Green Productivity for Green, Inclusive Development:
A Commitment Today for a Greener Tomorrow

APO 3rd World Conference on Green Productivity
APO Center of Excellence on Green Productivity: Milestone of APO movement

APO COE GP Models : Eco Agriculture

To strengthen bio-input for increasing the productivity of ecological agriculture

Dr. Gwo-Chen Li (李國欽)
Former Director
Agricultural Chemicals and Toxic Substances Research Institute

The Technical Services of APO COE GP

- 2013 APO COE GP hosted a *Workshop* in Taipei and identify emerging areas where GP needs to be focused to support member countries' needs.
- Help the COE GP and the APO in designing GP activities that are relevant to the needs of member countries, focusing on the following 4 models to provide technical services:

Why Going for Ecological (Organic) ?

- **20th Century – Chemical Agriculture**
  - Degradation of the physical and chemical properties of soil
  - Eutrophication of nature water resource
  - Disturbance of ecological balance
  - Exhaustion of mineral resources of earth
- **Organic farming – Sustainable Agriculture**
  - Biological Materials - To exclude the use of chemicals
  - Biodiversity-health ecology
  - Resources recycling

Difficulty of promoting organic agriculture

- Farmland soil become relatively poor due to long time intensive agriculture
- The excessive growth of the city and industries cause the agricultural environment heavily polluted.
- Production of organic agriculture relatively low in output.
- **Lack the safe agricultural materials.**
- Labor cost increase because the needs of hand-weeding and manpower for biological control, etc.
- The low-grade product is relatively high in proportion.
- Relative size of average production area is small.
- There is no ideal production system.

Development of Organic Agriculture in R.O.C. (Taiwan)

- Enhancing Productivity While Reducing Chemical Input Application

2007 → 2012: 2.76-fold increase in organic area

Organic Farming Pretesting

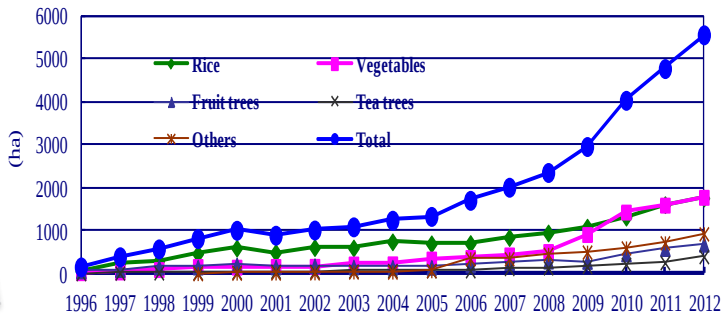
1994

Evaluation and Planning

1986

Organic Farming Technique

Biological Pesticide R&D



Organic Fertilizer Production

Exquisite Agriculture-Organic Farming Doubling Program

2008-Present

Safe agricultural Bio-materials

1. Breed the crop variety that suitable for organic agriculture
2. **Research and develop biological pesticide**
3. **Research and develop the biological fertilizer**
4. **Research and develop biological modifier of soil**

- Utilization of modern biotechnology
- Industrialization and **mass production**

Five major difficulties for the expanding the market of bio product

- **Hard to protect intellectual property rights**
- **Application technology is not easy to be mastered**
- **The price of the product very often lacks competition on the market**
- The public does not know the idea of sustainable agriculture
- The benefit by using bio-materials is not obvious enough

Policy Support

Research & Development

- Introduce modern biotechnology
- Encourage the cooperation of different research field
- Increase production efficiency and reduce production cost.
- Screen adjuvant and emulsifier used for the formulation of bio-products
- Develop new formula which enable the bio-products have steady physical and chemical property
- Improve effective rate of utilization of biologic product

Promoting the industry

- Bio-pesticide/fertilizer is one of the biological technical field most close to industrialization
- Induce capital input to form big enterprise gather the producing, supplying, selling and research developing together
- Regulating finance loan and coaching methods, to make the production of the biologic product scale up with benefit and to strengthen the competitiveness of its market

Extension and Application

- Make the relevant, make the strict standard in use for chemical pesticide.
- Strengthen communication with consumers , also peasants.
- Set-up the specification of the biologic product definitely and check stipulating to guarantee the quality commercial products
- Educating peasants to know the function mechanism of biological pesticide / fertilizer and using the skill correctly, Impel effective and rational use

R.O.C. experience

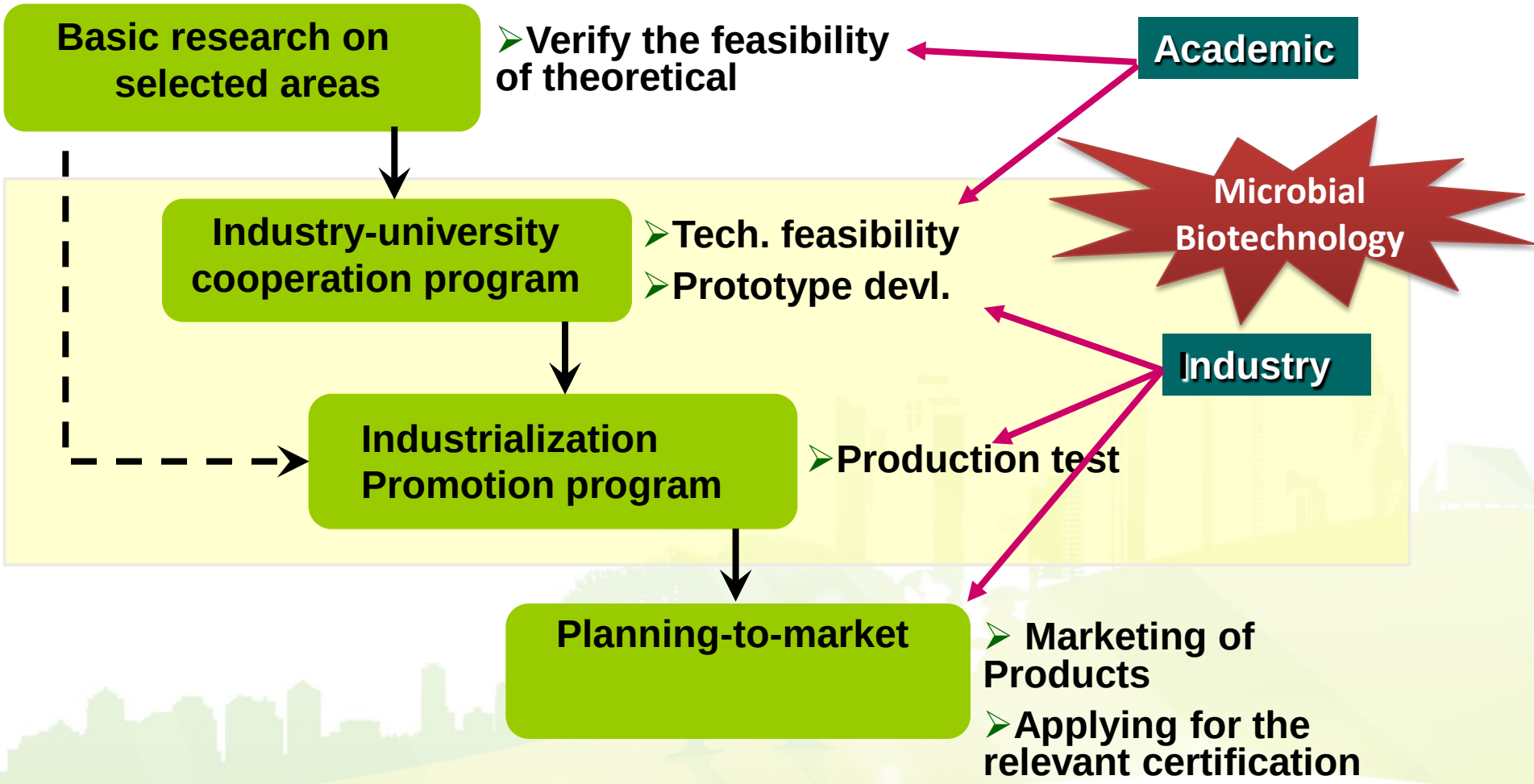
Office of National Science and Technology Program/Agri. Bio-technology (1999-2008)

↓

Office for Industrialization of Agricultural Biotechnology (2009-2013)

Agricultural Technology Research Institute (2014-)

Endeavour from Theoretic to Realistic

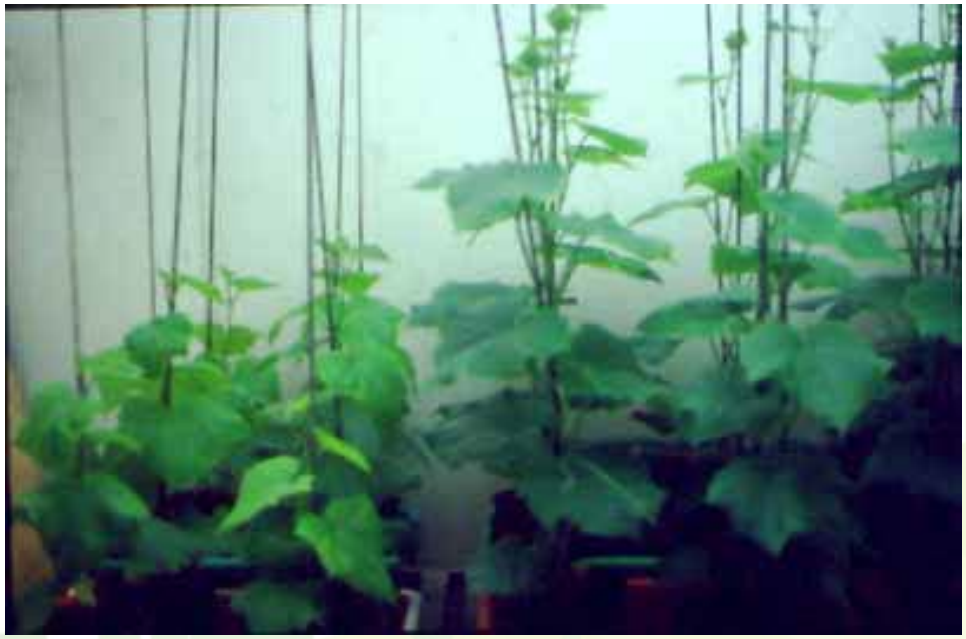


Type of microbial pesticide

- Microbial insecticide:
  - Bacteria: *Bacillus Thuringiensis*
  - Fungi: *Metarhizium*, *Becewenia bassiana*, etc.
  - Virus: baculovirus, Nuclear polyhedrosis virus
- **Microorganism:** Plant disease control, and weed control.
- **Some fungi stimulate the plant to develop immunity to disease: to promote plants to grow and to improve crop quality**

Trichoderma Tv-R42 could induce the cucumber seedlings resistance to cucumber green mottle mosaic virus (CGMMV).

Check

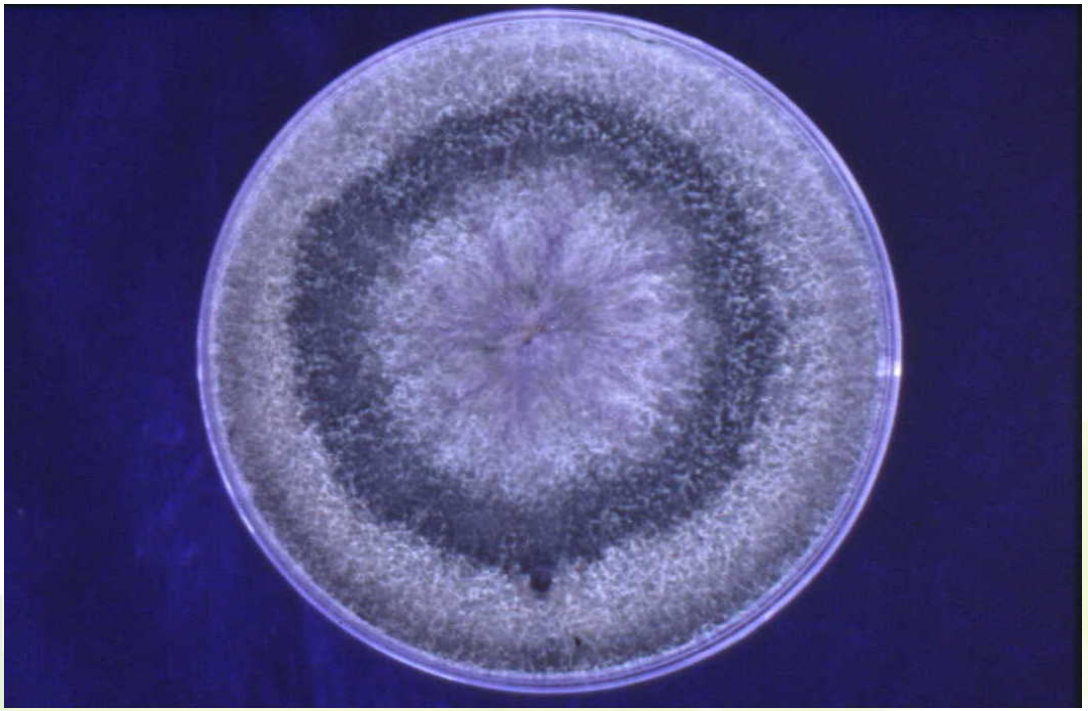


Trichoderma

Reduce plant dwarf caused by CGMMV

Trichoderma Tv-R42

produces volatile or nonvolatile antibiotics to restrain the growth of pathogen,



Trichoderma Tv-R42

Enhance root growth of crops and makes the crop grow very healthily, therefore can resist many diseases

Control Tv-R42

Control Tv-R42

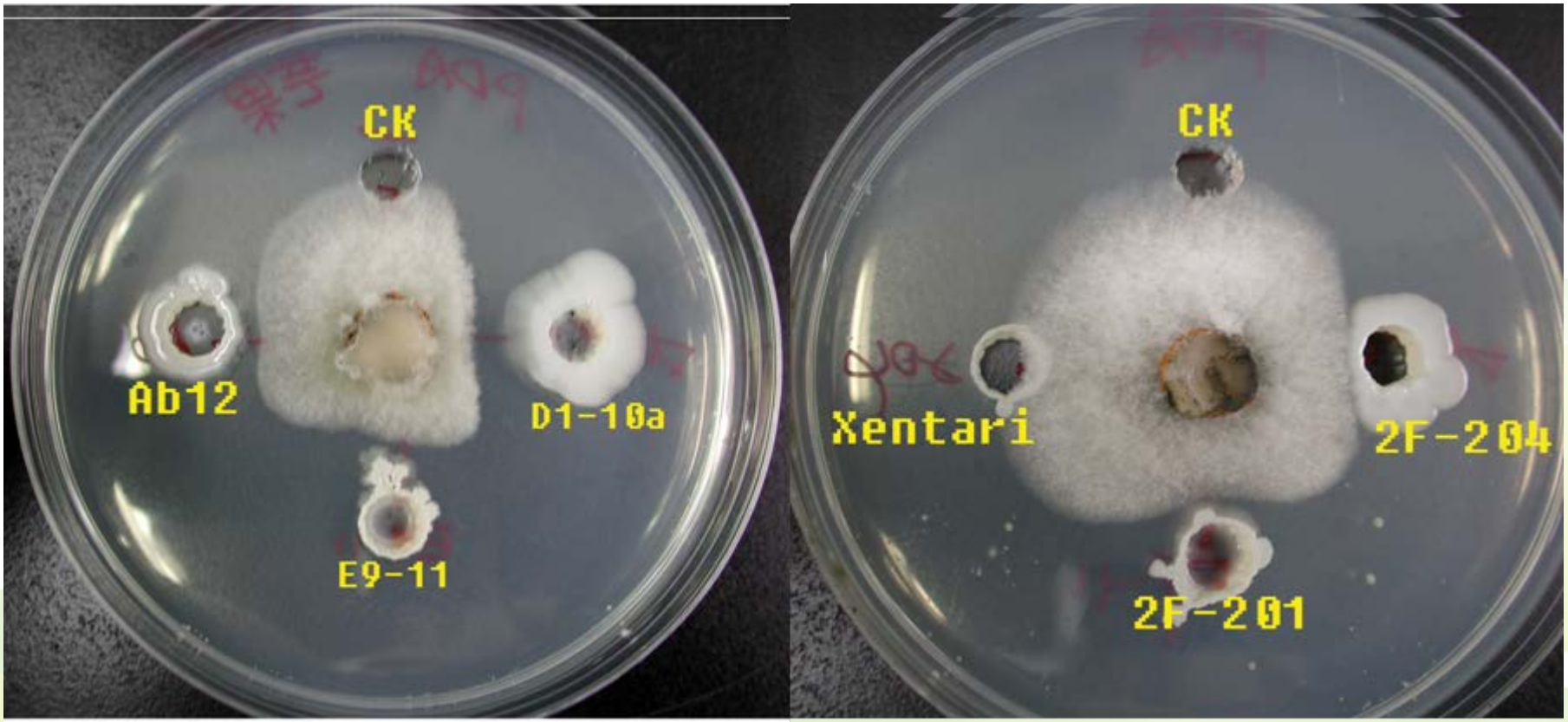
Control

Tv-R42

Bacillus Thuringiensis E-911

Control of Melon borer by E911

Growth inhibition of plant pathogen by different B.T.



Colletotrichum gloeosporioides Penz. (芒果炭疽病)

Entophyte bacteria, *Bacillus mycoides* isolates 136-24-01 and 136-24-02

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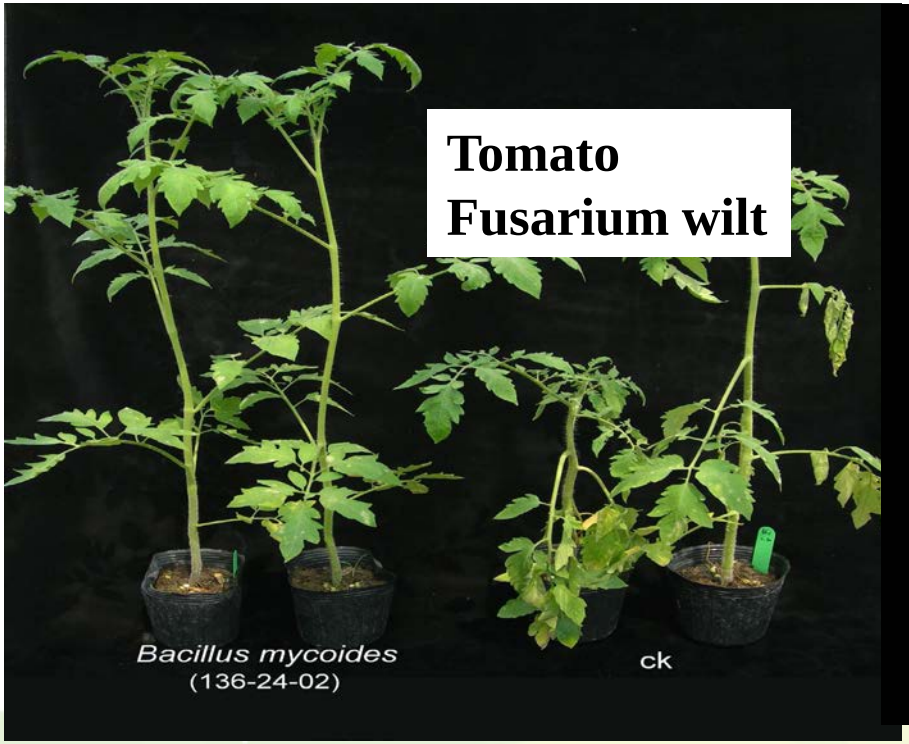
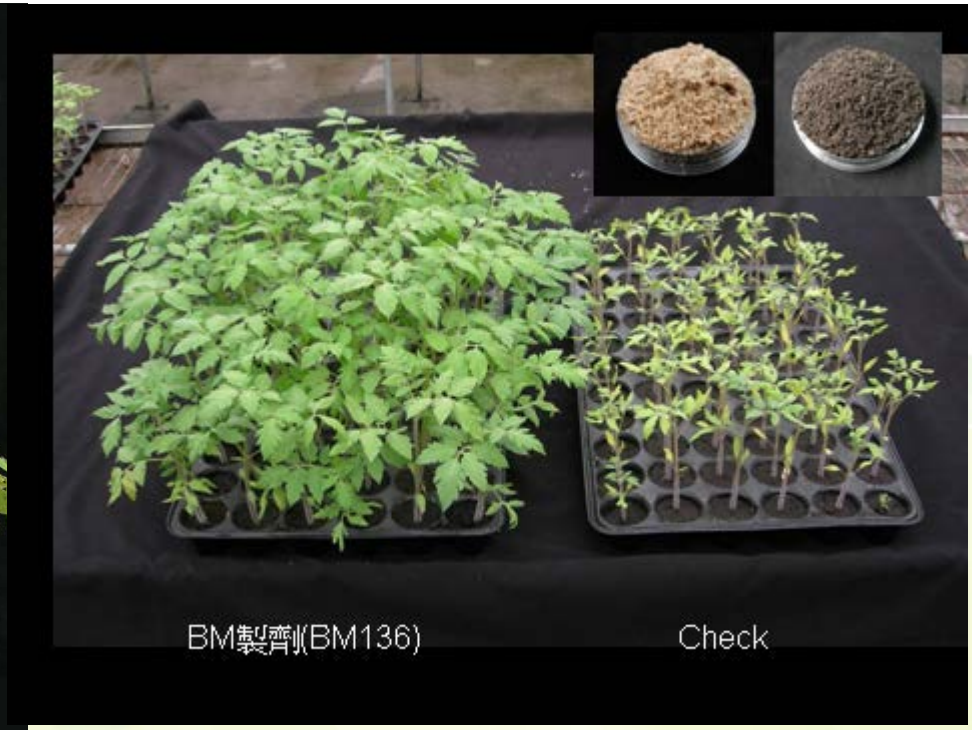
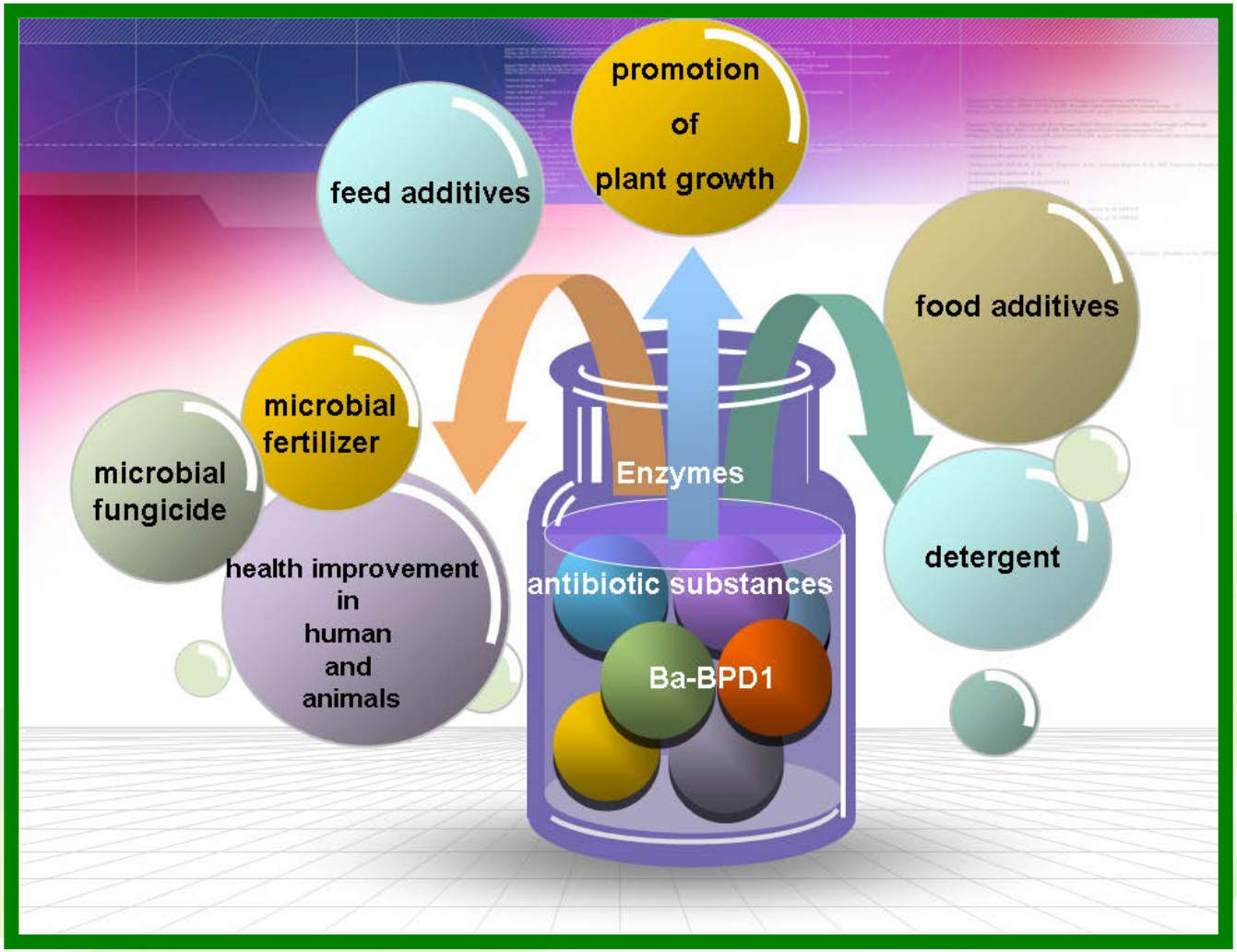




Bacillus amyloliquefaciens Ba-BPD1

1. Produce cellulase, protease, lipase, amylase
2. Have phosphate-solubilizing, fibrinolytic ability
2. High yield of iturin and surfactin
3. Inhibit the growth of *Erwinia chrysanthemi* ; *Erwinia carotovora* subsp. *Carotovora (Bateria)*
4. Inhibit the growth of *Botrytis elliptica and Fusarium oxysporum* f. sp. *Lycopersici (Fungi)*

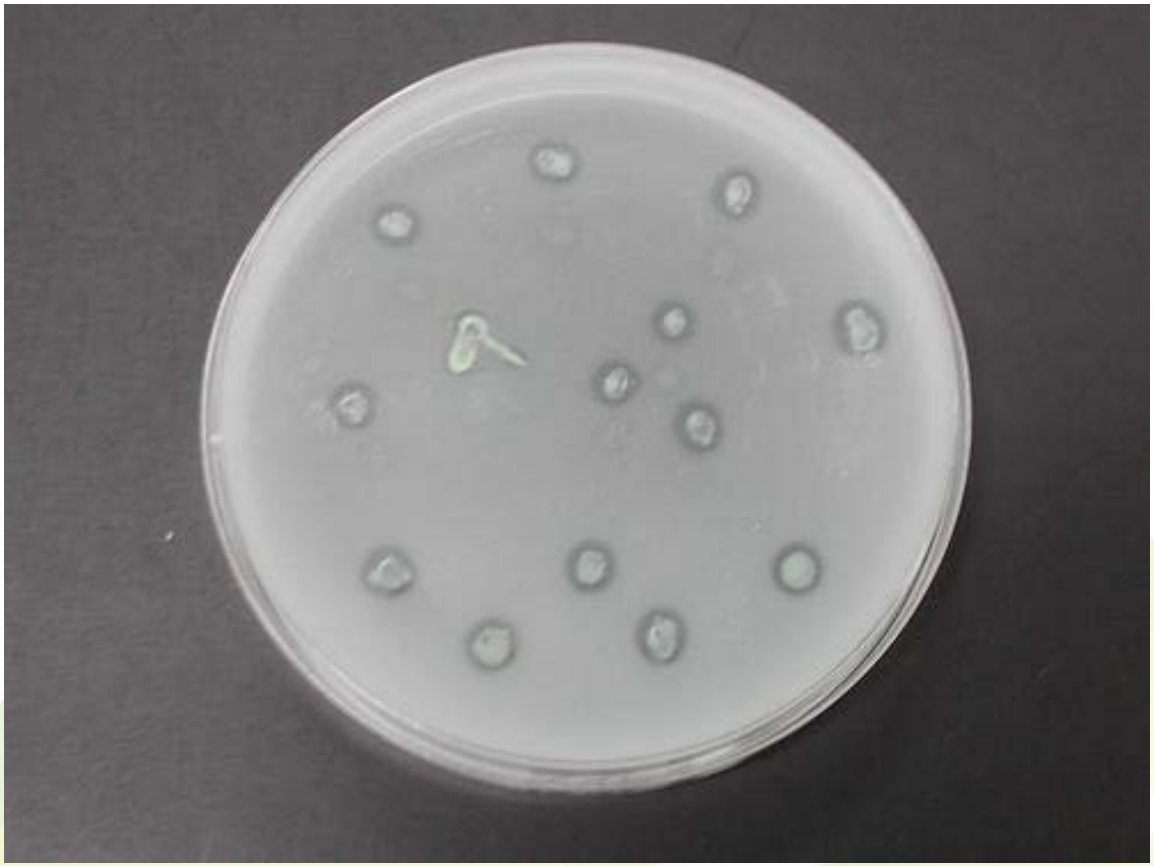
Bacillus amyloliquefaciens
Ba-BPD1



Bio-fertilizer

- Microbial fertilizer
  - Phosphate solubilizing microorganism
  - Potassium solubilizing microorganism
  - Nitrogen fixing microorganism
  - Beneficial microorganism from Rhizosphere
  - Photosynthetic bacteria
- Organic fertilizer
  - Organic decomposing microorganism
  - Agricultural waste

Phosphate solubilizing microorganism



Phosphate solubilizing microorganism

1. *Bacillus spp.*

   B. megatherium；*B. cereus*；*B. pumilus*

2. *Pseudomonas spp.*

   P. fluorsecens；*P. putida*

3. *Thiobacillus thiooxidans*）

4. *Aspergilus spp.*）；*Penicillium spp.*

Nitrogen fixing microorganism

http://highscope.ch.ntu.edu.tw/wordpress/?p=6762

Mycorrhizal fungi

Cited from／appliedturf.com、sci.waikato.ac.nz、Biologyjunction.com、Studyblue.com

Photosynthetic bacteria

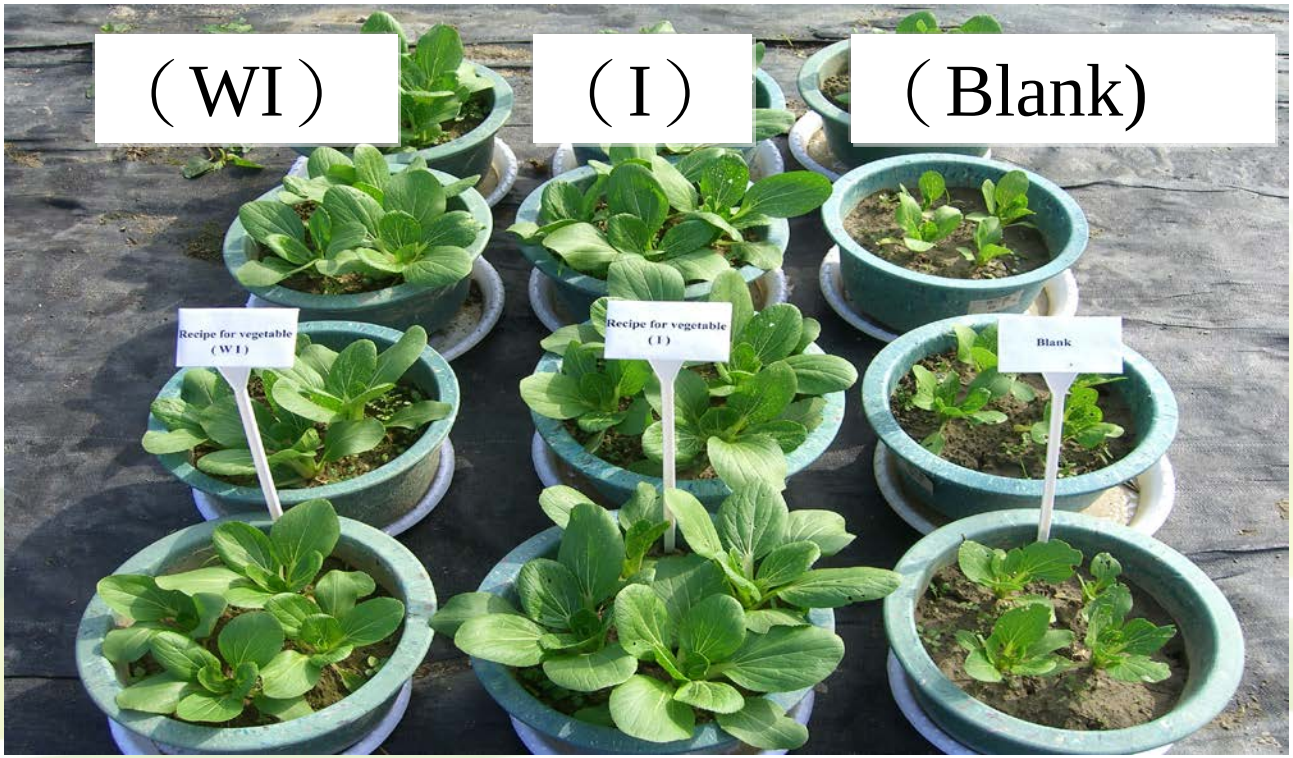
- Rhodospirllaqceae、 Chromatiaceae、Chlorobiaceae、 Chlorolexaceae
- Multi-functions: Nitrogen fixation、Dehydrogenation、 Carbon fixation、Sulfur oxidation
- Play an important role in the Carbon, nitrogen, and sulfur cycle, in the nature environment
- An important agricultural biotechnology research object in the 21st century

Cabbage treated with liquid organic fertilizer

（WI）Organic without microbial fermentation liquid

（I） Organic with microbial fermentation liquid

（Blank）Non-treament

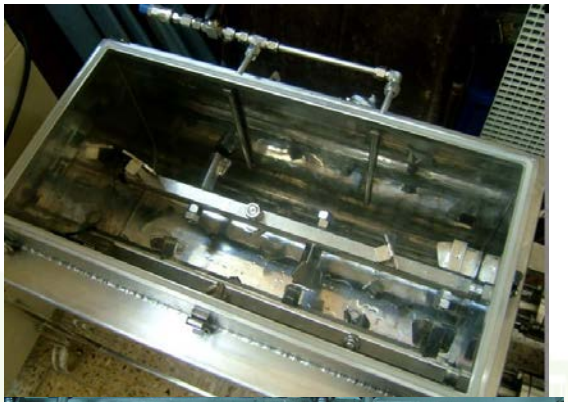


Organic decomposing microorganism

Production of multifunction ligninolytic enzymes with Agricultural wastes by white rot fungi.

(Manganese peroxidase, Lignin peroxidase, Laccase)

(A)Semi solid phase fermentor (40 L).

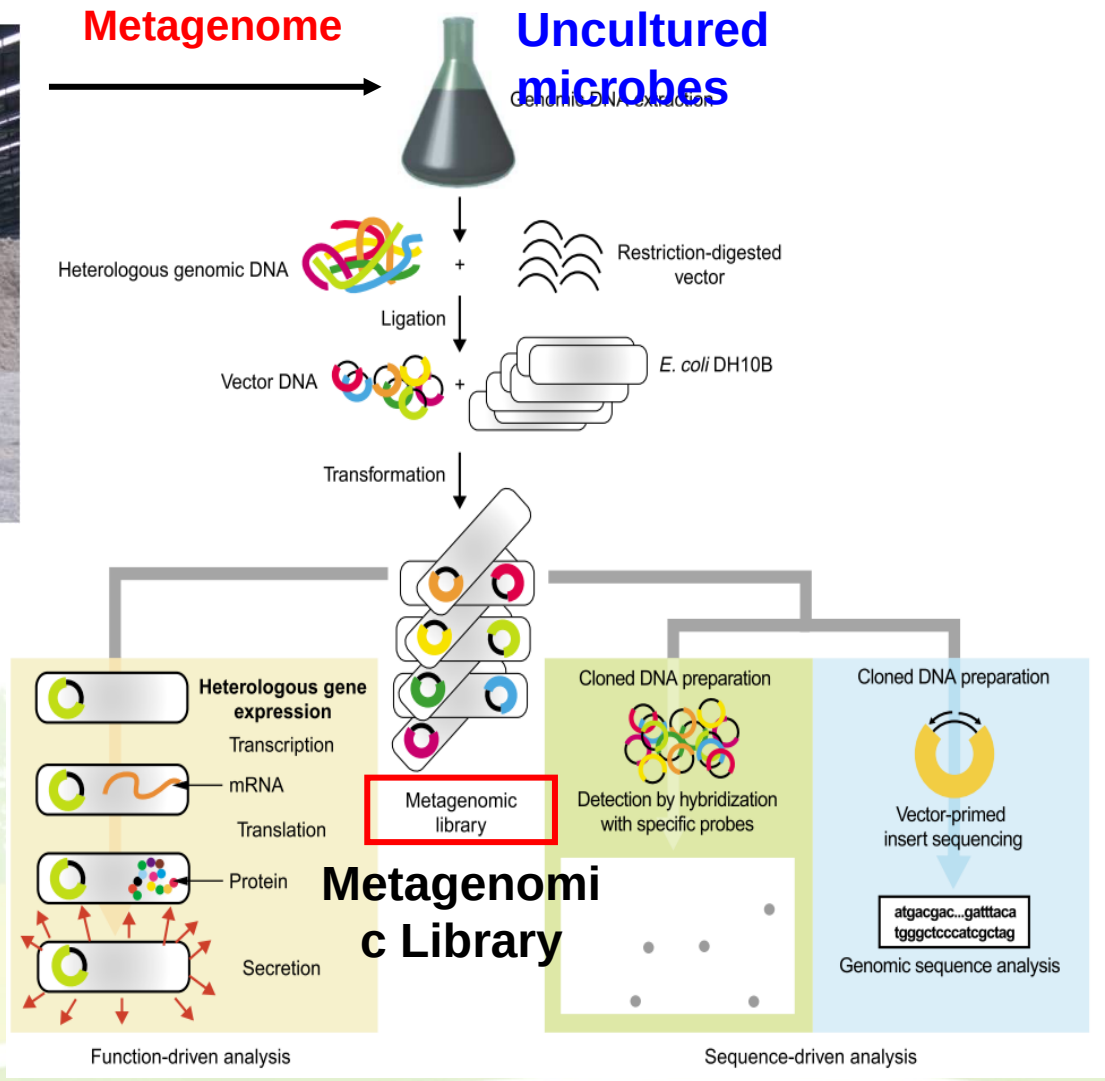


(B)The growth of white rot fungus TFRI707 after inoculation and incubation at 35℃ for 18 days in the 40 L semi solid phase fermentor.

Equipments for Rapid production of organic fertilizer from agricultural waste

Application of metagenomic technology

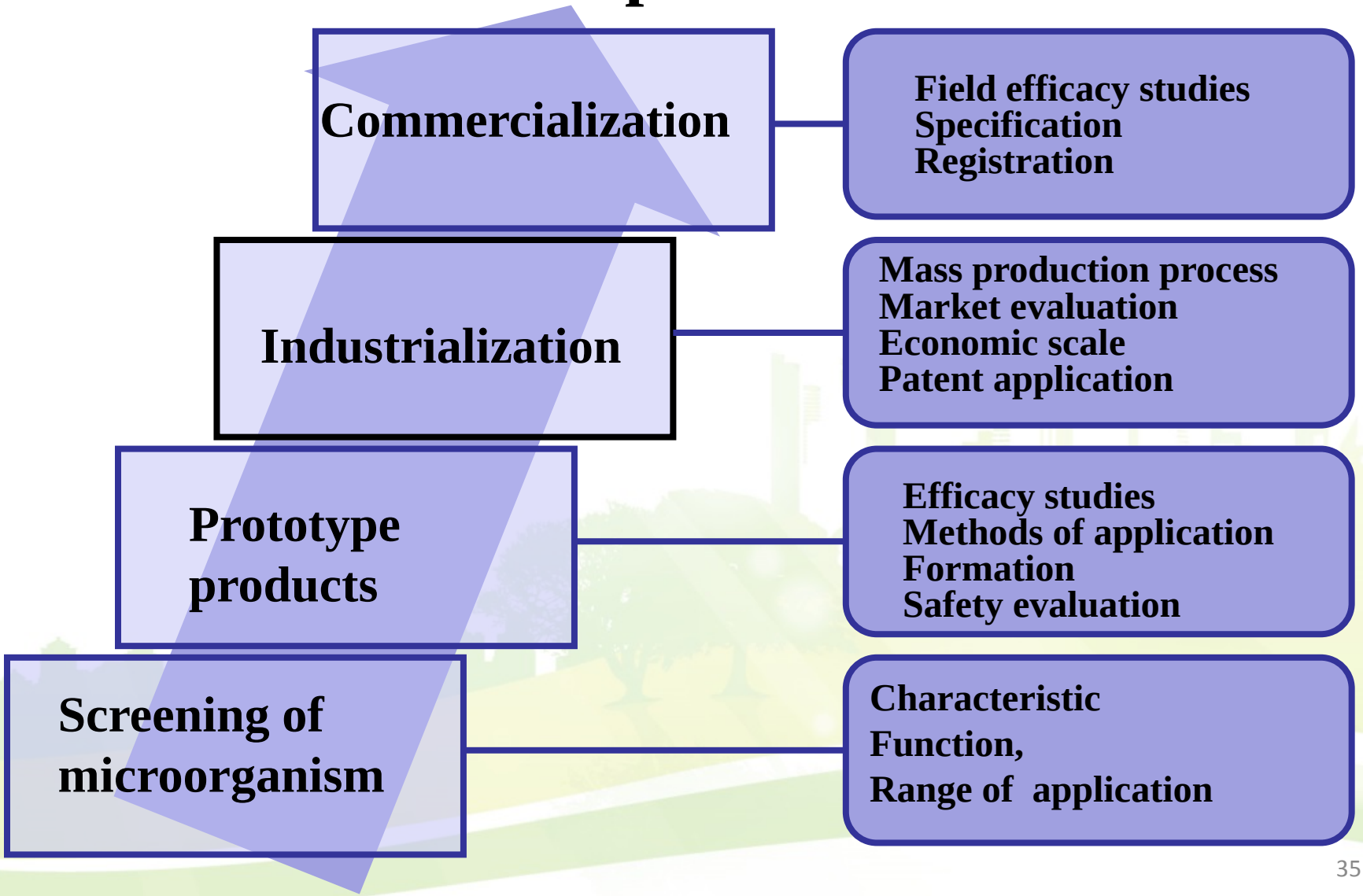
(Cited from Dr.Chang (2010))



Industry related to agricultural bio-materials

- **Microbial pesticides**
- **Bio-fertilizer**
  - Microbial fertilizer
  - Organic fertilizer
- **Agricultural waste treatment** – re-utilization
- Microorganism or relevant products as feed additives
- **Fermentation technology**
- **Bioreactor** for secondary metabolites

The development chain of microbial product



The cluster of producers in R.O.C. (Taiwan)

Companies

沅漢生物科技股份有限公司
YUAN MEI BIOTECH CO.,LTD.

台灣肥料股份有限公司
TAIWAN FERTILIZER CO.,LTD.

興農股份有限公司
SINON CORPORATION

BIONTECH®

常豐有機農業有限公司
Chang Fong Agriculture Co.,Ltd.

鴻福生態生技股份有限公司

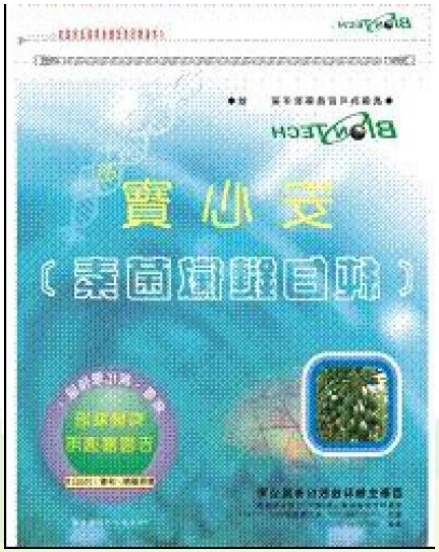
藍田生物科技有限公司
Landtek Biotech Co.,Ltd

Biopesticides

- *Bacillus spp.*
- *Bacillus thuringiensis,* Bt
- *Trichoderma spp.*
- *Streptomyces spp.*
- *Beauveria bassiana*
- *Metarhizium anisopliaeBacillus spp.*
- Azadirachtin, garlic
- Nicotine, Pyrethrum
- Rotenone, Sabadilla
- Vertrine, Saponins
- Pheromones, Hormones…

Crops

- Rice
- Fruits
- Leafy vegetables
- Berries
- Tea
- Orchids



Bio-products (Taiwan)

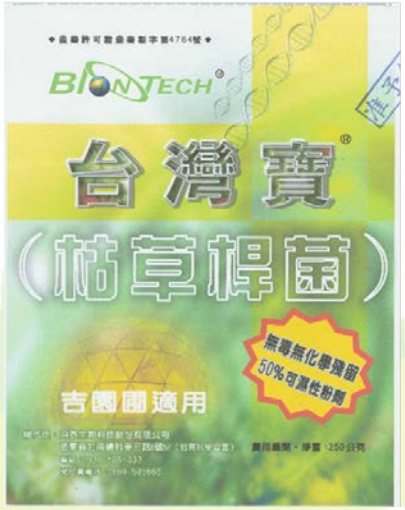

樂農寶
（枯草桿菌）
50%可濕性粉劑
無毒、無化學殘留
有機栽培
吉園圃適用
農用藥劑，淨重：250公克


一、有效成分：Bacillus subtilis Y1336
Viable spores of Bacillus subtilis Y1336.....50%(1×10⁷ CFU/g以上)
二、其他成份：稀釋劑、分散劑等.....50%（w/w）
三、物理性狀：褐色粉末。
四、使用方法：
作物 病害 每公頃每次用量（公斤） 稀釋倍數 施用方法 注意事項
豌豆 白粉病 1~1.5公斤 800倍 發病初期開始施藥，以後每隔七天一次，連續四次
蘆筍 莖腐病 500倍 發病初期開始施藥，以後每隔七天施藥一次，連續四次。
胡瓜 露菌病 1.5公斤 800倍 移植後七天開始施藥，以後每隔七天一次，連續三次。

農藥許可證農藥製字第5096號
農會牌農藥
農會寶
（枯草桿菌）
50% 可濕性粉劑
有機栽培
吉園圃適用
農用藥劑，淨重：250公克
台灣省農會附設各級農會農化廠
TFA
註冊商標


福壽牌
速力寶
（庫斯蘇力菌E-911）
30000 DBMU/mg（60%可濕性粉劑）
本土菌種（非基因改造）
農用藥劑（本農藥田間試驗結果經政府認定）
行政院農業委員會農業藥物毒物試驗所產學合作及技術授權


福壽牌
速力寶
FWUSOW BT1
庫斯蘇力菌
E-911
福壽實業股份有限公司
FWUSOW INDUSTRY CO., LTD.


BIONTECH
台灣寶
（枯草桿菌）
無毒無化學殘留
50%可濕性粉劑
吉園圃適用


BIONTECH
台灣水寶
（枯草桿菌）
農用藥劑
有機栽培 吉園圃適用
製造商：百泰生物科技股份有限公司
製造地址：苗栗縣竹南鎮科東三路6號5樓
（竹南科學園區內）
電話：（037）586-333

Guideline of recommending commercial materials to be used in organic agriculture

(Promulgated 2010/12/1)

Mission of visit of COE GP to Thailand July 27 to August 02, 2014

To build opportunities to:

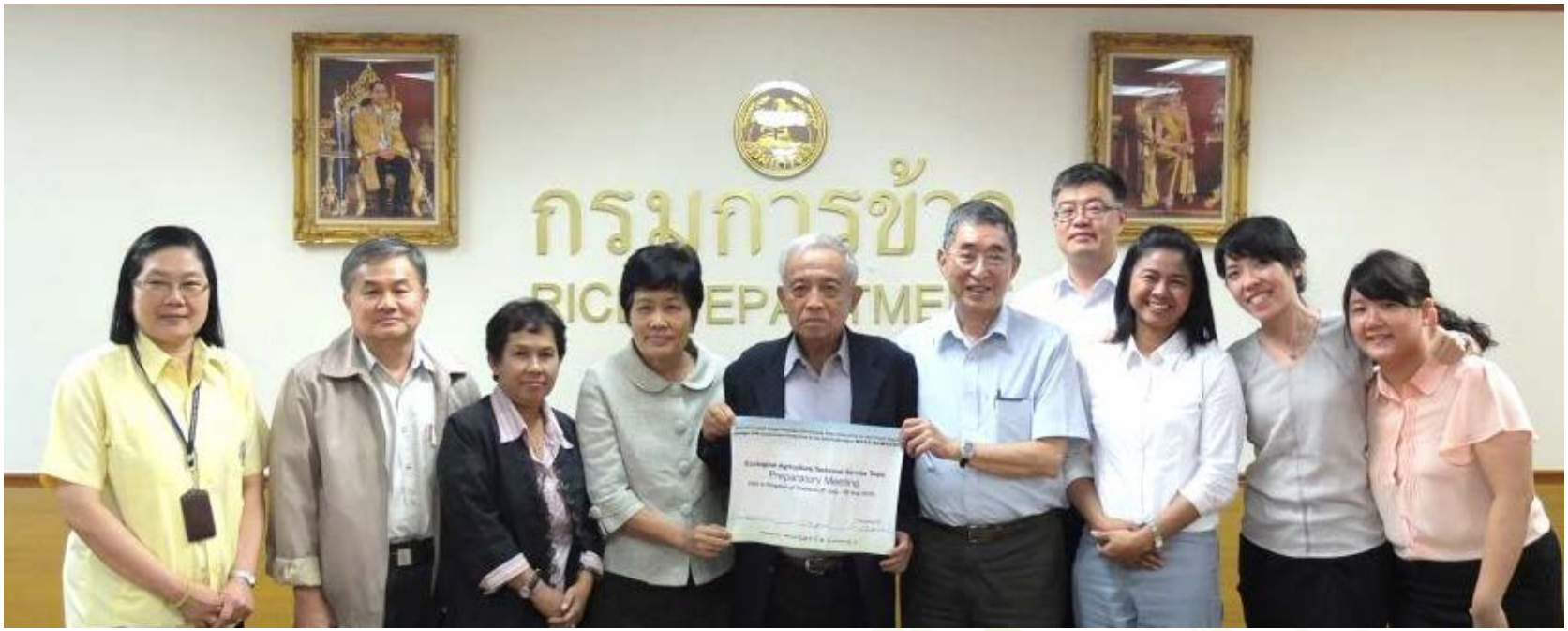
- Share experience, contribute to the green growth
- Promote innovation and sustainable development
- Enhance green productivity and competitiveness jointly

Sites visited

- Thailand Productivity Institute (FTPI)
- Minister of Agriculture and Cooperatives (MOAC)
- Green Net Cooperation
- Royal Project Foundation (RPF)
- Royal Agricultural Station Pang Da
- Thai-Sino trade and Investment information center
- J.I.M.Organic Products Business
- Known-you Seed (Thailand CO.,LTD

Bio-products (Thailand)

Wholesale Market



Minister of Agriculture and Cooperatives (MOAC)
Rice Department
Land Development Department

Royal Agricultural Station Pang Da

Follow-up for the visit

- A two days colloquium on Green Agricultural Practices for Sustainable Productivity will be held in Bangkok on December 2nd to 3rd, 2014
- One day in ChiangMai: A colloquium on the production and application of bio-materials
- Participants **:** Government authority, experts, industry, managers and farmers of organic farm, etc.

Objective

- To share the experiences and knowledge
- To exchange technical information and expertise
- To hold a series of activities and to stimulate developers and industry to promote GP, ecological farming technologies.
- To facilitate technical upgrading of engineers through exchange of technologies and services on a mutually beneficial basis.
- To explore opportunities for cooperation
- To host bilateral study mission for further technical and management exchange

Paradigm Shift towards Green Productivity for Asia-Pacific Region

Thank you

Speaker

Current Position:
Council Member
Chinese Sustainable Agriculture Association (Taiwan)

Li, Gwo-chen

Education Background

University of Rhode Island, USA -1971-Ph.D –Agricultutal Chemistry
McGill University, Canada -1967 - M.Sc -Plant Physiology
National Chung-Hsing University, Taiwan, R.O.C. BS

Working Experience

Chief Operation Officer
Office for Industrialization Promotion of Agricultural Biotechnology. Jan. 2009 to Dec. 2010
Chief Operation Officer,
National Science and Technology Program for Agricultural Biotechnology, Jan. 2002 to Dec. 2008
Director
Taiwan Agricultural Chemicals and Toxic Substances Research Institute. Jan. 1985 to Jan. 2005