The results of the analysis of the highest fungi population level (cfu) were found in SR type with a total of $40.5x10^5$ cfu and the lowest colony density was found in the STH type with a total of $25.5\ x10^5$ cfu.

Optimalization of Marginal Soils with Consortium of Hydrocarbon Degrading, Phosphate-Solubilizing Bacteria, Rhizobium and Mycorrhizae in Legumes

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Phytoremediation is a new and promising approach to optimize the marginal soils. Therefore, the application of plant growth-promoting rhizobacteria (PGPR) has been extended to optimize marginal soils in association with plants. The development of the model will use the analogy of tripartite symbiosis between plants, mycorrhizae, and rhizobium. The purpose of this study was to develop models of optimalization of marginal soil with the use of soil microorganism interactions of hydrocarbon degradation bacteria, phosphate-solubilizing bacteria, rhizobium, and mycorrhizae in legume. This study was conducted in three stages. The first stage was the isolation and identification of indigenous microorganisms from several marginal soils (i.e., saline soil and oil-contaminated soil) which include hydrocarbon degradation bacteria, phosphate-solubilizing bacteria and rhizobium. The indigenous mycorrhizae were also isolated. The second stage was to test the production of an effective type of indigenous microorganisms for optimalization in marginal soils. The third stage was to test in

determining the best combination of organisms in order to obtain patterns of interactions in the process of optimalization of marginal soils. Research data was analyzed with T test, and ANOVA. The first stage has been carried out and obtained many types of indigenous bacteria that have the properties to degrade hydrocarbon compound or to solubilize the phosphate (i.e., Pseudomonas pseudomallei, P. fluorescens-25, Flavobacterium odoratum and Enterococcus sp.), included the rhizobium (i.e., Rhizobium japonicum and R. Phaseolus), and also the mycorrhizal spores (i.e., Glomus etunicatum and G. mosseae). In the second stage of data showed that the bacterium P. fluorescens-25, and Enterococcus sp. were effective bacteria that degrade hydrocarbons, whereas F. odoratum, and Enterococcus sp. were effective bacteria to solubilize phosphate in oil contaminated soils. In the third stage, the results indicated that there were differences in the growth of soybean plants caused by different patterns of interactions between hydrocarbon degradation bacteria, phosphate-solubilizing bacteria, rhizobium and mycorrhizae grown in marginal soil. In general, the model of optimalization in marginal soil revealed that the plant tolerance increased due to these multi-symbiotic interaction between soil microorganism and legume.

Potential of Bacteria as Fat and Oil Biodegradation in Environment Contaminated with Domestic Waste

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The contamination of waste oil and grease to the aquatic environment from industrial food processing, restaurants and kitchens or by accidental oil spills is increasingly being found. Biodegradation by a consortium of bacteria can be an effective way to overcome this. The aim of this research was to isolate and identify bacterial strains from waste oil and grease and test their potential to degrade oil and grease in vitro. Samples were taken from waste oils and fats. Enrichment techniques were carried out for all samples followed by isolation of bacterial strains to determine which strains could degrade oil and fat *in vitro*. Identification of bacteria were conducted by using kit BBL Crystal System. The total bacterial count was carried out using the dilution method. The results showed that there were three strains of oil and fat degrading bacteria, identified as *Bacillus licheneformis, B. coagulant* and *Psedomonas diminuta*. The consortium of these three types of bacteria were able to degrade waste oil and fat with a total of 6.24 x 10^5 CFU/ml to 8.16 x 10^5 CFU/ml bacteria with a control without the addition of a bacterial consortium which was 5.6 x 10^1 CFU/ml. The total bacteria in various treatment wastes with a consortium of bacteria amended with molasses when tested *in vitro* showed the ability to live and develop from a fairly high bacterial consortium, of 2.92 x 10^4 CFU/ml to 9.04 x 10^4 CFU ml. The bacteria identified had the ability to degrade working oils and fats. The benefit of this research is that bacteria that have been found could be used as a starter for processing waste fats and oils in environments contaminated with domestic waste fats and oils.

Plant Growth-Promoting Activities of Mineral Solubilizing Microbes Isolated from Himalayan Agro-Ecosystem

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Mineral solubilizing bacteria (P, K and Zn) have been documented to enhance phosphate (P), potassium and zinc content in the soils and in the plant growth. The application of these microbes in agricultural systems is an eco-friendly alternative strategy for reducing negative environmental consequences of costly and energy intensive chemical fertilizers to increase crop productivity through various mechanisms. Hence, the present study was carried to isolate and characterize various mineral solubilizing bacteria from rhizosphere soils and to test their efficacy for plant growth promoting (PGP) activities. A total of 120 bacterial isolates were obtained from rhizosphere samples collected from high altitude regions of Ladakh and Kashmir valley. Among these isolates, 40 isolates showed phosphate solubilization, 31 isolates showed potassium solubilization and 23 isolates showed zinc solubilization on the respective mineral amended media under *in-vitro* conditions. The screening of these isolates for mineral solubilizing potential was carried at different temperatures of 3^{o}C, 5^{o}C, 7^{o}C, 15^{o}C and 20^{o}C and it was found that the isolate PSB (Grz), KSB (Drs) and ZnSB (Smg) displayed highest solubilization efficiency of 480, 462 and 390, respectively, at 20^{o}C. The quantitative analysis also revealed that maximum of 50.30 µg P/ml broth, 23.38 µg K/ml broth and 19.50 µg Zn/ml broth was solubilized by the isolates PSB (Grz), KSB (Drs) and ZnSB (Smg), respectively, at 20^{o}C. The mineral biological solubilizers were also evaluated for PGP activities and it was revealed that a total of 55 bacterial isolates showed the production of indole-3-acetic acid (IAA), ammonia (NH_3), siderophores and amino-cyclopropane-1-carboxylate (ACC) deaminase, nitrogen fixation and bio-control activity. Hence, it could be concluded that the biological mineral solubilizers could be used as biofertilizer for increased crop productivity and uptake of essential nutrients in the agricultural fields.

Impeccable Authentication of Bacterial Endophytes of Rice by Re-Isolation and DNA Fingerprinting Method

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Endophytic bacteria conferring multifaceted plant growth-promoting traits have the potential as inoculants in sustainable agriculture. During the isolation of putative endophytes, the opportunistic and passenger endophytes are inevitable, and the latter endophytes often tamper with the endophytic inoculant development. The existing authentication procedures could not discriminate the putative competitive endophytes from the opportunistic and passenger endophytes. In the present work, we postulated a new method viz., integrating the re-isolation procedure with repetitive elements-based PCR fingerprinting to undoubtedly discriminate the putative endophytes from the opportunistic and passenger endophytes and the epiphytes. In this method, the pure cultures of endophytic isolates were inoculated at hypocotyl regions of 5-days-old rice seedlings grown in a phytajar with Murashige and Skoog medium. After 5-days of incubation, the rice plants were uprooted and used for re-isolation of inoculated strains. The bacterial endophytes were re-isolated from the surface-sterilized whole plant, shoot, and root of rice. The epiphytic colonization was observed by the root imprint method from unsterilized roots. All the re-isolated colonies were compared with native isolate for the homology in BOX and ERIC DNA fingerprints. The results revealed that the putative competitive endophyte showed positive for re-isolation and BOX and ERIC fingerprints for the whole plant, root, and shoot. The opportunistic and passenger endophytes failed in re-isolation either from root or shoot. The epiphytes showed negative for endophytic re-isolation and positive for surface colonization. We also assessed the endophytic colonizing traits such as swimming and swarming motility, biofilm formation, and plant cell wall degrading enzymes for these isolates to validate our method. The results are in agreement with the discriminative efficiency of the newly developed method. This new

procedure could authenticate the putative competitive endophytes impeccably and can eliminate the opportunistic and passenger endophytes and epiphytes in the early stage of inoculant development.

Utilization of Rhizosphere Earthworm Extracts for Sustainable Food

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Periodontitis is an inflammatory condition by periodontopathic bacteria which is recognized by neutrophils, macrophages and other immune cells with the help of Toll-Like receptors. This interaction triggers the production of inflammatory molecules such as cytokines and chemokines by immune cells. Apart from the periodontal pathogenic effects, dysregulation of neutrophil activity also plays a role in periodontitis. In periodontitis, the neutrophil functions like a double-edged sword, not only to mobilize defense mediators and tissue repair mechanisms, but also to further tissue damage. The purpose of this study was to determine the effect of giving *Lumbricus rubellus* (EEW) earthworm extract on neutrophil cells in periodontitis rats. Experiments were xonducted in post-test design. Five Wistar rats, each induced with *P gingivalis*, consisting of a control group (without earthworm extract), oral administration of EEW (200 mg/ kg/body weight), topical gel EEW (20%). Decavutation on day 3,7,14,21 to determine the number of neutrophil cells. The research was conducted at the Veterinary Medicine Laboratory and the Udayana University Analytical Laboratory. Day 3 and 7 between control, oral and topical administration of *Lumbricus rubellus* extract were significant ($p < 0.05$). Day 14 and 21 there was a significant difference ($p < 0.05$) between control with oral administration and earthworm *L. rubellus* extract gel. Meanwhile, there was no significant difference between oral administration and gel extract of earthworm L. *rubellus* on day 14 and 21 ($p > 0.05$). Descriptive administration of *L. rubellus* earthworm extracts orally and typically showed a decrease in the number of neutrophils significantly.

Isolation and Identification of Potential Bio-Inoculants Based on Phosphate Solubilizing Molds from Different Plant Rhizospheres

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Phosphorus (P) is the second most indispensable limiting nutrient in crop production. Its availability in soil, however, possess an immense problem due to precipitation reaction with Al^{3+}, Fe^{3+} in acidic soil or Ca^{2+} in akaline soil. Recently, the utilization of microbes is considered as an alternative to improve the bioavailability of soil phosphate for plants. This study aimed to isolate and to identify the phosphate solubilizing molds (PSM) from different plant rhizospheres; Gadung (*Dioscorea hispida*

Dennst), Maize (*Zea mays* L.), Bamboo (*Dendrocalamus asper*), Pineapple (*Ananas comosus* L.) and Banana (*Musa, sp*). Isolation of PSM was performed under *in vitro* condition, followed by dilution plate technique using Pikovskaya's solid medium. Out of fourteen colonies formed from those rhizospheres, five colonies were confirmed as PSM, namely *Talaromyces aculeatus, Metarhizium anisopliae, Fusarium proliferatum, Mucor hiemalis and Aspergillus niger*. These isolates were capable of solubilizing insoluble-P with solubilization with indices ranged from 2.05 to 3.03. The best P solubilizer was *Talaromyces aculeatus* (125.6 mg L^{-1}), followed by *Metarhizium anisopliae* (80.76 mg L^{-1}) and *Fusarium proliferatum* (41.59 mg L^{-1}), while *Mucor hiemalis* and *Aspergillus niger* by 9.51 mg L^{-1} and 7.85 mg L^{-1}, respectively. *Talaromyces aculeatus and Metarhizium anisopliae* are the most potential as a bioinoculant.

Recent Advances in PGPR: Commercialization, Regulatory Requirements and IPR Issues

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Considerable research has been done worldwide in the area of PGPR (Biofertilizers, Biopesticides, Biostimulants) and several products are available for use in sustainable agriculture. With the banning of several synthetic pesticides globally, the growth of biopesticides is likely to increase in future. Biopesticides are naturally occurring biologically safe microorganisms, used for sustainable management of pests and diseases. The global market demand for microbial based biopesticides is increasing annually. The estimated market for biopesticides has grown at a rate of 14% and is predicted to generate US$ 1.88 billion worldwide by 2020 and US$ 1.95 billion by 2022. Currently, it is estimated that nearly 80% of the global market revenues are recorded in Europe and Latin America. However, the acceptance and diffusion of biopesticides in Indian agricultural market is quite evident with the Indian contribution to the global biopesticide market being 2.89% during 2005, and a meagre improvement to 5% by 2016. Intellectual property involves inventions, fictional and creative work, industrial designs for article, symbols, etc. utilized as a part of trade. Today, it is widely accepted that any new result of a man's brain work needs to be secured as private property. During the late 1970s with the advancement in recombinant gene technology, patenting microbes came into the existence including the famous genetically engineered superbug which catabolizes petroleum oil. Under Indian Patent Act 1970, Amendment 2002, implemented form May 20, 2003, microbe's development can be patented in India. Several PCT and US Patent have been awarded to our group for novel agriculturally important microorganisms. A *Trichoderma harzianum* strain useful as nematode inhibitor, fungicide and plant growth promoter and a process for the isolation have been patented in 2002 (US Patent No. 6,475,772). In 2004 PCT patent awarded to the synergistic fermented plant growth promoting biocontrol composition (PCT WO 2004-087618A1). Another PCT patent has been awarded in 2005 to synergistic bioinoculant composition comprising bacterial strains of *Bacillus subtilis* or *B. lentimorbus* from cow milk (PCT WO 03/020038A1). In the year 2007, US patent has been awarded to a synergistic fermented plant growth promoting, bio-control composition (US Patent No.7,297,659B2). Likewise, bacterial strains of accession no. NRRL B30486, NRRL B30487 and B30488 and method of producing the composition have been patented in 2006 (U. S. Patent No. 7097830 B2). US patent was awarded to the rapid composting of bovine dung using *Trichoderma* of Accession No. NRRL 30598 having ability to promote plant growth. Under the present political, technological and socio-economic situation it is very complicated to build up our national system of IPR in according to those of developed nations. Patenting life forms bring with them imperious issues of pious and ethical values. Thus, it would be a great favor to our nation to file, document, keep and modify new microbes isolated from different parts of the country. The talk will pinpoint various

regulatory issues in registration and commercialization of such innovative technologies of biopesticides with regulatory bodies and challenges involved in patenting microbes.

Crop Microbiomes - Modification and Optimization for Improved Crop Productivity

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The ever-increasing human populations across the globe demands more agricultural production, despite the environmental challenges faced by farmers. Microbial products are being used commercially in global agriculture for over decades, but have recently received increased attention. There is a huge scope for the use of microbial based applications in agriculture and the momentum is gaining utmost importance in global agriculture in view of their multidirectional support to the crops and their productivity. Major growth drivers for this kind of productivity include growing consumer interest in organic agriculture with the reducing use of chemical fertilizers, fungicides and pesticides for the economic potential in emerging global agricultural markets. Plant, soil and insect microbiomes and their interactions with the surrounding environments play a major role in crop plant's lifecycle for sustainable agriculture. Usage and exploitation of such situations for increased crop productivity is the order of the day and much research and concerted efforts are being made in this direction to engineer and develop suitable delivery systems to impart in global agricultural practices. Evidences are in place that crop microbiomes play a greater role in nutrient supply, improved nutrient use efficiency, tolerance to abiotic stresses, plant immunity and insect pest management. The understanding of the intimate interactions of indigenous crops with their associated microbiomes and further modifications with the addition of essential and functional microbial candidates to optimize the rhizosphere is the key for the successful application of microbes to mitigate biotic and abiotic stresses. The pouring in research and development of microbiome based products, their applications shows that there is a huge potential to reduce the use of chemical fertilizers and pesticides in agriculture considerably. The real challenge ahead is engineering and linking microbiomes with their functions and applications to varied crop ecosystems. Global agri-industry made considerable progress in this direction and several microbial products are being introduced in several markets with special reference to seed treatments, foliar sprays and soil amendments. This paper provides an overview of critical considerations involved in engineering microbiomes starting from a strain discovery to developing a delivery system. Also discuss global trends in microbiome research and their applications based on present and future perspectives on utilization of crop microbiomes to increase productivity, commercialization and associated bottlenecks.

Quantification of Ecosystem Services Rendered by Soil Microorganisms

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Microorganisms are involved in plethora of ecosystem services in soil ranging from nitrogen fixation, nutrient solubilization, mineralization, recycling of organic wastes, bioremediation, disease suppression and soil formation. However, these services go unnoticed as many of these activities have not been quantified in correlation with soil health and plant productivity. Current estimates of the

contribution of soil biota to ecosystem services provided by soils globally range from 1.5 to 13 trillion US Dollars annually. Key genes have been identified for each of the microbial processes like nitrogen fixation, nitrification, P-solubilization and mineralization, S metabolism and disease suppression. It is hypothesized that quantification of different fractions of N, P, K, Zn, Fe and S in soil; abundance of genes involved in nitrogen fixation, nitrification, ammonification, P solubilization and mineralization, S metabolism, phytohormone production, disease suppression; and numerical abundance of functional groups of microbes would provide answers to ecosystem services by microbes to improve soil health, leading to plant productivity. A framework of parameters can be developed to capture the ecosystem services provided by the microbial resources in the terrestrial soils which include microbial biomass, microbial diversity, potential net nitrogen mineralization, concentration of ammonium, NO_3 and inorganic P, plant productivity, disease incidence and keystone taxa.

Enhancing Soil and Crop Health by Strategic Microbiomes from Microbial Fermentation Collection

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Sustainable crop production depends much on good soil health. Intensive agriculture leads to constant and irrational application of inorganic fertilizers which have caused a sensible loss of biodiversity in the living portion of the soil resulting in the loss of organic matter and physicochemical functional properties. Use of High Yield Technology (HYT) based Microbial Consortia (MC) helped to re-establish soil biological activity and biodiversity. Further, it accelerated nutrient transformation and production. HYT Microbial Consortia is being produced through co-fermentation process utilizing Agrinos' proprietary consortia of microbes from Microbial Fermentation Collection (MFC) which promotes highly productive soil microbial community. During co-fermentation process continuous spore forming let to dormant state that naturally encapsulated the spores in an osmotically supportive liquid environment. As a result, HYT MC has long shelf-life stability. HYT Microbial consortia holds both aerobic and anaerobic microbial strains which facilitated to create an enhanced crop nutritional environment. When applied to the soil, HYT MC microbes increased soil organic matter and stimulated root biomass formation resulting in a more vigorous root system. Soil and Plant productive capacity increased when microbes freed up nutrients bound to soil particles and decomposition of crop residues resulted in enhanced nutrient release and uptake. HYT MC application promotes the growth of a robust soil microbiome, demonstrates consistency across varying soil conditions and found effective in wide range of agricultural crops. Studies conducted all over the world at 650 locations in diverse crops revealed that both soil and plant health improved to a greater extend with an average yield increase of 10. 8 %. HYT MC tank mix compatibility flexible to conventional agricultural practices deployed in large acre farming systems. A critical point of differentiation is the ability to tank mix of HYT Microbial Consortia directly with liquid fertilizers, which provides an easy way of application with conventional farm practices.

Recent Happenings in Exploration of Endophytes and Biocontrol Based Green Nanoparticles in Management of Soybean Diseases and Productivity Enhancement in India - An Overview

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The major constraints in soybean production are climate, rainfall, edaphic factors, biotic and abiotic stresses. Soil borne fungal pathogens are the major stumbling block in successful cultivation of soybean in recent years in India. Over the years chemical management of the plant diseases has posed a greater threat to the Indian agriculture by the development of new races of the pathogens, pesticidal residues and environmental hazards. In this context, use of biological control is gaining importance to protect the environment and soil health. Endophytes and green nano particles have emerged as a new innovative and sustainable approach to manage the diseases, abiotic stresses and to promote plant growth. The benefits of native endophytes have been recognized over the past ten years from around the world and many interesting research have been undertaken. In India, though there is research on fungal endophytes, the potentiality of endophytes in suppressing soil borne pathogens remained as untapped resources. Hence, with a view of exploiting the native endophytes and their role in suppression of soil borne pathogens of soybean, the present investigation was undertaken. The work green synthesis of nano particles and their effect against anthracnose of soybean is the first report from India. Nanoscience, an emerging technology in the field of phytopathology was explored to manage the anthracnose disease of soybean caused by *Colletotrichum truncatum*. The results are of study are discussed as below. Thirty fungal endophytes were isolated from major soybean growing areas of northern Karnataka and Maharashtra. Out of which eight effective fungal endophytes were obtained by in vitro screening against major soil-borne pathogens viz., *Sclerotium rolfsii*, *Rhizoctonia bataticola* and *Fusarium oxysporum*. The fungal endophytes RF-BV-3 (46.46%), SF-DM-8 (49.15%) were effective against *S. rolfsii*, and the isolate SF-DM-8 (49.32%) was effective against *R. bataticola*. The effective fungal endophytes against *F. oxysporum* were RF-BV-3 (66.61%), SF-BV-3 (59.66%), SF-DM-8 (69.21%), SF-DS-10 (56.49%), LF-HH-5 (66.31%), LF-DM-10 (59.78%), LF-DD-13 (61.15%) and LF-KK-14 (59.78%). Based molecular methods, the effective fungal endophytes were identified as *Daldinia eschscholtzi* (RF-BV-3), *Fusarium solani* (SF-BV-3 & LF-KK-14), *Neofusicoccum parvum* (SF-DM-8), *Diaporthe phaseolorum* (SF-DS-10 & LF-HH-5), *Phomopsis* sp. (LF-DM-10) and *Colletotrichum aenigma* (LF-DD-13). The antagonistic effect of 30 bacterial endophytes of soybean collected from northern Karnataka and parts of Maharashtra against *Sclerotium rolfsii*, *Rhizoctonia bataticola* and *Fusarium oxysprum* were assayed *in vitro* through dual culture plate technique. The bacterial endophytes RB-KK-6 (40.78 %), SB-BS-6 (50.08 %) and LB-BU-1 (47.02 %) were found effective against *S. rolfsii* and the isolates SB-DG-11 (47.41 %), LB-BiN-8 (41.22 %) were effective against *R. bataticola.* The effective bacterial endophytes against *F. oxysporum* were RB-HS-1 (41.99 %), SB-BiJ-9 (40.07 %), LB-BU-1 (54.20 %) and LB-BV-2 (51.64 %). Based on molecular characterization the effective bacterial endophytes were identified as *Acinetobacter* sp. (RB-HS-1), *Alcaligenes faecalis* (RB-KK-6), *Stenotrophomonas* sp. (SB-BiJ-9), *Bacillus pumilus* (SB- DG-11 & LB-BiN-8), *Paenalcaligenes* sp. (LB-BU-1), *Bacillus cereus* (SB-BS-6) and *Brevibacillus* sp. (LB-BV-2). Among all the endophytes evaluated to assess their antagonistic potentiality and understanding of mechanism of disease suppression, the best inhibition was noticed in *Neofusicoccum parvum* against all the tested pathogens ranging from 69.41 to 82.35 per cent by production of volatile compounds. *Neofusicoccum parvum* and *Daldinia eschscholzii* showed positive results for siderophore production and zinc solubilisation. *Neofusicoccum parvum, Daldinia eschscholzii* and *Colletotrichum aenigma* showed positive results for HCN production test. For chitinase test only *Neofusicoccum parvum* was found to be positive. *Neofusicoccum parvum* and *Colletotrichum aenigma* were recorded positive for phosphate solubilization. The study was conducted to assess the effectiveness of four green synthesized nano formulations viz., chitosan-based zinc nano formulation (ChZnNF), *Pseudomonas fluorescens* based zinc nano formulation (PfZnNF),

pomegranate aril-based sulphur nano formulation (PASNF) and pomegranate aril-based silver nano formulation (PAAgNF) at different concentrations under in vitro and glasshouse conditions. Entophytes and green synthesized PAAgNF can be explored as a novel technology in managing soybean diseases and productivity enhancement of soybean in India.

Isolation, Screening and Biochemical Characterization of Methane-Utilizing Bacteria from Sediment of Lowland Rice

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Methane gas or CH_4 is one of the greenhouse gases that contribute to climate change. Most of the methane in the Earth's atmosphere comes from biological processes, and rice paddies are one of the main sources. Methanogen and methanotrophic group microbes play a role in CH_4 emissions in lowland rice fields. A large fraction of the methane produced in rice soils is emitted; however, it is oxidized to carbon dioxide by methane-utilizing bacteria in the soil, so it never makes it to the atmosphere. This research aims to isolate, screen, and characterize methane-utilizing bacteria from several lowland rice rhizosphere in several provinces in Indonesia. We have isolated and screened 21 methane-utilizing bacteria from the sediments or rhizosphere of rice fields in Lampung, West Java, and East Nusa Tenggara Province. Six isolates have a high ability to reduce methane emissions. All strains have *a pmoA-like* gene encoding one of the subunits of the particulate mono-oxidase found in all methanotrophs. Based on characterization and identification of the bacterial strains using Biolog OmniLog® ID System, they were classified into 5 genera and 6 species such as *Mycobacterium senegalense, Bacillus marisflavi, Bacillus methylotrophicus, Providencia stuartii, Flavobacterium tirrenicum, Rhizobium rhizoryzae.* They all can fix nitrogen (nitrogenase activity 68.1 - 92.0 nmol C_2H_2 ml^{-1} h^{-1}), solubilize P, and produce IAA (41.798 - 61.921 µg mL^{-1}). Hence, these species can be further formulated and used for greenhouse and field applications as biofertilizers and mitigation agents to reduce methane emissions.

Intermittent Irrigation for Improvement of Rhizobacteria Population Dynamics and Rooting of Some Rice Varieties (*Oryza sativa* L.)

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Intermittent irrigation is one of the rice cultivation technologies developed in Indonesia and the world. This study aims to determine the effect of varieties of superior rice and irrigation system on

rhizobacteria population dynamics, root development, and rice yield. The research used experimental methods with a 3x4 Factorial Strip-Plot experiment design in a Complete Randomized Block Design. The irrigation system consisted of 3 treatments: conventional irrigation, intermittent irrigation, ten days watering of 5-day dry, and intermittent irrigation, seven days watering of 3-day dry. Factor II is rice varieties consisting of 4 varieties: Cempo Merah, Inpari 23, Sintanur, and Inpari 42. The results showed that the 7-day watering 3-day dry system has a relatively larger population of Rhizobacteri week 16 and increases the length of the root than other watering treatments. Intermittent irrigation provides the weight of grain per clump is no different from conventional irrigation. Inpari 23 rice varieties have a population of Rhizobacteri week 16 more and weigh 1000 seeds higher than the varieties Inpari 42. The yield of superior rice Inpari 23, Sintanur, and Inpari 42 is higher than Cempo Merah. Inpari 23, Sintanur, and Inpari 42 varieties can be cultivated by intermittent irrigation.

Selection and Characterization of Phosphate Solubilizing Bacteria from Chili (*Capsicum Annuum* L.) Plantation Area in Rejang Lebong District

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Phosphorus (P) nutrient is very important for plant growth and development but it often inefficient because it is not to be ready absorbed by plant roots. Therefore, availability of P elements in the soil need tobe helped by presence of Phosphate Solubilizing Bacteria (PSB). This research is aimed to obtain potential PSB from chili plantation area. The methods used in this study included bacterial isolation, selection, characterization of the P solubilizing ability of bacteria, identified the morphology, Gram staining, physiology, and 16 rRNA genes. The result showed two potential isolates namely CB1A56 and CB2A50 quantitatively had the largest phosphate solubilizing values that are 311,88 mg/L and 225,21 mg/L respectively. Based on the biochemical test, CB1A25 isolate have a close similarity with *Pseudomonas*. CB2A50, CB2A55, and CB1A59 isolates have close similirity to the *Bacillus*. CB2A53 isolate have a close similarity with *Streptomyces*. CB3B06 isolate has close similarity with *Mycobacterium*. CB3B07 isolate has similarity with *Micrococcus* and isolate CB2A45 have similarity with *Streptococcus*. 16S rRNA genes identification showed that the selected isolate of CB1A56 were genetically close to *Weissella confusa* with 99.92% similarity. CB1A56 isolate (*Weissella confusa*) was recommended as an effective inoculant to increase chili plant growth in greenhouse experiments.

Rhizosphere Engineering of Rice to Harness the Plant-growth Promoting *Pseudomonas chlororaphis* for Effective Colonization and Soil Health improvement

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Plant growth-promoting rhizobacteria (PGPR) are a group of beneficial bacteria that inhabit the rhizosphere and rhizoplane of plants and are either directly or indirectly involved in plant growth promotion. However, PGPR in the rhizosphere or purposely introduced strains through seed or soil often fail to perform their functions in the plant for several reasons. Rhizosphere engineering is the control of the structure and function of crop plants rhizosphere through root exudation, now gaining importance for sustainable agriculture. Hence, in the present investigation, an attempt was made to modulate the root exudation pattern of the rice plant using an exogenous spray of small molecules in order to improve PGPR strain rhizosphere colonization and soil health. PGPR (*Pseudomonas chlororaphis)* strain ZSB15 was tagged with a green fluorescent (gfp) protein-producing gene through the transposon vector. The transconjugant (ZSB15 M) and wild strain (ZSB15) had no genetic differences as revealed by BOX and ERIC-PCR fingerprints. Gnotobiotic experiments were performed in rice plants (Cultivar Co51) to screen for plant-growth regulating small molecules improving soil-inoculated PGPR strain rhizosphere colonization and soil health. Foliar application of *Corynebacterium glutamicum* cell extract and yeast cell extract increased ZSB15 M root colonization ability and improved rhizosphere soil biological attributes such as soil organic carbon, microbial biomass carbon, soil protein index, dehydrogenase, and acid-and alkaline phosphatase. The available nitrogen, phosphorus, potassium, and zinc were also enhanced due to these rhizosphere priming efforts.

Potential of Bacillus as Plant Growth Promoting Rhizobacteria (PGPR) to Improve P and K Nutrient in Acid and Saline Soil

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Bacillus is rhizobacterium found in many plants rhizosphere as Plant growth promotion rhizobacteria (PGPR) can play a role in the soil nutrient cycle. This study aims to (1) examine the capabilities of *Bacillus sp* to accelerate and increase the availability of phosphate and potassium in saline and acid soils; (2) analyze the secondary metabolites produced, i.e., organic acids and the hormone IAA. The research was carried out in stages: (1) Test the capability of the Bacillus genus isolates against several concentrations of NaCl and on saline and acid soils; and (2) quantification of secondary metabolites of rhizobacteria in the form of hormones and organic acids. The isolates tested were *Bacillus valezensis* (BPF2) which can dissolve phosphate, *Bacillus sp* (BPK1); and *Bacillus subtilis* (BPK2) as potassium solubilizing bacteria. The result showed the three isolates were still able to dissolve both P and K with the addition of NaCl up to 3%, but the concentration decreased with incubation time up to H+15. Inoculation by *Bacillus valezensis* improves soil phosphate available up to 88% in acid soil, and 73% in saline soil compare to control. While *Bacillus sp* and *Bacillus subtilis* raise the concentration of

potassium in the acid soil until day-10, with a maximum concentration of 0.37me.100g^{-1}. The three PGPRs (*Bacillus valezensis, Bacillus sp*, and *Bacillus subtilis*) can produce metabolites of Indole Acetic acid (IAA), respectively, 13.25; 11.97; and 14.97g.mL^{-1}. Organic acids produced include acetic, lactic, citric, malic, and oxalic acids. *Bacillus valezensis* produced lactic acid with the highest concentration of 4.94mg.L^{-1}, while *Bacillus sp*. and *Bacillus subtilis* produced acetic acid with the greatest concentration of 2.91 and 2.547 mg.L^{-1}.

Use of Selected Rhizosphere Bacteria as Bio-Inoculants in Organic Rice Cultivation

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Beneficial rhizosphere microorganisms can be used as an alternative nutrient supplement in developing bio-inoculants for low land organic rice cultivation. A pot experiment was conducted to assess the suitability of isolated rhizosphere bacterial inoculants from selected three rice varieties grown under organic farming conditions. Two strains as Bg 1 and Bg 2 from Bg *358*, one strain as Su *1* from Suwandal and two strains as Kh 1 and Kh 3 from Kaluheenati were used for molecular identification using 16S rRNA gene sequencing. Beneficial inoculants were compared with and without 100% chemical fertilizer, 100% compost, 70% chemical fertilizer + compost and no fertilizer. The grain yield showed by Kh 1 (*Stenotrophomonas maltophilia)* and Kh 3 (*Rhizobium pusense)* with 100% compost in variety Kaluheenati were not significantly differerent with the highest yield (18 g plant^{-1}) of 100% chemical fertilizer application. In Bg 358 and Suwandal varieties, the second highest grain yields have showed by inoculants Bg 2 (*Rhizobium pusense strain 76)* with 24.4 g plant^{-1} yield and Su 1*(Pseudomonas aeruginosa)* with 15.2 g plant^{-1}, which were not significantly different to 70% and 100% chemical fertilizer applications. These inoculants could be used as beneficial organisms in organic farming as alternative nutrient sources.

ABSTRACTS - ROOM 4

Screening of Multi-Trait Phyllosphere Bacteria for Plant Growth-Promotion in Soils Amended with Agro-Industrial Wastes Under Biotic Stress Conditions

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Global demand for agricultural crops is increasing and may continue to do so for decades. However, the impacts and limits of fertilizer and insecticide applications have raised public concerns about the sustainability and security of the food supply for identifying alternatives to chemical fertilizers, such

as PGPR's. PGPR's are living microorganisms that when applied to the seeds or plant surfaces adjacent to soil, can colonize the rhizosphere, phyllosphere and/or the inner regions of plant tissues to promote plant growth. The phyllosphere is an important microbial habitat, but our understanding of how plant hosts drive the composition of their associated leaf microbial communities between plants and phyllosphere microbes represent adaptive matching remains limited. In this study, we evaluated the bacteria isolated from the leaves of *Carica papaya* for various plant growth-promoting traits such asnitrogen fixation, phosphate solubilization (zone size-14mm) Zinc (zone size-16mm) potassium solubilization (zone size-12mm), and production of phytohormone (IAA). Biological control activities that help plant growth were assayed such as hydrolytic enzyme profile, ammonia and HCN production. Growth of the selected bacteria (W1) was checked in the presence of abiotic ($CdCl_2$ and $NiCl_2$) and biotic stresses conditions.Our results showed that the selective phyllosphere bacteria possessed plant growth-promoting traits.These same bacteriashowed inhibitory activity against *Fusarium oxysporum*, *Pythium* spp., *Rhizoctonia solani* and bacterial pathogens, *Xanthomonas camprestris* and Erwinia spp. Our *in-vitro* assays showed that these bacteria possessed multi-trait potentials for enhancing the plant growth, including the ability to grow in presence of 5% of salt, 10mM $CdCl_2$ and 16mM $NiCl_2$. Further, pot experiments were carried-out to assess these bacteria, against phytopathogens with amended agro-industrial wastes such as pectin and press mud compost in which diverse results of plant growth were noticed. Our results suggest that this multi-trait bacterium, Bacillus spp. W1 could be used to enhance the plant growth in contaminated soils as an alternative as biofertilizer in agriculture offers an economically and environmentally beneficial way to reduce the use of chemical fertilizers, antibiotics, herbicides, and pesticides.

Hand-On Experience with Ecological Friendly Farming in Malaysia

Ting Ho

As a president of SATA foundation, an NGO fascinated in promoting clean safe food, and as a founder of Global Agro Innovation Limited interested to introduce Innovative Agro Technologies for food farming. with countless communities of microbes. These microbial life forms come in many shapes and sizes, and they live all over us. Not only, they are alive, they are also an integral part our life on planet earth. Some of them are beneficial while most of them seem inert and still others are disease agents. To live a healthy life on earth, it is futile to avoid direct contact with these microscopic beings. Not only is our health and well-being directly affected by their presence or absence, even the quality of our sleep, even mood and sentiment are significantly affected by the metabolites and interactions of the gut microbiome with our nervous system. Advanced analytical tools have now been developed to study the environment in which microbiome thrives. The emergence of Covid 19 Pandemic has convinced, that, microbes affect the direction of the global economy. Nature abounds with vastly diverse lives to realize their roles in sustaining us. My talk will share of my personal journey in developing two small farms, to utilize eco-friendly practices, incorporating the microbials in the process. It is feasible and wise to grow pesticide-free food by working with nature and using its natural resources. Food and health are intimately related. Food that we consume is also to feed the gut microbiome. It is also possible to rejuvenate a wasteland to make it productive again. The fishponds were established with different species of fish. Our results showed that a sustainable way of working with nature without harming to revolutionize food farming could make a difference by embracing reverence for our lives.

Industrial Production of Nitrogen Fixing Bacteria in High Cell Density Culture: Challenges and Platform Design.

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Nitrogen is one of the main components in any fertilizer formula. This essential element is added to soil mainly in inorganic form by addition of different types of chemicals such as Urea, ammonium salts and nitrates. Organic fertilizers (such as composts and animal manures) have been also used to supplement soil with the needed nitrogen for healthy plant growth. In general, exogenous addition of nitrogen contribute largely to the overall cost of the plantation cost. Therefore, in the recent years special interest was paid to soil enrichment by nitrogen fixing bacteria to provide nitrogen naturally in balanced concentration to the plant without any extra nitrogen over-flow which cause many environmental problems. However, two type of nitrogen fixing bacteria are known so far (nodule forming and free living). For many years, many research groups in the world were focused on isolation, identification, and functional characterization of nitrogen fixing bacteria. However, production of nitrogen fixing bacteria in large scale is yet on of the big industrial challenges. This based on the fact that, most of nitrogen fixing bacteria belong to *Rhizopium* , Sinorhizobium, Azotobacter, and others have high capacity to produce polysaccharides when cultivated in submerged cultivation system. Therefore, the carbon flow goes to the direction of polysaccharides biosynthesis rather than biomass production. In addition, the polysaccharides production increased medium viscosity and convert the fermentation broth from Newtonian to non-Newtonian fluid which complicate the mixing characteristics and oxygen availability in culture and terminate biomass production accordingly. In this work, we present a new cultivation strategy to overcome this industrial challenges and to de-bottlenecking the process of high biomass production of nitrogen fixing bacteria in semi-industrial scale.

Development Technology and Commercialization of PGPR to Improve Relationship Between Above and Below Ground Biodiversity

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Biodiversity on earth plays a critical role in governing environmental sustainability. The interaction between plants and microbial population structure and function in the rhizosphere has important ecological implications in soil function, including biogeochemical cycles, altering many of these bio-physical-chemical processes. Eventually, plant productivity would be affected. In order to maintain the soil function, significant efforts have been made to increase microbial activity in the soil through the use of biofertilizer technologies, new modern composting crop residues, and limited use of synthetic pesticides. The use of microbes to maintain soil function that leads to an increase on plant productivities is often called soil management biotechnology. It provides a novel approach to deal with many problems that remain efficiently unsolved by conventional technology. It is believed that the enhanced relationship between above and below ground biodiversity contributes to the re-establishment and ability to carry out essential biological functions. This paper discusses the development technology and commercialization implemented at the Indonesian Research Institute for Biotechnology and Bioindustry (IRIBB), PT Riset Perkebunan Nusantara, on developing plant growth-promoting rhizobacteria (PGPR) as a biofertilizer to improve the relationship between above and below ground biodiversity for sustainable management to enhance plant productivity.

Molecular and Morphological identification of *Aschersonia sp*. Infected Whitefly on Citrus and Mulberry Plants

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Whitefly is one of the most common pests in agriculture because it has very wide distributions all over the world. The host of this pest is diverse from citrus, vegetables to ornamental plants. Whitefly potentially causing serious damage to the plant as a huge population of whitefly sucking big amount of nutrition from the plant. *Aschersonia* is one of the most effective natural enemies to control the whitefly population. *Aschersonia* is an entomopathogenic fungus that has been used to control whitefly since a long time ago. However, there is still a lack of information about *Aschersonia* in Indonesia. The objective of this research is to identify *Aschersonia* found on Citrus plant in Jehem (AC1) and *Aschersonia* found on a mulberry plant in Pancasari (AM1) morphologically and molecularly. The result showed both AC1 and AM1 were identified to be *Aschersonia placenta* based on their morphological analysis. The sequence of AC1 and AM1 has been successfully obtained through PCR and sequencing. Phylogenetic analysis showed that this *Aschersonia* belongs to a strongly supported clade included *the Aschersonia placenta*.

An Overview of Transfer and Adoption of High Technology in Permanent Food Production Park Program (PFPP) Participations in Peninsular Malaysia

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This study discovers that the Transfer and Adoption of high Technology in Permanent Food Production Park (PFPP) program participations in peninsular Malaysia. The PFPP program is one of the basic programs established by the government of Malaysia with the aims of increasing food production as well as reduces our food imports and auxiliary local agriculture entrepreneurs. The study employed a cross-sectional study design and has been conducted in peninsular Malaysia with a sample of size of 275 farmers. The study design and have been conducted in peninsular Malaysia. The explanatory variables were hypothesized to influence the respondents' attitude towards technology adoption through PFPP. The results showed that the respondents that the main factors that influence respondents' attitude towards technology adoption are benefit, education level, year of experience in agriculture and gross income.

Plant Growth-Promoting Potential of Commercial Product "Sanjeevni" - Anti-Fungal Agent

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The current research was undertaken with the perception that many of the commercial anti-fungal products in the market failed to give the desired results when applied in field. This was the reason we aimed to isolate a PGP agent from commercial product "Sanjeevni". The methods utilized were isolation of PGP agent (fungi) from the product, screening of its PGPR activity, and potential to antagonize the plant pathogens. *Trichoderma viride* isolated from this commercial product showed antagonistic effects against various plant pathogens. The current study also showed increased root length in corn seeds when *T. viride* was used for seed bacterization. The use of *T. viride* based products such as "Sanjeevni" is not only safe for the farmers and consumers but it is also good for the environment.

Microbial Formulation Technology for the Remediation of Explosives Contaminated Soil

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High energy explosives such as RDX, HMX, TNT contaminate the environment when released into surrounding soil and water during manufacturing, testing, open dumping, military, and civil operations. Hexahydro-1,3,5-trinitro-1,3,5-triazine or RDX is a widely used nitramine explosive that is highly persistent and toxic, categorized as a potential human carcinogen by the EPA. Remediation using biological systems to decontaminate xenobiotic-polluted sites has proved a worldwide success in recent years. However, prolonged survival of the potential microbes at the contaminated sites remains a challenge for successful microbial remediation. Thus, there is a need for an efficient technology package that could address the challenge by enhancing the microbial load and metabolism at the site. Formulating the explosives degrading microbes such as *Pelomonas aquatica* into a stable product with access to nutrients, moisture, and aeration shall help sustain its growth in a contaminated stressful environment, which could be an apt solution. The use of microbial formulations for plant disease and nutrient management has been explored extensively. In this study, the application of microbial formulations for the remediation of RDX contaminated sites is discussed, emphasizing bioformulation technology and degradation pathways.

Importance of CTAB DNA Plant Extraction Assay for Streptomyces DNA Extraction

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The choice of DNA extraction method is essential to obtain good quality of DNA. Nowadays, variable DNA extraction kits from various companies are available including those specific for bacterial DNA extraction. However, generally the price of DNA extraction kit is quite expensive and small lab often cannot afford it. The aim of this study was to extract DNA from Streptomyces sp. using modified CTAB DNA extraction method. The CTAB DNA extraction method is commonly used for plant DNA extraction. Streptomyces is categorized as plant growth-promoting bacteria due to its ability as an antibacterial. The isolates of Streptomyces used in this study were isolated from two sources, ginger plant and from soil at Udayana University, Kampus Bukit Jimbaran, Bali. The DNA was extracted from bacterial culture on agar plate and from liquid culture. Modification was done in the concentration of EDTA and no further purification was done. To evaluate the success of DNA extraction, the electrophoresis was employed using 1% agarose in TAE buffer and stained with ethidium bromide. This was followed by PCR reaction using 16SrRNA gene. The results showed that high quality of DNA was obtained which was showed by no degradation of DNA. The amplification of 16SrRNA gene resulted in 1000bp DNA fragment. Our results clearly showed that CTAB plant DNA extraction method is suitable for bacterial DNA extraction.

ABSTACTS - ROOM 5

Application of Microbial Consortium Against Major Pests of Cumin

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Microbial consortium of efficient strains for biological control helps in improving microbial efficacy, reliability and consistency under diverse soil and environmental conditions. Different species in consortia formulation occupy varied niches in the root zone thereby restrict competition among them. The need of consortia application of bioagents, their role in rhizosphere colonization and disease suppression. Potential of consortia application of bioagents against fungal, bacterial and nematodes can be utilized to fullest extent by selecting most potential strains and not by arbitrary use of consortia. Cumin (*Cuminum cyminum* L.) is an important seed spices crop in India and major producer and consumer in the world. Cumin crop is majorly infected by *Fusarium oxysoprum* f. sp. *cumini* (Fusarium wilt) and aphid (*Myzus persicae* (Sulzer)). The multi-location field trials were conducted at Zone III A semi-arid eastern plain zone (Jaipur- Jobner) and zone IVB southern humid zone (Banswara) to evaluate the efficacy biocontrol agents and insecticide against major pests of cumin (Variety: RZ19) at two different agroclimatic conditions during 2017, 2018 and 2019 rabi seasons. The strains and chemical compatibility were evaluated by co-cultivation method under lab and greenhouse conditions. The combined application of biocontrol agents for the management of wilt of cumin by soil application with *Trichoderma harzianum* Th3 and *M. anisopliae*Ma1 enriched FYM (1:20) + Seed treatment with *T. harzianum* Th3 and *M. anisoplia e*Ma1@ 8g/kg seeds + drenching at

30 and 60 days after sowing and three foliar sprays with Flonicamid at 0.015% clearly showed the maximum reduction of disease (62.16%) compared to control and also maximum yield of 570.94 kg/ha at Jaipur agroclimatic conditions. The maximum disease reduction of 60.22% and increased yield up to 541.50 kg/ha was observed at Banswara agroclimatic conditions. Based on the bliss independence hypothesis, the synergy factor was >1 (1.01) which demonstrated the interaction was synergistic in both pests of cumin.

Prathista 'S 5-G Agri-Inputs for Total Crop Management

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With ever increasing advancement in agricultural practices, there are different new strategies upcoming as a current trend. The extensive research in agriculture enables us to develop 5-G technology for agricultural advancement in providing the potential practical technology to farmers at a very reasonable price. The 5-G technology of Prathista deals with the utilization of agricultural promising PGPR strains for production of different natural molecules/metabolites such as polysaccharides, proteins, peptides, growth factors and hormones via high-end fermentation technology. These molecules are necessary for enhancing the growth of crops and to provide immunity against many fungal and pest's attack. Our 5-G technology is the revolution for 21st centuries produced in nano-formulations contain metabolites produced from PGPR for development of significant agri-inputs. Our nano-formulations aimed for uptake and absorption of nutrients by the crops, to combat the pathogens with self-immunity in the crop plants grown under different biotic and abiotic stress conditions. The natural molecules/metabolites produced by microbes were used to develop nanoparticles in formulations and products to enhance growth due to their pesticidal/insecticidal attributes. The products/solutions of 5-G technology developed at Prathista is of great importance in complete crop management system. This technology is now commercialized and available for the farmers around globe for sustainable agriculture and its long-lasting benefits will be discussed.

Genetics of Beneficial Plant-Microbe Interactions

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In their whole lifetime, plants co-exist with a variety of microorganisms with beneficial, neutral, or detrimental effects on themselves. Their sedentary nature restricts any escape from the potential adversaries. In turn, this led them to evolve innate mechanisms to deal with the various microbes. These mechanisms are facilitated by genetic changes which are blessed by natural selection and thus persist in plant populations. One important aspect of such genetic change in plants is their ability to interact with co-existing microbes and derive benefits by hosting them. Genetic basis of such ability to host the microbes was established and the co-evolution of hosts and their symbiotic microbes was shown to help in resisting the pathogenic microbes and other benefits like better growth and improved fecundity. These relationships were generally studied in pair-wise contexts like the legume-rhizobia in symbiosis, coffee-VAM etc. However, recent studies revealed a much larger canvas of complex

relationships of the phyllosphere, rhizosphere and whole plant microbiome in shaping the plant resistance and productive performance. In turn, this has implications for the development of consortia of microbes specific to the plants of interest that can be applied in agriculture to derive large scale benefits for the mankind. Present study made an attempt to summarize the available information on the genetic aspects of plant-microbiome interactions and looks at the possibility of microbiome engineering for improved plant resilience and crop yields.

Plant Growth-Promoting Microbes (PGPM) in Future Management of Indonesian Estate Forests

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Plant growth promoting microbes (PGPM) are soil borne microbes living on root surfaces or colonizing the internal tissues of plants as endophytes. They can be fungi (PGPF) or bacteria (PGPB/PGPR) and are classified into three main groups based on their growth promoting mechanisms, i.e. biofertilizers, biostimulants and biocontrol agents, each of which contributes directly or indirectly to improved plant growth and productivity in diverse ecosystems. Development of PGPM as biocontrol agents in the scenario of integrated pest and disease management has for some time been one of research program initiatives in several forestry companies. Recently, however, adoption of PGPM as biofertilizers and/or biostimulants, especially in the nursery operations to produce vigorous and healthy seedlings, has also gained momentum. This paper discusses current status and potential future role of PGPM in the sustainable production of Indonesian estate forests.

Increased Productivity and Income of Farmers Through Application of ICM Technology in Rice Under Rainfed Condition

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The productivity of rainfed rice is very low (2.0 ± 3.5 tonnes per hectare), needs to be improved. The objective of this study is to increase farmers productivity and income by applying the ICM technology package for rainfed land in Subak Babakan Anyar, Mambang, East Selemadeg, Tabanan, Bali in 2018. The design was a split plot with the application of ICM and non-ICM technology with Inpari 40, Situ Bagendit and Towuti varieties. The variables observed were the components of growth, productivity, income, institutions, pests and diseases, chemical and physical quality of rice. ICM technology showed increased plant height and panicle length compared with non ICM, but lower in number of tillers. Filled grain, total grain, 1000 grain weight and productivity per hectare, increased at 56.49; 32.41; 11.93 and 23.73%. The highest productivity in Situbagendit was 7.42 tons significantly different from Towuti (7.08 tons), not significantly different from the Inpari 40 (7.28 tonnes). The results of the analysis of the feasibility of farming with ICM technology were 2.34 (Situ Bagendit),

2.14 (Towuti) and 1.95 (Inpari 40), higher than non ICM 2:21, 1.86 and 1.73. Agribusiness institutions could play the highest role in upstream institutions and the lowest in financing institutions. The application of technological innovation takes into account to the balance of the ecosystem that is adjusted to the local ecology. lowering the pest attack. Role of varieties in determining the quality of the content of the chemical, nutritional and physical quality of rice.

Adaptation Test of New High Yielding Rice Varieties Through Integrated Crops Management (ICM) To Support Organic Agriculture

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Variety is one of the important components that contribute to increase rice productivity and farm income. The objective of this study was to obtain high productivity adaptive to high yielding varieties (HYV) and increase farmer income to support organic farming. The assessment was carried out in Subak Timpag, Kerambitan, Tabanan, Bali Province in 2017 in an area of four hectares using organic fertilizer ICM technology. The varieties used were Inpari 19, 24, 30, 31, 32, 33, and Mekongga for a comparison. The variables observed were the components of growth, yield, and farming. The data were analyzed using by ANOVA, single factor Random Block Design (RBD) with seven varieties as treatments with 10 replications. Farm costs and income were analyzed using income analysis and financial feasibility. Statistical analysis of the results of the treatment with some of HYV significant effect on some growth and yield. Productivity ranged from 5.01 ton/ha to 7.87 ton/ha, the highest in Inpari 30 variety (7.87 ton/ha) and Mekongga 4.06 ton/ha. Our study showed to increase rice productivity with an average of 2.41 ton/ha or an increase of 37.27%. Results of the analysis of the cost spent in rice farming with the application of ICM increased by 11.88% due to the use of organic fertilizer, but the reception was also increased by 59.40%. The average increase in income was 34.97% or Rp.3,400,000.00 per ha, with an increase in the R/C ratio before and after mentoring by 0.20 or 10.03%.

Growth and Yields of Three Tomato Strains (*Lycopersicum esculentum* Mill) with Various Dosage of *Trichoderma* sp.

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The tomato strains need to be tested for several generations (F) to observe the growth and yield characteristics of the plant. Increase in tomato yield can be done by giving *Trichoderma* sp as a biological agent and as a plant growth stimulator. This study aimed to observe the growth and yield of three tomato strains and dosage *Trichoderma* sp and their interaction. The research used Completely Randomized Design (CRD) with 2 factors and 3 replications. They were tomato strain and dosage of *Trichoderma* sp. The tomato strain was Servo varieties F1, F2, F3. and dosage of *Trichoderma* sp were 30 g/plant, 40 g/plant and 50 g/plant. Data were analyzed using ANOVA and a further test DMRT at 5% level. The results showed that F1 tomato strain significantly affected the higher in

plants, the F3 strain in tomato had a sweeter taste. The *Trichoderma* sp 40 g/plant accelerated the flowering age and diameter of fruits. The use of Servo F1 Tomato and *Trichoderma* sp 40 g/plant increased leaf number of tomato and total weight per plant. The F1, F2 and F3 tomato strains with *Trichoderma* sp 30 g/plant increased vitamin C content of tomato.

Efficacy of Halotolerant N-Fixing Bacterial Isolates on Biochemical Activity, Bacterial Population and N-Uptake in Rice Seedlings

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Saline soil contains a large amount of soluble salt and becomes a major constraint for rice farming. The high salt content inhibits plant growth and lead to deficiency of N nutrients and can also cause poisoning of Na and Cl ions. Beneficial microbes that adapted in saline ecosystems (halotolerant) can alleviate the effect of salinity and increase the rice growth. Halotolerant bacteria are a type of microorganisms that can survive in high salt levels by maintaining an osmotic balance. The use of halotolerant N-fixing bacteria (HNB) as biofertilizers is an effort to increase nitrogen nutrients and productivity of rice plants in saline land. This study was aimed to determine the effectiveness of HNB isolates in increasing the growth of rice plants. The experiment was carried-out in the greenhouse of Faculty of Agriculture, Universitas Padjadjaran, using a randomized block design consisted of 16 treatments (control, single and consortia of inoculant) and repeated three times. The rice seedlings were grown in Fahraeus saline medium and inoculated with HNB isolates. The results of the experiment revealed that HNB consortium application was able to increase plant height 9.03 cm, root-shoot ratio of 0.92, IAA content at 0.475 µg/mL, N content of 2.94% and the total number of the consortia HNB isolates (*Azotobacter, Azospirillum, Bacillus* and *Stenotrophomonas)* 8.10x10^7 CFU/g.

Evaluation of Azotobacter Isolates on Growth and Yield of Rice (*Oryza sativa* L) Under Greenhouse Conditions

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Azotobacter has the ability to fix nitrogen. The research on physiological characterization and efficacy of Azotobacter isolated from rhizosphere and soil has been carried out on the growth and yield of rice (*Oryza sativa* L) in the greenhouse. The aim is to obtain Azotobacter isolates that have

the potential as biological fertilizer. There were 21 Azotobacter isolates, 17 isolates capable of nitrogen-fixing activity, 16 isolates with protease activity, six isolates with IAA activity, and 13 isolates are able to dissolve phosphate. The experimental design was a completely randomized design with three replications for each treatment. Seedlings were harvested at 105 days after seeding, and the following parameters such as height of plants, number of leaves, dry weight of straw, grain and number of panicle and seeds were evaluated. The results showed that 1 KZ isolate from Turi (*Sesbania grandiflora*) plant and 15 KZ isolate isolated from Akasia (*Acasia mangium*) plant gave better yield of rice.

Effect of Liquid Leaf Extracts of Moringa (*Moringa oleifera*) and Keong Mas (*Pomacea canaliculata*) on Growth of Wangi Mentik Paddy

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The availability of local food ingredients is a strategic source in supporting healthy of food. Mentik fragrant rice is a local grown rice need to be improved for its healthy value. Utilizing the diversity of local materials are one of the alternative methods to grow organic rice. Extracts of Moringa leaf (*Moringa oleifera*) and golden snail (*Pomacea canaliculata*) may be alternative sources of nutrients to be used as liquid organic fertilizer for rice plants. The aim of this study was to determine the extracts of Moringa leaves and golden snails on growth of the Mentik Wangi rice. A factorial completely randomized design (CRD) with two factors was used in this study. The first factor was the type of POC and without POC (control), POC of Moringa leaf extract, POC of fermented Moringa leaf extract, POC of golden conch meat extract, POC of fermented conch meat extract, POC mixed with fermented Moringa leaf extract, fermented conch meat extract comparison at 1:1 ratio. The second factor was the concentration of POC at 20, 40, 60, 80 ml/litre of water. The data obtained were analyzed by Anova variance test followed by Duncan's Multiple Range Test at a 5% confidence level. The results showed that the fermentation treatment of Moringa leaves at a concentration of 60 ml/litre of water and fermentation of golden snails at a concentration of 60 ml/litre of water produced the highest number of tillers and leaves. The mixture of fermented moringa and golden snail at a concentration of 40 ml/litre of water provided good plant height. In the golden snail fermentation treatment, a concentration of 80 ml/litre of water produced the highest leaf area, as well as in the Moringa fermentation treatment. While the treatment of Moringa leaf extract and golden snail gave the best growth results at a concentration of 80 ml/litre of water.

Endophytic Fungus *Aspergillus Costaricensis* Mediated Growth and Yield Response in Rice

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Association of fungal endophytes can affect the crop growth and thus could serve as a promising mechanism for enhancing crop productivity. We isolated a novel fungal endophyte from rice plants and found that it showed high siderophore production, phosphorous solubilization and inhibited the growth of rice pathogens under *in vitro* conditions. Endophyte was identified as *Aspergillus costaricensis* by ITS sequencing. Endophyte was inoculated to rice plants and spores were detected in rice roots 15 days after inoculation. Endophyte was inoculated to two different genotypes of rice and growth and yield attributes of rice were studied under glass-house conditions. There was a significant difference in plant height, leaf area, root and shoot biomass in endophyte inoculated rice plants on comparison with uninoculated control. A higher grain yield (no. of grains per panicle) was also observed in endophyte inoculated plants. Impact of endophyte on uptake of macro and micronutrients were studied in inoculated plants in comparison with control and partition analysis of phosphorus was also carried out to study P mobilization potential of endophyte in different plant tissues.

Organic Sources of Plant Nutrient for Productivity Enhancement of Paddy in Hill Agro-Ecosystem of North-Eastern India

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Northeastern India is one of the most fascinating regions of India with the amalgamation of natural wonders with vast and varied landscape. The Farmers of this region are practicing organic farming with indigenous knowledge system from ages. The state has a natural choice for promoting and intensification of organic farming and the potential is also very high of the farmers for improve the economy and prosperity by adopting it. But due to the mono-cropping as well as imbalance fertilizer application to the crop field, the productivity of crop is very low, and soils are also deteriorated day by day. In this disadvantaged area regarding crop productivity and soil sustainability the promotion of fertilizer application is very much essential. A front-line demonstration was conducted at the farmers' field of Ri-Bhoi District of Meghalaya of Northeastern Region of India during the year 2017-2018 and 2018-2019 to test the feasibility of a technology and to demonstrate the organic sources of nutrients for maintaining the soil health and to increase the productivity of paddy. The results showed that the application of vermicompost 5 t/ha + Azospirillum at 3.5kg/ha + PSB at 3.5kg/ha + 30 kg of cow dung by root dip treatment had recorded significantly higher yield i.e., 42 q/ ha with B.C ratio of 2.08 followed by farmers practice (32.5 q/ha yield with B.C ratio 1.48). The nutrient content of soil also was recorded high after the treatment for both the years. Moreover, from the data of extension gap (9.5 q/ha), technology gap (8 q/ha) and the technology index (16) received after the implementation of the technology had showed the feasibility of the demonstrated technology at the farmers field and the suitability of the technology in the hill agro-ecosystem of Northeastern India.

Production of *Beauveria bassiana* Conidia in Solid Substrate Condition Using Biphasic System

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Beauveria bassiana is an important entomopathogenic fungus widely commercialized in the world as a biopesticide. The crucial step to produce high quality biopesticide is the formulation and fermentation technology. This study investigated three liquid culture mediums and five combinations of solid substrates for selection in the formulation process to enhance conidial production by *B. bassiana.* The fungus was isolated from the infected insects in cocoa plantation of PT Perkebunan Nusantara XII, Kediri, East Java, Indonesia. The three culture mediums were Malt Extract Broth (MB), Potato Dextrose Broth (PDB), and Yeast and Malt Extract Broth (YMB). Five combinations of solid substrate used were 100% of rice, 100% of corn, rice: corn (75%:25%), rice:corn (50%:50%), and rice:corn (25:75%). The system used in this research was biphasic, in which the fungus was first grown under submerged conditions and then allowed to conidiation in solid-state conditions. Our data showed that PDB was the optimum culture medium to produce blastophore and beauvericin, the active compound acting as a mycoinsecticide. In the selection test, 100% of rice was the optimum solid substrate to produce high numbers of conidia, and gave the same results in the consistency test, and production test with the numbers of conidia were 1.93 x 10^9, 1.78 x 10^9, and 2.08 x 10^9, respectively. *B. bassiana* storability test in rice showed stabile conidial numbers up to 105 days after storage at room temperature.

Genetic Parameter Estimation of Some Inodorus Melon Lines (*Cucumis melo* L.) on Generation S3 with Smart Farming Hidroponic System

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This study aims to estimate the genetic diversity of some inodorus melon lines on generation S3, estimate the morphologies and yields, and determine the growth and yield of some melon lines. The design of this study was a completely randomized design (CRD) which consist of a single factor with 4 replications. The level used were 6 melon lines on generation S3 consisted of DS-1-1-4, DS-1-1-10, DS-1-1-11, DS-1-2-10, DS-1-2-17, dan DS-1-3-3, so there were 24 experimental units. Each experimental unit consist of 10 plants. This study was applied the smart farming hydroponic system. The parameters observed included plant height, stem diameter, male and female flowering, horizontal and vertical fruit girth, pulp thickness, fruit weight, and total soluble solids. The data obtained were analyzed using analysis of variance (ANOVA), then continued with estimated the genetic parameter by analyzing the genetic coefficient of variation and broad sense heritability. The results showed that all of the characters on lines have the low value genetic coefficient of variation. The highest broad sense heritability is 84.56% on plant height character. The DS-1-1-10 lines show the best result of the appearance of horizontal fruit girth and pulp thickness characters, while the DS-1-3-3 lines on stem diameter character and the DS-1-2-10 lines on plant height, male and female flowering, vertical fruit girth, and fruit weight characters.

Climate Smart Agricultural Water Management
Best Practices, Policy Framework and Way Forward

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Water, as the key natural resource, is fundamental to all economic, social and environmental development processes. Thus, efficient water resources management is essential for achieving poverty reduction through inclusive growth; maintaining public health and food security; providing livelihoods for a life of dignity for all; and sustaining long-lasting harmony with the Earth's essential ecosystems. Globally, rising temperatures will translate into increased crop water demand. Therefore, special impetus should be given towards mitigation at farm-level by enhancing the capabilities of community adopted climate resilient technological options. This, together with an approach at a catchment level will help to increase the overall efficiency of water use. Given the rapid changes taking place within the global development scenario due to demographics, climate change and degradation of natural resources, agricultural water management (AWM) also needs to change in order to ensure water security, food security and sustainable rural development. In view of this dynamic development scenario International Commission on Irrigation and Drainage (ICID) as a network of AWM professionals decided to give itself a reality check and reorient its vision and strategies to achieve its stated objectives. "A water secure world free of poverty and hunger through sustainable rural development," a road map to ICID vision 2030, presents the strategies to convert this vision into actions. The relative quantities of water being lost at the different levels in an irrigation system needs to be considered carefully and measures should be taken to reduce the losses and manage the water resources efficiently. The largest volume of water lost is normally at the field level, where, both the irrigated surface area and percolation losses below the root zone are high. The second major loss of water happens at during the distribution of water from field-to-field in the field channels. Increasing water use efficiency should be one of the top priorities of countries where irrigation demands are high in order to cope with increased climate variability, droughts and water scarcity. This requires emphasis on water measurement and quantification, participatory irrigation water management, capacity building of farmers, scientists and government agencies, large-scale promotion of water saving crop production technologies and expansion of micro irrigation into canal-irrigated areas. The Clima Adapt Project (funded by the Ministry of Foreign Affairs, Norway and coordinated by NIBIO, Norway), AP Micro Irrigation Project (funded by NABARD, India), base line studies on Water Use Efficiencies of Irrigation Projects (Funded by Govt. of India) have made significant contributions to capacity building, design, and implementation of various measures to improve water use efficiency in the states of Andhra Pradesh and Telangana in India. The outcomes from these projects have helped in developing policy guidelines and wider adaptation of efficiency measures in the two states.

Bio-Inoculants for Enhanced Farm-Productivity and Profitability with Emphasis on Climate Change

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Crop production requires different kinds of inputs and the cost of cultivation will depend on the type of inputs used for raising a healthy crop with a good harvest. Various biotic and abiotic stresses affect the crop production systems of tropics and sub-tropics considerably. Further, the resource-poor farmers in SAT regions hardly have access to expensive inputs and thus suffer heavy crop losses due to these stresses. Cost-effective 'bio-inoculant technology' over years has emerged as a potential tool that can modulate various plant metabolic activities such as nutrient supplementation, induction of host defense, to protect from pests and diseases, and plant growth promotion. The unraveling of the complex interactions at the rhizosphere between plants and microorganisms along with the immediate environment are being understood with modern science tools coupled with the environmental hazards caused by synthetic molecules has reposed faith in the bio-inoculant technology. Such studies are helping to develop bioinoculants that can perform under various agro-ecosystems. Collecting, characterizing and cataloguing the microbial biodiversity from biodiversity hotspots for all primary and ancillary traits will help to select candidate strains for further evaluation, formulation and commercialization. Promising isolates possessing combinations of traits of biocontrol ability, plant growth promotion and abiotic stress tolerance will be useful as different types of stresses occur simultaneously during a single crop growing season. Understanding functional genomics of abiotic stress tolerance, variability in PGPR traits and ability to solubilize plant nutrients can help choose strains with stable performance. Impact of elevated CO_2 and temperature over generations on these beneficial microorganisms will be helpful to understand possible implications on crop production systems and develop suitable adaptation strategies. Several commercial microbial formulations are popular among farmers and many companies are promoting these products in India and abroad. Some of the popular formulations are nitrogen fixing bacteria; phosphorus solubilizing microbes; biocontrol formulations such as *Trichoderma*, *Pseudomonas*, *Verticillium*, *Metarrhizium*, *Beuvaria* and Bt for management of pests and pathogens.

Organic Home Gardens for Family Food and Nutrition Security in COVID-19 Pandemic: Solomon Islands Experience

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Home gardens are sometimes called backyard or kitchen gardens or "*sup-sup*" gardens. They play a crucial role in improving household food security, especially alleviating micronutrients (vitamins and minerals) deficiencies. A well-developed home garden provides immediate access to a variety of foods (roots and tubers, vegetables and fruits, legumes, herbs and spices, animals, and fish) throughout the year. Roots and tubers are rich in energy, and legumes are important sources of protein, fat, iron, and vitamins. Green leafy vegetables and yellow- or orange-colored fruits provide essential vitamins and minerals, particularly folate, and vitamins A, E and C. Thus, home gardens

promotion is important to address dietary-related, non-communicable diseases (NCDs), including anemia, cancer, diabetes, goiter, obesity and Vitamin A deficiency-related infant and childhood blindness, as well as especially in small children's diets to ensure normal growth and intellectual development. In addition to the nutritional security, they also support conservation of agrobiodiversity, savings on food bills, and income from sales of garden products, thereby addressing many of the United Nations Sustainable Development Goals (SDGs). This presentation provides step-by-step guidance on the development of the successful organic home garden model and highlight how they contribute to the United Nations Sustainable Development Goals. The experiences from the Solomon Islands home garden model project during 2010 will be shared. The ideas were developed without money from outside, but with full community participation and cost-sharing that would transform the whole Kwai Island from scarcity to sustainability ("S to S"). The project promoted the concept of sustainable land management using compost and turning sandy, less fertile soil into a healthy, productive soil. Aside from the obvious nutritional and economic benefits, the project also imparted practical trainings on waste segregation and proper disposal of non-biodegradable materials, composting, mulching, different types/methods used to plant crops, soil preparation, nursery establishment, transplanting, management of crop and pests, seed-saving, and nutrition. From the results of this project, the Solomon Island Government approved for implementation a policy on organic agriculture system and established a national task force on organic farming extension, research, and training. This model has become the blueprint for the Pacific Islands Countries and Territories and is sustainable and thus widely promoted until now. In addition, such organic home garden model has great applications to other island countries globally especially during the COVID-19 pandemic. The lessons learned to scale-up this initiative involving stakeholders at both national and international levels will also be shared.

Associations of Agronomically Important Microorganisms for Increasing the Productivity of Soybean

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To solve the problem of protein deficiency in human nutrition, it is necessary to increase the production of soybeans. However, the yield of soybeans in Kazakhstan is low. To increase its productivity, mineral nitrogen and phosphorus fertilizers are used, which leads to the destruction of the agrocenosis, decrease number of microorganisms and soil fertility. As a result, the use of biopreparations with several useful properties is of greater interest. The goal of the study was to create associations of agronomically important microorganisms to increase phosphorus and nitrogen nutrition and yield of soybeans. To create associations, phosphate-solubilizing and nodule bacteria were isolated, and their biocompatibility was studied. Three associations were created based on the strains. Model experiments showed that associations have high PGP-activity: inoculation of seeds increased the length of the stem by 1.8-2.0 times, root by 2.9-3.1 times, dry weight by 2.0- 2.5 times, the number of nodules 2.5 times. It was found that the associations actively fix nitrogen: the protein content in the dry mass increased 1.5-1.7 times and actively mobilizes tricalcium phosphate (diameter zone - 1.8-2.2 cm). High PGP activity, an increase in nitrogen and phosphorus nutrition of plants, indicates high prospects for using associations to increase the productivity of soybeans.

Sustainability and Policy Direction of Social Forestry Management in Yeh Sumbul Village of Jembran Regency

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One of the implementations of the social forestry program in Jembrana regency is in the protected forest area of Yeh Sumbul village. The forest area of Yeh Sumbul village is about 210 hectares with HPHD permit. In fact, the implementation of social forestry program in Yeh Sumbul village forest is mostly held by planting banana trees, fruit crops as well as plantation crops. It is feared that these activities will disrupt the hydrological cycle and the availability of water for agricultural activities in the downstream area as well as a source of clean water for the community. The purpose of this study was to analyze the sustainability status of social forestry management; formulate policy directions for sustainable social forestry management in the Yeh Sumbul Village Forest of Jembrana Regency. This research began to determine the attributes of forest resource functions that were include environmental, economic, socio-cultural, legal and institutional dimensions. The process used was Multidimensional Scaling (MDS) analysis to assess the sustainability status of the forest land by using RSI^{TM} Software (Rapid Sustainability Index). Policy directions for social forestry management was the Interpretative Structural Modeling method (ISM). The results showed that the sustainability status of social forestry management in Yeh Sumbul Village Forest, Jembrana Regency from the environmental dimension was quite sustainable with a value of 55.48%, the economic dimension was 68.40%, the socio-cultural dimension was 52.75%., and the legal and institutional dimensions were quite sustainable at 52.76%. The most sensitive attribute on the socio-cultural dimension was the lack of understanding, concern and responsibility of the community towards the forest with a value of 27.43. The policy directions for sustainable social forestry management in the Yeh Sumbul Village Forest, Jembrana Regency refer to four dimensions including the socio-cultural dimension, counseling on sustainable social forestry management through forest service programs and the role of indigenous peoples in forest management with customary forest schemes. The legal and institutional dimensions include the mechanism of cross-sectoral, inter-regional, and internal cooperation between the village government and LPHD in cooperation with the Jagatnatha Botanical Gardens for the development of biodiversity conservation and arboretums. The environmental dimensions, include the conservation of biodiversity and the reforestation program of 400 stems per hectare of timber and/or NTFP trees, as well as controlling the addition of agricultural fields; and the economic dimension was the development of agroforestry to generate eco-spiritual and biodiversity-based agro-ecotourism.

Aboveground Carbon Stock Estimation Model with Sentinel-2A Imagery in Bentang Alam Mbeliling of East Nusa Tenggara

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Information on carbon stocks and changes in each carbon pool to determine emission levels is essential. Aboveground biomass (AGB) is one carbon pool that contributes significantly to carbon storage, especially in the dry land. This study was aimed to build a model to estimate aboveground carbon stocks based of vegetation index, correlated with field carbon stocks in Mbeliling Landscape, Nusa Tenggara Timur. Also aimed to make a map of the distribution of carbon stocks from the best model. The research method used was simple linear regression analysis and multiple linear regression analysis. Image processing was done with a cloud system using Google Earth Engine. The correlation test showed a perfect correlation on the RGI Index to measure field carbon stocks compared to other indices. The results showed that the best model for aboveground biomass was the linear regression model of BAPT = 14,046 + 272, 496 RGI (R-sq = 0.86). There were symptoms of multicollinearity in the multiple linear regression model. The best model can be used to create a carbon stock map in Mbeliling Landscape with an overall accuracy value of 64% and a cappa accuracy of 51.19%.

Status of Gummy stem blight disease of cucurbits in India

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Gummy stem blight (GSB) is an economically important disease of various cucurbits such as chow-chow, cucumber, bitter gourd, ash gourd, muskmelon, ridge gourd, bottle gourd, watermelon etc., causing huge losses ever since its first occurrence in France during 1891 and then in India during 1972. The GSB was reported to be caused by *Stagonosporopsis cucurbitacearum* (Syn. *Didymella bryoniae*), *Fusarium incarnatum-equiseti* species complex, *F. chlamydosporum*, *F. verticilloides*, *F. roseum etc.*, indicates the complex nature of GSB and its subsequent identification by morpho-molecular methods and pathogenicity tests. The GSB pathogen causes marginal necrotic lesions which further progresses to leaf blight, stem splitting, necrotic lesions on the vine, exudation of red to amber colored gummy substance, sudden wilting, and subsequent collapse of the plant. The disease can be effectively managed by implementing IPM strategies includes growing resistant cucurbit varieties (Arka Ganga, Arka Nutan, IIHR BGH-10), application of biological control agents (*Trichoderma viride*, *T. harzianum*, *Pseudomonas fluorescens*, *P. aeruginosa*, Bacillus sp., Burkholderia sp.) and chemical fungicides (benomyl, carbendazim, propiconazole and strobilurin).

Evaluation of Decomposed Coconut Biowaste Amended with Fungal Isolates in Growth of Cowpea

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Agro-waste generated from senile coconut palms is a big menace that requires an improved means of utilization. The lignin and cellulose utilization potential of five fungal isolates were evaluated *in vitro*. Fungal isolate CS3, showed the highest growth index of 81% on lignin specific media and 100% on carboxymethyl cellulose agar, while CS1, showed the highest siderophore production. A lab study was conducted to test decomposing efficiency of CS1 and CS3 on pulverized coconut biowaste for a

period of 90 days. It was found that the physical properties such as bulk density, porosity, texture, and color of biowaste were improved when inoculated with fungal isolates. The isolate CS3 could reduce the initial C:N ratio of 60:1 to 32:1 in 60 days, whereas CS1 could reduce up to 24:1 during 90 days of incubation. After 90 days, decomposed biowaste was evaluated for its suitability as plant growth-promoting medium and found that CS1 inoculated bio-waste could enhance germination percentage and shoot length of cowpea followed by CS3. A consortium of CS1 and CS3 could be used for making plant growth promoting medium from coconut bio-waste.

Biochar Potential for Enhancing Tomato Productivity and Soil Acidity Indices in Acid Inceptisol of Meghalaya, India

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Soil acidity is one of the major constraints for crop production in the North-eastern Hill region of India where approximately 95% of soils are acidic, with nearly 65% soils under strong acidic. Liming is the conventional practice; however, it is not economical. At the same time, the region produces huge quantity of crop residue/weed biomass which can be converted into biochar for managing soil acidity, thereby improving crop productivity. Tomato is one of the important vegetable crops supporting the livelihood of many vegetable growers in Meghalaya, India. Therefore, a field trial was conducted during winter season of 2017-18 in acid Inceptisol of Meghalaya to optimize the dose of biochar (B) in combination with vermicompost (V) and graded for recommended doses of fertilizers (F) for maximizing tomato productivity and improving soil acidity indices. Sixteen treatments in different combinations of B, V and F were tested in a randomized block design with three replications of each treatment. The results showed that plant height, number of fruits/plants, fruit size and fruit yield of tomato was significantly higher with the application of B @ 4 t/ha + 100% RDF + V @ 2.5 t/ha and soil acidity indices of acid Inceptisol also improved significantly over controls in Meghalaya.

Characterization and Efficacy of Endophytic Bacteria Isolated from Banana Roots in Banana and Black Rice

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Endophytic bacterial isolates were isolated from banana roots with varying abilities as PGP. Selected seven isolates were tested on Cavendish banana and black rice for growth promotion. This study was aimed to characterize seven isolates of endophytic bacteria isolated from roots of Klutuk and Ambon

banana plants and then tested on banana and black rice. Prior to testing, bacterial suspensions were produced in NB medium overnight at room temperature. Cells were harvested and washed with phosphate buffer and then made a suspension with a turbidity of 0.8-1. The suspension was used for inoculation of sterile Cavendish banana plantlets and black rice seeds. Prior to use, banana plantlets were acclimatized to a mixed media of coco peat and roasted husk at 1:1; while the black rice seeds were planted in water agar media. Banana plant growth was observed after two months and black rice growth after 14 days of planting. The results showed that K3 isolates were able to increase the growth of banana and black rice plants while A22 only supported banana growth but severely inhibited black rice plants. The conclusion is that endophytic bacterial isolates from banana roots can support the growth of banana and black rice plants.

Potential of Various Organic Stimulators to Enhance the Performance of N-Fixing Bacteria in Soybean

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In this study, we evaluated the potential of three types of organic matter (coconut water, bran, and molasses) to improve the nitrogen fixing ability of the bacteria in soybean (*Glycine max* L.) in Incepticol soil field near Jatinangor of Indonesia. Experiments were conducted in a Completely Randomized Design (CRD) with 6 treatments and 3 replications. The treatments consisted of (1) control (without N-fixing bacteria); (2) with only N-fixing bacteria; and (3)-(5) N-fixing bacteria with different additives each: coconut water, molasses, bran; and (6) N-fixing bacteria with a mixture of all the three organic substrates. We evaluated N-fixing bacterial density, chlorophyll content, number of nodules, plant height and the number of pods. The result showed that the mixture of N-fixing inoculation added by coconut water showed an increase in *Azospirillium* spp density, nodulation, plant height, and number of pods, except Azotobacter spp. density and the chlorophyll content were not increased by coconut water addition. But Azotobacter spp. density and chlorophyll content were increased by addition of mixed additives. The coconut water is the most potential additive as an organic stimulant that improve the effectiveness of N-fixing inoculant in soybean grown in Incepticol.

Effect of NPK and Organic Manures in Growth and Yield of Flowers in *Dahlia variablis* L.

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The present study was carried out during November 2019 to March 2020 in research field of Department of Horticulture, SHUATS, Prayagraj. The experiment was conducted in a Randomized Block Design (RBD), with twelve treatments of organic and inorganic fertilizers with three replications per treatment. The treatments included were T_0 (Control (RDF 100:120:100) + FYM), T_1 (100% NPK), T_2 (90% RDF through NPK + 10% FYM), T_3 (90% RDF through NPK + 10%

Vermicompost), T_4 (90% RDF through NPK + 10% Poultry Manure), T_5 (80% RDF through NPK + 20% FYM), T_6 (80% RDF through NPK + 20% Vermicompost), T_7 (80% RDF through NPK + 20% Poultry Manure), T_8 (70% RDF through NPK + 30% FYM), T_9 (70% RDF through NPK + 30% Vermicompost), T_{10} (70% RDF through NPK + 30% Poultry Manure) and T_{11} (70% RDF through NPK + 10% FYM + 10% Vermicompost + 10% Poultry Manure). Our results showed that treatment T_5 was best in terms of growth, yield and quality parameters of Dahlia followed by treatment T_2. In terms of vase life of flowers, treatment T_{11} was the best and yielded maximum net return and followed by T_5 and T_2 compared to T_0 (Control).

Genetic Variability, Heritability and Correlation Studies in Tomato (*Solanum lycopersicum* L.)

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Twenty-five tomato genotypes were studied for genetic variability, heritability and correlation studies in tomato (*Solanum lycopersicum* L.) at a research field of Department of Horticulture, Naini Agricultural Institute, SHUATS, Prayagraj (Allahabad) Uttar Pradesh, India during *kharfi* 2018-19 in a Randomized Block Design. The data recorded for nineteen different characters to assess the genetic variability, heritability and genetic advance and subjected to correlation with analysis of variance. Among 25 tomato genotypes, 19 showed highly significant differences for all the characters assessed indicated the presence of substantial amount of genetic variability. The highest fruit yield per plant was by genotypes PKM-1 followed by Arka Rakshak, Pusa Hybrid-4 and Arka Abha. Highest genotypic coefficient of variance (GCV) and phenotypic coefficient variance (PCV) was observed in plant height followed by fruit weight, number of fruits per plant. Highest heritability was observed in plant height, number of fruits per cluster, days to 50% flowering, fruit length, number of fruits per plant, number of branches per plant and fruit weight. Highest heritability coupled with high genetic advance was observed in plant height, number of primary branches, days to 50% flowering, fruit length, and fruit weight. Correlation study revealed that fruit yield per plant at genotypic and phenotypic level was positively correlated with fruit weight, number of fruits per plant, number of primary branches per plant, number of flowers per cluster and number of locules per fruit. A positive non-significant genotypic correlation was observed in fruit width, days to 50% flowering and fruit length.

Biotechnology Based Replanting for The Improvement and Sustainability of Oil Palm Productivity in Ganoderma Endemic Land

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The choice of replanting technique greatly affects the restoration of the health of the Ganoderma endemic land. The degradation land is due to the Ganoderma colonization resulted with unbalanced

soil character which causes the dominance of Ganoderma sp. Special techniques are needed to restore soil characteristics in terms of a physical, chemical and biological perspective as well as their interactions. The restoration of soil health is closely related to reactivation of various nutrient cycles and the activity of microorganisms especially in the planting hole, which is an area that Ganoderma sp. pathogen intensively interacts with oil palm plants. This research has been conducted to implement the replanting technique in Ganoderma endemic land in an area of 55 hectares. The location of the research was at Unit Laras, PTPN IV. Preliminary analysis of soil chemistry showed that the endemic land used in this study contained a very low organic matter and the availability of selected nutrients such as such N, P, and K, and also the population of Ganoderma sp. In this replanting method, the return of soil characteristics was mainly carried-out by providing organic matter, and antagonistic and biofertilizer microbes such as arbuscular mycorrhizal fungi and selected PGPR in the planting hole. This product was given only once, at the T0 stage of the palm (the first year of replanting). The results showed that this technique was able to enhance the soil health with higher productivity of the fresh fruit bunches (FFB) of the palm. The palm produced fresh fruit bunches (FFB) at the early period i e. TBM 3 (immature palm), and the production was significantly higher than that of control up to the 5th year. The productivity of FFB per hectare from TBM3 to TM5 was 20.51, 24.62, 26.89, 30.42, 25.96, and 21.16 ton/Ha or total 149.56 ton/Ha, while the controls was 7.96, 20.12, 21.46, 18.24, 19.61 and 22.17 ton/Ha or total 109.56 ton/Ha. Based on this research, it was shown that the productivity of Ganoderma endemic land productivity could be restored through the provision of antagonistic microbes and arbuscular mycorrhizal fungi as well as PGPR and organic matter.

Performance of Agriculture Sector in Bali

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The agricultural sector has a multifunctional role in the development of a region. Bali Province is one of the provinces in Indonesia that uses rural areas as a gateway for the agricultural sector that supports the tourism sector. The contribution of the agricultural sector in 2020 is 15.09% of the GDP of the Province of Bali, number two of 17 sectors (the sector of providing accommodation, food and drink occupies the first position, which is 18.3 % The purpose of this study was to map the growth typology of each sector and evaluate the factors causing changes in the performance of the agricultural sector in Bali Province. The research was conducted in Bali Province, carried out purposively with the consideration that there had been an overly concerning increase in the conversion of agricultural land in Bali Province. The analysis used was Klassen Typology and ISM (Interpretative Structural Modeling). The results of this study were the agriculture, forestry and fisheries sectors were in quadrant II (developed but depressed sector). Judging from the ISM analysis, the factors that affect the performance of the agricultural sector in the short term were land conversion, reduced water discharge, and the decline in productive farmers; the medium term was the budget for the agricultural sector, agricultural subsidies and the synergy between agriculture and tourism. Meanwhile, for the long term, it was the application of new technology, the existence of subak, the orientation of the marketing system, and the strengthening of the agricultural agroindustry. Therefore, increasing the growth of the agricultural sector can be done through industry initiation for processing raw materials at least into raw materials, integration between regional regulations and awig-awig, and providing appropriate incentives for farmers.

Utilization of Mini Air Buds from the Bottom of Bp308 as A Prospective Seed to Support Sustainability and Increase Farmers Income in The Pupuan Robusta Coffee Area - Tabanan

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Coffee is one of the leading plantation commodities in the world trade. In Indonesia, coffee plantations are dominated by small-holder plantations, accounting for 96% of the total national coffee area. In Bali, small-holder coffee plantations, especially Robusta coffee, is being developed in the Mount Batukaru Belt. One of the obstacles to the sustainability of Robusta coffee is due to limit its seed availability. The use of mini watesopiar shoots from the rootstock of BP308 Robusta coffee as an innovation is one solution. This study aimed to support the availability of seeds by using water shoots as potential seeds that could provide added value to farmers income. The current research was conducted in the Robusta coffee area of Pupuan District in Tabanan of Bali during 2018 to 2020. The current research was designed with a paired experimental design. Data collection methods include direct observation and discussion as research supporting data. Data was collected and analyzed using t-test. The results showed that the seeds of existing technological innovations and the new innovations used were produced significantly increased wet weight, total seed, and dry weight of shoots at 42.14, 51.99 and 40.59% compared to control. Based on our results, we conclude that the added value from mini water shoots is Rp. 10,500.00 per tree. Conversion of this added value for each farmer with ownership of 0.3 – 0.8 hectares with 300-800 trees obtained an added value of Rp. 3,150.000,00 - 8,400,000.00 per farmer each year which is a great beneficial.

ABSTRACTS - ROOM 6

Linking Organic Agriculture with Agro Eco-Tourism - A Path to Sustainable Development

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Organic agriculture is a modern, holistic and sustainable form of agriculture focusing on improving soil health as well crop yield without harming natural environment. It works in synchronization with nature rather than against it. It offers a mixture of environment friendly practices which utilizes less resources and leads to contributing more yields. Agro eco-tourism is a mixture of eco-tourism and Agri-tourism. It not only involves visitors to participate in sustainable farming but also let them learn about social and eco-friendly causes behind it. Whether it's for leisure, education, or just curiosity, Agri-ecotourism has managed to attract both tourists; driven by the need for more sustainable solutions and has the potential to continue expanding in the future. In all under a symbiotic relationship organic agriculture and agro-ecotourism is only for goods production but rather it can become one of important service and may create economy experience within the tourism industry too.

Biodiversity Home Gardens: Potential Source for Global Food Security

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While land, water, air, fire, and sky being the basic elements of life on Earth, human endeavour and wisdom lie in their efficient management of these elements to create a hunger free and healthy environment not only for humans but also for other forms of life of plant and animal origin aquatic and terrestrial alike with a spirit of symbiosis i.e., 'Give to Receive' in equal, mutual, and reciprocal measure. Theory of relativity humbles all neither to claim big nor small, which eventually suggests establishing home gardens of typical biodiversity to create an eco-friendly environment conceptualized to 'Live and Let Live' culture and civilization. The creation and maintenance of home gardens to produce fruits and vegetables of diversity, serves to provide balanced, holistic, and nutritious food not only to the family but to the neighbourhood as well thereby bringing symbiotic relationship among humans and to trigger a chain reaction to set up home gardens extensively in the society. This eventually resolves the issue of food security across the world thereby driving out hunger. In this context, an attempt has been made to establish a home garden which turned out to be a source of recreation, hobby, efficient time management and pleasing pastime to the heart and soul which can be understood not simply by audio-visual expressions but by individual practice. The photos taken from my home garden as displayed to you, are self-speaking themselves to make you understand and appreciate the imperative need to establish home gardens of typical biodiversity worldwide. These gardens attract not only soil flora and fauna but also birds and predators which are beneficial to garden plants in the control of crop pests and diseases, so much so no synthetic fertilizers or pesticides which are harmful and poisonous to soil living phase, are used in preference to organic fertilizers such as compost and botanical extracts including PGPR based microbials produced less expensively right at the home garden. Bacteria known as Plant Growth-Promoting Rhizobacteria (PGPR) are diverse and represent a wide range of phyla. They also perform a wide variety of growth-promoting functions.

Valorisation of Fruit Peels of Pomegranate, Pineapple and Papaya for Antioxidant and Antimicrobial Activity

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The agriculture sector's demand keeps on rising, which indirectly linked to the agriculture wastes accumulation via post-harvest operation, transportation, wholesale, retail, storage, processing and packaging which has been one of the major challenges faced globally. Agricultural wastes contain diverse type of bioactive compounds. In the present study, several water-based extractions were analysed which involved maceration, digestion, infusion, decoction, percolation, Soxhlet, hydro distillation, steam-distillation, ultrasound-assisted and microwave-assisted extraction. The comparisons were based on the polyphenol content, antioxidant and antimicrobial activity of pomegranate peel (POMEP), pineapple peel (PINEP) and papaya peel (PAPAP). Throughout the study, various polyphenol compounds were identified in POMEP (ellagic acid and punicalagin), PINEP (ferulic acid, ascorbic acid and gallic acid) and PAPAP (tannin, coumarins and quercetin) that contributed for antioxidant and antimicrobial activities. In addition, the acceptable limit of radical

scavenging activities of POMEP, PINEP and PAPAP were 65%, 70% and 30% in water-based extractions, respectively. Lastly, numerous microbes were susceptible towards the studied extracts, this including pathogenic bacteria such as *Escherichia coli*, *Bacillus subtilis*, *Staphylococcus aureus* and *Salmonella typhimurium*. Hence, throughout the study, POMEP, PINEP and PAPAP revealed that water-based maceration, digestion, infusion, decoction, ultrasound-assisted and microwave-assisted extraction showed acceptable antioxidant and antimicrobial activities. Therefore, water-based extractions portrayed great potential to be assimilated into the market based on its antioxidant and antimicrobial potential and its non-toxic and environment friendly characteristics.

Evaluation of Natural Renewable Materials to Enhance Soil Microbial Populations to Control Plant Pathogens

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In modern agriculture there is an increasing interest in managing the naturally occurring antagonistic microbes in soil suppressiveness as an alternative measure to control plant pathogens and parasites. A suppressive soil would not only help to reduce agrochemical input, but also would stimulate microbial activity in nutrient cycling and plant growth enhancement. Such a system would provide an economically and environmentally safe alternative to some standard agricultural practices. Stimulation of soil microbial communities was accomplished in the past by incorporation of organic substrates into the soil such as wheat mash amendments, chitin, municipal solid waste, compost, sawdust, chicken manure, turkey manure, castor grind, green manure, velvet bean, kudzu and pine bark. However, effective rates of several tons per hectare made most of these organic amendments unsuitable for use in broad-scale agriculture. For practical use, effective rates far below 1 t/ha are required. Furthermore, the products should be broadly usable for soil application, as a soil drench, or in overhead and sprinkler irrigation. These requirements are met by products derived from renewable raw materials such as TerraPy®, Magic Wet® and Chitosan (Cognis Deutschland GmbH, Düsseldorf). The objective of this study was to investigate the effects of TerraPy®, Magic Wet® and Chitosan on the bacterial and nematode communities in the soil to enhance soil microorganism as an inducer of systemic resistance against plant pathogens. We have evaluated Chitin, Chitosan and its derivates to control plant pathogens. The three compounds TerraPy®, Chitosan and Magic Wet® significantly increased certain genera in the soil. Acinetobacter played a key role in the solubilization of phosphate in soils. The highest increase of Pseudomonas was observed following chitosan application. Some other non-identified bacteria contributed to plant growth and as an inducer of systemic resistance. The potential mode of action of Chitosan as an inducer of systemic resistance against Meloidogyne incognita was studied in tomato using a split-root system and foliar spray. Chitosan application to one-half of a split-root system caused a significant reduction of egg masses on the other side of the split root system. Similar results were achieved when Chitosan was applied as a foliar spray, indicating that a downward movement of signals associated with the resistance reaction occurs. It is concluded that TerraPy®, Magic Wet® and Chitosan contribute significantly to plant growth and health by stimulating soil microorganisms and thereby suppression of plant parasitic nematodes.

Activity of Andong Leaf Extract (*Cordyline terminalis* Kunth) as An Anti-Inflammatory Against Oedema of The Soles of Wistar Rats by Carrageenan Induction

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Andong (Cordyline terminalis Kunth) is a Balinese plant that has anti-inflammatory activity. This study aimed to evaluate the anti-inflammatory activity of andong leaf extract against carrageenan-induced edema on the soles of rats. In this study, inflammation was created by induction of carrageenan on the soles of Wistar rats. Furthermore, as many as 25 rats were divided into 5 treatment groups. Group I as a negative control was given distilled water, group II as a positive control was given diclofenac sodium at a dose of 4.5 mg/Kgbw, groups III, IV, and V as a test group were given ethanol extract of andong leaves with a dose of 150 mg/Kgbw each 300 mg/Kgbw, and 600 mg/Kgbw orally. Differences between treatment groups were tested by One way ANOVA. The results showed that there was maximum anti-inflammatory activity in the 6-hour period of giving the ethanol extract of andong leaves with each dose of 150 mg/Kgbw (36.36%±0.029), 300 mg/Kgbw (26.31%±0.201), and 600 mg/Kgbw (20.68%±0.157) with a significant difference ($p<0.05$) compared to the negative control (86.84%±0.092) and except for the 600mg/kg dose not significantly different from the positive control (22.22%±0.013). Based on these results, it can be concluded that the best dose in inhibiting inflammation is a dose of 600 mg/Kgbw

Enhancement of Bali Cattle Productivity with Corn Straw Amended with Molasis Containing Extracts of Leaves of Hibiscus

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This study was conducted to determine the productivity of Bali cattle that fed by corn straw with additional molasses containing *Hibiscus tiliaceus* leaf extract. The study was conducted for six months, with an average initial body weight of bulls 109.03 ± 32.55 kg. This study used a randomized block design with four treatments and five replications. The treatments were as follows: treatment A: bulls were given ad libitum corn straw; treatment B: bulls are fed with corn straw + 10 cc moladef / 1 liter of drinking water; treatment C: Bulls are fed corn straw + rice bran as much as 1% of body weight / head / day and treatment D: Bulls are fed with corn straw + rice bran as much as 1% of body weight / head / day + 10 cc moladef / liter of drinking water. The parameters measured include: (1) the content of bioactive compounds, (2) average daily weight gain (ADG), (3) feeds consumption, (4) feed conversion ratio (FCR) and (5) feeds digestibility. The results showed that the bulls that received treatment D had the highest ADG about 105.69 ± 25.90 g / head / day. This is in line with the highest feeds consumption at 3.10 ± 0.44 kg / head / day. For the lowest FCR value found in treatment B which is 29.12 ± 3.14. The digestibility of dry matter, crude fiber, energy and TDN in Bali cattle fed with additional rice bran (treatment C and D) was significantly higher than without rice bran (treatments A and B), but the feed digestibility between treatments C and D was not significantly different (P> 0.05). Among the treatments that were not given rice bran, treatment B had significantly

higher crude fiber digestibility (P <0.05) than treatment A. The results of the study concluded that the addition of molasses containing *Hibiscus tiliaceus* leaf extract was able to increase body weight gain and crude fiber digestibility in Bali cattle fed with corn straw based feed.

Effect Anthiperglycemic of Putri Malu (*Mimosa pudica* L) Leaf Ethanol Extract on Pancreas Histopathology in Hyperglycemic Male Rat Wistar

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This study is to determine the effect of Putri Malu (*Mimosa pudica* L) leaf ethanol extract in reducing glucose and histopathology pancreas change in hyperglycemic Wistar rats includes the maintenance of test animal, LCMS/MS, as well as experimental methods with direct post-test control group design. This has long been known to be typical by traditional people in curing various diseases such as diabetes mellitus. *Mimosa pudica* as a medicine that is able to overcome various diseases such as diabetes mellitus. Diabetes mellitus is a degenerative disease characterized by an above normal increase in blood glucose levels (hyperglycemia). Mimosa plants are known to have pharmacological activities such as antidiabetic, antitoxin, antihepatotoxin, antioxidant and wound healing. This study was aimed to find out the potential of the extract ethanol of mimosa leaves in lowering blood glucose levels against hyperglycemic Wistar rats and histopathology. Blood glucose reduction data was analyzed by ANOVA and post hoc LSD test to compare between groups. Blood glucose reduction test using 18 male Wistar rats induced with streptozotocin. The mice were divided into 6 different treatment groups consisting of P0 (normal control), P1 (group of streptozotocin induced negative control), P2 P3 P4 (streptozotocin induced group and with extracts of various doses of 25, 50, and 100 mg/kg BB/treatment group) and P5 (group of mice induced streptozotocin and given glibenkamid dose at 0.18 mg/kg/ treatment group). The results showed that the ethanol extract of mimosa leaves at a dose of 25, 50, 100 mg/kg BB could provide a decrease in blood glucose levels with an average blood glucose level after 14 days of administration *M. pudica*.. The results of statistical analysis showed ethanol extract of mimosa plant leaves with a dose of 100 mg/kg BB has the potential to significantly lower blood glucose levels ($p<0.05$) against negative control. LCMS/MS analysis showed that the ethanol extract of *M. pudica* plant leaves are suspected to contain 13 compounds that play a role in decreasing blood glucose levels including: Ethyl 4-amino-2-oxo-1,2-dihydro-5-pyrimidinecarboxylate,Phytosphingosine, Cyclohexylbenzene, p-cymene, 2,4,6-Tri(Tert-Butyl)Phenol, 4-Methyl-4-cyclohexene-1,2-dicarboxylic acid, Acetyl hexamethyl tetralin, Dihomo-γ-linolenic acid, N-{[(3S)-2-(L-Tyrosyl)-1,2,3,4-tetrahydro-3-isoquinolinyl]methyl}-L-phenylalanyl-L-phenylalanine, Bis(2-ethylhexyl) adipate, β,β-Caroten-4-one, (3β)-Cholest-5-en-3-yl acetate and Lutein. This reseach concludes that the ethanol fraction of Mimosa leaves can reduce protein levels in male Wistar hiperglicemic rats. The secondary metabolism phenol and phospholipid contained *M. pudica* leaves which contain antioksidant and histophatology determine with HE staining for pancreas of 18 Wistar rat indicates that there was a change from structural pancreas normal and hiperglicemis rat Wistar.

Innovation in The Use of Organic Input on Rice in Efforts to Create Food Safety - Case Study in Tabanan District

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Rice is one of the farming developed in Tabanan Regency. Of the total area of agricultural land in eight districts in Bali, 27.04% are in Tabanan Regency. Total rice production in Tabanan district in the last three years, was 188,446 tons each in 2018, in 2019 amounted to 158,757 tons and in 2000 as many as 142,846 tons. The production showed a decline. The decrease in farm productivity can be influenced by the use of inputs. Rice farmers have conventionally started to switch to the use of organic inputs through input processing technology innovations such as fermented organic fertilizers and the use of vegetable pesticides to combat disease. In addition, farmers land ownership is classified as narrow land. The awareness of farmers in providing healthy food is a strong motivation in producing rice with organic inputs. The research objective was to determine the efficiency of using rice farming inputs, in an effort to create food security. The research method was carried out in Tabanan Regency, in five farmer groups who manage their farms using organic fertilizers in Tabanan district. Data analysis using cost analysis, to determine the amount of input used in farming, acceptance analysis to determine the optimal amount of farm productivity and income. The results showed that the farmers had low land. The use of inputs was not efficient because farmers have not been able to use farm inputs according to the requirements of Indonesian national standards in an effort to create food security. R / C> 1 showed that rice farming innovations provided benefits to farmers.

Synthesis of Biofoam from Sago Waste as A Biodegradable Food Storage Candidates

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Research on the synthesis of bio foam from sago pulp has been carried out. This study aimed to obtain material to replace biodegradable plastics. The production of biofoam from sago pulp begins with characterizing the sago pulp and determining the optimum conditions for the biofoam polymerization process. The results of biofoam synthesis from the sago pulp waste showed the whiteness degree of biofoam raw material was 88.03%, biofoam water content ranges from 5.44-8.88%, biofoam density ranges from 0.27-0.30, water absorption from biofoam was around 0.35-0.66%, and grade biodegradability of 44.3%.

Evaluation of Fresh Cut Quality of Mango, Mangosteen and Rambutan Under Cold Storage Conditions

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Fresh-cut tropical fruit is a popular product because it is convenient, healthy, safe and of good quality. Fresh-cut fruits of different types produce different qualities during storage. Mango, mangosteen and rambutan are three tropical fruits that contain nutrients that are good for health. The physical characteristics of whole fruit to be processed and determined by their picking age, maturity stage, skin color, and texture. Fresh-cut mango preparation was carried out by peeling and cutting to a size of 4 x 4 x 2 while mangosteen and rambutan only removed the skin. Fresh-cut mango, mangosteen and rambutan was stored at cold temperature of 7±1°C in a plastic box and observed for 9 days. The quality attributes of fresh-cut fruit during storage that have been observed include acidity, vitamin C, moisture content, total dissolved solids, weight loss, texture, color differences and browning index. The results showed that changes in the quality of fresh-cut mango were faster than those of mangosteen and rambutan. Fresh-cut mango at cold storage only last 3 days, while mangosteen and rambutans last up to 6 days.

Detection of Specific Protein in Citrus Infected by Citrus Vein Phloem Degeneration Disease

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The main problem in citrus plantation is citrus vein phloem degeneration disease (CVPD) or citrus greening disease caused by a Gram-negative bacterium, *Liberibacter asiaticus* L. The disease is usually detected by using polymerase chain reaction (PCR) with the specific fragment of 16S rDNA as a primer. However, in this study we tried to use a specific protein that occurred as the result of infection. The protein from the leaves of citrus that was infected by the pathogen were isolated and then subjected to Sodium Dedocyl Sulphate Poly Acrylamide Gel Electrophoresis (SDS-PAGE). The result of this study showed two specific proteins from citrus leaves infected by CVPD. The specific protein that detected was 16 kDa and 66 kDa, however, there were no specific proteins detected from healthy plants. The specific proteins could be used to develop antibody to detect the CVPD by Elisa or Western Blotting.

Preliminary Comparative Phytochemical Screening of Stem Bark and Leaves of *Anthocephalus cadamba* Evaluating Antibacterial Activity

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Anthocephalus cadamba *(Roxb) Miq* is a Rubiaceae family tropical evergreen tree. It is commonly referred to as "kadamba." It was used in traditional medicine to treat fever, uterine problems, blood related illnesses, leprosy, diarrhoea, skin infections, and used to cure other ailments. The present work was to estimate preliminary phytochemical screening of bark and leaves extract of medicinal plant *Anthocephalus cadamba (Roxb) Miq by* using solvents like n-hexane. The standard methods were used for preliminary phytochemical screening of n-hexane extracts for bark and leaves shows positive result for steroid, terpenoid, cardiac glycoside, alkaloids, flavonoids, carbohydrate and triterpenes and significant antibacterial activity against the organisms: *Escherichia coli* and *Pseudomonas aeruginosa* cultures by agar well diffusion method. Zone of inhibition of bark extract for 20µl was 2 mm and for 40 µl was 4 mm, for *E. coli*, and bark extract for 20µl was 3 mm and for 40 µl was 5 mm, for *P. aeruginosa*, whereas, leaves extract for 20µl was 3 mm and for 40 µl was 6 mm, for *E. coli*, and bark extract for 20µl was 3.5 mm and for 40 µl was 7 mm, for *P. aeruginosa.* Results revealed the presence alkaloids, triterpenes and terpenoid possess antibacterial activity.

Validating Mutant *Rhizobium* for Volatile Compound Production by GCMS-ATD Analysis Suitable for Black gram Under Acid Soil Condition

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Legume –*Rhizobium* symbiosis is well known for its nodulation and symbiotic nitrogen fixation, which contributes >60 % of the total nitrogen fixed in terms of biological nitrogen fixation. Nodulation occurs mainly through host–rhizobia recognition mediated through the exchange of signaling molecules. Volatile organic compounds (VOCs) are the signal molecules produced by different rhizobacteria play an important role in plant microbe interactions directly or indirectly. These VOCs induce plant resistance to both biotic and abiotic stresses. In addition, these volatile organic compounds may also serve as marker compounds for the selective detection of bacterial species in the inoculated soil environment. In the present study, a *Rhizobium* mutant (VM1) was developed from the wild *Rhizobium* strain (VW) isolated from black gram nodules grown under acid soil condition. The stability of the rhizobial mutant (VM1) was test verified along with wild *Rhizobium* (VW) for its survival and plant infectivity. In order to validate the stability of the mutant, both the mutant and the wild rhizobial strains were analyzed for volatile organic compounds (VOCs) production at normal and acidic pH under *in vitro* by GCMS-ATD. In which butanoic acid, furan, 1-butanol, Acetic acid, alanine, benzene, 1-hexanol were found to be in common prissily reported for plant growth promotion; but the relative area percentage of the selected compounds were pronounced more in volatile blends of mutant than the wild strain. Benzothiazole, act as a signal molecule in legume - *Rhizobium* symbiosis, plant growth modulation and potent antimicrobials was observed in mutant strain alone in acidic ph. Therefore, the presence of benzothiazole may act as an early signal molecule initiating adhesion of mutant rhizobium towards black gram roots and resulted in enhanced nodulation under acidic pH condition.

Optimization of Oil, Surfactant and Cosurfactant Ethanol Extract of *Curcuma Xanthorriza* Rhizome Combination with *Andrographis paniculata* Stem Extract for Anti-Acne Drug

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The aim of this study was to develop optimal oil, surfactant and co-surfactant formulations in nanoemulsion for topical anti-acne. In this study we used a design and optimization using various doses of oils such as candlenut oil, sunflower oil, oleic acid oil, olive oil, virgin coconut oil, canola oil, grapeseed oil, rice bran oil and isopropyl myristate, surfactants (tween 80, tween 20, span 20) and cosurfactants (polyethylene glycol, propylene glycol) with self-nanoemulsifying system. The optimal formulation with characteristics for three independent variables involved were co-surfactant- (X3), surfactant- (X2), and oil- (X1). The results showed that the optimization of oil, surfactant and co-surfactant for topical anti-acne in nanoemulsion formulations was the use of isopropyl myristate, tween 80 and polyethylene glycol or propylene glycol. Formula 1 consisted of isopropyl myristate oil, tween 80 and polyethylene glycol with a composition of 1:5:1 mL; 1:6:1 mL; 1:7:1mL and 1:8:1 mL. The results of the emulsification time showed was 13.23, 27.64, 18.83, 21.14 seconds in a row according to the composition and % of transmission 97.7, 98.2, 98.1, 97.5 consecutively according to the composition. Formula 2 consists of isopropyl myristate oil, tween 80 and propylene glycol with a composition of 1:5:1 mL, 1:6:1 mL, 1:7:1 mL, and 1:8:1 mL. The result of emulsification time was 21.92, 28.16, 26.36, 29.84 seconds, respectively, and 97.7% transmission, 97.7, 98.4, 98.3 in a row according to the composition. The results of this study was concluded that the potential optimization of oil, surfactant and cosurfactant for topical anti-acne in nanoemulsion preparations were isopropyl myristate oil, tween 80 and polyethylene glycol and propylene glycol.

Percentage of Carcass, External and Internal of Crossed Village Chickens Maintained Free Range by Adding Levels of Dragon Peel Fruit Extract Through Drinking Water

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This research was aimed to study the effect of using dragon fruit peel juice in drinking water at the percentage of carcasses, external and internal organs of native chickens reared in free range. The study was carried out for 8 weeks in a completely randomized design (CRD) consisting of 4 treatments, 4 replications and each replication consisting of 5 animals with a total of 80 birds. Treatments were as follows: R0: without dragon fruit skin juice (JKBN); R1: 5% JKBN; R2: 4% JKBN and R3:15% JKBN in one liter of drinking water. Variables observed were percentage of carcass, external and internal organs offal. The results of the study obtained showed that the carcasses percentage of native chickens reared in free range

increased with the addition of 10% (R2) dan 15% (R3) dragon fruit feel extract (P<0.05), while the R0 and R1 treatments had no effect on the internal and external offal organs percentage of native chickens. It could conclude that giving 10% and 15% levels of dragon fruit peel extract through drinking water has a significant effect on the carcass percentage, while the use of 5%, 10% and 15% did not affect the percentage of external and internal offal organs of native chickens reared in free range.

Evaluation of Lignocellulolytic Fungal Consortium for Composting Sugarcane Bagasse, Filter Cake, and Manure

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Three lignocellulolytic fungal isolates, namely *Amblyosporium* sp, *Aspergillus* sp1 and *Aspergillus* sp2, were used as a consortium that has been tested for their ability to produce cellulase, hemicellulose, and ligninase enzymes. They were also used for making mixed compost from sugarcane bagasse, filter cake, and manure. Composting was carried out for 35 days in the compost home of State Agricultural Polytechnic of Pangkep. The experiment was carried out during the composting process of the consortium of lignocellulolytic fungi at the temperature of 32^{o}C-75^{o}C, with water content level of 12.58-30.32%, and pH level of 6.80-8.20. The 35-day lignocellulolytic fungal consortium was able to accelerate the composting process with C organic yield of 10.41-26.06%, C/N ratio of 9.00-22.00%, to increase nutrient contents of phosphorus 1.98%, magnesium 6866 ppm, and Sulphur 0.25%. The fungus consortium was able to accelerate the composting process effectively and can increase nutrient content in various composition in the composting media.

Sustainable Agriculture Development Strategy Based on Eco-Agro-Tourism on Subak Sembung in Denpasar City

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The agricultural sector is one of the potential sectors as a Bali tourism attraction based on cultural tourism. However, in its development, urban development has eroded the existence of rice fields in Bali. This is evident in terms of the conversion of paddy fields which continues to increase every year. Efforts to conserve subak in urban areas, in this case, Subak Sembung in Denpasar City generally have a bigger challenge because the movement of conversion of agricultural land (rice fields) which is intended to become non-agricultural is growing rapidly and is difficult to control. In an effort to support the sustainable agriculture program, the Bali government strives to maintain green belt areas in urban areas, especially the Subak Sembung area, Peguyangan Village, Denpasar City. Subak development in urban areas requires a synergy of tourism and agricultural development carried out by developing agro-tourism as well as ecotourism. This program is directed so that the people of Subak

have innovation and business diversification in their rice fields related to tourism development. Subak Sembung has great potential in the development of eco-agro-tourism in which Subak Sembung is not only limited to selling panoramic views of rice fields, jogging tracks, culture of rice cultivation, but also combined with modern recreation in the form of developing local culinary centers, camps, fishing ponds and others. The development of eco-agro-tourism is expected to support the program to control the conversion of paddy fields and increase farmers income from agriculture and tourism.

Evaluation of Textile Industry Wastewater Treatment as an Effort to Control River Water Pollution in Pringsurat District, Magelang Regency, Central Java

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The need for clean water is increase because of the growing population. However, poor management of water resources makes the amount of clean water decrease. The resulting textile industry waste comes from several process activities. Liquid waste produced by the textile industry generally has characteristics such as color, alkaline, high TSS, high BOD and some dyes are known to contain elements of chromium (Cr). The objective of this research is to evaluate the performance of textile industry waste treatment units as an effort in controlling river water pollution in Pringsurat Subdistrict, Magelang Regency, Central Java Province. The method of research analysis is quantitative and qualitative. Primary and secondary data collection is done by surveying and mapping methods. Primary data includes groundwater flow maps, river water and wastewater quality data with parameters BOD, COD, TSS, phenol, chromium, ammonia, sulfide. The results of this research would be the evaluation calculation between wastewater and river water quality. From the observation, it shows the appearance of unpleasant odors and the occurrence of discoloration of the body of the river. Constructed wetland with a combination of 2 types of plants, *Iris pseudacorus* and *Thypa angustifolia* will be used to control the wastewater.

Fermentation of Robusta Coffee (*Robusta coffea*) Using Termite Celulase Enzym to Improve Quality and Taste

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Research on the fermentation of Robusta coffee with termite cellulase enzymes has been carried out in Subak Pura Penggulu, Bongancina Village, Busungbiu District, Buleleng Bali, from end of May till end of December 2019. Observations were included physical quality, taste, caffeine and amino acid levels. The results showed that average yield of wet coffee beans was 51.95%, the yield of dry beans without skin (ose) was 18.42% where the 3-day fermentation time (R3) gave the best taste results with score of 83.50 which was classified as specialty coffee. which contain defect 13.4, moisture content 12.5, caffeine content 2, 21% w / w, acid content, oleic 51.146 ppm, α - linoleic acid: 0.585 ppm. Economically, fermented Robusta coffee for 3 days gave the highest profit compared to other treatments of Rp. 1,168,000.

Probiotics and Postbiotics: A New Approach to Understand and Manage Plant Microbe Interactions

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In the field of plant microbe interactions, probiotics are accepted as beneficial microorganisms that promote health and nutrient mobilization. Post-biotics are fermented products of plant beneficial microorganism that exerts specific growth promotion, biofortification of nutrients, and / or biocontrol, effects on crop plants. Few of such metabolites are hormones, organic acids, biosurfactants, short chain fatty acids, microbial cell fractions, cell free supernatant, functional proteins, extracellular polysaccharides, volatiles, and quorum sensing compounds. The use of symbiotic, prebiotics, probiotics and postbiotics are known to improve microbial diversity and soil health, ultimately effecting plant growth. We have isolated several epiphytic and endophytic bacteria from different sources and characterized for production of different postbiotic molecules mentioned above. Few potential bacteria were identified as *Bacillus subtilis*, *B. amyloliquefaciens*, *B. velezensis*, *B. mojavensis*, *B. cereus*, *Stenotrophomonas maltophilia*, *Pantoea allii*, *Pseudomonas lini*, *P. migulae* and *Rhizobium undicola* by 16srRNA sequence. Few selective strains were used for postbiotics production, plant growth and biocontrol studies. Hence, co-cultivation and formulation of compatible plant beneficial microorganisms and postbiotics should be the new approach to understand plant microbe interactions. Nevertheless, the information on agriculturally beneficial microorganisms is substantial, yet the approach of "biotics" salutary effect in soils and microbiome in agro-soil systems need to be explored further for sustainability.

Ethnobotany for Agritourism and Sustainable Food Resources: *Valuing Indigenous Plants*

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Addressing the increase of the world's population to 10 billion by 2050 requires an improvement of food production and nutrition locally and globally which cannot be achieved by only expanding industrial agriculture which reduces plant biodiversity. One potential approach to overcome this challenge is to combine between agritourism and food resources by integrating the philosophy of ethnobotany. This presentation will highlight the global state of edible indigenous plants (EIP) and explore the role of them as a part of Agri-tourism. The discussion will unlock the folk knowledge of the uses and practices of EIP as food resources and landscapers which could help support sustainable agriculture while ensuring better protection of the environment and the continued improve of its ecosystem services. To some extent, humans utilize only 150 of an estimated of 30,000 EIP worldwide, with only 30 plant species comprising most of our diets. Therefore, commercial uses of new plants/crops from indigenous or local plants have the potential to diversity of food production and better for local adaptation. Related to this, the advantages, the obstacles, and the risk of using indigenous plants will be reviewed. The goal of this synthesis is to support local food production and agritourism using indigenous plants in ecologically sustainable manner. This idea will provide important information for a wide range of user communities including scientists, conservation and development organizations, policymakers, and the public who has interest in biodiversity and tourism. However, enhanced collaboration among stakeholders is vital for the implementation of this concept.

PGPR and Bali - Ecotourism

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Bali is a province of Indonesia and the westernmost of the Lesser Sunda Islands, east of Java and west of Lombok. The province includes the island of Bali and a few smaller neighbouring islands, notably Nusa Penida, Nusa Lembongan, and Nusa Ceningan. The provincial capital, Denpasar, is the most populous city in the Lesser Sunda Islands and the second-largest, after Makassar, in Eastern Indonesia. The upland town of Ubud is considered Bali's cultural centre. The province is Indonesia's main tourist destination, with a significant rise in tourism since the 1980s. Bali is one of the most famous tourist destinations in the world, because of its natural beauty, agriculture, beaches, and culture. Various programs have been implemented in Bali to keep tourism sustainable. One of the concepts used to maintain Bali tourism is the concept of a sustainable agriculture ecotourism based on Balinese cultural values in the form of Tri Hita Karana, namely three concepts of harmony with God, humans, and nature. The organic garden villa concept is a concept developed in this research as a direct practice in collaboration with the Dewandaru Flora organic garden, by combining a natural

Balinese style villa with an organic garden. In planting of rice, vegetables and fruits in this organic garden, compost, liquid organic fertilizer and biopesticides are being used, where the ingredients are taken from agricultural waste from their own organic garden and cattle waste that is reared by themselves. For the use of biopesticides, *Piper caninum* extract is picked from the organic garden in the villa. All materials for the needs of guests in this villa are all taken from the organic garden contained in the villa. With a passion of Balinese culture, served with Balinese cuisine. Guests could enjoy the serenity of Bali's nature and organic food such as rice, vegetables, and fruit from our garden of the villa. As a courtesy, our villa resort will be surrounded by our own grown organic gardens. Guests could do Balinese-style organic gardening practices coupled with Balinese-style cooking practices. Among these, interested parties could do aromatherapy meditation with ingredients of Balinese plant spices and flowers raised from Luh's organic garden.

Agroforestry to Support Balinese Culture and Maintain Trees Protection Against Air Pollution

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The high rate of land conversion and deforestation could threaten the natural resources which support Balinese culture and reduce the capacity of the forest to maintain a healthy environment. It is speculated that agroforestry has an important environmental benefit to reduce air pollution and respiratory diseases. This study reviewed the importance of trees and forest cover in reducing air pollution which threatens public health, such as covid 19. The method employed in this review was collecting and understanding relevant articles using a search engine such as Google Scholar, Research Gate, Wiley online Library etc. **Keywords** for this search include; agroforestry, trees protection against air pollution, land conversion, deforestation, etc. This study found that the increasing number of respiratory infection diseases is closely related to the increasing air pollution which suggests that air pollution facilitates viral infections. Accordingly, forest cover should be increased to enhance the reduction of air pollution which resulted from the increasing fossil fuel combustion in road traffic. It is proposed that enhancing the production of tolerant crops in mixed culture with trees will maintain tree cover and agroforestry is becoming an important complement for the native forest in protecting people from air pollution and respiratory infection diseases.

Analyzation of Object Operation Area and Natural Tourist Attraction (ADO-ODTWA) Spots in The Coastal Area of Yeh Bakung Beach

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Tourism potential inside an area need to be turned up in terms of identification or inventory potential. Then, it will come into a basic foundation which will create a management strategy for tourism aspect. In this case, Yeh Bakung beach is one of the places that has some attractiveness. A coast itself

becomes a halter between shore and the sea. Despite of its role as a balancer, coast also has another function regarding aesthetic point. This point needs to be raised to create public preservation and welfare at the same time. Yeh Bakung beach not only becomes a tourist attraction, but also was used as a place for Melasti (Hinduism ceremony) by people outside Lalanglingah village. For the sake of all potencies within, then there are several analyses that need to be conducted. In this study The Analyzation of Object Operation Area and Natural Tourist Attraction (ADO-ODTWA) was conducted in Yeh Bakung beach near the Lalalinggah village of Tabanan district. The criteria of this process were divided into condition of the tourist object, market potential, accessibility, environment, public service, climate change, accommodation, facilities and infrastructure, availability of clean water, safety, and convenience of the object in relation of the object with other tourist attractions in carrying capacity of the area, adjustment of the visitors, marketing, and market share. After all the processes, Mekayu beach has potential that reach > 66.6%, and classified as a good or worthy spot. Due to this, the Yeh Bakung beach has potential to become an ecotourism spot in coastal area.

Sustainable Dry Agriculture System in the Citarum Upper Areas: Social, Economic and Environmental Problems

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The Citarum watershed is the most degraded in Indonesia. This is due to environmentally un-friendly agricultural practices in the upstream part, the expansion of vegetable crops into steep areas, and the destruction of forest areas. The management of the upstream watershed is the key to the sustainability of the overall watershed function. This paper aims to analyze the characteristics of agriculture in the upstream Citarum watershed and its impacts socially, economically, and environmentally. This study involved 500 farmers in 22 villages in 14 sub-districts in the administrative area of Bandung and West Bandung Regencies, West Java Province of Indonesia. The results from quantitative data analysis, enriched with qualitative information, were as follows: 1. Farmers are generally productive adults with low education (graduated from elementary school), cultivating the main vegetable commodity in a combination of monoculture and intercropping 2. Economic pressures and limited land have pushed farmers to cultivate state-owned forest and plantations using less environmentally friendly agricultural techniques 3. Farmer's behavior has an impact on increasing critical land, river pollution, landslides that cause silting and shortening the life of the Saguling reservoir. Structuring agricultural practices with environmentally friendly technology is the key that needs to be implemented immediately in the short term. Furthermore, building human resource capacity, curbing natural resource management, and utilizing social capital are being the long-term sustainable solutions to be addressed in the future.

Performance and Quality of Japanese Quail Eggs Treated with Fermented Dragon Fruit Peel (*Hylocereus* SP) Juice in Drinking Water

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This research aimed to study performance and quality of Japanese quail eggs given fermented dragon fruit peel (Hylocereus sp) juice in drinking water, which has been carried out for 10 weeks. The research design used was a completely randomized design (CRD) consisting of 5 treatments, each treatment with 4 replications and each replication consisted of 10 quails, total of 200 quails of 2-weeks-old. The treatments included were R0 = drinking water without dragon fruit peel juice; R1 = drinking water with 1% of dragon fruit peel juice, R2 = drinking water with 1% of fermented dragon fruit peel juice; R3= drinking water with 3% of dragon fruit peel juice, R4 = drinking water with 3% of fermented dragon fruit skin juice. Performance and the variables measured were performance and quality of Japanese quail eggs. The results of the study showed that treatment R2, R3 and R4 appears increased performance, body weight gain, final body weight, FCR and quality eggs weight, HU, eggs color of the quail significantly than R0 ($P<0.05$). It has concluded that the performance and eggs quality of Japanese quail received the treatment of 1% and 3% of fermented dragon fruit peel juice and 3% of dragon fruit peel juice in drinking water significantly increased body weight gain, final body weight, FCR and eggs quality, eggs weight, HU, eggs yolk color of the quail compared with treatment without being given fermented dragon fruit peel.

Analysis of Virgin Coconut Oil-Lemongrass Compared to Standard Quercetin by Gas Chromatography Mass Spectrometry

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Lemongrass as one of the plants with a distinctive smell, mixed with virgin coconut oil whose analysis is compared with standard quercetin as one of the suspected antioxidant compounds. The purpose of this study was to compare the content of compounds between virgin coconut oil and lemongrass at various mass ratios against standard quercetin. The analytical method used is Gas Chromatography Mass Spectrometry. The results of the standard quercetin analysis showed the presence of Fatty acid ethyl ester (FAEE) in the form of ethyl laurate and ethyl palmitate, and Benzenedicarboxylic acid at retention times of 11.7; 15.9; and 22.12 minutes, this compound was also contained in VCO-citronella at various mass ratios, as well as analyzed for other ethyl esters. This indicates that the VCO-Serai contains antioxidant compounds according to quercetin, with masses per ion (m/z) being 88 and 149.

Natamycin Treatment for Control of *Rhizopus* sp. Mold on Strawberries (*Fragaria virginiana)*

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Fragaria virginiana (strawberries) fruit has high economic value in food industry, which is discovered in Garut, West Java, Indonesia. However, problem on postharvest disease caused by *Rhizopus* sp. has not yet successfully resolved due to unavailable proper treatment methods of natamycin application. The aim of present study was to investigate the effects of natamycin concentration to control *Rhizopus* sp. mold. The natamycin was applied to the *F. virginiana* via dip coating method. The efficacy was observed by comparing with control samples. The natamycin concentration treatments used were 250 and 500 ppm. Total incidence caused by *Rhizopus sp.* and average weight of *F. virginiana* observed during the 7 days of storage at 25°C. The results showed that the *Rhizopus* sp. invasion at days 4 were 43, 30, 35, and 85 %, respectively. It is concluded that the natamycin treatment by dip coating preserved effectively at lower concentration.

Antioxidant Activity and Amino Acid Composition of Okara Protein Hydrolysate

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Okara is a by-product of soybean waste from the processing of tofu and soy milk. The remaining protein content in tofu dregs (okara) needs to be further utilized as a useful product. This study aimed to determine the ratio of enzyme-substrates (E/S ratio) capable of producing okara protein hydrolysate with the highest antioxidant activity, and also to determine the amino acid composition of the protein hydrolysate especially the content of amino acids type with the potential as antioxidants. The okara protein was isolated by the alkaline extraction method followed by isoelectric precipitation. The okara protein concentrate was then hydrolyzed with papain enzyme for 6 hours at 50-55°C and pH 7, and variations in E/S ratio were performed at 3%, 4%, 5%, 6%, and 7%. The okara protein hydrolysate was obtained then determined its antioxidant activity using the DPPH method. The results showed that the E/S ratio of 4% has the highest antioxidant activity of 98.86%. The results of the amino acid composition analysis showed the presence of amino acids that have the potential contributing antioxidant activity effects to the okara protein hydrolysate, namely L-Phenylalanine, L-Isoleucine, L-Valine, L-Glycine, L-Lysine, L-Tyrosine, and L-Proline. These results showed that okara protein hydrolysate has the potential to be used as a food ingredient with antioxidant activity.

The Effect of Seed Sounding with Suspension of Pseudomonas Alcaligenes and Bacillus Sp on Growth and Production of Bitter Melon (*Momordica charantia* L.) in Greenhouse

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This study aimed to determine the effect of soaking bitter melon seeds with a suspension of *Pseudomonas alcaligenes* and *Bacillus sp* bacteria on the growth and yield of bitter melon. This study used a Randomized Block Design with 11 treatments consisting of 3 types of suspension isolate *P. alcaligenes*, 4 isolates of *Bacillus sp*, 1 type of mixed suspension *P. alcaligenes*, 1 type of mixed *Bacillus sp*, 1 type of mixed *P. alcaligenes* with *Bacillus sp*, and 1 control, each of which was repeated 3 times so that there were 33 experimental pots. Data were analyzed using variance test with one-way ANOVA. The results showed that the highest number of fruits was found in Bacillus sp 1 treatment, which was 4.25 units, followed by mixed Bacillus sp. and Bacillus sp 2, every 4 units; while in the control as many as 2.75 units. The highest fresh weight per fruit was found in the treatment of P. alcaligenes TrN2 which was 89.25 g, followed by P. alcaligenes KtS1 which was 81 g, and Bacillus sp.4 which was 80.66 g, an increase of 34.57%, 22.13%, and 21.62% compared to the control.

The potential of Flavonoids in *Gyrinops versteegii* Tea Leaves as A Natural Antioxidant and Antibacterial

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Gyrinops versteegii leaves have a rich source of flavonoid that possess different biological and pharmacological activities. This study aimed at determining antioxidant and antibacterial activity value of flavonoid in water extracts of *G. versteegii* leaves. The methods for isolation flavonoids used in this study were extraction by maceration and partitioning, separation and purification by chromatography. Identification of compounds using UV-Vis and FTIR spectrophotometers and were assayed against to antioxidant activity with DPPH method and antibacterial activity with diffusion disc method. The highest total flavonoid content was found in ethyl acetate extract of 186,976 mg QE/100 g. The antibacterial activity test showed that ethyl acetate extract was the strongest extract in inhibiting the growth of S. *aureus* and *E. coli* with inhibition zone of 19- and 13-mm. Isolation, phytochemical screening, UV-Visible and FTIR spectroscopic identification showed that flavonoids were flavanols. Isolated flavanols have activity as a strong antioxidant's activity with IC_{50} = 60.27 ppm and strong antibacterial activity with inhibition zone of 33,82 mm towards *S. aureus* and 23,22 mm toward E. *coli*. This proved that tea of G. versteegi leaves with flavonoid flavanol has the potential to antibacterial and natural antioxidants.

Immuno-Modulators Perspective Inspired by Probiotic - a Review on Bovine Colostrum

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The Covid-19 pandemic is still a global problem that attracts the world's attention. Every effort is being made to eradicate the COVID-19. The countries are competing to find vaccines and drugs to overcome this COVID-19. Some prevention efforts are carried out by using immune modulators. Immuno-modulator is a drug or substance that has an effect on the immune system. One of the immuno-modulators used was bovine colostrum. Colostrum is the first secretion of the mammary gland produced after birth, differentiating itself from mature milk because it has a higher concentration of proteins, immunoglobulin-A, vitamins, minerals, bactericides (lactoferrin, lysozyme and lactoperoxidase) and growth factors. This review focuses on immune modulators from various characteristics and perspectives as an alternative in increasing the body's resistance. It also provides information on potential mechanisms. Therefore, this review facilitates the choice of a suitable immune enhancement for the prevention and treatment of Covid-19.

The Potential of the Punggualas Area as a Natural Tourism

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Nature tourism (ecotourism) has recently become new primadona in tourism development in line with increased lifestyle back to nature. The object of nature tourism in Punggualas region, Katingan regency, is well-known for its nature beauty, and there is higher and higher visit of domestic tourists, as a result of massive publication in social media. Unfortunately, the manager found many constraints to develop it. This study is intended to identify and analyze the attractiveness objects of the nature tourism in Punggualas region, Katingan regency, for ecotourism development. It was valuated based on ADO-ODTWA analysis established by the Directorate General of Forest Protection and Nature Conservation, whereas interests and potential stakeholders influencing the area management was approached using stakeholder's analysis. Results showed that first, the potency of Punggualasregion had high attractiveness for sustainable development as ecotourism area. Factors of high value were nature and its surrounding conditions, while factors with moderate value were tourist management and services, supporting facilities, and clean water availability. Factors of low value were accessibility and accommodation. Second, Infrastructures for ecotourism development, either directly or indirectly related with the ecotourism activities, were categorized as moderate, so that improvement efforts are still needed.

PGPR Based Phytohormones Play Critical Physiological Roles in Plant growth and Development Under Extreme Environments

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Gains associated with fertilizer inputs carried high environmental costs. Thus a bio-green revolution based on utilization of phytomicrobiome is required. Beneficial rhizobacteria are utilized to improve water and nutrient uptake during abiotic stresses. The microbiomes of plants native to extreme environments such as hypersaline, arid, and chilling, may be rich sources of stress-ameliorating microbes. Phytohormones released from PGPR are key players in regulating plant growth and development in response to environmental factors that otherwise become lethal when uncontrolled. Many rhizosphere bacteria are known to excrete hormones for root uptake or manipulate hormonal balance in the plants to boost growth and stress response. PGPR that produces auxins have been shown to elicit transcriptional changes in defense related and cell wall related genes, induce longer roots, increase root biomass, decrease stomata size and density, and activate auxin responsive genes that enhance plant growth. Many PGPR produce cytokinin and gibberellins, leading to increased plant shoot growth and enhanced root exudates production. Some PGPR have been shown to produce ACC deaminase, which decreases ethylene production in plants, leading to greater growth stimulation under stressful conditions. Although, PGPR have shown to enhance plant growth through hormonal action, but deep studies are yet to be carried out for understanding the roles of bacterially synthesized phytohormones.

Table 1. List of participants with abstracts

No	Name	Country	Title	Address
1	Abdul Gafur	Indonesia	Plant growth-promoting microbes (PGPM) in future management of Indonesian estate forests (5)	Sinarmas Forestry Corporate R&D Advisory Board Jalan Raya Minas, Perawang KM 26, Perawang, Riau 28772, Indonesia
2	Abeer Hashem	Saudi Arabia	Seed priming with *Bacillus subtilis* (Bera 71) to alleviate chromium toxicity in *Lycopersicon esculentum* Mill. (1)	Botany and Microbiology Department, College of Science, King Saud University, P.O. Box. 2460 Riyadh 11451, Saudi Arabia
3	Abhinav Aeron	India	Plant Growth-Promoting Potential of Commercial Product "Sanjeevni" (An anti-fungal agent) (4)	Department of Biosciences, DAV PG College, Muzaffarnagar, India
4	Abhisek Mathur	India	Nano-particle formulations of metabolites extracted from microbes with PGPR and pesticidal traits in lieu of sustainable and organic practices for agriculture (3)	Prathista Industries Limited, Telangana State, India
5	Adi Parwata	Indonesia	The Potential of Flavonoids Flavonol in Gyrinops versteegii Tea Leaves as a Natural Antioxidants and Antibacterial (6)	Chemistry Department, Faculty of Mathematic and Natural Science, Udayana University, Indonesia
6	Agung Wiwiek Indrayani	Indonesia	Optimization of oil, surfactant and cosurfactant ethanol extract of *Curcuma xanthorriza* rhizome combination with *Andrographis paniculata* stem extract for anti-acne drug (6)	Department of Pharmacology and Therapy, Faculty of Medicine, Udayana University
7	Alfi Inayati	Indonesia	Evaluation of *Trichoderma* species for production of enzymes, antagonistic ability and plant growth-promotion potential (2)	Indonesian Legume and Tuber Crop Research Institute
8	Ali Tan Kee Zuan	Malaysia	BENEFICIAL CHARACTERISTICS OF SALT-TOLERANT *BACILLUS ARYABHATTAI* IN REDUCING SALINITY EFFECT ON RICE (2)	Department of Land Management, Faculty of Agriculture, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia
9	Alka Sagar	India	Induced mutation in Erwinia sp. PR6 enhanced growth of finger millet var. CO14 under abiotic stress (2)	Department of Microbiology and Biotechnology, Meerut Institute of Engineering and Technology, Meerut, India
10	Amrutha V.	India	Phyto-stimulation of phosphate solubilizing fluorescence *Pseudomonas* on physiological and growth attributes of chilli (3)	Department of Microbiology, Acharya Nagarjuna University, Guntur 522510, A.P India and

11	Anand Dave	India	Effect of *Streptomyces* sp. and mycorrhizal strain on plant growth-promotion and protection of pigeon pea wilt caused by *Fusarium udum* Butler (1)	Department of Microbiology and Biotechnology Centre the Maharaja Sayajirao University of Baroda, Sayajigunj, Vadoadara-390002, Gujarat, India
12	Anne Nurbaity	Indonesia	Effect of Arbuscular Mycorrhiza and Magnetic Field on P Uptake, Ascorbic Acid Content, and Tomato Yield (*Lycopersicum escullentum*. Mill) Grown on Andisols (2)	Department of Soil Science, Faculty of Agriculture, Universitas Padjadjaran Jl. Raya Jatinangor km. 21 Sumedang 45363
13	Anto Budiharjo	Indonesia	Bioprospecting and bioformulation of *Bacillus altitudinis*-P10 as an environmentally friendly biopesticide against leaf blight caused by *Xanthomonas oryzae pv. Oryzae (1)*	Biotechnology Study Program, Faculty of Science and Mathematics, Diponegoro University, Jl. Prof. Sudharto SH, Semarang 50275, Indonesia.
14	Arunasri	Indonesia	Effect of *Trichoderma asperellum* GT_4 against stem rot of groundnut caused by *Sclerotium rolfsii* Sacc. (2)	Department of Plant Pathology, S. V. Agricultural College, ANGRAU, Tirupati, A. P. India
15	Arvind M. Deshmukh	India	Biofertilizers - an eco-friendly tool in agriculture to improve fertility of soil (1)	President, Microbiologists Society, India
16	Asmiaty Sahur	India	Response of Soybean (Glycine max) on biopriming applications with *Trichoderma harzianum* and Streptomyces sp.((2)	Department of Agronomy, Hasanuddin University, Makassar 90245, Indonesia
17	Awadhesh Kumar Pal	India	PGPR Based Phytohormones Play Critical Physiological Roles in Plant growth and Development Under Extreme Environments	Bihar Agricultural University, Sabour, Bhagalpur-813210, India
18	B.L. Geethu	India	Effect of organic and inorganic fertilizers on growth and fruit yield of bitter gourd (*Momordica charantia*) var: Preethi (1)	Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad, Utter Pradesh, India
19	Bambang Heri Isnawan	Indonesia	Intermittent Irrigation for Improvement of Rhizobacteria Population Dynamics and Rooting of Some Rice Varieties (*Oryza sativa* L.) (3)	Department of Agrotechnology, Faculty of Agriculture, Universitas Muhammadiyah Yogyakarta, Yogyakarta, Indonesia.
20	Bambang Supriyanta	Indonesia	Genetic Parameter Estimation Of Some Inodorus Melon Lines (*Cucumis melo* L.) On Generation S3 With Smart Farming Hidroponic System (5)	Fakultas Pertanian Universitas Pembangunan Nasional Veteran Yogyakarta
21	Betty Natalie Fitriatin	Indonesia	PGPR activity as a phosphate solubilizing bacteria influenced by different aciditic conditions (3)	Department of Soil Sciences and Land Resouces Management, Agriculture Faculty, Universitas Padjadjaran, Jatinangor, West Java, Indonesia

22	Boby Vattekkattu Unnikrishnan	India	Endophytic fungus *Aspergillus costaricensis* mediated growth and yield response in rice (5)	Department of Agricultural Microbiology, College of Agriculture, Kasaragod, Kerala Agricultural University, India
23	Bony Cyriac	India	Plant growth promoting rhizobacteria (PGPR) of the acidic saline soils of Pokkali rice (*Oryza sativa* L.) in Kerala, India (2)	Department of Agricultural Microbiology, College of Agriculture, Kerala Agricultural University, Thrissur, Kerala, India
24	Bowya	India	Rhizosphere engineering of rice to harness the plant-growth promoting *Pseudomonas chlororaphis* for effective colonization and soil health improvement (3)	Department of Agricultural Microbiology, Thanthai Roever Institute of Agriculture and Rural development, Perambalur- 621 115, Tamil Nadu, India
25	Chandra Kant Sharma	India	*Agele marmelos* loaded polymeric nanoparticles evaluation against carbon tetrachloride induced toxicity (3)	Faculty of Agriculture, College of Agriculture, Parul University, Limda Vadodara (Gujarat)-391760, India
26	Chotimatul Azmi	Indonesia	Effect of seaweed extract amended with endophytic microbes in chili growth (4)	Indonesian Vegetables Research Institute. Jl. Tangkuban Perahu No. 517 Lembang, West Bandung, West Java, Indonesia, 40391, Indonesia
27	Dadan N. Ramdani	Indonesia	Indigenous microbials as liquid organic biofertilizers to enhance the rice growth and productivity (1)	Agrotechnology Program Study of Agricultural Faculty – Universitas Majalengka –Majalengka West Java, Indonesia
28	Darwis Suleman	Indonesia	Isolation and identification of potential bio-inoculants based on phosphate solubilizing molds from different plant rhizospheres (3)	Departement of Soil Science, Faculty of Agriculture, Halu Oleo University, Kendari
29	Deden D. Eris	Indonesia	Biotechnology Based Replanting for the Improvement and Sustainability of Oil Palm Productivity in Ganoderma Endemic Land (5)	Indonesian Research Institute for Biotechnology and Bioindustry, Jl. Taman Kencana No.1 Bogor 16128
30	Deepika sahu	India	Effect of NPK and organic manures in growth and yield of flowers in *Dahlia variablis* L. (5)	Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, India
31	Desak Ketut Tristiana Sukmadewi	Indonesia	Inoculation of *Aspergillus costaricaensis* and *Staphylococcus pasteuri* Mutants to Increase the Microbes Population and the Availability of Phosphorus and Potassium in soil (3)	Agrotechnology Department, Faculty of Agriculture, Warmadewa University, Terompong street 24, Denpasar 80239, Indonesia

32	Dewa Ngurah Suprapta	Indonesia	Potential of rhizobacteria as bio-agents for sustainable crop production in Bali (1)	Laboratory of Biopesticide, Faculty of Agriculture, Udayana University, Bali, Indonesia
33	Dian Astriani	Indonesia	Utilization of Soapberry fruit extract as a natural surfactant in Cashew nut shell liquid bioinsecticide formulation for Soybean pest management (2)	Agrotechnology Study Program, Faculty of Agroindustry, Mercu Buana University Yogyakarta, Indonesia
34	Didi Rahmanto	Indonesia	Influence of Liquid organic biofertilizer (LOB®) as PGPR in rice (*Oryza sativa*) and sweet corn (*Zea mays* saccarata) production (1)	Head of Liquid Organic Biofertilizer R&D, Great Giant Pineapple Company (GGPC). Lampung. Indonesia
35	Dinata	Indonesia	Enhancement of Bali cattle productivity with corn straw amended with molasis containing extracts of leaves of *Hibiscus* (6)	Assessment Institute for Agricultural Technology Jl. By Pas Ngurah Rai Pesanggaran, Denpasar-Bali
36	Dinesh Singh	India	Biological control of bacterial wilt of tomato through plant growth-promoting rhizobacteria (1)	Division of Plant Pathology, Indian Agricultural Research Institute, New Delhi -110012, India
37	Dissanayake	Sri Lanka	Use of selected rhizosphere bacteria as bio-inoculants in organic rice cultivation (3)	Sustainable Agriculture Research and Development Centre, Makandura, Gonawila, Sri Lanka
38	Dwi N. Susilowati	Indonesia	Characteristics and potency of culturable bacteria from tidal swamp soils in South Kalimantan and lowland swamp soils in South Sumatra, Indonesia (3)	Indonesian Center for Agricultural Biotechnology and Genetic Resources Research and Development, Jl. Tentara Pelajat 3A Bogor 16111, West Java, Indonesia
39	Elly Roosma Ria	Indonesia	PGPR Bamboo Roots to Increase Growth and Yield of Peanuts DM-1 Situraja Variety (1)	Faculty of Agriculture, University of Winaya Mukti, Sumedang, Indonesia
40	Ema Lindawati	Indonesia	Effect of *Micrococcus* sp. to promote Pineapple rooting (1)	Product & Development Department, Research & Development PT. GGP, Jl. Lintas Timur KM.77, Lampung Tengah, 34165, Indonesia
41	Endah Wahyurini	Indonesia	GROWTH AND YIELDS OF THREE TOMATO STRAINS (*Lycopersicum esculentum* Mill) WITH VARIOUS DOSAGE OF *Trichoderma* sp. (5)	Agrotechnology, University of Pembangunan Nasional "Veteran" Yogyakarta, Indonesia
42	Erna Rusliana M. S.	Indonesia	SYNTHESIS OF BIOFOAM FROM SAGO WASTE AS A BIODEGRADABLE FOOD STORAGE CANDIDATES (6)	Department of Agricultural technology, Universitas Khairun
43	Erny Yuniarti	Indonesia	Effect of heavy metal-tolerant microorganisms on growth narra seedlings (1)	Soil Research Institute, Indonesian Agency of Agricultural Research and Development, Indonesia

44	Etty Handayani	Indonesia	Shoots Induction of Chrysanthemum on Foliar Fertilizer Media Combined with Coconut Water and Plant Puree by In Vitro Culture (1)	Department of Agrotechnology, Faculty of Agriculture
45	Etty Pratiwi	Indonesia	Isolation, Screening and Biochemical Characterization of Methane-Utilizing Bacteria from Sediment of Lowland Rice	Indonesian Soil Research Institute, Bogor 16114, Indonesia
46	Fikrinda	Indonesia	Recovering soil quality of elephant grass cultivated suboptimal land by mycorrhizae and organic fertilizer (1)	Department of Soil Science, Universitas Syiah Kuala, Jl. Tgk.. Hasan Krueng Kalee No. 3, Banda Aceh, 23111, Indonesia
47	Fiqriah Hanum Khumairah	Indonesia	Abundance of Halotolerant Nitrogen Fixing Rhizobacteria, C-organic of Soil, Chlorophyll Content and Growth of Rice Plants due to Different composition and dosage of organic ameliorant on saline ecosystems (3)	Environmental Management Study Program, Department of Agricultural Management, Polytechnic of Agriculture Samarinda, Jl. Samratulangi, Sei Keledang, Samarinda, East Kalimantan, 75131, Indonesia
48	G. Swapna	India	Bacterial biostimulants: revitalization of plant and soil health (1)	Lecturer in Botany, DRG Government Degree College, Tadepalligudem, West Godavari District-534101, Andhra Pradesh
49	Gururaj Sunkad	India	Significance of Plant Growth Promoting Microorganisms for the Integrated Management of Plant Diseases (1)	Department of Plant Pathology, University of Agricultural Sciences, Raichur-584101, India
50	Gusti A.M.K. Dewi	Indonesia	PERFORMANCE AND QUALITY OF JAPANESE QUAIL EGGS TREATED WITH FERMENTED DRAGON FRUIT PEEL (*Hylocereus* sp.) JUICE IN DRINKING WATER (6)	Poultry Science Laboratory Faculty of Animal Science, Udayana University, Bali- Indonesia
51	H. B. Singh	India	Recent advances in PGPR: commercialization, regulatory requirements and IPR issues (3)	Department of Biotechnology, GLA University, Mathura-281406, India
52	Hameeda Bee	India	Probiotics and postbiotics: a new approach to understand and manage plant microbe interactions (6)	Department of Microbiology, UCS, OU, Hyderabad
53	Haseena	India	A comparative study of the PGPR population and its enzymatic activities in the flood and non-flood affected regions of Kerala, India – a case study (1)	Department of Agriculture and Microbiology, Kerala Agricultural University, Vellanikara, Thrissur, Kerala, India
54	Haslina	Indonesia	Influence of the ratio of methanol and concentration of methanol with ultrasonic-assisted	Faculty of Agricultural Technology, Semarang University, Semarang 50196, Central Java,

			extraction on the phytochemical content in cornsilk extracts (1)	Indonesia
55	Hendri Bustamam	Indonesia	The efficacy of the organic fertilizer formula of the decomposer microbial and biological agents consortium on the growth and reduction of leek soft rot (1)	Department of Plant Protection, Faculty of Agriculture, University of Bengkulu. Jl. WR Supratman Bengkulu.
56	Henny Hendarjanti	Indonesia	Influence of Arbuscular Mycorrhiza Fungi and *Trichoderma* spp. to control basal stem rot disease in oil palm (2)	PT. Astra Agro Lestari Tbk. Jl.Pulo Ayang Raya Blok OR/I Pulogadung Industrial Area, East Jakarta 13930
57	Herlina Tarigan	Indonesia	Sustainable dry agriculture system in the Citarum upper areas: social, economic and environmental problems (6)	Indonesian Center for Agricultural Socio-Economic and Policy Studies, Jln. Tentara Pelajar No.3B Cimanggu, Bogor, Jawa Barat, Indonesia
58	Hersanti	Indonesia	Biocontrol of root-knot caused by *Meloidogyne* spp. in tomato by *Bacillus subtilis* and *Lysinibacillus* sp. formulated with graphite and silica nanoparticles (1)	Department of Plant Pests and Diseases, Faculty of Agriculture, Universitas Padjadjaran, Jln. Raya Bandung-Sumedang Km 21, 45363, West Java, Indonesia
59	Hesham Ali El Enshasy	Malaysia	Industrial production of Nitrogen Fixing Bacteria in High Cell Density Culture: Challenges and Platform Design. (4)	Institute of Bioproduct Development (IBD), Universiti Teknologi Malaysia (UTM), Skudai, Johor, Malaysia.
60	I Gede Ketut Adiputra	Indonesia	Agroforestry to support Balinese culture and maintain trees protection against air pollution (6)	Department of Biology, Faculty of Information Technology and Sciences, University of Hindu Indonesia Denpasar. Jl. Sangalangit, Tembau, Penatih, Denpasar, Bali, Indonesia
61	I Gusti Agung Ayu Putu Swastini	Indonesia	Antibacterial effects of various concentrations of natural ingredients of Snail Mucus (*Achatina fulica*) against inhibition zones of *Fusobacterium nucleatum* causes Periodontitis *in vitro* (2)	Health Polytechnic of Denpasar
62	I Gusti Ayu Lani Triani	Indonesia	Use of plant growth-promoting rhizobacteria in vegetables as an environmentally friendly cultivation (1)	Faculty of Agricultural Technology, Universitas Udayana, Badung, Bali, Indonesia
63	I Nengah Simpen	Indonesia	Green Nano-Composite of CaO/K-Sulfated TiO2 and Its Potential as Single-Step Reaction Solid Catalyst into Biofuel Production (3)	Department of Chemistry, Faculty of Mathematics and Natural Sciences, Udayana University, Kampus Bukit Jimbaran, Badung-Bali, Indonesia

64	I Nyoman Rai	Indonesia	Isolation and identification of indigenous endomycorrhiza in Cocoa plantation and its propagation by giving water stress and different planting media to develop as a biofertilizer (2)	Faculty of Agriculture Udayana University, Denpasar, Bali.
65	I Putu Sudiarta	Indonesia	Disease and pest management of cabbage using compost, *Trichoderma* sp. and *Bacillus thuringensis* in Pancasari Village, Buleleng Regency, Bali (1)	Faculty of Agriculture, Udayana University, Indonesia Jl. Panglima Sudirman, Denpasar, Bali, Indonesia
66	I Putu Wirya Suputra	Indonesia	Molecular and Morphological identification of *Aschersonia* sp. Infected Whitefly on Citrus and Mulberry Plants (4)	Faculty of Agriculture, Udayana University, Indonesia Jl. Panglima Sudirman, Denpasar, Bali, Indonesia
67	I Wayan Suardika	Indonesia	SUSTAINABILITY AND POLICY DIRECTION OF SOCIAL FORESTRY MANAGEMENT IN YEH SUMBUL VILLAGE OF JEMBRANA REGENCY (5)	Faculty of Agriculture Udayana University
68	I Wayan Sudarma	Indonesia	FERMENTATION OF ROBUSTA COFFEE (*Robusta coffea*) USING TERMITE CELULASE ENZYM TO IMPROVE QUALITY AND TASTE (6)	Assessment Institute for Agricultural Technology of Bali, By Pass Ngurah Rai, Pesanggaran, South Denpasar, 80222, Bali
69	I Wayan Sunanjaya	Indonesia	Utilization of mini air buds from the bottom of Bp308 as a prospective seed to support sustainability and increase farmers income in the Pupuan Robusta Coffee area - Tabanan (6)	Assessment Institute for Agricultural Technology, Bali, Indonesian Agency for Agricultural Research and Development (IAARD), Ministry of Agriculture, Jalan Bypass Ngurah Rai, Pesanggaran, Denpasar, Bali, 80222 (INDONESIA)
70	I Wayan Wijana	Indonesia	Percentage of Carcass, external and internal of crossed village chickens maintained free range by adding levels of Dragon peel fruit extract through drinking water (6)	Poultry Science Laboratory, Faculty of Animal Husbandry, Udayana University, Denpasar
71	I. B. G. Darmayasa	Indonesia	Liquid Organic Fertilizer Formulation Based on Potential Microbial Consortium in Growth of Mustard Greens (*Brassica juncea* L.) (1)	Department of Biology, Faculty of Mathematics and Natural Sciences, Udayana University, Denpasar, Bali
72	Ida bagus Ketut widnyana Yoga	Indonesia	Isolation of β-carotene in non-polar fraction of *Gardenia jasminoides* Ellis leaves extract (6)	Staff at Food Analysis Laboratory, Agriculture Technology Faculty, Udayana University, Bali-Indonesia

73	Ifra Zoomi	India	PGPR in Mitigation of Abiotic and Biotic stress in plants (2)	Sadasivan Mycopathology Laboratory, Department of Botany, University of Allahabad–211002, UP, India
74	IGA Ayu Dharmawati	Indonesia	Utilization of rhizosphere earthworm extracts for sustainable food(3)	Politeknik Kemenkes Denpasar, Bali, Indonesia
75	Iin P. Handayani	USA	Ethnobotany for Agritourism and Sustainable Food Resources: Valuing Indigenous Plants (6)	Murray State University, Kentucky, USA
76	Jafar Nabati	India	Biofertiliser Containing Plant-growth-promoting Rhizobacteria on Chickpea (*Cicer arietinum* L.) Plant Growth and Yield (1)	*Department of Legume Research Center for Plant Sciences, Ferdowsi University of Mashhad, Mashhad, Iran.*
77	Jagadeesh Reddy	India	Hands on experiences in PGPR based natural farming for 21st Century sustainable agriculture in Chittoor District of Andhra Pradesh, India (1)	Danduvaripalli, Chittoor District, AP., India and Asian PGPR Society for Sustainable Agriculture, Auburn University, USA
78	Jean W. H. Yong	Swedden	Understanding the role of biostimulants in photosynthesis, nutrition, and growth of plants (1)	Department of Biosystems and Technology, Swedish University of Agricultural Sciences, Alnarp, Sweden
79	Jitendrakumar Patel	India	Linking organic agriculture with agro eco-tourism - a path to sustainable development (6)	AsiaGreen Biocrops, Kani GIDC.Bardoli.394350, India
80	K. R. K. Reddy	India	Crop microbiomes - modification and optimization for improved crop productivity (3)	Prof. Bir Bahadur centre for crop Microbiome and Nano research, Sri BioAesthetics Pvt.Ltd. Hyderabad, India
81	K. Yella Reddy	India	Climate smart agricultural water management best practices, policy framework and way forward (5)	Dean, ANGRAU and Vice President Hon., ICID, AP., India
82	K.S. Sudirga	Indonesia	Biological Control Crude Leaf Extract of *Ficus septica* to *Colletotrichum gleosporioides* Causes of Anthracnose Disease in *Carica papaya*	Department of Biology, Faculty of Mathematics and Natural Science, University of Udayana, Campus Bukit Jimbaran Bali, Indonesia
83	K.V.S.S. Sairam	India	Prathista 's 5-G agri-inputs for total crop management (5)	Prathista Industries Limited, Telangana State, India
84	Ketut Ratnayani	Indonesia	Antioxidant activity and amino acid composition of okara protein hydrolysate (6)	Chemistry Department, Faculty of Mathematic and Natural Sciences, Udayana University, Jimbaran, Bali, Indonesia
85	Ketut Widnyana	Indonesia	Isolation of β-carotene in non-polar fraction of Gardenia jasminoides Ellis leaves extract (6)	Staff at Food Analysis Laboratory, Agriculture Technology Faculty, Udayana University, Bali-Indonesia

86	Komang Dean Ananda	Indonesia	Analyzation of Object Operation Area and Natural Tourist Attraction (ADO-ODTWA) spots in the coastal area of Yeh Bakung beach (6)	Agrotechnology Study Program, Faculty of Agriculture and Business, Universitas Mahasaraswati, Denpasar
87	Krishna Sundari Sattiraju	India	Explorations with Trichoderma beyond biocontrol and plant growth-promotion (1)	Plant and Microbial Biotechnology Group, Biotechnology Department, JIIT, NOIDA, 201307, U. P. India
88	KRS Sambasiva Rao	India	Scope and prospects of organic farming in Northeast India (1)	Mizoram University (A Central University), Aizawl, Mizoram, India
89	Kumari Sunita	India	Plant growth-promoting rhizobacteria (PGPR): a potential role in crop improvement and sustainable agriculture (1)	Plant Physiology, Biochemistry and PGPR Lab, Department of Botany, DDU Gorakhpur University, Gorakhpur, U.P., India
90	L. Suriati	Indonesia	EVALUATION OF FRESH CUT QUALITY OF MANGO, MANGOSTEEN AND RAMBUTAN UNDER COLD STORAGE CONDITIONS (6)	Department of Food Science and Technology, Agriculture Faculty, Warmadewa University, Denpasar, Bali, Indonesia
91	Lakshmi Prasad Mekala	India	Enhanced mycorrhiza colonization in presence of Biochar (2)	Sujay Biotech Pvt. Ltd., 19A, 3rd Road, III Phase, Jawahar Autonagar, Vijayawada, India
92	Lakshmikantha Pothireddy	USA	BIODIVERSITY HOME GARDENS: POTENTIAL SOURCE FOR GLOBAL FOOD SECURITY (6)	2211 Colony Woods Dr, Apex, NC, USA
93	Laksmita Prima Santi	Indonesia	Development technology and commercialization of PGPR to improve relationship between above and below ground biodiversity (4)	Indonesian Research Institute for Biotechnology and Bioindustry, PT Riset Perkebunan Nusantara, Jl. Taman Kencana No.1 Bogor ,16128, Indonesia
94	Lalit Kumar	India	Plight of biofertilizer scientists and entrepreneurs to review world vide biofertilizer regulations (1)	205 Samata Colony, Raipur City, Chhattisgarh, India and Founder
95	Loekas Soesanto	Indonesia	Aplication of Two *Pseudomonas fluorescens* Isolates Secondary Metabolites to Control Bacterial Wilt in Potato (1)	Faculty of Agriculture, Jenderal Soedirman University Jl. dr. Suparno, Karangwangkal, Purwokerto 53123.
96	Luh Putu Kirana Pratiwi	Indonesia	Sustainable agriculture development strategy based on eco-agro-tourism on Subak Sembung in Denpasar City (6)	Agribusiness Study Program, Faculty of Agriculture and Business Mahasaraswati University Denpasar
97	Luluk Setyaningsih	Indonesia	The dependence of trembesi (*Samanea saman*) and johar (*Cassia siamea*) seedlings on arbuscular mychorriza fungi in gold mine tailings media(2)	Faculty of Forestry, Nusa Bangsa University, Jl. Baru Km 4, Tanah Sareal, Bogor. Indonesia. 16166

98	M. Khais Prayoga	Indonesia	Enriched *Azolla* extract as liquid biofertilizer to increase the resilient of a rice farming on flooded prone coastal area as a strategy for adapting to climate change (1)	Research Institute for Tea and Cinchona, Bandung, Indonesia
99	M.Gnanachitra	India	Validating mutant *Rhizobium* for volatile compound production by GCMS-ATD analysis suitable for blackgram under acid soil condition	Dept.of Agrl. Microbiology, Tamil Nadu Agricultural University, Coimbatore, India
100	Mabena	Africa	Characterization and activity of plant growth-promoting rhizobacteria in sweet potato production in south Africa (1)	Department of Plant and Soil Sciences, Faculty of Natural and Agricultural Sciences, University of Pretoria, South Africa
101	Made Pharmawati	Indonesia	Importance of CTAB DNA plant extraction assay for *Streptomyces* DNA extraction (4)	Biology Department, Faculty of Mathematics and Natural Sciences, Udayana University, Kampus Bukit Jimbaran, Bali
102	Made Ria Defiani	Indonesia	Effect of eco-enzyme on germination of mung bean (*Vigna radiata*) (1)	Biology Department, Math and Basic Sience Faculty, Udayana University
103	Mahendra Bairwa	Indonesia	Effect of plant growth regulators and micronutrients in quality of Strawberry (*Fragaria* X *Ananassa* Duch.) cv. chandler (1)	Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, U.P. India
104	Markus Susanto	Indonesia	Potential of organic waste as a source for plant growth-promoting rhizobacteria (1)	Managing Director, PT. Maggot Indonesia Lestari – Bioconversion & Derivatives Product of Black Soldier Fly Farming.
105	Marwan Khalis	Indonesia	Evaluation of textile industry wastewater treatment as an effort to control river water pollution in Pringsurat district, Magelang Regency, Central Java (6)	Departement of Environmental Engineering Faculty of Mineral Technology Universitas Pembangunan Nasional Veteran Yogyakarta, Indonesia 55283
106	Meenu Saraf	India	Essential role of phytohormones and osmolytes in balancing abiotic stress in plants (2)	Department of Microbiology and Biotechnology, University School of Sciences, Gujarat University, Ahmedabad – 380 009, India
107	Meitini Wahyuni Proborini	Indonesia	The role of Arbuscular Mycorrhizal Fungi (AMF) native to Bali in acceleration growth of Cashew (*Anacardium occidentale* L.) seedlings (2)	Laboratory of Mycology, Department of Biology faculty of Basic Science University of Udayana Bali
108	Mieke Rochimi Setiawati	Indonesia	Efficacy of halotolerant N-fixing bacterial isolates on biochemical activity, bacterial population and	Soil Science Department, Faculty of Agriculture, Padjadjaran University, Jl. Raya

			N-uptake in rice seedlings (5)	Bandung Sumedang KM. 21, Jatinangor, Sumedang Regency, West Java, 45363, Indonesia
109	Mohd Aamir Khan	India	Microbial formulation technology for the remediation of explosives contaminated soil (4)	Centre for Rural Development & Technology, Indian Institute of Technology Delhi, Hauz Khas, New Delhi 110016
110	Muh. Akhsan Akib	Indonesia	EXPLORATION AND PROPAGATION OF NATIVE ENDOMYCORRHIZA TOLERANCE TO HEAVY METAL ON VARIOUS ORGANIC CULTURE MEDIA (2)	Universitas Muhammadiyah Parepare, Parepare, Indonesia
111	Mui-Yun Wong	Malaysia	Induced systemic resistance and antibiotic production by microbial biofungicides (2)	Department of Plant Protection, Faculty of Agriculture, Universiti Putra Malaysia, Serdang, Selangor, Malaysia
112	Mulawarman	Indonesia	Evaluation of natural renewable materials to enhance soil microbial populations to control plant pathogens (6)	Plant Protection Department, Agriculture Faculty, Sriwijaya University, Jl. Raya Palembang - Prabumulih Km. 32 Indralaya, OI, Sumatera Selatan 30662
113	Muthusamy Nithya	Malaysia	Evaluation of different indigenous *Streptomyces* spp. for the biological control of Rhizome rot disease of turmeric (*Curcuma longa* L.) in India (1)	Research and Development Centre, Bharathiar University, Coimbatore - 641 046, Tamil Nadu, India
114	N. W. Bogoriani	Indonesia	Activity of Andong leaf extract (*Cordyline terminalis* Kunth) as an Anti-inflammatory against Oedema of The Soles of Wistar Rats by Carrageenan induction (6)	Depatment of Chemistry, Faculty of Mathematic and Natural Science, University of Udayana. Jl. Kampus Jimbaran Badung , Bali 80362, Indonesia
115	Narasimha Rao	India	Biocontrol efficacy of *Gliocladium virens* and *Trichoderma harzianum* against *Sclerotium rolfsii* Sacc. a causal agent of collar rot of field bean (2)	Department of Plant Pathology, College of Horticulture, Dr. YSRHU, V.R. Gudem
116	Narendra Kumar	India	Effect of chemical fertilizers and biofertilizers on growth and yield of Dahlia (*Dahlia variabilis* L.) cv. Kenya orange (1)	Department of Horticulture, Naini Agricultural Institute Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, India
117	Ni Luh Suriani	Indonesia	PGPR and Bali - ecotourism (6)	Udayana University, Mathematics and Natural Sciences Faculty, Biology Study Program, Indonesia

118	Ni Made Delly Resiani (2)	Indonesia	Effect of *Trichoderma* sp. against *Alternaria porri* in red onion (2)	Assessment Institute for Agricultural Technology, Bali, Indonesia
119	Ni Made Suaniti	Indonesia	Analysis of Virgin Coconut Oil-Lemongrass compared to standard quercetin by Gas Chromatography Mass Spectrometry (6)	Chemistry Department, University of Udayana, Campus Bukit Jimbaran, Badung 80361 Bali, Indonesia
120	Ni Putu Sukanteri	Indonesia	INNOVATION IN THE USE OF ORGANIC INPUT ON RICE IN EFFORTS TO CREATE FOOD SAFETY - Case Study in Tabanan District (6)	Agribusiness Study Program, Faculty of Agriculture and Business, Denpasar Mahasaraswati University
121	Noshin Ilyas	Pakistan	Amelioration of abiotic stresses by soil microbes and amendments (2)	Department of Botany, PMAS Arid Agriculture University Rawalpindi, Pakistan
122	Nunna Sai Aparna Devi	India	Impeccable authentication of bacterial endophytes of rice by re-isolation and DNA fingerprinting method (3)	Department of Agricultural Microbiology, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India
123	Nur Farhana Adilah	Malaysia	Valorisation of fruit peels of pomegranate, pineapple and papaya for antioxidant and antimicrobial activity (6)	Faculty of Applied Sciences, Universiti Teknologi MARA, 40450 Shah Alam, Selangor, Malaysia
124	Pauliz Budi Hastuti	Indonesia	Effect of empty fruit bunch and rhizobacteria in growth of oil palm Seedlings in a pre-nursery (1)	Department of Agrotechnology, Faculty of Agriculture, Stiper Agricultural Institute, Yogyakarta, Indonesia
125	Popiha Bordoloi	India	Organic sources of plant nutrient for productivity enhancement of paddy in hill agro-ecosystem of North-eastern India (5)	Subject Matter Specialist, Krishi Vigyan Kendra Ri- Bhoi, ICAR (RC) for NEH Region, Umiam - 793103, Meghalaya
126	Pranab Dutta	India	*Trichoderma* spp: a potential bio-fungicide for the management of soil-borne plant pathogens *(2)*	School of Crop Protection, College of Post Graduate Studies in Agricultural Sciences, Central Agricultural University (Imphal), Umiam, Meghalaya-793103, India
127	Pratibha Sharma	India	Application of microbial consortium against major pests of cumin (5)	Department of Plant Pathology, SKN Agricultural University, Jobner- Jaipur-303328, Rajasthan- India
128	Priyanka J. Patel	India	SELENORHIZOBACTERIA MEDIATED SELENIUM BIOFORTIFICATION IN MUNG BEAN UNDER SELENIUM DEFICIENT REGION – A SUSTAINABLE AGRICULTURAL APPROACH (3)	Department of Microbiology and Biotechnology, University School of Sciences, Gujarat University, Ahmedabad – 380 009

129	Pujawati Suryatmana	Indonesia	Potential of various organic stimulators to enhance the performance of N-fixing bacteria in soybean (5)	Soil Science and Land Resources Department, Agriculture Faculty Universitas of Padjadjaran, jl. Raya Bandung-Sumedang Km.21, Jatinangor, West Java, Indonesia
130	Purwo Aprianto	Indonesia	The Potential of the Punggualas Area as a Natural Tourism	[1]Graduate Program of Palangka Raya University
131	Puspita Harum Maharani	Indonesia	Influence of plant growth-promoting rhizobacteria (PGPR) on growth and yield of Chili in various growing media (1)	Assessment Institute for Agricultural Technology in South Kalimantan, Panglima Batur Street Banjarbaru, South Kalimantan
132	Rabia Naz	Pakistan	Enhancement of Drought Stress Tolerance in Maize (*Zea mays* L.) by Endophytic Growth Promoting *Bacillus licheniformis* and *Bacillus glycinifermentans*	Dept. of Biosciences, COMSATS University Islamabad, Pakistan
133	R.N. Pandey	India	*Trichoderma* spp. in the mitigation of stresses in plants, their commercialization for sustainable agriculture and rural prosperity (1)	Department of Plant Pathology, B. A. College of Agriculture, Anand Agricultural University, Anand -388 110, India and Past President, IPS, & Professor & Head (Retd.)
134	Ragil S.B. Irianto	Indonesia	Application of Plant Growth Promoting Rhizobacteria and Arbuscular Mycorrhizal Fungi on the Growth of Four Month Old *Acacia mangium* Seedlings in Nursery	Pusat Penelitian dan Pengembangan Hutan, Jl. Gunung Batu No. 5 Bogor, 16610 Indonesia.
135	Rahmad	Indonesia	Evaluation of lignocellulolytic fungal consortium for composting sugarcane bagasse, filter cake, and manure (6)	Department of Estate Crops Cultivation, Pangkep State Polytechnic of Agriculture, South Sulawesi, Indonesia
136	Rahmad Fadli	Indonesia	The effect of vermicompost dosage and plant spacing on growth of sweet corn (*Zea mays* Saccharata Sturt) (1)	Faculty of Agriculture Mataram University, Jl. Majapahit 62 Mataram, 83115, Indonesia
137	Rahmi	Indonesia	Isolation and analysis of soil fungal population from rhizosphere of rice plants grown under field conditions in Bumirava Morowali Regency (3)	Department of Agrotechnology,Universitas Tadulako,Jl. Sukarno Hatta Km 9.Palu,Sulawesi Tengah,94118,Indonesia
138	Rana Pratap Singh	India	Assessing the multiple strategies to enhance use of plant Growth-promoting microbes for agricultural sustainability (1)	Department of Environmental Science, Babasaheb Bhimrao Ambedkar University Lucknow-226025, India
139	Ranita Das	India	Role of PGPR, PGPF and microbial biostimulants for sustainable crop production and soil health (1)	Geolife Agritech India Pvt Ltd. Address: 301, Marathon Max, Oppo. Nirmal Lifestyle, L.B.S

				Marg, Mulund(W), Mumbai-400080
140	Raval	India	Screening of multi-trait phyllosphere bacteria for plant growth-promotion in soils amended with agro-industrial wastes under biotic stress conditions (4)	Department of Microbiology, Arts, Science and Commerce College, Kamrej Crossroads, Surat-396445 India
141	Ravindra Chandra Joshi	Philiphine	Organic home gardens for family food and nutrition security in COVID-19 pandemic: Solomon Islands Experience (5)	Senior Consultant, Philippine Rice Research Institute, Philippines Pacific Islands Coordinator, SAFE-Network, Indonesia Visiting Professor, Central Bicol State University of Agriculture, Philippines
142	Reginawati Hindersah	Indonesia	Evaluation of strawberry seedlings in various planting media amended with biofertilizer (1)	Department of Soil Science, Faculty of Agriculture Universitas Padjadjaran, Sumedang, West Java, Indonesia
143	Retno Kawuri	Indonesia	Potential of bacteria as fat and oil biodegradation in environment contaminated with domestic waste (3)	Program studi Biologi, Fakultas MIPA, Universitas Udayana, Kampus Bukit Jimbaran, Bali
144	Rika Alfianny	Indonesia	Potential of rhizosphere bacterial consortium as PGPR in suppression of root-knot nematode in tomato (3)	School of Life Sciences and Technology, Institut Teknologi Bandung, Indonesia
145	Risky Hadi Wibowo	Indonesia	Selection and characterization of phosphate solubilizing bacteria isolated from chili (*Capsicum annuum* L.) from plantation of Rejang Lebong district (3)	Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Bengkulu, Kandang Limun, Bengkulu 38112, Indonesia
146	Ritu Mawar	India	Potentials of microbial biostimulants to decipher the basal stem rot in Ganoderma species (1)	Central arid zone research institute, Jodhpur, Rajasthan, India
147	Riyazuddin	India	Sustainable agriculture approach: chickpea rhizobacteria tolerant to trace elements and silver ions (1)	Department of Plant Biology, Faculty of Science and Informatics, University of Szeged, Kozep fasor 52, H-6726, Hungary
148	Rumella Simarmata	Indonesia	The effect of consortium of plant growth-promoting rhizobacteria (PGPR) in shallots *(Allium cepa* L.) production and soil health (1)	Research Center for Biotechnology, Indonesian Institute of Science, Cibinong, 16911, Indonesia
149	S. Purwaningsih	Indonesia	Evaluation of *Azotobacter* isolates on growth and yield of rice (*Oryza sativa* L) under greenhouseconditions (5)	Microbiology Division, Research Center for Biology, Indonesian Institute of Sciences Jl. Raya Jakarta-Bogor KM 46 Cibinong Science

				Center, Bogor, West Java, Indonesia
150	Sagung Ayu Nyoman Aryawati (1)	Indonesia	Increased productivity and income of farmers through application of ICM technology in rice under rainfed condition (5)	Assessment Institute for Agricultural Technology-Bali, Jl. By Pass Ngurah Rai, Pesanggaran, Denpasar, Bali,
151	Sagung Ayu Nyoman Aryawati (2)	Indonesia	Adaptation test of new high yielding rice varieties through integrated crops management (ICM) to support organic agriculture (5)	Assessment Institute for Agricultural Technology-Bali, Jl. By Pass Ngurah Rai, Pesanggaran, Denpasar, Bali, 80222, Indonesia
152	Samina Mehnaz	India	*Pseudomonas aurantiaca* - an overview of its potential as a biofertilizer and biofungicide *(1)*	School of Life Sciences, Forman Christian College (A Chartered University), Ferozepur Road, Lahore, 54600, Pakistan
153	Sanjay-Swami	India	Biochar potential for enhancing tomato productivity and soil acidity indices in acid inceptisol of Meghalaya, India (5)	School of Natural Resource Management, College of Post Graduate Studies in Agricultural Sciences, Central Agricultural University, Umiam (Barapani) – 793 103, Meghalaya, India
154	Santa Ram	India	Genetics of beneficial plant-microbe interactions (5)	Head, Division of Genetics and Plant Breeding (Retd.), Central Coffee Research Institute, India and *Present address: #234, 1-A Main, Bapuji Layout, Bogadi, Mysore 570026, Karnataka, India
155	Sarjiya Antonius	Indonesia	Evaluation of Indole Acetic Acid (IAA) producing and phosphate (P) solubilizing PGPR isolated from Clove (*Syzygium aromaticum L.*) plantations in Bali, Indonesia (1)	Research Center Biology, Indonesia Institute of Science, Cibinong, Indonesia
156	Saxena	India	Quantification of ecosystem services rendered by soil microorganisms (3)	ICAR. National Bureau of Agriculturally Important Microorganisms, Mau, Uttar Pradesh-275103, India
157	Selvasundaram Rajagopal	India	Enhancing soil and crop health by strategic microbiomes from microbial fermentation collection (3)	Agrinos (American Vanguard Company) India Private Limited., 217, DLF Tower A, Jasola District Centre, New Delhi – 110025, India
158	Serlina Hestiani Oktian	Indonesia	Aboveground carbon stock estimation model with Sentinel-2A Imagery in Bentang Alam Mbeliling of East Nusa Tenggara (5)	Faculty of Forestry, Nusa Bangsa University, Jl. Baru Km 4, Tanah Sareal, Bogor. Indonesia. 16166
159	Sesha Kiran Kollipara	India	Status of Gummy stem blight disease of cucurbits in India (5)	College of Horticulture, Venkataramannagudem, Dr. Y. S. R. Horticultural University, Andhra

				Pradesh, India
160	Shamarao Jahagirdar	India	Recent happenings in exploration of endophytes and biocontrol based green nanoparticles in management of soybean diseases and productivity enhancement in India - an overview (3)	Pandit Jawaharlal Nehru College of Agriculture & Research Institute, Karaikal-609 603
161	Shams shaila Islam	Bangladesh	Impact of vermicompost as a plant growth-promoting rhizobacteria for sustainable production of boro rice in northern regions of Bangladesh (1)	Department of Agronomy, Faculty of Agriculture, Hajee Mohammad Danesh Science and Technology University, Dinajpur 5200, Bangladesh
162	Shehzad Mehmood	India	Elucidation of germination potential and growth of wheat seedlings under salinity stress through *Bacillus mycoides* PM35 - A *in vitro* study (2)	Department of Plant Sciences, Quaid-i-Azam University, Islamabad, 45320, Pakistan
163	Smirnova	Kazakhstan	Associations of agronomically important microorganisms for increasing the productivity of soybean (5)	LLC “Research and Production Center for Microbiology and Virology"
164	Sopialena (1)	Indonesia	Control of antracnose disease in Tomato (*Solanum lycopersicum*) using endophytic fungi (2)	Agroecotechnology Study Program, Faculty of Agriculture, Mulawarman University, Jalan Pasir Belengkong Gunung Kelua Campus, Mulawarman University, Samarinda, East Kalimantan, Indonesia.
165	Sopialena (2)	Indonesia	Investments in *Metarhizium* sp. and *Trichoderma* sp. in post-mining land on soil fertility, growth and production of tomato plants (*Solanum lycopersicum* L) (5)	Agroecotechnology Study Program, Faculty of Agriculture, Mulawarman University, Jalan Pasir Belengkong Gunung Kelua Campus, Mulawarman University, Samarinda, East Kalimantan, Indonesia.
166	Sri Suryanti	Indonesia	Effect of plant growth-promoting rhizobacteria, bio-phosphate microorganism and phosphate on growth of oil palm seedlings under drought stress conditions (1)	Faculty of Agriculture, INSTIPER
167	Sri Wahjuni	Indonesia	Effect anthiperglycemic of Putri Malu (*Mimosa pudica* L) leaf ethanol extract on pancreas histopathology in hyperglycemic male rat Wistar (6)	Departemen of Chemistry, Faculty of Mathematic and Natural science, Udayana University, Campus Bukit Jimbaran, Bali, Indonesia
168	Srie Juli	Indonesia	Effect of liquid leaf extracts of Moringa (*Moringa*	Student of the UNS Agricultural Sciences

	Rachmawatie		*oleifera*) and Keong Mas (*Pomacea canaliculata*) on growth of Wangi Mentik Paddy (5)	Doctoral Program
169	Sujatha	India	Evaluation of decomposed coconut biowaste amended with fungal isolates in growth of cowpea (5)	NAHEP- CAAST, Coconut Mission, College of Agriculture, Padannakkad, Kasaragod 671 314, Kerala Agricultural University, Kerala, India
170	Sukmawati	Indonesia	Biodiversity and Characterization of Indigenous Arbuscular Mycorrhizal Fungi of on Agricultural Soils in Central Lombok (2)	Faculty of Agriculture Post Graduate Study, Udayana University Bali
171	Sulastri	Indonesia	The Colonization Assay of Halotolerant Plant Growth-Promoting Bacteria into Agronomic Crops Under Saline Stress (2)	Informatics Department, [Universitas] Center for Agricultural Production Technology, Agency for the Assessment and Application of Technology (BPPT), LAPTIAB-BPPT, Kawasan Puspiptek, Serpong, Tangerang Selatan, Indonesia
172	Suseelendra Desai	India	Bioinoculants for enhanced farm-productivity and -profitability with emphasis on climate change (5)	Former Head, Division of Crop Sciences, ICAR-Central Research Institute for Dryland Agriculture, Santoshngar, Hyderabad 500059, India
173	Sushil K. Sharma	India	Acid hydrolysed casein: a key substrate to unravel operation of tryptophan - independent pathway in rhizobacteria for IAA production (1)	ICAR-National Institute of Biotic Stress Management, Raipur - 493 225, Chhattisgarh, India
174	Susiana Purwantisari	Indonesia	Evaluation of plant growth-promoting rhizobacteria (PGPR) and *Trichoderma* sp. on growth of potato (1)	Department of Biology, Faculty of Science and Mathematics, Diponegoro University Jl. Prof. Soedarto, S.H, Kampus Undip
175	Susila Herlambang	Indonesia	The Effect of Soil Ameliorant Biochar for Roots Growth on Sustainable Agriculture (1)	Departement of soil science Faculty of Agriculture Universitas Pembangunan Nasional Veteran Yogyakarta 55283 Indonesia
176	Syaffiary	Indonesia	Effect of organic fertilizer products on the growth and health of *Acacia crassicarpa* seedlings (1)	PT Fajar Surya Swadaya, Desa Muara Toyu, Kabupaten Penajam Paser Utara, Kalimantan Timur, Indonesia
177	Sylvia J. R. Lekatompessy	Indonesia	Characterization of endophytic bacteria and growth promoting activity in shallots (1)	Research Centre for Biotechnology-LIPI, Cibinong Jl. Raya Bogor Km.46, Bogor Indonesia
178	Ting Ho	Malaysia	Hand-on experience with ecological friendly farming in Malaysia (1)	Malaysia

179	Tiwit Widowati	Indonesia	Isolation and characterization of plant growth-promoting endophytic bacteria from Celery (*Apium graveolens* L.) (1)	Reseach Center for Biotechnology, Indonesian Institute of Sciences, Jalan Raya Bogor KM 46 Cibinong, Bogor, Indonesia
180	Tri Chandra Setiawati	Indonesia	Potential of *Bacillus* as Plant Growth Promoting Rhizobacteria (PGPR) to improve P and K nutrient in acid and saline soil (3)	Soil Science Department, Faculty of Agriculture, University of Jember, Kalimantan 37, Jember, East Java, Indonesia, 68121
181	Triastuti Rahayu	Indonesia	Characterization and efficacy of endophytic bacteria isolated from banana roots in banana and black rice (5)	Research Center for Biotechnology, Universitas Gadjah Mada, Yogyakarta, 55281, Indonesia
182	Tualar Simarmata	Indonesia	Engineering of halotolerant PGPR biodiversity in rhizo-microbiome for alleviating the salinity stress, enhancing nutritional status and rice growth in saline soils (3)	Setiawati Department of Soil Sciences and Land Resources Management, Faculty of Agriculture of Padjadjaran University, Jatinangor 45363. West Java – Indonesia
183	Uma Devi Koduru	India	Mycopesticide Formulation Suitable for Tropical Conditions for use in Crop Pest Management (2)	Department of Botany, Andhra University, Visakhapatnam, 530003, India
184	Vaishnavi Palwe and Nutan Rathod	India	Preliminary Comparative Phytochemical Screening of stem bark and leaves of *Anthocephalus cadamba* evaluating Antibacterial Activity (6)	KBC North Maharashtra University Jalgaon, Maharashtra, India
185	Vishnuvardhan reddy	India	Genetic variability, heritability and correlation studies in tomato (*Solanum lycopersicum* L.) (5)	Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, India
186	Vita Meylani	Indonesia	Natamycin treatment for control of *Rhizopus* sp. mold on strawberries (*Fragaria virginiana)* (6)	Department of Biology Education, Faculty of Education and Teacher Training, Universitas Siliwangi
187	Wahyu Astiko	Indonesia	Effect of plant density on intercropping with Maize-Soybean inoculated with mycorrhizae amended with organic fertilizer enhance yield in dryland of north Lombok, Indonesia (2)	Post Graduate University of Mataram Indonesia
188	Wayan Alit Artha Wiguna	Indonesia	Sustainable agroindustry and agrotourism in rural areas - case study on chocolate industry of Cau Chocolates of Bali (2)	Cau Chocolates
189	Widhiantini	Indonesia	Performance of Agriculture Sector in Bali (5)	Department of Agribusiness, Faculty of Agriculture Udayana University, Gedung Agrokompleks Sudirman Denpasar Bali,

				Indonesia
190	William Carrie	India	Antifungal activity of the tomato endophytic bacteria and evaluation of their bioactive compounds as potent biocontrol agents against major phytopathogneic fungi (2)	Department of Biotechnology, Mizoram University, Aizawl- 796004, Mizoram India
191	Winny Andalia	Indonesia	Immuno-modulators perspective inspired by probiotic - a review on bovine colostrum (6)	Industrial Department, Tridinanti of University, Jalan Kapten Marzuki No 2446, Palembang, 30129, Indonesia
192	Wirawan	Indonesia	Detection of specific protein in citrus infected by citrus vein phloem degeneration disease (6)	Department of Agricultural Biotechnology, Faculty of Agriculture, Udayana University, Jl. P.B. Sudirman, Denpasar, Bali, Indonesia
193	Wiwik Susanah Rita	Indonesia	Antifungal activity of phenolic compounds from *Samanea saman* Jacq. (Merr) leaves against stem rot disease in dragon fruits caused by *Fusarium solani* (2)	Chemistry Department, Faculty of Mathematics and Natural Sciences, Universitas Udayana, Kuta, Bali, 80361, Indonesia
194	Yanisworo Wijaya Ratih	Indonesia	DECREASING OF CELL VIABILITY AND PHOSPHATE SOLUBILIZING ACTIVITY OF THE SOIL PHOSPHATE SOLUBILIZING BACTERIA CAUSED BY LEATHER TANNING WASTE WATER EXPOSURE (3)	Soil Science Department of Universitas Pembangunan Nasional Veteran Yogyakarta.
195	Yuda Purwana Roswanjaya	Indonesia	Production of Beauveria bassiana conidia in solid substrate condition using biphasic system (5)	Centre of Technology for Agricultural Production, Agency for the Assessment and Application of Technology (BPPT), Serpong, South Tangerang, Indonesia
196	Yulmira Yanti	Indonesia	Evaluation of PGPR strains on growth of tomato and suppression of bacterial wilt caused by Ralstonia (1)	Department of Plant Protection, Faculty of Agriculture, Andalas University, Padang, West Sumatra, Indonesia 25163
197	Yuni Sri Rahayu	Indonesia	Optimalization of marginal soils with consortium of hydrocarbon degrading, phosphate-solubilizing bacteria, rhizobium and mycorrhizae in legumes (3)	Biology Department, Faculty of Mathematics and Natural Sciences Universitas Negeri Surabaya
198	Zahoor Ahmad Baba	India	Plant growth-promoting activities of mineral solubilizing microbes isolated from Himalayan agro-ecosystem (3)	Division of Basic Science and Humanities, FoA, SKUAST-K, India

199	Zainal Arifin	Indonesia	Effect of arbuscular mycorrhizae on the growth of *Eucalyptus pellita* seedlings (2)	Sinarmas Forestry Corporate R&D, Jalan Raya Minas – Perawang KM 26, Perawang, Riau 28772, Indonesia
200	Zulqarnain	Pakistan	An overview of transfer and adoption of high technology in permanent food production park program (PFPP) participations in Peninsular Malaysia (4)	Agriculture Technology Department, Faculty of Agriculture, Universiti Putra Malaysia, Serdang,43300, Selangor, Malaysia
201	Zumrotul Hidayah	Indonesia	Increased growth of shallots (*Allium ascalonicum* L.) against fusarium wilt disease with combination of vermicompost and *Trichoderma* sp.(2)	Universitas Pembangunan Nasional Veteran Yogyakarta, Jalan Padjajaran 104, Condongcatur, Sleman, 55283, Indonesia

Table 2. List of partcipant without abstract

No	Name	Country
1	Achirul Nditasari	Indonesia
2	Alinaj Yasin	India
3	Anwhesa Sharma	India
4	Ayunasri	Indonesia
5	Baic	Indonesia
6	Binitha	India
7	Binod Pokhrel	Nepal
8	Dara Puspita	Indonesia
9	Desy Deawati	Indonesia
10	Dewa Ayu Mahasaraswati	Indonesia
11	Doddala Anitha Chowdary	India
12	Dr. Ida Bagus Komang Mahardika	Indonesia
13	Dr. Vikram Sahai	India
14	Dwi Agustini	Indonesia
15	Dwi Kartika Risfianty	Indonesia
16	Era Wahyuni	Indonesia

17	Fahmi	Indonesia
18	I Gusti Ayu Rai	Indonesia
19	Ira Erdiandini	Indonesia
20	Irfan	Indonesia
21	Irma	Indonesia
22	Kaerul Ihwan	Indonesia
23	Lagiman	Indonesia
24	Madhusmita	India
25	Mahesh Mohan	India
26	Mirah	Indonesia
27	Mr. Saurabh Singal	India
28	Muliawati	Indonesia
29	Naili	Indonesia
30	Nilam	Indonesia
31	Ni Putu Anggaila Amaral	Indonesia
32	Ni Putu Eka Pratiwi	Indonesia
33	Reni Lestari	Indonesia
34	Riki Rahmat	Indonesia
35	Shankar Bale	India
36	Suanda	Indonesia
37	Sulfa	Indonesia
38	Uday Anil Pawar	India
39	Tirta Kumala Dewi	Indonesia
40	Vijay Krishna	India
41	Vijay Kumar Naik	India
42	Yuniari	Indonesia
43	Yunita Barus	Indonesia