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USING TRICHODERMA SPECIES FOR BIOLOGICAL CONTROL OF PLANT PATHOGENS IN VIET NAM

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ABSTRACT

Trichoderma spp. are fungi that occur worldwide. Recent studies show that they are not only parasites of fungal plant pathogens but also can produce antibiotics. In addition, certain strains can induce systemic and localized resistance to several plant pathogens. Moreover, some strains may enhance plant growth and development. The potential of *Trichoderma* species used as biological agents of plant diseases have been known since the 1930s, however these were introduced in Vietnam about two decades. Surveys conducted on food crops, industrial crops, vegetable crops and fruit crops in the north and south of Vietnam indicate that *Trichoderma* are common and can be isolated easily from soil, root and plant organic matters. *Trichoderma viride*, *T. harzianum*, *T. hamatum* were predominant species in Viet Nam. Laboratory and field trials in Viet Nam also proved that *Trichoderma* species had ability to suppress growth of fungal plant pathogens and enhance plant growth and development. Experiments conducted on several crops such as: peanut, tomato, cucumber and durian indicate that selected *Trichoderma* strains could reduce significant diseases caused by fungal pathogens including: *Phytophthora palmivora*, *Rhizoctonia solani*, *Fusarium* spp., *Sclerotium rolfsii* and *Pythium* spp. The efficacy of *Trichoderma* species on soil borne fungal disease is higher than fungicides and maintain longer. The value obtained through development, exploitation and use of *Trichoderma* products are not only plant disease control but also gave the local people opportunities to reduce health risks, costs and environmental damage due to over fungicide usages. Moreover, crop treated with *Trichoderma* grown better and had higher yields to compare with the one without application. There have been extensive efforts to commercial *Trichoderma* products for managing plant diseases in the field in Viet Nam. *Trichoderma* products have been developed by several companies, institutes and universities such as: BIMA, Trico-ĐHCT, Promot Plus WP, Vi – ĐK, NLU-Tri, Bio – Humaxin Sen Vang and Fulhumaxin are available commercially now. *Trichoderma* product can be used in many ways including: seed treatment, applied direct to the soil before planting and added to organic fertilizers.

Key words: fungal plant pathogens, resistance

INTRODUCTION

Members of the *Trichoderma* genus are known as imperfect fungi, fast growing in culture and produce numerous green spores. These occur worldwide and are commonly associated with root, soil and plant debris (Howell *et al*, 2003). These have long been recognized as biological agents to control plant diseases. Since the first application in 1930s, *Trichoderma* species became popular biological agents to protect crops against plant pathogens all over the world. Past research indicated that *Trichoderma* can parasitize fungal pathogens and produce antibiotics. Weindling (1932) described in detail the mycoparasitism of a fungal pathogen causing damping off disease (*Rhizoctonia solani*) by the hyphae of *Trichoderma*, including coiling around the hyphae, penetration, and subsequent dissolution of the host cytoplasm. He also described an antibiotic which was toxic to both *R. solani* and *Sclerotinia americana*, and named it gliotoxin. In the year following

this study, many similar results were reported by other plant pathologists. The mechanism of antibiosis was demonstrated in several studies. An antibiotic, gliovirin, from *Trichoderma virens* demonstrated strong inhibition of *Pythium ultimum* and the *Phytophthora* species (Howell and Stipanovic, 1995). More recent research indicated that certain strains of *Trichoderma* can induce systemic and localized resistance to several plant pathogens. Plants treated with *Trichoderma* in the root zone can produce higher levels of peroxidase, chitinase activity, deposition of callose-enriched wall appositions on the inner surface of cell walls and pathogenesis-related proteins. Moreover, some strains may enhance plant growth and development. These phenomena was observed by several researchers who treated plants with *T. harzianum* resulting in large increases in root area and cumulative root length, as well as significant increases in dry weight, shoot length, and leaf area over that of the untreated control (Howell, 2003). Due to effective control of plant diseases, several commercial biological products based on *Trichoderma* species are manufactured and marketed in Asia, Europe and USA for use on a wide range of crops. These can be efficiently used as conidia, mycelium and chlamydospores which are produced in either solid state or liquid fermentation (Harman *et al*, 2004).

The use of *Trichoderma* as a biological agent of plant diseases has long been known, however, these were introduced to Vietnam only in the last two decades (Tran, 1998). Research has been done on biological control potential of *Trichoderma* spp. against several pathogens attacking vegetables, fruits, field and industrial crops. Surveys conducted in the north and south Vietnam on several type of crops showed that *Trichoderma* have been isolated from soils, root, leaves and plant debris (Table 1).

Table 1. Trichoderma species isolated from several crops in Viet Nam.

No	Species	Crop	Location
1	*T. atroviiride*	Coffee, tea	Central Highland
2	*T. hamatum*	Peanut, soybean	South, North
3	*T. harziamum*	Tomato, pineapple, peanut	South, North
4	*T. koningii*	Rubber	South, North
5	*T. reesei*	Rice, maize	South, North
6	*T. virens*	Peanut, soybean, tomato	South, North
7	*T. viride*	Peanut, soybean, tomato, durian	South, North

Trichoderma viride, *T. harzianum*, *T. hamatum* are predominant species in Viet Nam. After identification, *Trichoderma* isolates were preserved, tested and selected based on their efficacy on growth inhibition of fungal pathogens in *in vitro, in vivo*and green house as well as under field conditions. The first successful use of a *Trichoderma* product to control fungal diseases of rice and peanut was demonstrated by researchers at the National Institute of Plant Protection in 1995.

Trichoderma species, which were grown on solid media, were screened at different doses to determine the efficacy of the antagonists. Disease incidence decreased significantly when *Trichoderma* was used to treat soil and seeds compared with untreated controls. After that *Trichoderma* species became the most common fungal biological agents that have been extensively researched and deployed throughout Viet Nam. The number of research projects on *Trichoderma* on various crops are presented (Fig. 1).

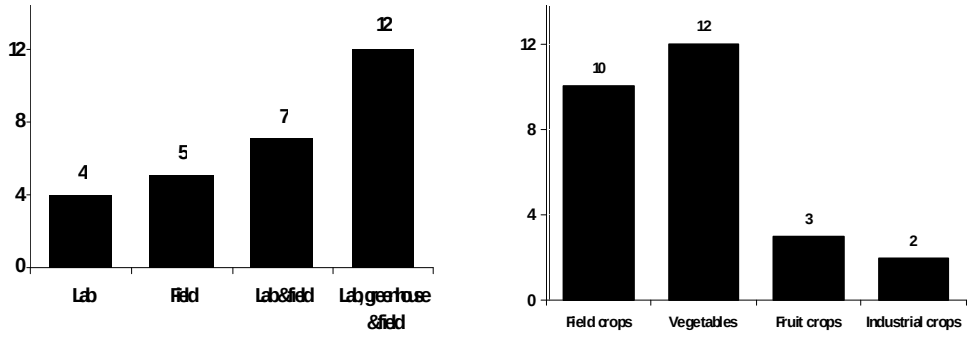

Fig. 1. Number of *Trichoderma* research projects grouped by site and by crops

For last twenty years, a total of 28 research projects on *Trichoderma* was conducted in Viet Nam which included laboratory, greenhouse and field works. These projects were carried on most of economical important group of crops such as field, vegetable, fruit and industrial crops. Results came out from the projects proved that *Trichoderma* spp. could be used to control several fungal pathogens causing plant diseases. Several plant diseases caused by fungi can be potentially controlled by *Trichoderma* species (Table 2).

Table 2. Plant diseases controlled by Trichoderma species.

Name of disease	Crop	Fungal pathogens	*Trichoderma* species
Wilt	Tomato, Chili, Peanut, Potato, Coffee, Black pepper, Lychee	*Fusarium* spp.	*T. hamatum*, *T. harzianum*, *T. viride*, *T. virens*
Root rot	Citrus, Tobacco, Pineapple, Durian, Rubber, Black pepper, Lychee	*Phytophthora* spp.	*T. harzianum*, *T. viride*
Damping off	Tomato, Chili, Peanut, Potato, Soybean, Maize, Cabbage, Chinese cabbage	*Pythium* spp., *Rhizoctonia solani*	*T. hamatum*, *T. harzianum*, *T. viride*. *T. virens*
Southern stem rot	Tomato, Chili, Peanut, Potato, Soybean,	*Sclerotium rolfsii*	*T. hamatum*, *T. harzianum*, *T. viride*. *T. virens*
Cottony rot	Cabbage, Chinese cabbage, Soybean	*Sclerotinia sclerotiorum*	*T. harzianum*, *T. viride*
Sheath blight	Rice, Maize	*R. solani*	*T. harzianum*, *T. viride*

The application of *Trichoderma* species can control a large number of foliar and soil borne fungi i.e. *Fusarium* spp., *R. solani*, *Pythium* spp., *S. sclerotium*, *S. rolfsii*, in vegetables, field, fruit and industrial crops (Tran, 1998; Ngo et al, 2006). These results were similar to previous studies in other countries where *Trichoderma* spp. was used successfully to control fungal pathogens.

Therefore, farmers have reduced their use of chemical fungicides.

Further studies were conducted to find techniques for mass multiplication and development of a bioformulation of the biological control agent. Several growth media and protocols for *Trichoderma* spp. spore production were reported as mass scale production would have great potential for commercial use. At the beginning, *Trichoderma* propagules, in the form of conidia, mycelium and chlamydospore, were mass produced on conventional synthetic media. However the cost of these materials was too high. To overcome cost limitation, alternative substrates such as rice husks, coffee, sugarcane waste, rice bran, corn meal were used. *Trichoderma* products can be applied to the soil, used as seed treatment, seedling root dip or added to organic fertilizers/or compost.

The use of *Trichoderma* product has both short term effects: immediate control of diseases and growth enhancement of crops as well as long-term effects which are demonstrated by the decrease in fungal pathogen inoculum in the field. Health plants mean less contamination from chemicals. Presently, *Trichoderma*-based products are considered as relatively novel biological control agents which can help farmers to reduce plant diseases and increase plant growth.

Several commercial *Trichoderma* based products were registered and sold in Vietnam market (Table 3).

Table 3. *Trichoderma* based products commercialized in Viet Nam.

Trade name	Company	Active ingredients
Promot PlusWP Promot PlusDD	Tan Quy	*Trichoderma* spp. *Trichoderma koningii* *Trichoderma harzianum*
TRiB$_1$	National Institute of Plant	*Trichoderma* spp.
TRICÔ-ĐHCT	Can Tho University	*Trichoderma* spp.
Vi – ĐK	Pesticide Corp.	*Trichoderma* spp.
NLU-Tri	Ho Chi Minh University of Agriculture and Forestry	*Trichoderma virens*
Biobus 1.00WP	Nam Bac	*Trichoderma viride*
Bio – Humaxin Sen Vàng 6SC,	An Hung Tuong	*Trichoderma* spp.
Fulhumaxin 5.15SC	An Hung Tuong	*Trichoderma* spp.

It is interesting to note that *Trichoderma* based products in Viet Nam were developed and commercialized by companies, institutes and universities (Table 3). This provides more opportunities for farmers to multiply and use fungi. The successful application of *Trichoderma* spp. to control soil borne fungal diseases were reported by farmers around Viet Nam. Soon after short time training, the farmers can understand and do it by themselves.

CONCLUSION

Trichoderma species play an important role in controlling fungal plant pathogens, especially soil borne fungal pathogens. The use of *Trichoderma*-based products is not only safe for the farmers and consumers but it is also good for the environment. However, much more work needs to be done to develop stable, cost effective, easy to produce and easy to apply formulations.

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