

FRUIT FLIES AND THEIR CONTROL BY USING PROTEIN BAIT IN VIETNAM

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1. Introduction and Research Objectives

Fruit fly is one the most serious insect pests of fruit and vegetable planted throughout the world. This is great concern to farmers, as it causes substantial loses in quantity and quality. Up to 100% of guava can become infected in the Mekong Delta while in North Vietnam 70 to 100% of peach crops in June – July (2000, were reported to be infected [2]). All most vegetable and fruits can be infected by fruits flies including cucurbits, citrus, litchi, and dragon fruit... Many species of fruit flies are quarantine pests in various countries and export of susceptible fruit is not allowed without recognized disinfection practices. This problem prevents the economic export of fruit from Vietnam.

Since 1999, the Technical Cooperation on fruit fly with Australian Center for International Agricultural Research (ACIAR) with National Institute for Plant Protection (NIPP) has been operational. The results identified the distribution and species and levels of infestation by fruit fly and the use of protein baits to control fruit flies. These papers display the results at some locations in 2001 to 2007.

2. Materials and Methods

Trapping collected fruit flies

Fruit fly traps were set up with the attractant methyl eugenol (ME) or Culure (CuE), which are specific for different fruit fly species. The traps were emptied at intervals of one or two weeks depending on the location, at weekly intervals in Hanoi but two weekly at other locations.

Location of traps:

- Mountain rural : Dien bien, Son la, Hoa binh, Thai nguyen, Ha giang, Lang son, Yen bai, Lao cai province
- Mountain low: Bac Giang, Phu Tho province
- Red river delta: Ha Noi, Vinh Phuc, Hai Phong, Ninh Binh, Ha Nam
- Northern centre: Nghe An, Thua Thien Hue

Host fruit surveys

Host fruit surveys involved collecting samples of commercial/edible and wild fruits and incubating them in container for two to three weeks in laboratory to determine where flies emerge from the fruits

Levels of infestations

Collecting samples to find the number of larvae per fruit and percentage of fruits infested in each commodity, and the stage of maturity when attacked.

Control by using protein bait

Treatment was applied on peach, luffa, guava...

Mixing: 100ml Ento – Pro, 0,1 Regent 800WG and 0,9 lit clean water

Pray 50ml mix liquid underside of leave of 1m²

Treated 1, 5 to 2 months pre-harvest

100 fruits were collected from each commodity that was treated and not treated with protein bait And the number of larvae per fruit and percentage of fruits infested in each commodity determined.

3. Results and discussion

3.1. The species composition

Fruit fly in different ecological area

The fruit fly composition was collected from ME and CuE traps and 23 fruit flies species were identified. They belong to the *Bactrocera* and *Dacus* genus. The *Bactrocera* genus has three sub-genus with 21 species. The *Dacus* genus has two species belong to sub-genus *Callantra*. The CuE traps collected 16 fruit flies species but the ME traps collected 5 species. The *B. pyrifoliae* and *B. latifrons* were not collected from the ME and CuE traps.

The results showed that: (i) The number of species in the Mountain rural (MR) areas are more abundant than in the Mountain low (ML) and Red river delta (RRD). In MR(Son La, Lai Chau, Lao Cai, Lang Son, Hoa Binh province), 19 species of fruit flies were collected but in the ML (Bac Giang, Phu Tho), NCC (Nghe An, Thua Thien Hue) and RRD (Ha Noi, Hai Phong, Ha Tay, Vinh Phuc) there were 7 to 10 species.

3.2. Host of fruit flies

A total of 1122 samples (fruits) were collected. There were 831 samples that were infected by fruit flies. Fruit flies emerged from 34 species of cultivated and wild fruits (Table 1). More than 7 host species of fruit fly that were not identified in 2000 were collected. 6 fruit flies species emerged from 18 species of cultivated fruits. 3 fruit flies species emerged from 11 species of vegetable fruits and 4 fruit flies species emerged from 5 species of wild fruits (Table 2, 3,4).

Table 1. Fruit flies collected on some host in the North and Northern centre (2001-2005)

Host	Number of plant species		Number of sample	
	Plants collected	Infected plant	Sample (fruit collected)	Fruit infected
Cultivated fruits	31	18	575	483
Vegetable fruits	13	11	366	256
Wild fruits and other	8	5	181	92
Total	52	34	1122	831

Table 2. List of cultivated fruit are host of fruit flies (2001-2005)

TT	Scientific name	Species						Total
		<i>BDO</i>	<i>BTA</i>	<i>BVE</i>	<i>BCO</i>	<i>BPY</i>	<i>BCA</i>	
1	<i>Citrus grandis</i>	+			+			2
2	<i>Citrus sinensis</i>	+						1
3	<i>Citrus reticulata</i>	+				+		2
4	<i>Psidium guajava</i>	+			+			2
5	<i>Prunus persica</i>	+				+	+	3
6	<i>Prunus domestica</i>	+				+		2
7	<i>Pyrus communis</i>	+						1
8	<i>Prunus armeniaca</i>	+						1
9	<i>Syzygium jambos</i>	+	+					2
10	<i>Dimocarpus longan</i>	+						1

11	<i>Nephelium litchi</i>	+		+				2
12	<i>Averrhoa carambola</i>	+			+			2
13	<i>Achras sapota</i>	+			+			2
14	<i>Clausena lansium</i>	+						1
15	<i>Annona squamosa</i>	+						1
16	<i>Diospiros kaki</i>	+						1
17	<i>Ziziphus jujuba</i>	+			+		+	3
18	<i>Carica papaya</i>	+						1
	Total	18	1	1	5	3	2	

Note: BDO: *B. dorsalis*; BCO: *B. correcta*; BPY: *B. Pyrifoliae*; BCA: *B. carambolae*;
BCU : *B. cucurbitae* ; BTA : *B. tau*; BLA: *B. latifrons*; BVE : *B. verbascifoliae*

Table 3. List of vegetable fruit are host of fruit flies (2001-2005)

No	Scientific name	Species			Total
		BCU	BTA	BLA	
1	<i>Cucurbita maxima</i>	+	+		2
2	<i>Luffa aegyptiaca</i>	+	+		2
3	<i>Luffa acutangula</i>	+	+		2
4	<i>Cucumis sativus</i>	+			1
5	<i>Solanum melongena</i>			+	1
6	<i>Capsicum annuum</i>			+	1
7	<i>Benincasa hispida</i>	+			1
8	<i>Lycopersicon esculentum</i>	+	+		2
9	<i>Lagenaria siceraria</i>	+			1
10	<i>Momordica cochinchinensis</i>	+	+		2
11	<i>Vigna unguiculata</i>	+			1
		9	5	2	

Note : BCU : *B. cucurbitae* ; BTA : *B. tau* ; BLA : *B. latifrons*

Table 4. List of wild fruit are host of fruit flies (2001-2005)

No	Scientific name	Species				Total
		BDO	BCA	BCU	BLA	
1	<i>Terminalis bellirica</i>	+	+			2
2	<i>Ficus carica</i>	+				1
3	<i>Milletia</i> sp.			+		1
4	<i>Artabotrys hexapetalus</i>			+		1
5	<i>Solanum</i> sp.				+	1
	Total	2	1	2	1	

Note: BD: *B. dorsalis*; BCA: *B. carambolae*; BCU : *B. cucurbitae* ; BLA: *B. latifrons*

3.3. Fruit fly infection

Assessments of fruit fly infestation were done in 1999 to 2007 on 7 cultivated fruits and one vegetable crop in some the large cultivated areas. The results showed that all kinds of fruit were severely infected.

The cultivated fruits were infected from 40 to 45 days before mature fruit harvest time. The fruits were harvested in summer or autumn. A low percentage infestation during the early season rose quickly towards the end of the season. For example: in the early season, 4% of the peach crop was infected and this figure rose to 100% by late season. For litchi this figure is 2% and 10%, for apple (*Ziziphus jujuba*) was infected 5% and then rose to 40 % and for *Psidium guajava* was 4% and 94%.

Fruits that were harvested in late autumn and winter, that has the highest percentage infestation at the mid- season (51.5% and 100% of *Diospiros kaki*; 29% of *Citrus reticulate* , Table 5). In late season this figure reduced because cold temperature, that unsuitable for fruit flies. The vegetable fruits (*Luffa acutangula*) often were infected in young fruits. In spring summer season the fruits were infected more than in autumn winter (Table 5).

Table 5: The fruit fly infestation on some cultivated fruit and vegetable fruit (2002 - 2007)

No	Kind of fruit	Time	Local	Fruit infected (%)		
				Early season	Mid season	Late season
1	<i>Prunus sp.</i>	2002-2005	Moc Chau-Son La	4	50	100
2	<i>Luffa acutangula</i>	2002 Spring Summer	Tu Liem -Ha Noi	3	75	100
		2002 Autumn Winter	Me Linh - Vinh Phuc	2	4	16
3	<i>Nephelium litchi</i>	2002	Luc Ngan - Bac Giang	0	2	10
4	<i>Ziziphus jujuba</i>	2003	Thuy Nguyen - Hai Phong	5	28	40
5	<i>Citrus reticulata</i>	2004	Bac Son - Lang Son	22	29	0
6	<i>Diospiros kaki</i>	2004	Da Bac - Hoa Binh	2	51.5	7,5
		2007			100	-
7	<i>Psidium guajava</i>	2007	Huong Tra - Thua Thien Hue	4	60	94
			Thanh Ha-Hai Duong		25*	

Note: * Fruits were covered by plastic bag

3.4. Control fruit fly by using protein bait

3.4.1. Control fruit fly by protein bait for small area

The use of protein bait sprays on peach, citrus, guajava at Lao cai, Hoa binh, Ha nam, Son la in 1999-2002. Each orchard is 1,000m² to 5,000m². On treated orchard, the infected fruits were reduced but limited (only 5 to 53%, Table 6).

Table 6: The result control fruit fly using protein bait in some local (1999-2002)

Time	Local	Kind of fruit	Fruit infected (%)	
			Using protein bait	Control
1999	Sa Pa- Lao Cai	Peach	0	60.49
2 000			14.00	21.00
1999	Cao Phong- Hoa Binh	Orange	7.00	12.00
2000	Thanh Liem-Ha Nam	<i>Guajava</i>	5.00 – 7.00	40 - 60
2002	Moc Chau – Son La	Peach	89.00	99.00

3.4.2. Relation between density population fruit flies trap catch and fruit infected

Results showed that in 2002 the fruit fly traps caught more than twice the number of fruit flies than in 2004. In 2002 (late season) the number of fruit flies trapped was reduced by 150 flies/trap (63.10%) over the controls, but fruit infection was only reduced by 11%. In 2004 the control trapped 109 flies/trap compared with 26/trap (81.95%), but fruit infection was only 5% (reduced 95% compared with the untreated the orchard) (Table 7). The control of fruit fly by using protein bait in large areas reduced the density fruit fly population and fruit infection.

Table 7. Fruit flies trap catch and peach fruit infected

Date	2002				2004			
	Treated		Control		Treated		Control	
	Flies/per trap	Fruit infected (%)	Flies/per trap	Fruit infected (%)	Flies/per trap	Fruit infected (%)	Flies/per trap	Fruit infected (%)
11/5	1	-	0	-	0		13	-
18/5	9	-	7	-	0	0	19	0
25/5	58	0	62	0	0	0	83	0
1/6	306	4.00	372	5.00	0	0	79	0
8/6	368	9.00	445	67.00	0	0	169	1.0
15/6	224	13.00	376	81.00	10	3.00	146	33.00
23/6	311	51.00	593	93.00	25	5.00	96	95.00
30/6	121	89.00	271	100.00	26	4.00	109	100
5/7					24	5.00	133	100

Note: In 2002: the orchard area was 0.5 ha

In 2004, the orchard area was 35 ha

3.4.3. Control fruit fly for large area by protein bait

Control fruit fly on apple (Ziziphus jujuba) at Phuc le - Thuy nguyen – Hai phong in 2003

There are hundreds ha of apple (*Ziziphus jujuba*) planted at Thuy nguyen – Hai phong. On average each farmer has planted from 10-50 trees equivalent 300 per 1,000m². Every year fruit resulted in serious damage to apples from by fruit fly. Sometimes 100% of fruit was lost. The fruit losses were highest at late September and early October. Chemical control fruit fly was used but had a given low effect, and it has disadvantages of being unsafe for the environmental and health of people.

Protein bait was used in the all apple area at Nam Phuc le village (8 ha) in 2003.

The result showed that in the late season, in treated orchards were treated, the infected fruits was 4 to 6% while in the untreated orchard, fruit infected was 37% (Table 8).

Table 8. Apple fruit was infected flies at Nam Phuc Le - Thuy Nguyen – Hai Phong in 2003

Date make sampling	Infected fruits (%)	
	Using protein bait	Control
11/10	3.00	5.00
18/10	0	9.00
23/10	6.00	28.00
28/10	4.00	37.00

Fruit Fly Control on peach at Long luong-Moc Chau – Son La 2004-2005

35 ha of peach at Co long and San cai Long luong – Moc chau was used to measure the impact of protein bait. In the late season, only 5% of peaches were damaged by fruit fly in these orchards. At the same time, on the orchards, that were not applying protein bait, almost all peach fruits were damaged (100% fruit infected) (Table 9).

Table 9. Peach fruit was infected flies at Long Luong-Moc Chau – Son La 2004

Date make sampling	Sample (number fruit collected)	Using protein bait		Control	
		Number fruit infected	Fruit infected (%)	Number fruit infected	Fruit infected (%)
21/5	100	0	0	0	0
27/5	100	0	0	0	0
2/6	100	0	0	0	0
8/6	100	0	0	1	1.00
16/6	100	3	3.00	33	33.00
21/6	100	5	5.00	95	95.00
26/6	100	4	4.00	100	100
1/7	100	5	5.00	100	100

In 2005 this trial was repeated applying protein bait on 35 ha of peaches. Experimental results indicate that bait spraying is the most effective treatment. This method of fruit fly control through using protein bait on large areas of apples and peaches has provided a very successful result.

Table 10. Peach fruit was infected flies at Longluong-Mocchau – Sonla 2005

Date make sampling	Sample (number fruit collected)	Using protein bait		Control	
		Number fruit infected	Fruit infected (%)	Number fruit infected	Fruit infected (%)
9/5	100	0	0	0	0
3/6	100	0	0	0	0
15/6	100	0	0	0	0
20/6	100	0	0	6	6.0
25/6	100	3	3.00	41	41.00
4/7	100	2	2.00	79	79.00
17/7	100	4	4.00	100	100

3.4.4. Control fruit fly by using protein bait for large area in some provinces

After some experiment to control fruit fly by using protein bait for large area of apple and peach in 2003-2005 research work continued through applying treatments for peach, *Psidium guava* and *Diospiros kaki* in some provinces from 2006 to 2007.

Table 11. Control fruit fly by protein bait for large area in some provinces

Time	Location	Area (ha)	Species	Infected fruits (%)	
				Treated	Control
2006	Mocchau Sonla	35	Peach	4.00	100
2007	Mocchau Sonla	35	Peach	4.00	100
2007	Huongtra Thuathienhue	10	<i>Psidium guava</i>	4.00	94.00
2007	Thanhha Haiduong	50	<i>Psidium guava</i>	5.00	25.00*
2007	Dongdu Hanoi	1	<i>Psidium guava</i>	9.50	96.50
2007	Dabac Hoabinh	7,5	<i>Diospiros kaki</i>	8.00	95.00

Note: * Fruits were covered by plastic bag

In all locations, control of fruit fly in large areas produces good results. The infected fruit was only 4.00 to 5.00%, while for untreated fruit this figure was 94.00 to 100%. For fruit (*Psidium guava*) that was covered by plastic bags, the infected fruit was 25%. The infected fruit reached 9.50% for the treated small area (Table 11).

4. Conclusion and suggestion

Conclusion

- There are many different fruit flies species in the North and mid Northern regions. There were 23 fruit flies species collected, of which 8 species cause high levels of damage on cultivated fruit and vegetables.
- Fruit flies emerged from 34 plant species. Among them 18 species of cultivated fruits, 11 species of vegetable fruits and 5 species of wild fruits. 7 new host species of fruit fly, not previously collected were identified.
- Fruit fly causes serious damage seriously on 6 important cultivated plant species. Rate of infected in late season was 100% with peaches, 100% in spring summer luffa (spring summer), 10% in litchi, 40% in apple (*Ziziphus jujuba*), 29% in yellow citrus (mid season), 52% in *Diospiros kaki*, 25 - 60% in *Psidium guajava*.
- Control of fruit fly by using protein bait for large areas gave excellent results. The damaged fruit was only 6% in apple, 5% in peach and 4.0 to 9.5% in *Psidium guava* (reduced 25.0- 95%),

Suggestion:

The protein bait for control of fruit flies model needs to be applied on large areas in order to give high effect and to provide safe commodities for domestic and export markets.

References

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