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Success of using antagonistic fungi for control of plant pests in the Royal Project's area

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Plant protection program in the Royal Project has put emphasis on IPM. Biological control has been introduced to the farmers in all 3 production systems i.e. GAP, EUREPGAP and organic. Most highland farmers are poor; they do not have much money for investment. To reduce the cost of investment, PPC (Plant Protection Center) has developed IPM completed program for the farmers. Intensive training on IPM which has demonstrations and practice on important activities of plant protection including multiplication of antagonistic fungi in the compost mixed with rice bran. *Trichoderma harzianum* (control of foot and root rot diseases) and *Paecilomyces lilacinus* (egg parasite of root knot nematode) are the main fungi used in the areas. Because of having limited area, monocrop and continuous planting is the cause of accumulation of pests. Using biological control method alone without IPM cannot succeed. Only training the farmers on IPM which include biological control cannot make the farmers change their habit on using chemical pesticides. Providing them the effective fungal starters (the fungi grown on steamed sorghum seeds) training them to multiply and how to use will enable them to use. Their understanding from their own use makes them accept and continuously use. Record made by PPC shows that orders of *T. harzianum* starter from the highland farmers are increasing from 563 kg (yr. 2005) to 1,467 kg (yr 2007), *P. lilacinus* from 17 kg to 63 kg. This is not including the bioproduct of *T. harzianum* which some farmers still use, but the amount they bought does not increase (87 kg in 2005 and 84 kg in 2007). At present (year 2008), orders of the fungal starters from the farmers increase tremendously both from the Royal Project's farmers and outside farmers but the figure in the record has not yet been summarized.

Key words: Biological control, antagonistic fungi, *Trichoderma harzianum*, *Paecilomyces lilacinus*, bioproduct

Introduction

Royal Project was founded by King Bhumibol Adulyadej in 1969. Since then it has been progressing and become a most famous and useful project known to the Thai people and to the world. In 1986 it was reestablished as a foundation "Royal Project Foundation". The king kindly accepted to be the

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honorary president of the foundation and donated 500,000 baht for the beginning. He has changed the way of life of the hilltribe from shifting cultivation of opium poppy, selling opium, smoking opium; having poor health and being poor to no opium poppy cultivation, no smoking opium, doing legal good agriculture, having good health and earning enough money or even more than enough for their living (Development Division, 2008).

The King while visiting the Royal Project

The King went to the area where opium poppy planted

Royal Project Foundation (RPF) in 2007 had 150,248 farmers of 269 villages in 5 provinces in northern part of Thailand. Most crops introduced to the farmers are temperate which were resulted form research works of researchers from many government institutes. Record on Royal Project's produces sold to the markets (including export) in 2007 showed that vegetables of 42 kinds from 5 groups of cultivation (GAP, EUREPGAP, Organic, New kinds and Herb) came highest in total of 11.2 tons. Cutflowers (39 kinds) and leaves (17 kinds) came second with the income of 20 millions baht. Fruits (temperate, tropical, small fruit) came third with the production in total of temperate fruits 201,508 kg. (3.8 millions baht), small fruits 219,714 kg. (6.9 millions baht) and tropical fruits 106,300 kg. (1.8 millions baht). This paper does not include field crops, mushroom, cultivated forest, domesticated animals and fishery.

Plant Protection Center (PPC) is responsible for controlling diseases and all other pests of all kinds of plant in the areas of 38 Royal Project Development Centers (RPDC). PPC is also responsible for controlling pesticide use and pesticide residues in the produces. With this heavy task, PPC has set a plant protection plan by training the extension workers (EW) of all RPDCs on integrated pest management (IPM) continuously for 5 years (Development Division, 2002). It was an intensive training by lecture and practice to enable them to understand how to make the plant strong and healthy. They must learn how to improve soil structure, to make compost and biofertilizer, to check soil pH and adjust it to the suitable level. They should be able to diagnose plant

disease symptoms and insect damages, to distinguish between natural enemies and pests of plant. They must know how to reduce the use of chemical pesticides by using medicinal plant extract and beneficial microorganisms. PPC team did some research and extended the best results to the extension workers, trained them to be the trainer. One trained EW from each RPDC was chosen to be "plant doctor" at his centre, having 38 plant doctors together. PPC has 34 pesticide residue testers at 34 out of 38 RPDCs (produces of the 4 RPDCs are too small to set a laboratory).

Head lettuce

Gerbera

Strawberry

Beneficial fungi, antagonistic fungi in particular, have become our most interest. Many research pieces were carried out by our staff during there were doing B.Sc. and M.S. theses. They tested the efficacy of fungi in the Royal Project's cultivation plots. *Trichoderma* spp. have been isolated from soil, leaves and roots of cutflowers and vegetables. They were tested and selected from their efficacy on growth inhibition of many kinds of fungal pathogen, using dual culture technique. There are 5 species of Trichoderma in our collection but only *Trichoderma harzianum* is being used at this time.

Trichoderma starter

Dual culture

Composition of Trichoderma compost

Preparation of Trichoderma compost

Trichoderma compost, Ready to be used

Spore suspension of Trichoderma

Application of Trichoderma compost

Spraying spore Suspension to the plant

The first success of using *Trichoderma harzianum* for control of root rot of carnation and chrysanthemum was at Khun Wang RPDC. We had tried so many kinds of fungicides without success. However, using the antagonist alone without IPM cannot have a good success.

Foot rot disease

From our experience, we must confess that it took us a long time before the farmers could change their habit of using chemical pesticides. To persuade the farmers to use Trichoderma, we started with training them to multiply the fungus in the compost and showing them how to use it in a demonstration plot. When they learned how to multiply and use the fungus, PPC prepares Trichoderma starter (*Trichoderma harzianum* grown on sterilized sorghum seeds) and sold to them at 40 baht per 1 kilogram which is very cheap. One kilogram of the starter can be multiplied to 61 kilograms of Trichoderma compost (50 kg compost + 10 kg rice bran + 1 kg Trichoderma). If any farmer produces his own compost, he does not have to pay for its cost. Success on application of antagonistic fungi comes from good treatment of soil and crop management in IPM. Crop rotation of different plant family is one of crop

management in IPM. Burning the diseased plant residues is recommended for another way of cutting life cycle of plant pests. Plowing the land and expose it to the hot sunlight is very useful and does not cost money for killing soil borne pathogens and other pests. Spore suspension of Trichoderma is effective on controlling foliar and fruit rot diseases. Preparation of the spore suspension, ½ kilogram of Trichoderma starter is washed off spores in 20 liters of water and filtered through muslin cloth to take the sorghum seeds out. Spraying spore suspension should be made in the evening.

Multiplication of Trichoderma in the compost is easy but it needs understanding on how to make it: 1 The compost must be good (not sticky and well decomposed). 2 Trichoderma must be newly prepared (7-15 days) and shows good sporulation. 3 Rice bran must be new, not infested with mold and 4 The moisture must be optimum.

The amount of Trichoderma for application to the soil depends on how serious the foot or root rot diseases. If it was serious, more amount of the fungal mixed compost should be used.

Paecilomyces lilacinus is another antagonistic fungus brought to be used in the Royal Project's area where the plants are attacked by root knot nematode (*Meloidogyne* spp.). This fungus is parasitic to the nematode egg.

Professor Dr. Suebsak Sonthirat and his students (Kasetsart University) reported about the good results of their research work. We took the fungus and his advice to test in the field. The method on multiplication in the compost and the use of this fungus are the same as mentioned above on Trichoderma.

From the year 2005 up to now the order of the two fungal starters is increasing tremendously while the order of commercial Trichoderma bioproduct does not increase but still have orders from the farmers about the same amount as shown in Table 1, Table 2 and Fig.1 – Fig. 5.

Root knot disease symptom

Parasitized egg of root knot nematode

Table 1. Increasing amount of *Trichoderma harzianum* in sorghum seed medium (Trichoderma starter) purchased by the farmers from year. 2006 to year. 2007.

year	Amount (kg)				
	Vegetable	Flower	Fruit tree	Other	Total
2005	336	115	105	7	563
2006	1151	7.5	186	45	1389.5
2007	841	156	450	10	1467

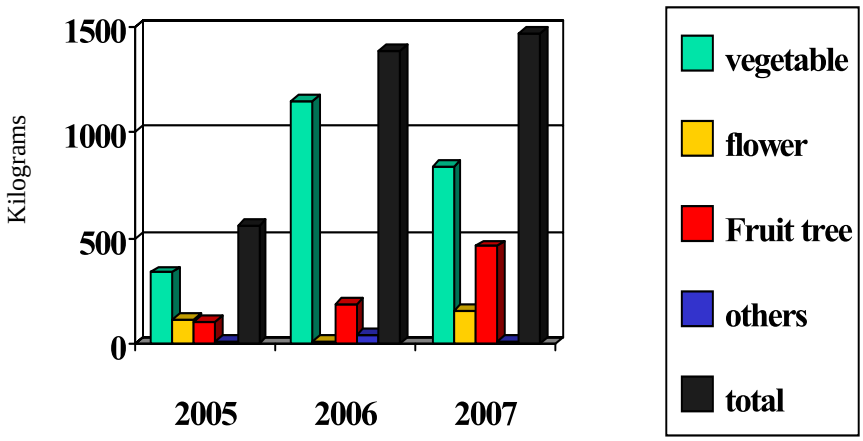

Fig. 1. Increasing amount of *Trichoderma harzianum* in sorghum seed medium purchased by the farmers to be used in various crops form 2005 – 2007.

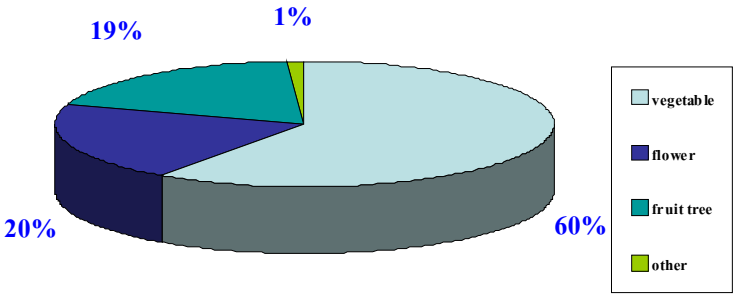

Fig. 2. Percentage of *Trichoderma harzianum* in sorghum seed medium purchased by the farmers to be used in various crops in 2005.

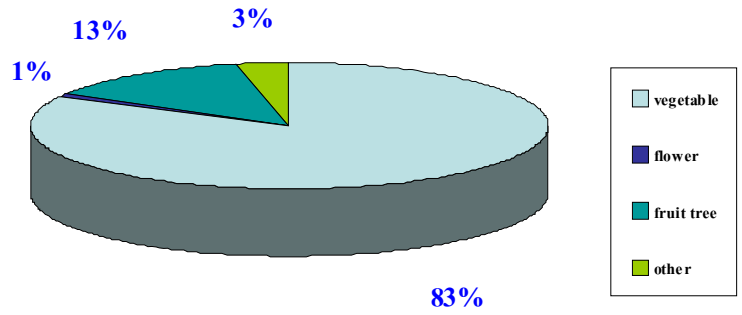

Fig. 3. Percentage of *Trichoderma harzianum* in sorghum seed medium purchased by the farmers to be used in various crops in 2006.

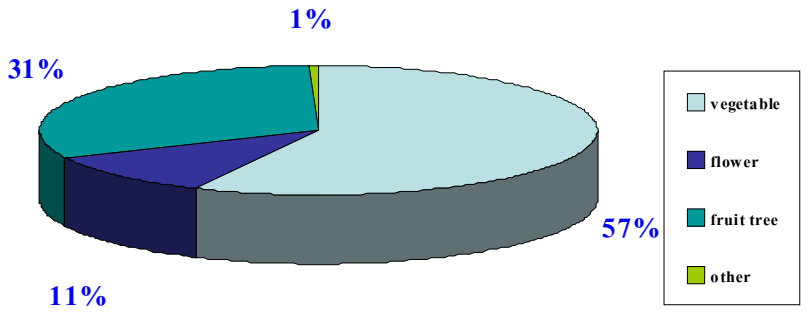

Fig.4. Percentage of *Trichoderma harzianum* in sorghum seed medium purchased by the farmers to be used in various crops in 2007.

Table 2. Increasing amount of *Paecilomyces lilacinus* in sorghum seed medium purchased by the farmers from 2006 – 2007.

year	Amount (kg)			
	Vegetable	Herbs	Strawberry	Total
2005	14	8	20	42
2006	30	0	0	30
2007	63	0	0	63

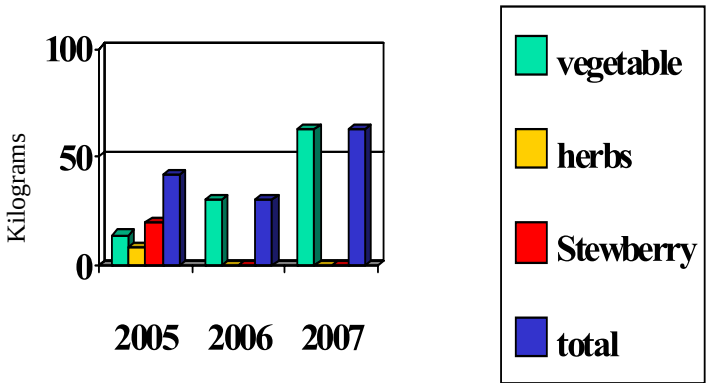

Fig. 5. Increasing amount of *Paecilomyces lilacinus* in sorghum seed medium purchased by the farmers to be used in various crops form 2005 – 2007.

PPC staff is now testing a commercial bioproduct on efficacy of a fungus namely *Beavearia bassiana* (Tr.n. Beuverin) for control of thrips in organic crops. We plan to seek for natural entomogenous fungi to do research and to make our own bioproduct. This is for helping the farmers on reduction cost of investment. A predatory or nematophagous fungus, *Arthrobotrys* spp. has been studied and now is being tested in the field.

Using antagonistic fungi is not only safe for the crop producer and consumer but it is also good for the environment.

Discussion and conclusion

Using beneficial fungi for control of plant diseases is a useful and acceptable method for the farmers. However, this biological control must be used in the IPM program to get a good success (Jonglaekha, 2003). Biological agents must be effective and the cost of the agents should be low. The success of Royal Project on reduction of chemical pesticide comes from the PPC produces fungal starters of *Trichoderma harzianum* and *Paecillomyces lilacinus* and sells to the farmers at a cheap price. The method for multiplication of the fungi in the compost is simple, after short time training, the farmers can understand and do it by themselves. Since most farmers are poor and do not have much education, anything introduced to them must be easy to understand, to do, and does not cost much. Soil management which includes improvement of soil structure and adjusting soil pH is a major must to do before planting. The amount of antagonistic fungus to put in the soil depends on how serious the root disease was in the previous crop; if it's was serious, large amount of the antagonistic fungal compost should be applied. Using old, ineffective fungi brings a failure to disease control. Moreover, application of the fungi to the soil

without enough moisture can also cause a big failure. New preparation of the fungal and compost is recommended. Application of the fungus should be at transplanting time so that the soil will have continuous moisture from watering.

Trichoderma harzianum was reported as an effective biocontrol agent against *Sclerotium rolfsii* and *Rhizoctonia solani* (Elad *et.al*., 1980). These two fungal pathogens are very serious soil-borne diseases.

In Thailand, Trichoderma has been proved to be an effective antagonistic fungus by many researchers. Chamswang and Roungwiset (1992) reported that when Trichoderma was used together with micronutrients and organic matter showed good control for *Phytophthora palmivora* root rot of durian as well as using Trichoderma with Ridomil 5G. Jomduang and Meon (1995) confirmed that *T. harzianum* was effective against Sclerotium root rot of chilli.

For Paecilomyces not much work have been found but Sontirat *et.al*. (1995) reported that Using *Paecilomyces lilacinus* at 220 g/30 m^2 by sowing and plow at transplanting date and again at 15 days after planting compared with using Basmid-G 40 g/m^2 was as effective as Basmid G.

In conclusion antagonistic fungi play important role in controlling diseases, especially soil-borne pathogens. It is well accepted by the farmers. It helps reducing the used of chemicals and keeping the environment clean.

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