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B&B e-Paper No. 4:

Biofertilizers and Biopesticides (B&B) for Sustainable Agriculture No. 4

Multiple Benefit Products of *Bacillus subtilis* Y1336

Devoting to agricultural biotechnology, Biontech Co., Ltd is engaged in the production of biopesticide, biofertilizer and feed additive. Biontech provides farmers with superior products for organic agriculture. Conducting the products into IPM system in different countries is an important mission. Developing foreign markets, Biontech wants to promote these excellent products globally. Biontech has succeed in obtaining biopesticide registration permits in many countries, such as Brazil, Japan, Turkey, Vietnam... etc. (countries listed in Table 1).

Bacillus subtilis Y1336 is isolated from the soil in Taiwan and the foremost registered fungicide in Taiwan. In addition, Biontech became the first Taiwanese company which obtained biopesticide certificate in 2002. *B. subtilis* Y1336 has a property as a fungicide which means it can compete with various plant pathogenic microorganisms and produce antibiotic to prevent crops damage. The targets of *B. subtilis* Y1336 are soil borne and foliar diseases. *B. subtilis* Y1336 has been registered as two products, BioBac® WP and BioSol® AL.

Table 1. Commercial Product of *Bacillus subtilis* Y1336 information in different countries

Disease	Crops	Country	Dosage /100L	Dilution rate	Application Type	Application method
Gray Mold <i>Botrytis cinerea</i>	All crops	Brazil	800-1000g	200-1000X	Foliar	
	Tomato	Japan	100g	1000X	Foliar	Before pathogenesis to the early stage via duct application
	/Cherry Tomato		15g/1000ml/Day		Dust Application	
	Vegetables		100g	1000X		100-300g/100L. Spray. Before pathogenesis to the early stage of pathogenesis.
	Citrus		200-700g	1000X		200-700g/100L. Spray. Before pathogenesis to the early stage of pathogenesis.
	Tomato	Turkey	125g		Foliar	3 application sprayed at 10 days interval.
		Morocco	150g		Foliar	Beginning of disease (1 st treatment after emergence or transplanting), every 7~10 days, for 4-5 times.
		Tunisia	150g		Foliar	1 st treatment after emergence or transplanting, 3~4 applications sprayed at 7-10 days interval.
	Grape	Turkey	125g		Foliar	3 application sprayed at 10 days interval.
	Strawberry	Turkey	125g		Foliar	3 application sprayed at 10 days interval.
		Morocco	150g		Foliar	Beginning of disease (1 st treatment before flowering), every 7~10 days, for 4-5 times.
		Tunisia	150g		Foliar	1 st treatment after emergence or transplanting, 3~4 applications sprayed at 7-10 days interval.

Table 1 (continued). Commercial Product of *Bacillus subtilis* Y1336 information in different countries

Disease	Crops	Country	Dosage /100L	Dilution rate	Application Type	Application method
Bacterial wilt <i>*Ralstonia solanacearum</i> <i>*Pseudomonas solanacearum</i> E. F. Smith.	Tomato	Vietnam	200-300g	800-1000X	Soil	Spray 4 times, repeat every 7 days.
		China	125-165g	600-800X	Soil	Soil drench at Planting(500ml/hole), every 7 days for 4 times
		China*1	137.5-200ml	300-500X	Soil	Soil drench at Planting(500ml/hole), every 7 days for 4 times
Club Root <i>Plasmiodiophora brassicae</i> Woronin	Cabbage	Vietnam	200-300g		Soil	1 st : Before planting, repeat every 7 days.
		Taiwan*1	100-200g	500-1000X	Soil	7 days before field planting, using 200g/100L or 500X planting hole disc. Every 10 days after field planting, using 100g/100L or 1000X, continues 3 times. After soil preparation, 100g/100L or 1000X soil drench at Planting (3L/m ²).
Stem end rot of fruit <i>*Botryosphaeria rhodina</i> <i>*Lasiodiplodia theobromae</i>	Mango	Japan	200-700g	1000X	Foliar	200-700g/100L. Spray before pathogenesis to the early stage of pathogenesis.
		Taiwan	200g	500X	Foliar	Spray once in 7 day interval for 4 consecutive during the full blooming season.
Fruit rot <i>Pestalotiopsis eugeniae</i>	Wax apple	Taiwan	200g	500X	Foliar	Blossom, every 7 days, 4 times Foliar spray successively.

Table 1 (continued). Commercial Product of *Bacillus subtilis* Y1336 information in different countries

Disease	Crops	Country	Dosage /100L	Dilution rate	Application Type	Application method
Fruit rot <i>Botryosphaeria rhodina</i>	Sugar apple	Taiwan	125g	800X	Foliar	Spray in the beginning of seeding fruit, every 7 days for 3 times.
Brown Rot <i>Monolinia fructicola</i>	Cherry	Turkey	100g		Foliar	3 application sprayed at 10 days interval.
Brown Root <i>Monilinia laxa</i>	Apricot		125g		Foliar	Beginning of disease, every 5~7 days for 4-5 times.
Root Rot <i>*Pythium aphanidermatum</i> <i>*Pythium myriotylum</i> <i>*Pythium coloratum</i> <i>*Pythium ultimum</i> var. <i>ultimum</i>	Cauliflower	Vietnam	200-300g		Soil	1 st : Before planting, repeat every 15 days/time.
Leaf Mold <i>Fulvia fulva</i>	Tomato /Cherry Tomato	Japan	100g	1000X	Foliar	100-300g/100L. Spray before pathogenesis to the early stage of pathogenesis.
Late blight <i>Phytophthora infestans</i>	Potato	Turkey	125g		Foliar	Beginning of disease, every 5~7 days for 4-5 times.
Downy mildew <i>Pseudoperonospora cubensis</i>	Cucumber	Taiwan	125g	800X	Foliar	Beginning of disease, every 7 days for 4 times.

Table 1 (continued). Commercial Product of *Bacillus subtilis* Y1336 information in different countries

Disease	Crops	Country	Dosage / 100L	Dilution rate	Application Type	Application method
Powdery Mildew	Vegetables	Japan	100g	1000X	Foliar	100-300g/100L. Spray. Before pathogenesis to the early stage of pathogenesis.
Powdery Mildew <i>Sphaerotheca pannosa</i>	Flower	Japan	100g	1000X	Foliar	100-300g/100L. Spray. Before pathogenesis to the early stage of pathogenesis.
Powdery Mildew <i>Erysiphe pisi</i>	Pea	Taiwan	125g	800X	Foliar	Before disease breaks out, spray every 7 days for 4-5 times. Add a spreading reagent in the dilution so as to spray evenly on the whole plants.
Powdery Mildew <i>Sphaerotheca macularis</i> f. sp. <i>fragariae</i>	Strawberry	Korea	167g		Foliar	Beginning of disease, every 7 days for 4-5 times.
		Vietnam	300g		Foliar	Spray 4 times, repeat every 7 days.
Powdery Mildew <i>Sphaerotheca fuliginea</i>	Muskmelon	Korea	167g		Foliar	Beginning of disease, every 7 days for 4-5 times.
	Pumpkin		125g		Foliar	
	Cantaloupe					
Powdery Mildew <i>Leveillula taurica</i>	Pepper	Turkey	125g		Foliar	Beginning of disease, every 5~7 days for 4-5 times.
		Korea	167g		Foliar	Beginning of disease, every 7 days for 4-5 times.
	Eggplant	Korea	167g		Foliar	Beginning of disease, every 7 days for 4-5 times.
Powdery mildew <i>Sphaerotheca fusca</i>	Cucumber	Egypt	200g		Foliar	Beginning of disease, every 7 days for 3-5 times.
		Korea	167g		Foliar	Beginning of disease, every 7 days for 3-5 times.
		China	125-250g	400-800X	Foliar	Beginning of disease, every 7 days for 3-5 times.
Powdery mildew <i>Erysiphe schisandrae</i>	Schisandrae Chinensis Fructus	Korea	125g		Foliar	Beginning of disease, every 7 days for 3-5 times.

Table 1 (continued). Commercial Product of *Bacillus subtilis* Y1336 information in different countries

Disease	Crops	Country	Dosage / 100L	Dilution rate	Application Type	Application method
Sheath blight <i>*Thanatephorus cucumeris</i> <i>*Rhizoctonia brassicae</i>	Rice	Taiwan*1	250g	400X	Foliar	Spray 2 times. First at tiller and second at heading stage. *Evenly spray to the whole plant, especially the part near ground and sheath.
		Thailand	125g	30g/20L	Foliar	Beginning of disease, every 7 days, continues 3 times. 2 weeks before harvesting, spray once again.
		Myanmar	150g			Beginning of disease, repeated spray every 7 days.
Rust <i>Hemileia vastatrix</i>	All crops	Brazil	250-750g 170-500g	400X 600X	Foliar	
Purple blotch <i>Alternaria porri</i>	All crops		500-1000g 100-200g	200X 1000X	Foliar	
Bull's-eye Rot <i>Neofabraea perennans</i>	All crops		600-800g 300-400g	500X 1000X	Foliar	
Damping-Off and Seeding Blight <i>Rhizoctonia solani</i>	All crops		1000-1300g 600-800g 375-500g	300X 500X 800X	Planting groove Drench Foliar	15-30ml/Plant.

Application of Hyperspectral Imaging to Evaluate the Effectiveness of Biofertilizer on Plant Growth

Evaluating the effectiveness of fertilizer through comprehensive tests on crop yield, nutrient analysis, and soil analysis takes a long time. It might hinder the progress of fertilizer development. Over the last few years, the hyperspectral image analysis was conducted to evaluate nutrient composition and health condition of plants. Therefore, ATRI collaborates with Taiwan HiPoint Cooperation to develop a hyperspectral imaging and analysis system for preliminary evaluation of the effect of fertilizer on plant growth. With high resolution hyperspectral image data, we can accelerate the evaluation process of fertilizer and as in biofertilizer.

Ghost pepper plants with different compound biofertilizers at three-day post treatment are demonstrated in pseudocolor images in Fig.1. Leaves with warmer color represent plant in better health condition, by contrast, cooler color means plant in poorer health condition. Comparing to the conventional evaluation process which might take weeks to several months (depends on types of fertilizers and varieties of plants) to visualize and quantify

the difference between treatments, the study shown below only need three days to distinct the difference between treatments. Among three treatments, the plant with treatment B shows in the healthiest condition via computing hyperspectral image data which correlates the conventional evaluation results two weeks after (data not shown).

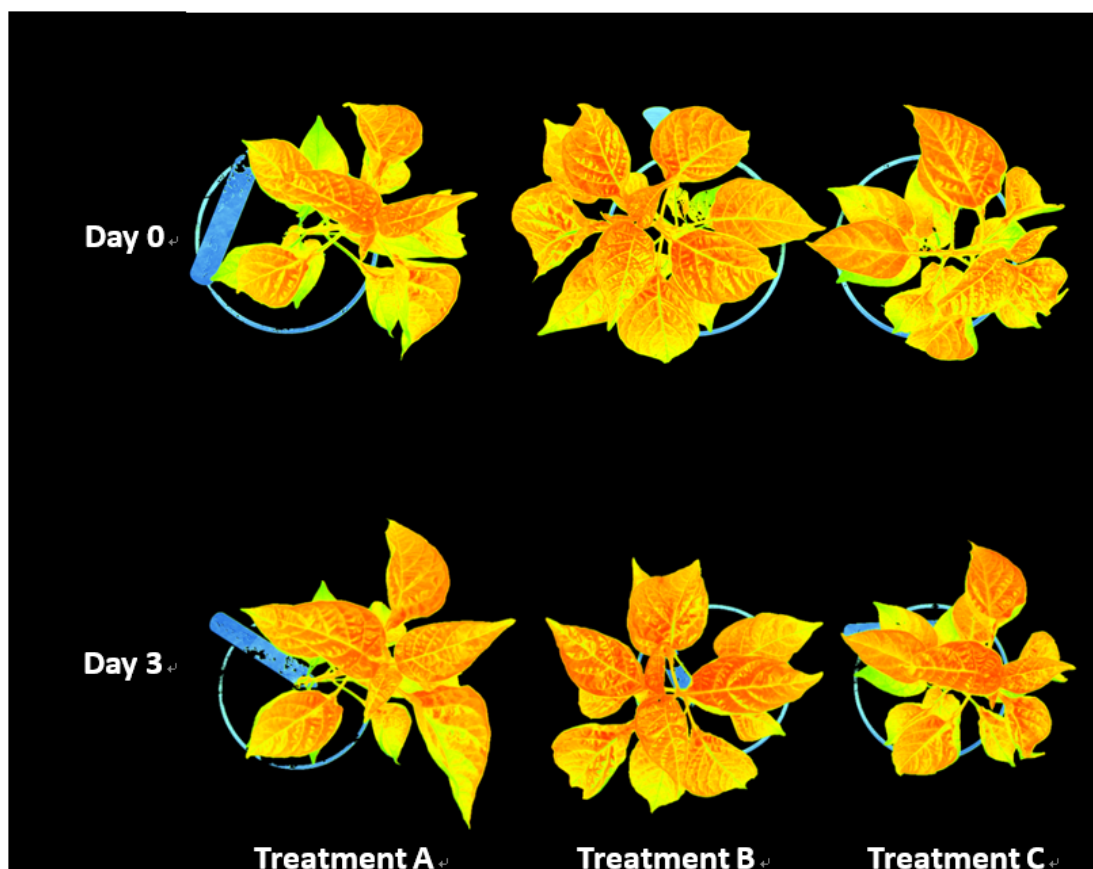


Fig. 1. Pseudocolor spectral image of ghost pepper with biofertilizer treatments.

Shiny Gem - Cherry Tomato

Cherry tomato is considered one of the most important Taiwanese breeding items. Due to its high sweetness and fantastic taste, it earns great international popularities in recent years and demands for new varieties is increasing. Taiwan is located in the tropical and subtropical regions. The geographical environment and climate make it suitable for breeding disease-resistant and tolerant varieties. In addition, Taiwan's breeders are more focused on the high-yield, disease-resistant and easy-to-cultivate characteristics. Besides research inputs from the agricultural sector and academic institutes, private companies have also selected a number of excellent varieties suitable for growing in the Asian region (described below). For more details, please visit the Taiwan Seed Service website.

◦ TO-4881 SUMMER EXPRESS (夏越)

Determinate tomato, med-small dark green leaves, well-branched, med-short internode, single or multiple flower clusters, jointed fruit peduncle and easy to pick by hand, green shoulder, long oval fruit shape, weighting 12-13 grams, brix 9%. Fruit turns red early, bright red to deep red. Moderate bacterial wilting and heat tolerance. Very strong and

resistant to cracking. Excellent variety for growing in greenhouse over summer period, suitable for long-distance container transport and export.



◦ TO-4111 GOLDEN SWEET (橙蜜香)

Strong and indeterminate plant with short internode. Good heat and salt stress tolerance, resistance to ToMV and strong TYLCV (Ty-2) tolerance, multiple wide clusters, olive-shaped fruit, weighting 20 grams, with good looking long calyx, the orange-yellow fruit has no green spots at ripening and turned deep orange at maturity. Thick flesh with 14-15% Brix, cracking tolerant, long shelf life. Very unique flavor with less residue, high beta-carotene, suitable for small packages, high prices in supermarket.



**Seek Now >> Taiwan Commercial Seed
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