

CHAPTER 8

Conclusion

8.1 The Finding of This Study

The most effective antagonistic isolates ERY1 and PRE5 of total 66 isolates that were isolated from medicinal plants had the strong inhibition on damping-off pathogenic fungi *F. oxysporum*, *P. aphanidermatum*, *R. solani* and *S. rolfii* with the inhibition percentage greater than 60%. ERY1 had gray aerial mycelia with a rectiflexibles type spore chain and yellowish brown substrate mycelia. ERY1 was the most closely related to *S. rochei* strain A-1 with 99% similarity. PRE5 had white aerial mycelia with a spiral type spore chain and light yellow substrate mycelia. PRE5 was the most closely related to *S. albus* subsp. *albus* strain DSM 40313^T with 99% similarity.

S. rochei ERY1 and *S. albus* subsp. *albus* PRE5 produced the effective antifungal metabolites to inhibit damping-off pathogenic fungi. The antifungal metabolites produced by *S. rochei* ERY1 inhibited colony growth and development of *P. aphanidermatum* by 84.31% and antifungal metabolites produced by *S. albus* subsp. *albus* PRE5 completely inhibited *S. rolfii*.

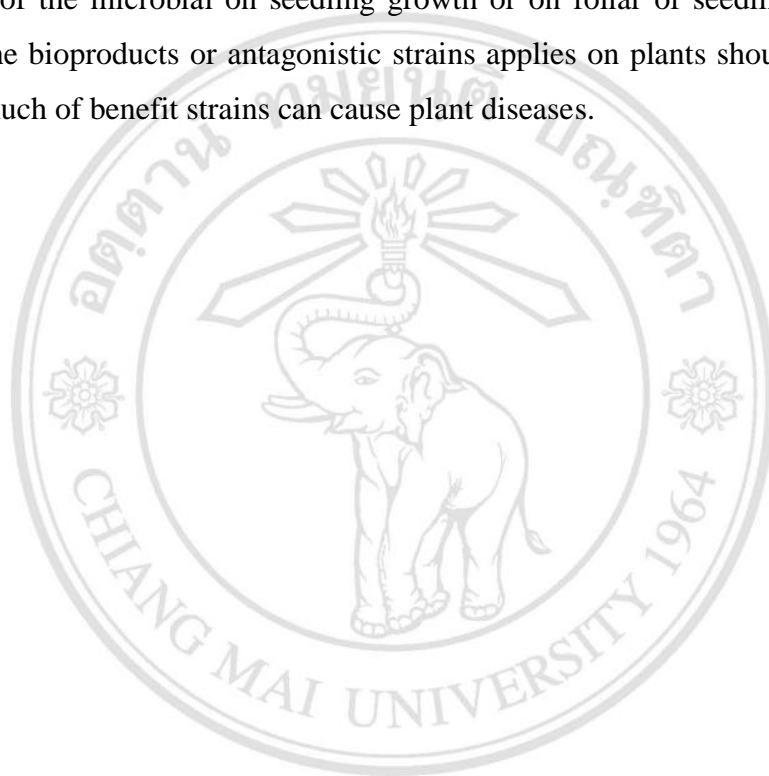
Antifungal metabolites were extracted from the culture filtrate of *S. rochei* ERY1 and *S. albus* subsp. *albus* PRE5. The metabolites of *S. rochei* ERY1 had MIC₉₀ values on *P. aphanidermatum* at 3.58 mg/ml and *S. albus* subsp. *albus* PRE5 on *S. rolfii* at 5.19 mg/ml. The antifungal metabolites at MIC₉₀ values of both isolates were evaluated for their ability to control damping-off of cabbage seedlings. The results showed the metabolites extracted from culture filtrate of ERY1 controlled damping-off disease caused by *P. aphanidermatum* by 78% at concentration 6 mg/ml, and the disease caused by *S. rolfii* decreased by 70% after treatment with the metabolites extracted from culture filtrate of PRE5 at concentration 2 mg/ml.

S. rochei ERY1 and *S. albus* subsp. *albus* PRE5 could also produce hormone-like plant growth regulations, such as free IAA, cytokinin and gibberellin. *S. rochei* ERY1 produces free IAA at 4.490 mg/l, free GA3 at 0.179 mg/l and free cytokinin at 0.067 mg/l. *S. albus* subsp. *albus* PRE5 produces free IAA at 32.49 µg/l, free GA3 at 0.05 mg/l and free cytokinin at 0.20 mg/l. Although those hormones were detected in culture medium of the effective isolates, the strains could promote the growth of treated seedlings as the increased in root length, fresh and dry weight, implying that the growth regulators may be produced by the isolates and enhancing plant growth after successfully colonized the plants. Non-host plant colonization of the isolates on cabbage seedlings were confirmed by SEM observation. The observation indicated that the strains colonized on epidermal-cell and guard-cell of seedling leaves and preferring to colonize on roots.

Three formulations of bioproducts were successfully developed from the biomass and/or crude extract of antifungal metabolites of *S. rochei* ERY1 and *S. albus* subsp. *albus* PRE5. The bioproducts such as powder, granular and effervescence were developed by considering the convenient of using. Powder formulation has an intention to apply as seed coating, which we added the excipient supporting the adhesion of the powder product on seed coat. Granular formulation has an intention to apply in the hole bottom of transplant seedlings or sowing. The biomass and/or antifungal metabolites in the granules will gradually release into the surrounding areas to prevent and protect the seedlings from soil-borne infection, especially damping-off pathogenic fungi. Effervescent tablet has an intention to apply for spraying. All ingredients in the tablets are water soluble, which will not brock up or have any damage on the spray nozzle of sprayer. The effervescent tablet disintegrates in water and releases the biomass and/or antifungal metabolites of the effective strains. The released biomass of the *S. rochei* ERY1 and *S. albus* subsp. *albus* PRE5 could colonize in non-host plants, enhance the growth of plants or induce plant tolerance to the disease and their antifungal metabolites could inhibit soil-borne pathogenic fungi. Preliminary development showed that the effective strains in almost formulas were not affected by the excipients or other ingredients in the developed products and their survival rate in the developed bioproducts were 10^5 - 10^8 cfu/ml, from beginning to 7 month after storage.

8.2 Future Perspectives and Recommendations

The developed bioproducts are aimed to use as alternative damping-off disease managements and to distribute the product toward developing areas and/or organic farming. However, a suitable packaging should be considered and developed with the purpose to stability the form of bioproducts and storage life of antagonistic strains in the products. In case of using the developed formulas with other antagonists, the phytotoxicity of the microbial on seedling growth or on foliar of seedlings should be conducted. The bioproducts or antagonistic strains applies on plants should be balance because too much of benefit strains can cause plant diseases.



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