

MANGO EXPANDING YEAR-ROUND PRODUCTION TOWARD GAP IN CAO LANH DISTRICT, DONG THAP PROVINCE

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ABSTRACT

*This study was conducted to establish mango expansion to year-round production toward GAP in Cao Lanh district, Dong Thap province. A survey of flowering technique was carried out by directly interviewing 110 growers whose mango growing area was larger than 2,000 square meters from March to June/2007. Demonstrations of flowering in early-season and late-season of “cat Hoa Loc” mango and “cat Chu” mango were established at My Xuong village with an area of 0.5 hectare per demonstration. Nitrate residue in fruit flesh was analyzed by Spectrophotometer at λ 450 nm; pesticide residue was estimated by High Pressure Liquid Chromatography (HPLC) at the Advanced laboratory at Can Tho university. The results showed that Anthracnose and Bacterial Black Spot are the two most serious diseases in the rainy season, while thrips, fruit borer and *Idioscopus* spp. are detrimental insects in the dry season. Growers applied pesticide 11.7 ± 2.7 and 14.1 ± 2.9 times in case of with or without using bags to wrap young fruit, respectively. 35% of growers used the Taiwanese bag for fruit wrapping at 45 days after fruit setting. Yield of late-season is higher than that of early-season by 1.8-2 fold. Fruit wrapping at 40 days after fruit setting could help reduce damage of bacteria fruit gumming, and 3 pesticide sprays in the fruit development stage. Allowed pesticide application and stopping using pesticides 30 days prior to harvesting helped achieve no detectable pesticide residue in fruit flesh. Fruit wrapping should be applied in rainy season.*

Keywords: Nitrate, residue, year-round, GAP, “cat Hoa Loc” mango, “cat Chu” mango

1 INTRODUCTION

“High yield, low price” is the proverb lasting long in mind of fruit growers. Due climate effects, fruits flood the market in the in-season, thus its price is very low, in other words, the higher the fruit yield and the lower the price. On the other hand, price is very high in off-seasons because of lack of product. In Thailand the price of off-season mango is 2-3 fold that of in-season mango (Tongumpai et al., 1991). Consequently, methods for off-season production or expanding year-round production not only brings higher income for growers but also provides significant amounts of fruits for social demand. In mango, the protocols for manipulating flowering (Tran Van Hau, 2005; Vo The Truyen and Nguyen Thanh Hieu, 2003), fruit set and fruit retention techniques (bui phuong mai, 2003; le thi trung, 2003; Tran Thi Kim Ba, 2007) have been qualified and recommended to fruit growers. However, how these protocols and techniques are applied efficiently in particular production seasons, especially to achieve safe products adapting gap standard, is a pressing demand prior to progress to producing fruit that can meet standards of Europe (Eurepgap), Asean (ASEANGAP), or the World (GLOBALGAP). Within this context, the study was conducted

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in order to build up a protocol for the year-round production of mango toward GAP in Cao Lanh district, Dong Thap province.

2 MATERIALS AND METHODS

The survey of year-round flowering technique for mango in Cao Lanh district, Dong Thap province was carried out by a direct interview approach with pre-composed questionnaires from March to June, 2007. The interviewees were growers possessing more than 2,000 square meter area of mango in five villages in the largest mango areas, i.e. My Hoi, My Tho, Binh Hang Tay, Binh Hang Trung and My Xuong. The total interviewed growers was 110. Demonstrations for mango year-round production were implemented on “cat Hoa Loc” mango (*Mangifera indica* L. var. Hoa Loc) at age of 6-8 years and “Cat Chu” mango (*Mangifera indica* L. var. Chu) grown for 6 years in a grower’s orchard in My Xuong village from February/ 2007 to March/ 2008. Flowering and cultivation protocols of Tran Van Hau (2005) were utilized. Demonstration plots were 0.5 ha (equal to 80–130 mango trees). After harvesting, mango trees were pruned and treated with Paclobutrazol (PBZ) (1 g a.i./m canopy diameter) by collar drench when new leaves reached 15 days. For flowering induction, Thiourea at a concentration of 0.5% was applied by foliar spray when leaves of Hoa Loc cultivar were at the 90th day since PBZ application, and the 60th day in the case of Chu cultivar. Fruit wrapping was applied 40 days after fruit set using Taiwanese bags. Fruit samples used for nitrate and pesticide residue analyses were peeled; only flesh was analysed. Nitrate residue analysis was done by Spectrophotometer at λ 450 nm; and pesticide residue was demonstrated by High Pressure Liquid Chromatography (HPLC) approach in the Advanced laboratory, Can Tho university.

3 RESULT AND DISCUSSION

3.1 Survey

3.1.1 Flowering protocol

Growers in Cao Lanh district, Dong Thap province mainly stimulate flowering by chemicals. They induce flower initiation by paclobutrazol (PBZ) at 1.5 – 2.0 g a.i./m canopy diameter when leaves reach to 15 – 20 days, and induce flowering by Thiourea 0.3 - 0.5% at 45 – 60 day after applying PBZ (Table 1). Although there are some differences, this protocol is quite similar to the one recommended by Tran Van Hau (2005). The reason for this similarity may be because Cao Lanh is not only the main mango growing zone of Dong Thap but it is also an important mango zone of the Mekong delta; thus receiving many training programs on cultural techniques, pest management from regional institutes, universities and local extension service.

Table 1: Flowering protocol practiced by growers in Cao Lanh district, dong Thap province.

Flowering treatment	(%) survey orchard
Flowering initiation treatment: PBZ	95.5
• Concentration	
✓ 1 g a.i./m	2.7
✓ 1,5-2 g a.i./m	81.8
✓ 2,5-3 g a.i./m	12.7
• PBZ application period	
15-20 day after leaf flushing	100
Flowering induction treatment	
1. Thiourea	80.9
• Concentration: 0.3-0.5 (%)	70
• Period of Thiourea spraying since PBZ application	
✓ 30 day	11.8
✓ 45 day	32.7
✓ 60 day	42.7
✓ 70-75 day	10.0
2. Potassium nitrate + Thiourea	16.4
• Potassium nitrate concentration	
✓ 0.6-1 (%)	18.2
✓ >2 (%)	9.1

n = 110

3.1.2 Period of flowering treatment

In the weather conditions of Mekong delta, mango flowers naturally in January –February. due to cool and dry climate (Tran Van Hau, 1997, 2005). Recently, with flowering treatments, growers usually practice two flowering periods per year and flowering practices could be divided to three primary periods, i.e. in-season (Jan-Feb), late-season (May–June), off-season (July-September) and early-season (Nov–Dec) (Figure. 1). In-season flowering treatment is not applied frequently because of low price; while in the off–season mango price is higher, but rains and low flowering rate and high expenditures for pesticide are reasons of lower practice rate in comparison with early and late–season.

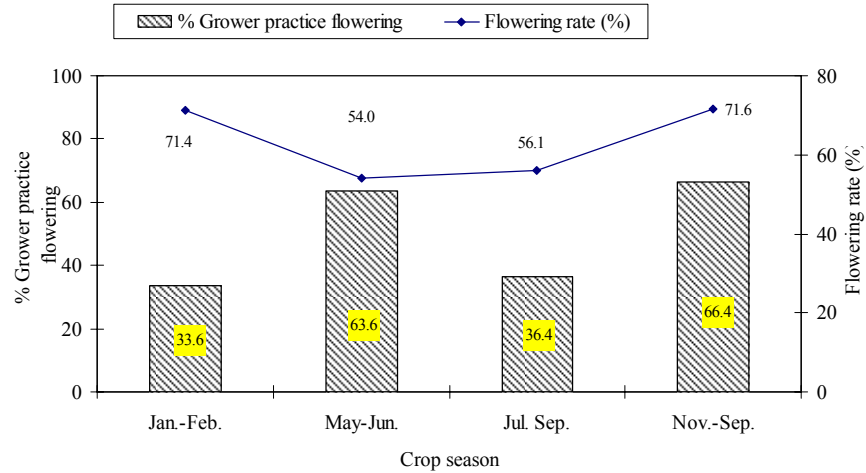


Figure 1: Rate of grower practicing flowering treatment vs. flowering rate in different period/season at Cao Lanh district, Dong Thap province

3.1.3 Yield

Average yield in dry season is about 70 kg/tree (Fig. 2). The fluctuation in average yield is great and depends efficiency of flowering technique and pest management. There could be complete loss or unsold fruits due to bacterial black spot.

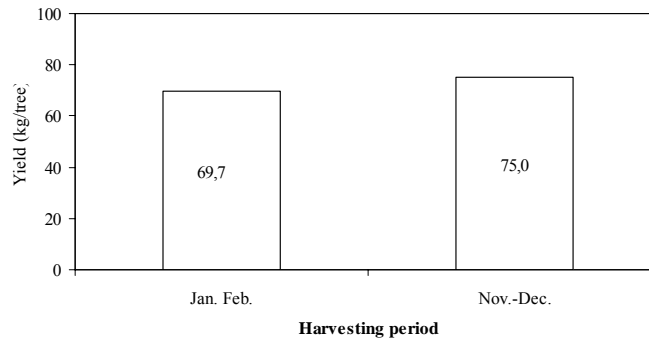


Figure 2: Mango yield (kg/tree) of two surveyed early-season in Cao Lanh dist., Dong Thap province

3.1.4 Insect pest and pesticide

There are many kinds of insect pests in mango orchards in Cao Lanh dist.; among them, thrips (*Thrips sp.*) and fruit borer (*Deanolis albizonalis*) cause highest damage to mango orchards (Figure. 3). Besides, insects usually cause higher damage in the dry season. In order to prevent insect from attacking, most growers are using insecticides that are allowed. Insecticides belonging to Cypermethrin group are the most favorite (40.9%) because it is less toxic and they have a short time in existence in the environment in comparison to other groups. Modern insecticide ingredient, abamectin, is also utilized by growers (Figure. 4)

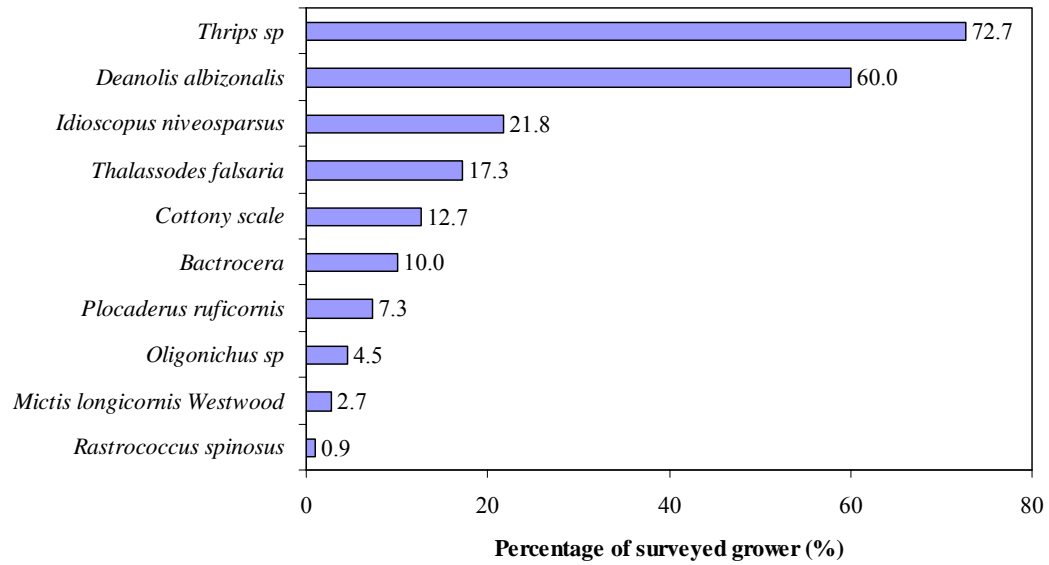


Figure 3: Percentage (%) of damaged orchards vs. insect pest species in Cao Lanh dist, DongThap province.

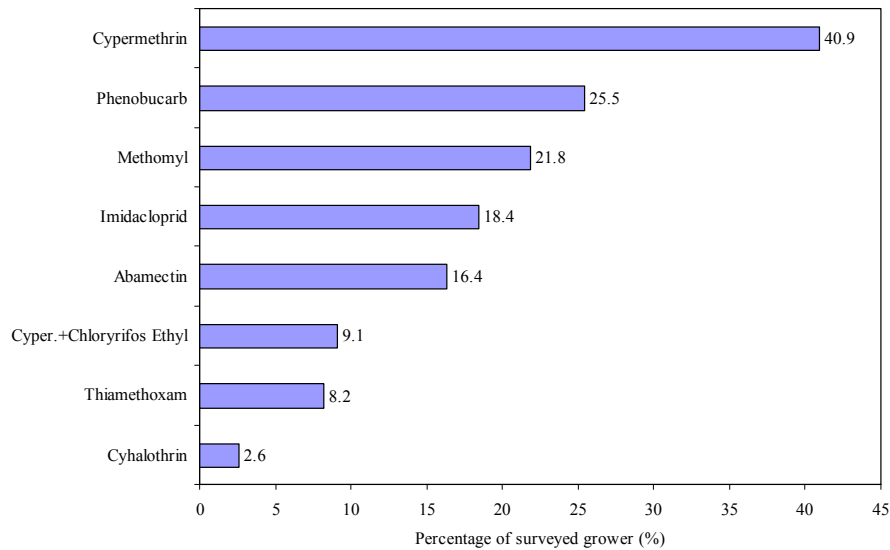


Figure 4: Percentage (%) of mango growers vs. utilized insecticide ingredients in Cao Lanh dist., Dong Thap province

3.1.5 Diseases and fungicides

Anthracnose (*Colletotrichum gloeosporioides*) is the most serious disease in mango, especially in rainy season (85.5%). Bacterial black spot (*Xanthomonas campestris pv. Mangifera*) is at lower damage level (Figure. 5). Mango disease always breaks out in rainy season, especially during showery periods and typhoons. Anthracnose is an important disease because this fungus can attack in nearly all growing phases of mango, i.e. shoot flushing, flowering, fruit development and post harvest. This results in a range of fungicides utilized for mango, primarily Probineb (75.5%), Mancozeb (50.9%), Difenconazole + Propiconazole (44.5%), Carbendazim (20.9%) (Figure. 6). Azoxystrobin is only used to protect mango in

the bloom stage because of its high price. In short, anthracnose is a very serious disease which may cause complete loss in rainy season; therefore, growers are using many kinds of fungicide routinely for prevention its out break. Bacterial black spot is also a disease causing high damage rates equal to anthracnose, but there are no effective pesticides to treat it.

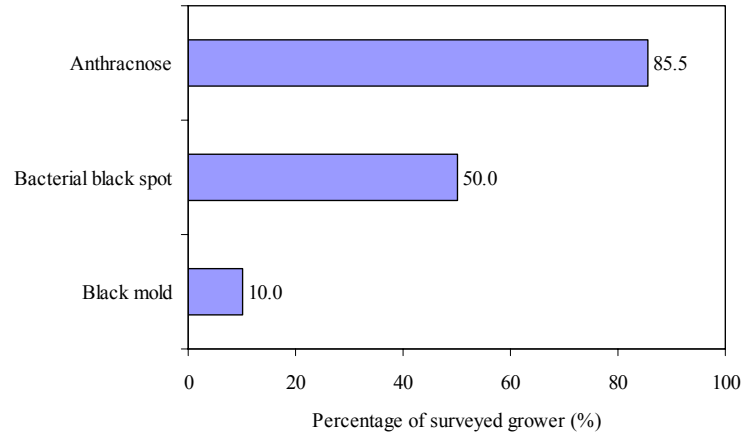


Figure 5: Percentage (%) of surveyed orchards damaged by diseases in mango in Cao Lanh dist., Dong Thap province

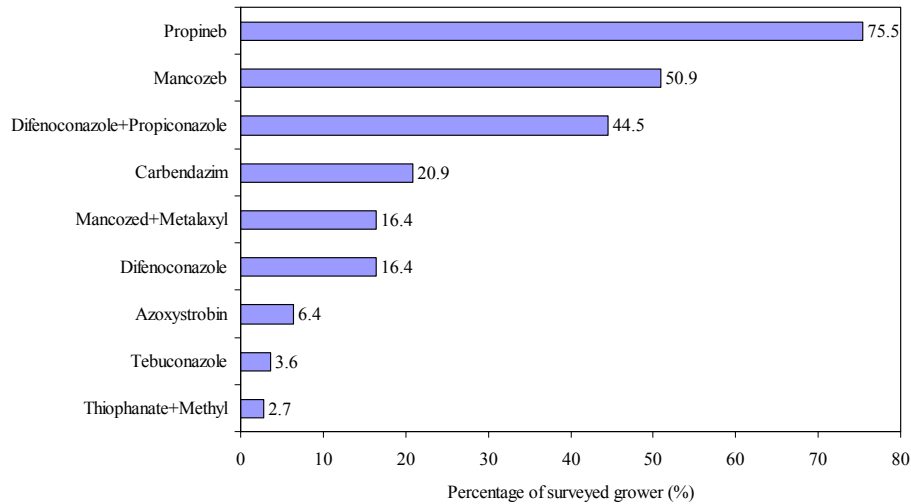


Figure 6: Percentage (%) of surveyed orchards vs. utilized fungicides utilized on mango in Cao Lanh dist., Dong Thap province

3.1.6 Fruit wrapping approach

35.5% growers use fruit wrapping techniques to protect mango from fruit bacteria gumming. Although the expense for bags and labor is quite high, growers still take interest and apply fruit wrapping to lessen damage, especially in the rainy season. The most favorite kind of bag is Taiwanese, one fruit in one bag. According to experience of growers, bags can be reused for 2-3 years with care and utilization of germ removing reagents after harvesting. Fruit covering period starts at 15 – 60 day after fruit setting. Frequently, it is started at the 45th day after fruit set because, at this period, physiological immature fruit drops have already finished, thus fruit number is more stable than at the early stages when abscission still occurs.

(Table 2). Besides reducing damage of bacterial black spot, fruit covering bags also help fruits achieve bright green skin due to protective effects from physical damages (Figure 7). In addition, fruit wrapping approach reduces the number of fungicide spraying by 3 times, during fruit development stage (Figure. 8).

Table 2: Types of bag and wrapping period of growers in Cao Lanh dist., Dong Thap province

1. Fruit covering	(%) surveyed orchard
– Practice	35.5
– Not practice	65.5
2. Bag type	
• Taiwanese	82.1
• Mai Xuan	10.2
• oilpaper	7.7
3. wrapping period after fruit setting	
• 15-20 day	17.9
• 30 day	12.8
• 45 day	59.0
• 60 day	10.3

n= 110



Hình 7 Effect of wrapping on skin color and physical damage of “cat Hoa Loc” mango fruit.
a) Without wrapping; with wrapping.

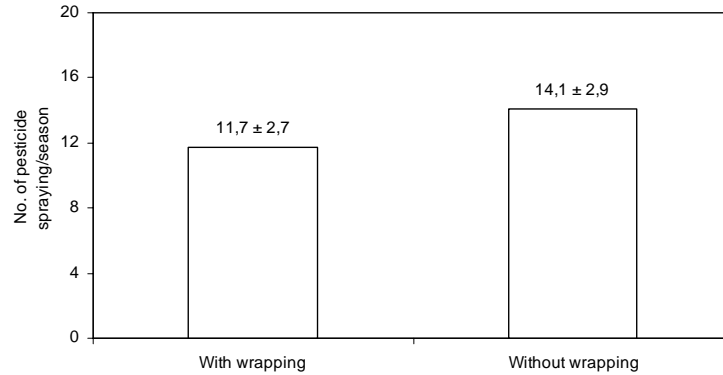


Figure 8: Number of pesticide application (time/season) in orchards applied/not applied bag covering in Cao Lanh dist., Dong Thap province

3.2 Cat Hoa Loc and Cat Chu cultivar demonstration

3.2.1 Flowering rate and yield

Demonstration results of Hoa Loc and Chu cultivar in early and late-season showed that flowering rate of Hoa Loc cultivar is equivalent to Chu in the early season and high in both seasons, while flowering rate of Chu cultivar is lower in the late season. However, this may be because late-season occurs in the dry more favored climate with less disease damage. The yield in the late season is always higher than in the early season for both cultivars - Hoa Loc and Chu (Table 3)

Table 3: Flowering rate, yield and yield components of Hoa Loc and Chu cultivar in early and late-season in Cao Lanh dist., Dong Thap province

Flowering and yield	Early-season (Sept./2007-Feb./2008)		Late season (Feb.-Aug./2007)	
	Cat Hoa Loc	Cat Chu	Cat Hoa Loc	Cat Chu
Flowering rate (%) (± sd)	83,6 ± 16,4	78,9 ± 13,2	76,9 ± 10,5	57,9 ± 10,8
No. of fruit/tree (No. ± sd)	52 ± 9,1	91 ± 10,8	90 ± 7,9	239 ± 44,17
Average weight of 1 fruit (g ± sd)	460 ± 32,7	390 ± 46,3	440,6 ± 61	300 ± 36,5
yield (kg/tree ± sd)	23,7 ± 7,3	35,5 ± 18,3	42,5 ± 6,8	71,6 ± 15,4

3.2.2 Number of pesticide applications

To guarantee safety of fruit, there is a need to apply some pest protective approaches in accordance with growing stage and to apply fruit wrapping at 40 days after fruit setting and stop using pesticide 30 days prior harvest. The results showed that the number of pesticide sprays was 11 with fruit wrapping and 13-14 times without the use of wrapping young fruit. (Table 4). Number of sprays in the rainy season is more than in the dry season and sprays are used mainly from fruit setting to harvest. Earlier fruit wrapping application could help reduce number of pesticide spraying; but the expense for bag and labor is higher.

Table 4: Number of pesticide spraying in early and late-season in conditions of applying and not applying fruit covering in Cao Lanh dist., Dong Thap province

Spraying periods	Early season (Sep./2007- Feb./2008)		Late season (Feb.-Aug./2007)	
	Wrapping	Not Wrapping	Wrapping	Not Wrapping
Shooting	1	1	2	2
Flowering and fruit set induction	5	5	5	5
Fruit development	5	8	4	6
Total	11	14	11	13

Note: Fruit covering is practiced at 40 day after fruit setting.

3.2.3 Plant protection

Pest damage in the two seasons is very different due to variation in climatic conditions. In the early-season, flowering occurs at the end of rainy period and fruit develops in dry conditions. Therefore, anthracnose causes damage primarily at the flowering stage, while fruit development is attacked by insects, especially thrips, *Idioscopus* spp., and fruit borer. Consequently, the number of routine fungicide sprays to treat anthracnose (Dithane, Folicur, Antracol, Bavistin) is from 4 to 7 times, plus 3 – 6 times for insecticide spraying (Table 5a). In the late-season, flowering and fruit setting occurs in a dry climate and only fruit maturing occurs during the rainy season. Because of this the number of pesticide sprays is less than in the early season. Insecticide was used 3 – 4 times plus 2 – 4 times use of anthracnose fungicide (Antracol, Glory, Tilt Super) (Table 5b)

Table 5a: Percentage of pesticide spraying time in early season in Cao Lanh dist., Dong Thap province

Trade name	Ingredient	No. of spraying %/ season	No. of spraying /season
1. Insecticide			
Regent	Fipronil	18.2	2
Abatimec, Abakill, Vibamec	Abamectin	27.3	3
Cyrux	Cypermethrin	45.5	5
Lannate	Methomyl	54.5	6
2. Fungicide			
Amista	Azoxystrobin	7.1	1
Tilt Super	Difenoconazole	14.3	2
Bavistin, Arin, Glory	Carbendazin	28.6	4
Antracol	Propineb	35.7	5
Folicur	Tebuconazole	35.7	5
Dithane	Mancozeb	50.0	7

Total No. of spraying in season: with fruit covering: 11 times ; without fruit covering : 13 times

Table 5b: percentage of pesticide spraying time in late season in Cao Lanh dist., Dong Thap province

Tradename	Ingredient	No. of spraying %/season	No. of spraying /season
1. Insecticide			
Abatimec	Abamectin	36.4	4
Cyrux, Sec Saigon	Cypermethrin	36.4	4
Bassa	Fenobucarb	27.3	3
Admire	Imidacloprid	9.1	1
Lannate	Methomyl	9.1	1
2. Fungicide			
Antracol	Propineb	30.8	4
Carbendazim, Glory	Carbendazin	23.1	3
Amista	Azoxystrobin	15.4	2
Tilt Super	Difenoconazole	15.4	2
Dithane	Mancozed	15.4	2
Super Mastercop	Copper sulfate, Pentahydrate	7.7	1

Total No. of spraying in season: with fruit covering: 11 times ; without fruit covering : 13 times

3.2.4 Efficiency of fruit wrapping on Bacterial black spot and pesticide residue

Gumming rate of fruit without wrapping in the early – season was higher than for late – season (8 – 10% and 5 – 6%, respectively), contrary to rate of infectious spot (Figure 9). Fruit wrapping can help reduce the rate of fruit damage in both cultivars in both seasons. Nitrate concentration in fruit flesh of late – season was lower than that of early season, but these are all lower than safety standard of MARD which is 1 mg/kg (Table 6a and 6b). Analyzed samples of fruit, regardless of being wrapped or not did not detect pesticide residue in fruit flesh. This may be because pesticides had already disintegrated since they were stopped being used 30 days prior to harvesting. In addition, peeling before analysis also removes pesticide residues on the skin that may not have disintegrated.

Table 6a: Efficiency of fruit wrapping on damage of bacteria fruit gumming, nitrate and pesticide residue in “Hoa Loc” mango

Fruit gumming rate and pesticide residue	Early season (Sep./2007-Feb./2008)		Late season (Feb.- Aug./2007)	
	With wrapping	Without wrapping	With wrapping	Without wrapping
Fruit gumming rate (%)	1,0	8,0	1,5	5,0
Infectious spot rate (%)	3,0	6,0	12,0	30,0
Nitrate residue (mg/kg)	0,534	0,626	0,016	0,016
Carbamate (ppb)	ND	ND	ND	ND
Cypermethrin (ppb)	ND	ND	ND	ND

ND: not detected

Table 6b: Efficiency of fruit wrapping on damage of bacteria fruit gumming, nitrate and pesticide residue in “cat Chu” mango

Fruit gumming rate and pesticide residue	Early season (Sep./2007-Feb./2008)		Late season (Feb.- Aug./2007)	
	With wrapping	Without wrapping	With wrapping	Without wrapping
Fruit gumming rate (%)	2,0	10,0	2,5	6,5
Infectious spot rate (%)	2,0	6,0	12,0	30,0
Nitrate residue (mg/kg)	0,534	0,626	0,011	0,006
Abamectin (ppb)	ND	ND	-	-
α - Cypermethrin(ppb)	ND	ND	-	-
Carbamate (ppb)	-	-	ND	ND
Cypermethrin (ppb)	-	-	ND	ND

ND: not detected

Fruit wrapping is applied at 40 day after fruit setting



Figure 9: Fruit wrapping practice with Taiwanese bag in Cao Lanh dist, Dong Thap province

4 CONCLUSION AND RECOMMENDATIONS

4.1 Conclusion

- Growers in Cao Lanh district, Dong Thap province are practicing mango flowering in one of four seasons per year in which flowering rate varies from 54% (late-season) to 71.6% (early-season), and yield reaches to 70 - 75 kg/tree. Anthracnose and Bacterial black spot are among the most serious diseases in rainy season, while thrips, fruit borer and *Idioscopus* spp. cause highest damage rate in dry season. Growers are applying pesticide 11.7 ± 2.7 and 14.1 ± 2.9 times in case of with or without wrapping young fruit, respectively. There are 35% of grower utilizing Taiwanese bags at 45 days after fruit setting.
- Flowering induction in late-season from Feb.-Aug./2007 and early-season from Sep./2007- Mar./ 3008 has achieved high flowering rates (>60%) in both cultivars, Hoa

Loc and Chu. However, yield of late-season is 1.8 fold and 2 fold higher than that of early-season for Hoa Loc and Chu cultivar, respectively. Late-season fruit production has a lower rate of insect and disease damage than early-season. Fruit wrapping at 40 day after fruit set could help reduce pesticide sprays by 3 times in the fruit development stage, and also damage of bacterial black spot compared without wrapping. Utilization of allowed pesticide and stopping spraying 30 days prior to harvesting may be the reason for not detecting pesticide residue in fruit flesh. Nitrate residue of fruit in late-season is lower than that in early-season, but these are all lower than safety standards.

4.2 Recommendations

- Fruit wrapping should be practiced, especially in rainy season, in order to reduce damage of bacterial black spot and physical damage, and achieve bright green for fruit skin.
- There is a need to conduct studies on economic efficiency of fruit wrapping at different periods after fruit setting in order to determine the most effective ones.

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