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DEVELOPMENT OF ATTRACTANT SYSTEMS FOR TRAPPING FEMALE *Ceratitis capitata* (WIED.) (DIPTERA: TEPHRITIDAE) IN THE SOCONUSCO REGION, CHIAPAS, MEXICO

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Abstract

With the aim of developing a system of attractants and trapping to optimize the capture of female Mediterranean fruit flies, *Ceratitis capitata* (Wied.) as well as other fruit flies, six experiments were carried out during the period 1994 -1997, in a sterile-insect release zone in the Soconusco region of Chiapas, Mexico. Relating to the system of attractants, the evaluation focused on the comparison of food attractants (i.e. ammonium acetate, putrescine and trimethylamine) with standard attractants, such as Trimedlure and liquid hydrolyzed protein. For the trapping system, dry traps (Jackson trap, Open bottom dry trap, etc.) as well as wet traps (McPhail trap, Tephri trap, etc.) were tested alternately with the different kinds of attractants. The experiments were performed in agrosystems of coffee and groves of citrus and mango. Results consistently showed that a combination of ammonium acetate + putrescine + trimethylamine was the best for the capture of female *Ceratitis capitata* (Wied.) when used in traps such as the OBDT and the plastic McPhail trap (IPMT), while for *Anastrepha spp.*, the McPhail trap baited with liquid hydrolyzed protein still appears to be the best option, although the combination of ammonium acetate with putrescine was quite consistent in the trapping of *A. obliqua* and *A. ludens* in traps such as the IPMT.

1. INTRODUCTION

To adequately carry out the operative actions in fruit fly eradication programs which involve Sterile Insect Technique (SIT), it is necessary to rely on an accurate estimate of these insect populations in the field. Trapping occupies a preponderant position in the monitoring of populations, and the detection of females is of even greater relevance if one includes or is planning to use genetic-sexing strains where only males are released [1].

It is known that adult tephritids, especially females, at different stages of physiological development (feeding, mating, egg-laying, etc.), flies respond to different stimuli present in their environment [2]. When monitoring populations in the field, artificial lures are competing against these stimuli, thus attractants must be powerful enough to compete successfully and be also able to correlate to population size, particularly when populations are at low levels.

Some of the first food attractants used with fruit flies were molasses, fermented sugar and yeasts. Subsequently, the use of hydrolyzed proteins was initiated, which, although generally less effective than yeast, are easier to manage and standardize [3]. The smell of the hydrolyzed protein has been the most potent attractant for both sexes, for which reason, a combination of the food odors and another type of attractant (i.e., color, parapheromones and pheromones) can markedly increase the number of fruit flies caught in the traps [4]. At present, emphasis is on the analysis of volatile materials released from food attractants, including protein baits, for combination with visual attractants [5,6]. The volatile components of these mixtures typically contain ammonia, acetic acid [7] and various other volatile attractants [8].

Based on the above, and, on the tendencies which have marked the operative programs which apply the SIT using genetically-sexed strains for control and eradication of the medfly, the main objective of the current study was to develop a trapping system with food attractants exclusively for females, in order to optimize, in a practical way, the systems for detection of fertile females of this species of fruit fly.

2. MATERIALS AND METHODS

2.1. Traps

The different kinds of trap used in this study were:

1) Closed bottom dry trap (CBDT) - a cylindrical trap approximately 20 cm in height made with phosphorescent green acetate with three holes 2.2 cm in dia, and covered at both ends with plastic tops, similar to petri dishes, containing a lethal agent, dimethyl dichlorovinyl phosphate (DDVP)

2) Open bottom dry trap (OBDT) - a cylindrical trap 20 cm in height made with dark green acetate, three holes and a yellow sticky insert hung in the center of the trap

3) Jackson trap (JT) a cardboard triangular prism-shaped trap with faces measuring 9.5 x 12.5 cm, with a sticky white insert

4) McPhail glass trap (McPhail) - a bottle-shaped trap with an invaginated bottom and center orifice

5) McPhail plastic trap (International Pheromone's McPhail Plastic Trap [IPMT]) a two-part trap, with an invaginated yellow base inserted into an upper transparent part

6) Tephri trap - a cylindrical trap with an invaginated yellow base, and four orifices in the upper part and a translucent top

7) Frutect trap - a yellow rhomboid trap (29 x 29 cm), with a spherical red insert containing an attractant from a protein source

The number and type of traps varied in each experiment, as did the attractants used. Several of the traps, such as the IPMT and the Tepri were used as both wet and dry traps, depending on the type of attractant used and the vehicle for catching flies. For each particular trial, we will describe the manner in which each trap was used.

2.2. Attractants

The various attractants tested were: ammonium acetate (AA) which was impregnated in a white patch; putrescine (P) in a silver-covered patch; trimethylamine (TMA) on a white patch; Trimedlure (TML) medfly parapheromone in tablet-shape; NuLure (NU+B) liquid protein attractant; and Captor 300 (CP 300) liquid protein attractant made in Mexico. Triton was used as a surfactant in wet traps.

2.3. Experimental design (standard protocol)

In a design of random blocks, five rows were used (A-E) with a variable number of traps (depending on the experiment). The traps were placed, alternately, every 25 m in trees of standard size and shape; the traps were rotated weekly, and checked twice a week. The rebaiting of the traps which used AA+P+TMA (FA-3) was performed every four weeks. Traps having liquid protein were rebaited every week. For Jackson TML traps, the tablet was changed every two weeks. Sticky inserts were changed once or twice a week depending on the

captures. For collection from the moist traps, a colander, forceps and jar of 70% alcohol were used. All specimens caught were duly labeled and taken to the laboratory for correct identification.

Data from the coordinated experiments are expressed as flies/trap/day (F/T/D). Data were analyzed using a variance analysis with a 95% confidence level, using Tukey's multiple-range test. The analysis were performed using *Statgraphics 7.1* (1993) software.

2.3.1. Description of experiments with standard protocol

Year 1. In 1994, the performance of the CBDT baited with AA+P (FA-2 attractants) was compared with that of the JT baited with TML in a sterile-insect dispersion zone. In each row, the two types of trap were alternated (i.e. row A: JT-CBDT-JT-CBDT; row B: CBDT-JT-CBDT-JT; etc.) until five rows were completed, so that there were 10 traps of each type per grove. The coordinated experiment was carried out simultaneously in a coffee plantation and in a citrus grove, both located in the municipality of Cacahoatán, adjoining the experimental grounds INIFAP-SAGAR "Rosario Izapa" (altitude 435 m; average annual rainfall of 3050 mm; mean temperature 26.1° C [9].

Year 2. In the 1995 trial, the CBDT and OBDT traps (both baited with FA-2), the JT, TML, the IPMT, NU+B and the McPhail glass trap baited with Captor 300 protein were compared, using the five rows (A-E) and alternate placing of the traps. The experiment was carried out on coffee plantations in two localities situated at different altitudes: a) Santo Domingo Commune, at 820 m with an average annual rainfall of 1900 mm. The canopy of the trees was dominated by *Inga spp.* (coffee shade tree) and in the herbaceous stratum, the best-represented families were Compositae, Graminae, Leguminosae, Cruciferae and Labiatae. b) Talquián Commune, at an altitude of 1600 m with an average temperature of 16-25°C and 2500 mm of rainfall. In the selected plantation, coffee trees are mixed with other fruit trees which serve as shade (*Persea americana, Inga spp., Citrus aurantum,* etc.)

Year 3. In 1996, according to standard protocol, at each site, five rows (A-E) were used with seven traps each, with the objective being to evaluate the addition of another component, TMA, to the attractant system (FA-3 attractants). The treatments studied were the following: 1) OBDT trap baited with FA-2; 2) OBDT trap baited with FA-3; 3) IPMT baited with FA-2; 4) IPMT baited with FA-3; 5) McPhail glass trap baited with NU+B; 6) Tephri trap baited with FA-3; and 7) JT baited with TML.

The experimental sites were: a) San José Nexapa plantation, located in the municipality of Tapachula, 22.5 km along the highway to Nueva Alemania at altitude ca. 303 m and having an annual average rainfall of 3150 mm. The mean annual temperature is 26.5°C and the tree canopy is dominated by *Inga spp.* b) The "Don Mario" grove with 6 ha. of "Valenciana" variety oranges, located in the municipality of Tuxtla Chico to one side of the highway which connects the City of Tapachula with the Talismán-El Carmen border. The grove is located at an altitude of 117 m, and has an average annual rainfall of 2088 mm and mean annual temperature of 27.5°C.

Year 4. During 1997, the main objective was to compare some of the trap-attractant combinations as moist and as dry traps. The treatments tested were: 1) The IPMT as a wet trap, baited with FA-3 attractants, plus 300 ml of water and 2 drops of surfactant, 2) The IPMT as a dry trap, baited with FA-3 attractants + DDVP as a lethal agent, 3) the Tephri-trap as a dry trap, baited with FA-3 attractants + DDVP as a lethal agent, 4) the IPMT baited with NU+B; 5) the OBDT trap, baited with FA-3 attractants; and 6) the JT baited with TML.

This experiment was carried out on two coffee plantations which are described as follows: a) The Palmira plantation. Located in the municipality of Cachoatán at the 22.6 km point along the Tapachula-Unión Juárez highway, the plantation is at an altitude of 570 m and has an average annual rainfall of 3683 mm. The mean annual temperature is 25.6 °C. Arabica coffee is grown on the plantation, using for shade, cocoa, citrus and guava (*Psidium sp)* trees, as well as young trees of the *Inga* spp. b) The Monteperla plantation is located in the municipality of Unión Juárez at the 38.2 km point along the highway joining Tapachula to Unión Juárez. It is at an altitude of ca. 1106 m and has a mean annual rainfall of 2408 mm. The average annual temperature is 23.3 °C. Arabica coffee is grown on the plantation, with "chalum" (*Inga* spp.) predominating as shade trees.

2.3.2. Additional experiments

Experiment 1. In order to compare the performance of the OBDT trap baited FA-2 with respect to the JT, TML during the season when the introduction of fertile flies into Mexico is the greatest, a trial was carried out over an eight-week period in the Mexico-Guatemala border region in a sterile insect dispersion zone, where a route of 40 traps was set up along the stretch between Santo Domingo and Unión Juárez, Chiapas. The traps were placed alternately at a distance of approximately 28 m apart, in fruit trees reported as hosts to medfly, and were checked every seven days, changing the attractants every four weeks in the case of OBDT, and every two weeks in the case of the JT. The trapping route began at an altitude of 840 m and finished at 1360 m.

Experiment 2. With the aim of testing the sensitivity of different traps and attractants at differing levels of fly density, the following experiment was carried out. Over an eight-week period, four different densities of *Ceratitis capitata, Anastrepha ludens* and *A. obliqua* (100, 1000, 2500 and 5000 / hectare) were released independently in four groves of Ataulfo mango. The release densities were rotated each week so that each density was evaluated twice in each grove. Likewise, the released insects were marked with a different colorant. Eight different trap-attractant combinations were tried and are listed as follows: 1) JT, TML; 2) JT, FA-3; 3) OBDT, FA-3; 4) IPMT, FA-2; 5) IPMT, FA-3; 6) the Frutect trap with its attractant, 7) the McPhail glass trap with NU+B; 8) the Tephri trap with FA-3, plus water with 2%DDVP. These traps were placed over a hectare according to a wind-vane pattern (N, S, E, W, NE, SE, NW, and SW) and were rotated in their positions twice a week. The point where flies were released was taken as center with a surrounding radius of 50 m for each trap. Three repetitions per grove per week were made to achieve 24 repetitions in 8 weeks.

The groves where the research was carried out correspond to Tere, Jasso, Triple "A" and Andreas, and are located in a coastal zone of the municipality of Tapachula. In this zone the annual rainfall is 2016 mm, the mean annual temperature is 27.5°C and the altitude is 60 m.

3. RESULTS

3.1. Experiments using standard protocol

Year 1. In this first experiment, the CBDT showed a tendency to capture a greater number of *C. capitata* females than males (Table I), where it can be observed that the number of captured females obtained both from the coffee and orange crops are greater in this type of trap. For the genus *Anastrepha,* a similar situation can be observed, with higher F/T/D for females than for males, in both the citrus grove and the coffee plantation.

Year 2. In this experiment, the Jackson trap was the only one to capture exclusively *C. capitata* males, in comparison with the other traps which captured both females and males. (Table II). The CBDT and OBDT traps showed the best tendency to catch females in both

TABLE I. FRUIT FLY SPECIMENS CAPTURED IN JACKSON AND CBDT TRAPS IN THE SOCONUSCO REGION,CHIAPAS, MEXICO - 1994

Host	*Ceratitis capitata*				*Anastrepha distincta*				*Anastrepha ludens*			
Treatment	F	F/T/D	M	F/T/D	F	F/T/D	M	F/T/D	F	F/T/D	M	F/T/D
Orange trees												
JT, TML	66	0.047	502	0.359	0	0.000	0	0.000	0	0.000	0	0.000
CBDT, FA-2	45	0.032	7	0.005	17	0.012	2	0.001	7	0.000	4	0.003
Coffee plants												
JT, TML	20	0.014	2241	1.601	0	0.000	0	0.000	0	0.000	0	0.000
CBDT, FA-2	23	0.016	20	0.014	13	0.009	5	0.004	2	0.000	0	0.000

F/T/D = Flies/Trap/Day; M = males; F = females

localities when compared to the rest of the traps, however it can be seen that the OBDT was quite superior in this sense since it caught close to 43% of all of the female *C. capitata*. While this does not register a significant difference from the other treatments, it does give evidence of a noteworthy superiority of the OBDT trap in this respect. In catching flies of the *Anastrepha* genus, it was observed that the McPhail glass and the IPMT traps baited with hydrolyzed protein represent the best option.

Year 3. The addition of a third attractant to the OBDT and McPhail (IPMT) traps permitted the best captures of female *C. capitata* in this trial (Table III). At the San José Nexapa plantation, it was found that both traps registered the highest MTD, showing significant differences between treatments. At the "Don Mario" grove, the results were similar, the OBDT trap with the three attractants being notably the best.

For *Anastrepha ludens* and *A. obliqua*, the best catches were again made with the McPhail glass trap baited with NU+B, although on this occasion, it was followed in second place by the McPhail plastic trap (IPMT) baited with FA-2, which was the best at catching female *A. obliqua* at the "Don Mario" citrus grove.

Year 4. Again, there were no significant differences in the capture of female *C. capitata* between the various combinations of traps and attractants under study, but once more the OBDT and McPhail moist traps, baited with FA-3 stood out with most elevated FTD (Table IV). The McPhail trap in its dry version, although baited with the same attractants, captured a considerably lesser number of females , which we first attributed to the presence of the lethal agent (DDVP), which may have exerted a repellent effect during the first days of the application.

For the genus *Anastrepha (A. distincta, A. ludens* and *A. striata)*, the McPhail glass trap, baited with NU+B, once again captured the highest number of flies (Table IV).

3.2. Additional experiments

Experiment 1. The total number of catches and F/T/D of female and male *C. capitata* for both types of trap are shown in Table V, where it can be seen that for females that the OBDT proved to be 4.4 times more efficient; nevertheless no fertile specimen of the pest was detected in any of the traps being compared, which was the principal objective of this experiment.

Experiment 2. Although the results in Table VI do not show significant differences between treatments for any of the densities, female catches are consistently higher in all of the traps (except the JT) which used the three food attractants. This is seen most clearly at densities of 1000, 2500 and 5000 flies /ha. The highest sensitivity for detecting flies at low density demonstrated by the JT, TML, for capture of males, followed immediately by the OBDT, FA-3 for capture of females.

TABLE II. FRUIT FLY SPECIMENS CAPTURED IN FIVE COMBINATIONS OF TRAP AND ATTRACTANTS IN THE SOCONUSCO REGION, CHIAPAS, MEXICO - 1995

Locality	*Ceratitis capitata*							*Anastrepha distincta*				*Anastrepha ludens*			
Treatment	F	F/T/D		M	F/T/D			F	F/T/D	M	F/T/D	F	F/T/D	M	F/T/D
Talquián (coffee)															
JT, TML	0	0.000	A	750	2.679		B	0	0.000	0	0.000	0	0.000	0	0.000
CBDT, FA-2	68	0.243	A	42	0.150	A		2	0.007	0	0.000	0	0.000	0	0.000
OBDT, FA-2	127	0.454	A	46	0.164	A		1	0.004	1	0.004	0	0.000	0	0.000
McPhail, Torula yeast	53	0.189	A	43	0.154	A		27	0.096	10	0.036	6	0.021	2	0.007
IPMT, NU+B	42	0.150	A	25	0.089	A		23	0.082	26	0.093	2	0.007	0	0.000
Santo Domingo (coffee)															
JT, TML	0	0.000	A	1,064	3.800	A		0	0.000	0	0.000	0	0.000	0	0.000
CBDT, FA-2	48	0.171	A	23	0.082	A		5	0.018	1	0.004	0	0.000	0	0.000
OBDT, FA-2	102	0.364	A	24	0.086	A		3	0.011	5	0.018	0	0.000	0	0.000
McPhail, Torula yeast	38	0.136	A	26	0.093	A		878	3.136	397	1.418	22	0.079	1	0.004
IPMT, NU+B	56	0.200	A	20	0.071	A		1050	3.750	532	1.900	14	0.050	6	0.021

F/T/D = Flies/Trap/Day; M =males; F =females

TABLE III. FRUIT FLY SPECIMENS CAPTURED WITH SEVEN COMBINATIONS OF TRAPS AND ATTRACTANTS IN COFFEE PLANTS AND VALENCIA ORANGE TREES, IN THE SOCONUSCO REGION, CHIAPAS, MEXICO - 1997

Locality	*Ceratitis capitata*										*Anastrepha ludens*									*Anastrepha obliqua*								
Treatment	F	F/T/D	*			M	F/T/D	*			F	F/T/D	*		M	F/T/D	*			F	F/T/D	*		M	F/T/D	*	
S.J. NEXAPA (coffee)																												
JT, TML	1	0.004	A			135	0.482			C	0	0.000	A		0	0.000	A			0	0.000	A		0	0.000	A		
OBDT, FA-2	34	0.121	A	B		6	0.021	A			1	0.004	A	B	0	0.000	A			1	0.004	A		1	0.004	A		
OBDT, FA-3	88	0.314		B	C	16	0.057	A	B		1	0.004	A	B	0	0.000	A			0	0.000	A		0	0.000	A		
IPMT, FA-2	29	0.104	A	B		5	0.018	A			10	0.036	A	B	3	0.011	A	B		3	0.011	A		4	0.014	A		
IPMT, FA-3	70	0.250	A	B	C	9	0.032	A			1	0.004	A	B	3	0.011	A	B		3	0.011	A		1	0.004	A		
McPhail, NU+B	13	0.046	A			1	0.004	A			16	0.057		B	6	0.021	A	B		4	0.014	A		3	0.011	A		
Tephri, FA-3	40	0.143	A	B		4	0.014	A			3	0.011	A	B	1	0.004	A	B		1	0.004	A		0	0.000	A		
DON MARIO (orange)																												
JT, TML	0	0.000	A			17	0.061			C	0	0.000	A		0	0.000	A			0	0.000	A		0	0.000	A		
OBDT, FA-2	6	0.021	A	B		2	0.007		B	C	0	0.000	A		0	0.000	A			1	0.004	A		0	0.000	A		
OBDT, FA-3	9	0.032	A	B		3	0.011		B	C	0	0.000	A		0	0.000	A			0	0.000	A		0	0.000	A		
IPMT, FA-2	4	0.014	A	B		2	0.007		B	C	4	0.014		B	5	0.018		B		40	0.143		B	14	0.050	A		
IPMT, FA-3	5	0.018	A	B		3	0.011		B	C	5	0.018		B	0	0.000	A			4	0.014	A		2	0.007	A		
McPhail, NU+B	1	0.004	A			0	0.000		B		3	0.011	A	B	0	0.000	A			4	0.014	A		1	0.004	A		
Tephri, FA-3	5	0.018	A	B		0	0.000		B		0	0.000	A		0	0.000	A			3	0.011	A		2	0.007	A		

* same letters are employed when there in no significant difference using ANOVA with Tukey
F/T/D = Flies/Trap/Day; M =males; F =females

TABLE IV. TOTAL FRUIT FLIES CAPTURED/TRAP/DAY IN SIX COMBINATIONS OF TRAPS AND ATTRACTANTS IN TWO COFFEE PLANTATIONS AT TWO DIFFERENT ALTITUDES, IN THE SOCONUSCO REGION, CHIAPAS, MEXICO - 1997

Locality	*Ceratitis capitata*						*Anastrepha ludens*						*Anastrepha distincta*						*Anastrepha striata*					
Treatment	F	F/T/D	*	M	F/T/D	*	F	F/T/D	*	M	F/T/D	*	F	F/T/D	*	M	F/T/D	*	F	F/T/D	*	M	F/T/D	*
PALMIRA (coffee)																								
IPMT, FA-3, wet	44	0.571	A	52	0.675	A	0	0.000	A	0	0.000	A	1	0.013	A	0	0.000	A	0	0.000	A	0	0.000	A
IPMT, FA-3, dry	18	0.234	A	26	0.338	A	1	0.013	A	0	0.000	A	0	0.000	A	0	0.000	A	0	0.000	A	0	0.000	A
Tephri, FA-3, dry	37	0.481	A	51	0.662	A	0	0.000	A	0	0.000	A	0	0.000	A	1	0.013	A	0	0.000	A	0	0.000	A
McPhail, NU+B	6	0.078	A	11	0.143	A	0	0.000	A	0	0.000	A	2	0.026	A	2	0.026	A	0	0.000	A	0	0.000	A
OBDT, FA-3	156	2.026	A	16	0.208	A	0	0.000	A	0	0.000	A	0	0.000	A	0	0.000	A	0	0.000	A	0	0.000	A
JT, TML	8	0.104	A	828	10.753	B	0	0.000	A	0	0.000	A	0	0.000	A	0	0.000	A	0	0.000	A	0	0.000	A
MONTE PERLA (coffee)																								
IPMT, FA-3, wet	144	1.870	A	52	0.675	A	0	0.000	A	2	0.026	A	97	1.260	A	41	0.532	A	0	0.000	A	3	0.039	A
IPMT, FA-3, dry	37	0.481	A	12	0.156	A	0	0.000	A	0	0.000	A	22	0.286	A	22	0.286	A	0	0.000	A	0	0.000	A
Tephri, FA-3, dry	84	1.091	A	23	0.299	A	0	0.000	A	0	0.000	A	67	0.870	A	12	0.156	A	0	0.000	A	0	0.000	A
McPhail, NU+B	10	0.130	A	6	0.078	A	7	0.091	A	3	0.039	A	266	3.455	B	52	0.675	A	2	0.026	A	3	0.039	A
OBDT, FA-3	169	2.195	A	33	0.429	A	0	0.000	A	0	0.000	A	26	0.338	A	7	0.091	A	0	0.000	A	0	0.000	A
JT, TML	5	0.065	A	442	5.740	B	0	0	A	0	0	A	1	0.013	A	26	0.338	A	0	0	A	0	0	A

* same letters are employed when there in no significant difference using ANOVA with Tukey; F/T/D = Flies/Trap/Day; M =males; F=females

TABLE V. TOTAL *C. capitata* CAPTURED DURING AN EIGHT WEEKS STUDY IN THE STERILE INSECTS DISPERSION ZONE IN THE SOCONUSCO REGION - CHIAPAS

Treatment	# Females	F/T/D females	% female captures	Weekly average by trap	S.E.	
JT, TML	254	0.227	18.25	1.59	0.404	A
OBDT, FA-2	1138	1.016	81.75	7.11	1.782	B

F/T/D = Flies/Trap/Day

TABLE VI. FRUIT FLY SPECIMENS CAPTURED IN EIGHT COMBINATIONS OF TRAPS AND ATTRACTANTS USING 4 LIBERATION DENSITIES (100, 1000, 2500 AND 5000 STERILE ADULTS) ON MANGO, IN THE SOCONUSCO REGION, CHIAPAS, MEXICO - 1997

	ADULTS RELEASED AT A CENTRAL POINT																							
Locality/	100						1000						2500						5000					
Treatment	M	F/T/D	*	F	F/T/D	*	M	F/T/D	*	F	F/T/D	*	M	F/T/D	*	F	F/T/D	*	M	F/T/D	*	F	F/T/D	*
C. capitata																								
JT, TML	9	0.032	A	3	0.011	A	54	0.193	B	6	0.021	A	126	0.450	B	12	0.043	A	158	0.564	B	13	0.046	A
JT, FA-3	1	0.004	A	1	0.004	A	19	0.068	A	2	0.007	A	17	0.061	A	18	0.064	A	29	0.104	A	14	0.050	A
OBDT, FA-3	3	0.011	A	6	0.021	A	15	0.054	A	12	0.043	A	29	0.104	A	15	0.054	A	14	0.050	A	31	0.111	A
IPMT, FA-2	2	0.007	A	0	0.000	A	9	0.032	A	6	0.021	A	14	0.050	A	14	0.050	A	14	0.050	A	11	0.039	A
IPMT, FA-3	1	0.004	A	1	0.004	A	6	0.021	A	18	0.064	A	14	0.050	A	12	0.043	A	19	0.068	A	26	0.093	A
McPhail, NU+B	1	0.004	A	1	0.004	A	1	0.004	A	1	0.004	A	2	0.007	A	1	0.004	A	11	0.039	A	7	0.025	A
Tephri, FA-3	0	0.000	A	1	0.004	A	3	0.011	A	13	0.046	A	11	0.039	A	18	0.064	A	30	0.107	A	27	0.096	A
Frutect	1	0.004	A	0	0.000	A	8	0.029	A	0	0.000	A	9	0.032	A	5	0.018	A	15	0.054	A	11	0.039	A
A. ludens																								
JT, TML	0	0.000	A	0	0.000	A	0	0.000	A	0	0.000	A	0	0.000	A	0	0.000	A	0	0.000	A	0	0.000	A
JT,FA-3	0	0.000	A	0	0.000	A	0	0.000	A	0	0.000	A	0	0.000	A	0	0.000	A	2	0.007	A	2	0.007	A
OBDT, FA-3	1	0.004	A	2	0.007	A	2	0.007	A	2	0.007	A	3	0.011	A	10	0.036	A	4	0.014	A	3	0.011	A
IPMT, FA-2	14	0.050	A	2	0.007	A	27	0.096	B	9	0.032	B	28	0.100	A	27	0.096	A	50	0.179	A	33	0.118	A
IPMT, FA-3	6	0.021	A	5	0.018	A	10	0.036	A B	3	0.011	A	23	0.082	A	14	0.050	A	50	0.179	A	19	0.068	A
McPhail, NU+B	1	0.004	A	0	0.000	A	1	0.004	A	2	0.007	A	12	0.043	A	11	0.039	A	14	0.050	A	7	0.025	A
Tephri, FA-3	2	0.007	A	0	0.000	A	2	0.007	A	0	0.000	A	2	0.007	A	0	0.000	A	7	0.025	A	10	0.036	A
Frutect	1	0.004	A	2	0.007	A	10	0.036	A B	2	0.007	A	25	0.089	A	12	0.043	A	24	0.086	A	16	0.057	A
A. obliaua																								
JT, TML	0	0.000	A	0	0.000	A	0	0.000	A	0	0.000	A	0	0.000	A	1	0.004	A	0	0.000	A	0	0.000	A
JT, FA-3	0	0.000	A	1	0.004	A	0	0.000	A	0	0.000	A	0	0.000	A	0	0.000	A	0	0.000	A	0	0.000	A
OBDT, FA-3	0	0.000	A	0	0.000	A	0	0.000	A	0	0.000	A	0	0.000	A	0	0.000	A	4	0.014	A	0	0.000	A
IPMT, FA-2	3	0.011	A	3	0.011	A	9	0.032	B	5	0.018	A B	3	0.011	A	1	0.004	A	7	0.025	A	8	0.029	A
IPMT, FA-3	1	0.004	A	3	0.011	A	3	0.011	A B	2	0.007	A B	7	0.025	A	13	0.046	A	6	0.021	A	7	0.025	A
McPhail, NU+B	1	0.004	A	0	0.000	A	1	0.004	A B	0	0.000	A	1	0.004	A	1	0.004	A	2	0.007	A	1	0.004	A
Tephri, FA-3	1	0.004	A	0	0.000	A	2	0.007	A B	2	0.007	A B	3	0.011	A	1	0.004	A	0	0.000	A	1	0.004	A
Frutect	5	0.018	A	3	0.011	A	5	0.018	A B	9	0.032	B	11	0.039	A	1	0.004	A	7	0.025	A	8	0.029	A

* same letters are employed when there in not significant difference using ANOVA with Tukey; F/T/D = fly/trap/day; M = males; F = females.

In the capture of *Anastrepha ludens* the IPMT, FA-2 consistently performed better at all density levels, while, for *A. obliqua*, similar capture data were obtained in the McPhail plastic trap and in the Frutect trap.

We consider that the low proportion of flies captured in all treatments was strongly influenced by rain, since this experiment was performed during the season of heaviest rainfall.

Finally, Figure 1 shows the capture trend for female *C. capitata* in seven trap-attractant combinations on coffee, where the performance of the OBDT, FA-3 once again stands out.

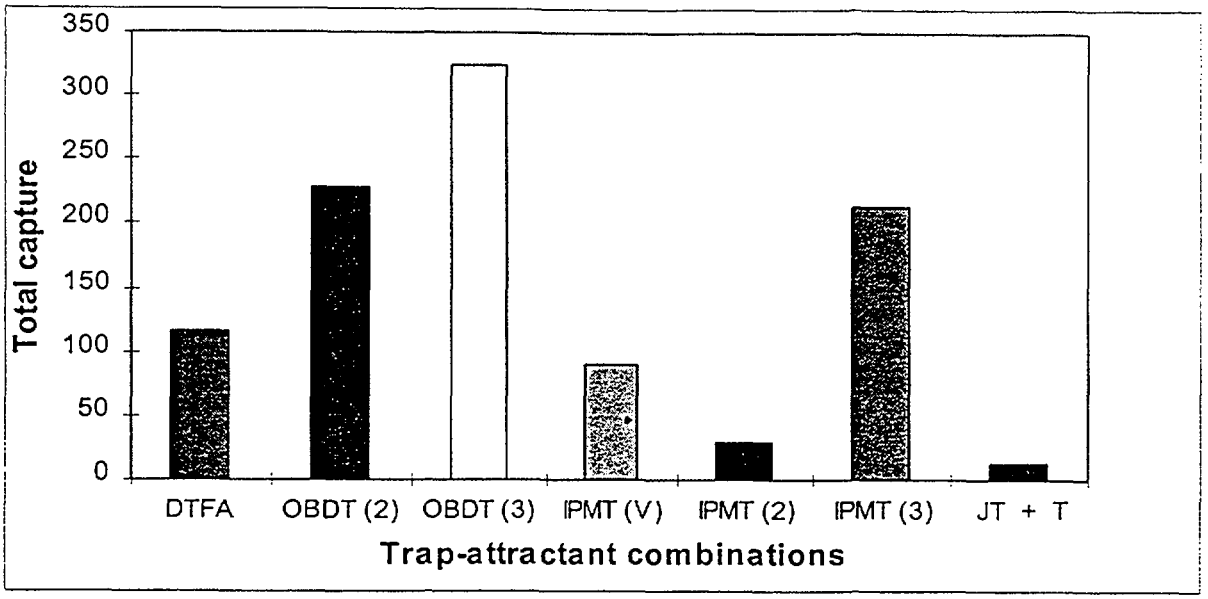

Figure 1.- Female Ceratitis capitata (Wied.) capture trend for 7 trap-attractant combinations, in two experiments on coffee plantations in the Soconusco region of Chiapas, Mexico.

4. DISCUSSION

Over the course of this research program, 13 trap-attractant combinations were evaluated for effectiveness in catching female *C. capitata*. From the results shown, the best option was consistently represented by the OBDT trap baited with FA-3. This trap combines a series of advantages with respect to the others (i.e., the IPMT and the Tephri-trap), also tested with these three attractants. The advantages worthy of mention are: a) it is cheaper, b) it is easier to manage and service, c) it is less frequently stolen and d) it is more efficient.

The OBDT trap includes a very user-friendly (it doesn't stick to skin) yellow insert, which under the highly humid conditions of the Soconusco works very well, although we realize that in semi-desert area with high levels of dust, the results may be very different [10].

The IPMT, FA-3, used as a moist trap, was second in efficiency and was quite superior to this same trap used with the same attractants as a dry trap. This, we believe, to is due to the lethal agent used in the dry trap (DDVP), which caused a repellent effect during the first days after deployment, or perhaps during the last few days its toxicity may be low enough to permit an increase in the number of flies which manage to escape. However, in the first case (IPMT trap moist version) there still remain the major inconveniences which have always been pointed out where the McPhail trap is concerned: the servicing (a supply of water has to be carried to the trap), and the collection and preservation of the specimens captured.

The three component Tephri trap gave a performance similar to that of the IPMT although it was less effective, and showed little difference between the moist and wet modalities. The rest of the treatments demonstrated little efficiency in the capture of female *C. capitata.*

The lack of significant differences among treatments in the capture of these females, may perhaps be related to the fact that the experiments were done with sterile insects, and, according to [11], feral medflies are more attracted to the combination of the three components than sterile flies. We consider that climatic factors, especially the rain, may have affected capture indexes, since several of the experiments were carried out during the rainy season.

As to the capture of flies of the genus *Anastrepha,* we found that the IPMT could be baited with liquid hydrolyzed protein (NU+B or Captor 300) as well as used with FA-2, since in experiments where these attractants were used, it captured comparatively high numbers of female *A. ludens* and *A. obliqua.* The addition of TMA seems to exert a repellent effect on individuals of this genus as opposed to what occurs with *C. capitata,* because, in all cases, fewer *Anastrepha* specimens were captured with three components than with two. Although [12] showed participation of AA in the attraction of *A. ludens,* our data from captures in both the glass McPhail trap and IPMT, baited with hydrolyzed protein, suggest that this alternative continues to be the best option for this species of fruit fly.

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