CHAPTER VII

CONCLUSION AND RECOMMENDATIONS

7.1 Conclusion

Isolaton and identification of LAB as well as fungi were done in the Chapter 3 of study summarizes the major findings contributed by antifungal activity of lactic acid bacteria (LAB) against *Fusarium* species, with a focus on the pathogenicity of chilli plant. Antagonistic LAB from soil samples inhibited the growth of *Fusarium* species especially *Fusarium solani*-CS, which was observed to be very virulent and pathogenic fungi for chilli plants. Both the LAB cells and LAB-CFS showed strong inhibitory activity against *Fusarium* species, whereby the cells of selected LAB were co-cultivating together with fungi was better in suppressing the biomass growth against *Fusarium* species. Furthermore, in Chapter 4, further characterization of LAB was carried out and they were found to have antifungal activity against *Fusarium* species. The antifungal metabolites of LAB were heat stable compound active at pH 6 to 9 and their inhibitory activity were completely changed after treatment with proteolytic enzymes. These antifungal compounds have potential to be used as plants protection to inhibit conidia germinationand mycelia growth of phytopathogenic fungi. This is because germination of conidia and growth of mycelia are responsible for plant damages and reduction in plant yield of chill. Based on above potential activity of LAB, these strains were used as bio-

control agent against *Fusarium* species and promoter of chilli seeds germination was further elaborated in Chapter 5. Thus, the germination of chilli seeds had improved when the seeds were treated with both the cells and LAB-CFS of the LAB isolates as observed by the good germination percentage and elongation of chilli seedling plant systems (seedling height, shoot length and root length) where seeds were infected with the fungi or seeds soaked with LAB-CFS of LAB isolates. These findings were further supported that cells and LAB-CFS of LAB-MSS1, LAB-MSS5, IDLAB6, IDLAB7 and LAB-FF11 isolates can be used as biocontrol agents against *Fusarium* species. In this study cells LAB-MSS1 and LAB-FF11 were selected to evaluate inhibitory activity and as plant regulators against *F. solani*-CS on mainly Solanaceae plant such as chilli that was described in detail in Chapter 6. Cells of LAB were noticed to be more useful in improving the chilli systems and productivity. Finally, the following are other conclusions made from this study;

I. Lactic acid bacteria (LABs) were isolated from rhizospheric soil samples were collected from different areas in Malaysia 21 isolates were obtained from Malaysian soil samples, about 14/21 LAB-MSS showed good antifungal activity by using overlay technique.

II. Four *Fusarium* species isolated from infected plant samples were collected from Nilai local areas, such as *F. oxysporum* f. *sp. lycopersici*-CL, *F. solani*-CS, *F. acuminatum*-FC and *F. proliferatum*-LR.

III. Based on screening by overlay technique, five isolates were selected for

further experiments with strong antifungal activity against *Fusarium* sp.

IV. Cells and LAB-CFS of selected LAB isolates were showed good inhibitory activity against fungi *Fusarium* species based on well diffusion method, PDA method, fungal biomass dry method in MEB medium with CFS and fungal biomass dry method in MRSB medium. The latter method showed stronger fungal biomass inhibition compared to other methods.

V. In LAB-CFS of selected LAB was observed that the quantity of lactic acid and proteolytic activity with LAB cells.

VI. Cells and LAB-CFS of both LAB-FF11 and LAB-MSS1 have more ability to promote percentage germination of chilli seeds compare to other LAB isolates.

VII. The all fungi *Fusarium* species had higher pathogenicity effect on chilli seeds germination.

VIII. The seedling systems such as seedling height, shoot and root were improved with cells and LAB-CFS of LAB-FF11 and LAB-MSS1 even the seeds infected with fungi *Fusarium* species.

IX. Cells of both LAB-FF11 and LAB-MSS1 easily entered into chilli plant through the root system when the chilli plants were survived in soil treated with both cells of LAB isolates without supplementing with any nutritional sources to improve the chilli plant after 25 d, 45 d and 65 d of transplanting.

X. Endophytic nature of LAB was confirmed in different part of chilli plants, both LAB-FF11 and LAB-MSS1 were isolated treated chilli plants at the time of ripening fruits of chilli.

XI. All plants those were survived in soil treated with cells of LAB was recorded to have maximum number of yield products at ripening time for chilli fruits those turned green into red.

XII. Endophytic nature of fungi *F. solani*-CS was confirmed in different parts of chilli plants because, fungi *F. solani*-CS was isolated from treated chilli plants.

XIII. Fungi *F. solani*-CS on chilli plants was noticed at the fruiting time because some plants of chilli were started dried and this symptom was known as plant wilt or wilt disease of chilli.

XIV. At time of chilli fruits ripening, some plants fruits did not turned green to red color because they started to store water in fruits and spoilages because chilli plants were survived in soil infected with *F. solani*-CS.

7.2 Recommendations

This study examined the effects of LAB cells and supernatant on the *Fusarium* ***species*** both *in vitro* and *in vivo*. Positive effects were seen on the plant performance affecting growth, fruit and seeds production. However, it is recommended that future study should include the following areas:

I. To determine and characterize the antifungal compounds produced by the two LAB (LAB-MSS1 and LAB-FF11) or other LAB.

II. To investigate the phyto-hormones compounds produced by LAB-MSS1 and LAB-FF11 that could be responsible for growth enhancement of the chilli seeds plants.

III. To identify the possible role of LAB-MSS1 and LAB-FF11 as biofertiliser in not only for chilli but also for other plants.

IV. To develop a method for maintaining the survival of LAB cells for soil application:

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