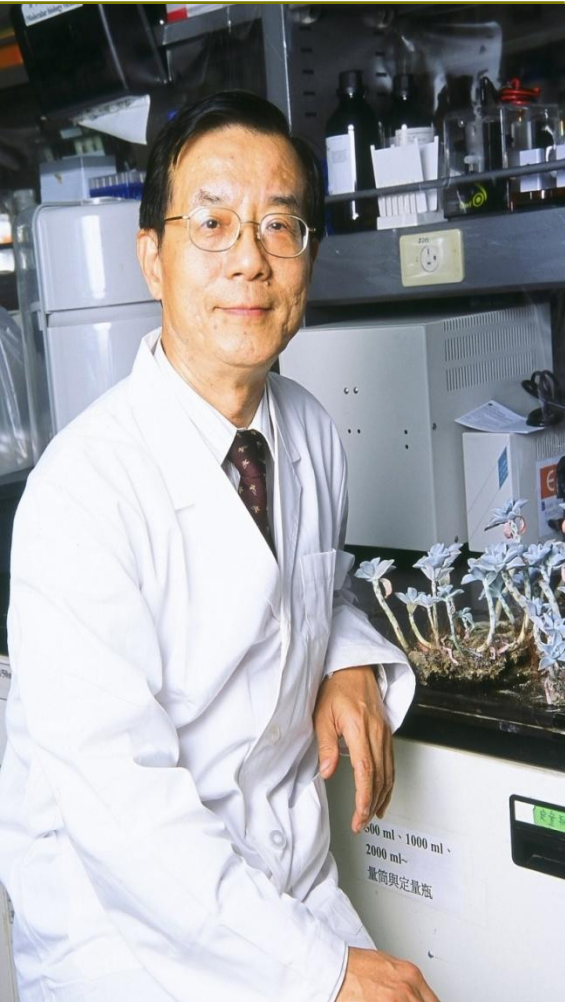
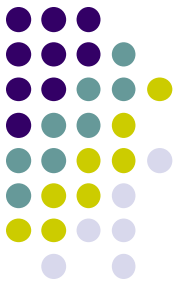


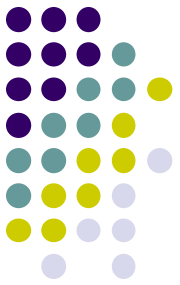
# Prof. Chiu-Chung Young

## National Chair Professor



- **Ministry of Education:** National Chair (lifetime honor) (**only one in Taiwan agriculture**)
- **National Chung Hsing University:** Chair Professor, Prof. Dept. Soil Environ.Sci. (**first one in NCHU**)
- **ROC Members of the IUBS and SCOPE**
- **Editorial Boards:** Nature-Sci. Rep., Dataset Papers in Science-Microbiol., J. Biomed. Biotechnol., Recent Patents Material Sci., Recent Patent Food, Nutrit. Agri
- **Publications Review Boards:** Allelopathy J., J. Microbiol., J. Appl. Ecol., Int J Syst Evol Microbiol., Int. J.Mol. Sci., J.Soil Sci., Plant Soil, etc. (**review 70 papers nearly 5 years**)

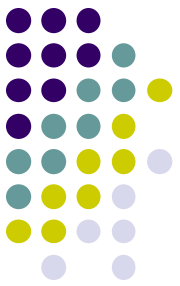
# RESEARCH AREA



## **Interaction Between Soil and Plant:**

- 1. Soil microbiology and biochemistry**
- 2. Microbial biofertilizer**
- 3. Fast treatment for organic wastes to produce organic fertilizer**
- 4. Soil bioremediation**

# RESEARCH AREA



## ■ Research and development of biofertilizers

1. The isolation, selection and characterization of indigenous **beneficial microorganisms** are carried out routinely, which include dinitrogen-fixing bacteria, rhizobia, phosphate-solubilizing bacteria and arbuscular mycorrhizal fungi.
2. The physiological and biochemical characterization and mechanisms for their behaviors have been focused in various microorganisms. **Plant growth promoting bacteria** are identified based on gene sequences analysis and genotyping method.
3. Effects of the bioinoculants on different crops are analyzed by bioassay, pot experiment, field experiment and soil analysis and the performance of the **biofertilizers** are shown.
4. **The mechanism** of the solubilization of mineral phosphate (tricalcium phosphate or ferric phosphate) and fixation of dinitrogen (free-living or symbiotic) and associated genes are studied.



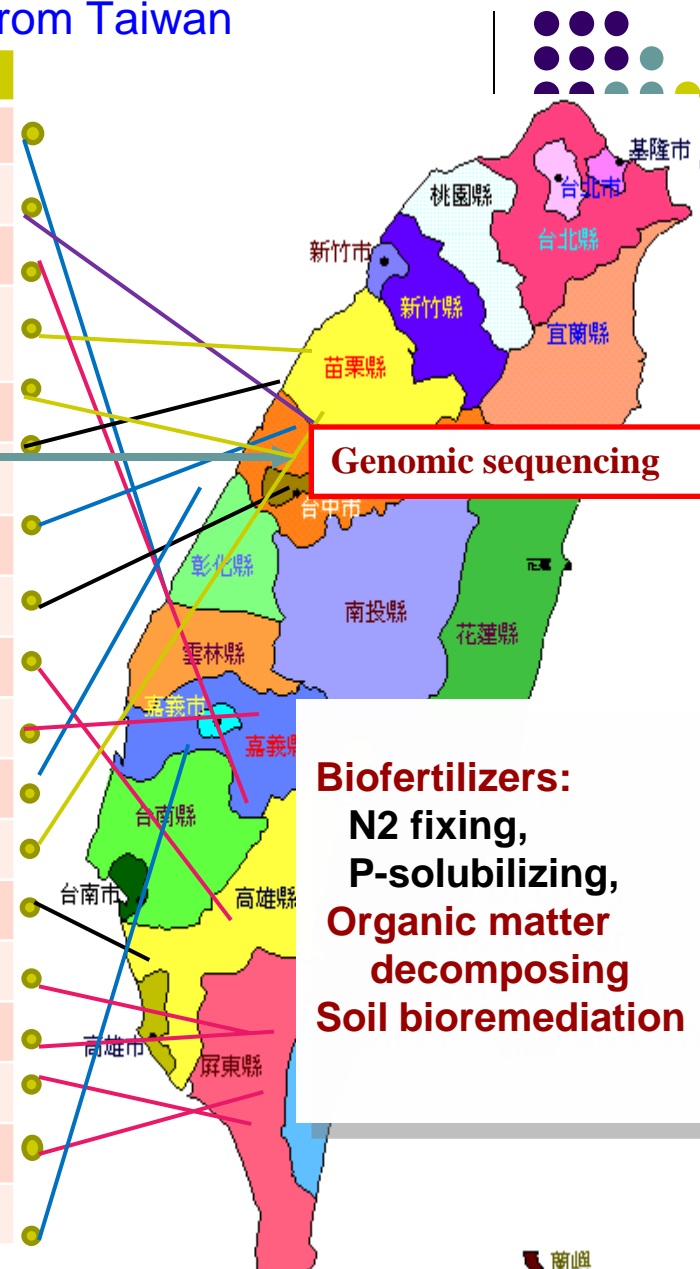
# Selection and Development of Biofertilizers

1. Rhizobial inoculants
2. P-solubilizing microbial inoculants
3. Arbuscular-mycorrhizal fungi inoculants
4. Multi-functional microbial inoculants  
for the adaptation of various soils

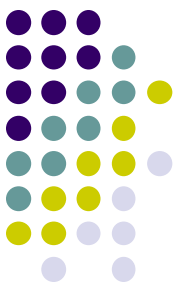


Table 3. Sources of indigenous novel bacteria isolated from Taiwan

Taxon	Sample type
<i>Arenimonas malthae</i> CC-JY-1 <sup>T</sup>	Oil contaminated soil
<i>Chitinophaga skermanii</i> CC-SG1B <sup>T</sup>	Faeces of millipede
<i>Chryseobacterium formosense</i> CC-H3-2 <sup>T</sup>	Rhizosphere soil
<i>Chryseobacterium taichungense</i> CC-TWGS1-8 <sup>T</sup>	Oil contaminated soil
<i>Comamonas odontotermite</i> CC-Dant3-8 <sup>T</sup>	Gut of termite
<i>Deinococcus ficus</i> CC-FR2-10 <sup>T</sup>	Rhizosphere soil
<i>Gordonia soli</i> CC-AB07 <sup>T</sup>	Soil
<i>Luteimonas compostus</i> CC-YY255 <sup>T</sup>	Compost
<i>Lysobacter defluvii</i> CC-APB9 <sup>T</sup>	Municipal land fill
<i>Modestitepidum taiwanensis</i> CC-on7 <sup>T</sup>	Hot spring water
<i>Paenibacillus fonticola</i> CC-ZL <sup>T</sup>	Hot spring water
<i>Pseudoburkholderia malthae</i> CC-AFH3 <sup>T</sup>	Oil contaminated soil
<i>Pseudolabrys taiwanensis</i> CC-BB4 <sup>T</sup>	Oxisol type soil
<i>Pseudoxanthomonas spadix</i> CC-AFH5 <sup>T</sup>	Oil contaminated soil
<i>Tenacibaculum litopenaei</i> CC-B-I <sup>T</sup>	Shrimp mariculture pond
<i>Tepidimonas taiwanensis</i> CC-I1-1 <sup>T</sup>	Hot spring water
<i>Trabulsiella odontotermite</i> CC-Eant 3-9 <sup>T</sup>	Gut of termite
<i>Williamsia serinedens</i> CC-SR-4 <sup>T</sup>	Oil contaminated soil



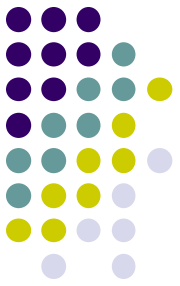
**112 papers** published in *International Journal of Systematic and Evolutionary Microbiology* (IJSEM) **2006-2015** (>6,000 identified isolates in the gene pool)



## ■ Research and development of organic matter

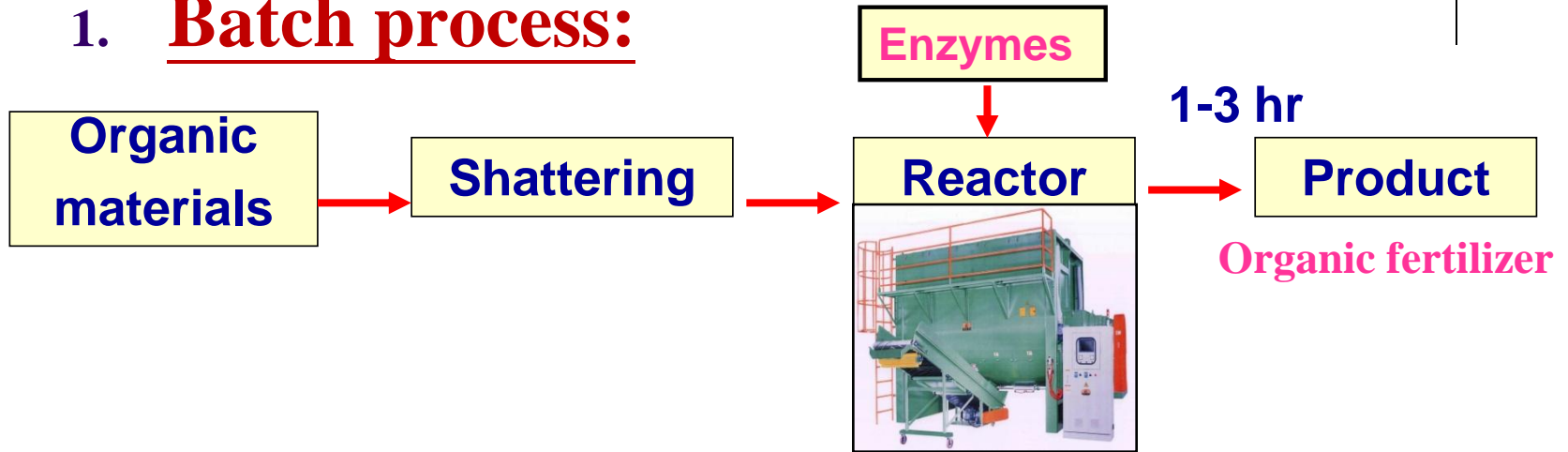
1. The effects and functions of humic substance in the soil have been studied. These research topics include the reaction between humic acid and nitrogen gas, the function of polyamine in the soil and the water and fertility preservation of peat in hillside fields.
2. The new concepts for the treatment of organic matter by using **composting-free techniques** have been developed and the performances have also been proved.



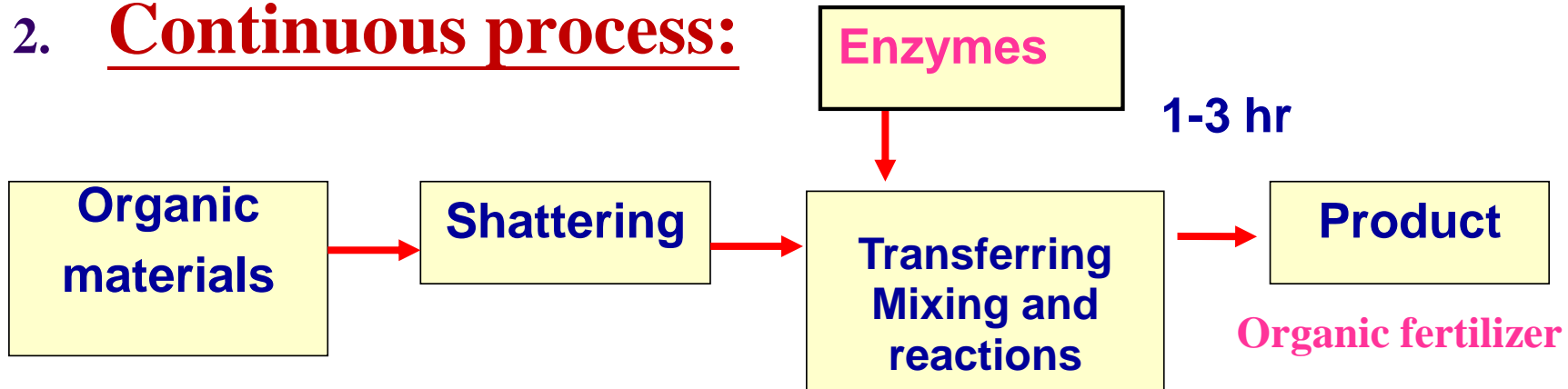


# The Processes of Fast Treatment Technology

## 1. Batch process:



## 2. Continuous process:





# Products from Fast Treatment treatment of organic wastes

## Chicken dung

## Cattle dung

## Pig dung



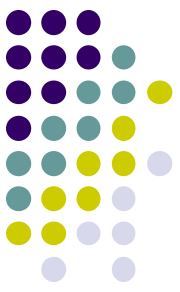
## Leaf litter

## Oil palm fiber

## Food wastes







- **Research and development in the environmental biotechnology (soil bioremediation)**

1. **The microbiological techniques to remove hazard or toxic substance, odor and organic waste** have been developed, which include the use of toxin- or odor- removing bacteria, multiple functional bacteria or biologically organic fertilizers.

2. **Various organic wastes can be turn into crop cultivated medium or substance and used friendly in agriculture.**



## Screening of oil-degrading and floating bacteria



### Floating bacteria

JG39 : *Gordonia alkanivorans*

BC04 : *Rhodococcus erythropolis*

BC11 : *Rhodococcus erythropolis*



### Non-floating bacteria

CCRC16048: *Bacillus subtilis*

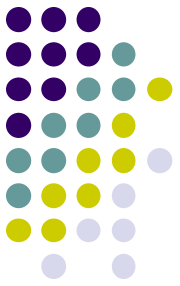
CF3 : *Comamonas testosteroni*

CF5 : *Acinetobacter* sp.

CG22 : *Shingomonas yanoikuyae*

Fig. Floating behavior of three actinomycetes in BH mineral medium containing 3% diesel oil

# RESEARCH TOPICS



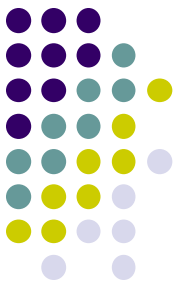
## ■ Microbial fertilizers (Biofertilizers)

1. Indigenous superior rhizobia, phosphate solubilizing bacteria and vesicular-arbuscular mycorrhizal fungi have been isolated and characterized in Taiwan.

2. The application of these bioinoculants shows advantages not only in the reduction of chemical fertilizers, improvement of soil quality, increases of nutrient availability in the soil, but also assists with the ability of crops to tolerate different stress conditions, leading to the promotion in the quality and yields of crops.

3. These research works can also be used as demonstrations/criteria and are useful for farmers and the government (District Agricultural Research and Extension Station, Council of Agriculture, Executive Yuan).





## ■ **Novel techniques for the rapid fertilization of kitchen waste and petroleum pollution**

1. The fastest techniques for the fertilization of wastes all over the world have been developed by our team. By using these novel techniques kitchen waste can become fertilizers in simply 3-6 hrs, which shows powerful potential in the treatment of waste after popularization.
2. We used novel floating microorganisms for bioremediation

## ■ **Novel techniques for the composting-free treatment of organic wastes**

1. The composting-free techniques have been developed based on the knowledge of biology, biochemistry and soil science.
2. These novel techniques provide the transformation of organic waste to organic fertilizers without composting and show powerful potential in the treatment of waste after popularization.







# Mass production and quality control of biofertilizer

## Fig. 17a. Production of liquid biofertilizer ( $N_2$ fixing, P-solubilizing bacteria)



## Fig. 17b. Production of solid biofertilizer (Arbuscular mycorrhizal fungi)







## Potential for the promotion of plant growth

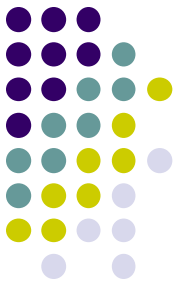
- *Chryseobacterium formosense* CC-H3-2<sup>T</sup>
- *Sphingobium rhizovicinum* CC-FH12-1<sup>T</sup> (Free-living nitrogen fixation)

## Potential for the degradation of organic waste

- *Chitinophaga skermanii* CC-SG1B<sup>T</sup> (Chitinase production)
- *Comamonas composti* CC-YY287<sup>T</sup>
- *Comamonas odontotermite* CC-Dant3-8<sup>T</sup>
- *Deinococcus ficus* CC-FR2-10<sup>T</sup> (Protease production, UV-resistance)
- *Luteimonas compostus* CC-YY255<sup>T</sup>
- *Lysobacter defluvii* CC-APB9<sup>T</sup>
- *Trabulsiella odontotermite* CC-Eant 3-9<sup>T</sup>



# Publication



## Total Publications: 734

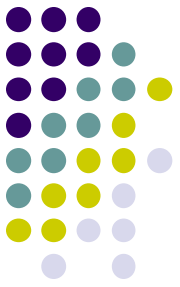
- (A) Refereed papers: 266 (100 within 5 years)
- (B) Conference papers: 260
- (C) Books: 23
- (D) Technical and extension publications: 185

## Technology Transfers and Patents: 66

- (A) Technology Transfers: 38
- (B) Patents: 16, pending patents: 28



# Teaching



- ◆ **Biological and Organic Fertilizers**
- ◆ **Soil Biochemistry**
- ◆ **Soil Biotechnology**
- ◆ **Crop and Soil**
- ◆ **Environmental Biochemistry and Research Methods**
- ◆ **Plant Biochemistry**
- ◆ **Research Method and Thesis Writing**



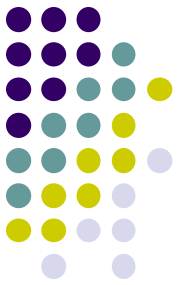
# Major research accomplishments



## 1. Biofertilizer:

- The pioneering contributions were in the development and implementation of biofertilizer programs
- Application of  $N_2$  fixing (Rhizobium), P-solubilizing bacterial and VAMycorrhizal fungi as inoculants in agriculture which not only provided economic benefit to small farmers, but also reduced chemical fertilizer input drastically. technology transferred and cohabitation to farmers and farming industries in Taiwan and other countries. (eg. Taiwan Fertilizer Co., Indah Kiat PP Co. (Indonesia) EGB SDN.BHD (Malaysia) and other 21 companies).





## 2. Waste Management:

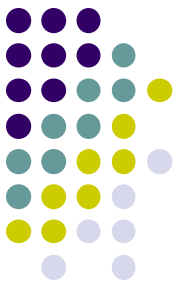
- Designed and implanted the rapid (1-3 h), novel and patented composting-free technology for the organic waste treatment. This technology was transferred to various organisations and industries worldwide.

## 3. Bioremediation and Biotechnology:

- Implimented a program that uses microbial consortium with floating abilities to cleanup diesel oil pollution. Successfully developed a novel primer, that can rapidly detect the Gordonia members from environmental samples.





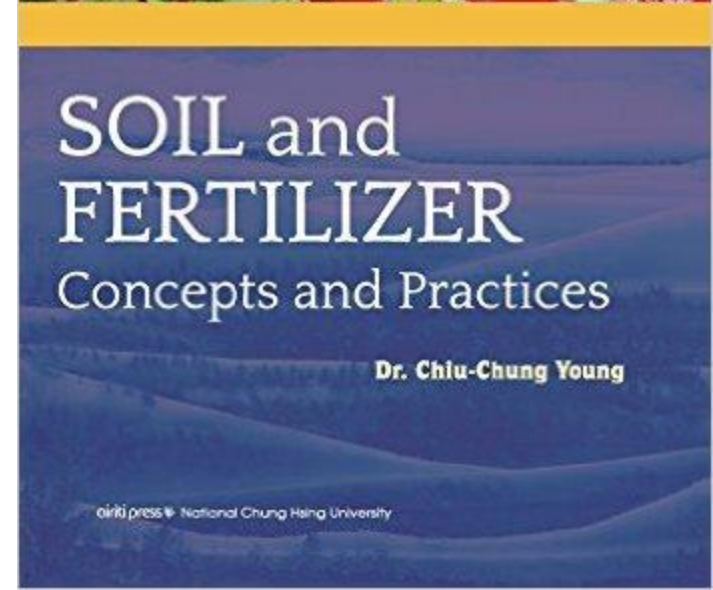


## 4. Novel species identification:

- 123 Novel bacteria were identified and were potentially useful in biotechnology.

## 5. Publication:

- Total 734 research articles were published, both in Chinese and English and a famous Hand book of agriculture-“Soil and Fertilizer” with 9 editions in 4 languages.



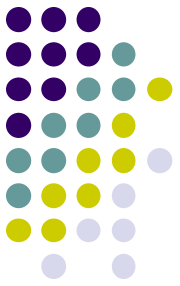
# Development of key technologies in biofertilizer



- 1. Selection and identification for best microorganisms :**  
Fast screening and molecular identification, finding novel species, screening for high soil adaptation and stress resistance.
- 2. Development from mono-function to multi-functions:**  
N<sub>2</sub>-fixation, P-solubilizing (Ca-P, Fe-P, Al-P, RP, Org-P) and organic decomposition for multi-functional biofertilizer.
- 3. Development from single fertilizer to complex fertilizer:**  
Producing microbial complex organic fertilizer and microbial complex organic chemical fertilizer (**biotech-fertilizer**).
- 4. Development from fast release and slow release to control release:**  
Application of high molecular polymers and micro-capsulation to produce slow and **control release fertilizer (biowise-fertilizer)**.



***We hunger for knowledge, seek for challenge and innovate for excellence***





*Thanks for your attention*

