

**CONTROL OF THE CARAMBOLA FRUIT FLY,  
*Bactrocera carambolae* (DIPTERA : TEPHRITIDAE)  
BY MALE ANNIHILATION METHOD AND WRAPPING**

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**ABSTRACT**

*The carambola fruit fly, Bactrocera carambolae Drew & Hancock, is one of the major pests of star-fruit/carambola, Averrhoa carambolae. Control study of this fly was carried out from March '94 to January '95 at a commercial carambola fruit orchard in Cirebon, West Java. Two types of trap (Delta and round trap) with four different solution of methyl eugenol (ME) as an attractant was applied at the beginning of the florescence. One month after this period, conventional preventive method was applied by wrapping individual fruit with a plastic transparent bag. The result showed that round trap with pure ME attracted the most number of flies. The number of flies caught by ME diluted by two time of commercial oil, were not significantly different with that caught by pure ME with both in round trap and delta trap. During the study, the population number of B. carambolae started to increase in May, at the beginning of florescence then, reached to peak in July to August 1994 when the fruit ripened. The population was then decreased at the end. This pattern was the same to the following season (September, 1994 January, 1995). From fruit production data, it is indicate that application of the male annihilation method and wrapping using ME fruits reduce the infestation of the fruit fly up to one fourth, which is, from 25% to 6%.*

**I. INTRODUCTION**

Fruit flies which belong to the genus of *Dacus* (now *Bactrocera*) are one of a severe economic insect pests of fruits and several vegetables in Indonesia (Kalshoven, 1981). The exact number of fruit's damage cause by the infestation of the fruit flies has not been reported yet. However, Sutrisno (1991) reported that approximately 75% of fruit varieties currently grown are attacked by fruit flies. The inventory survey of fruit flies in Indonesia was reported by Hardy (1982, 1983) and Isnadi (1983). While, study on fruit fly host plants and fruit fly control was very limited.

Species in the *Bactrocera dorsalis* complex are certainly the most significant fruit fly pest species in Asia/South-East Asia. It is well known that a complex of sibling

species exist in the region. The extensive field collection and the data from different museum in Asia, Hawaii and London have been able to Drew & Hancock (1994) for re-identified and revised fifty-two (52) species of the *B. dorsalis* complex in Asia.

Indonesian fruits often attacked by the fruit fly, this insect pest would reduced the fruit quality and quantity. One of the fruits that always infested by the fruit fly is star-fruit or carambola (*Averrhoa carambolae*). Our study conducted in 1993, showed that the fruit-star attacked by oriental fruit fly (*Dacus dorsalis* complex), and during the wet season the infestation of this species may lead to the total loss of the fruit up to 25%, and more over 35% - 50% during the dry season. From the worked of Drew & Hancock (1994) in the systematic of *B. dorsalis* complex in Asia, it is clear that Carambola fruit fly has became one species and the new scientific name is *Bactrocera carambolae* Drew & Hancock. This species is known as important pest of fruit star, mango (*Mangifera indica* L.), guava (*Psidium guava* L.), and *Syzigium javanica*.

The larvae of *B. carambolae* live in the pulp of ripe fruit of fruit-star, after the larvae hatch, the pulp soon starts to decay and often this lead to premature fruit fall. The full grown larvae leave the fruit to pupate just below the surface of the soil. Female adult laying the egg by inserting the ovipositor inside the fruit and the newly hatched larvae will make a tunnel to penetrate deeper into the tissues of the fruit. Controlling fruit flies population is emphasize to the adult form, since the immature one is not the available target.

The male of many fruit flies species are strongly attracted to particular chemical compound, termed male lure or parapheromones. (Chambers, 1977; Fletcher, 1987). For example the male of melon flies, *B. cucurbitae* are attracted to cue-lure (CL), the male oriental fruit flies, *B. dorsalis* are very strongly attracted to methyl eugenol (ME), and male Mediterranean fruit flies, *Ceratitidis capitata* are attracted to trimedlure.

The wide use of parapheromones are important in current control program of tephritid pests. The male annihilation technique (MAT) using ME was applied successfully for the oriental fruit fly, *B. dorsalis* on Rota Island (Steiner, 1965), then on Saipan, Tinian and Agiguan Islands (Steiner, 1970). The same technique for the same fly was also applied successfully against this pest in the Amami Island, Japan (Ushio *et al.*, 1982) also in Okinawa islands (Koyama *et al.*, 1984), and in Hawaii island (Vargas & Spencer, 1991)

In Indonesia, few experiments in population monitoring and control method for fruit flies have already been carry out. Although with little success, fruit grower in Indonesia still using a tradition methods which is using insecticides, and preventive measure which is wrapping up the fruits with various material, such as plastic bags, coconut leaves, paper bags or straws.

From biological perspectives, it is wise to think that a new method to control the fruit flies should be pursued. In this paper we describe the population monitoring of *B. carambolae* in a small star- fruit orchard, also the combination methods of control measure by male annihilation using ME, and of an individual fruit wrapping.

## II. MATERIALS AND MEHODS

The study was located in Cirebon, West Java in a fruit-star (*Averhoa carambolae*) orchard, sampling area consisted of 250 commercial fruit-star trees (ca. 0.3 ha.) with several varieties of fruit star, such as Demak, Madiun, Wulan and Manila. Next to the area of study there were other small orchard with mango's, guava's and jack-fruit's trees (*Artocarpus spp.*). Study was carried out from the end of March 1994 till January 1995. The trees start flowering in May and there were no fruit left on trees at the end of August. At the end of September the second flowering season was began.

Two kind of traps were used in this experiment. The first one is a yellow delta trap which was made from corrugated plastic (30 x 20 x 20 h cm.). Lure treatment (ME) was then dropped in the paper glue and put at the bottom of the trap. The second trap one is a made from round plastic bucket (14 cm h. and 20 cm diam.). At the side of the bucket, four holes (1 cm diam.) were made and were connected with a funnel for flies entrance, then a cotton rolled soaked with lure was hung in the middle of the trap. At the bottom side, a water plus detergent was used as a killing agent. Each treatment consisted of 1 ml. of Pure ME, or pure ME diluted by 2, 5 and 10 of commercial oil, were either placed on the paper glue at the delta trap or soaked in the cotton rolled at round trap. Traps were then hung at the branches of tree, 1.5 m. above the ground and were 15 m to 20 m apart. Trapped flies were counted every day, lures in paper glue and cotton rolled were changed weekly, while water + detergent were added as needed. Three replication were made for each lure treatment, the traps were then arranged in a randomized complete-block design from March to August 1994. Four replication of round trap were used with pure ME and ME diluted by 2 times of commercial oil from September 1994 to January 1995

Means number of flies catch/trap/day was calculated (Vargas & Spencer, 1991; Manoto, 1991) and subjected to Anova, means were separated by Tukey is test.

One month after flowering period the fruits Were wrapped by transparent plastic bag. Infested fruit by the flies was collected from the trees and the dumping places. Number of larvae in each fruit was counted in the laboratory. In harvesting period, the percentage of infested fruit was calculated. Fruits were weighed in the bamboo buckets (50 kg), infested fruits were separated and reweigh.

## III. RESULTS AND DISCUSSION

Carambola fruit flies, *B. carambolae* were attracted to ME with both, round traps and delta traps, immediately after traps were hanged up. The result of this study showed that pure ME-round trap attracted the highest number of flies, total number of flies trapped from March 1994 to January 1995 was up to 9130 (Table 1). The actual total number of flies captured by ME round trap was higher than that by ME-delta trap. It is

happened since the flies which entered the round trap could not exit anymore, on the other hand, in the delta trap, many of flies were not stick to the paper glue.

Conversion of number of flies captured to the means number of flies catch/trap/day is show in table 2. In the first season, May to August 1994, the maximum average number of flies catch/trap/day was on the period of fruit ripened which is up to 130.7. Similar result was obtained in the second season, September 1994 to January 1995. Although the actual number of flies catch by pure ME was higher than that caught with ME diluted by 2 times of commercial oil, however the mean number of flies catch/trap/day by pure ME were not significantly different with the number that caught with ME diluted by 2 times of commercial oil.

Figure 1. shows number of *B. carambolae* captured weekly by ME-round trap, the population number of carambolae fruit fly seemed to start increase in May, at the beginning of florescence in first season, the population then reached to peak at the end of July when the fruit ripened then decreased again at the end of harvesting period. The similar trend of population was also occurred with the flies captured by ME-delta trap (Figure 2).

	ROUND TRAP				DELTA TRAP			
	ME	ME/2	ME/5	ME/10	ME	ME/2	ME/5	ME/10
March '94	125	108	22	16	67	60	31	22
April	391	353	111	63	263	260	83	51
May	656	580	183	104	243	198	90	51
June	521	438	167	110	235	228	120	77
July	2744	2596	384	180	757	688	321	267
August	319	242	134	93	180	147	47	31
September '94	463	434	-	-	-	-	-	-
October	1119	1067	-	-	-	-	-	-
November	1130	1123	-	-	-	-	-	-
December	1447	1372	-	-	-	-	-	-
January '95	215	165	-	-	-	-	-	-
Total	9130	8478	1001	566	1745	1581	692	499

Table 1. Total number of *B. carambolae* captured by ME-traps at Cirebon star-fruit orchard

ME = pure methyl eugenol,

- ME/2 = pure methyl eugenol diluted by 2 times of commercial oil,  
ME/5 = pure methyl eugenol diluted by 5 times of commercial oil,  
ME/10 = pure methyl eugenol diluted by 10 times of commercial oil.

In first season, flies catch by trap with M:E diluted by 5 times and 10 times of commercial oil were not effective to suppressing or to control *B. carambolae*. In the second season, September '94 to January '95, we carried out this study using the round trap with pure ME and ME diluted by 2 times of commercial oil. The same trend pattern was observed as the previous season, population start to increase in the flowering period, in October, reached the peak in December, when the fruit ripened, and decreases after harvesting period.

At the end of this study (January '95), means number of flies catch/trap/day by pure ME round trap was still up to 10. This condition seemed due to the flies from other area or fruit trees were come to this orchard, and we were not able to make a barrier control for this orchard.

Table 2. *B. carambolae* captured by ME-traps at Cirebon star-fruit orchard

	ROUND TRAP				DELTA TRAP			
	(Mean no. of flies catch/trap/day $\pm$ standard deviation)							
	ME	ME/2	ME/5	ME/10	ME	ME/2	ME/5	ME/10
March '94	6.0 $\pm$ 1.5	5.1 $\pm$ 0.5	1.0 $\pm$ 0.2	0.8 $\pm$ 0.1	3.2 $\pm$ 0.2	2.9 $\pm$ 0.1	1.5 $\pm$ 0.2	1.0 $\pm$ 0.1
April	18.6 $\pm$ 2.0	16.8 $\pm$ 1.5	5.3 $\pm$ 0.8	3.0 $\pm$ 0.6	12.5 $\pm$ 1.7	12.4 $\pm$ 1.8	4.0 $\pm$ 0.7	2.4 $\pm$ 0.5
May	31.2 $\pm$ 3.3	27.6 $\pm$ 3.2	8.7 $\pm$ 0.6	5.0 $\pm$ 0.7	11.6 $\pm$ 1.6	9.4 $\pm$ 1.5	4.3 $\pm$ 0.6	2.4 $\pm$ 0.4
June	24.8 $\pm$ 2.8	20.9 $\pm$ 2.6	8.0 $\pm$ 0.4	5.2 $\pm$ 0.2	11.2 $\pm$ 1.5	10.9 $\pm$ 1.7	5.7 $\pm$ 0.9	3.7 $\pm$ 0.7
July	130.7 $\pm$ 26.4	123.6 $\pm$ 25.2	18.3 $\pm$ 2.6	8.6 $\pm$ 1.5	36.0 $\pm$ 2.3	32.8 $\pm$ 2.2	15.3 $\pm$ 1.0	12.7 $\pm$ 1.2
August	15.2 $\pm$ 2.3	11.5 $\pm$ 2.2	6.1 $\pm$ 1.3	4.4 $\pm$ 1.0	8.6 $\pm$ 1.6	7.0 $\pm$ 1.4	2.2 $\pm$ 0.4	1.5 $\pm$ 0.3
September	22.0 $\pm$ 4.2	20.7 $\pm$ 5.2	-	-	-	-	-	-
October	52.3 $\pm$ 4.1	50.8 $\pm$ 4.3	-	-	-	-	-	-
November	53.8 $\pm$ 12.5	53.5 $\pm$ 12.2	-	-	-	-	-	-
December	68.9 $\pm$ 21.2	65.3 $\pm$ 21.4	-	-	-	-	-	-
January '95	10.2 $\pm$ 2.1	7.9 $\pm$ 2.1	-	-	-	-	-	-

Note :

ME = pure methyl eugenol; ME/2 = pure methyl eugenol diluted by 2 times of commercial oil, ME/5 and ME/10 = diluted by 5 and 10 times  
 From March - August 1994 : 3 traps per treatment lure; September 1994 - January 1995 : 4 traps per treatment lure

Figure 1. Weekly captured of *B. carambolae* captured by ME-round trap at Cirebon star-fruit orchard

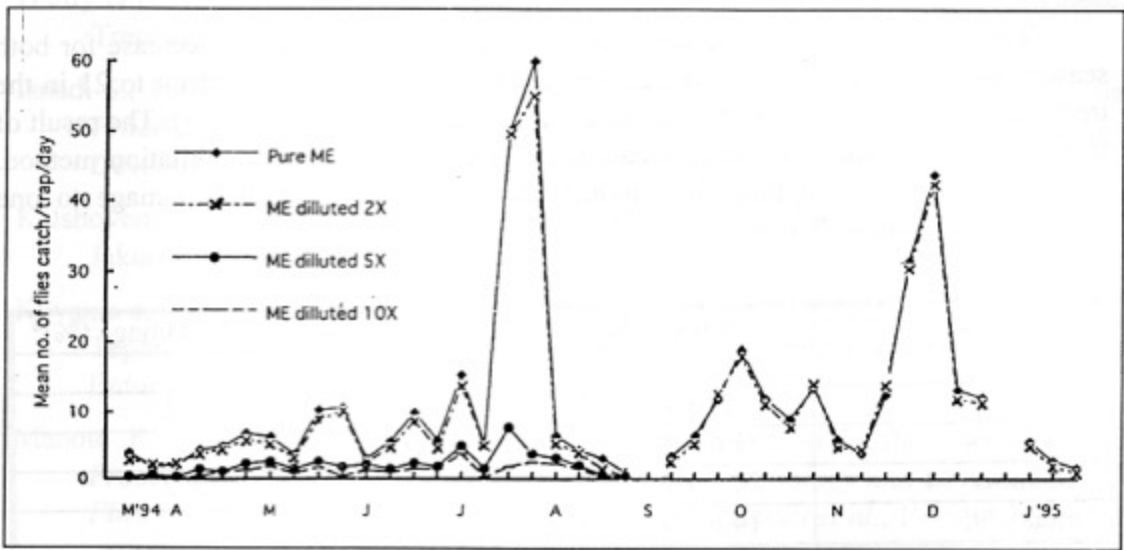
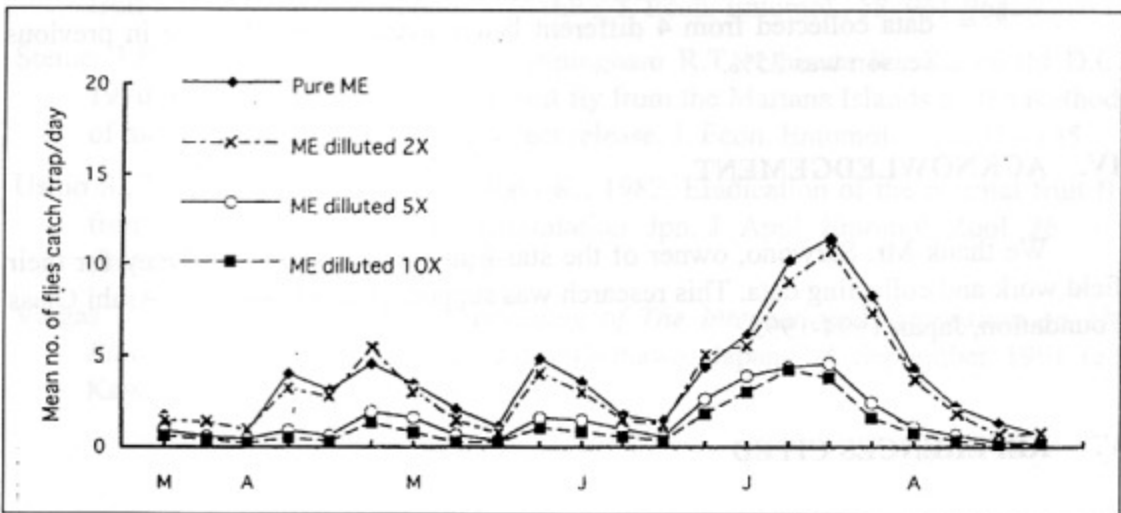


Figure 2. Weekly captured of *B. carambolae* captured by ME-delta trap at Cirebon star-fruit orchard



Utilization of lure with the male annihilation method to suppressed the fruit fly, *Bactrocera dorsalis* was showed by several authors in different countries (Steiner, 1965; 1970, Ushio *et al.*, 1982, Kawasaki, 1991, Vargas & Spencer, 1991), some of them showed that the male annihilation method should be followed by the other technique, such as sterile insect release.

Results from collected fruits indicated that female carambola fruit flies oviposit their eggs when fruit was became yellowish, because no larva was found inside the green fruits. Our result was consistent with report of Prokopy *et al.*, 1990, which

indicated that role of host-finding behavior in the oriental fruit fly, *B. dorsalis* was influencing by color, size and shape of the fruit. and Nakagawa *et al.*, 1978 also reported in Mediterranean fruit fly, *Ceratitidis capitata*.

The mean number of carambola fruit fly larvae/fruit seemed to decrease for both season, after the harvesting period, at the first season, from 31 larvae/fruit to 21 in the trees (unwrapping fruit), and from 33 to 20 in the dumping place (Table 3). The result of fruit production indicated that application of the ME in the male annihilation method, following with the wrapping of individual fruit were decreased the damage to one fourth, that is from 25% to 6%.

	Mean no. of larvae / fruit $\pm$ SEM		Mean fruit damage (%)*
	I	II	
July '94	31.6 + 4.8	33.2 + 9.4	6.2
August '94	21.6 + 4.6	20.0 + 2.9	-
December '94	20.2 + 2.2	20.6 + 3.1	5.7
January '95	14.6 $\pm$ 3.4	19.0 + 3.7	-

Table 3. Number of *B. carambolae* larvae from star-fruit and Fruit damage at harvesting period.

I = fruit collected from the trees (unwrapped fruit) n = 25 fruit.

II = fruit collected from dumping place n = 25 fruit.

\* = data collected from 4 different batch, average fruit damage in previous season was 25%.

#### IV. ACKNOWLEDGEMENT

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