

Chapter 6

Conclusion

The effects of everbearing mango rootstock (Choke Anan) and Kaew on 3 scion cultivars namely 'Pim Sen Mun', 'Khiew Sawoey' and 'Nam Dok Mai' were studied on the following parameters: vegetative growth and development, flowering, fruit-setting, fruit production, fruit quality, chlorophyll content, photosynthetic rate, stomatal behavior of leaves, changing in carbohydrate, mineral nutrients, gibberellin-like substances of terminal shoots during the 4 stages of inflorescence development (which corresponding to mature shoot stage, bud-break, inflorescence 3-4 cm long and the inflorescence 10-12 cm long) and cytokinins content in xylem exudate. This studied was conducted in the experimental plots at Department of Horticulture, Faculty of Agriculture, Chiang Mai University, in Chiang Mai during May 1998 to April 2000. The results of the study were summarized in Table 6.1 and as followed:

1. Nam Dok Mai and Khiew Sawoey on Choke Anan rootstock had higher percentage of flowering, total numbers of flowering, fruit weight, stomata width and the C/N ratio of leaves in the 3rd stage of inflorescence development than on Kaew rootstock. While Nam Dok Mai on Kaew had higher ratio of male to perfect flower, gibberellin-like substances in the 2nd and the 4th stages of inflorescence development and the average gibberellin-like substances in the terminal shoots, and the C/N ratio of terminal shoots in the 1st to the 3rd stage of inflorescence development than on Choke Anan but lower total soluble solids (TSS) in the fruits. Whereas Khiew Sawoey and Pim Sen Mun on Choke Anan had higher phosphorous level of leaves, the average gibberellin-like substances of terminal shoots and the width of new leaves than on Kaew but shorter new shoots length.

2. Choke Anan rootstock caused the scions to have higher net photosynthetic rate, stomatal density, the amount of total non-structural carbohydrate (TNC) of leaves in all 4 stages of inflorescence development, the potassium level of leaves of scions and the zeatin/zeatin riboside (Z/ZR) level in xylem exudate than on Kaew.

3. There were no effect of rootstocks on stem height, canopy width and stem diameter growth rate, percentage of shooting, total numbers of shooting, number of leaves per new shoot, percentage of fruit setting, number of fruits per tree, titratable acid (TA), amount of chlorophyll

a and b of leaves, dry weight of roots, stems, leaves and whole plants, amount of reducing sugar (RS) of leaves and terminal shoots, amount of TNC of terminal shoots, total nitrogen (TN), calcium, and magnesium level of leaves of scions and N⁶-(Δ²-Isopentenyl) adenine/N⁶-(Δ²-Isopentenyl) adenosine (iP/iPA) level in xylem exudate of the stocks

4. The result of the study on the stomatal behavior of scions by Silicone rubber impression technique showed that the stomata of Pim Sen Mun and Nam Dok Mai on Choke Anan opened widest at 9.30 a.m., while Pim Sen Mun on Kaew and Khiew Sawoey on Choke Anan opened widest at 10.30 a.m. Whereas Nam Dok Mai and Khiew Sawoey on Kaew open widest at 13.30 p.m. and 16.30 p.m., respectively. Stomata of all scions on the two rootstocks closed at 12.30 p.m. and opened wider at 13.30 p.m., then closed again at 18.30 p.m. Another method of measuring stomata behavior was by using mixed solvents in the Infiltration Technique. Leaves of the scions on Kaew rootstock required more time for the solvents to penetrate than those on Choke Anan which indicated a smaller stomatal opening and lower density.

5. The amounts of TNC, RS and potassium of the leaves were decreased from the 1st stage to the 4th stage. The amount of TNC of the terminal shoots were low in the 1st stage, increased in the 2nd stage and constant in the 3rd and 4th stages, while the RS of the terminal shoots were increased from the 1st stage to the 4th stage. The amount of TN of leaves and 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. The C/N ratio of leaves and terminal shoots were increased from the 1st stage to the highest in the 2nd stage, then decreased in the 3rd to the 4th stage. While the content of GA-like substances of the terminal shoots of all scion-rootstock combinations were increased from the 1st to the 4th stage.

6. The impact of severe climatic variability of 'El Niño' (from June to September 1998) and 'La Niña' condition (from June to September 1999) showed that, the rate of height, canopy width, stem diameter and percentage of new shoots of all scion-rootstock combinations were definitely higher during 'El Niño' than 'La Niña' condition. During 'El Niño' condition, almost all scion-rootstock combinations had off-season flowering from May to November 1998; especially, Nam Dok Mai on Choke Anan which had the highest percentage of flowering. Only Khiew Sawoey on Kaew had no off-season flowering. Whereas during 'La Niña' condition, there were no off-season flowering in all scion-rootstock combinations.

It was concluded that, the everbearing mango rootstock 'Choke Anan' had significantly influenced on physiological properties and flowering of the scions; especially, on improving off-season flowering during 'El Niño' condition, the normal season flowering and the fruit-quality of 'Nam Dok Mai' and 'Khiew Sawoey' scions.

Table 6.1 Effect of everbearing mango rootstock on growth and development, physiology and flowering of scions

Parameters	Rootstocks		Scions		Interaction (scions-rootstocks)				CV (%)
	Kaew	Choke Anan	Pim Sen Mun	Khiew Sawoey	Nam Dok Mai	Pim Sen Mun/ Choke Anan	Khiew Sawoey/Kaew	Nam Dok Mai /Kaew Choke Anan	
1. Growth rate									48.64
1.1. stem height	ns	ns	b	a	c	ns	ns	ns	ns
1.2. canopy width	ns	ns	ab	a	b	ns	ns	ns	36.53
1.3. stem diameter	ns	ns	ab	a	b	ns	ns	ns	18.46
2. Shooting									29.89
2.1. percentage of shooting	ns	ns	a	a	b	ns	ns	ns	29.89
2.2. numbers of shooting	ns	ns	a	a	b	ns	ns	ns	7.90
2.3. numbers of leaves per new shoot	ns	ns	a	a	b	ns	ns	ns	7.93
2.4. length of new shoots	a	b	b	a	c	c	d	a	4.27
2.5. diameter of new shoots	a	b	b	a	a	ns	ns	ns	9.68
2.6. length of new leaves	b	a	b	b	ns	ns	ns	ns	8.47
2.7. width of new leaves	b	a	ns	ns	cd	a	d	ab	hcd
3. Flowering and fruit-setting									22.67
3.1. percentage of flowering	b	a	b	b	a	c	bc	d	22.67
3.2. number of flowering	b	a	b	b	a	c	bc	d	a
3.3. ratio of male to perfect flower									
3.3.1. off-season	ns	ns	a	-	b	a	a	-	10.57
3.3.2. normal season	a	b	a	b	c	a	a	b	6.92
3.4. Fruit setting									
3.4.1. fruit size of match's head									
3.4.1.1. off-season	ns	ns	ns	ns	-	ns	ns	-	ns
3.4.1.2. normal season	ns	ns	ns	ns	ns	ns	ns	ns	ns
3.4.2. fruit size of 1.5 cm									
3.4.2.1. off-season	ns	ns	ns	ns	ns	ns	ns	-	ns
3.4.2.2. normal season	ns	ns	ns	ns	ns	ns	ns	ns	ns
3.4.3. average number of fruit per tree									
3.4.3.1. off-season	ns	ns	b	c	a	ns	ns	ns	59.92
3.4.3.2. normal season	ns	ns	b	b	a	ns	ns	ns	62.02

Table 6.1 (continued)

Table 6.1 (continued)

Parameters	Rootstocks				Scions				Interaction (scions-rootstocks)				CV (%)
	Kaew Choke Anan	Choke Anan	Pim Sen Mun	Khiew Sawoeys	Nam Dok Mai	Pim Sen Mun/ Choke Anan	Khiew Sawoeys/Kaew	Nam Dok Mai / Kaew Choke Anan					
9.3. TNC content of terminal shoots													
stage 1	ns	ns	c	b	a	ns	ns	ns	ns	ns	ns	ns	2.21
stage 2	ns	ns	b	b	a	ns	ns	ns	ns	ns	ns	ns	3.18
stage 3	ns	ns	b	b	a	ns	ns	ns	ns	ns	ns	ns	3.68
stage 4	ns	ns	b	b	a	ns	ns	ns	ns	ns	ns	ns	4.23
9.4. RS content of terminal shoots													
stage 1	ns	ns	b	ab	a	ns	ns	ns	ns	ns	ns	ns	9.83
stage 2	ns	ns	b	ab	a	ns	ns	ns	ns	ns	ns	ns	11.17
stage 3	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	13.52
stage 4	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	13.74
9.5. TN content of leaves													
stage 1	ns	b	a	c	b	b	a	a	d	d	c	c	1.30
stage 2	b	a	b	a	c	d	c	b	f	e	e	1.04	
stage 3	ns	ns	b	a	c	c	c	b	d	e	e	0.86	
stage 4	a	b	b	a	c	c	c	b	e	d	d	0.90	
9.6. TN content of terminal shoots													
stage 1	ns	ns	b	a	c	c	c	a	b	e	d	d	2.16
stage 2	b	a	b	a	c	c	b	a	a	e	d	d	2.45
stage 3	b	a	b	a	c	c	b	a	b	d	d	d	2.46
stage 4	ns	ns	b	a	c	b	b	a	b	d	c	c	2.55
9.7. C/N ratio of leaves													
stage 1	ns	ns	b	b	a	ns	ns	ns	ns	ns	ns	ns	3.44
stage 2	ns	ns	b	b	a	b	bc	c	b	a	a	a	2.43
stage 3	b	a	b	c	a	b	c	d	c	b	a	a	3.38
stage 4	ns	ns	b	c	a	ns	ns	ns	ns	ns	ns	ns	3.28
9.8. C/N ratio of terminal shoots													
stage 1	ns	ns	b	c	a	c	c	d	c	a	b	b	3.03
stage 2	ns	ns	b	c	a	d	d	d	d	a	b	b	4.52
stage 3	ns	ns	b	b	a	bc	c	bc	c	a	b	b	4.19
stage 4	ns	ns	b	b	a	b	b	b	b	a	a	a	5.26

Table 6.1 (continued)

Parameters	Interaction (scions-rootstocks)										CV (%)	
	Rootstocks		Scions									
	Kaew	Choke Anan	Pim Sen Mum	Khiew Sawoey	Nam Dok Mai	Pim Sen Mun/ Kaew	Pim Sen Mun/ Choke Anan	Khiew Sawoey/ Kaew	Nam Dok Mai / Kaew	Choke Anan		
9.9. Level of nitrogen of leaves	ns	ns	b	a	c	ns	ns	ns	ns	ns	9.53	
9.10. Level of phosphorous of leaves	b	a	a	b	c	b	a	c	b	d	2.02	
9.11. Level of potassium of leaves	b	a	ns	ns	ns	ns	ns	ns	ns	ns	4.43	
9.12. Level of calcium of leaves	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	14.85	
9.13. Level of magnesium of leaves	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	11.82	
10. Endogenous hormone												
10.1. GA-like substances in terminal shoots	a	b	a	b	b	a	b	b	c	b	29.41	
stage 1	ns	ns	b	b	a	c	cd	c	a	b	4.08	
stage 2	b	a	c	a	b	d	c	b	a	bc	4.40	
stage 3	a	b	c	a	b	c	b	a	a	c	3.71	
stage 4	ns	ns	c	a	b	e	d	b	a	c	1.84	
average												
10.2. cytokinin content in xylem exudate												
10.2.1 Z/ZR level	b	a	-	-	-	-	-	-	-	-	-	
10.2.2 IP/PA level	ns	ns	-	-	-	-	-	-	-	-	-	

Mean with in the same row in the same subtitle with different letter differ significantly at 95% confidence by Duncan's Multiple Range Test (DMRT)

ns = non-significance at 95% confidence

Stages of the terminal shoots' development during the flowering

when; stage 1 = Mature terminal shoots (ready to bud-break)

stage 2 = Bud-break (bud emergence with whitish tip)

stage 3 = Inflorescence 3-4 cm long.

stage 4 = Inflorescence 10-12 cm long.