

CHAPTER 6

Conclusion

6.1 The Findings of the Study

150 isolates of *C. gloeosporioides* from anthracnose of mango cv. Chaokhunthip, Chokanan, Falun, Kaew, Khiaomorakod, Khiaosawoey, Mahacharnok, Mankhunyi, Namdokmai, Nareeluemrang, Okrong, Phetbanlat, Phimsen and Talapnak expressed a phenotype highly resistant to carbendazim (Car^{HR}) of 75 %. Those isolates able to grow well in the presence of carbendazim at 500 mg/l. But for *C. gloeosporioides* isolate from cv. Namdokmai was found a phenotype moderately resistant to carbendazim (Car^{MR}) that able to grow at 100 mg/l concentration. The sequence of *TUB2* in the Car^{HR} phenotype showed a single nucleotide mutation that converted codon 198, an adenine (A) to cytosine (C), resulting in the amino acid substitution of glutamic acid (GAG) in Car^S phenotype with alanine (GCG). Furthermore, the Car^{MR} phenotype showed a single nucleotide that was a thymine (T) to adenine (A) transversion. This resulted in substituting codon 200, which encoded phenylalanine (TTC), with a codon for tyrosine (TAC).

Three chitosan groups were tested as follows:-, commercial chitosan solution group: CC1 and CC2 applied at 1 cc/l, polymer chitosan group: PC1 [poly-(1,4-β-D-glucopyranosamine)] and PC2 [poly (D-glucosamine)] applied at 0.5%, 1.0% and 1.5%, and oligomer chitosan group: OC1 (oligomer chitosan solution)

applied at 1 cc/l and OC2 (chitosan oligosaccharide lactate) applied at 0.5%, 1.0% and 1.5%. Those tested chitosan showed clearly delay in conidial germination of the tested 7 isolates of carbendazim resistant *C. gloeosporioides* for 24 hr. Moreover, CC1 and CC2 at 1 cc/l, and PC1 and PC2 at 0.5%, 1.0% and 1.5% were delayed the mycelia growth of tested 7 isolates of the carbendazim resistant *C. gloeosporioides*.

Dropping CC2 at 1 cc/l and PC2 at 1.5% on wounded mango fruits before inoculation with isolate of CAN_F095 decreased disease incidence of 68.81 and 66.09%, respectively, followed by dropping PC1 and PC2 at 1.5% before inoculated with isolate of NDM_F116 decreased disease incidence of 62.58 and 61.40%, respectively. The carbendazim at 500 mg/l were treated before and after inoculation with isolates of CAN_F095 and NDM_F116 that was not decreased disease incidence on mango fruits.

Chitosan was sprayed to un-wounded mango fruits at 15 min before inoculation with carbendazim resistant isolates at 1×10^6 spore/ml. It showed that chitosan 1.5 % PC1 and PC2 could against the inoculated isolates of CAN_F095 and NDM_F116 as disease reduction of 75 %. It revealed the disease reduction of 75 % when sprayed with 1.0 % PC1 against the inoculated isolate of CAN_F095 and sprayed 1.0 % PC2 against the inoculated isolate of NDM_F116. Spraying 1.0 % PC1 inhibited the isolate of NDM_F116 for delaying infection on mango fruits and the spraying 1.0 % PC2 inhibited the isolate of CAN_F095 to infect on mango fruits as disease reduction of 66.75%.

After inoculation of carbendazim resistant isolates at 1×10^6 spore/ml for 24 hr and sprayed chitosan to un-wounded mango fruits were studied and resulted that spraying 1.5 % PC1 and PC2 could inhibit the isolates of CAN_F095 and NDM_F116

to infect mango fruits as the disease reduction of 75 %. The disease reduction was also shown when spraying 1.0 % PC1 and 1 cc/l CC2 against inoculated isolates of CAN_F095 and spraying 1.0 % PC2 against the inoculated isolates of NDM_F116 as 75 %.

6.2 Future Perspectives and Recommendations

This study demonstrated that fungicide resistance is caused by an altered amino acid sequence at the chemical fungicide-binding site. Nevertheless, the possibility of fungicide resistance developing from a mutation at another site, or multiple gene mutations, cross fungicide resistance might be interested for future study.

Chitosan may possible integrate to anthracnose disease management to protect post harvest of mango and it would be interesting to test these tested chitosan in the fields.

However, the current understanding of chitosan mechanisms is rather limited, especially defense mechanism as elicitor to induce disease immunity not only in mango but also other plants as well.