Chapter 4

Results

1. Effect of scion-rootstock combinations on growth and development of mangoes

1.1 Effect of scion-rootstock combinations on stem height

Table 4.1 and Figure 4.1 showed that during June 1998 to November 1999, all scion-rootstock combinations had nearly the same percentage of stem height growth rate; except only Pim Sen Mun on Choke Anan had significantly higher percentage of height growth rate than Pim Sen Mun on Kaew in May 1999, and Khiew Sawoey on Kaew had significantly than Khiew Sawoey on Choke Anan in July 1998 and February 1999.

Table 4.1 Effect of scion- rootstock combinations on the percentage of stem height growth rate during June 1998 to November 1999

June 1998

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.71	1.49	2.75	1.65
Choke Anan	0.00	3.87	1.06	1.64
Mean^{NS}	0.35	2.68	1.91	

July 1998

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	3.06 ab	10.46 a	2.99 ab	5.51
Choke Anan	7.36 ab	0.00 b	3.34 ab	3.57
Mean^{NS}	5.21	5.23	3.17	

August 1998

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	3.74	10.22	5.56	6.51
Choke Anan	1.61	9.87	3.42	4.97
Mean*	2.68 b	10.05 a	4.49 b	

September 1998

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	1.02	12.97	1.24	5.08
Choke Anan	5.59	7.62	2.12	5.11
Mean*	3.31 b	10.30 a	1.68 b	

Table 4.1 (continued)

October 1998

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	1.14	5.09	0.18	2.14
Choke Anan	5.02	6.41	2.57	4.67
Mean^{NS}	3.08	5.75	1.37	

November 1998

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.27	0.00	1.82	0.70
Choke Anan	0.66	0.60	0.64	0.63
Mean^{NS}	0.46	0.30	1.23	

December 1998

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	11.62	6.32	7.04	8.33
Choke Anan	12.82	12.16	1.09	8.69
Mean*	12.22 a	9.24 ab	4.06 b	

January 1999

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.93	0.32	0.00	0.42 a
Choke Anan	0.00	0.00	0.00	0.00 b
Mean^{NS}	0.47	0.16	0.00	

February 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00 b	5.51 a	0.00 b	1.84
Choke Anan	0.43 b	0.00 b	0.00 b	0.14
Mean*	0.22 b	2.75 a	0.00 b	

March 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00	7.95	1.29	3.08
Choke Anan	2.37	8.57	3.17	4.70
Mean*	1.19 b	8.26 a	2.23 b	

April 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00	0.00	0.00	0.00
Choke Anan	0.00	0.00	0.00	0.00
Mean^{NS}	0.00	0.00	0.00	

Table 4.1 (continued)

May 1999

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00 b	2.67 ab	2.11 ab	1.59 b
Choke Anan	6.66 a	0.00 b	6.74 a	4.47 a
Mean^{NS}	3.33	1.33	4.43	

June 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	6.64	0.69	2.73	3.35
Choke Anan	4.51	1.34	0.00	1.95
Mean*	5.58 a	1.01 b	1.37 b	

July 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.84	0.10	0.19	0.38
Choke Anan	0.36	0.12	0.00	0.16
Mean*	0.60 a	0.11 b	0.09 b	

August 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00	0.00	0.00	0.00
Choke Anan	0.00	0.00	0.00	0.00
Mean^{NS}	0.00	0.00	0.00	

September 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00	1.72	0.00	0.57
Choke Anan	0.00	0.74	2.19	0.98
Mean^{NS}	0.00	1.23	1.10	

October 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00	2.85	0.00	0.95
Choke Anan	0.00	1.49	0.00	0.50
Mean^{NS}	0.00	2.17	0.00	

Table 4.1 (continued)

November 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00	0.00	0.00	0.00
Choke Anan	0.00	0.00	0.00	0.00
Mean^{NS}	0.00	0.00	0.00	

*Means within the same row or column with different superscript and the interaction value with different superscript differ significantly at 95% confidence by Duncan's Multiple Range Test (DMRT)

NS = non-significance

Choke Anan on Kaew rootstock

The percentage of stem height growth rate (June.98 to Nov.99)																	
Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
98	98	98	98	98	98	98	99	99	99	99	99	99	99	99	99	99	99
0.00	1.15	0.49	1.29	2.53	0.00	4.42	0.00	0.00	1.89	0.00	0.42	1.34	0.13	0.00	0.00	0.98	0.00

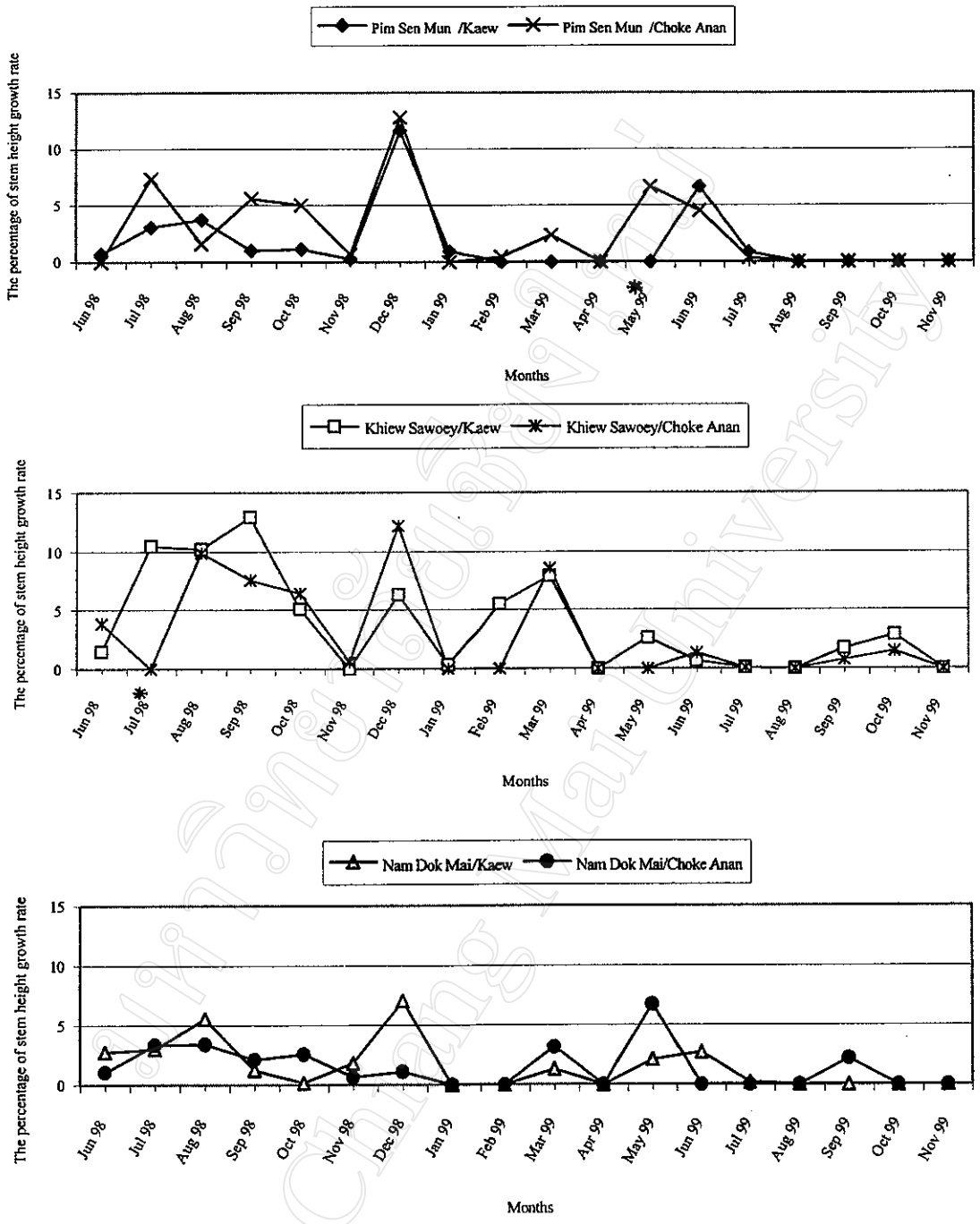

Figure 4.1 Effect of scion-rootstock combination on the percentage of stem height growth rate during June 1998 to November 1999

*Means of each pair of scion-rootstock combinations within the same months with remark (*) differ significantly at 95% confidence by Duncan's Multiple Range Test (DMRT), detailed in Table 4.1.

Table 4.2 and Figure 4.2 showed that Khiew Sawoey had significantly higher the cumulative percentage of stem height growth rate following by Pim Sen Mun and Nam Dok Mai, respectively. However, there were non significant difference between the two rootstocks.

Table 4.2 Effect of scion-rootstock combinations on the cumulative percentage of stem height growth rate during June 1998 to November 1999.

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	32.41	68.33	27.70	42.81
Choke Anan	47.40	52.80	24.35	41.52
Mean*	39.91 b	60.56 a	26.02 c	

*Means within the same row or column with different superscript differ significantly ,whereas the interaction value were not difference at 95% confidence by Duncan's Multiple Range Test (DMRT)
NS = non-significance.

Choke Anan on Kaew rootstock, the cumulative percentage of stem height growth rate was 51.61%

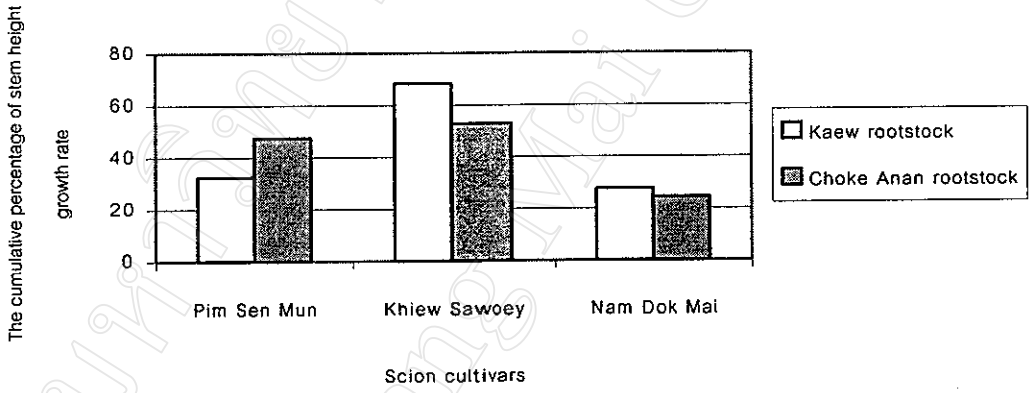

Figure 4.2 Effect of scion-rootstock combinations on the cumulative percentage of stem height growth rate during June 1998 to November 1999.

Table 4.3 and Figure 4.3 compared the cumulative percentage of stem height growth rate during June to September 1998 (El Niño condition) and June to September 1999 (La Niña condition) showed that the stem height growth rate in El Niño were higher than in La Niña for all scion-rootstock combinations. There were non statistical significant difference between the two rootstocks during both conditions. Among the three scions, Khiew Sawoey had higher cumulative percentage of stem height growth rate than Pim Sen Mun and Nam Dok Mai with significant difference during El Niño condition but there were non difference during La Niña

condition. From Figure 4.1 showed that in December 1998 (the beginning of La Niña and ending of El Niño), the percentage of stem height growth rate rapidly increased for all scion-rootstock combinations, whereas Nam Dok Mai on Choke Anan rootstock had the lowest percentage of stem height growth rate.

Table 4.3 Impact of El Niño and La Niña on the cumulative percentage of stem height growth rate (El Niño = during June to September 1998; La Niña = during June to September 1999)

(a) El Niño

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	8.53	35.11	12.54	18.73
Choke Anan	14.73	21.37	9.94	15.35
Mean*	11.63 b	28.24 a	11.24 b	

Choke Anan on Kaew rootstock, the cumulative percentage of stem height growth rate was 2.93%

(b) La Niña

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	7.49	2.51	2.92	4.31
Choke Anan	4.87	2.19	2.19	3.08
Mean^{NS}	6.18	2.35	2.56	

*Mean within the same row or column with different superscript differ significantly, whereas the interaction value were not difference at 95% confidence by Duncan's Multiple Range Test (DMRT)
NS = non-significance.

Choke Anan on Kaew rootstock, the cumulative percentage of stem height growth rate was 1.60%

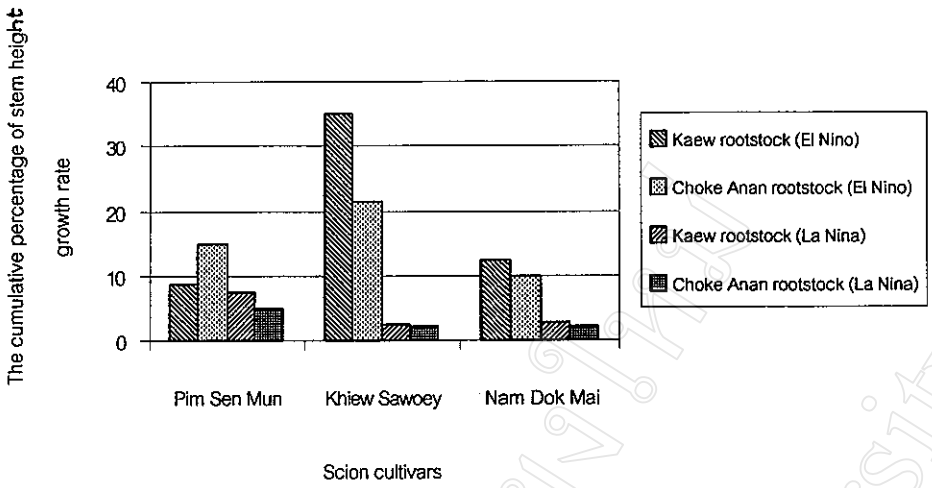

Figure 4.3 Impact of El Niño and La Niña on the cumulative percentage of stem height growth rate. (El Niño = during June to September 1998; La Niña = during June to September 1999.)

1.2 Effect of scion-rootstock combinations on canopy width

During June 1998 to November 1999, all scion-rootstock combinations had nearly the same percentage of canopy width growth rate; except Pim Sen Mun on Choke Anan had significantly higher percentage of canopy width growth rate than Pim Sen Mun on Kaew in September 1998 but lower in January 1999.

Khiew Sawoey on Kaew had significantly higher than Khiew Sawoey on Choke Anan in July 1998, and Nam Dok Mai on Choke Anan had significantly higher than Nam Dok Mai on Kaew in May 1999.(Table 4.4 and Figure 4.4)

Table 4.4 Effect of scion-rootstock combinations on the percentage of canopy width growth rate during June 1998 to November 1999

June 1998

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	1.11	3.88	3.04	2.68
Choke Anan	2.28	3.12	3.62	3.00
Mean^{NS}	1.69	3.50	3.33	

July 1998

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	1.78 a	6.02 a	2.91 ab	3.57
Choke Anan	2.91 ab	0.88 b	6.17 a	3.32
Mean^{NS}	2.34	3.45	4.54	

Table 4.4 (continued)

August 1998

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	4.11	10.63	9.24	8.00
Choke Anan	2.80	9.38	8.54	7.01
Mean*	3.45 b	10.01 a	9.04 a	

September 1998

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	4.80 b	6.00 b	6.54 b	5.78 b
Choke Anan	13.76 a	6.66 b	8.82 b	9.74 a
Mean^{NS}	9.28	6.33	7.68	

October 1998

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	4.49	9.40	3.60	5.83 b
Choke Anan	8.91	14.15	5.94	9.66 a
Mean*	6.70 b	11.77 a	4.77 b	

November 1998

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	2.03	1.60	3.39	2.34 b
Choke Anan	4.37	3.59	6.10	4.69 a
Mean^{NS}	3.20	2.60	4.74	

December 1998

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	31.10	15.77	13.64	20.17 a
Choke Anan	16.35	13.06	2.92	10.78 b
Mean*	23.72 a	14.41 ab	8.28 b	

January 1999

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	2.50 a	0.71 b	0.77 b	1.33 a
Choke Anan	0.64 b	0.36 b	0.53 b	0.51 b
Mean*	1.57 a	0.53 b	0.65 b	

February 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.79	7.58	1.46	3.28
Choke Anan	0.00	6.20	0.33	2.18
Mean*	0.40 b	6.89 a	0.90 b	

Table 4.4 **(continued)**

March 1999

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	1.05	5.66	1.31	2.67 b
Choke Anan	5.17	8.34	7.71	7.07 a
Mean^{NS}	3.11	7.00	4.51	

April 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	1.51	0.76	0.12	0.80
Choke Anan	0.29	0.69	0.51	0.50
Mean^{NS}	0.90	0.73	0.32	

May 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	3.65 ab	7.53 ab	3.01 b	4.73
Choke Anan	5.23 ab	0.46 b	11.15 a	5.61
Mean^{NS}	4.44	3.99	7.08	

June 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	4.72	1.59	2.26	2.86
Choke Anan	1.55	1.76	1.03	1.45
Mean^{NS}	3.13	1.67	1.65	

July 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00	0.00	0.00	0.00
Choke Anan	0.00	0.00	0.00	0.00
Mean^{NS}	0.00	0.00	0.00	

August 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00	0.00	0.00	0.00
Choke Anan	0.00	0.00	0.00	0.00
Mean^{NS}	0.00	0.00	0.00	

September 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00	0.12	0.38	0.17
Choke Anan	0.06	0.00	0.00	0.02
Mean^{NS}	0.03	0.06	0.19	

Table 4.4 (continued)

October 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00	4.17	0.33	1.50
Choke Anan	0.17	2.04	0.27	0.82
Mean^{NS}	0.08	3.10	0.30	

November 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00	0.00	0.22	0.07
Choke Anan	0.00	0.22	0.00	0.07
Mean^{NS}	0.00	0.11	0.11	

*Means within the same row or column with different superscript and the interaction value with different superscript differ significantly at 95% confidence by Duncan's Multiple Range Test (DMRT) NS = non-significance.

Choke Anan on Kaew rootstock

The percentage of canopy width growth rate (June.98 to Nov.99)																	
Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
98	98	98	98	98	98	98	99	99	99	99	99	99	99	99	99	99	99
1.59	0.88	1.97	1.96	2.46	2.81	9.57	0.41	0.94	4.04	0.22	2.00	0.77	0.00	0.00	0.25	2.28	0.31

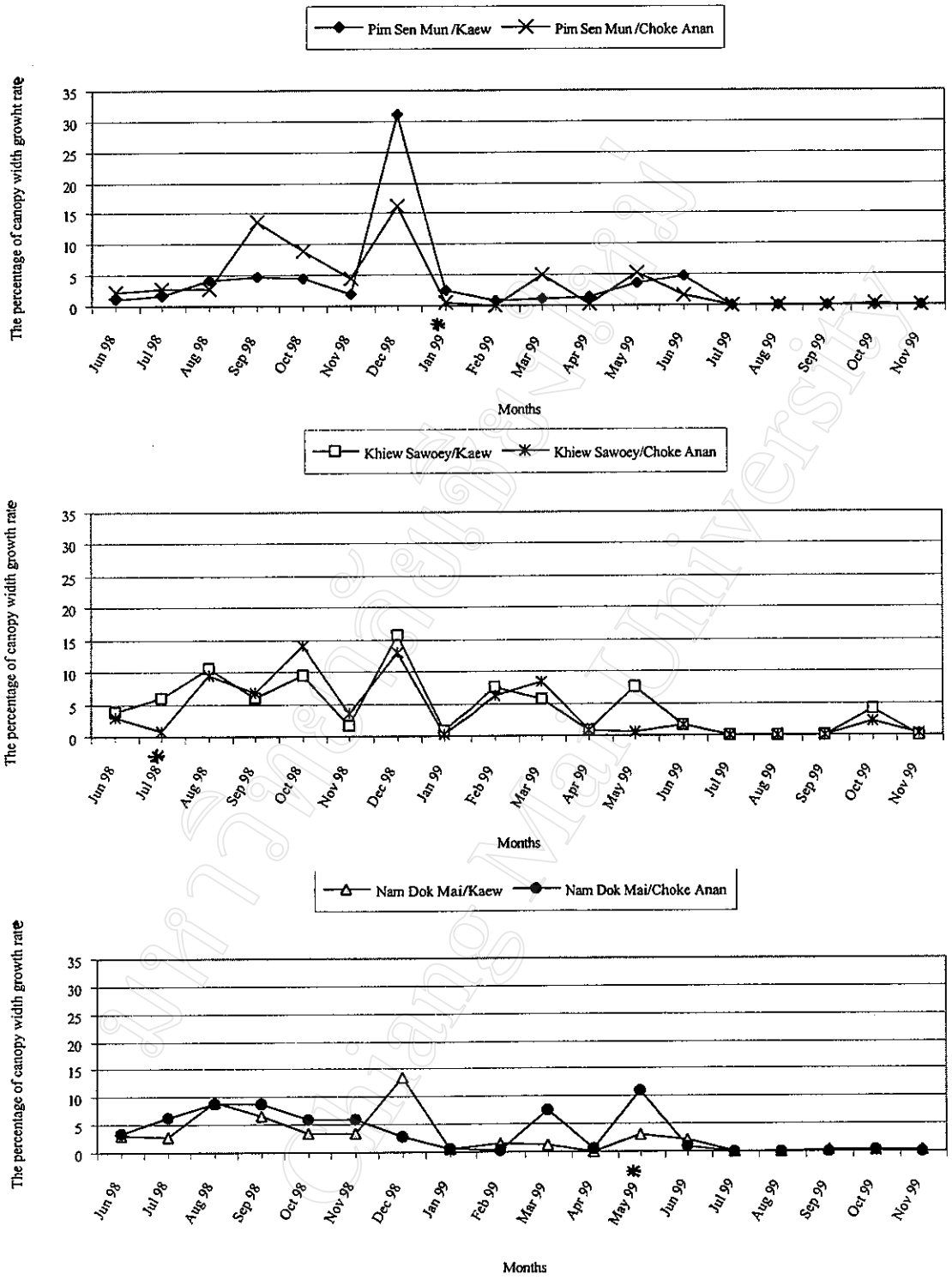

Figure 4.4 Effect of scions-rootstock combinations on the percentage of canopy width growth rate during June 1998 to November 1999.

*Means of each pair of scion-rootstock combinations within the same months with remark (*) differ significantly at 95% confidence by Duncan's Multiple Range Test (DMRT), detailed in Table 4.4.

Table 4.5 and Figure 4.5 showed that there were non significant difference at 95% confidence between the two rootstocks. Among the scions, Khiew Sawoey had the highest cumulative percentage of canopy width growth rate followed by Pim Sen Mun and Nam Dok Mai with significant difference.

Table 4.5 Effect of scion-rootstock combinations on the cumulative of canopy width growth rate during June 1998 to November 1999.

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	63.65	84.50	52.02	66.72
Choke Anan	64.47	70.70	63.94	66.37
Mean*	64.06 ab	77.60 a	57.98 b	

*Means within the same row or column with different superscript differ significantly, whereas the interaction value were not difference at 95% confidence by Duncan's Multiple Range Test (DMRT)
NS = non-significance.

Choke Anan on Kaew rootstock, the cumulative percentage of canopy width growth rate was 32.45%

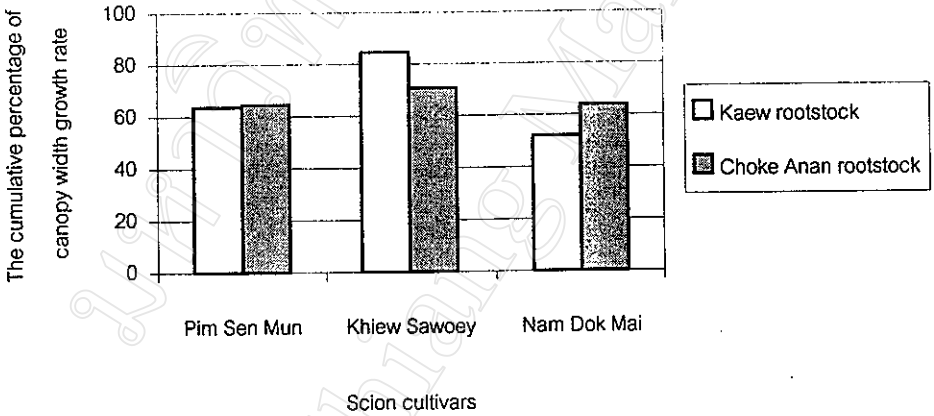

Figure 4.5 Effect of scion-rootstock combinations on the cumulative of canopy width growth rate during June 1998 to November 1999

Table 4.6 and Figure 4.6 showed the comparison of the cumulative percentage of canopy width growth rate of mango during June to September 1998 (El Niño) to June to September 1999 (La Niña) found that canopy width growth rate in El Niño were higher than in La Niña for all scion-rootstock combinations. Pim Sen Mun on Choke Anan had significantly higher cumulative percentage of canopy width growth rate than on Kaew during El Niño but non significant difference among the three scions during La Niña. Whereas there were non significant difference between both rootstocks during both conditions.

From Figure 4.4, in December 1998 (the end of El Niño and beginning of La Niña) there were rapidly increased cumulative percentage of canopy width growth rate of all rootstocks and scions; except Nam Dok Mai on Choke Anan had the least.

Table 4.6 Impact of El Niño and La Niña on the cumulative percentage of canopy width growth rate.

(El Niño = during June to September 1998; La Niña = during June to September 1999)

(a) El Niño

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	11.80 b	26.55 a	21.52 a	19.96
Choke Anan	21.74 a	19.85 ab	21.45 a	23.01
Mean*	16.77 b	23.20 a	24.48 a	

Choke Anan on Kaew rootstock, the cumulative percentage of canopy width growth rate was 6.87%

(b) La Niña

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	4.72	1.71	2.65	3.03
Choke Anan	1.61	1.76	1.03	1.47
Mean^{NS}	3.16	1.73	1.84	

*Mean within the same row or column with different superscript and the interaction value with different superscript differ significantly at 95% confidence by Duncan's Multiple Range Test (DMRT)
NS = non-significance.

Choke Anan on Kaew rootstock, the cumulative percentage of canopy width growth rate was 1.02%

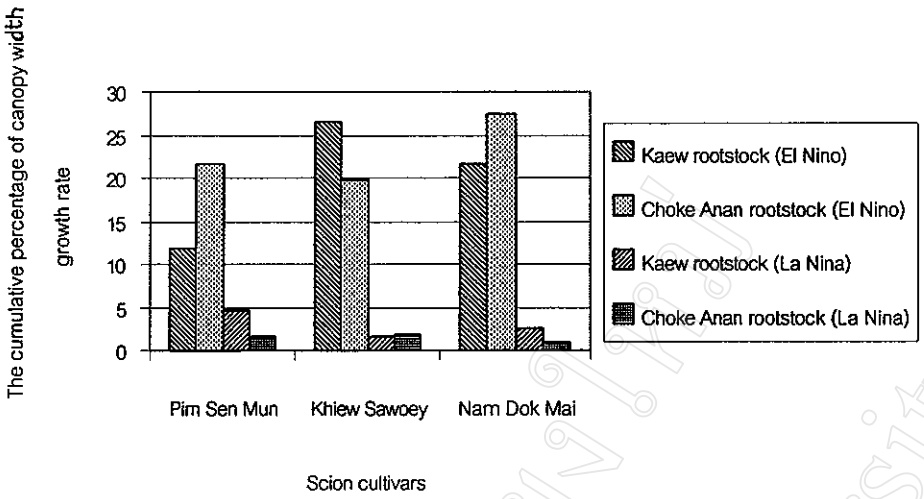

Figure 4.6 Impact of El Niño and La Niña on the cumulative percentage of canopy width growth rate. (El Niño = during June to September 1998; La Niña = during June to September 1999.)

1.3 Effect of scion-rootstock combination on stem diameter

All scion-rootstock combinations had nearly the same percentage of stem diameter growth rate; except Pim Sen Mun on Kaew had significantly higher percentage of stem diameter growth rate than on Choke Anan rootstocks in August 1999, while Khiew Sawoey on Kaew had significantly higher than on Choke Anan rootstocks in October 1999, and Nam Dok Mai on Kaew had higher than on Choke Anan rootstocks during on October 1999. (Table 4.7 and Figure 4.7)

Table 4.7 Effect of scion-rootstock combinations on the percentage of stem diameter growth rate during June 1998 to November 1999

June 1998

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	1.74	2.06	2.06	1.95 b
Choke Anan	2.59	2.51	1.91	2.34 a
Mean^{NS}	2.17	2.28	1.98	

July 1998

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	2.50	2.32	2.12	2.31 b
Choke Anan	3.29	3.16	2.69	3.05 a
Mean^{NS}	2.89	2.74	2.41	

Table 4.7 (continued)

August 1998

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	2.52	3.41	2.08	2.67 b
Choke Anan	4.31	3.55	2.98	3.61 a
Mean*	3.42 a	3.48 a	2.53 b	

September 1998

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	2.32	2.90	1.84	2.35 b
Choke Anan	3.34	3.91	4.45	3.90 a
Mean^{NS}	2.83	3.41	3.15	

October 1998

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	2.02	2.86	2.12	2.34 b
Choke Anan	3.58	3.59	3.07	3.41 a
Mean^{NS}	2.80	3.23	2.60	

November 1998

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	2.76	3.15	2.05	2.56 b
Choke Anan	3.71	3.62	3.88	3.73 a
Mean^{NS}	3.23	3.38	2.96	

December 1998

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	5.76	6.56	5.51	5.94
Choke Anan	6.16	6.32	4.67	5.71
Mean^{NS}	5.96	6.44	5.09	

January 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	4.52	5.70	4.45	4.89
Choke Anan	5.02	5.01	4.44	4.82
Mean^{NS}	4.77	5.36	4.44	

February 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	4.17	5.62	4.30	4.70
Choke Anan	5.22	4.52	4.38	4.71
Mean^{NS}	4.70	5.07	4.34	

Table 4.7 (continued)

March 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	4.22	5.23	4.18	4.54
Choke Anan	5.05	5.17	4.50	4.91
Mean^{NS}	4.63	5.20	4.34	

April 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	3.97	5.05	4.07	4.36
Choke Anan	4.61	4.22	3.77	4.20
Mean^{NS}	4.29	4.63	3.92	

May 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	4.03	5.08	4.00	4.37
Choke Anan	4.95	4.09	3.90	4.31
Mean^{NS}	4.49	4.59	3.95	

June 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	3.41	2.20	3.21	2.94
Choke Anan	3.17	2.21	1.11	2.17
Mean^{NS}	3.29	2.21	2.16	

July 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	1.22	1.28	1.36	1.29
Choke Anan	0.90	1.22	1.20	1.10
Mean^{NS}	1.06	1.25	1.28	

August 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	1.86 a	1.40 ab	1.36 ab	1.54
Choke Anan	0.96 b	1.49 ab	1.43 ab	1.29
Mean^{NS}	1.41	1.44	1.39	

September 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	1.50	3.21	2.03	2.25
Choke Anan	0.94	1.67	1.82	1.48
Mean^{NS}	1.22	2.44	1.92	

Table 4.7 (continued)

October 1999

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	1.50 d	2.64 a	2.30 b	2.15 a
Choke Anan	1.47 d	1.97 c	1.94 c	1.79 b
Mean*	1.49 b	2.30 a	2.12 a	

November 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	1.66	2.86	1.94	2.15
Choke Anan	1.67	2.44	1.91	2.01
Mean*	1.67 c	2.65 a	1.92 b	

*Means within the same row or column with different superscript and the interaction value with different superscript differ significantly at 95% confidence by Duncan's Multiple Range Test (DMRT) NS = non-significance.

Choke Anan on Kaew rootstock

The percentage of canopy stem diameter growth rate (June.98 to Nov.99)																	
Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
98	98	98	98	98	98	98	99	99	99	99	99	99	99	99	99	99	99
2.99	2.73	3.14	3.22	3.07	3.56	4.13	3.43	3.36	3.13	3.22	3.30	2.35	1.48	1.64	2.85	2.21	2.30

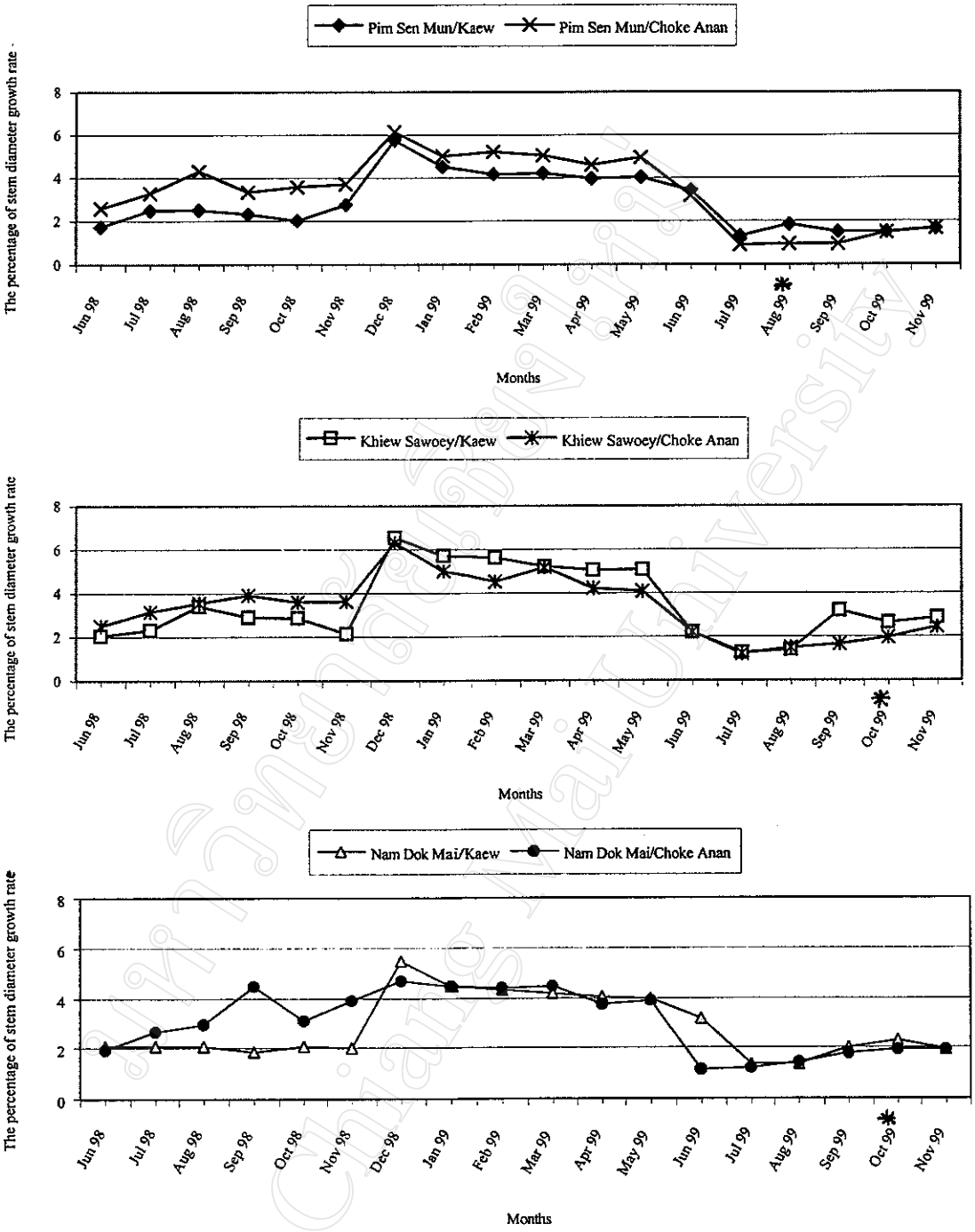

Figure 4.7 Effect of scion-rootstock combinations on the percentage of stem diameter growth rate during June 1998 to November 1999.

*Means of each pair of scion-rootstock combinations within the same months with remark (*) differ significantly at 95% confidence by Duncan's Multiple Range Test (DMRT), detailed in Table 4.7.

Figure 4.8 and Table 4.8 showed that among the three scions, Khiew Sawoey had significantly higher cumulative percentage of stem diameter growth rate than Pim Sen Mun and Nam Dok Mai, respectively; but both rootstocks were non significant difference.

Table 4.8 Effect of scion-rootstock combinations on cumulative percentage of stem diameter growth rate during June 1998 to November 1999.

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	51.89	63.97	50.98	55.61
Choke Anan	60.37	60.67	52.99	58.01
Mean*	56.13 ab	62.32 a	51.98 b	

*Mean within the same row or column with different superscript differ significantly, whereas the interaction value were not difference at 95% confidence by Duncan's Multiple Range Test (DMRT)
NS = non-significance.

Choke Anan on Kaew rootstock, the cumulative percentage of stem diameter growth rate was 33.40%

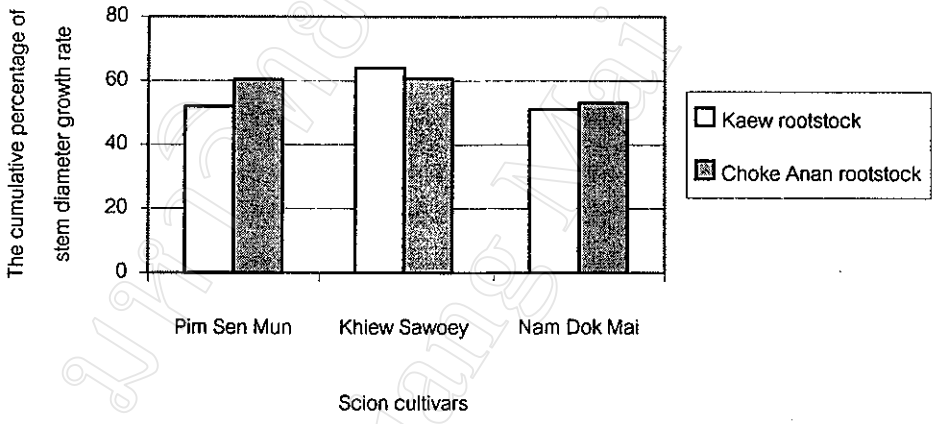

Figure 4.8 Effect of scion-rootstock combinations on cumulative percentage of stem diameter growth during June 1998 to November 1999.

Figure 4.9 and Table 4.9 showed the comparison of cumulative percentage of stem diameter growth rate during June to September 1998 (El Niño) and June to September 1999 (La Niña), found that cumulative percentage of stem diameter growth rate were higher during El Niño than La Niña for all scions and rootstocks. Choke Anan rootstock had significantly higher cumulative percentage of stem diameter growth rate than Kaew rootstocks during El Niño. Among the three

scions, Khiew Sawoey, and Pim Sen Mun had significantly higher the growth rate than Nam Dok Mai. While during La Niña, there were non significant difference between rootstocks and scions. Figure 4.7 showed that in December 1998 which were the end of El Niño and beginning of La Niña, all scions and rootstocks had the rapid increasing cumulative percentage of stem diameter growth rate.

Table 4.9 Impact of El Niño and La Niña on the cumulative percentage of stem diameter growth rate (El Niño = during June to September 1998; La Niña = during June to September 1999)

(a) El Niño

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	9.09	10.68	8.10	9.29 b
Choke Anan	13.60	13.13	11.04	12.62 a
Mean*	11.39 a	11.90 a	9.57 b	

Choke Anan on Kaew rootstock, the cumulative percentage of stem diameter growth rate was 10.58%

(b) La Niña

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	8.09	8.09	7.95	8.04
Choke Anan	5.98	6.59	5.55	6.04
Mean^{NS}	7.03	7.34	6.75	

*Mean within the same row or column with different superscript differ significantly, whereas the interaction value were not difference at 95% confidence by Duncan's Multiple Range Test (DMRT) NS = non-significance.

Choke Anan on Kaew rootstock, the cumulative percentage of stem diameter growth rate was 8.32%

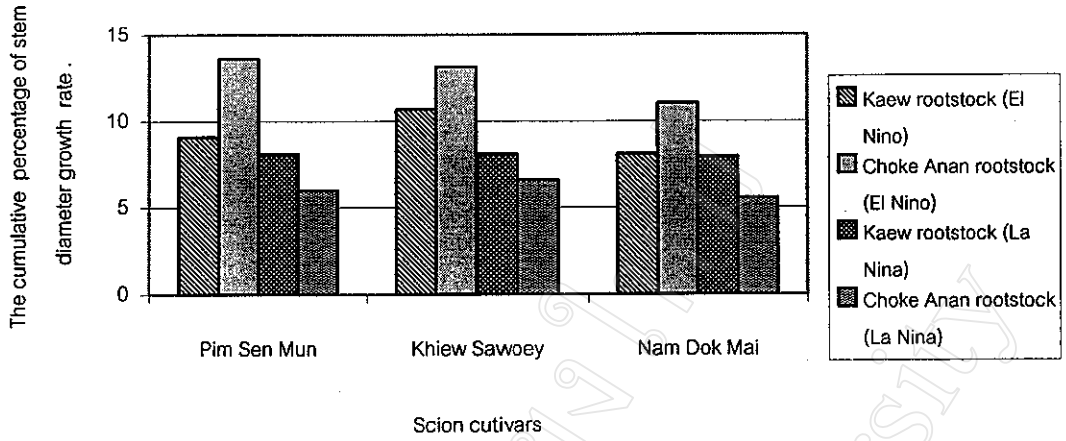

Figure 4.9 Impact of El Niño and La Niña on the cumulative percentage of stem diameter growth rate (El Niño = during June to September 1998; La Niña = during June to September 1999)

2. Effect of scion-rootstock combinations on terminal shoots.

2.1 Effect of scion-rootstock combinations on percentage of shooting.

During May 1998 to March 2000, all scion-rootstock combinations had nearly the same percentage of shooting. While Pim Sen Mun on Choke Anan had significantly higher the percentage than on Kaew in August 1998 and lower in December 1998 and January 1999. There were no shooting in February, April, July, August 1999 and during November 1999 to February 2000, for Pim Sen Mun on both rootstocks. Khiew Sawoey on Choke Anan had significantly higher percentage of shooting than on Kaew in May 1998 and lower in 1998 and December 1999. While in April, July, August ,November 1999, January and February 2000, there were no shooting of Khiew Sawoey on both rootstocks. Nam Dok Mai on Choke Anan had higher percentage of shooting than on Kaew in and May 1999; Whereas in January, April, July, August 1999 and among November 1999 to February 2000, there were no shooting of Nam Dok Mai on both rootstocks. (Table 4.10 and Figure 4.10)

Table 4.10 Effect of scion-rootstock combinations on the percentage of shooting during May 1998 to March 2000

May 1998

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	12.88 b	2.92 b	11.05 b	8.95 b
Choke Anan	14.90 b	50.05 a	15.47 b	26.81 a
Mean*	13.89 b	26.49 a	13.26 b	

Table 4.10 (continued)

June 1998

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	20.59	14.31	25.71	20.21
Choke Anan	18.66	23.34	32.60	24.87
Mean^{NS}	19.63	18.82	29.16	

July 1998

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	35.69 a	33.92 a	19.74 ab	29.78
Choke Anan	32.62 a	1.50 b	26.65 a	20.26
Mean*	34.16 a	17.71	23.19	

August 1998

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	25.37 b	56.35 a	36.30 ab	39.34
Choke Anan	61.48 a	35.49 ab	42.95 ab	46.64
Mean^{NS}	43.42	45.92	39.62	

September 1998

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	33.67	19.91	17.68	23.76
Choke Anan	43.72	47.94	14.57	35.41
Mean*	38.70 a	33.93 a	16.13 b	

October 1998

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	38.95	23.64	9.21	23.93
Choke Anan	49.26	50.20	15.67	38.38
Mean*	44.10 a	36.92 a	12.44 b	

November 1998

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	9.52	0.29	6.95	5.59 b
Choke Anan	10.78	18.61	15.03	14.81 a
Mean^{NS}	10.15	9.45	10.99	

December 1998

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	64.53 a	25.76 b	32.82 b	41.04 a
Choke Anan	15.66 b	33.51 b	3.99 b	17.72 b
Mean^{NS}	40.10	29.63	18.41	

Table 4.10 (continued)

January 1999

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	6.33 a	2.36 b	0.00 b	2.90 a
Choke Anan	0.00 b	0.00 b	0.00 b	0.00 b
Mean*	3.17 a	1.18 b	0.00 b	

February 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00 b	17.34 a	1.02 b	6.12
Choke Anan	0.00 b	11.31 ab	22.37 a	11.23
Mean*	0.00 b	14.33 a	11.70 a	

March 1999

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	10.00	10.82	3.34	8.05 b
Choke Anan	29.43	18.96	28.77	25.72 a
Mean^{NS}	19.71	14.89	16.06	

April 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00	0.00	0.00	0.00
Choke Anan	0.00	0.00	0.00	0.00
Mean^{NS}	0.00	0.00	0.00	

May 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	2.87 b	13.64 b	6.55 b	7.68
Choke Anan	16.05 b	0.00 b	31.60 a	15.88
Mean^{NS}	9.46	6.82	19.07	

June 1999

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	62.73	11.55	25.58	33.29 a
Choke Anan	22.21	12.08	2.47	12.25 b
Mean*	42.47 a	11.81 b	14.03 b	

July 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00	0.00	0.00	0.00
Choke Anan	0.00	0.00	0.00	0.00
Mean^{NS}	0.00	0.00	0.00	

Table 4.10 (continued)

August 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00	0.00	0.00	0.00
Choke Anan	0.00	0.00	0.00	0.00
Mean^{NS}	0.00	0.00	0.00	

September 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00	13.09	1.57	4.89
Choke Anan	0.80	0.00	4.62	1.80
Mean^{NS}	0.40	6.54	3.09	

October 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.10	2.99	0.11	1.07
Choke Anan	5.18	3.24	0.35	2.93
Mean^{NS}	2.64	3.12	0.23	

November 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00	0.00	0.00	0.00
Choke Anan	0.00	0.00	0.00	0.00
Mean^{NS}	0.00	0.00	0.00	

December 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00 b	30.00 a	0.00 b	10.00
Choke Anan	0.00 b	0.00 b	0.00 b	0.00
Mean*	0.00 b	15.00 a	0.00 b	

January 2000

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00	0.00	0.00	0.00
Choke Anan	0.00	0.00	0.00	0.00
Mean^{NS}	0.00	0.00	0.00	

February 2000

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00	0.00	0.00	0.00
Choke Anan	0.00	0.00	0.00	0.00
Mean^{NS}	0.00	0.00	0.00	

Table 4.10 (continued)

March 2000

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	7.81	28.47	13.27	16.51
Choke Anan	17.80	30.53	36.31	28.21
Mean^{NS}	12.80	29.50	24.79	

*Mean within the same row or column with different superscript and the interaction value with different superscript differ significantly at 95% confidence by Duncan's Multiple Range Test (DMRT) NS = non-significance.

Choke Anan on Kaew rootstock

The percentage of shooting (May 98 to March 00)											
May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
98	98	98	98	98	98	98	98	99	99	99	99
98.00	7.33	3.42	5.00	5.37	4.87	4.02	47.20	0.00	0.00	12.33	0.00

The percentage of shooting (May 98 to March 00)										
May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
99	99	99	99	99	99	99	99	00	00	00
4.48	12.41	0.00	0.00	3.49	0.90	0.00	10.00	0.00	0.00	21.65

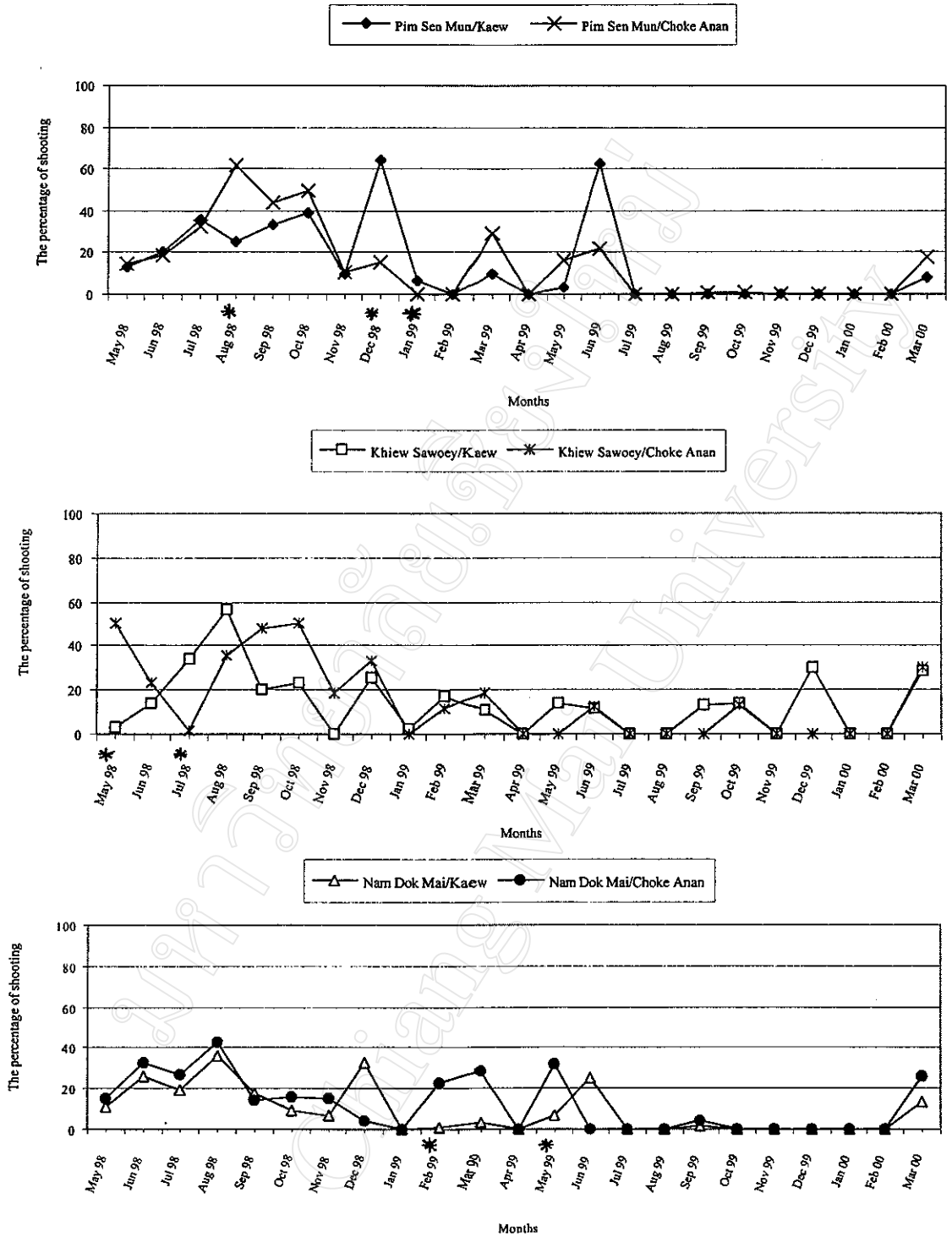

Figure 4.10 Effect of scion-rootstock combinations on the percentage of shooting during May 1998 to March 2000

*Means of each pair of scion-rootstock combinations within the same months with remark (*) differ significantly at 95% confidence by Duncan's Multiple Range Test (DMRT), detailed in Table 4.10.

Table 4.11 and Figure 4.11 showed the comparison of cumulative percentage of shooting during May to September 1998 (El Niño) and during May to September 1999 (La Niña) found that During El Niño, rootstock had significantly higher cumulative percentage of shooting than Kaew, but there were non significant different among the three scions. However, there were non significant difference of both rootstocks and three scions during La Niña.

Figure 4.10 showed that in December 1998 (the beginning of La Niña and end of El Niño) there were rapidly increased percentage of shooting in all rootstocks and scions, except decreased in Nam Dok Mai on Choke Anan.

Table 4.11 Impact of El Niño and La Niña on the cumulative percentage of shooting (El Niño = during May to September 1998; La Niña = during May to September 1999)

(a) El Niño

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	128.21	127.42	110.49	122.04 b
Choke Anan	171.64	158.31	132.54	154.16 a
Mean^{NS}	149.92	142.87	121.51	

Choke Anan on Kaew rootstock, the cumulative percentage of shooting was 119.36%

(b) La Niña

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	65.60	38.28	33.70	45.86
Choke Anan	39.76	15.32	39.04	31.37
Mean^{NS}	52.68	26.80	36.37	

*Mean within the same row or column with different superscript differ significantly, whereas the interaction value were not difference at 95% confidence by Duncan's Multiple Range Test (DMRT)
NS = non-significance.

Choke Anan on Kaew rootstock, the cumulative percentage of shooting was 20.91%

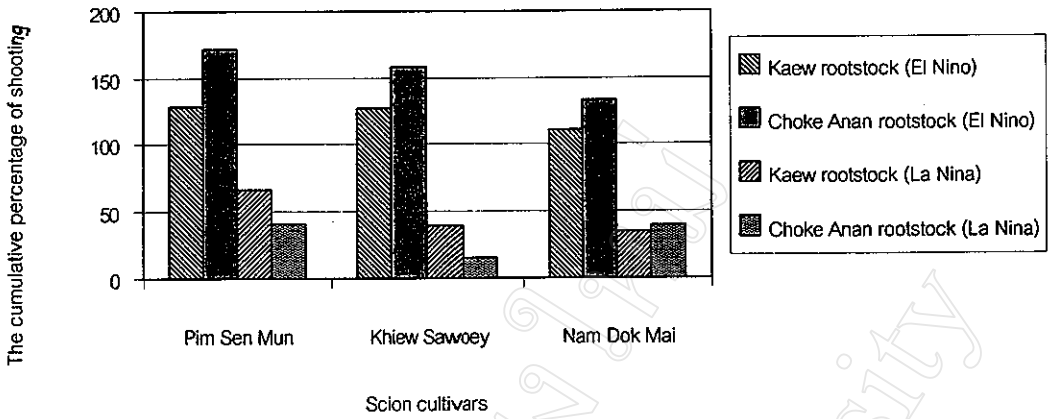

Figure 4.11 Impact of El Niño and La Niña on the cumulative percentage of shooting. (El Niño = during May to September 1998; La Niña = during May to September 1999.)

2.1 Effect of scion-rootstock combinations on the number of new shoots.

During May 1998 to March 2000, all scion-rootstock combinations had nearly the same average number of new shoots; except Pim Sen Mun on Kaew had significantly the average number of new shoots higher than on Choke Anan in January 1999. Khiew Sawoey on Choke Anan had significantly higher than on Kaew in May 1998 and lower in July 1998. While Nam Dok Mai on Choke Anan had significantly higher than on Kaew in May 1999 and lower in December 1998.(Table 4.12 and Figure 4.12)

Table 4.12 Effect of scion-rootstock combinations on the average numbers of new shoots during May 1998 to March 2000

May 1998

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	1.07 bc	0.50 c	1.43 ab	1.00 b
Choke Anan	1.63 ab	1.85 a	1.64 ab	1.70 a
Mean^{NS}	1.35	1.17	1.53	

June 1998

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	1.37	0.77	1.81	1.32 b
Choke Anan	1.77	1.47	1.71	1.65 a
Mean*	1.57 a	1.12 b	1.76 a	

July 1998

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	2.55 a	1.69 b	1.40 b	1.88
Choke Anan	2.62 a	0.17 c	1.73 b	1.50
Mean*	2.58 a	0.93 c	1.55 b	

Table 4.12 (continued)

August 1998

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	1.98	3.03	1.48	2.16
Choke Anan	1.83	1.76	1.49	1.69
Mean^{NS}	1.91	2.39	1.48	

September 1998

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	1.97	2.23	1.29	1.83
Choke Anan	2.01	2.21	1.86	2.02
Mean^{NS}	1.99	2.22	1.57	

October 1998

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	1.35	1.60	1.18	1.38
Choke Anan	1.18	2.08	2.01	1.76
Mean^{NS}	1.26	1.84	1.60	

November 1998

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	1.04	0.21	1.32	0.85 b
Choke Anan	1.30	1.43	1.51	1.41 a
Mean^{NS}	1.17	0.82	1.41	

December 1998

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	2.33 ab	0.66 cd	2.65 a	1.88 a
Choke Anan	1.79 ab	1.49 bc	0.40 d	1.23 b
Mean*	2.06 a	1.07 b	1.52 ab	

January 1999

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	1.24 a	0.20 b	0.00 b	0.48 a
Choke Anan	0.00 b	0.00 b	0.00 b	0.00 b
Mean*	0.62 a	0.10 b	0.00 b	

February 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00	0.76	2.20	0.32
Choke Anan	0.00	0.77	0.75	0.51
Mean*	0.00 b	0.77 a	0.47 a	

March 1999

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.24	0.63	0.36	0.41 b
Choke Anan	0.86	2.26	1.03	1.38 a
Mean^{NS}	0.55 b	1.45 a	0.69 b	

Table 4.12 (continued)

April 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00	0.00	0.00	0.00
Choke Anan	0.00	0.00	0.00	0.00
Mean^{NS}	0.00	0.00	0.00	

May 1999

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.49 b	0.52 b	0.86 b	0.62 b
Choke Anan	2.17 a	0.00 b	2.07 a	0.41 a
Mean*	1.33 a	0.26 b	1.46 a	

June 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	1.80	0.84	1.29	1.31
Choke Anan	2.31	0.88	0.26	1.15
Mean*	2.05 a	0.86 b	0.78 b	

July 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00	0.00	0.00	0.00
Choke Anan	0.00	0.00	0.00	0.00
Mean^{NS}	0.00	0.00	0.00	

August 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00	0.00	0.00	0.00
Choke Anan	0.00	0.00	0.00	0.00
Mean^{NS}	0.00	0.00	0.00	

September 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00	0.83	0.80	0.55
Choke Anan	1.09	0.00	0.31	0.47
Mean^{NS}	0.55	0.42	0.55	

October 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.10	0.38	0.20	0.23
Choke Anan	1.16	0.33	0.28	0.59
Mean^{NS}	0.63	0.35	0.24	

November 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00	0.00	0.00	0.00
Choke Anan	0.00	0.00	0.00	0.00
Mean^{NS}	0.00	0.00	0.00	

Table 4.12 (continued)

December 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00 b	0.71 a	0.00 b	0.24
Choke Anan	0.00 b	0.00 b	0.00 b	0.00
Mean*	0.00 b	0.35 a	0.00 b	

January 2000

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00	0.00	0.00	0.00
Choke Anan	0.00	0.00	0.00	0.00
Mean^{NS}	0.00	0.00	0.00	

February 2000

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00	0.00	0.00	0.00
Choke Anan	0.00	0.00	0.00	0.00
Mean^{NS}	0.00	0.00	0.00	

March 2000

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	1.72	1.41	2.06	1.73
Choke Anan	1.62	1.49	2.21	1.78
Mean^{NS}	1.67	1.45	2.14	

*Mean within the same row or column with different superscript and the interaction value with different superscript differ significantly at 95% confidence by Duncan's Multiple Range Test (DMRT)

NS = non-significance.

Choke Anan on Kaew rootstock

The average numbers of new shoots (May 98 to March 00)											
May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
98	98	98	98	98	98	98	98	99	99	99	99
4.10	0.80	0.50	0.65	0.42	0.58	1.05	1.86	0.00	0.00	0.54	0.00

The average numbers of new shoots (May 98 to March 00)										
May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
99	99	99	99	99	99	99	99	00	00	00
0.42	0.77	0.00	0.00	0.63	0.30	0.00	0.30	0.00	0.00	1.53

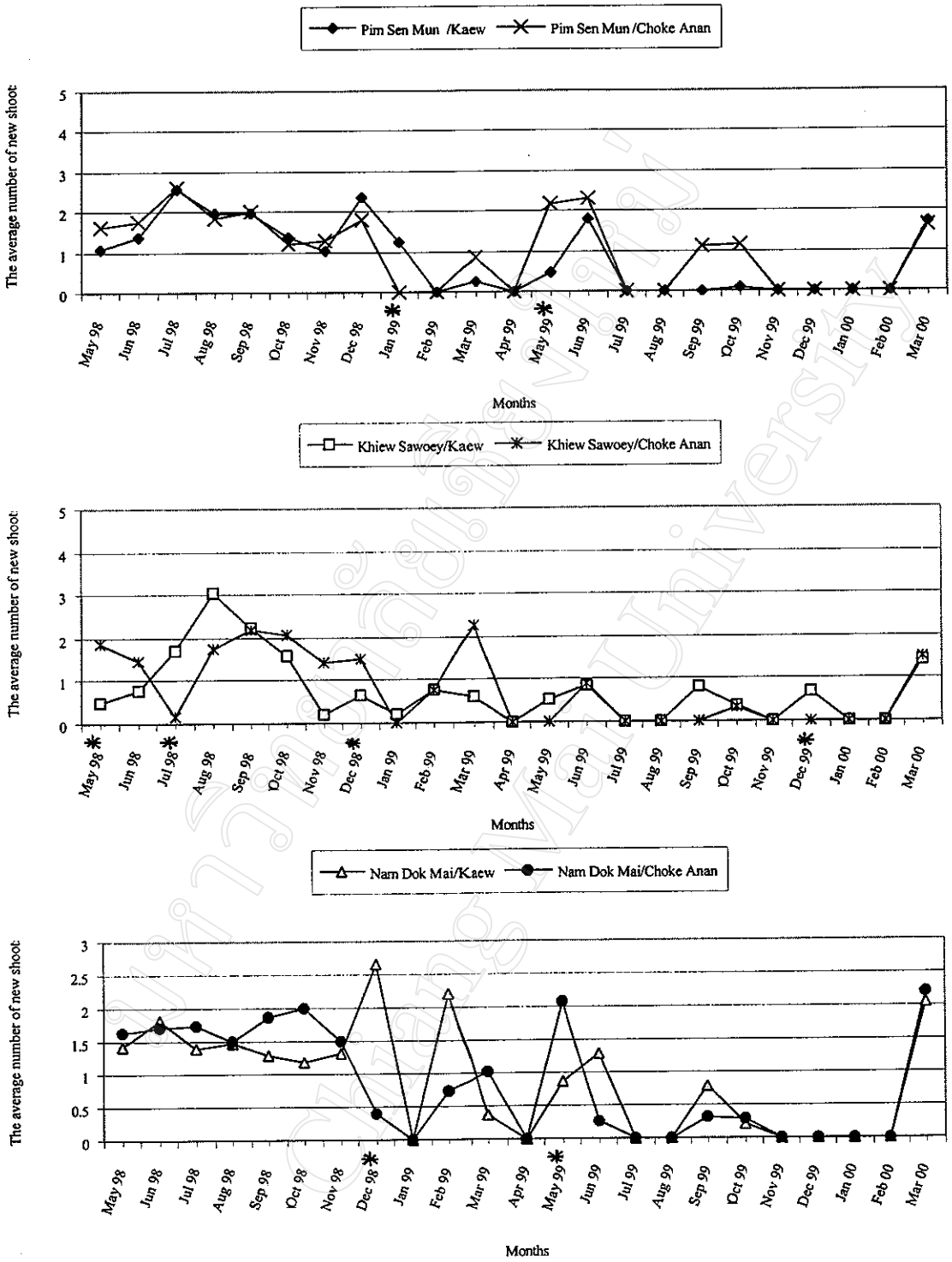

Figure 4.12 Effect of scion-rootstock combinations on the average numbers of new shoots during May 1998 to March 2000

*Means of each pair of scion-rootstock combinations within the same months with remark (*) differ significantly at 95% confidence by Duncan's Multiple Range Test (DMRT), detailed in Table 4.12.

2.3 Effect of scion-rootstock combinations on the number of shooting

2.3.1 Effect of scion-rootstock combinations on the number of shooting (monthly)

Pim Sen Mun on Kaew had the highest number of shooting up to 0.64 in December 1998; while Pim Sen Mun on Choke Anan had the highest number up to 0.39 in October 1998. Kheiw Sawoey on Kaew had the highest number up to 0.56 in August 1998 whereas Khiew Sawoey on Choke Anan had the highest number up to 0.50 in May and October 1998. Nam Dok Mai on Kaew had the highest number up to 0.36 in August 1998. While Nam Dok Mai on Choke Anan had the highest number up to 0.48 in August 1998. (Table 4.13).

Table 4.13 Effect of scion-rootstock combinations on the numbers of shooting during May 1998 to March 2000

May 1998

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.13 b	0.03 b	0.11 b	0.09 b
Choke Anan	0.12 b	0.50 a	0.16 b	0.26 a
Mean*	0.12 b	0.27 a	0.13 b	

June 1998

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.20	0.14	0.26	0.20
Choke Anan	0.19	0.23	0.33	0.25
Mean^{NS}	0.20	0.19	0.29	

July 1998

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.36 a	0.34 a	0.20 ab	0.30
Choke Anan	0.33 a	0.02 b	0.27 a	0.20
Mean^{NS}	0.34	0.18	0.23	

August 1998

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.25 b	0.56 a	0.36 ab	0.39
Choke Anan	0.61 a	0.36 ab	0.48 ab	0.48
Mean^{NS}	0.43	0.46	0.42	

September 1998

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.33	0.20	0.18	0.24
Choke Anan	0.44	0.48	0.15	0.35
Mean*	0.39 a	0.34 a	0.16 b	

Table 4.13 (continued)

October 1998

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.39 a	0.24 a	0.09 a	0.24
Choke Anan	0.49 a	0.50 a	0.16 a	0.38
Mean*	0.44 a	0.37 a	0.12 b	

November 1998

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.09	0.00	0.07	0.05 b
Choke Anan	0.11	0.18	0.15	0.15 a
Mean^{NS}	0.10	0.09	0.11	

December 1998

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.64 a	0.26 b	0.33 b	0.14 a
Choke Anan	0.16 b	0.34 b	0.04 b	0.18 b
Mean^{NS}	0.40	0.30	0.18	

January 1999

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.11 a	0.02 b	0.00 b	0.04 a
Choke Anan	0.00 b	0.00 b	0.00 b	0.00 b
Mean*	0.05 a	0.01 b	0.00 b	

February 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00 b	0.17 a	0.01 b	0.06
Choke Anan	0.00 b	0.11 ab	0.22 a	0.11
Mean*	0.00 b	0.14 a	0.12 a	

March 1999

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.10	0.11	0.03	0.08 b
Choke Anan	0.29	0.19	0.29	0.26 a
Mean^{NS}	0.20	0.15	0.16	

April 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00	0.00	0.00	0.00
Choke Anan	0.00	0.00	0.00	0.00
Mean^{NS}	0.00	0.00	0.00	

Table 4.13 (continued)

May 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.03 b	0.14 b	0.07 b	0.08
Choke Anan	0.16 b	0.00 b	0.32 a	0.16
Mean^{NS}	0.09	0.07	0.19	

June 1999

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.63	0.12	0.26	0.33 a
Choke Anan	0.22	0.12	0.00	0.11 b
Mean*	0.42 a	0.12 b	0.13 a	

July 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00	0.00	0.00	0.00
Choke Anan	0.00	0.00	0.00	0.00
Mean^{NS}	0.00	0.00	0.00	

August 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00	0.00	0.00	0.00
Choke Anan	0.00	0.00	0.00	0.00
Mean^{NS}	0.00	0.00	0.00	

September 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00	0.13	0.01	0.05
Choke Anan	0.01	0.00	0.05	0.02
Mean^{NS}	0.00	0.06	0.03	

October 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00	0.03	0.00	0.01
Choke Anan	0.05	0.03	0.00	0.03
Mean^{NS}	0.03	0.03	0.00	

November 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00	0.00	0.00	0.00
Choke Anan	0.00	0.00	0.00	0.00
Mean^{NS}	0.00	0.00	0.00	

Table 4.13 (continued)

December 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00 b	0.30 a	0.00 b	0.10
Choke Anan	0.00 b	0.00 b	0.00 b	0.00
Mean*	0.00 b	0.15 a	0.00 b	

January 2000

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00	0.00	0.00	0.00
Choke Anan	0.00	0.00	0.00	0.00
Mean^{NS}	0.00	0.00	0.00	

February 2000

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00	0.00	0.00	0.00
Choke Anan	0.00	0.00	0.00	0.00
Mean^{NS}	0.00	0.00	0.00	

March 2000

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.08	0.28	0.13	0.17
Choke Anan	0.18	0.31	0.36	0.28
Mean^{NS}	0.13	0.30	0.25	

*Mean within the same row or column with different superscript and the interaction value with different superscript differ significantly at 95% confidence by Duncan's Multiple Range Test (DMRT) NS = non-significance.

Choke Anan on Kaew rootstock

The Number of shooting (May 98 to March 00)											
May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
98	98	98	98	98	98	98	98	99	99	99	99
0.98	0.07	0.04	0.05	0.05	0.02	0.04	0.47	0.00	0.00	0.12	0.00

The Number of shooting (May 98 to March 00)										
May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
99	99	99	99	99	99	99	99	00	00	00
0.04	0.12	0.00	0.00	0.03	0.01	0.00	0.10	0.00	0.00	0.22

2.3.2 Effect of scion-rootstock combinations on the total number of shooting during May 1998 to March 2000.

Among three scions, Pim Sen Mun and Khiew Sawoey had significantly higher total number of shooting than Nam Dok Mai, but there were non significant difference between the two rootstocks. (Table 4.14)

Table 4.14 Effect of scion-rootstock combinations on the total numbers of shooting during May 1998 to March 2000.

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	3.29	3.07	2.10	2.82
Choke Anan	3.39	3.37	3.01	3.26
Mean*	3.34 a	3.22 a	2.56 b	

*Mean within the same row or column with different superscript differ significantly , whereas the interaction value were not difference at 95% confidence by Duncan's Multiple Range Test (DMRT)
NS = non-significance.

Choke Anan on Kaew rootstock, the total numbers of shooting was 2.39.

2.4 Effect of scion-rootstock combinations on the percentage of flowering.

During May 1998 to March 2000, all scions-rootstocks combinations had nearly the same percentage of flowering. While Pim Sen Mun on Kaew had significantly higher percentage of flowering than on Choke Anan in March 1999 and lower in July 1998 and had no flowering on both rootstocks in June, December 1998, February, April to December 1999 and March 2000. Nam Dok Mai on Choke Anan had significantly higher percentage than on Kaew in October 1998 and had no flowering on both rootstocks during February to November and March 2000. Whereas Khiew Sawoey on Choke Anan had no flowering on both rootstocks during July to October, December 1998, February, April to November 1999 and March 2000(Table 4.15 and Figure 4.13).

Figure 4.13 Showed the comparison of percentage of flowering during El Niño (May to September 1998) and La Niña conditions (May to September 1999). All scions and rootstocks had fluctuation in percentage of off-season flowering during El Niño. Most of them had more flowering in May and June 1998; except Khiew Sawoey on Kaew had no off-season flowering ; while comparing with La Niña (May to September 1999) there were no off-season flowering from all scions and rootstocks. Even though Choke Anan on Kaew which were the off-season mangoes had also no flowering during La Niña. These showed the definite difference of both conditions.

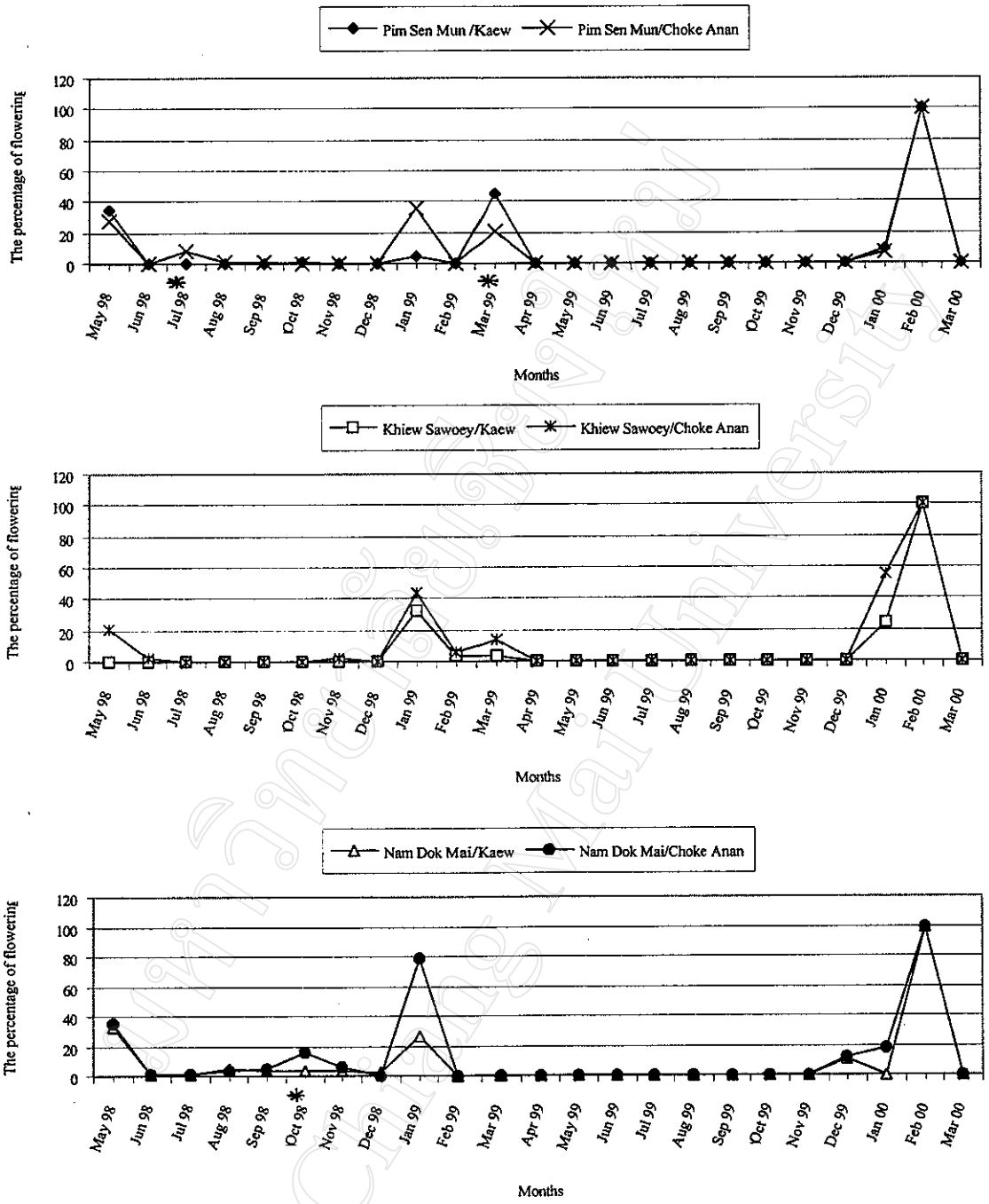

Figure 4.13 Effect of scion-rootstock combinations on the percentage of flowering during May 1998 to March 2000

*Means of each pair of scion-rootstock combinations within the same months with remark (*) differ significantly at 95% confidence by Duncan's Multiple Range Test (DMRT), detailed in Table 4.15.

Table 4.15 Effect of scion-rootstock combinations on the percentage of flowering during May 1998 to March 2000

May 1998

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	34.04	0.00	32.67	22.23
Choke Anan	28.03	21.25	35.64	28.31
Mean*	31.03 a	10.63 b	34.15 a	

June 1998

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00	0.00	1.23	0.41
Choke Anan	0.00	2.78	0.77	1.18
Mean^{NS}	0.00	1.39	1.00	

July 1998

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00 b	0.00 b	1.29 b	0.43 b
Choke Anan	7.76 a	0.00 b	1.36 b	3.04 a
Mean*	3.88 a	0.00 b	1.32 ab	

August 1998

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00	0.00	5.24	1.75
Choke Anan	1.43	0.00	3.45	1.63
Mean*	0.71 b	0.00 b	4.35 a	

September 1998

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.27	0.00	4.04	1.44
Choke Anan	0.97	0.00	4.56	1.85
Mean*	0.62 b	0.00 b	4.30 a	

October 1998

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.89 b	0.00 b	3.44 b	1.44 b
Choke Anan	0.29 b	0.00 b	15.50 a	5.26 a
Mean*	0.59 b	0.00 b	9.47 a	

November 1998

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00	0.00	3.94	1.31
Choke Anan	0.31	2.00	5.78	2.70
Mean*	0.15 b	1.00 b	4.86 a	

Table 4.15 (continued)

December 1998

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00	0.00	2.76	0.99
Choke Anan	0.00	0.00	0.00	0.00
Mean^{NS}	0.00	0.00	1.48	

Jauary 1999

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	5.09	32.27	26.50	21.29 b
Choke Anan	35.28	43.95	79.35	52.86 a
Mean*	20.19 b	38.11 ab	52.93 a	

February 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00	3.23	0.00	1.08
Choke Anan	0.00	6.19	0.00	2.06
Mean*	0.00 b	4.71 a	0.00 b	

March 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	44.45 a	3.13 c	0.00 c	15.86
Choke Anan	20.95 b	14.10 bc	0.00 c	11.68
Mean*	32.70 a	8.61 b	0.00 c	

April 1999 to November 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00	0.00	0.00	0.00
Choke Anan	0.00	0.00	0.00	0.00
Mean^{NS}	0.00	0.00	0.00	

December 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00	0.41	10.50	3.64
Choke Anan	0.00	0.00	12.23	4.08
Mean*	0.00 b	0.21 b	11.37 a	

January 2000

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	8.94	23.99	0.00	10.97 b
Choke Anan	6.35	54.85	17.75	26.32 a
Mean*	7.64 b	39.42 a	8.88 b	

Table 4.15 (continued)

February 2000

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	100.00	100.00	100.00	100.00
Choke Anan	100.00	100.00	100.00	100.00
Mean^{NS}	100.00	100.00	100.00	

March 2000

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00	0.00	0.00	0.00
Choke Anan	0.00	0.00	0.00	0.00
Mean^{NS}	0.00	0.00	0.00	

*Means within the same row or column with different superscript and the interaction value with different superscript differ significantly at 95% confidence by Duncan's Multiple Range Test (DMRT)
NS = non-significance.

Choke Anan on Kaew rootstock

The percentage of flowering (May 98 to March 00)												
May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
98	98	98	98	98	98	98	98	99	99	99	99	99
0.00	35.76	2.84	0.94	3.22	0.00	0.00	0.00	71.94	2.72	3.05	0.00	0.00

The percentage of flowering (May 98 to March 00)									
Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
99	99	99	99	99	99	99	00	00	00
0.00	0.00	0.00	0.00	0.00	0.00	10.00	29.60	100.0	0.00

2.5 Effect of scion-rootstock combinations on the number of flowering

2.5.1 Effect of scion-rootstock combinations on the number of flowering (monthly)

Pim Sen Mun on Kaew had high the number of flowering 3 times as followed; in May 1998 = 0.34, in March 1999 = 0.45 and February 2000 = 1.00, but in October 1998, January 1999 and January 2000 as followed: 0.01, 0.05 and 0.09, respectively. While Pim Sen Mun on Choke Anan had higher the number of flowering in May 1998, January, March 1999 and February 2000 as followed : 0.28, 0.35, 0.21 and 1.00, respectively; But decreased July, August, September 1998 and January 2000 as followed 0.08, 0.01, 0.01 and 0.06, respectively. (Table 4.16)

Khiew Sawoey on Kaew had high the numbers of flowering as usual; in January, February, March 1999, January and February 2000 as followed 0.32, 0.30, 0.30, 0.24 and 1.00, respectively.

Mean while Khiew Sawoey on Choke Anan had high the numbers of flowering in May 1998, January, March 1999, January and February 2000; as followed 0.21, 0.44, 0.14, 0.55 and 1.00, respectively; but decreased in June, November 1998 and February 1999 as followed 0.03, 0.02 and 0.06 respectively.

Nam Dok Mai on Kaew had high the numbers of flowering in May 1998, January 1999 and February 2000 as followed : 0.33, 0.26 and 1.00, respectively, and but decreased during June to December 1998 and February 2000 as followed : 0.01, 0.05, 0.04, 0.03, 0.04, 0.03 and 0.09, respectively. While Nam Dok Mai on Choke Anan had high the numbers of flowering in May , October 1998, January, December 1999,January and February 2000 as followed 0.36, 0.16, 0.79, 0.12, 0.18 and 1.00, respectively, and decreased during June to September 1998 and November 1998 as followed 0.01, 0.01, 0.03, 0.05 and 0.06, respectively. (Table 4.16)

Choke Anan on Kaew had high the numbers of flowering in June 1998, January 1999, January and February 2000 as followed 0.36, 0.72, 0.30 and 1.00, respectively, and decreased during July to September 1998, February, March and December 1999 as followed 0.03, 0.01, 0.03, 0.03, 0.03 and 0.01, respectively. (Table 4.16).

Table 4.16 Effect of scion-rootstock combinations on the numbers of flowering during May 1998 to March 2000

May 1998

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.34	0.00	0.33	0.22
Choke Anan	0.28	0.21	0.36	0.28
Mean*	0.31 a	0.11 b	0.34 a	

June 1998

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00	0.00	0.01	0.00
Choke Anan	0.00	0.03	0.01	0.01
Mean^{NS}	0.00	0.01	0.01	

July 1998

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00 b	0.00 b	0.01 b	0.00 b
Choke Anan	0.08 a	0.00 b	0.01 b	0.03 a
Mean*	0.04 a	0.00 b	0.01 ab	

Table 4.16 (continued)

August 1998

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00	0.00	0.05	0.02
Choke Anan	0.01	0.00	0.03	0.02
Mean*	0.01 b	0.00 b	0.04 a	

September 1998

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00	0.00	0.04	0.01
Choke Anan	0.01	0.00	0.05	0.02
Mean*	0.01 b	0.00 b	0.05 a	

October 1998

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.01 b	0.00 b	0.03 b	0.01 b
Choke Anan	0.00 b	0.00 b	0.16 a	0.05 a
Mean*	0.01 b	0.00 b	0.10 a	

November 1998

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00	0.00	0.04	0.01
Choke Anan	0.00	0.02	0.06	0.03
Mean*	0.00 b	0.01 b	0.05 a	

December 1998

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00	0.00	0.03	0.01
Choke Anan	0.00	0.00	0.00	0.00
Mean^{NS}	0.01	0.00	1.40	

January 1999

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.05	0.32	0.26	0.21 b
Choke Anan	0.35	0.44	0.79	0.53 a
Mean*	0.20 b	0.38 ab	0.53 a	

February 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00	0.03	0.00	0.01
Choke Anan	0.00	0.06	0.00	0.02
Mean*	0.00 b	0.05 a	0.00 b	

Table 4.16 (continued)

March 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.45 a	0.03 c	0.00 c	0.16
Choke Anan	0.21 b	0.14 bc	0.00 c	0.12
Mean*	0.33 a	0.09 b	0.00 b	

April to November 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00	0.00	0.00	0.00
Choke Anan	0.00	0.00	0.00	0.00
Mean^{NS}	0.00	0.00	0.00	

December 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00	0.00	0.09	0.03
Choke Anan	0.00	0.00	0.12	0.04
Mean*	0.00 b	0.00 b	0.11 a	

January 2000

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.09	0.24	0.00	0.11 b
Choke Anan	0.06	0.55	0.18	0.26 a
Mean*	0.08 b	0.39 a	0.09 b	

February 2000

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	1.00	1.00	1.00	1.00
Choke Anan	1.00	1.00	1.00	1.00
Mean^{NS}	1.00	1.00	1.00	

March 2000

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.00	0.00	0.00	0.00
Choke Anan	0.00	0.00	0.00	0.00
Mean^{NS}	0.00	0.00	0.00	

*Means within the same row or column with different superscript and the interaction value with different superscript differ significantly at 95% confidence by Duncan's Multiple Range Test (DMRT)

NS = non-significance.

Choke Anan on Kaew rootstock

The numbers of flowering (May 98 to March 00)												
May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
98	98	98	98	98	98	98	98	99	99	99	99	99
0.00	0.36	0.03	0.01	0.03	0..00	0.00	0.00	0.72	0.03	0.03	0.00	0.00

The numbers of flowering (May 98 to March 00)									
Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
99	99	99	99	99	99	99	00	00	00
0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.30	1.00	0.00

2.5.2 Effect of scion-rootstock combinations on the total numbers of flowering

Nam Dok Mai on Choke Anan had significantly higher the total numbers of flowering which was 2.67 than Khiew Sawoey on Choke Anan (2.45), Pim Sen Mun on Choke Anan (2.11) Nam Dok Mai on Kaew (2.01), Pim Sen Mun on Kaew (1.94) and Khiew Sawoey on Kaew (1.39), respectively. (Table 4.17 and Figure 4.14)

Table 4.17 Effect of scion-rootstock combinations on the total numbers of flowering during May 1998 to March 2000

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	1.94 c	1.39 d	2.01 bc	1.78 b
Choke Anan	2.11 bc	2.45 ab	2.67 a	2.41 a
Mean*	2.02 b	1.92 b	2.34 a	

*Means within the same row or column with different superscript and the interaction value with different superscript differ significantly at 95% confidence by Duncan's Multiple Range Test (DMRT)
NS = non-significance.

Choke Anan on Kaew rootstock, the total numbers of flowering was 2.60.

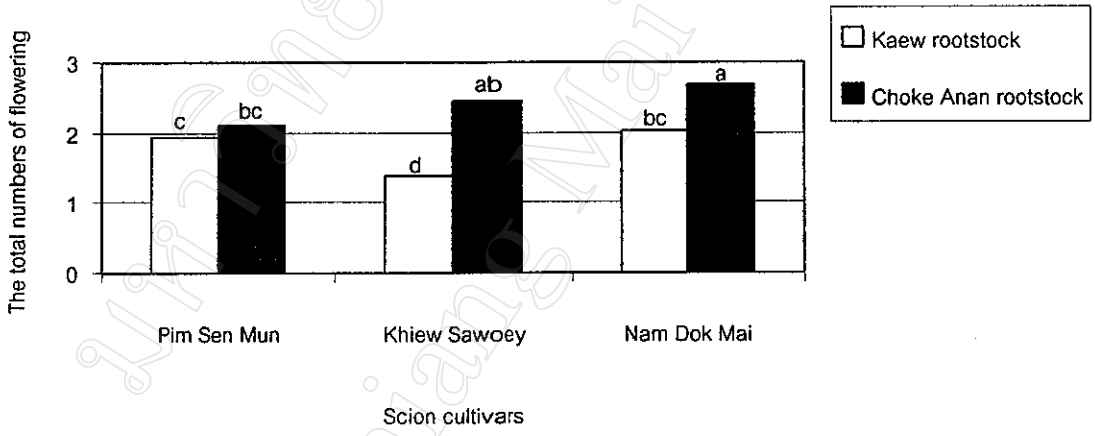

Figure 4.14 Effect of scion-rootstock combinations on the total numbers of flowering during May 1998 to March 2000

2.6 Effect of scion-rootstock combinations on the new shoots.

2.6.1 Effect of scion-rootstock combinations on the number of leaves per new shoot, the length of new shoots and the diameter of new shoots.

A. Effect of scion-rootstock combinations on number of leaves per new shoot.

Among all three scions, Pim Sen Mun and Khiew Sawoey had non significant difference in number of leaves, but both were significantly higher than Nam Dok Mai. However, there were non significant difference between the two rootstocks. (Table 4.18).

Table 4.18 Effect of scion-rootstock combinations on number of leaves per new shoot during May 1998 to May 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	14.51	14.79	13.67	14.32
Choke Anan	14.36	14.43	12.94	13.91
Mean*	14.43 a	14.61 a	13.30 b	

*Means within the same row or column with different superscript differ significantly, whereas the interaction value were not difference at 95% confidence by Duncan's Multiple Range Test (DMRT)
NS = non-significance.

Choke Anan on Kaew rootstock, number of leaves per new shoot was 12.86.

B. Effect of scion-rootstock combinations on the length of new shoots

Khiew Sawoey on Kaew had significantly longer the length new shoots than Khiew Sawoey on Choke Anan, Pim Sen Mun on Kaew, Pim Sen Mun on Choke Anan and Nam Dok Mai on Kaew, respectively; whereas Nam Dok Mai on Kaew had non significant difference with Nam Dok Mai on Choke Anan. (Table 4.19)

Table 4.19 Effect of scion-rootstock combinations on the length of new shoot (cm) during May 1998 to May 1999

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	22.03 c	28.81 a	15.40 e	22.10 a
Choke Anan	20.18 d	25.28 b	14.68 e	20.04 b
Mean*	21.11 b	27.04 a	15.06 c	

*Means within the same row or column with different superscript and the interaction value with different superscript differ significantly at 95% confidence by Duncan's Multiple Range Test (DMRT)
NS = non-significance.

Choke Anan on Kaew rootstock, the length of new shoot was 20.22 cm.

C. Effect of scion-rootstock combinations on the diameter of new shoots.

Both rootstocks, Kaew rootstock had larger diameter of new shoots than Choke Anan. The three scions, Khiew Sawoey and Nam Dok Mai had non significant difference in diameter of new shoot, but had significantly larger diameter than Pim Sen Mun. (Table 4.20).

Table 4.20 Effect of scion-rootstock combinations on the diameter of new shoots (cm) during May 1998 to May 1999

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.72	0.77	0.76	0.75 a
Choke Anan	0.71	0.74	0.74	0.73 b
Mean*	0.71 b	0.75 a	0.75 a	

*Means within the same row or column with different superscript differ significantly, whereas the interaction value were not difference at 95% confidence by Duncan's Multiple Range Test (DMRT) NS = non-significance.

Choke Anan on Kaew rootstock, the diameter of new shoot was 0.73 cm.

2.6.2 Effect of scion-rootstock combinations on width and length of new leaves

A. Effect of scion-rootstock combinations on the length of the new leaves

Both rootstocks, Choke Anan had significantly longer the length of new leaves than Kaew. The three scions, Pim Sen Mun had significantly longer length of new leaves than Khiew Sawoey and Nam Dok Mai. Meanwhile there were non significant difference between Khiew Sawoey and Nam Dok Mai. (Table 4.21)

Table 4.21 Effect of scion-rootstock combinations on the length of new leaves (cm) during May 1998 to May 1999

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	14.68	16.96	14.37	15.34 b
Choke Anan	16.11	19.64	15.09	16.95 b
Mean*	15.40 a	18.30 b	14.73 b	

*Means within the same row or column with different superscript differ significantly, whereas the interaction value not difference at 95% confidence by Duncan's Multiple Range Test (DMRT) NS = non-significance.

Choke Anan on Kaew rootstock, the length of new leaves was 16.90 cm.

B. Effect of scion-rootstock combination on the width of new leaves.

Pim Sen Mun on Choke Anan had significantly wider the width of new leaves than on Kaew and Khiew Sawoey on Choke Anan had significantly wider than on Kaew too, but Nam Dok Mai on Choke Anan had non significance difference with on Choke Anan. (Table 4.22)

Table 4.22 Effect of scion-rootstock combinations on the width of new leaves (cm) during May 1998 to May 1999

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	4.51 cd	4.23 d	4.70 bc	4.48 b
Choke Anan	5.25 a	5.02 ab	4.59 bcd	4.95 a
Mean^{NS}	4.88	4.62	4.65	

*Means within the same row or column with different superscript and the interaction value with different superscript differ significantly at 95% confidence by Duncan's Multiple Range Test (DMRT) NS = non-significance.

Choke Anan on Kaew rootstock, the width of new leaves was 5.51 cm.

3. Effect of scion-rootstock combinations on yields

3.1 Effect of scion-rootstock combinations on the ratio of male to perfect flower

3.1.1 Off-season (during May to November 1998)

Pim Sen Mun on Choke Anan had non significant difference in the ratio of male to perfect flower with Pim Sen Mun on Kaew, whereas Nam Dok Mai on Kaew had significantly higher the ratio than on Choke Anan. (Table 4.23)

Table 4.23 Effect of scion-rootstock combinations on the ratio of male to perfect flower during May to November 1998 (off-season)

Rootstocks	Scions		Mean^{NS}
	Pim Sen Mun	Nam Dok Mai	
Kaew	4.63 a : 1	2.91 b : 1	3.77 : 1
Choke Anan	4.71 a : 1	2.22 c : 1	3.47 : 1
Mean*	4.67 a : 1	2.57 b : 1	

*Means within the same row or column with different superscript and the interaction value with different superscript differ significantly at 95% confidence by Duncan's Multiple Range Test (DMRT) NS = non-significance.

Choke Anan on Kaew rootstock, the ratio of male to perfect flower (off-season) was 3.66 : 1.

3.1.2 Normal season (during December 1998 to March 1999).

Pim Sen Mun on Choke Anan had non significant difference in the ratio of male to perfect flower with Pim Sen Mun on Kaew and Khiew Sawoey on Choke Anan had the ratio with on Kaew too. Nam Dok Mai on Kaew had significantly higher the ratio than on Choke Anan. (Table 4.24).

Table 4.24 Effect of scion-rootstock combinations on the ratio of male to perfect flower during December 1998 to March 1999 (normal season)

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	5.18 a : 1	4.50 b : 1	3.79 c : 1	4.49 a : 1
Choke Anan	5.40 a : 1	4.43 b : 1	2.87 d : 1	4.23 b : 1
Mean*	5.29 a : 1	4.47 b : 1	3.33 c : 1	

*Means within the same row or column with different superscript and the interaction value with different superscript differ significantly at 95% confidence by Duncan's Multiple Range Test (DMRT)
NS = non-significance.

Choke Anan on Kaew rootstock, the ratio of male to perfect flower was 4.00:1.

3.2 Effect of scion-rootstock combinations on the percentage of fruit setting

3.2.1 Effect of scion-rootstock combinations on the percentage of fruit setting (fruit size of match's head) during May to November 1998(off –season).

In off-season, there were non significant difference of all rootstocks, scions and their combinations on the percentage of fruit setting. (Table 4.25).

Table 4.25 Effect of scion-rootstock combinations on percentage of fruit setting (fruit size of match's head) during May to November 1998 (off-season)

Rootstocks	Scions		$Mean^{NS}$
	Pim Sen Mun	Nam Dok Mai	
Kaew	50.37	50.11	50.24
Choke Anan	48.69	54.17	51.43
$Mean^{NS}$	49.53	52.14	

*Means within the same row or column with different superscript differ significantly, whereas the interaction value were not difference at 95% confidence by Duncan's Multiple Range Test (DMRT)
NS = non-significance.

Choke Anan on Kaew rootstock, the percentage of fruit setting was 50.36%

3.2.2 Effect of scion-rootstock combinations on the percentage of fruit setting (fruit size of match's head) during December 1998 to March 1999 (normal season)

In normal season, there were non significant difference of all rootstocks, scions and their combinations on the percentage of fruit setting. (Table 4.26)

Table 4.26 Effect of scion-rootstock combinations on percentage of fruit setting (fruit size of match's head) during December 1998 to March 1999 (normal-season)

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	51.28	49.51	50.17	50.32
Choke Anan	52.70	51.36	52.69	52.25
Mean^{NS}	51.99	50.43	51.43	

*Means within the same row or column with different superscript differ significantly, whereas the interaction value were not difference 95% confidence by Duncan's Multiple Range Test (DMRT) NS = non-significance.

Choke Anan on Kaew rootstock, the percentage of fruit setting was 52.03%

3.2.3 Effect of scion-rootstock combinations on the percentage of fruit setting (fruit size of 1.5 cm) during May to November 1998 (off-season).

In off-season, there were non significant difference of all rootstocks, scions and their combinations on the percentage of fruit setting. (Table 4.27).

Table 4.27 Effect of scion-rootstock combinations on percentage of fruit setting (fruit size of 1.5 cm) during May to November 1998. (off-season)

Rootstocks	Scions		Mean^{NS}
	Pim Sen Mun	Nam Dok Mai	
Kaew	2.30	2.02	2.16
Choke Anan	2.35	2.36	2.35
Mean^{NS}	2.32	2.19	

*Means within the same row or column with different superscript differ significantly, whereas the interaction value were not difference at 95% confidence by Duncan's Multiple Range Test (DMRT) NS = non-significance.

Choke Anan on Kaew rootstock, the percentage of fruit setting was 3.19%

3.2.4 Effect of scion-rootstock combinations on percentage of fruit setting (fruit size 1.5 cm), during December 1998 to March 1999 (normal season).

In normal season, there were non significant difference of all rootstocks, scions and their combinations on the percentage of fruit setting. (Table 4.28)

Table 4.28 Effect of scion-rootstock combinations on percentage of fruit setting (fruit size of 1.5 cm) during December 1998 to March 1999 (normal-season)

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	3.90	3.22	3.56	3.56
Choke Anan	4.30	3.56	4.25	4.04
Mean^{NS}	4.10	3.39	3.91	

*Means within the same row or column with different superscript differ significantly, whereas the interaction value were not difference at 95% confidence by Duncan's Multiple Range Test (DMRT) NS = non-significance.

Choke Anan on Kaew rootstock, the percentage of fruit setting was 4.65%

3.3 Effect of scion-rootstock combinations on the average numbers of fruit per tree.

3.3.1 Effect of scion-rootstock combinations on the average numbers of fruit per tree (off-season, during May to November 1998).

In off-season, there were non significant difference of both rootstocks. But among the three scions, Nam Dok Mai had significantly higher average number of fruit per tree than Pim Sen Mun and Khiew Sawoey, respectively (Table 4.29).

Table 4.29 Effect of scion-rootstock combinations on the average numbers of fruit per tree during May to November 1998 (off-season)

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.90	0.00	2.90	1.27
Choke Anan	1.56	0.10	3.50	1.72
Mean*	1.23 b	0.05 c	3.20 a	

*Means within the same row or column with different superscript differ significantly, whereas the interaction value were not difference at 95% confidence by Duncan's Multiple Range Test (DMRT) NS = non-significance.

Choke Anan on Kaew rootstock, the number of fruit per tree was 3.20.

3.3.2 Effect of scion-rootstock combinations on the average numbers of fruit per tree (normal season, during December 1998 to May 1999).

In normal season, there were non significant difference of both rootstocks. Among the three scions, Nam Dok Mai had significantly higher the average number of fruits in normal season

than Khiew Sawoey and Pim Sen Mun; but there were non significant difference between Pim Sen Mun and Khiew Sawoey. (Table 4.30)

Table 4.30 Effect of scion-rootstock combinations on the average numbers of fruit per tree during December 1998 to May 1999 (normal-season)

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	4.60	3.90	7.70	5.40
Choke Anan	6.50	4.60	9.20	6.77
Mean*	5.55 b	4.25 b	8.45 a	

*Means within the same row or column with different superscript differ significantly, whereas the interaction value were not difference at 95% confidence by Duncan's Multiple Range Test (DMRT) NS = non-significance.

Choke Anan on Kaew rootstock, the number of fruit per tree was 7.90.

4. Effect of scion-rootstock combinations on fruit qualities

4.1 Effect of scion-rootstock combinations on fresh fruit weight.

Nam Dok Mai on Choke Anan had significantly higher the fresh fruit weight than on Kaew and Khiew Sawoey on Choke Anan had significantly higher than on Kaew too, but there were non significant difference for Pim Sen Mun on both rootstocks. (Table 4.31 and Figure 4.15)

Table 4.31 Effect of scion-rootstock combinations on fresh fruit weight (g) harvested during May to June 1999

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	243.46 c	327.08 b	313.12 b	294.56 b
Choke Anan	260.38 c	367.80 a	392.22 a	340.13 a
Mean*	251.92 b	347.44 a	352.67 a	

*Means within the same row or column with different superscript and the interaction value with different superscript differ significantly at 95% confidence by Duncan's Multiple Range Test (DMRT) NS = non-significance.

Choke Anan on Kaew rootstock, the fruit weight was 274.79 g

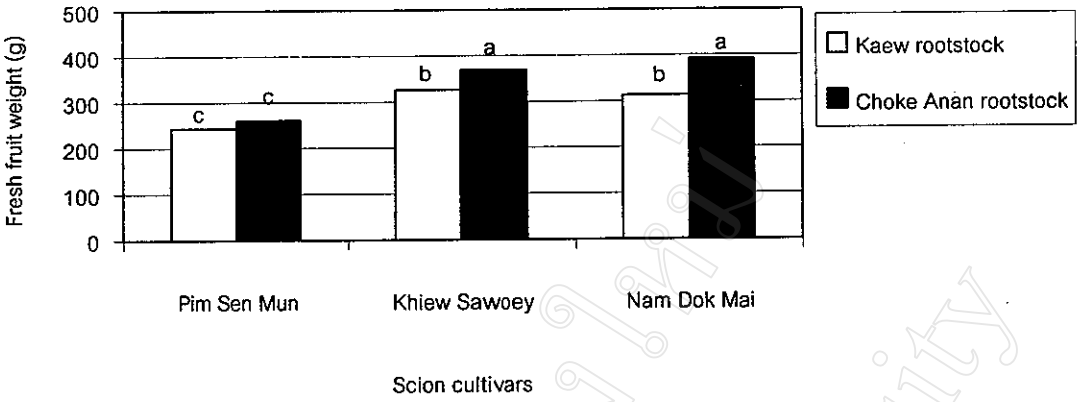

Figure 4.15 Effect of scion-rootstock combinations on fresh fruit weight (harvested during May to June 1999).

4.2 Effect of scion-rootstock combinations on fruit size

4.2.1 Fruit width

In normal season, between both rootstocks; Choke Anan had significantly wider fruit than Kaew. Among the three scions, there were non significant difference in fruit width between Pim Sen Mun and Khiew Sawoey, but had significantly narrower than Nam Dok Mai (Table 4.32 and Figure 4.16).

Table 4.32 Effect of scion-rootstock combinations on fruit width (cm) harvested during May to June 1999

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	6.90	6.64	7.05	6.86 b
Choke Anan	7.03	6.95	7.33	7.10 a
Mean*	6.97 b	6.80 b	7.19 a	

*Means within the same row or column with different superscript differ significantly, whereas the interaction value were not difference at 95% confidence by Duncan's Multiple Range Test (DMRT) NS = non-significance.

Choke Anan on Kaew rootstock, the fruit width was 7.12 cm.

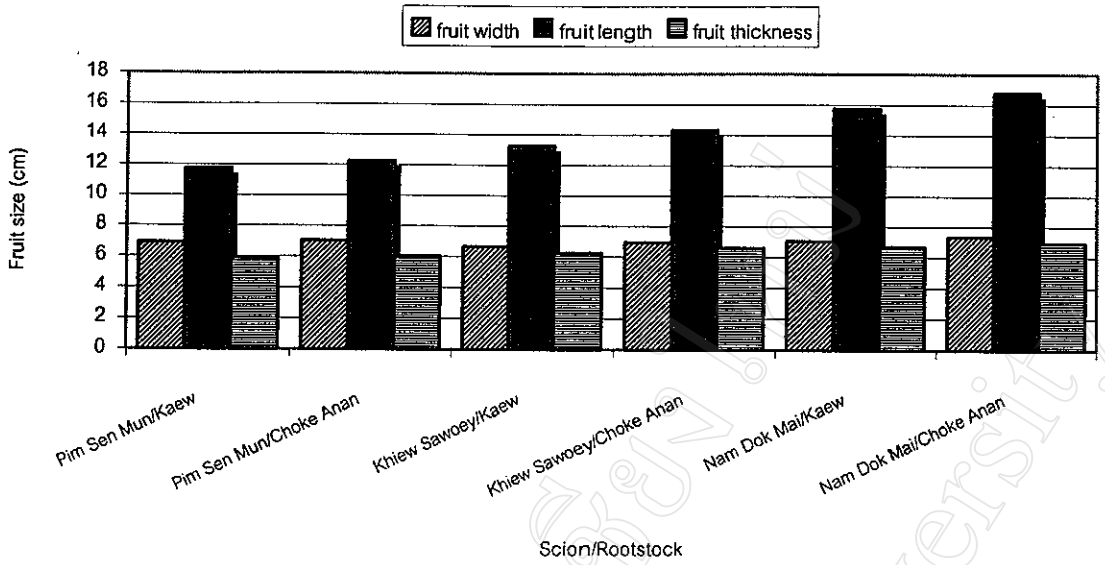

Figure 4.16 Effect of scion-rootstock combinations on fruit size (cm) harvested during May to June 1999

4.2.2 Fruit length

In normal season, between both rootstocks, Choke Anan had significantly longer fruit than Kaew. All three scions, Nam Dok Mai had significantly longer than Khiew Sawoey and Pim Sen Mun, respectively. (Table 4.33 and Figure 4.16).

Table 4.33 Effect of scion-rootstock combinations on fruit length (cm) harvested during May to June 1999

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	11.74	13.27	15.76	13.59 b
Choke Anan	12.25	14.34	16.79	14.16 a
Mean*	12.00 c	13.80 b	16.28 a	

*Means within the same row or column with different superscript differ significantly, whereas the interaction value were not difference at 95% confidence by Duncan's Multiple Range Test (DMRT) NS = non-significance.

Choke Anan on Kaew rootstock, the fruit length was 12.28 cm.

4.2.3 Fruit thickness

In normal season, between both rootstocks, Choke Anan had significantly more fruit thickness than Kaew, and the same for all three scions, Nam Dok Mai had significantly more fruit thickness than Khiew Sawoey and Pim Sen Mun, respectively.(Table 4.34 and Figure 4.16).

Table 4.34 Effect of scion-rootstock combinations on fruit thickness (cm) harvested during May to June 1999

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	5.89	6.23	6.68	6.27 b
Choke Anan	6.04	6.58	6.94	6.52 a
Mean*	5.97 c	6.40 b	6.81 a	

*Means within the same row or column with different superscript differ significantly, whereas the interaction value were not difference at 95% confidence by Duncan's Multiple Range Test (DMRT) NS = non-significance.

Choke Anan on Kaew rootstock, the fruit thickness was 6.17 cm.

4.3 Effect of scion-rootstock combinations on total soluble solids (TSS)

Nam Dok Mai on Choke Anan contained significantly higher the total soluble solids (TSS) of fruit than Nam Dok Mai on Kaew. While, Pim Sen Mun and Khiew Sawoey on Choke Anan had non significant difference with on Kaew. (Table 4.35 and Figure 4.17)

Table 4.35 Effect of scion-rootstock combinations on total soluble solids (^{o}Brix) ; TSS of fruits harvested during May to June 1999

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	19.90 a	18.60 b	17.70 c	18.73 b
Choke Anan	20.10 a	18.95 b	18.65 b	19.23 a
Mean*	20.00 a	18.78 b	18.17 c	

*Means within the same row or column with different superscript differ and the interaction value with different superscript significantly at 95% confidence by Duncan's Multiple Range Test (DMRT) NS = non-significance.

Choke Anan on Kaew rootstock, the total soluble solids was 20.55 ^{o}Brix.

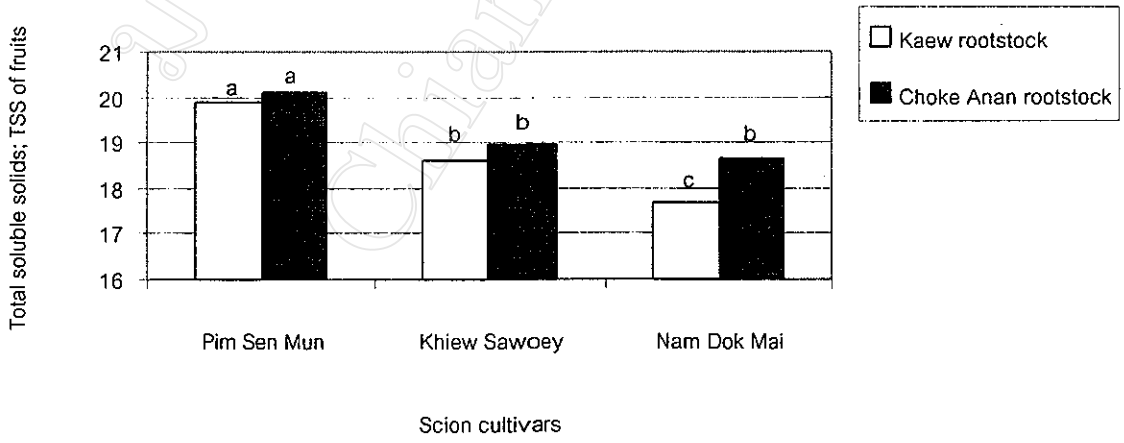

Figure 4.17 Effect of scion-rootstock combinations on total soluble solids (^{o}Brix); TSS of fruits harvested during May to June 1999

4.4 Effect of scion-rootstock combinations on titratable acid (TA)

In normal season, there were non significant difference of both rootstocks, but in three scions which Pim Sen Mun contained significantly lesser TA of fruits than Khiew Sawoey and Nam Dok Mai, (Table 4.36 and Figure 4.18).

Table 4.36 Effect of scion-rootstock combinations on titratable acid (%) ; TA of fruits harvested during May to June 1999

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.093	0.211	0.225	0.176
Choke Anan	0.094	0.202	0.215	0.170
Mean*	0.094 b	0.207 a	0.220 a	

*Means within the same row or column with different superscript differ significantly, whereas the interaction value were not difference at 95% confidence by Duncan's Multiple Range Test (DMRT)
NS = non-significance.

Choke Anan on Kaew rootstock, the titratable acid was 0.223%

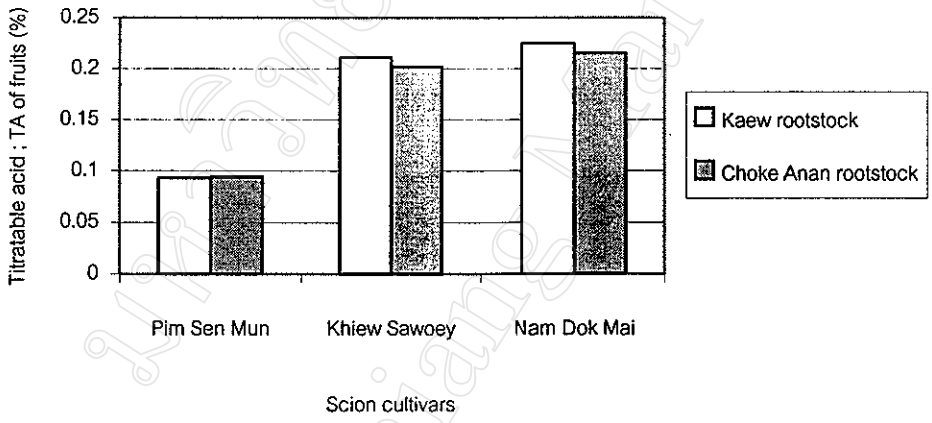

Figure 4.18 Effect of scion-rootstock combinations on titratable acid (%) ; TA of fruits harvested during May to June 1999

5. Effect of scion-rootstock combinations on net photosynthetic rate

Both rootstocks, Choke Anan rootstocks had significantly higher the net photosynthetic rate than Kaew rootstocks. Three scions, Khiew Sawoey had significantly higher net photosynthetic rate than Pim Sen Mun and Nam Dok Mai, respectively. (Table 4.37 and Figure 4.19).

Table 4.37 Effect of scion-rootstock combinations on net photosynthetic rate (μmol CO_2 $m^{-2}s^{-1}$) of scions measured during 3-18 February, 2000.(08.30 to 10.30 a.m.)

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	10.74	12.81	8.37	10.64 b
Choke Anan	12.44	13.38	10.55	12.12 a
Mean*	11.59 b	13.09 a	9.46 c	

*Means within the same row or column with different superscript differ significantly, whereas the interaction value were not difference at 95% confidence by Duncan's Multiple Range Test (DMRT) NS = non-significance.

Choke Anan on Kaew rootstock, the net photosynthetic rate of scions was 10.77 μmol CO_2 $m^{-2}s^{-1}$

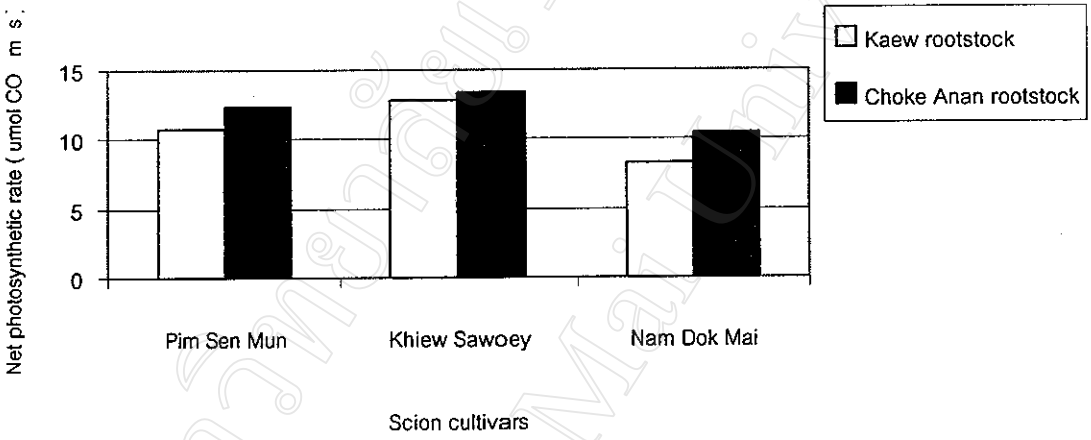

Figure 4.19 Effect of scion-rootstock combinations on the net photosynthetic rate (μmol CO_2 $m^{-2}s^{-1}$) of scions measured during 3-18 February, 2000.(08.30 to 10.30 a.m.)

6. Effects of scion-rootstock combinations on chlorophyll a and b content of leaves

There were non significant difference among the rootstocks, scions and their combinations on the chlorophyll a and b content of leaves. (Table 4.38)

Table 4.38 Effect of scion-rootstock combinations on chlorophyll a and b content (mg/g FW.)of leaves

(a) Chlorophyll a

Rootstocks	Scions			$Mean^{NS}$
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.130	0.129	0.130	0.130
Choke Anan	0.130	0.129	0.129	0.129
$Mean^{NS}$	0.130	0.129	0.130	

Table 4.38 (continued)

(b) Chlorophyll b

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.223	0.224	0.224	0.224
Choke Anan	0.216	0.224	0.222	0.221
Mean^{NS}	0.219	0.224	0.223	

*Means within the same row or column with different superscript differ significantly, whereas the interaction value were not difference at 95% confidence by Duncan's Multiple Range Test (DMRT)
NS = non-significance.

Choke Anan on Kaew rootstock, the chlorophyll a content of leaves was 0.132 mg/g FW and chlorophyll b content was 0.217 mg/g FW.

7. Effect of scion-rootstock combinations on the stomatal behavior.

7.1 Effect of scion-rootstock combinations on the stomatal width.

Table 4.39 showed that Pim Sen Mun on Choke Anan rootstocks had significantly wider the stomatal width than on Kaew at 06.30 to 09.30 a.m., 13.30, 17.30 and 18.30 p.m. but narrower than on Kaew at 10.30 a.m., 12.30 p.m. and 16.30 p.m. Khiew Sawoey on Choke Anan had significantly wider the stomatal width than on Kaew at 06.30 a.m. to 10.30 a.m., 14.30 p.m. and 15.30 p.m. but narrow at 12.30 p.m. , 16.30 p.m. and 17.30 p.m. While Nam Dok Mai on Choke Anan had significantly wider than Kaew at 06.30 a.m., 09.30 a.m., 10.30 a.m., 14.30 p.m., 17.30 p.m. and 18.30 p.m. but narrower at 07.30 a.m., 12.30 p.m. and 16.30 p.m. Whereas at 11.30 a.m., Choke Anan rootstock had significantly wider the stomatal width than Kaew but had non-significant difference among the three scions.

Figure 4.20 showed that, Pim Sen Mun on Choke Anan had the widest stomatal opening = 2.71 μm at 09.30 a.m. and wider than Pim Sen Mun on Kaew (2.61 μm) at 10.30 a.m.; Khiew Sawoey on Choke Anan had = 2.88 μm at 10.30 a.m. wider than Khiew Sawoey on Kaew (1.98 μm) at 16.30 p.m.; and Nam Dok Mai on Choke Anan had = 2.48 μm at 09.30 a.m. wider than Nam Dok Mai on Kaew 2.19 μm at 13.30 p.m. All scion-rootstock combinations had the widest or nearly widest stomatal opening at 09.30 a.m. or 10.30 a.m., next the narrowest stomatal opening (midday-closure) at 12.30 p.m. and had wider again at 13.30 p.m., then narrower again at 18.30 p.m.

Table 4.39 Effect of scion-rootstock combinations on the stomatal width (μm) from 06.30 a.m. to 18.30 p.m.

AT TIME : 06.30

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.56 d	0.73 c	1.04 b	0.78 b
Choke Anan	1.36 a	1.46 a	1.46 a	1.42 a
Mean*	0.96 c	1.09 b	1..25 a	

AT TIME : 07.30

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.94 c	0.98 c	1.18 b	1.03 b
Choke Anan	1.21 b	1.36 a	0.94 c	1.17 a
Mean^{NS}	1.07	1.17	1.06	

AT TIME : 08.30

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	1.42 e	1.58 c	1.46 de	1.48 b
Choke Anan	1.98 b	2.13 a	1.56 cd	1.89 a
Mean*	1.70 b	1.85 a	1.51 c	

AT TIME : 09.30

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	1.83 d	1.73 de	1.58 e	1.71 b
Choke Anan	2.71 a	2.19 c	2.48 b	2.46 a
Mean*	2.27 a	1.96 b	2.03 b	

AT TIME : 10.30

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	2.61 b	1.31 e	1.36 e	1.76 b
Choke Anan	2.19 c	2.88 a	1.98 d	2.35 a
Mean*	2.40 a	2.09 b	1.67 c	

AT TIME : 11.30

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	1.46	1.36	1.25	1.35 b
Choke Anan	1.77	1.67	1.88	1.77 a
Mean^{NS}	1.61	1.51	1.56	

AT TIME : 12.30

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.98 a	1.00 a	0.71 b	0.90 a
Choke Anan	0.56 c	0.56 c	0.58 c	0.57 b
Mean*	0.77 a	0.78 a	0.64 b	

Table 4.39 (continued)

AT TIME : 13.30

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	1.36 c	1.61 b	2.19 a	1.72
Choke Anan	1.67 b	1.67 b	2.08 a	1.81
Mean*	1.51 c	1.64 b	2.13 a	

AT TIME : 14.30

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	1.75 ab	1.36 c	1.46 c	1.52 b
Choke Anan	1.63 b	1.77 a	1.67 ab	1.69 a
Mean*	1.69 a	1.56 b	1.56 b	

AT TIME : 15.30

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	1.77 a	1.25 d	1.46 c	1.49 b
Choke Anan	1.67 ab	1.71 ab	1.56 bc	1.65 a
Mean*	1.72 a	1.48 b	1.51 b	

AT TIME : 16.30

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	1.79 b	1.98 a	1.98 a	1.92 a
Choke Anan	1.56 c	1.88 ab	0.79 d	1.41 b
Mean*	1.68 b	1.93 a	1.39 c	

AT TIME : 17.30

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	1.31 c	1.73 a	1.21 c	1.42 b
Choke Anan	1.63 a	1.50 b	1.67 a	1.60 a
Mean*	1.47 b	1.62 a	1.44 b	

AT TIME : 18.30

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	1.25 bc	1.39 ab	1.23 c	1.29 b
Choke Anan	1.52 a	1.36 bc	1.39 ab	1.42 a
Mean^{NS}	1.38	1.38	1.31	

*Means within the same row or column with different superscript and the interaction value with different superscript differ significantly at 95% confidence by Duncan's Multiple Range Test (DMRT)

NS = non-significance.

The average stomatal length of mango leaves at the experimental plot was 8.19 μm.

Choke Anan / Kaew rootstock had stomatal width (μm)

06.30	07.30	08.30	09.30	10.30	11.30	12.30	13.30	14.30	15.30	16.30	17.30	18.30
0.73	1.35	2.04	1.98	2.40	2.15	0.79	1.88	2.19	1.88	1.42	1.38	1.35

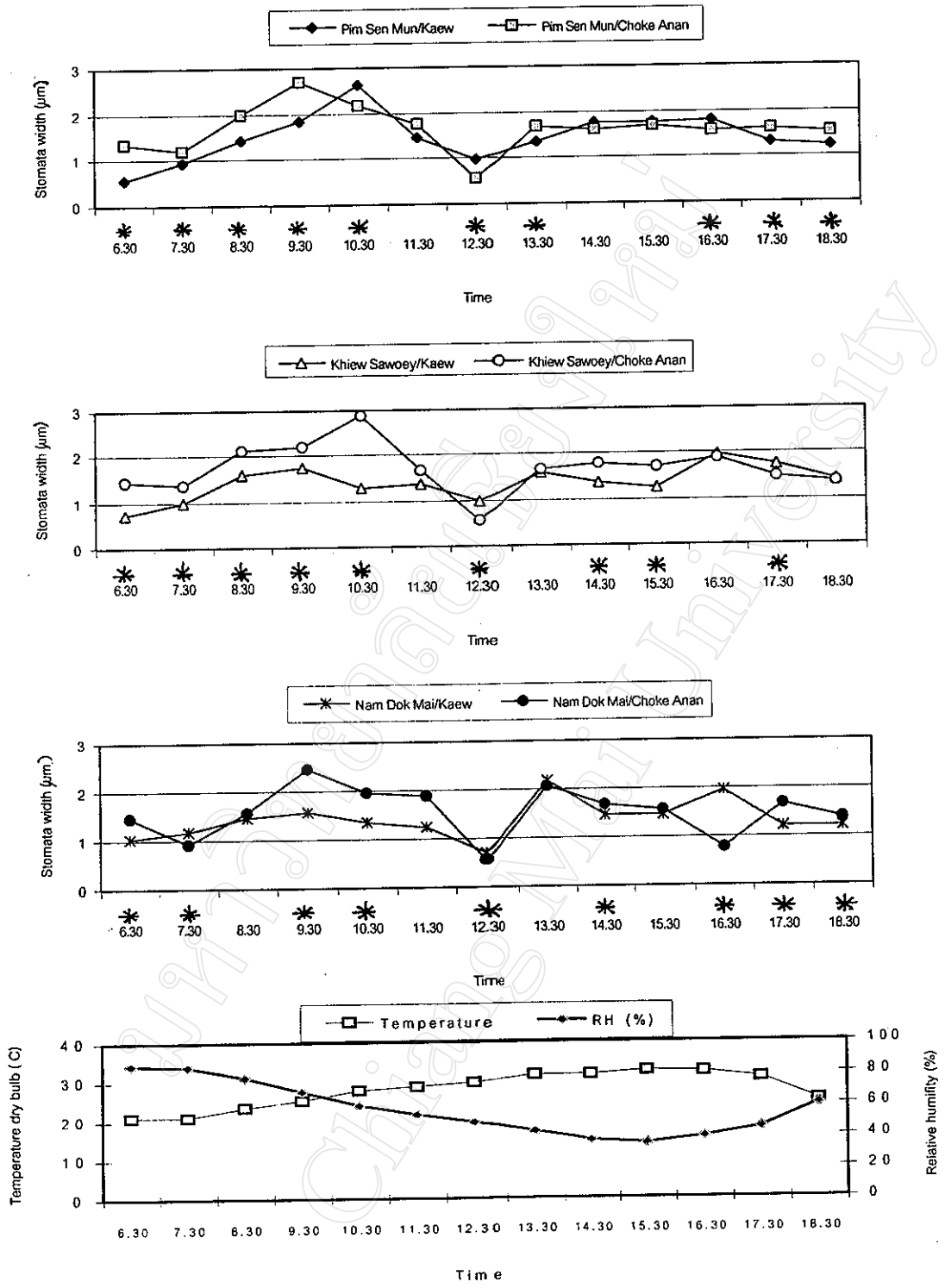

Figure 4.20 Effect of scion-rootstock combinations on the stomatal width (µm) from 06.30 a.m. to 18.30 p.m. (upper), and the temperature dry bulb (^{o}C) and relative humidity (%) in the experimental date (February 17, 2000) (lower)

*Means of each pair of scion-rootstock combinations within the same time with remark (*) differ significantly at 95% confidence by Duncan's Multiple Range Test (DMRT), detailed in Table 4.39

Pim Sen Mun and Khiew Sawoey on Choke Anan had the same average stomatal width but had significantly higher than Nam Dok Mai on Choke Anan and Nam Dok Mai on Kaew, respectively; while there were non significance difference among Nam Dok Mai on Kaew, Khiew Sawoey on Kaew and Pim Sen Mun on Kaew. (Table 4.40 and Figure 4.21)

Table 4.40 Effect of scion-rootstock combinations on the average stomatal width (μm) from 06.30 a.m. to 18.30 p.m.

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	1.46 c	1.39 c	1.39 c	1.41 b
Choke Anan	1.65 a	1.70 a	1.54 b	1.63 a
Mean*	1.56 a	1.55 a	1.47 b	

*Means within the same row or column with different superscript and the interaction value with different superscript differ significantly at 95% confidence by Duncan's Multiple Range Test (DMRT)
NS = non-significance.

Choke Anan on Kaew rootstock, the average stomatal width was 1.66 μm.

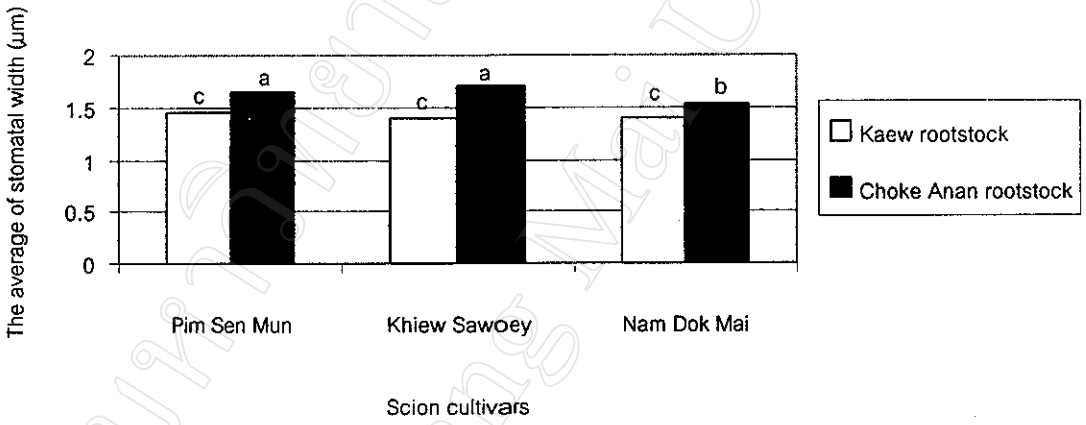

Figure 4.21 Effect of scion-rootstock combinations on the average stomatal width (μm) from time 06.30 a.m. to 18.30 p.m.

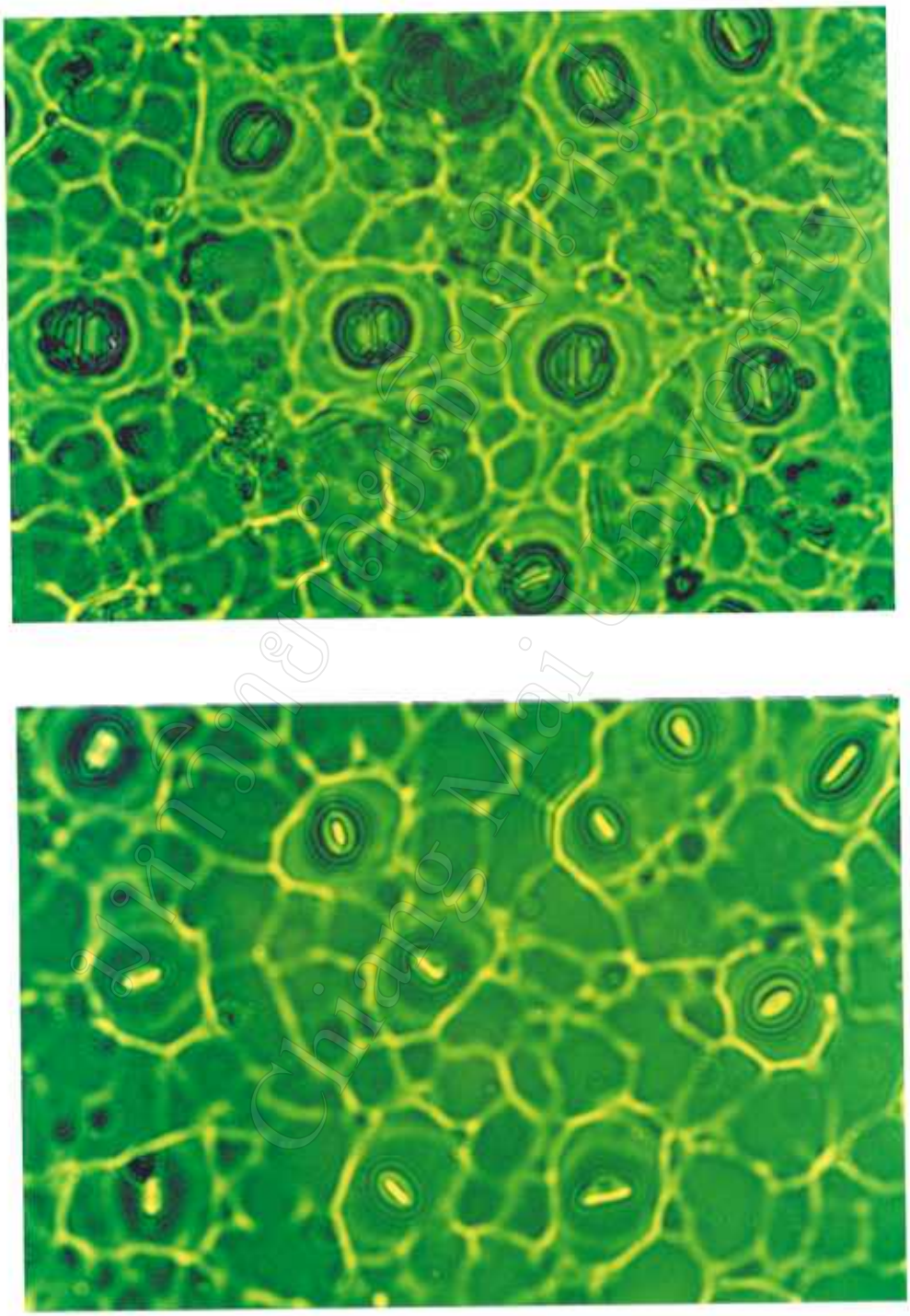

Figure 4.22 Stomata of mango leaf cv. Khiew Sawoey on Choke Anan rootstock at 12.30 p.m., narrowest opening was 0.53 µm (upper) and cv. Pim Sen Mun on Choke Anan rootstock at 10.30 a.m., widest opening was 3.01µm (lower)

From figure 4.22 (upper) showed the stomata of mango leaf cv. Khiew Sawoey on Choke Anan rootstock observed under light microscope (bright field), the narrowest opening 0.53 μm at 12.30 p.m. and from figure 4.22 (lower) showed the stomata of mango leaf cv. Pim Sen Mun on Choke Anan rootstock, the widest opening 3.01 μm at 10.30 a.m.

7.2 Effect of scion-rootstock combinations on the stomatal density

Table 4.41 and figure 4.23 showed that Choke Anan rootstocks had significantly higher the stomatal density than Kaew rootstock of all scions. Among the three scions, Pim Sen Mun and Nam Dok Mai had significantly higher the stomatal density of leaves than Khiew Sawoey.

Table 4.41 Effect of scion-rootstock combinations on the stomatal density (numbers/mm^2) of leaves

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	659.34	600.02	628.20	629.19 b
Choke Anan	720.04	601.52	694.64	672.07 a
Mean*	689.69 a	600.77 b	661.42 a	

*Means within the same row or column with different superscript differ significantly, whereas the interaction value were not difference at 95% confidence by Duncan's Multiple Range Test (DMRT) NS = non-significance.

Choke Anan on Kaew rootstock, the stomatal density of leaves was 671.20 numbers/mm^2

Figure 4.23 Effect of scion-rootstock combinations on the stomatal density (numbers/mm^2) of leaves

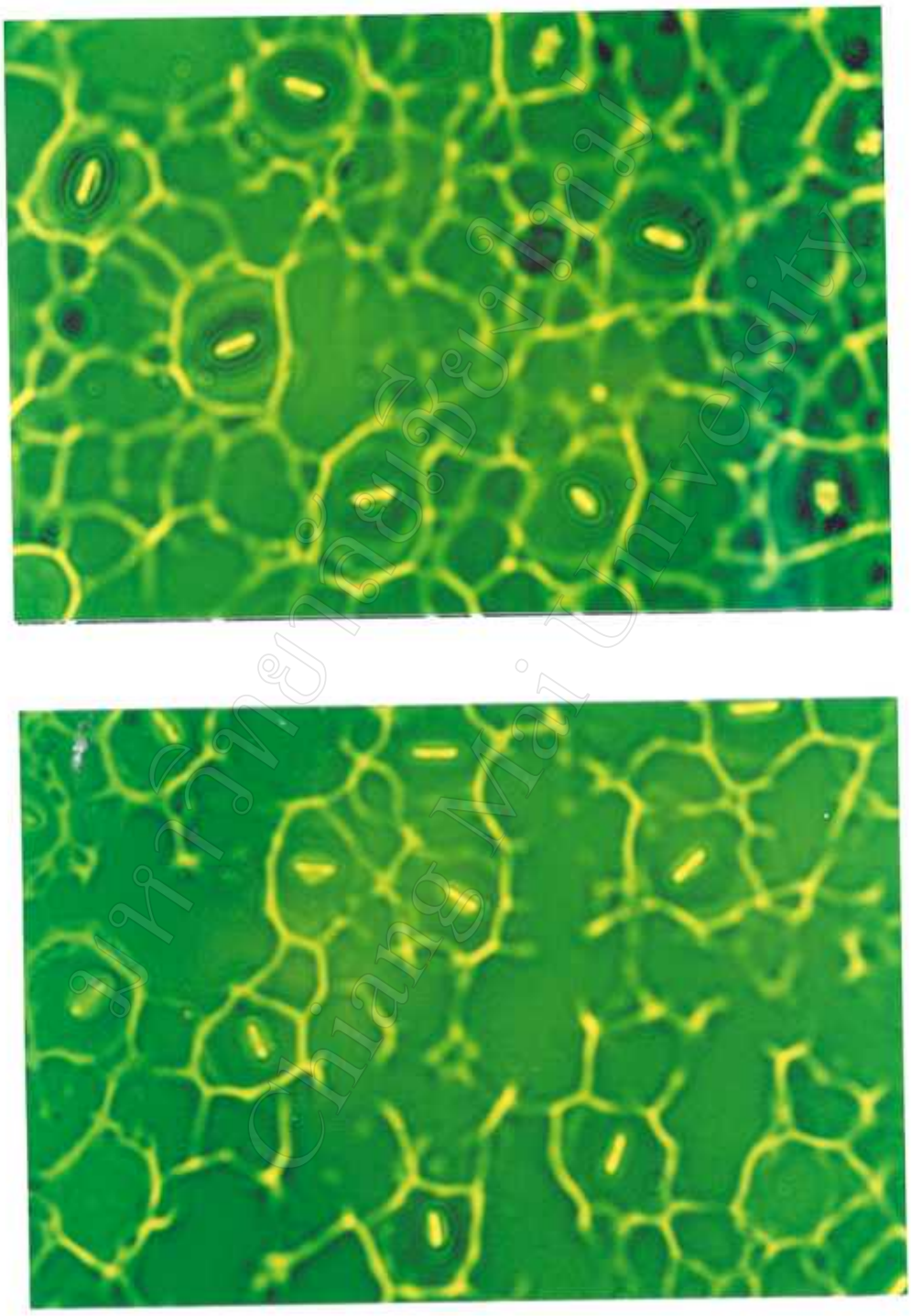

Figure 4.24 Stomatal density of mango leaf cv. Khiew Sawoey on Kaew rootstock (upper), and cv. Nam Dok Mai on Choke Anan rootstock (lower)

From figure 4.24 (upper) showed the stomatal density of mango leaf cv. Khiew Sawoey on Kaew rootstock observed under light microscope (bright field) and from figure 4.24 (lower) showed the stomatal density of mango leaf cv. Nam Dok Mai on Choke Anan rootstock.

7.3 Effect of scion-rootstock combinations on the infiltration rate of leaves.

Table 4.42 showed that Pim Sen Mun on Kaew rootstock had significantly higher the infiltration rate of leaves than Choke Anan at 6.30 a.m. to 09.30 a.m. and 14.30 p.m., but lower at 17.30 p.m. Khiew Sawoey on Kaew had slightly higher the rate than on Choke Anan at 06.30 a.m. to 09.30 a.m., 11.30 a.m., 12.30 p.m. and 17.30 p.m. While Nam Dok Mai on Kaew had significant higher the rate than Choke Anan at 06.30 a.m. to 09.30 a.m. and 12.30 p.m. Choke Anan rootstock had significantly higher the rate than Kaew at 10.30 a.m., 13.30 p.m. and 15.30 p.m. Pim Sen Mun significantly higher the rate than on Khiew Sawoey and Nam Dok Mai at 13.30 p.m., whereas Pim Sen Mun and Khiew Sawoey had significant higher than Nam Dok Mai at 16.30 p.m. and 18.30 p.m.

Table 4.42 Effect of scion-rootstock combinations on the infiltration rate (second) of leaves.

AT TIME : 06.30

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	25.32 a	21.95 b	19.81 c	22.36 a
Choke Anan	11.14 f	13.02 e	15.63 d	13.26 b
Mean^{NS}	18.23	17.48	17.72	

AT TIME : 07.30

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	15.24 b	17.88 a	15.90 b	16.34 a
Choke Anan	10.79 d	12.92 c	12.54 c	12.08 b
Mean*	13.01 c	15.40 a	14.22 b	

AT TIME : 08.30

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	11.63 b	15.00 a	11.64 b	12.76 a
Choke Anan	10.52 c	10.40 c	8.72 d	9.88 b
Mean*	11.07 b	12.70 a	10.18 c	

AT TIME : 09.30

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	10.69 b	12.93 a	8.42 d	10.68 a
Choke Anan	8.59 cd	9.54 c	7.81 d	8.65 b
Mean*	9.64 b	11.24 a	8.12 c	

Table 4.42 (continued)

AT TIME : 10.30

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	9.67	9.95	8.84	9.49 a
Choke Anan	9.14	8.20	8.29	8.54 b
Mean^{NS}	9.41	9.07	8.56	

AT TIME : 11.30

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	9.86 b	10.59 a	9.05 cd	9.83 a
Choke Anan	9.51 bc	8.62 d	8.37 d	8.83 b
Mean*	9.68 a	9.61 a	8.71 b	

AT TIME : 12.30

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	11.22 b	11.31 b	12.49 a	11.67 a
Choke Anan	10.50 b	9.30 c	9.26 c	9.69 b
Mean^{NS}	10.86	10.30	10.88	

AT TIME : 13.30

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	10.36	10.31	9.81	10.16 a
Choke Anan	9.93	8.67	8.41	9.00 b
Mean*	10.14 a	9.49 b	9.11 b	

AT TIME : 14.30

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	11.62 a	8.80 c	9.33 bc	9.92
Choke Anan	10.02 b	9.27 bc	9.67 bc	9.65
Mean*	10.82 a	9.03 b	9.50 b	

AT TIME : 15.30

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	11.66	11.04	11.58	11.43 a
Choke Anan	10.49	9.31	9.63	9.81 b
Mean*	11.08 a	10.18 b	10.61 ab	

AT TIME : 16.30

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	11.59	12.50	10.96	11.68
Choke Anan	12.16	12.05	10.42	11.54
Mean*	11.87 a	12.28 a	10.69 b	

Table 4.42 (continued)

AT TIME : 17.30

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	11.49 c	13.02 a	11.49 cd	12.00 a
Choke Anan	12.27 b	10.84 c	10.57 d	11.23 b
Mean*	11.88 a	11.93 a	11.03 b	

AT TIME : 18.30

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	12.87	12.87	11.54	12.43
Choke Anan	12.21	13.25	10.67	12.04
Mean*	12.54 a	13.06 a	11.10 b	

*Means within the same row or column with different superscript and the interaction value with different superscript differ significantly at 95% confidence by Duncan's Multiple Range Test (DMRT)

NS = non-significance.

Choke Anan / Kaew rootstock

At time	06.30	07.30	08.30	09.30	10.30	11.30	12.30	13.30	14.30	15.30	16.30	17.30	18.30
Infiltration rate (sec)	18.34	12.15	10.09	9.68	8.84	9.06	10.32	9.75	9.52	10.72	10.77	11.97	12.14

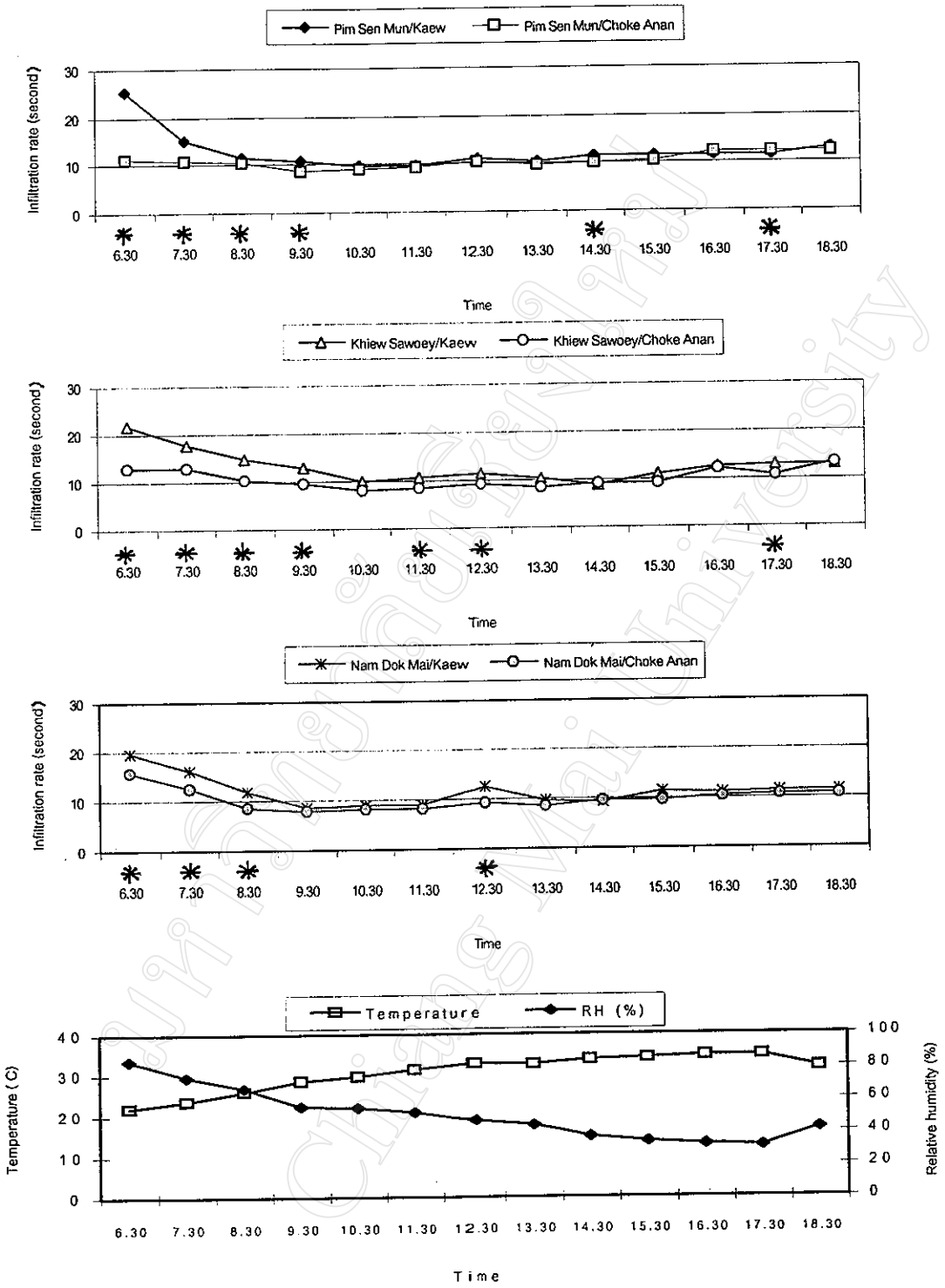

Figure 4.25 Effect of mango rootstocks on the infiltration rate (second) of leaves (upper), and the temperature dry bulb ($^{\circ}$C) and relative humidity (%) in the experimental date (April 1, 2000) (lower)

*Means of each pair of scion-rootstock combinations within the same time with remark (*) differ significantly at 95% confidence by Duncan's Multiple Range Test (DMRT), detailed in Table 4.42.

Figure 4.25 showed that all scions and rootstocks had the highest infiltration rate of leaves at 06.30 a.m. and decreased to the lowest at 9.30 or 10.30 a.m. Pim Sen Mun on Choke Anan, Nam Dok Mai on Choke Anan, Nam Dok Mai on Kaew, Khiew Sawoey on Kaew, Khiew Sawoey on Choke Anan. Among all scion-rootstock combinations increased the infiltration rate at 12.30 p.m. and decreased at 13.30 p.m., and increasing up again to at 18.30 p.m.; however still lower than at 6.30 a.m.

8. Effect of scion-rootstock combinations on dry weight of mango tree.

8.1 Effect of scion-rootstock combinations on dry weight of roots, stem and leaves.

There were non significant difference of both rootstocks, but the three scions, Khiew Sawoey had significantly higher dry weight of roots than Pim Sen Mun and Nam Dok Mai (Table 4.43 (a) and Figure 4.26). However, there were non significant difference of rootstocks, scions and their combinations on dry weight of stems and leaves (Table 4.45 (b),(c) and Figure 4.26)

Table 4.43 Effect of scion-rootstock combinations on dry weight (g) of roots

(a) Roots

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	2092.63	3144.42	1860.95	2366.00
Choke Anan	2337.05	2780.23	1610.06	2242.45
Mean*	2214.84 b	2962.33 a	1735.50 b	

(b) Stems

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	3358.54	4288.18	3259.85	3635.53
Choke Anan	3919.47	3952.19	2949.82	3607.16
Mean^{NS}	3639.01	4120.19	3104.84	

(c) Leaves

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	1287.96	1713.49	1320.21	1440.55
Choke Anan	1677.53	1668.86	1287.41	1544.60
Mean^{NS}	1482.75	1691.18	1303.81	

*Means within the same row or column with different superscript differ significantly, whereas the interaction value were not difference at 95% confidence by Duncan's Multiple Range Test (DMRT)
NS = non-significance.

Choke Anan on Kaew rootstock, the dry weight of roots, stem and leaves were 1237.01, 2199.37 and 993.11 g, respectively.

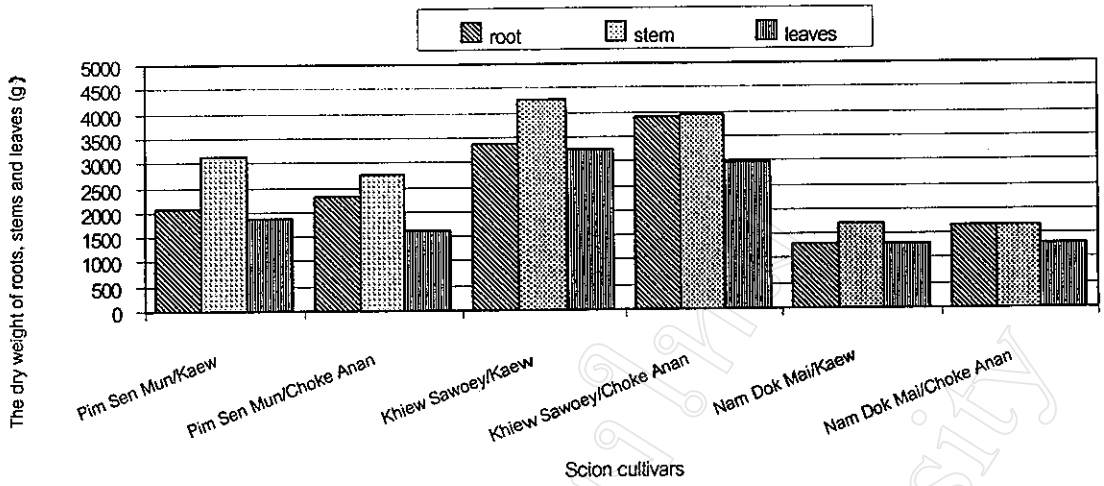

Figure 4.26 Effect of scion-rootstock combinations on dry weight (g) of roots, stems and leaves

8.2 Effect of scion-rootstock combinations on dry weight of whole plants

There were non significant difference of both rootstocks, but the three scions, Khiew Sawoey had significantly higher dry weight of whole plants than Pim Sen Mun and Nam Dok Mai, respectively.

Table 4.44 Effect of scion-rootstock combinations on dry weight (g) of whole plants

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	6739.13	9146.10	6441.01	7442.08
Choke Anan	7934.07	8401.28	5847.25	7394.20
Mean*	7336.60 ab	8773.69 a	6144.13 b	

*Means within the same row or column with different superscript differ significantly, whereas the interaction value were not difference at 95% confidence by Duncan's Multiple Range Test (DMRT) NS = non-significance.

Choke Anan on Kaew rootstock, the dry weight of whole plants were 4429.49 grams.

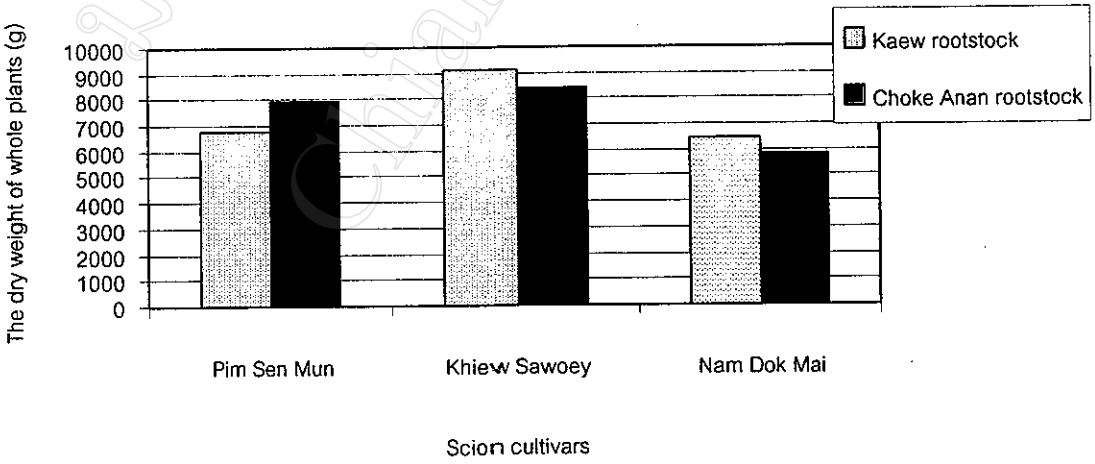

Figure 4.27 Effect of scion-rootstock combinations on dry weight (g) of whole plants.

9. Effect of scion-rootstock combinations on total-nonstructural carbohydrate (TNC), reducing sugar (RS) and nutrient content of leaves and terminal shoots

9.1 Effect of scion-rootstock combinations on total non structural carbohydrate: (TNC) of leaves

Table 4.45 found that all 4 stages during the periods of inflorescence development. Choke Anan rootstock had significantly more TNC content of leaves at all 4 stages than Kaew rootstock. Among the three scions, Nam Dok Mai had significantly more TNC content of leaves than Khiew Sawoey and Pim Sen Mun, respectively. Figure 4.28 found that TNC content of leaves were decreased from the 1st stage to the 4th stage similar in all scion-rootstock combinations.

Table 4.45 Effect of scion-rootstock combinations on total-nonstructural carbohydrate (TNC) content (mg/g DW) of leaves during inflorescence development.

Stage 1: Mature terminal shoots (ready to bud-break)

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	115.23	118.65	124.35	119.41 b
Choke Anan	116.95	122.65	130.62	123.41 a
Mean*	116.09 c	120.65 b	127.49 a	

Choke Anan on Kaew rootstock, the TNC content of leaves was 125.95 mg/g DW

Stage 2: Bud-break (bud emergence with whitish tip)

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	112.41	115.23	122.08	116.57 b
Choke Anan	112.41	119.80	127.20	119.80 a
Mean	112.41 a	117.51 b	124.64 a	

Choke Anan on Kaew rootstock, the TNC content of leaves was 123.20 mg/g DW

Stage 3: Inflorescence 3-4 cm long.

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	108.97	112.41	118.65	113.34 b
Choke Anan	111.84	116.95	123.78	117.52 a
Mean*	110.40 c	114.68 b	121.21 a	

Choke Anan on Kaew rootstock, the TNC content of leaves was 119.78 mg/g DW

Stage 4: Inflorescence 10-12 cm long.

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	106.10	108.97	116.92	110.67 b
Choke Anan	108.97	114.68	120.35	114.67 a
Mean*	107.54 c	111.83 b	118.64 a	

*Means within the same row or column with different superscript differ significantly, whereas the interaction value were not difference at 95% confidence by Duncan's Multiple Range Test (DMRT) NS = non-significance.

Choke Anan on Kaew rootstock, the TNC content of leaves was 118.08 mg/g DW

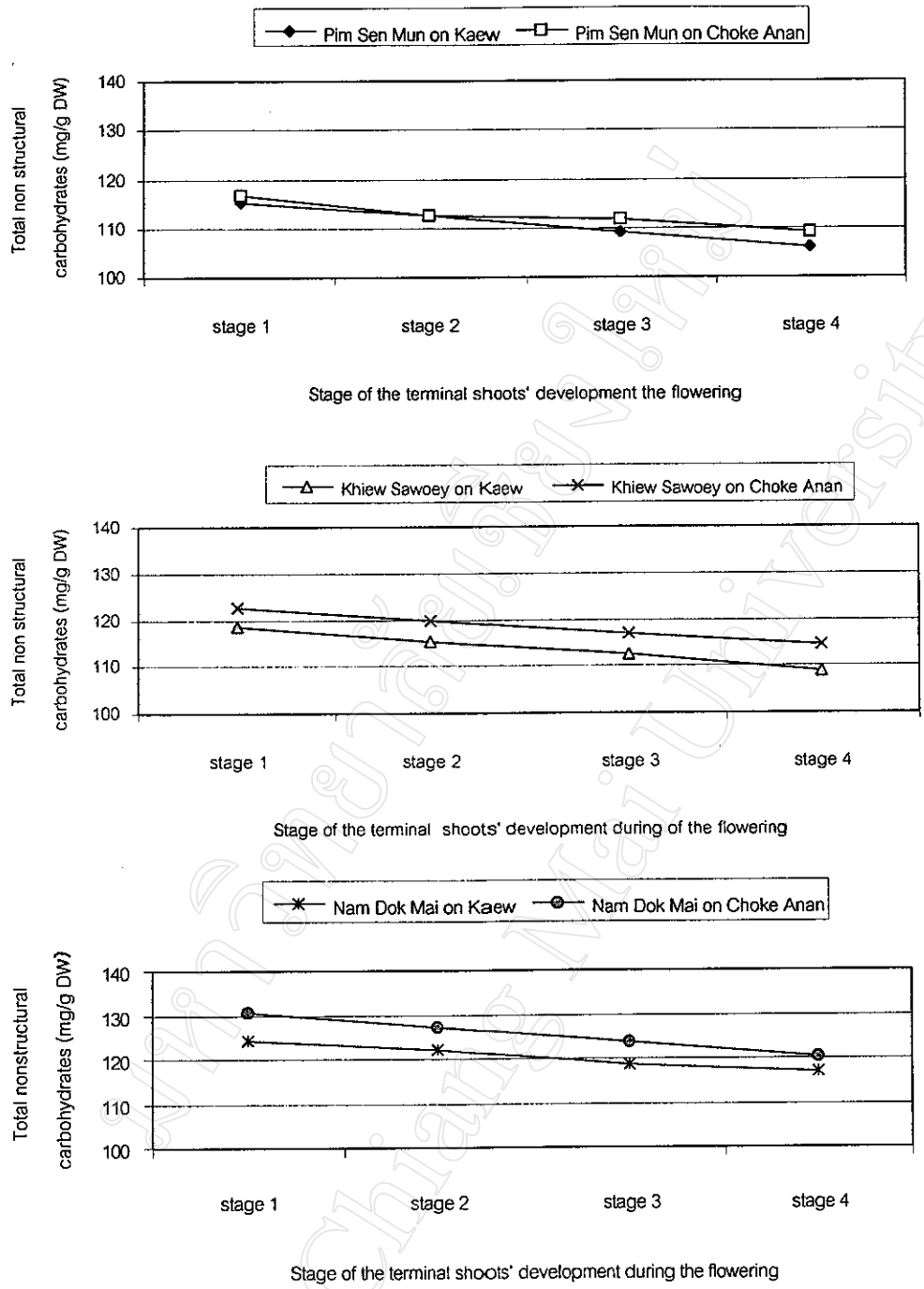

Figure 4.28 Effect of scion-rootstock combinations on the changes in the total nonstructural carbohydrate (TNC) content (mg/g DW) of leaves during inflorescence development.

*Means of each pair of scion-rootstock combinations within the same stage with remark (*) differ significantly at 95% confidence by Duncan's Multiple Range Test (DMRT), detailed in Table 4.45.

9.2 Effect of scion-rootstock combinations on reducing sugar: (RS) of leaves.

Table 4.46 found that all 4 stages during the periods of inflorescence development, there were non significant difference in all scion, rootstocks and their combinations. Figure 4.29 RS content slightly decreased from the 1st stage to the 4th stage similar in all scion-rootstock combinations .

Table 4.46 Effect of scion-rootstock combinations on reducing sugar (RS) content (mg/g DW) of leaves during inflorescence development.

Stage 1: Mature terminal shoots (ready to bud-break)

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	28.68	29.82	30.39	29.63
Choke Anan	29.82	29.82	32.69	30.78
Mean^{NS}	29.25	29.82	31.54	

Choke Anan on Kaew rootstock, reducing sugar (RS) content of leaves was 31.54 mg/ g DW

Stage 2: Bud-break (bud emergence with whitish tip)

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	28.10	28.68	29.82	28.87
Choke Anan	28.68	29.25	32.11	30.01
Mean^{NS}	28.39	28.96	30.97	

Choke Anan on Kaew rootstock, reducing sugar (RS) content leaves was 30.97 mg/ g DW

Stage 3: Inflorescence 3-4 cm long.

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	27.53	28.68	29.82	28.67
Choke Anan	28.10	29.25	31.54	29.63
Mean^{NS}	27.82	28.96	30.68	

Choke Anan on Kaew rootstock, reducing sugar (RS) content of leaves was 30.40 mg/ g DW

Stage 4: Inflorescence 10-12 cm long.

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	27.53	28.11	28.68	28.10
Choke Anan	27.53	28.68	31.54	29.25
Mean^{NS}	27.53	28.39	30.11	

*Means within the same row or column with different superscript differ significantly, whereas the interaction value were not difference at 95% confidence by Duncan's Multiple Range Test (DMRT) NS = non-significance.

Choke Anan on Kaew rootstock, reducing sugar (RS) content of leaves was 29.82 mg/ g DW

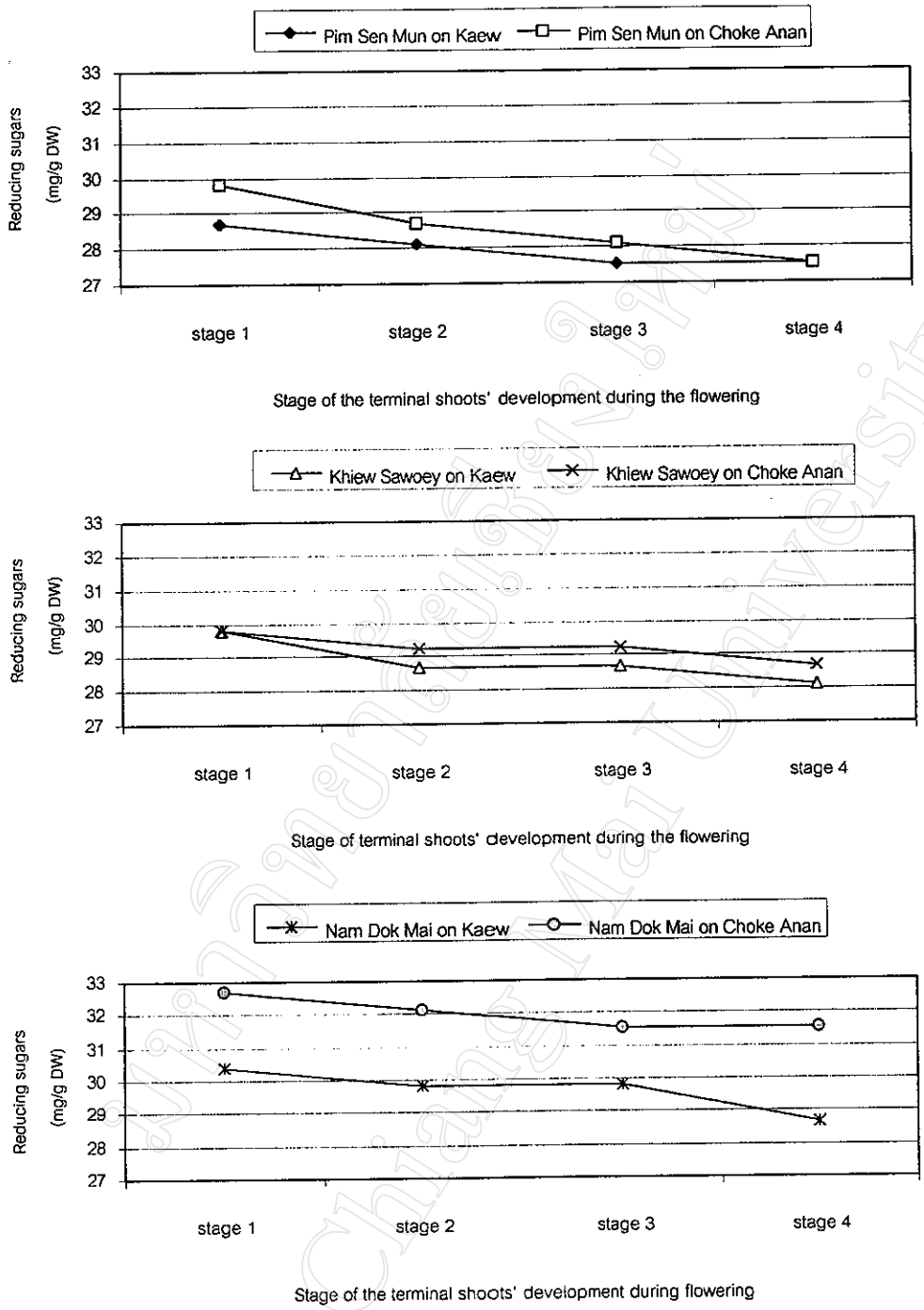

Figure 4.29 Effect of scion-rootstock combinations on the changes in the reducing sugar(RS) content (mg/g DW) of leaves during inflorescence development.

*Means of each pair of scion-rootstock combinations within the same stage with remark (*) differ significantly at 95% confidence by Duncan's Multiple Range Test (DMRT), detailed in Table 4.46.

9.3 Effect of scion-rootstock combinations on total non structural carbohydrate (TNC) of terminal shoots

Table 4.47 found that all 4 stages during the periods of inflorescence development, there were non significant difference in TNC content of terminal shoots between both rootstocks. Among the three scions, Nam Dok Mai had significantly more TNC content of terminal shoots than Khiew Sawoey and Pim Sen Mun. Figure 4.30 found that TNC content of the terminal shoots were low in the 1st stage and increased rapidly in the 2nd stage and nearly constant in the 3rd stage and the 4th stage similar in all scion-rootstock combinations.

Table 4.47 Effect of scion-rootstock combinations on total-nonstructural carbohydrate (TNC) content (mg/g DW) of terminal shoots during inflorescence development

Stage 1: Mature terminal shoots (ready to bud-break)

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	115.80	118.65	126.63	120.36
Choke Anan	117.50	122..65	127.20	122.45
Mean*	116.65 c	120.65 b	126.91 a	

Choke Anan on Kaew rootstock, the TNC content of terminal shoots was 130.62 mg/g DW

Stage 2: Bud-break (bud emergence with whitish tip)

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	120.35	121.50	129.48	123.78
Choke Anan	119.80	125.50	130.05	125.12
Mean*	120.07 b	123.50 b	129.76 a	

Choke Anan on Kaew rootstock, the TNC content of terminal shoot was 131.21 mg/g DW

Stage 3: Inflorescence 3-4 cm long.

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	119.80	122.65	128.94	123.80
Choke Anan	119.22	124.93	130.66	124.94
Mean*	119.51 b	123.79 b	129.80 a	

Choke Anan on Kaew rootstock, the TNC content of terminal shoots was 131.79 mg/g DW

Stage 4: Inflorescence 10-12 cm long.

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	120.35	121.52	130.09	123.99
Choke Anan	119.80	124.35	128.33	124.16
Mean*	120.07 b	122.94 b	129.21 a	

*Means within the same row or column with different superscript differ significantly, whereas the interaction value were not difference at 95% confidence by Duncan's Multiple Range Test (DMRT)
NS = non-significance.

Choke Anan on Kaew rootstock, the TNC content of terminal shoots was 132.38 mg/g DW

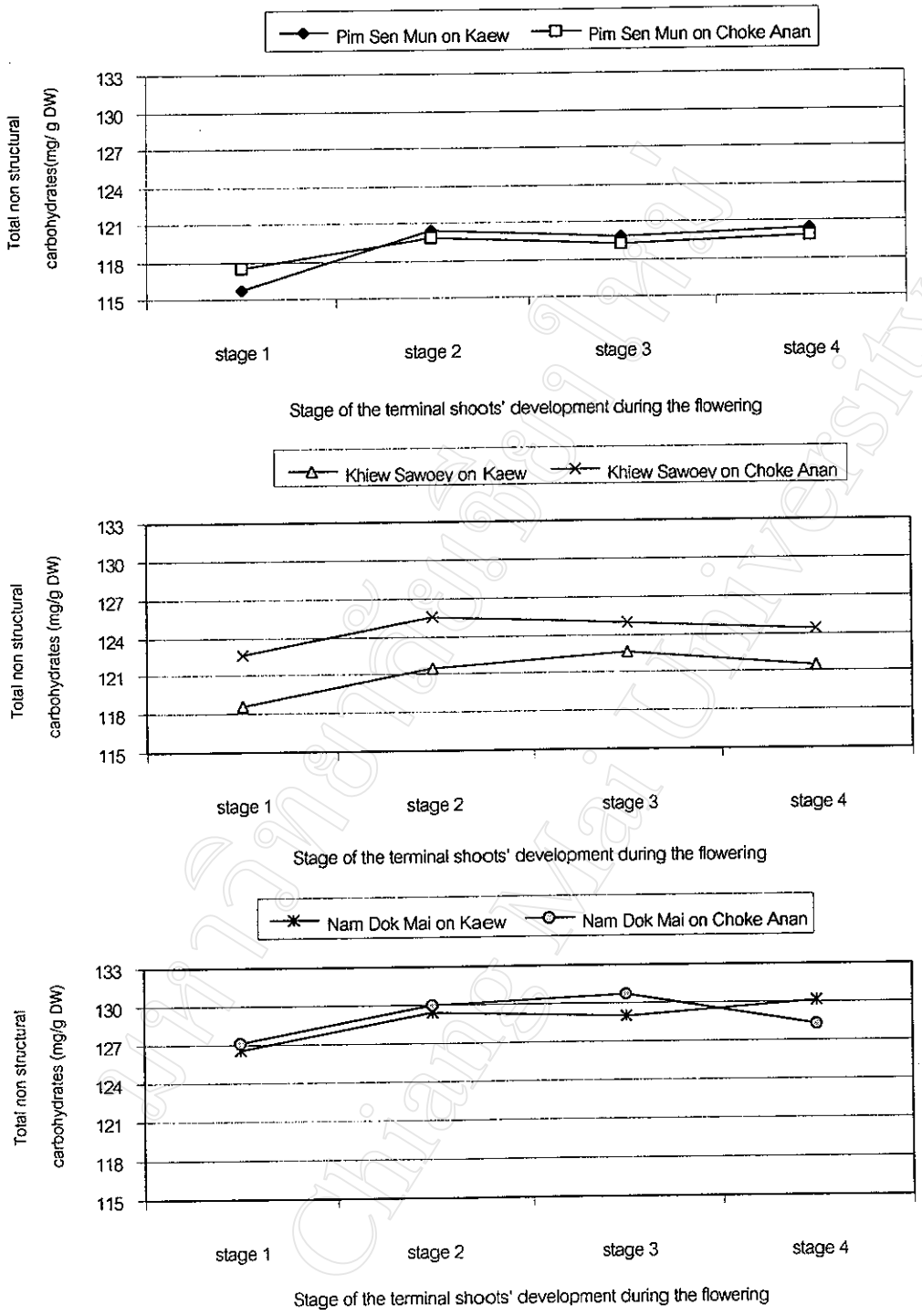

Figure 4.30 Effect of scion-rootstock combinations on the changes in the total nonstructural carbohydrate (TNC) content (mg/g DW) of the terminal shoots during inflorescence development

*Means of each pair of scion-rootstock combinations within the same stage with remark (*) differ significantly at 95% confidence by Duncan's Multiple Range Test (DMRT), detailed in Table 4.47.

9.4 Effect of scion-rootstock combinations on reducing sugar : RS of terminal shoots

Table 4.48 found that all 4 stages during the period of florescence development, there were non significant difference between both rootstocks on amount of reducing sugar (RS) of terminal shoots. Among the three scions, in the 1st and 2nd stages, Nam Dok Mai had significantly more RS content of terminal shoots than Khiew Sawoey and Pim Sen Mun, respectively. While in the 3rd and the 4th stages, there were non significant difference among the three scions. Figure 4.31 found that the RS content of terminal shoots were increased from the 1st stage to the 4th stage in all scion-rootstock combinations; except only Khiew Sawoey on Kaew had the highest in the 3rd stage then decreased in the 4th stage.

Table 4.48 Effect of scion-rootstock combinations on reducing sugar (RS) content (mg/g DW)of terminal shoots during inflorescence development

Stage 1: Mature terminal shoots (ready to bud-break)

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	28.10	29.25	32.69	30.01
Choke Anan	28.68	30.97	33.83	31.16
Mean*	28.39 b	30.11 ab	33.26 a	

Choke Anan on Kaew rootstock, the RS content terminal shoots was 29.24 mg/g DW

Stage 2: Bud-break (bud emergence with whitish tip)

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	29.25	30.29	33.84	31.16
Choke Anan	29.82	32.12	34.98	32.31
Mean*	29.54 b	31.25 ab	34.41 a	

Choke Anan on Kaew rootstock, the RS content of terminal shoots was 29.82 mg/g DW

Stage 3: Inflorescence 3-4 cm long

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	30.39	34.51	34.98	32.31
Choke Anan	30.97	33.26	35.56	33.26
Mean^{NS}	30.68	32.40	35.27	

Choke Anan on Kaew rootstock, the RS content of terminal shoots was 31.54 mg/g DW

Stage 4: Inflorescence 10-12 cm long

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	31.54	32.69	35.56	33.26
Choke Anan	32.12	33.84	37.28	34.41
Mean^{NS}	31.83	32.40	36.42	

* Means within the same row or column with different superscript differ significantly, whereas the interaction value were not difference at 95% confidence by Duncan's Multiple Range Test (DMRT) NS = non-significance.

Choke Anan on Kaew rootstock, the RS content of terminal shoots was 32.69 mg/g DW

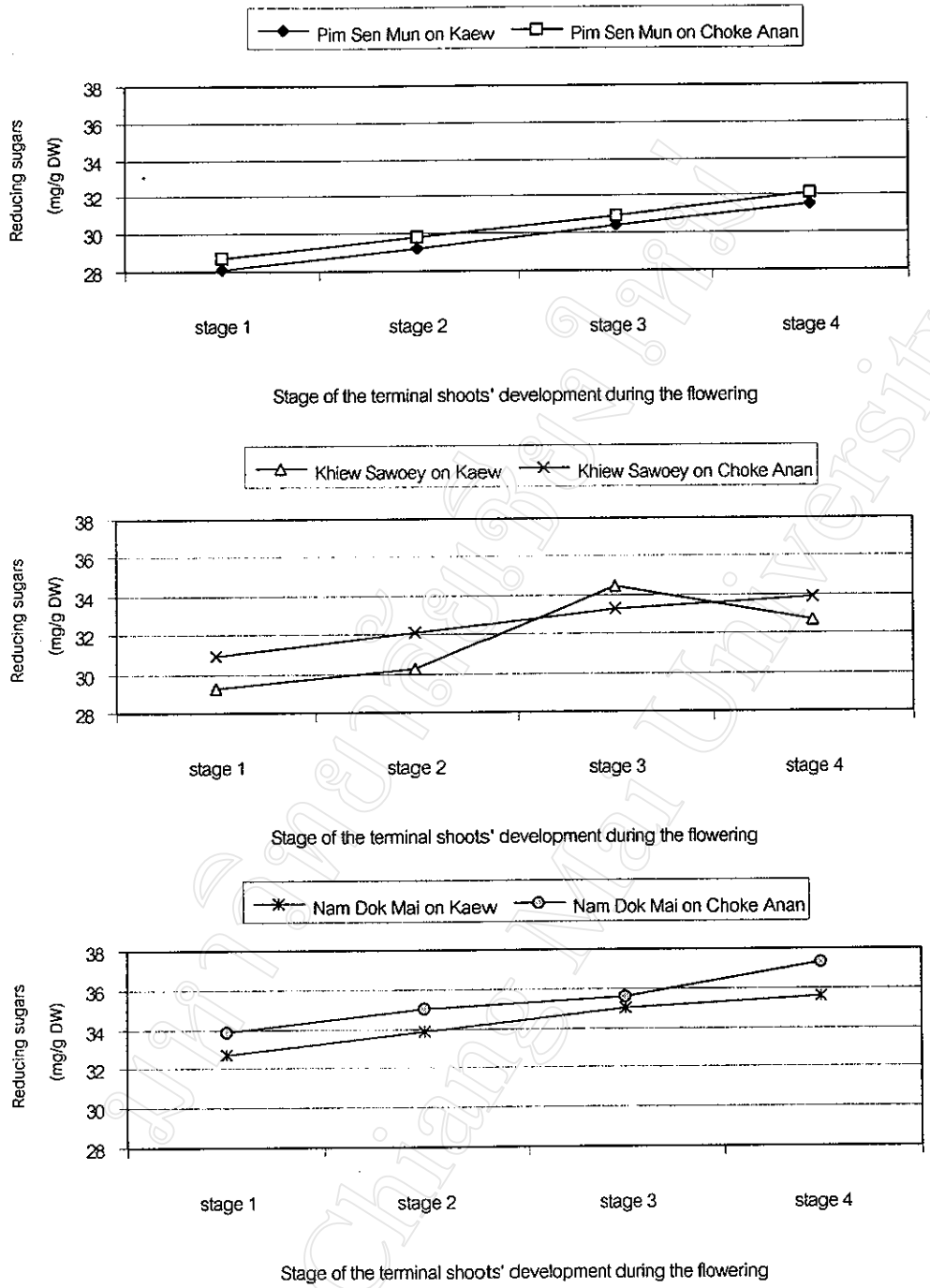

Figure 4.31 Effect of scion-rootstock combinations on the changes in the reducing sugars (RS) content (mg/g DW) of terminal shoots during inflorescence development

*Means of each pair of scion-rootstock combinations within the same stage with remark (*) differ significantly at 95% confidence by Duncan's Multiple Range Test (DMRT), detailed in Table 4.48.

9.5 Effects of scion-rootstock combinations on total nitrogen : TN of leaves.

Table 4.49 showed that Nam Dok Mai on Choke Anan had significantly higher total nitrogen (TN) of leaves in the 1st , the 2nd and the 4th stages than Nam Dok Mai on Kaew, but lower in the 3rd stage with non significance. While Khiew Sawoey on Kaew had significantly higher TN of leaves than Khiew Sawoey on Choke Anan in the 2nd , the 3rd and the 4th stages, but non significant difference in the 1st stage. Pim Sen Mun on Choke Anan had higher than on Kaew in the 2nd and the 3rd stages but non significant difference in the 1st and the 4th stages. Figure 4.32 found that the amount of TN content of leaves were decreased from the 1st stage and to the lowest in the 2nd stage, then increased in the 3rd and the 4th stages similar in all scion-rootstock combinations.

Table 4.49 Effect of scion-rootstock combinations on total nitrogen (TN) content (% DW) of leaves during inflorescence development.

Stage 1: Mature terminal shoots (ready to bud-break)

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	1.075 b	1.138 a	1.004 d	1.072
Choke Anan	1.072 b	1.117 a	1.052 c	1.081
Mean*	1.075 b	1.127 a	1.028 c	

Choke Anan on Kaew rootstock, the TN content of leaves was 0.990 %

Stage 2: Bud-break (bud emergence with whitish tip)

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.995 d	1.031 a	0.902 f	0.962 b
Choke Anan	0.979 c	1.011 b	0.924 e	0.971 a
Mean*	0.967 b	1.021 a	0.913 c	

Choke Anan on Kaew rootstock, the TN content of terminal shoots was 0.882%

Stage 3: Inflorescence 3-4 cm long.

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.991 e	1.241 a	1.054 d	1.095
Choke Anan	1.112 c	1.187 b	0.944 d	1.647
Mean*	1.051 b	1.124 a	1.024 c	

Choke Anan on Kaew rootstock, the TN content of terminal shoots was 1.070 %

Stage 4: Inflorescence 10-12 cm long.

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	1.173 c	1.372 a	1.123 d	1.222 ns
Choke Anan	1.182 c	1.227 b	1.157 a	1.188
Mean*	1.177 b	1.299 a	1.139 c	

*Mean within the same row or column with different superscript and the interaction value with different superscript differ significantly at 95% confidence by Duncan's Multiple Range Test (DMRT) NS = non-significance.

Choke Anan on Kaew rootstock, the TN content of terminal shoots was 1.147 %

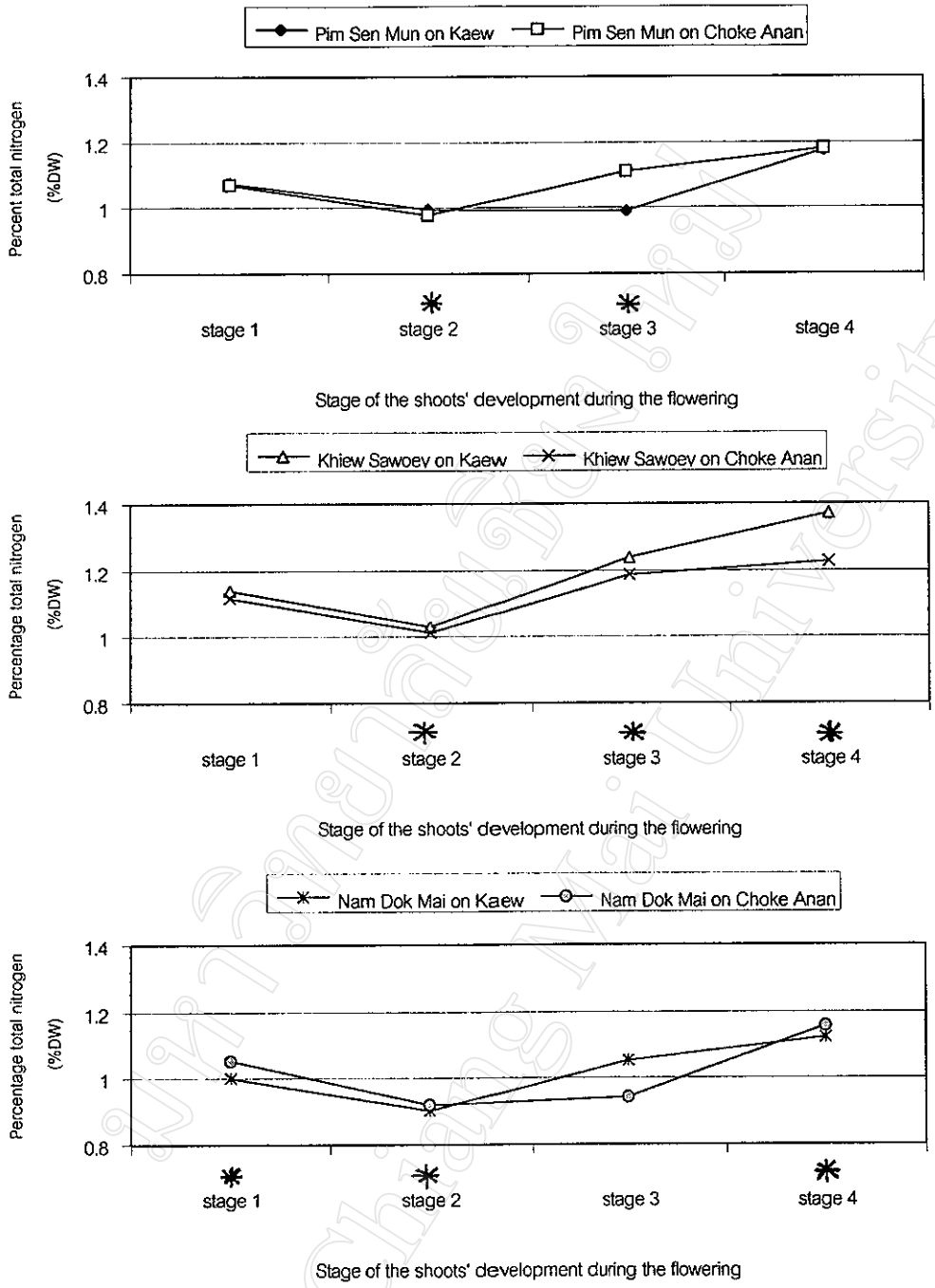

Figure 4.32 Effect of scion-rootstock combinations on the changes in the total nitrogen (TN) content (%DW) of leaves during inflorescence development.

*Means of each pair of scion-rootstock combinations within the same stage with remark (*) differ significantly at 95% confidence by Duncan's Multiple Range Test (DMRT), detailed in Table 4.49.

9.6 Effect of scion-rootstock combinations on total nitrogen (TN) of terminal shoots.

Table 4.50 found that Nam Dok Mai on Choke Anan had significantly higher TN content of terminal shoots higher than on Kaew in all 4 stages. While Khiew Sawoey on Kaew had significantly higher TN content higher than on Choke Anan in the 1st, the 3rd and the 4th stages, but non significant difference in the 2nd stage. Pim Sen Mun on Choke Anan had TN content higher than on Kaew in the 2nd and the 3rd stages, but non significant difference in the 1st and the 4th stages. Figure 4.33 indicated that TN content of terminal shoots were decreased from the 1st stage and to the lowest in the 2nd stage then increased in the 3rd to the 4th stage, similar in all scion-rootstock combinations.

Table 4.50 Effect of scion-rootstock combinations on total nitrogen (TN) content (% DW) of terminal shoots during inflorescence development.

Stage 1: Mature terminal shoots (ready to bud-break)

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.492 c	0.560 a	0.440 e	0.497
Choke Anan	0.507 c	0.531 b	0.462 d	0.500
Mean*	0.499 b	0.545 a	0.449 c	

Choke Anan on Kaew rootstock, the TN content of terminal shoots was 0.443 %

Stage 2: Bud-break (bud emergence with whitish tip)

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.431 c	0.501 a	0.388 e	0.440 b
Choke Anan	0.462 b	0.496 a	0.412 d	0.484 a
Mean*	0.447 b	0.498 a	0.400 c	

Choke Anan on Kaew rootstock, the TN content of terminal shoots was 0.388 %

Stage 3: Inflorescence 3-4 cm long.

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.479 c	0.524 a	0.415 e	0.472 b
Choke Anan	0.504 b	0.504 b	0.443 d	0.484 a
Mean*	0.491 b	0.514 a	0.429 c	

Choke Anan on Kaew rootstock, the TN content of terminal shoots was 0.424 %

Stage 4: Inflorescence 10-12 cm long.

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.508 b	0.545 a	0.444 d	0.499
Choke Anan	0.524 b	0.517 b	0.468 c	0.504
Mean*	0.516 b	0.531 a	0.456 c	

*Means within the same row or column with different superscript and the interaction value with different superscript differ significantly at 95% confidence by Duncan's Multiple Range Test (DMRT) NS = non-significance.

Choke Anan on Kaew rootstock, the TN content terminal shoots was 0.458 %

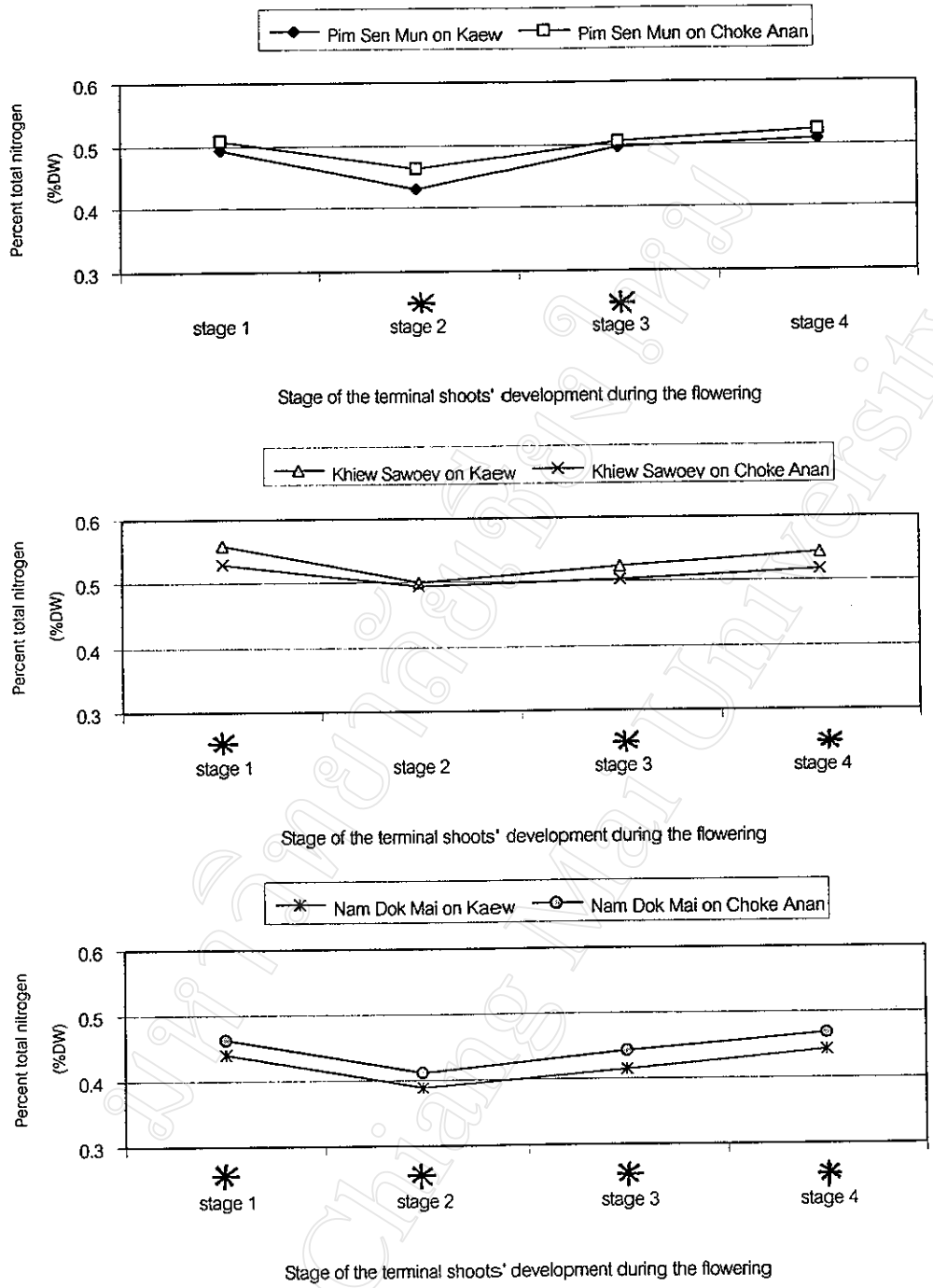

Figure 4.33 Effect of scion-rootstocks combinations on the changes in the total nitrogen (TN) content (%DW) of terminal shoots during inflorescence development

*Means of each pair of scion-rootstock combinations within the same stage with remark (*) differ significantly at 95% confidence by Duncan's Multiple Range Test (DMRT), detailed in Table 4.50.

9.6 Effect of scion-rootstock combinations on carbohydrate/nitrogen (C/N) ratio of leaves.

Table 4.51 indicated that in the 2nd stage, Khiew Sawoey on Choke Anan had significantly higher the C/N ratio than on Kaew, while Pim Sen Mun, Khiew Sawoey and Nam Dok Mai on Choke Anan had significantly higher than on Kaew in the 3rd stage. Whereas in the 1st and the 4th stages, there were non significant difference between both rootstocks. Among three scions, Nam Dok Mai had significantly higher than Pim Sen Mun and Khiew Sawoey, respectively in the 1st stage. But Pim Sen Mun had non difference with Khiew Sawoey in the 4th stage. Figure 4.34 showed that C/N ratio were low in the 1st stage and increased to the highest in the 2nd stage, then decreased in the 3rd and 4th stages, similar in all scion-rootstock combinations.

Table 4.51 Effect of scion-rootstock combinations on carbohydrate/nitrogen (C/N) ratio of leaves during inflorescence development.

Stage 1: Mature terminal shoots (ready to bud-break)

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	10.72	10.29	12.39	11.13
Choke Anan	10.88	10.98	12.42	11.43
Mean*	10.80 b	10.64 b	12.41 a	

Choke Anan on Kaew rootstock, the C/N ratio of leaves was 12.86

Stage 2: Bud-break (bud emergence with whitish tip)

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	11.70 b	11.18 c	13.55 a	12.14
Choke Anan	11.49 bc	11.85 b	13.77 a	12.37
Mean*	11.59 b	11.52 a	13.66 a	

Choke Anan on Kaew rootstock, the C/N ratio of leaves was 13.97

Stage 3: Inflorescence 3-4 cm long.

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	11.00 c	9.06 d	11.25 b	10.44 b
Choke Anan	10.07 b	9.85 c	12.45 a	10.79 a
Mean*	10.53 b	9.45 c	11.85 a	

Choke Anan on Kaew rootstock, the C/N ratio of leaves was 11.20

Stage 4: Inflorescence 10-12 cm long.

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	9.05	7.94	10.43	9.14
Choke Anan	9.22	7.94	10.41	9.19
Mean*	9.13 b	7.94 c	10.42 a	

*Means within the same row or column with different superscript and the interaction value with different superscript differ significantly at 95% confidence by Duncan's Multiple Range Test (DMRT) NS = non-significance.

Choke Anan on Kaew rootstock, the C/N ratio of leaves was 10.30

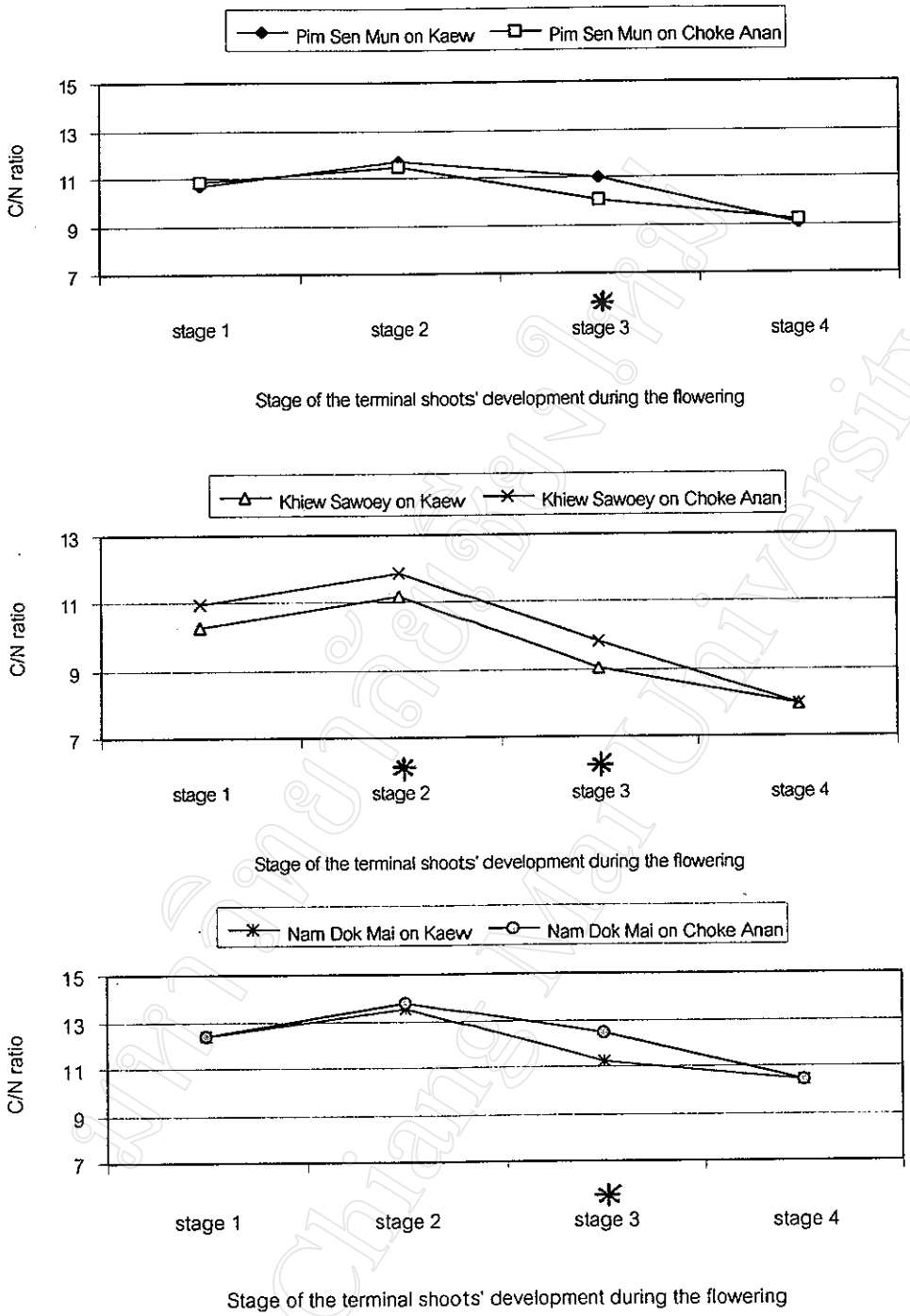

Figure 4.34 Effect of scion-rootstock combinations on the changes in the C/N ratio of leaves during inflorescence development

*Means of each pair of scion-rootstock combinations within the same stage with remark (*) differ significantly at 95% confidence by Duncan's Multiple Range Test (DMRT), detailed in Table 4.51.

9.7 Effect of scion-rootstock combinations on C/N ratio of terminal shoots

Table 4.52, showed that Nam Dok Mai on Choke Anan had significantly higher amount of C/N ratio higher than on Kaew in the 1st , the 2nd and the 3rd stages, but non significant difference for Nam Dok Mai on both rootstocks in the 4th stage. Khiew Sawoey on Choke Anan had higher than on Kaew in the 1st stage, but there were non significant difference on the 2nd , the 3rd and the 4th stages. Pim Sen Mun on Kaew had higher than on Choke Anan in the 2nd stage, but non significant difference in the 1st , the 3rd and the 4th stages. Figure 4.35 showed that the amount of C/N ratio of terminal shoot were decreased from the 1st stage and increased rapidly in the 2nd stage, then decreased in the 3rd and 4th stages, similar in all scion-rootstock combinations.

Table 4.52 Effect of scion-rootstock combinations on carbohydrate/nitrogen (C/N) ratio of terminal shoots during inflorescence development.

Stage 1: Mature terminal shoots (ready to bud-break)

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	23.56 c	21.20 d	29.01 a	24.59
Choke Anan	23.20 c	23.12 c	27.54 b	24.62
Mean*	23.38 b	22.16 c	28.28 a	

Choke Anan on Kaew rootstock, the C/N ratio in terminal shoots was 29.28

Stage 2: Bud-break (bud emergence with whitish tip)

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	27.94 c	24.27 d	33.84 a	28.68
Choke Anan	25.93 d	25.34 d	31.62 b	27.63
Mean*	26.93 b	24.81 c	32.73 a	

Choke Anan on Kaew rootstock, the C/N ratio of terminal shoots was 34.34

Stage 3: Inflorescence 3-4 cm long.

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	25.05 b	23.10 c	33.84 a	28.68
Choke Anan	23.67 bc	24.79 c	31.62 b	27.63
Mean*	24.36 b	23.94 b	32.73 a	

Choke Anan on Kaew rootstock, the C/N ratio of terminal shoots was 31.06

Stage 4: Inflorescence 10-12 cm long.

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	23.70 b	22.33 b	29.31 a	25.11
Choke Anan	22.94 b	24.07 b	27.47 a	24.82
Mean*	23.32 b	23.20 b	28.39 a	

*Mean within the same row or column with different superscript and the interaction value with different superscript differ significantly at 95% confidence by Duncan's Multiple Range Test (DMRT) NS = non-significance.

Choke Anan on Kaew rootstock, the C/N ratio of terminal shoots was 28.89

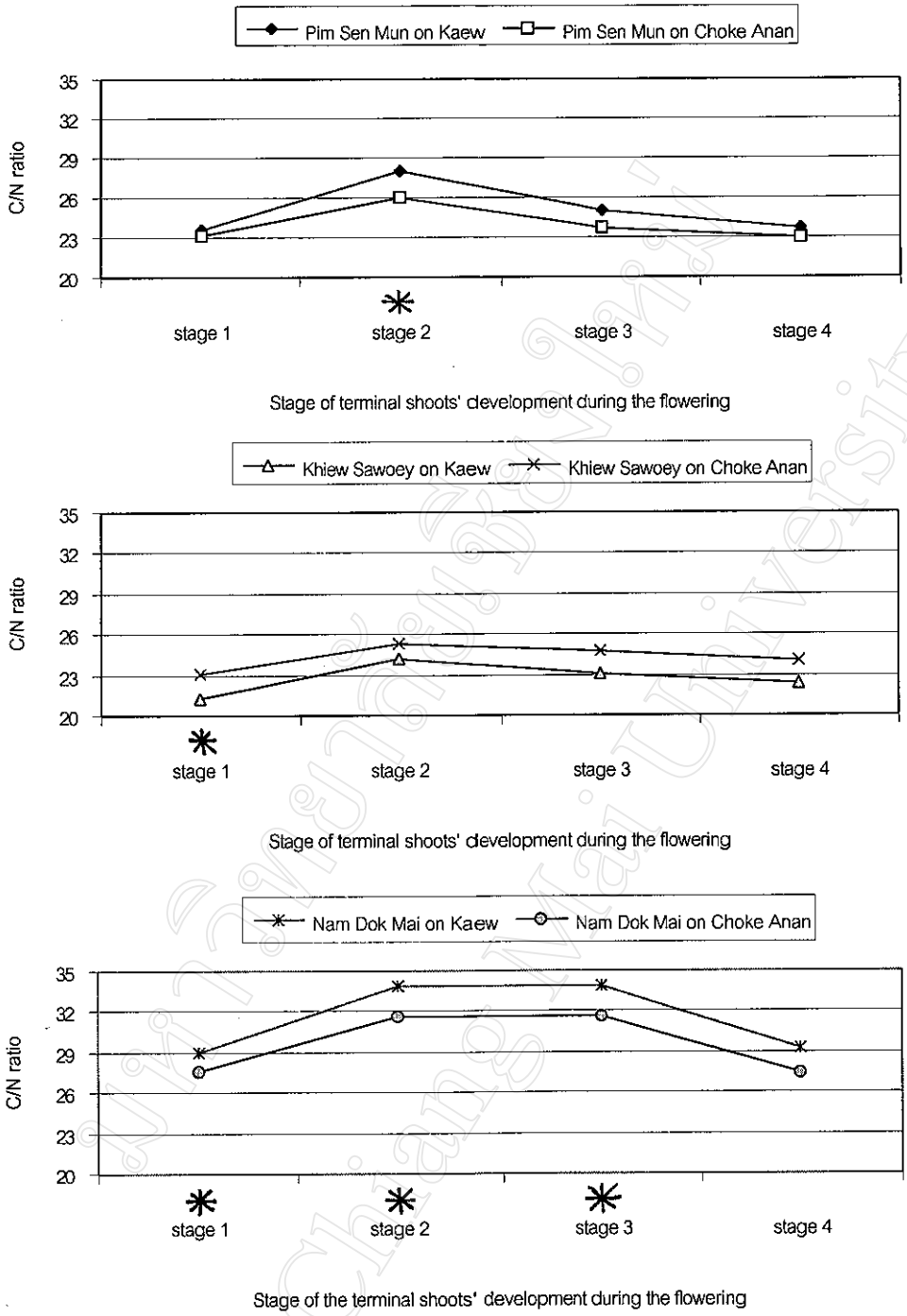

Figure 4.35 Effect of scion-rootstock combinations on the changes in the in C/N ratio of terminal shoots during inflorescence development

*Means of each pair of scion-rootstock combinations within the same stage with remark (*) differ significantly at 95% confidence by Duncan's Multiple Range Test (DMRT), detailed in Table 4.52.

9.9 Effect of scion-rootstock combinations on phosphorous of leaves.

Table 4.53 showed that in the 1st , the 2nd and 4th stages on Choke Anan rootstocks had significantly more the levels of phosphorous than on Kaew, but there were non significant difference in the 3rd stage. Among three scions found that in the 1st and the 2nd stages Pim Sen Mun had significantly more than Khiew Sawoey and Nam Dok Mai, respectively with; while the 3rd and the 4th stages, Pim Sen Mun and Khiew Sawoey had nearly the same levels but significantly more than Nam Dok Mai.

Figure 4.36 showed that Khiew Sawoey on Kaew, Khiew Sawoey on Choke Anan, Nam Dok Mai on Kaew and Nam Dok Mai on Choke Anan had in creased the amount phosphorus from the 1st stage to the 3rd stage and to the highest in the 4th stage. In Pim Sen Mun on Choke Anan and Nam Dok Mai on Kaew, the levels were increased in the 1st , the 2nd and highest in the 3rd stages, but decreased in the 4th stage. Whereas the levels in Pim Sen Mun on Kaew were increased in the 1st and the 2nd stages and decreased in the 3rd stage, then increased to the highest in the 4th stage.

Table 4.53 Effect of mango rootstocks on the level of phosphorous (% DW) of the terminal shoots' development during the flowering.

Stage 1: Mature terminal shoots (ready to bud-break)

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.114	0.104	0.085	0.106 b
Choke Anan	0.119	0.110	0.086	0.105 a
Mean*	0.117 a	0.107 b	0.086 c	

Choke Anan on Kaew rootstock, level of phosphorus was 0.141%

Stage 2: Bud-break (bud emergence with whitish tip)

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.115	0.109	0.094	0.106 b
Choke Anan	0.119	0.110	0.086	0.105 a
Mean*	0.117 a	0.110 b	0.090 c	

Choke Anan on Kaew rootstock, level of phosphorus was 0.146

Stage 3: Inflorescence 3-4 cm long.

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.112	0.110	0.102	0.108
Choke Anan	0.122	0.117	0.100	0.113
Mean*	0.117 a	0.114 b	0.101 b	

Choke Anan on Kaew rootstock, level of phosphorus was 0.148%

Stage 4: Inflorescence 10-12 cm long.

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.118	0.115	0.099	0.111 b
Choke Anan	0.119	0.120	0.103	0.114 a
Mean*	0.119 a	0.118 a	0.101 b	

*Means within the same row or column with different superscript differ significantly, whereas the interaction value were not difference at 95% confidence by Duncan's Multiple Range Test (DMRT)
NS = non-significance.

Choke Anan on Kaew rootstock, level of phosphorus was 0.149%

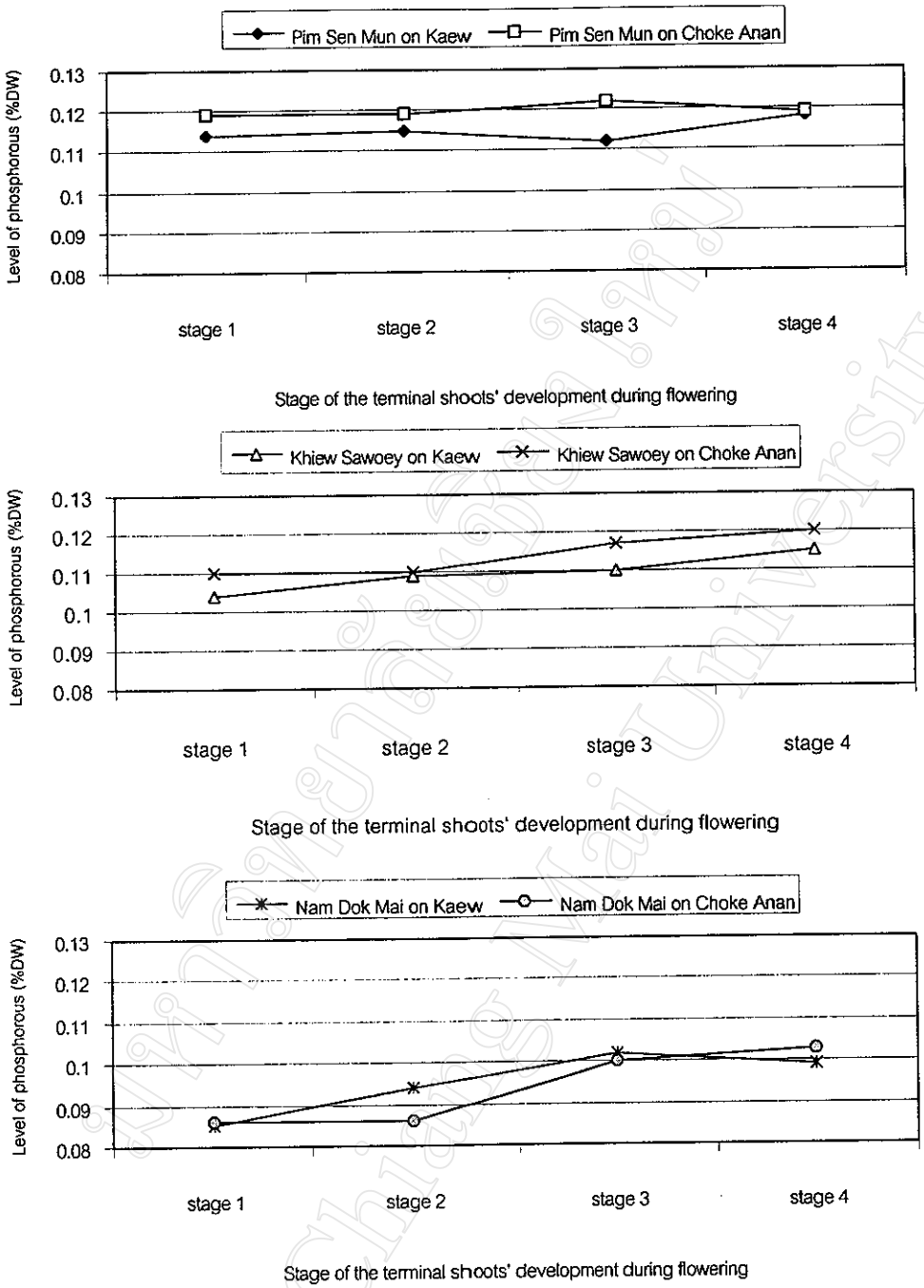

Figure 4.36 Effect of scion-rootstock combinations on changes in the level of phosphorous (%DW) of leaves during inflorescence development

*Means of each pair of scion-rootstock combinations within the same stage with remark (*) differ significantly at 95% confidence by Duncan's Multiple Range Test (DMRT), detailed in Table 4.53.

9.10 Effect of scion-rootstock combinations on potassium of leaves.

Table 4.54 showed that Choke Anan rootstocks had significantly more the levels of Potassium than Kaew rootstocks in all 4 stages; while among three scions, there were non significant difference. Figure 4.37 showed that Pim Sen Mun on Kaew, Pim Sen Mun on Choke Anan, Khiew Sawoey on Kaew and Nam Dok Mai on Kaew had the levels of potassium highest in the 1st stage and were decreased in the 2nd , the 3rd stages and to the lowest in the 4th stage. While the levels in Khiew Sawoey on Choke Anan were increased from the 1st stage and to the highest in the 2nd stage, then decreased in the 3rd stage and to the lowest in the 4th stage. But Nam Dok Mai on Choke Anan had the highest levels in the 1st stage, and decreased in the 2nd stage and to the lowest in the 3rd stage, then increased in the 4th stage.

Table 4.54 Effect of scion-rootstock combinations on the level of potassium (% DW) of leaves in the 4 stages of the terminal shoots' development during the flowering.

Stage 1: Mature terminal shoots (ready to bud-break)

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.841	0.828	0.770	0.813 b
Choke Anan	0.905	0.849	0.898	0.884 a
Mean^{NS}	0.873	0.839	0.834	

Choke Anan on Kaew rootstock, level of potassium was 0.855%

Stage 2: Bud-break (bud emergence with whitish tip)

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.698	0.733	0.696	0.709 b
Choke Anan	0.851	0.851	0.856	0.853 a
Mean^{NS}	0.775	0.792	0.776	

Choke Anan on Kaew rootstock, level of potassium was 0.799%

Stage 3: Inflorescence 3-4 cm long.

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.621	0.704	0.667	0.664 b
Choke Anan	0.762	0.731	0.685	0.726 a
Mean^{NS}	0.692	0.718	0.676	

Choke Anan on Kaew rootstock, level of potassium was 0.516%

Stage 4: Inflorescence 10-12 cm long.

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.512	0.531	0.619	0.554 b
Choke Anan	0.679	0.682	0.773	0.712 a
Mean^{NS}	0.596	0.607	0.696	

*Means within the same row or column with different superscript differ significantly, whereas the interaction value were not difference at 95% confidence by Duncan's Multiple Range Test (DMRT)
NS = non-significance

Choke Anan on Kaew rootstock, level of potassium was 0.530%

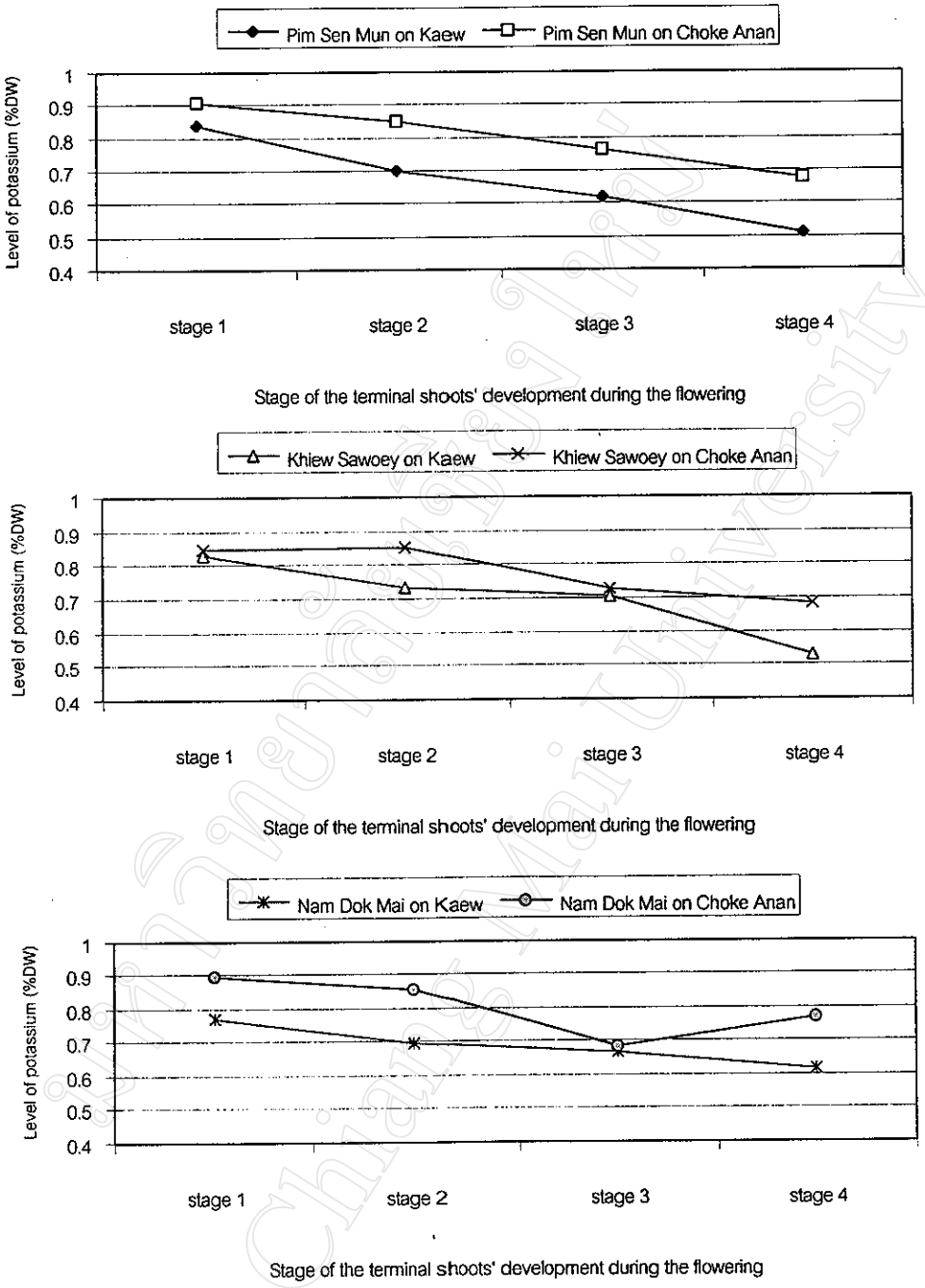

Figure 4.37 Effect of scion-rootstock combinations on changes in the level of potassium (% DW) of leaves during inflorescence development.

*Means of each pair of scion-rootstock combinations within the same stage with remark (*) differ significantly at 95% confidence by Duncan's Multiple Range Test (DMRT), detailed in Table 4.54.

9.11 Effect of scion-rootstock combinations on calcium of leaves.

Table 4.55 showed that there were non significant difference among all rootstocks, scions and their combinations. Figure 4.38 showed that the amount of calcium in Khiew Sawoey on Kaew and Khiew Sawoey on Choke Anan were increased from the 1st stage to the highest in the 2nd stage, then decreased in the 3rd stage, and to the lowest in the 4th stage. The levels in Nam Dok Mai on Choke Anan and Choke Anan on Kaew were increased in the 1st and the 2nd stages and decreased in the 3rd stage, then increased in the 4th stage. The levels in Nam Dok Mai on Choke Anan were increased in the 1st , the 2nd stage and decreased in the 3rd stage, then increased in the 4th stage. The levels in Nam Dok Mai on Kaew were increased in the 1st and the 2nd stages, to the highest in the 3rd stage, then decreased in the 4th stage. The level in Pim Sen Mun on Kaew were decreased in the 1st and the 2nd stages to the highest in the 3rd stage, then decreased in the 4th stage. While in Pim Sen Mun on Choke Anan, the levels were decreased in the 1st and the 2nd stages, then increased in the 3rd stage, to the highest in the 4th stage.

Table 4.55 Effects of mango rootstocks on the level of calcium (% DW) of the terminal shoots' development during the flowering.

Stage 1: Mature terminal shoots (ready to bud-break)

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.959	0.839	0.951	0.916
Choke Anan	1.008	0.997	1.149	1.051
Mean^{NS}	0.984	0.918	1.050	

Choke Anan on Kaew rootstock, level of calcium was 0.984%

Stage 2: Bud-break (bud emergence with whitish tip)

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.951	1.149	1.068	1.056
Choke Anan	0.989	1.182	1.206	1.126
Mean^{NS}	0.970	1.166	1.137	

Choke Anan on Kaew rootstock, level of calcium was 0.928%

Stage 3: Inflorescence 3-4 cm long.

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	1.081	0.993	1.101	1.058
Choke Anan	1.007	0.916	0.813	0.912
Mean^{NS}	1.044	0.955	0.957	

Choke Anan on Kaew rootstock, level of calcium was 0.879%

Stage 4: Inflorescence 10-12 cm long.

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.990	0.931	0.991	0.971
Choke Anan	1.022	0.826	1.049	0.966
Mean^{NS}	1.006	0.879	1.020	

*Means within the same row or column with different superscript differ significantly, where as the interaction value were not difference at 95% confidence by Duncan's Multiple Range Test (DMRT)
NS = non-significance

Choke Anan on Kaew rootstock, level of calcium was 1.069%

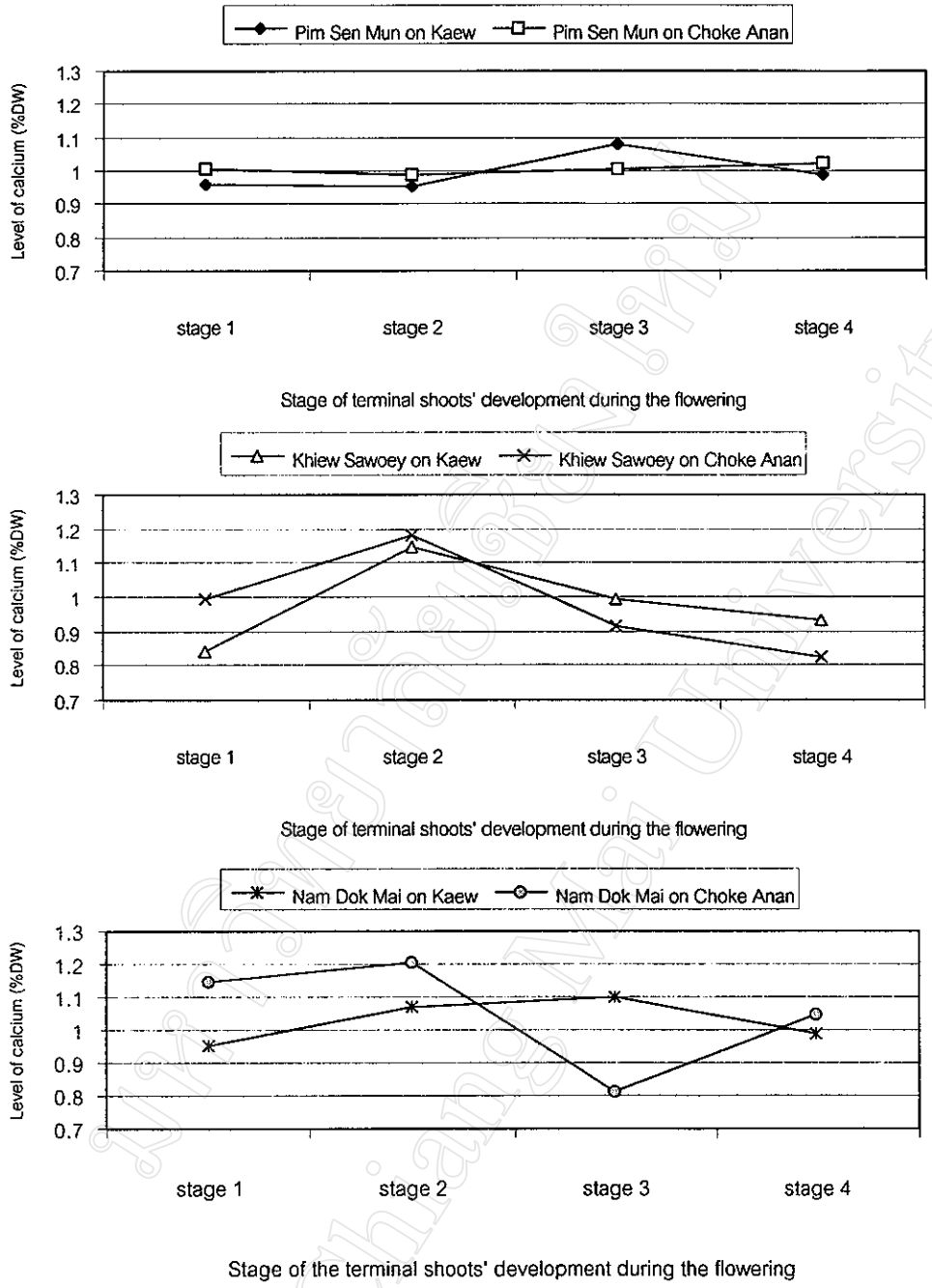

Figure 4.38 Effect of scion-rootstock combinations on the level of calcium (% dry weight) of leaves during inflorescence development

*Means of each pair of scion-rootstock combinations within the same stage with remark (*) differ significantly at 95% confidence by Duncan's Multiple Range Test (DMRT), detailed in Table 4.55.

9.12 Effect of scion-rootstock combinations on the level of magnesium

Table 4.56 Showed that there were non significant difference among all scions, rootstocks and their combinations. Figure 4.39 showed that Pim Sen Mun on Choke Anan and Choke Anan on Kaew had decreased the levels of magnesium in the 1st stage, to the lowest in the 2nd stage, then increased from the 3rd to the 4th stage. The levels in Pim Sen Mun on Kaew were decreased in the 1st and the 2nd stages, increased in the 3rd stage, then decreased to the lowest in the 4th stage. The levels in Khiew Sawoey on Kaew and Khiew Sawoey on Choke Anan were increased from the 1st stage to the 2nd stage and to the lowest in the 3rd stage, then decreased in the 4th stage. The level in Nam Dok Mai on Kaew were increased in the 1st and the 2nd stages, decreased in the 3rd stage then increased in the 4th stage, while the levels in Nam Dok Mai on Choke Anan were decreased from the 1st to the lowest in the 2nd stage, increased in the 3rd stage, then decreased again in the 4th stage.

Table 4.56 Effect of scion-rootstock combinations on the level of magnesium (%DW) of the terminal shoots' development during the flowering.

Stage 1: Mature terminal shoots (ready to bud-break)

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.141	0.128	0.133	0.134
Choke Anan	0.143	0.113	0.116	0.124
Mean^{NS}	0.142	0.121	0.125	

Choke Anan on Kaew rootstock, level of magnesium was 0.139%

Stage 2: Bud-break (bud emergence with whitish tip)

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.120	0.152	0.142	0.138
Choke Anan	0.130	0.142	0.105	0.126
Mean^{NS}	0.125	0.147	0.124	

Choke Anan on Kaew rootstock, level of magnesium was 0.112%

Stage 3: Inflorescence 3-4 cm long.

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.139	0.166	0.118	0.141
Choke Anan	0.122	0.154	0.140	0.139
Mean^{NS}	0.131	0.160	0.129	

Choke Anan on Kaew rootstock, level of magnesium was 0.120%

Stage 4: Inflorescence 10-12 cm long.

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.100	0.115	0.142	0.129
Choke Anan	0.147	0.124	0.128	0.133
Mean^{NS}	0.124	0.120	0.135	

*Means within the same row or column with different superscript differ significantly, whereas the interaction value were not difference at 95% confidence by Duncan's Multiple Range Test (DMRT)
NS = non-significance.

Choke Anan on Kaew rootstock, level of magnesium was 0.127%

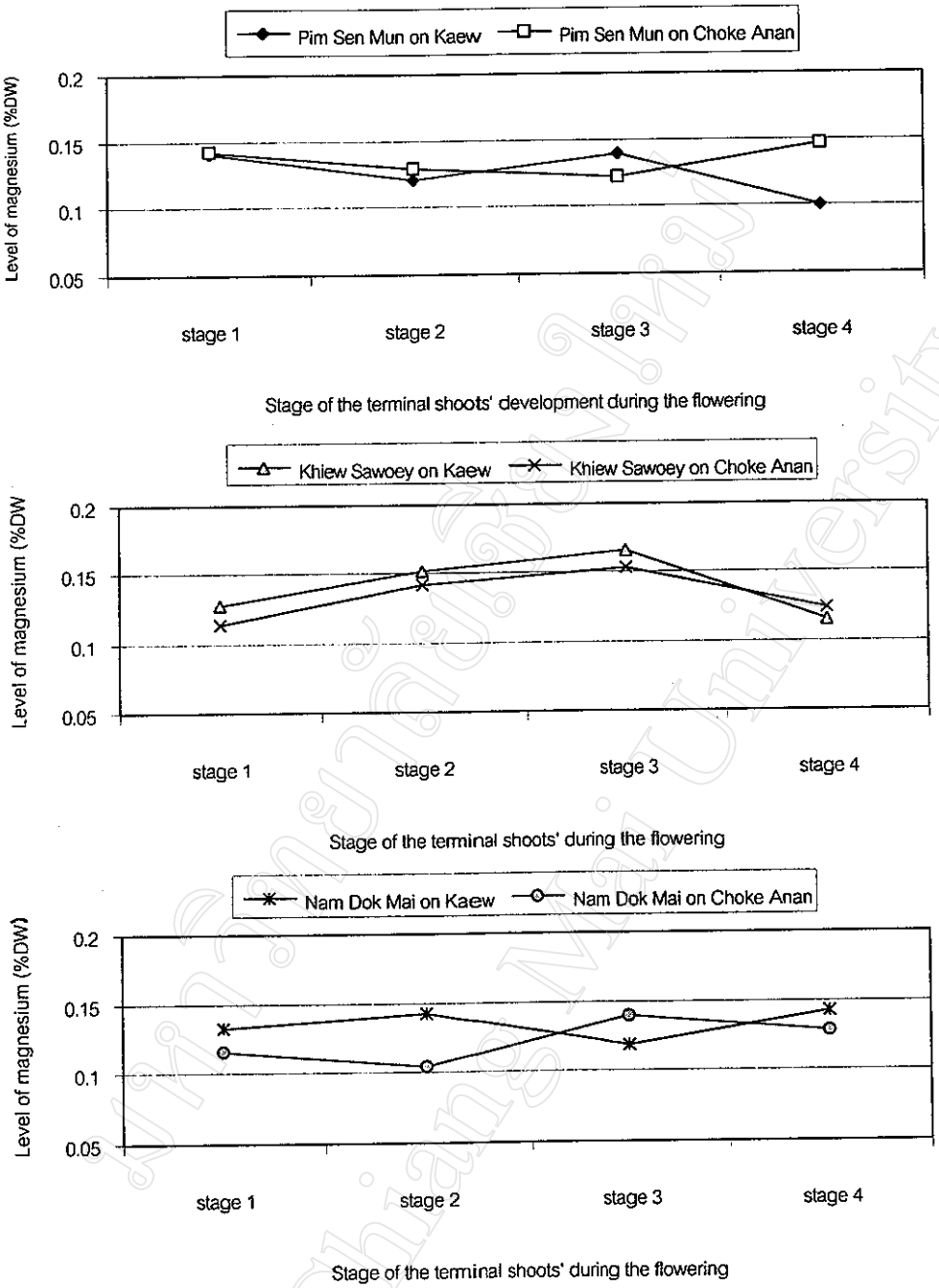

Figure 4.39 Effect of scion-rootstock combinations on the level of magnesium (% dry weight) of leaves during inflorescence development.

*Means of each pair of scion-rootstock combinations within the same stage with remark (*) differ significantly at 95% confidence by Duncan's Multiple Range Test (DMRT), detailed in table 4.56.

Table 4.57(a) and Figure 4.40 showed that among three scions, Khiew Sawoey had significantly higher average level of total nitrogen content of the leaves than Pim Sen Mun and Nam Dok Mai, respectively; but there were non significant difference between both rootstocks.

Table 4.57(b) and Figure 4.40 showed that Pim Sen Mun and Khiew Sawoey on Choke Anan had significantly higher the level of phosphorous than on Kaew, but there were non significant difference between Nam Dok Mai on both rootstocks.

Table 4.57(c)and Figure 4.40 showed that both rootstocks, Choke Anan had significantly higher the average level of potassium than Kaew but there were non significant difference among the scions.

Table 4.57 (d),(e) and Figure 4.40 showed that there were non significant difference among all scions, rootstocks and their combinations in the average level of calcium and magnesium.

Table 4.57 Effect of mango rootstocks on mineral content (%dry weight) for all four stages.

a) Nitrogen

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	1.049	1.199	1.021	1.090
Choke Anan	1.087	1.136	1.032	1.085
Mean*	1.068 b	1.168 a	1.027 c	

Choke Anan on Kaew rootstock, the level of nitrogen was 1.022%

b) Phosphorous

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.115 b	0.109 c	0.095 d	0.106 b
Choke Anan	0.121 a	0.116 b	0.096 d	0.111 a
Mean*	0.118 a	0.113 b	0.096 c	

Choke Anan on Kaew rootstock, the level of phosphorous was 0.112%

c) Potassium

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.668	0.699	0.688	0.685 b
Choke Anan	0.800	0.779	0.803	0.794 a
Mean^{NS}	0.734	0.739	0.746	

Choke Anan on Kaew rootstock, the level of potassium was 0.675%

d) Calcium

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.995	0.978	1.028	1.000
Choke Anan	1.006	0.980	1.054	1.013
Mean^{NS}	1.001	0.979	1.041	

Choke Anan on Kaew rootstock, the level of calcium was 0.965%

Table 4.57 (continued)

e) Magnesium

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	0.125	0.140	0.123	0.129
Choke Anan	0.136	0.133	0.122	0.130
Mean^{NS}	0.131	0.137	0.123	

*Means within the same row or column with different superscript and the interaction value with different superscript differ significantly at 95% confidence by Duncan's Multiple Range Test (DMRT)
NS = non-significance.

Choke Anan on Kaew rootstock, the level of magnesium was 0.125%

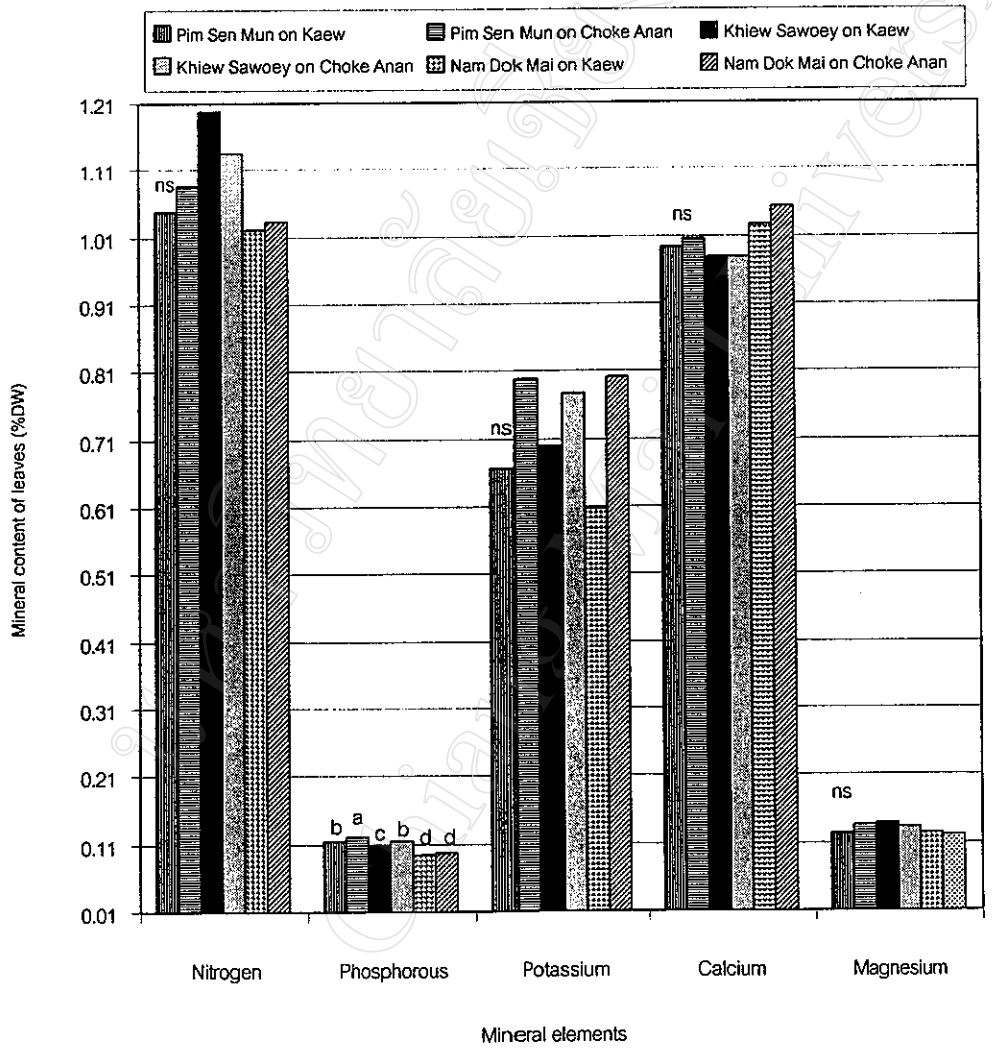

Figure 4.40 Effect of scion-rootstock combinations on the average mineral content of leaves (%dry weight) for all four stages.

10. Effect of rootstock and scion-rootstock combinations on endogenous hormone

10.1 Effect of rootstocks on cytokinins content in xylem exudate.

Both rootstocks, Choke Anan had significantly higher Z/ZR level in xylem exudate (8.67 ng/ml of xylem exudate) than Kaew (2.45 ng/ml of xylem exudate) (Table 4.58 and Figure 4.41). These should be observed that Choke Anan had Z/ZR level more than Kaew for 3.54 times.

Table 4.58 Effect of rootstocks on zeatin/zeatin riboside (Z/ZR) level in xylem exudate

Replications	Z/ZR level on xylem exudate (ng/ml of xylem exudate)	
	Rootstocks	
	Choke Anan	Kaew
1	10.40	2.80
2	6.20	2.40
3	8.67	2.10
4	9.40	2.50
Mean**	8.67 a	2.45 b

** significant difference at 99% confidence

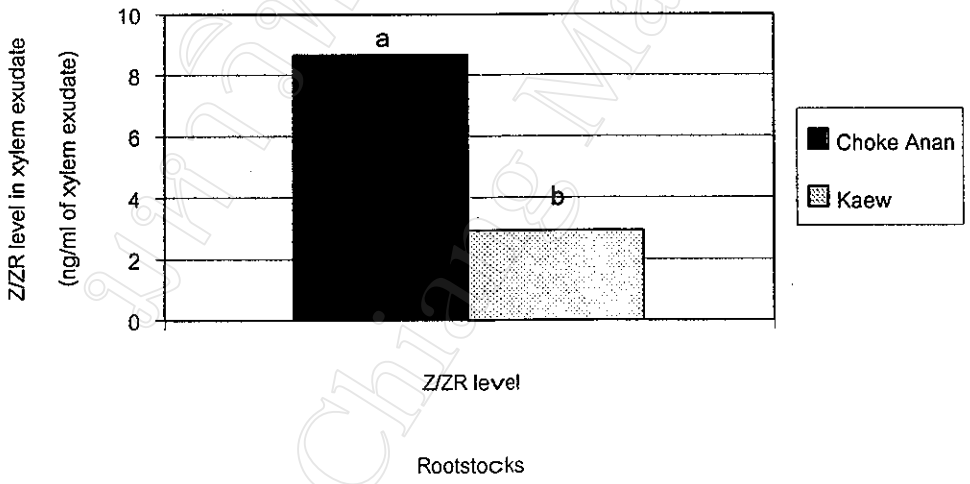

Figure 4.41 Effect of rootstocks on zeatin/zeatin riboside (Z/ZR) level (ng/ml) in xylem exudate.

Table 4.59 Effect of rootstocks on N^6-(δ^2-Isopentenyl) adenine/ N^6-(δ^2-Isopentenyl) adenosine (iP/iPA) level in xylem exudate comparing between Choke Anan and Kaew.

Replications	iP/iPA level on xylem exudate (ng/ml of xylem exudate)	
	Rootstocks	
	Choke Anan	Kaew
1	0.257	0.208
2	0.363	0.165
3	0.134	0.132
4	0.291	0.156
Mean^{NS}	0.261	0.165

NS = non significance at 95% confidence

Both rootstocks, Choke Anan had slightly higher iP/iPA level on xylem exudate (0.261 ng/ml of xylem exudate) than Kaew (0.165 ng/ml of xylem exudate) but there were non significant difference between them.(Table 4.59 and Figure 4.42).

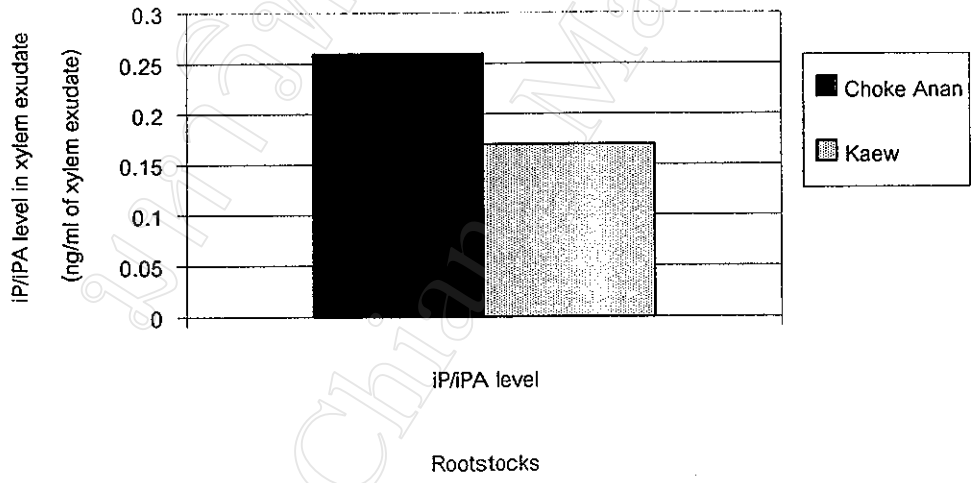

Figure 4.42 Effect of rootstocks on N^6-(δ^2-Isopentenyl) adenine/ N^6-(δ^2-Isopentenyl) adenosine (iP/iPA) level (ng/ml) in xylem exudate.

10.2 Effect of scion-rootstock combinations on Gibberellin-like substances of terminal shoots during flowering

Table 4.60 showed that in the 1st stage, Pim Sen Mun and Khiew Sawoey on Kaew had significantly higher the content of GA-like substances of terminal shoot than on Choke Anan, but there were non significant difference between Nam Dok Mai on both rootstocks. In the 2nd stage, Pim Sen Mun and Khiew Sawoey on Choke Anan had significantly higher the content than Kaew, whereas Nam Dok Mai on Kaew had significantly higher than on Choke Anan. In the 3rd stage, Pim Sen Mun and Khiew Sawoey on Choke Anan had significantly higher the content than on Kaew, but there were non significant difference between Nam Dok Mai on both rootstocks. In the 4th stage, Nam Dok Mai and Pim Sen Mun on Kaew had significantly higher the content than on Choke Anan, but there were non significant difference between Khiew Sawoey on both rootstocks.

Figure 4.43 showed that the content of GA-like substances of terminal shoots were low in the 1st stage and increased from 1st stage to the 4th stage, similar in all scion-rootstock combinations.

Table 4.60 Effect of scion-rootstock combinations on changes in the gibberellin-like substances (x 10^{-3} µg/g FW) of shoot during stages of inflorescence development.

Stage 1: Mature terminal shoots (ready to bud-break)

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	3.50 a	1.86 b	1.24 b	2.20 a
Choke Anan	1.46 b	0.45 c	1.17 b	1.03 b
Mean*	2.48 a	1.16 b	1.21 b	

Choke Anan on Kaew rootstock, the gibberellin-like substances was 0.42 x 10^{-3} µg/g FW.

Stage 2: Bud-break (bud emergence with whitish tip)

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	10.90 e	11.45 de	17.82 a	13.39
Choke Anan	12.07 cd	12.67 c	16.60 b	13.78
Mean*	11.49 b	12.06 b	17.21 a	

Choke Anan on Kaew rootstock, the gibberellin- like substances was 8.73 x 10^{-3} µg/g FW.

Stage 3: Inflorescence 3-4 cm long.

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	15.17 d	19.38 b	18.55 bc	17.70 b
Choke Anan	17.80 c	22.75 a	17.80 c	19.45 a
Mean*	16.49 c	21.06 a	18.17 b	

Choke Anan on Kaew rootstock, the gibberellin- like substances was 18.30 x 10^{-3} µg/g FW.

Stage 4: Inflorescence 10-12 cm long.

Rootstocks	Scions			Mean*
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	25.17 c	31.40 a	31.05 a	29.21 a
Choke Anan	27.72 b	32.07 a	25.03 c	28.27 b
Mean*	26.45 c	31.74 a	28.04 b	

*Means within the same row or column with different superscript and the interaction value with different differ significantly at 95% confidence by Duncan's Multiple Range Test (DMRT)
NS= non-significance.

Choke Anan on Kaew rootstock, the gibberellin- like substances was 25.90 x 10^{-3} µg/g FW.

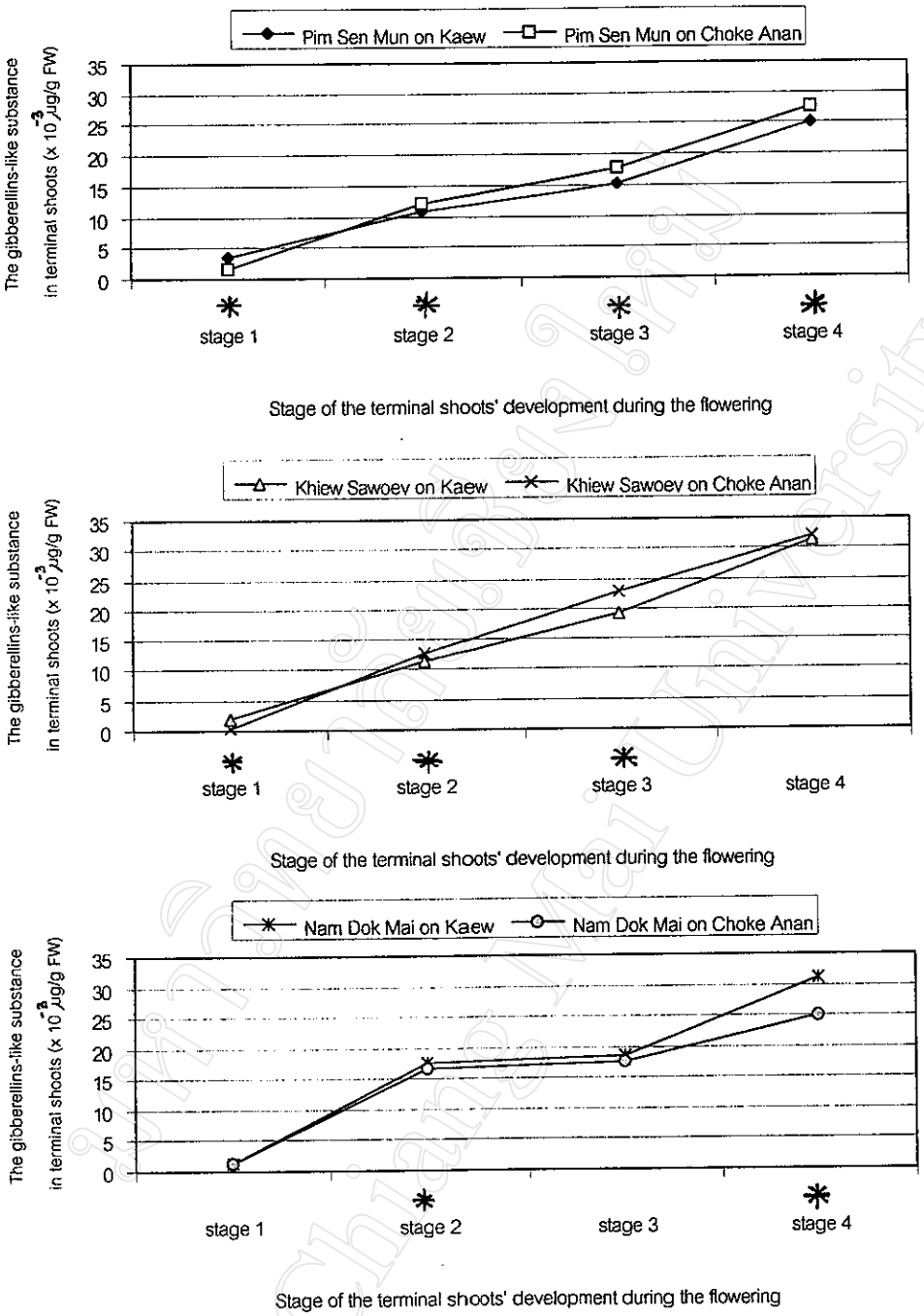

Figure 4.43 Effect of scion-rootstock combinations on the changes in the gibberellin-like substances of terminal shoot during inflorescence development

*Means of each pair of scion-rootstock combinations within the same stage with remark (*) differ significantly at 95% confidence by Duncan's Multiple Range Test (DMRT), detailed in Table 4.60.

Table 4.61 and Figure 4.44 showed that, Nam Dok Mai on Kaew and Khiew Sawoey on Choke Anan had significantly higher the average content of GA-like substances of terminal shoots than Khiew Sawoey on Kaew, Nam Dok Mai on Choke Anan, Pim Sen Mun on Choke Anan and Pim Sen Mun on Kaew, respectively.

Table 4.61 Effect of scion-rootstock combinations on changes in the average gibberellin- like substances (x 10^{-3} μg/g FW) of shoot during of inflorescence development

Rootstocks	Scions			Mean^{NS}
	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	
Kaew	13.69 e	16.02 b	17.17 a	15.63
Choke Anan	14.70 d	16.99 a	15.15 c	15.61
Mean*	14.19 c	16.50 a	16.15 b	

*Means within the same row or column with different superscript and the interaction value with different differ significantly at 95% confidence by Duncan's Multiple Range Test (DMRT)
NS = non-significance.

Choke Anan on Kaew rootstock, the average gibberellins-like substances of shoot was 13.34 x 10^{-3} μg/g FW.

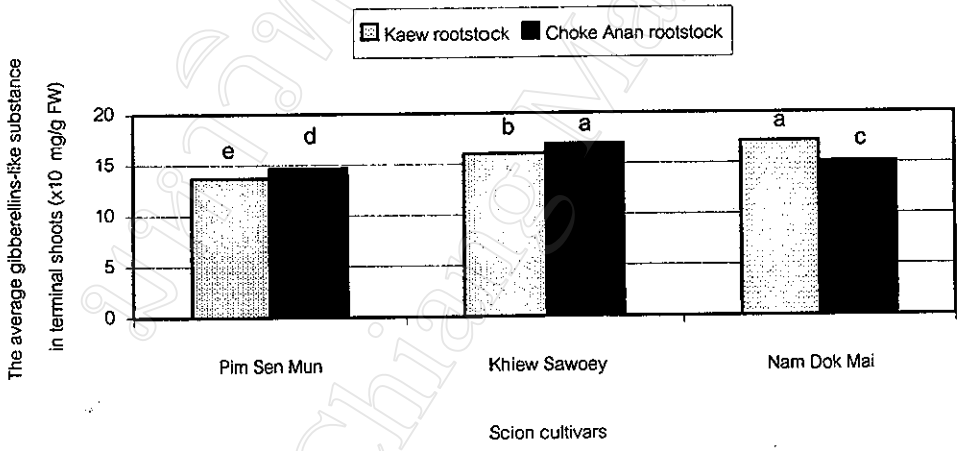

Figure 4.44 Effect of scion-rootstock combinations on changes in the average gibberellin-like substances (x 10^{-3} μg/g FW) of shoot during inflorescence development