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Research investigation of natural products from microorganisms for sustainable agriculture in Vietnam: A short comminication

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Abstract The potent microorganisms used for sustainable agriculture in Vietnam has been investigated by Soytong, K. for years. The natural products named synegistic *Chaetomium* and *Trichoderma* Biofungicide, Biodegradable nano-elicitor for plant immunity and Biodecomposer for soil revitalization and improvement through fermentation to increase organic matter and fertility in the cultivated soils. The mixture of several strains of powerful *Chaetomium* for plant disease control to be a broad spectrum biofungicide and enzymatic fungi for biodecomposer are proved to be synergistic fungal community. A novel biodegradable nano-particles contructed from active metabolites of *Chaetomium* spp named nano-elicitor is discovered to induce immunity in plants eg rice, tomato, durian and citrus. Biodecomposer demonstasrtes as a synergistic group of microorganism producing cellulase, hemicellulase, ligninase and protease that produced from *Achaetomium* sp., *Eurotium* sp, *Emericella* sp, *Trichoderma* sp., *Aspergillus japonicus, Aspergillus terreus* and 3 benefit bacteria to degrade organic and inorganic materials, and improve soil revitalization and productivity. Withis some parts of research projects were supported by Ministry of Agriculture and Rural Development in Vietnam.

Keywords: Chaetomium, Biodecomposer, Nano-elicitor, Plant disease and immunity

The synegistic *Chaetomium* and *Trichoderma* broad spectrum biofungicide

Chaetomium and *Trichoderma* species have been isolated from forestry soil and soil planted to coffee and tea etc. in Vietnam. There were tested to compare disease control efficiency to former effetive *Chaetomium* and *Trichoderma* species which isolated elsewhere. There are found effetive species, studied amd compared biological activities with the previous strains isolated from other countries. They have developed to be the syngernistic mixture as a broad spectrum biofungicide for plant disease control and promoted to the

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farmers in Vietnam. The synergistic mixture of *Chaetomium* and *Trichoderma* species proved to be good biofungicide for plant disease control. It is a unique board spectrum synergistic biofungicide which not only for disease control but also for stimulating plant growth. The active ingredients of synergistic mixture of Chaetomium species is the spores of 1.5 X 10^6 CFU/ml from *Chaetomium* sp. strtains CCo, C*B, CL, CG, CC,* and spores 1.2 X 10^4 CFU/m/ of *Trichoderma* sp. (Fig.1 &2).

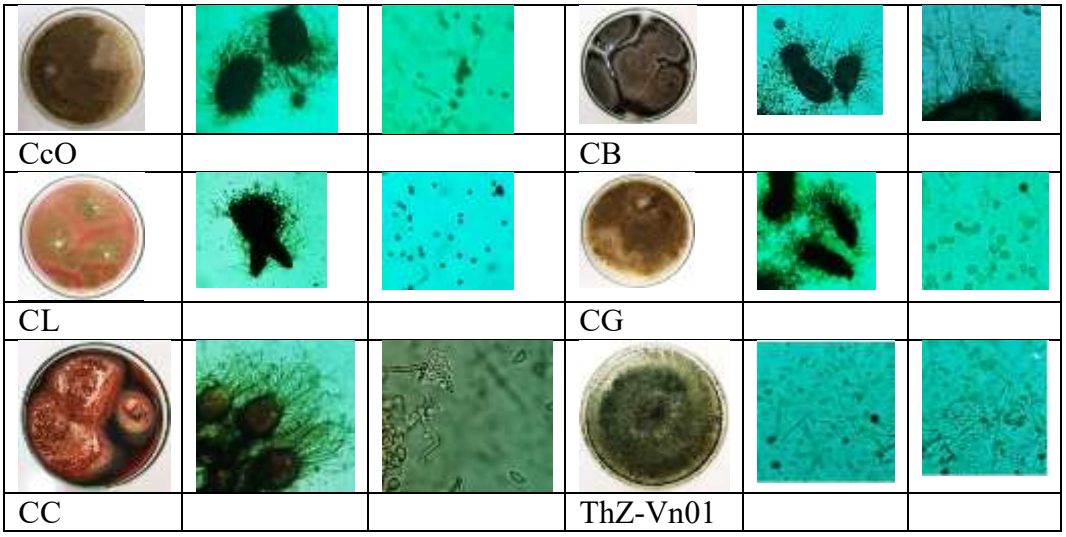

Figure 1. Characteristics of *Chaetomium* and *Trichoderma* species

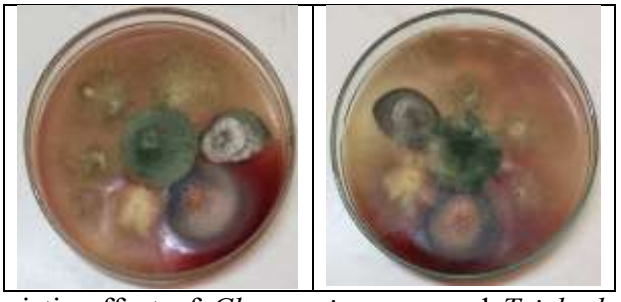

Figure 2. Synergistic effect of *Chaetomium* spp and *Trichoderma harzian*um Thz=Vn0

The application synergistic mixture of *Chaetomium* and *Trichoderma* species successfully controlled several diseases in the adjustable proper soil, neutralize soil pH with adding organic fertilizer. Then, the active spores of *Chaetomium* spp and *Trichoderma* sp can be properly grown and released the metabolites to inhibit the target phytopathogens as a control mechanism. It

found that after the active strains grow generation by generation, they have been faced the naturally weak on artificial media and possible died due to naturally lysis or attack by other living organisms in the soil. Then, the application to control diseases need to be repeated and treated for sustainable crop protection from diseases. *Chaetomium* species are also produced by the fungal biomass leading to improve soil fertility and humus layer soil The application rate for perennial crops e.g. Apple, Peach, Sweet Orange, lime, Pamelo, Black Pepper,Tobacco, Tea, Coffee, Guava, Durian, and Mango etc., are used as protection at 25 cc/20 L, and apllied control at 50 cc/20 L. For annual crops like Vegetables e.g. Kale, Chinese Cabbage, Radish, Cucumber, Chili, Asparagus and potato etc. Field crops e.g. Rice, Corn, Tomato, Soybean, Water Melon, Cantaloup, Grape and Tobacco etc. Cut Flower crops e.g Carnation, Rose, Statis Caspier, Bird's of Paradise and Orchids etc., are applied for protection at 25 cc/20 L, and applied for control at 50 cc/20 L. (Suwan *et al*., 2000; Soytong *et al*., 2001; Phong *et al*., 2016; Kanokmedhakul *et al.,* 2006; Kaewchai *et al*., 2009; Thahinung *et al*., 2010; Panthama *et al.,* 2011; Khumkomkat *et al.,* 2009; Panthama *et al*., 2014; Phonkerd *et al*., 2008; Hung *et al.,* 2015; Hung *et al*., 2015ab; Nguyen *et al.,* 2015, 2018; Udompongsuk *et al.,* 2018; Soytong *et al*., 2019; and Tantapakul *et al.,* 2020).

Nano-elicitor for plant immunity

Nano elicitor is discovered as biodegradable naturtal product nano particles derived from active metabolites from *Chaetomium* spp. It declares the active ingredients of the naturally degradable nano-particles derived from active compounds (substances) or natural products of fine particles bioactive copumpounds eg. chaetoglobsin C, chaetomanone, rotiorins etc.which extracted from fungal biomass of spores 1.5 X 10^6 CFU/ml of *Chaetomium* spp. Photosynthesizing bacteria is mixing in formulation to stimulate plant growth, help to fix NO_2 to be NO_3 (nitrate), and SO_2 to be SO_4 (sulfate) for plant growthm (Fig.3 & 4).

Figure 3. Nano particles (lefet, middle) and bacterial cells under scanning electyron miucroscope

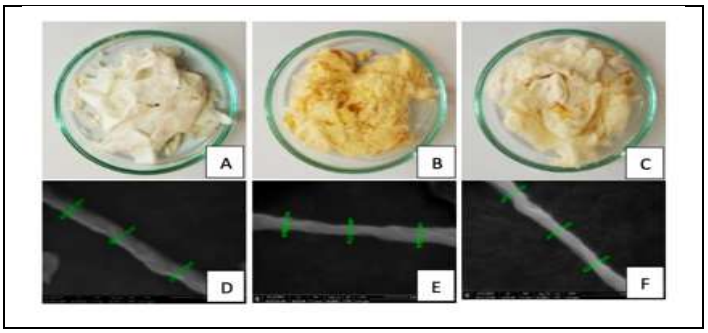

Figure 4. Nano particles (A, B, C) and nano partices under scanning electyron miucroscope (source: Song *et al.*, 2020)

It can be appled to induce disease immunity in plants, stimulate phytoalexin production in plants against diseases like chilli, citrus, durian, rice and tomato, moreover to stimulate new root growth, revitalize soil and make available plant nutrient for plant and increase plant ability to uptake nutrients and increase yield. Application rate is recommended at 25-50 cc per 20 Litre of water and spraying over the plant and around basal stem (Tan *et al.,* 2016, 2017; Song *et al*., 2018; Thongkham *et al*., 2018; Tongon *et al.,* 2018; Vareeket *et al.,* 2018; and Vilavong *et al.,* 2018).

Bio-decomposer

Biodecomposer for organic degradation, soil improvement and revitalization is the reserch finding of...the high potential microorganism producing cellulase, hemicellulase, ligninase and protease etc. as follows:- *Achaetomium* sp., *Aspergillus japonicus, Aspergillus terreus, Emericella* sp, *Eurotium* sp, *Penicillium* sp*., Trichoderma* sp. (Fig. 5) and 3 potent enzymatic bacteria to degrade organic substances and naturally inorganic materials for releasing available nutrients in soil for plant uptake and to increase soil revitalization and productivity. These enzymatic producung fungi and bacteria were friendly grown as synergistic relation (Fig. 6). It is a group of potential microorganisms to degrade organic materials or make compost or degrade rice straws in paddy fields. The composition to make compost are as follows:- bio-decomposer 200 ml(g) per plant and animal debris 1,000 kg with 10 kg lime. For comopst production, it can be used for degrading rice straws in paddy, it can be applied at 200 g per 1,600 m^2 before ploughing the paddy fields prior to transplanting for 7-15 days (Phuwiwat and Soytong, 1999; Suwan *et al.,* 2000; Phuwiwat and Soytong, 2001; Srinon *et al*., 2006; Kanokmedhakul *et al.,* 2011;

Kaewchai *et al*., 2009; Moosophon *et al*., 2009; Thiep *et al.*, 2019; Soytong and Nguyen, 2013; Soytong *et al.*, 2013). Moreover, it can also be applied directly into cutivated soil to revitalize and increase organic matter in cultivated soil.

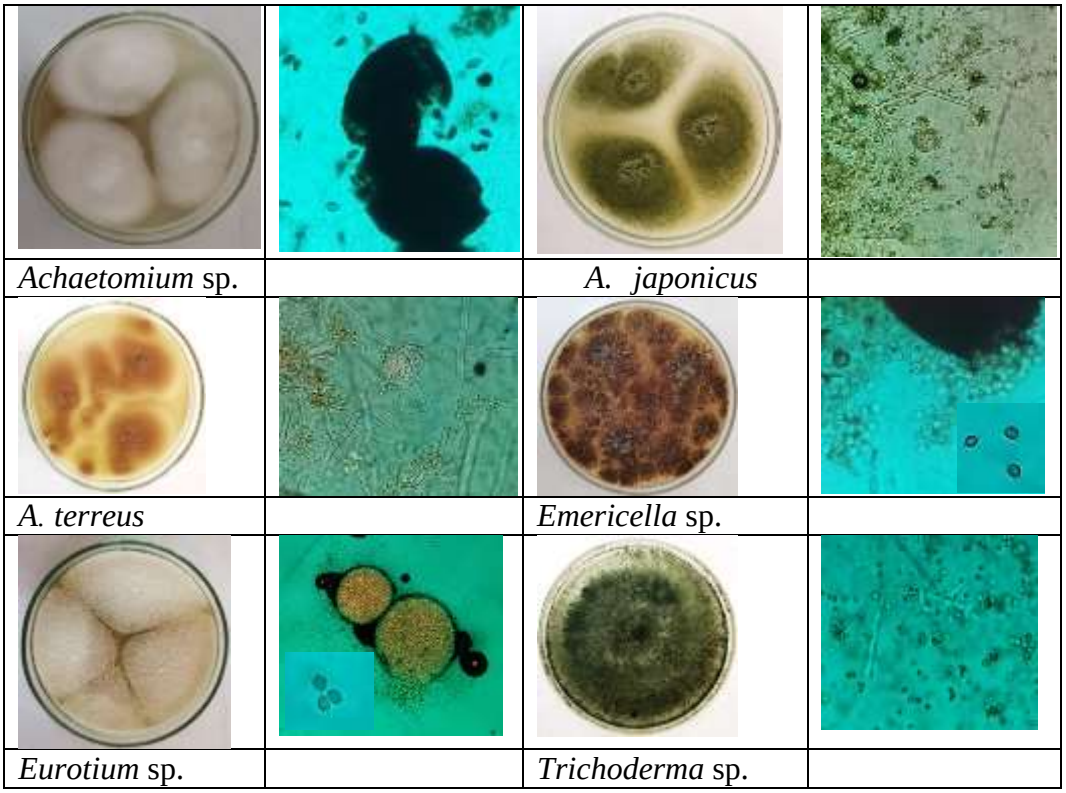

Figure 5. Characteristic of enzymatic producing fungi

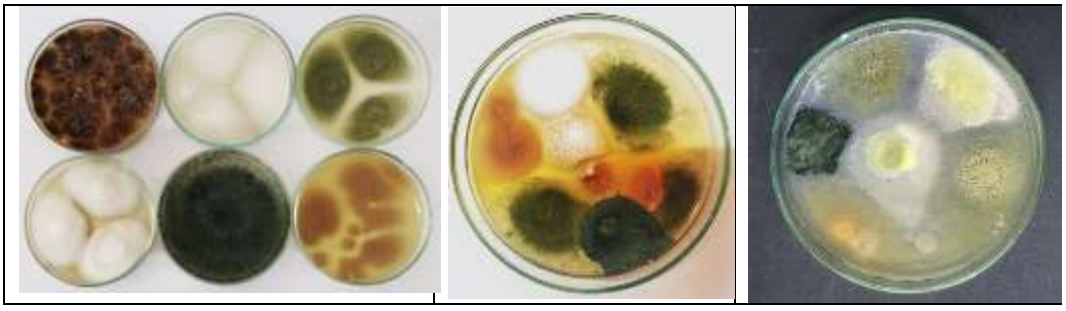

Figure 6. Snergistic effect of Characteristic of enzymatic producing fungi and bacteria

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