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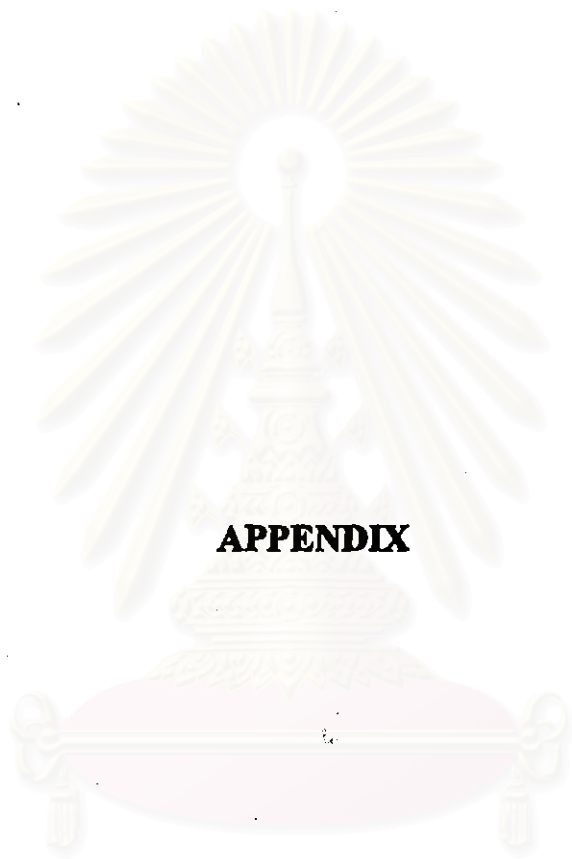
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สถาบันวิทยบริการ  
จุฬาลงกรณ์มหาวิทยาลัย

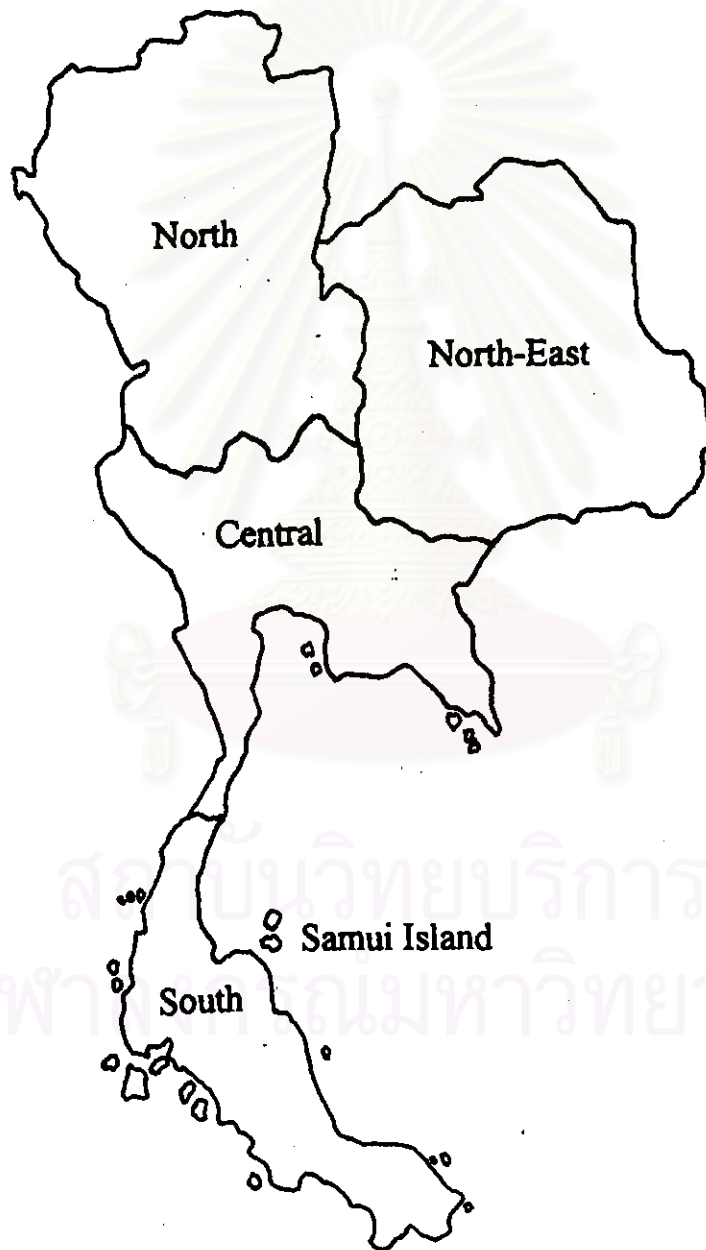


**APPENDIX**

สถาบันวิทยบริการ  
จุฬาลงกรณ์มหาวิทยาลัย

## APPENDIX 1

Thailand map indicate sampling locations of *A. cerana*



## APPENDIX 2

### Collection of *A. cerana* from the North of Thailand

Code of colonies	Date of collection	Sampling area	Composite Haplotype ( <i>TaqI</i> , <i>SspI</i> , <i>VspI</i> )
N01	07/09/1995	Muang, Lamphun	AAA
N02	05/12/1995	Muang, Uttaradit	AAA
N06	07/09/1996	Muang, Lamphun	AAA
N07	08/09/1996	San pa tong, Chiang mai	AAA
N09	08/09/1996	San pa tong, Chiang mai	AAA
N11	08/09/1996	San pa tong, Chiang mai	AAA
N12	08/09/1996	San pa tong, Chiang mai	AAA
N13	09/09/1997	Hang dong, Chiang mai	AAA
N14	10/09/1996	Muang, Uttaradit	AAA
N15	10/09/1996	Muang, Phitsanulok	AAA
N16	10/09/1996	Muang, Phitsanulok	AAA
N17	10/09/1996	Muang, Phitsanulok	AAA
N19	05/02/1997	Phayuha khiri, Nakhon sawan	AAA
N20	05/02/1997	Manorom, Chai nat	AAA
N21	06/02/1997	Wat sing, Chai nat	AAA
N22	06/02/1997	Muang, Chai nat	AAA
N23	05/06/1997	Banphot phisai, Nakhon sawan	AAA
N24	05/06/1997	Banphot phisai, Nakhon sawan	AAA
N25	05/06/1997	Banphot phisai, Nakhon sawan	AAA
N26	06/06/1997	Muang, Kamphaeng phet	AAA
N27	06/06/1997	Ban Tak, Tak	AAA
N29	06/06/1997	Sam ngao, Tak	ACA
N32	06/06/1997	Thoen, Lampang	AAA
N34	06/06/1997	Thoen, Lampang	AAA
N36	06/06/1997	Mae tha, Lamphun	AAA
N37	07/06/1997	Doi saket, Chiang mai	AAA
N38	07/06/1997	Doi saket, Chiang mai	AAA
N39	07/06/1997	Doi saket, Chiang mai	AAA
N41	07/06/1997	Wiang pa pao, Chiang mai	ACA
N42	07/06/1997	Wiang pa pao, Chiang mai	AAA
N43	07/06/1997	Wiang pa pao, Chiang mai	AAA
N44	07/06/1997	Ngao, Lampang	AAA
N45	08/06/1997	Sungmen, Phrae	AAA
N46	08/06/1997	Sungmen, Phrae	AAA
N47	08/06/1997	Sungmen, Phrae	AAA
N48	08/06/1997	Sungmen, Phrae	AAA



**Collection of *A. cerana* from the North-East of Thailand**

Code of colonies	Date of collection	Sampling area	Composite Haplotype ( <i>TaqI</i> , <i>SspI</i> , <i>VspI</i> )
NE02	07/04/1996	Na hao, Loei	AAA
NE03	07/04/1996	Na hao, Loei	AAA
NE04	14/02/1993	Nong bun nak, Nakhon ratchasima	AAA
NE06	15/03/1993	Prasat, Surin	AAA
NE07	16/03/1993	Warin chamrab, Ubon ratchathani	BAA
NE08	14/03/1993	Nong bun nak, Nakhon ratchasima	AAA
NE09	16/03/1993	Rattanaburi, Surin	AAA
NE10	15/03/1993	Muang, Si sa ket	AAA
NE11	19/03/1993	Kranuan, Khonkaen	AAA
NE12	15/03/1993	Muang, Khonkaen	AAA
NE13	15/03/1993	Chom phra, Surin	AAA
NE14	06/12/1996	Muang, Khonkaen	AAA
NE15	06/12/1996	Muang, Khonkaen	AAA
NE16	06/12/1996	Chum phae, Khonkaen	AAA
NE17	06/12/1996	Chum phae, Khonkaen	AAA
NE18	06/12/1996	Chum phae, Khonkaen	AAD
NE20	07/12/1996	Ubol ratana, Khonkaen	ACA
NE21	07/12/1996	Non sang, Nong bua lamphu	AAA
NE22	07/12/1996	Non sang, Nong bua lamphu	AAA
NE23	07/12/1996	Non sang, Nong bua lamphu	AAA
NE24	07/12/1996	Non wua so, Udon thani	AAA
NE25	07/12/1996	Muang, Udon thani	AAA
NE26	07/12/1996	Muang, Udon thani	AAA
NE27	08/12/1996	Muang, Udon thani	AAA
NE28	08/12/1996	Muang, Nong khai	AAA
NE29	08/12/1996	Muang, Nong khai	AAA
NE30	08/12/1996	Nong han, Udon thani	AAA
NE31	09/12/1996	Phang khon, Sakon nakhon	AAA
NE32	09/12/1996	Nong bun nak, Nakhon ratchasima	AAA
NE33	10/12/1996	Nong bun nak, Nakhon ratchasima	AAA

**Collection of *A. cerana* from the Central of Thailand**

Code of colonies	Date of collection	Sampling area	Composite Haplotype (TaqI, SspI, VspI)
C01	21/01/1996	Phrapradaeng, Samut prakan	AAA
C02	22/01/1996	Kamphaengsan, Nakhorn Pathom	AAA
C03	17/02/1996	Dan chang, Suphan buri	ADA
C04	28/02/1996	Muang, Samut songkhram	AAA
C05	28/02/1996	Muang, Samut songkhram	AAA
C06	28/02/1996	Muang, Samut songkhram	AAA
C07	31/03/1996	Phrapradaeng, Samut prakan	AAA
C08	12/04/1996	Don tum, Nakhorn pathom	AAA
C09	10/02/1997	Dan chang, Suphan buri	AAA
C10	10/02/1997	Dan chang, Suphan buri	AAA
C11	18/03/1996	Pong nam ron, Chanthaburi	AAA
C12	10/08/1996	Makham, Chanthaburi	AAA
C13	10/08/1996	Makham, Chanthaburi	AAA
C14	10/08/1996	Makham, Chanthaburi	AAA
C15	06/03/1997	Muang, Trat	AAA
C16	07/03/1997	Khao saming, Trat	AAA
C17	07/03/1997	Khao saming, Trat	AAA
C18	07/03/1997	Muang, Trat	AAA
C20	24/03/1996	Sam roi yod, Prachuap khiri khan	AAA
C21	24/03/1996	Sam roi yod, Prachuap khiri khan	AAA
C22	24/03/1996	Sam roi yod, Prachuap khiri khan	AAA
C23	16/04/1996	Thong pha phum, Kanchana buri	ABA
C24	29/01/1996	Muang, Phetchaburi	AAA
C25	14/04/1997	Mae krong, Samut songkhram	AAA
C26	14/04/1997	Mae krong, Samut songkhram	AAA
C27	14/04/1997	Mae krong, Samut songkhram	AAA
C28	14/04/1997	Mae krong, Samut songkhram	AAA
C29	14/04/1997	Mae krong, Samut songkhram	AAA
C30	10/06/1997	Muang, Samut sakhorn	AAA
C31	20/05/1996	Muang, Suphan buri	AAA
C32	25/05/1996	Lad lum kaew, Pratum tani	AAA

Collection of *A. cerana* from the South of Thailand

Code of colonies	Date of collection	Sampling area	Composite Haplotype (TaqI, SspI, VspI)
*S01	25/03/1996	Thalang , Phuket	ND
S02	25/03/1996	Muang, Chumphon	AEF
*S03	25/03/1996	Muang, Chumphon	ND
*S04	25/03/1996	Tha chana, Suratthani	ND
*S05	24/03/1996	Muang, Chumphon	ND
*S06	12/05/1996	Tha chana, Suratthani	BBB
*S07	12/05/1996	Tha chana, Suratthani	BBB
*S08	12/05/1996	Tha chana, Suratthani	BBB
*S09	12/05/1996	Tha chana, Suratthani	BBB
*S10	12/05/1996	Tha chana, Suratthani	BBB
S11	13/05/1996	Muang, Phuket	BBB
S12	13/05/1996	Muang, Phuket	BBB
*S13	13/05/1996	Muang, Phuket	BBB
*S14	14/05/1996	Thalang, Phuket	BBB
*S15	14/05/1996	Thalang, Phuket	BBB
*S16	14/05/1996	Muang, Phuket	BBB
*S17	15/05/1996	Sawi, Chumphon	ND
S18	15/05/1996	Sawi, Chumphon	BBB
*S19	15/05/1996	Sawi, Chumphon	ND
*S20	15/05/1996	Sawi, Chumphon	ND
*S21	15/05/1996	Muang, Chumphon	ND
*S22	15/05/1996	Muang, Chumphon	ND
S23	21/03/1997	Muang, Chumphon	BBB
S24	21/03/1997	Muang, Chumphon	BBB
*S25	21/03/1997	Kra buri, Ranong	ND
*S26	21/03/1997	Kra buri, Ranong	ND
*S27	22/03/1997	Kapoe, Ranong	ND
S28	22/03/1997	Kapoe, Ranong	BBB
*S29	22/03/1997	Kapoe, Ranong	ND
S30	22/03/1997	Kapoe, Ranong	BBB
*S31	22/03/1997	Muang, Ranong	BBB
*S32	22/03/1997	Muang, Ranong	BBB
*S33	23/03/1997	Khuraburi, Phangnga	BBB
*S34	23/03/1997	Khuraburi, Phangnga	BBB
*S35	23/03/1997	Phanom, Suratthani	BBB
*S36	24/03/1997	Ao Luk, Krabi	BBB

\* = appearance of heteroplasmy

ND = not determined

Collection of *A. cerana* from the South of Thailand (continue)

Code of colonies	Date of collection	Sampling area	Composite Haplotype ( <i>TaqI</i> , <i>Sspl</i> , <i>Vspl</i> )
*S37	24/03/1997	Ao Luk, Krabi	BBB
*S38	24/03/1997	Ao Luk, Krabi	BBB
*S39	24/03/1997	Ao Luk, Krabi	BBB
*S40	24/03/1997	Ao Luk, Krabi	BBB
*S41	24/03/1997	Muang, Krabi	BBB
*S42	24/03/1997	Muang, Krabi	BBB
*S43	25/03/1997	Muang, Krabi	BBB
S44	25/03/1997	Muang, Krabi	BBB
S45	25/03/1997	Muang, Krabi	BBB
*S46	25/03/1997	Nua khlong, Krabi	BBB
*S47	25/03/1997	Nua khlong, Krabi	BBB
*S48	25/03/1997	Nua khlong, Krabi	BBB
*S49	25/03/1997	Nua khlong, Krabi	BBB
*S50	25/03/1997	Khao phanom, Krabi	BBB
*S51	25/03/1997	Thung yai, Nakhon si thammarat	BBB
*S52	25/03/1997	Thung yai, Nakhon si thammarat	BBB
*S53	25/03/1997	Thung yai, Nakhon si thammarat	BBB
*S54	26/03/1997	Sikao, Trang	BBB
*S55	26/03/1997	Huai yot, Trang	BBB
*S56	26/03/1997	Huai yot, Trang	BBB
*S57	26/03/1997	Huai yot, Trang	BBB
*S58	26/03/1997	Huai yot, Trang	BBB
*S59	26/03/1997	Srinakarin, Phatthalung	BBB
S60	26/03/1997	Srinakarin, Phatthalung	AEE
*S61	26/03/1997	Srinakarin, Phatthalung	BBB
*S62	26/03/1997	Pha bon, Phatthalung	BBB
*S63	26/03/1997	Pha bon, Phatthalung	BBB
*S64	27/03/1997	Hat yai, Songkhla	BBB
*S65	27/03/1997	Muang, Songkhla	BBB
S66	27/03/1997	Muang, Songkhla	BBB
*S67	26/03/1997	Muang, Songkhla	BBB
*S68	26/03/1997	Muang, Songkhla	BBB
*S69	26/03/1997	Muang, Songkhla	BBB
*S70	28/03/1997	Nakhon si thammarat	BBB
*S71	28/03/1997	Nakhon si thammarat	BBB
*S72	28/03/1997	Tha sala, Nakhon si thammarat	BBB

\* = appearance of heteroplasmy

ND = not determined

**Collection of *A. cerana* from Samui Island of Thailand**

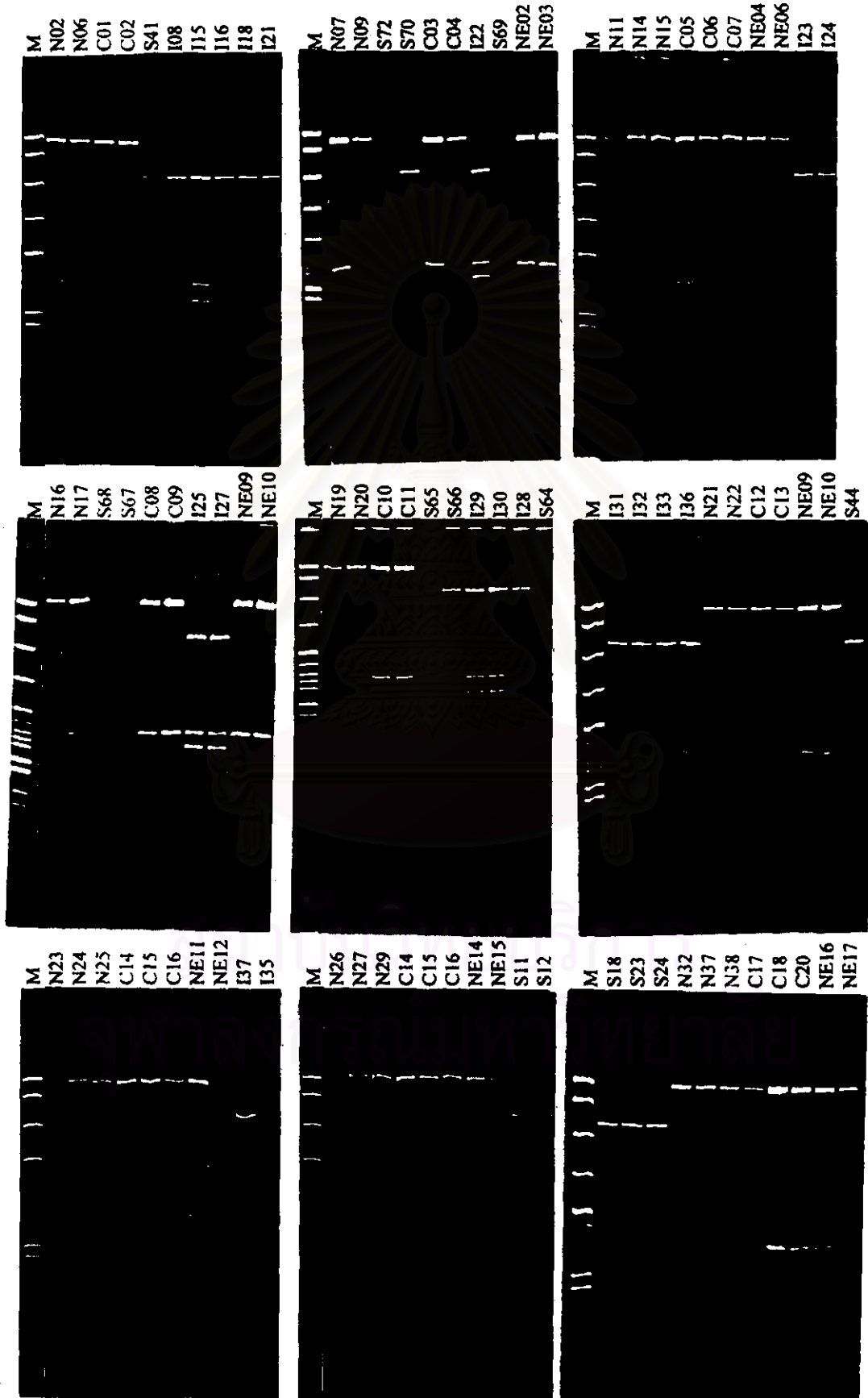
Code of colonies	Date of collection	Sampling area	Composite Haplotype ( <i>TaqI</i> , <i>SspI</i> , <i>VspI</i> )
*I01	12/03/1996	Tham Bon Aungthong	ND
*I02	12/03/1996	Tham Bon Aungthong	ND
*I03	12/03/1996	Tham Bon Aungthong	ND
I04	12/03/1996	Tham Bon Aungthong	BBB
*I05	12/03/1996	Tham Bon Aungthong	ND
I06	12/03/1996	Tham Bon Aungthong	BBB
*I07	12/03/1996	Tham Bon Aungthong	ND
I08	14/03/1996	Tham Bon Boput	BBC
*I09	14/03/1996	Tham Bon Boput	BBB
*I10	13/03/1996	Tham Bon Maret	BBB
*I11	13/03/1996	Tham Bon Maret	ND
*I12	13/03/1996	Tham Bon Maret	BBB
*I13	13/03/1996	Tham Bon Maret	ND
*I14	13/03/1996	Tham Bon Limpanoi	BBB
I15	13/03/1996	Tham Bon Limpanoi	BBC
*I16	30/03/1997	Tham Bon Maenam	BBC
I17	30/03/1997	Tham Bon Maenam	BBB
I18	30/03/1997	Tham Bon Maenam	BBC
*I19	30/03/1997	Tham Bon Maenam	BBB
*I20	30/03/1997	Tham Bon Maenam	BBB
I21	30/03/1997	Tham Bon Maenam	BBC
I22	30/03/1997	Tham Bon Maenam	BBC
I23	30/03/1997	Tham Bon Maenam	BBC
I24	30/03/1997	Tham Bon Maenam	BBC
I25	30/03/1997	Tham Bon Boput	BBB
I26	30/03/1997	Tham Bon Boput	BBB
I27	30/03/1997	Tham Bon Boput	BBC
*I28	30/03/1997	Tham Bon Boput	BBB
I29	30/03/1997	Tham Bon Maret	BBC
I30	30/03/1997	Tham Bon Maret	BBC
I31	30/03/1997	Tham Bon Maret	BBC
I32	30/03/1997	Tham Bon Maret	BBC
I33	30/03/1997	Tham Bon Maret	BBC
*I34	30/03/1997	Tham Bon Maret	BBB
*I35	30/03/1997	Tham Bon Maret	BBB
I36	30/03/1997	Tham Bon Maret	BBC
*I37	30/03/1997	Tham Bon Boput	BBB

\* = appearance of heteroplasmy

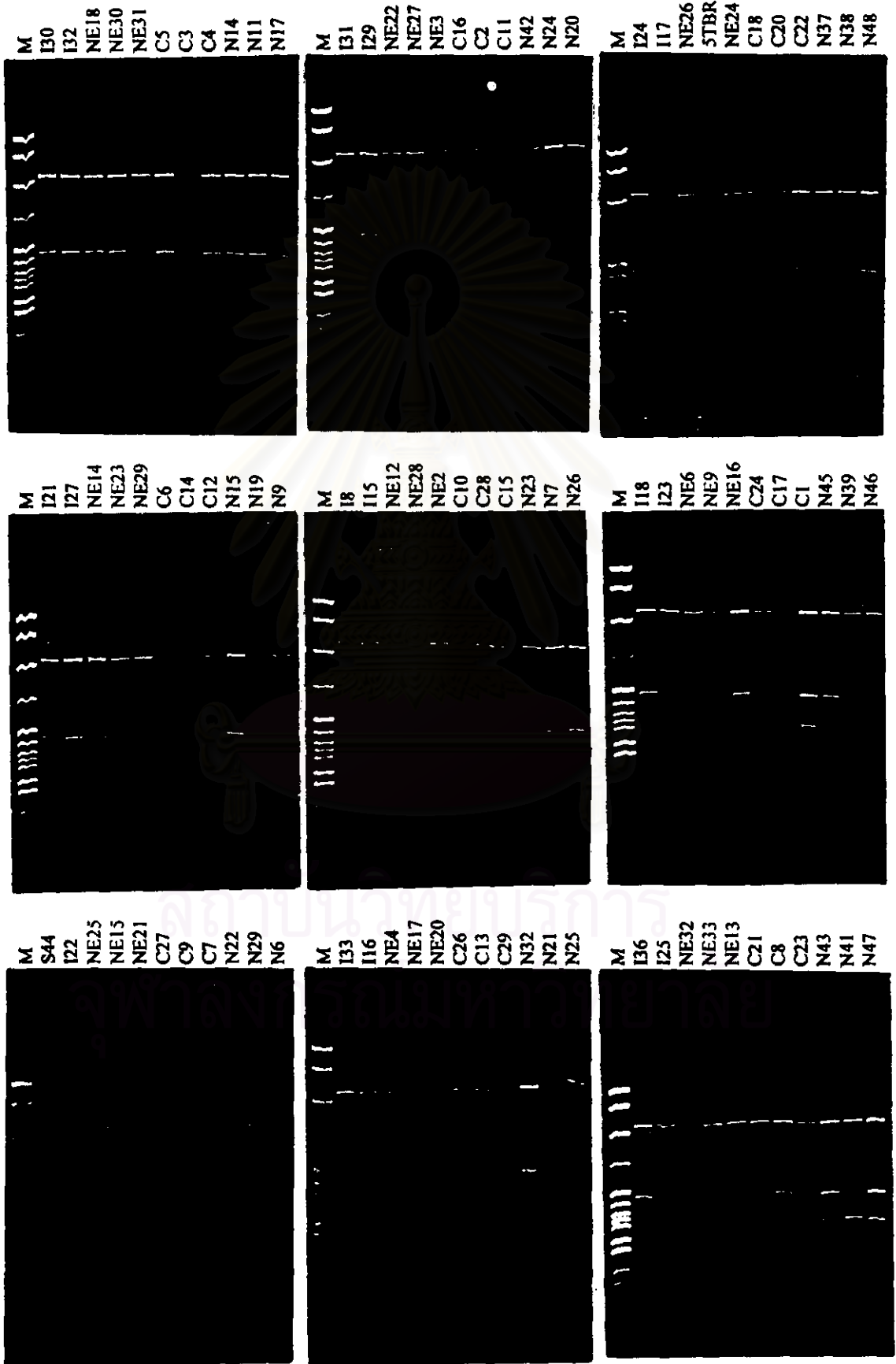
ND = not determined

### APPENDIX 3

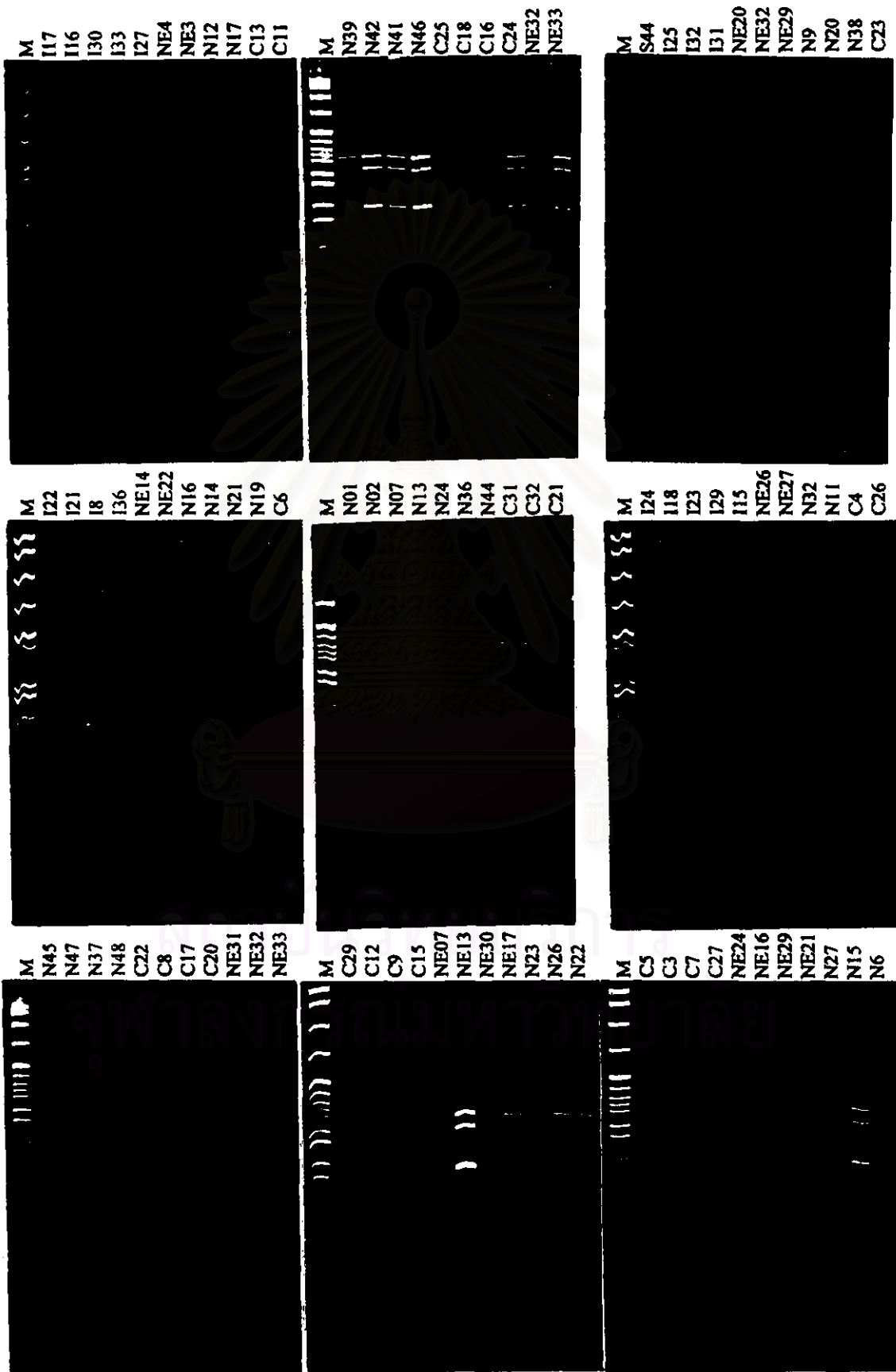
Examples of ATPase6-ATPase8 digested with *TaqI*



M = *MspI* digested pBR322

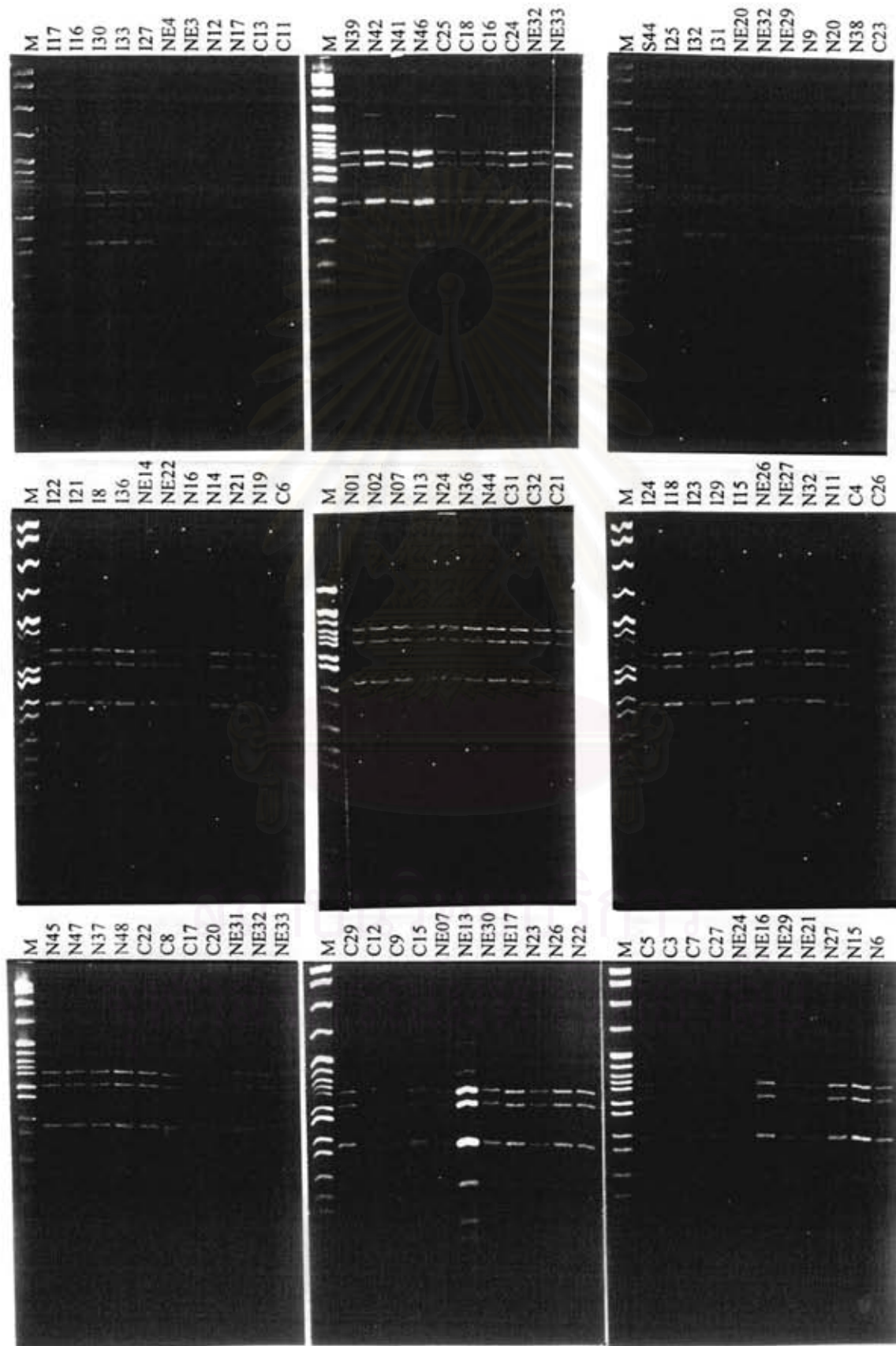
Examples of ATPase6-ATPase8 digested with *SspI*M = *MspI* digested pBR322

Examples of ATPase6-ATPase8 digested with *VspI*



M = *MspI* digested pBR322



Examples of ATPase6-ATPase8 digested with *VspI*

M = *MspI* digested pBR322

## APPENDIX 4

### Restriction endonuclease used for restriction pattern analysis

Restriction endonuclease	Recognition sequence	Salt	Incubation Temperature (°C)
<i>AcsI</i>	(A,G)↓AATT (T,C)	high	50
<i>AluI</i>	AG↓CT	low	37
<i>BamHI</i>	G↓GATCC	high	37
<i>BfrI</i>	C↓TTAAG	med	37
<i>BglI</i>	GCC(N) <sub>4</sub> ↓NGGC	high	37
<i>BglII</i>	A↓GATCT	med	37
<i>BstEII</i>	G↓GTNACC	high	60
<i>BstNI</i>	CC↓(A,T)GG	low	60
<i>Clal</i>	AT↓CGAT	high	37
<i>DraI</i>	TTT↓AAA	med	37
<i>EcoRI</i>	G↓AATTC	high	37
<i>HaeIII</i>	GG↓CC	med	37
<i>HincII</i>	GT(T,C)↓(A,G)AC	med	37
<i>HindIII</i>	A↓AGCTT	high	37
<i>Hinfi</i>	G↓ANTC	high	37
<i>KpnI</i>	GGTAC↓C	low	37
<i>MluNI</i>	TGG↓CCA	low	37
<i>NdeI</i>	CA↓TATG	high	37
<i>PstI</i>	CTGCA↓G	high	37

## Appendix 4 (continued)

Restriction endonuclease	Recognition sequence	Salt	Incubation Temperature (°C)
<i>SaI</i>	G↓TCGAC	high	37
<i>Sau3AI</i>	↓GATC	low	37
<i>ScaI</i>	AGT↓ACT	high	37
<i>SmaI</i>	CCC↓GGG	low	25
<i>SspI</i>	AAT↓ATT	high	37
<i>SwaI</i>	ATTT↓AAAT	high	25
<i>TaqI</i>	T↓CGA	high	65
<i>ThaI</i>	CG↓CG	med	60
<i>Tru9I</i>	T↓TAA	med	65
<i>VspI</i>	AT↓TAAT	high	37
<i>XbaI</i>	T↓CTAGA	high	37
<i>XhoI</i>	C↓TCGAC	high	37

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## APPENDIX 5

### 5.1 ATPase6-ATPase8 sequences of *A. mellifera* (Crozier and crozier, 1993)

TTTAATTCCTCAAATAATACCTATAAAATGATTTTTAATTATTTTATTT  
 ATTTATTAATTTTTTTATTTATTCATTATATTAATTAATTCAATACTAAT  
 CAAACTAAAATCAATAAAGAAACATTAAAAATTAAATTAAAAAAATGA  
 AATTGATTTTGATAATAAATTTATTTGAAATATTTGATCCATCAACTAG  
 AAATAATTTATCAATAAATTGATTATTTATAATATTACCAATTATTATT  
 TTTCCAAGAATTTTTTGATTAATTCAATCACGAATTATATTTATTATAA  
 AAACACTAATAAATTTTATATATAATGAATTTAAAGTTGTTTCAAATC  
 TAAATATCAATCTAATATTATTATTTTTATTAGATTAATACTTTATATT  
 ATAATTACTAACATTTTTAGATTAATTCCTTATGTTTTTACATTAACAA  
 GACATCTACTTTTAAATATAATTTTATCATTAAACATTATGATTTAGATT  
 TCTAATTTATTTAATTTATAATAATTATATTATATTCCTTAGTCATTTA  
 GTTCCATTAAATTCACCAGTATTTTTAATAAACTTTATAGTAATTATTG  
 AACTTATTAGATTAATTATTCGACCTTGAACATTATCAATTCGATTATC  
 AGCAAATTTAATTTCTGGACATTTAATTTAACATTATTAGGAATTTTT  
 ATTAGAACTTTATTTCAATTTTACCAATTAATTTAATAATTCAAATA  
 TACTTTTAACTTTAGAAATTTTTATATCAATAATTCAAAGTTATGTATT  
 TTCAATTCTTTTAATTTTATATTTCTCTGAATCAAATTAA

### 5.2 Restricted fragment size (in base pair) generated from digestion of amplified ATPase6-ATPase8 gene of *A. mellifera* with *DraI*, *Sau3AI*, *SspI* and *VspI*.

Enzymes		Restricted fragment size	$\Sigma$
<i>DraI</i>	A	370, 325, 130	825
<i>Sau3AI</i>	A	635, 190	825
<i>SspI</i>	A	465, 180, 125, 55	825
<i>TaqI</i>	A	620, 205	825
<i>VspI</i>	A	195, 188, 115, 115, 110, 55, 35, 20	825

## BIOGRAPHY

Miss Onuma Songram was born on January 30, 1970. She graduated with the Bachelor degree of science in Radiation Technology from Mahidol University in 1992.



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