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B&B e-Paper No. 3:

Biofertilizers and Biopesticides (B&B) for Sustainable Agriculture No. 3

Effective Solutions for Bacterial Wilt and Fusarium Wilt Diseases

The growth of fresh fruits and vegetables are crucial to applying a good control agent to manage the pest during production. The Solanaceae is essential crops for ready-to-cook and ready-to-eat food. Bacterial wilt disease, caused by *Ralstonia solanacearum* (Rs), is one of the most devastating diseases on the Solanaceae. On the other hand, Cucumber Fusarium wilt, caused by *Fusarium oxysporum* f. sp. *cucumerinum* (Foc), is one of the most devastating disease on cucumber. Until now, there are no effective chemicals for the above two disease control.

In Taiwan, Kaohsiung District Agricultural Research and Extension Station has developed a biopesticide with *Bacillus amyloliquefaciens* PMB01 to effectively control Rs and Foc diseases. The whole genome shotgun sequencing revealed that PMB01 harbors genes involved in the biosynthesis of cyclic lipopeptides, bacillibactin and bacilysin, which might collectively contribute to its biocontrol activity. Toxicity test demonstrated that PMB01 was not toxic to mammals.

The technology and the large-scale fermentation system for *B. amyloliquefaciens* PMB01 strain have been transferred to a local company, Jianon Enterprise Co., Ltd. in 2014 hence has registered as a bio-fungicide in 2015. Saviour® (AL 1×10^9 CFU/mL) and Busters® (WP 1×10^9 CFU/g) are registered bio-fungicides products.

· Jianon Enterprise Co., Ltd.

Jianon Enterprise Co., Ltd. is a pioneer, who introduce the first bio-insecticide, *Bacillus thurgensis*, to Taiwan. And currently, Jianon has hold the only product of nuclear polyhedrosis virus (NPV) in the bio-insecticides industry in Taiwan. In the past few years, Jianon Enterprise Co., Ltd. has successfully transformed from an importer to a producer with their own bio-fungicide agents. Jianon Enterprise Co., Ltd. has entered the Vietnamese market in Southeast Asia for nearly a decade, and has cooperated with Indonesia, Malaysia, India and other markets for analysis and evaluation. In addition, *B. amyloliquefaciens* PMB01 is testing on several diseases of coffee and pepper in different countries in ASEAN (Association of South East Asian Nations).



Fig. 1. Using Busters® dilute to 200X (10^6 CFU/g) to control bacterial wilt (Rs) of tomato.



Fig. 2. Using water as control.



Fig. 3. Using Saviour® dilute to 200X (10^6 CFU/g) to control Fusarium wilt (Foc) of cucumber.



Fig.4. Using water as control.

Commercial Biofertilizer and Biopesticide (B&B) Products of Taiwan

Biopesticides and biofertilizers are the natural, environmentally friendly alternative to chemical pesticides and synthetic fertilizers. Biofertilizers can make better soil condition, healthier plants growth, and enhance sustainable environment. By the late March 2019, there are 33 biofertilizer licensed products. The products' functions include phosphate solubilizing, potassium solubilizing and root function reinforcement in the soil (Table 1).

Table 1. The list of commercial biofertilizer products of Taiwan

Function	Number of Product	Company Name
Phosphate Solubilization	1	Moralburg Co., Ltd (漢寶工業股份有限公司)
	1	Tai Yeh Chemical Industry (臺益工業股份有限公司)
	4	Fwusow Industry Co., Ltd. (福壽實業股份有限公司)
	3	Sinon Corporation (興農股份有限公司)
	1	Kuang Hwa Chemical Co., Ltd. (光華化學股份有限公司)
	2	Great Victory Chemical Industry Co., Ltd. (大勝化學工業股份有限公司)
	3	Yanten Biotechnology Co., Ltd. (陽田生物科技股份有限公司)
	1	Taiwan Fertilizer Co., Ltd. (台灣肥料股份有限公司)
	10	Advanced Green Biotechnology Inc. (聯發生物科技股份有限公司)
	1	Greenpic Biotech Corporation (綠世紀生物科技股份有限公司)
	1	Wellness Top Biotechnology. Co., Ltd. (微新生物科技股份有限公司)
Potassium Solubilization	1	Envirolink Corporation (環盟生技股份有限公司)
	2	Sinon Corporation (興農股份有限公司)
Potassium Solubilization	1	Taiwan Fertilizer Co., Ltd. (台灣肥料股份有限公司)
Reinforcement of Root Function	1	Advanced Green Biotechnology Inc. (聯發生物科技股份有限公司)

Up to today, a total of 40 biopesticides (microbial pesticides) licenses has been issued in Taiwan, including 22 bio-insecticides (Table 2) and 18 bio-fungicides (Table 3). Among all 40 biopesticides (microbial pesticides), bio-insecticides of *Bacillus thuringiensis* which consists 21 kinds is the most abundance, followed by bio-fungicides of *Bacillus subtilis* that consists of 10 kinds.

Table 2. The list of commercial bio-insecticide products of Taiwan

Targeted Pest	Number of Product	Company Name
<i>Noctuidae</i> <i>Pieris canidia</i> <i>Hellula undalis</i> <i>Crocidolomia pavonana</i> <i>Plusia agnate</i> <i>Andraca bipunctata</i> <i>Ostrinia furnacalis</i>	7	Sumitomo Chemical Taiwan Co., Ltd. (台灣住友化學股份有限公司)
<i>Hellula undalis</i> <i>Crocidolomia pavonana</i> <i>Plusia agnate</i> <i>Plutella xylostella</i> <i>Pieris canidia</i> <i>Lymantria</i>	2	Fwusow Industry Co., Ltd (福壽實業股份有限公司)
<i>Crocidolomia pavonana</i> <i>Noctuidae</i> <i>Hellula undalis</i> <i>Plusia agnate</i> <i>Andraca bipunctata</i>	1	Farmers' association (中華民國農會附設各級農會農化廠)
	1	Lanlix Crop Science Co. Ltd. (聯利農業科技股份有限公司)
	1	Tai Yeh Chemical Industry (臺益工業股份有限公司)
<i>Ostrinia furnacalis</i> <i>Plutella xylostella</i>	4	Sinon Corporation (興農股份有限公司)
	1	Songtree International Corporation (松樹國際有限公司)
	4	Jianon Enterprise Co., Ltd. (嘉農企業股份有限公司)
<i>Plutella xylostella</i>	1	Yuan Mei Biotech Co., Ltd. (沅漢生物科技股份有限公司)

Table 3. The list of commercial bio-fungicide products of Taiwan

Targeted Disease	Number of Product	Company Name
Elongation disease of rice	2	Yuan Mei Biotech Co., Ltd. (沅漢生物科技股份有限公司)
	1	Moralburg Co., Ltd (漢寶工業有限公司)
Sheath blight Clubroot of cabbage Downy mildew Powdery mildew Phytophthora fruit rot Stem end rot of mango fruit	2	Kuang Hwa Chemical Co., Ltd. (光華化學股份有限公司)
	1	Farmers' association (中華民國農會附設各級農會農化廠)
	1	Sinon Corporation (興農股份有限公司)
	3	BION TECH INC. (百泰生物科技股份有限公司)
Gray mold	1	Sinon Corporation (興農股份有限公司)
	1	Taiwan Fertilizer Co., Ltd. (台灣肥料股份有限公司)
Leaf spot Leaf blight Brown spot Black spot Early blight Ring rot Purple blotch	1	BION TECH INC. (百泰生物科技股份有限公司)
Fusarium wilt of tomato and cucumber Bacterial wilt of solanaceous crops	1	Jianon Enterprise Co., Ltd. (嘉農企業股份有限公司)
Downy mildew of litchi Phytophthora fruit rot Phytophthora heart rot of pineapple	1	BION TECH INC. (百泰生物科技股份有限公司)
Panama disease	2	Advanced Green Biotechnology Inc. (聯發生物科技股份有限公司)

If you need any further information on commercial cooperation or product supply, please feel free to contact the editor, and regarding the application techniques ATRI also can assist if needed.

Information service of Taiwan commercial seed

From the "Taiwan Commercial Seed Information Service" website that you could find variety of seeds. The seeds are categorized into Agronomy and Horticulture two sections. The former includes *Brassicaceae*, *Cucurbitaceae*, *Solanaceae* and others. The later

includes bedding plants, herb, pot flower, turf and green manure crop seeds.

The web site also provides suppliers lists. The list provides general contact information, and best-seller. The seed you need can also be found more efficiently by the queries of products and/or suppliers.

In addition, the database has a seedling library, which includes references related to marketing information and trade regulations. Also, the information of development of the seedling industry, exhibition activities, related news, and latest version of the regulations of Taiwan are also provided. The purposes of the database to help the use to follow up the industry and future trends. Interested personals are all welcome to use.

Seek Now>>Taiwan Commercial Seed
(<http://tssb2b.tss.gov.tw>)

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